KO'OLAU POKO WATERSHED MANAGEMENT PLAN

PREPARED FOR:
HONOLULU BOARD OF WATER SUPPLY

PREPARED BY:
TOWNSCAPE, INC.
SEPTEMBER 2012

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ORDINANCE 12-30

BILL 48 (2012), CD1

A BILL FOR AN ORDINANCE

TO AMEND THE OAHU WATER MANAGEMENT PLAN.

BE IT ORDAINED by the People of the City and County of Honolulu:

SECTION 1. Purpose and Intent. The purpose of this ordinance is to amend a portion of the Oahu Water Management Plan (OWMP), enacted by Ordinance 90-62 and codified as Chapter 30, Articles 1, 2, 2A, 2B, and 3, Revised Ordinances of Honolulu (ROH) 1990, as amended, by adopting the Ko'olau Poko Watershed Management Plan.

The Ko'olau Poko Watershed Management Plan provides a long-range 20-year plan for the preservation, restoration, and balanced management of ground water, surface water, and related watershed resources in the Ko'olau Poko District. The Ko'olau Poko Watershed Management Plan is one of several regional Watershed Management Plans that will, together with islandwide water management policies and strategies in Article 2 of ROH Chapter 30, form the updated Oahu Water Management Plan.

SECTION 2. Chapter 30, ROH 1990, as amended, is amended by adding a new Article 2C to read as follows:

"Article 2C. Ko'olau Poko Watershed Management Plan

Sec. 30-2C.1 Applicability.

This article applies to the Ko'olau Poko district, which is described in the Ko'olau Poko watershed management plan. This article supplements Article 2 with respect to the Ko'olau Poko district.

Sec. 30-2C.2 Adoption of the Ko'olau Poko watershed management plan.

Pursuant to Hawaii Revised Statutes Chapter 174C, the plan entitled "Ko'olau Poko Watershed Management Plan," dated February 2012, attached to this ordinance as Exhibit A, is hereby adopted and by reference is incorporated herein as a regional watershed management plan for Oahu. Exhibit A need not be included in this code.

A BILL FOR AN ORDINANCE

Sec. 30-2C.3 Conflicting provisions.

Any provision contained in this article shall, with respect to the Koʻolau Poko district, prevail should there be any conflict with any other provisions of Article 1 or 2 of this chapter."

SECTION 3. This ordinance shall take effect upon its approval.

INTRODUCED BY:

Ernest Martin (BR)

Councilmembers

DATE OF INTRODUCTION:

May 30, 2012
Honolulu, Hawaii

APPROVED AS TO FORM AND LEGALITY:

Deputy Corporation Counsel

APPROVED this 31st day of August, 2012.

PETER B. CARLISLE, Mayor
City and County of Honolulu

CITY COUNCIL
CITY AND COUNTY OF HONOLULU
HONOLULU, HAWAII
CERTIFICATE

ORDINANCE 12-30

BILL 48 (2012), CD1

Introduced: 05/30/12 By: ERNEST MARTIN (BR) Committee: ZONING AND PLANNING

Title: A BILL FOR AN ORDINANCE TO AMEND THE OAHU WATER MANAGEMENT PLAN.

Links: BILL 48 (2012)
BILL 48 (2012), CD1
CR-230
CR-269

Voting Legend: Y= Aye, Y* = Aye w/Reservations, N = No, A = Absent, ABN = Abstain

COUNCIL	06/06/12	BILL PASSED FIRST READING AND REFERRED TO COMMITTEE ON ZONING AND PLANNING.
		ANDERSON Y, BERG Y, CACHOLA Y, CHANG Y, GABBARD Y, GARCIA Y, HARIMOTO Y, KOBAYASHI Y, MARTIN Y
ZONING AND PLANNING	06/28/12	CR-230 – BILL REPORTED OUT OF COMMITTEE FOR PASSAGE ON SECOND READING AS AMENDED IN CD1 FORM AND SCHEDULING OF A PUBLIC HEARING.
PUBLISH	06/30/12	PUBLIC HEARING NOTICE PUBLISHED IN THE HONOLULU STAR-ADVERTISER.
COUNCIL/PUBLIC HEARING	07/11/12	CR-230 ADOPTED. BILL PASSED SECOND READING AS AMENDED, PUBLIC HEARING CLOSED AND REFERRED TO COMMITTEE ON ZONING AND PLANNING.
		ANDERSON A, BERG Y, CACHOLA Y, CHANG Y, GABBARD A, GARCIA Y, HARIMOTO Y, KOBAYASHI Y, MARTIN Y
PUBLISH	07/21/12	SECOND READING NOTICE PUBLISHED IN THE HONOLULU STAR-ADVERTISER.
ZONING AND PLANNING	07/26/12	CR-269 – BILL REPORTED OUT OF COMMITTEE FOR PASSAGE ON THIRD READING.
COUNCIL	08/15/12	CR-269 ADOPTED AND BILL 48 (2012), CD1 PASSED THIRD READING.
		ANDERSON Y, BERG Y, CACHOLA Y, CHANG Y, GABBARD Y, GARCIA Y, HARIMOTO Y, KOBAYASHI Y, MARTIN Y

I hereby certify that the above is a true record of action by the Council of the City and County of Honolulu on this BILL.

Bernice K.N. Mau

BERNICE K. N. MAU, CITY CLERK

ERNEST Y. MARTIN, CHAIR AND PRESIDING OFFICER

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KO‘OLAU POKO WATERSHED MANAGEMENT PLAN

PREPARED FOR:
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PREPARED BY:
TOWNSCAPE, INC.
SEPTEMBER 2012

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GLOSSARY

NOTE: Many of the terms included in this Glossary have different meanings in different jurisdictions.

Aquifer

A geologic formation(s) that is water bearing. A geological formation or structure that stores and/or transmits water, such as to wells and springs. Use of the term is usually restricted to those water-bearing formations capable of yielding water in sufficient quantity to constitute a usable supply for people's uses.[1]

Aquifer Sector Area

A large region with hydrogeological similarities. "Sectors reflect broad hydrogeological similarities yet maintain traditional hydrographic, topographic and historical boundaries where possible."[2]

Aquifer System Area

An area within a sector showing ground water hydraulic continuity.[3]

Continuous Stream

A type of perennial stream that flows to the sea year-round under normal conditions, including streams with diversions.[4]

Criteria

Measures or standards for judging or selecting among choices.[5]

Domestic Use

"any use of water for individual personal needs and for household purposes such as drinking, bathing, heating, cooking, noncommercial gardening and sanitation."[6]

Ground Water

"any water found beneath the surface of the earth, whether or not in perched, dike-confined or basal supply; in underground channels or streams; in standing, percolating or flowing condition; or under artesian pressure."[7]

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[1] USGS, Water Science Glossary of Terms, http://ga.water.usgs.gov/edu/dictionary.html#A
[2] Wilson Okamoto & Associates, Inc., March 1990, *Oahu Water Management Plan Technical Reference Document*, Department of General Planning City and County of Honolulu, p. 21.
[3] Wilson Okamoto & Associates, Inc., March 1990, *Oahu Water Management Plan Technical Reference Document*, Department of General Planning City and County of Honolulu, p. 21.
[4] *Hawaii Stream Assessment: A Preliminary Appraisal of Hawaii's Stream Resources*, 1990, p. 9.
[5] American Planning Association Hawaii Chapter, 1999, *From the Ground Up: A Handbook for Community-Based Land Use Planning*, p. 97.
[6] Revised Ordinances of Honolulu Chapter 30: Water Management, §30-1.2 Definitions
[7] Revised Ordinances of Honolulu Chapter 30: Water Management, §30-1.2 Definitions

GLOSSARY (continued)

NOTE: Many of the terms included in this Glossary have different meanings in different jurisdictions.

Instream Flow Standard

"a quantity or flow of water or depth of water which is required to be present at a specific location in a stream system at certain specified times of the year to protect fishery, wildlife, recreational, aesthetic, scenic, and other beneficial instream uses."[8]

The amount of water required to protect instream uses such as to protect fish and wildlife habitat, aesthetic values, or traditional Hawaiian uses.[9]

Instream Use

"beneficial uses of stream water for significant purposes which are located in the stream and which are achieved by leaving the water in the stream."[10]

Interim Instream Flow Standard

"a temporary instream flow standard of immediate applicability, adopted by the commission without the necessity of a public hearing, and terminating upon the establishment of an instream flow standard."[11]

Intermittent Streams

Streams that are normally dry during part of the year.[12]

Interrupted Streams

A type of perennial stream that flows year-round in the upper portions and intermittently at lower elevations under normal conditions. The interruption may be natural or man-made.[13]

Median Stream Flow

The flow at the gaging station that is exceeded 50% of the time.

Metered Consumption

The amount of water consumed by a specific user or system as measured by a water meter or aggregation of meters. Not all water infrastructure has a water meter, therefore making it difficult to determine the amount of water that is conveyed by that system.

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[8] HRS §174 C-3, State Water Code.
[9] *Oahu Water Management Plan.* 1992. p.11
[10] HAR §13-167-2.
[11] HRS §174 C-3, State Water Code.
[12] *Hawaii Stream Assessment: A Preliminary Appraisal of Hawaii's Stream Resources*, 1990, p. 9.
[13] *Hawaii Stream Assessment: A Preliminary Appraisal of Hawaii's Stream Resources*, 1990, p. 9.

GLOSSARY (continued)

NOTE: Many of the terms included in this Glossary have different meanings in different jurisdictions.

Municipal Use

"the domestic, industrial, and commercial use of water through public services available to persons of a county for the promotion and protection of their health, comfort, and safety, for the protection of property from fire, and for the purposes listed under the term "domestic use."[14]

Non-instream Use

"the use of stream water that is diverted or removed from its stream channel and includes the use of stream water outside of the channel for domestic, agricultural, and industrial purposes."[15]

Palustrine Wetland

Shallow non-tidal freshwater areas that lack flowing water and are dominated by trees and shrubs.

Perennial Streams

Streams that normally have surface flow year-round, in all or part of their course, as opposed to intermittent streams.[16]

Stream

"any river, creek, slough, or natural watercourse in which water usually flows in a defined bed or channel. It is not essential that the flowing be uniform or uninterrupted. The fact that some parts of the bed or channel have been dredged or improved does not prevent the watercourse from being a stream."[17]

Streams are considered separate entities when they have a separate mouth to the sea.[18]

Stream Channelization

Stream channelization is the realignment or lining of a natural stream channel for the purposes of flood or erosion control.

Stream Diversion

"the act of removing water from a stream into a channel, pipeline, or other conduit."[19]

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[14] HRS §174 C-3, State Water Code.
[15] HRS §174 C-3, State Water Code.
[16] *Hawaii Stream Assessment: A Preliminary Appraisal of Hawaii's Stream Resources*, 1990, p. 9.
[17] HAR §13-167-2.
[18] *Hawaii Stream Assessment: A Preliminary Appraisal of Hawaii's Stream Resources*, 1990, p. 9.
[19] HRS §174 C-3, State Water Code.

GLOSSARY (continued)

NOTE: Many of the terms included in this Glossary have different meanings in different jurisdictions.

Surface Water

"both contained surface water (that is, water upon the surface of the earth in bounds created naturally or artificially including, but not limited to, streams, other watercourses, lakes, and reservoirs) and diffused surface water (that is, water occurring upon the surface of the ground other than in contained waterbodies). Water from natural springs is surface water when it exits from the spring into the earth's surface."[20]

Sustainable Yield

"maximum rate at which water may be withdrawn from a water source without impairing the utility or quality of the water source as determined by the commission."[21]

Forced withdrawal rate of ground water that could be sustained indefinitely from an aquifer without affecting either the quality of the pumped water or the volume rate of pumping. Meant to be a guide for planning.[22]

Total Maximum Daily Loads

Calculations of the maximum amount of each pollutant that can enter a given water body without violating state water quality standards

Water or Waters of the State

"any and all water on or beneath the surface of the ground, including natural or artificial watercourses, lakes, ponds, or diffused surface water and water percolating, standing, or flowing beneath the surface of the ground."[23]

Water Management Area

"a geographic area which has been designated pursuant to chapter 13-171 as requiring management of the ground or surface water resource, or both."[24]

Designated by the Commission when it is determined that water resources in the area may be threatened by existing or proposed withdrawals or diversions of water.[25]

Water Pumpage

The volume of water pumped from a ground water source.

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[20] HAR §13-167-2.
[21] HAR §13-167-2.
[22] *Oahu Water Management Plan*. 1992. p.3
[23] HAR §13-167-2.
[24] HAR §13-167-2.
[25] *Oahu Water Management Plan*. 1992. p.7

GLOSSARY (continued)

NOTE: Many of the terms included in this Glossary have different meanings in different jurisdictions.

Watershed

An area of land that is defined by ridgelines and drains into a distinct stream or river.

Water Source

"a place within or from which water is or may be developed, including but not limited to: (1) generally, an area such as a watershed defined by topographic boundaries, or a definitive ground water body; and (2) specifically, a particular stream, other surface water body, spring, tunnel, or well or related combination thereof."[26]

Water Withdrawal

The volume of water withdrawn from a ground or surface water source.

Wetlands

Areas that are regularly wet or flooded throughout most of the year and are often characterized by specific plant associations and soil types.

[26] HAR §13-167-2.

ACRONYMS

NOTE: Some of these acronyms are generic, while some are specific to a particular governmental program.

AAG	*Ahupuaʻa* Advisory Group
ADC	Agribusiness Development Corporation
ALISH	Agricultural Lands of Importance to the State of Hawaiʻi
ASYA	Aquifer System Area
AWUDP	Agricultural Water Use and Development Plan
AWWA	American Water Works Association
BMP	Best Management Practice
BOR	U.S. Department of the Interior Bureau of Reclamation
BWS	Honolulu Board of Water Supply
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFS	Cubic Feet per Second
CP	Capital Program
CLGP	Certified Local Government Program
CNO	Chief of Naval Operations
CTAHR	University of Hawaiʻi College of Tropical Agriculture and Human Resources
CWA	Clean Water Act
CWB	Clean Water Branch
CWRM	State of Hawaii Commission on Water Resource Management
CY	Calendar Year
CZM	Hawaiʻi Coastal Zone Management Program
DAR	Division of Aquatic Resources
DFM	Department of Facility Maintenance
DHHL	Department of Hawaiian Home Lands
DLNR	State of Hawaiʻi Department of Land and Natural Resources
DOA	State of Hawaiʻi Department of Agriculture
DOFAW	Division of Forestry and Wildlife
DOH	State of Hawaiʻi Department of Health
DP	Development Plan

ACRONYMS (continued)

NOTE: Some of these acronyms are generic, while some are specific to a particular governmental program.

DPW	U.S. Army Garrison, Hawai'I, Directorate of Public Works
ENV	Department of Environmental Services, City and County of Honolulu
EPA	United States Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FY	Fiscal Year
GP	General Plan
GPAD	Gallons per Acre per Day
GPCD	Gallons per Capita per Day
GPD	Gallons per Day
GWCM	Ground Water Contamination Maps
HEER	Hazard Evaluation and Emergency Response
HFBF	Hawai'i Farm Bureau Federation
HHFDC	Hawai'i Housing Finance and Development Corporation
HIMB	Hawai'i Institute of Marine Biology
HISWAP	Hawai'i Source Water Assessment and Protection Program
HWP	Hawai'i Water Plan
HRS	Hawaii Revised Statutes
HSA	Hawaii Stream Assessment
HSBP	Hawai'i Stream Bioassessment Protocol
HWP	Hawai'i Water Plan
IFS	Instream Flow Standard
IIFS	Interim Instream Flow Standard
IRP	Integrated Resource Planning
KP	Ko'olau Poko
KPSCP	Ko'olau Poko Sustainable Communities Plan
KPWMP	Ko'olau Poko Watershed Management Plan
MA'O	Mala 'Ai 'Ōpio
MAPS	Multi-Attribute Prioritization of Streams

ACRONYMS (continued)

NOTE: Some of these acronyms are generic, while some are specific to a particular governmental program.

MCL	Maximum Contaminant Level
MG	Million gallons
MGD	Millions of gallons per day
MS4	Municipal Separate Stormwater Sewer Systems
MSL	Mean Sea Level
NARS	Natural Area Reserves System
NAVMAG	Naval Magazine
NB	Neighborhood Board
NCTAMS	Naval Computer and Telecommunications Area Master Station
NELHA	Natural Energy Laboratory of Hawai'i Authority
NPDES	National Pollutant Discharge Elimination System
NRCS	U.S. Department of Agriculture Natural Resources Conservation Service
OTEC	Ocean Thermal Energy Conversion
OWMP	O'ahu Water Management Plan
PCA	Potential Contaminating Activity
PUC	Primary Urban Center
RAM	Robust Analytical Model
ROH	Revised Ordinances of Honolulu
RTF	Radio Transmitter Facility
SAP	Special Area Plans
SCHHA	State Council of Hawaiian Homestead Associations
SCP	Sustainable Communities Plan
SDWA	Safe Drinking Water Act
SDWB	Safe Drinking Water Branch
SMA	Special Management Area
SMZ	Streamside Management Zones
SWAP	Source Water Assessment Program
SWPP	State Water Projects Plan

ACRONYMS (continued)

NOTE: Some of these acronyms are generic, while some are specific to a particular governmental program.

SWQP	State Water Quality Plan
SY	Sustainable Yield
TMDL	Total Maximum Daily Load
TNCH	The Nature Conservancy Hawaiʻi
TSS	Total Suspended Solids
UH NREM	University of Hawaiʻi Department of Natural Resources and Environmental Management
UIC	Underground Injection Control
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WCCHC	Waiʻanae Coast Comprehensive Health Center
WEC	Waiʻanae Ecological Characterization Project
WMA	Water Management Area
WMP	Watershed Management Plan
WOSWCD	West Oʻahu Soil and Water Conservation District
WQLS	Water Quality Limited Segment
WQP	Water Quality Plan
WRPP	Water Resources Protection Plan
WRRC	Water Resources Research Center
WUDP	Water Use and Development Plan
WUZ	Water Use Zone

EXECUTIVE SUMMARY

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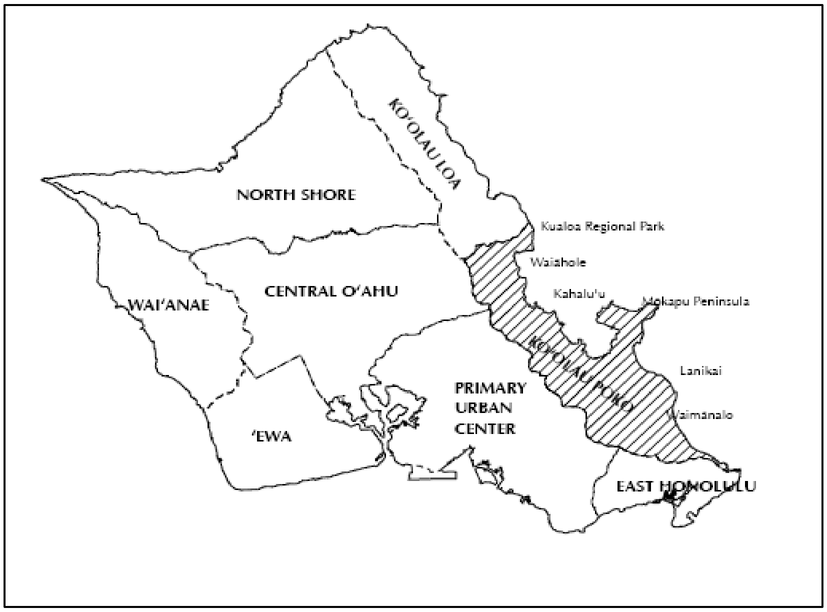
ES EXECUTIVE SUMMARY

ES.1 PURPOSE OF THE KO'OLAU POKO WATERSHED MANAGEMENT PLAN

The KO'OLAU POKO WATERSHED MANAGEMENT PLAN (KPWMP) is a long-range, 20-year plan to the year 2030 for the preservation, restoration, and balanced management of ground water, surface water, and related watershed resources in the Ko'olau Poko District, island of O'ahu. The City and County of Honolulu Department of Planning and Permitting (DPP) and the Honolulu Board of Water Supply (BWS) have jointly prepared the KPWMP, in accordance with the State Water Code, the Hawai'i Water Plan, and the City's Ordinance 90-62 that established the O'ahu Water Management Plan. The KPWMP is one of eight district-specific plans that together will form the updated O'ahu Water Management Plan.

The PUBLIC REVIEW DRAFT of the KPWMP was posted on the BWS website at www.hbws.org in December 2010. After an extended public review period, support for the KPWMP was requested and obtained from each of the four Neighborhood Boards in the district: Kahalu'u (#29), Kāne'ohe (#30), Kailua (#31), and Waimānalo (#32). DPP and BWS finalized the KPWMP and the plan was approved by the Honolulu City Council in August 2012 and adopted by the State Commission on Water Resource Management (CWRM) in September 2012.

Figure ES.1 The Eight Districts of the O'ahu Water Management Plan



This EXECUTIVE SUMMARY provides a brief synopsis of the planning process, major findings, and recommendations of the KPWMP.

The plan is presented in five chapters and a number of appendices:

Chapter 1. O'ahu Water Management Plan Overview

Chapter 2. Ko'olau Poko Watershed Profile

Chapter 3. Existing Water Use and Forecasts of Future Water Use and Demand

Chapter 4. Plan Objectives, Water Supply and Watershed Management Projects and Strategies

Chapter 5. Implementation of the KPWMP

ES.2 THE KPWMP AND THE KO'OLAU POKO SUSTAINABLE COMMUNITIES PLAN

The State Water Code requires that the County water use and development plans be consistent with County land use plans and policies. Thus, throughout the planning process for the KPWMP, BWS and DPP have been mindful of the policies and guidelines of the Ko'olau Poko Sustainable Communities Plan (KPSCP), which was first enacted in August

2000. DPP began the KPSCP update process in mid-2009, and thus the KPWMP reflects some of the policy changes that are included in the draft revised KPSCP.

The KPSCP provides a vision for the preservation, conservation, and enhancement of the region's natural and scenic resources, cultural and historical resources, agricultural lands, and residential neighborhoods. This overarching vision for the district is the overall policy guide for the KPWMP as well.

ES.3 THE PLANNING PROCESS

At the outset of the planning process, BWS and DPP established several key guiding principles for the KPWMP. They directed that the Plan be:

- Community-based
- Environmentally holistic
- Reflective of ahupuaʻa management principles
- Action-oriented
- In alignment with State and City water and land use policies

In accordance with these overall guiding principles, the planning process for the KPWMP emphasized the importance of two complementary sets of studies and actions:

1. **Technical research work**, including data collection and analysis, review of relevant plans and programs, creation of maps, charts and graphs, and statistical projections of future demands for potable and non-potable water;

2. **Stakeholder outreach and consultation:** individual interviews and small group meetings with community leaders, community groups and organizations, land owners, developers, public agencies, and elected officials, and general community meetings to provide a forum for the discussion of watershed issues and needed actions. More than 50 stakeholder meetings of various kinds were held.

Thus, the planning process was both technical and community-based in nature, and the conclusions and recommendations that emerged from the planning process were based both on technical analysis and on the values and ideas of the many stakeholders.

It is also important to note that much of the research and community outreach work was organized by "Neighborhood Board Area" in order to reflect and respect the diversity of resources and community issues in Kahaluʻu, Kāneʻohe, Kailua, and Waimānalo.

ES.4 GOALS AND OBJECTIVES OF THE KPWMP

BWS and DPP established an overall GOAL and five major OBJECTIVES for all of the watershed management plans:

GOAL: ***To formulate an environmentally holistic, community-based, and economically viable watershed management plan that will provide a balance between: (1) the preservation and restoration of Oahu's watersheds, and (2) sustainable ground water and surface water use and development to serve present and future generations.***

The five major OBJECTIVES which are common to all of the watershed management plans for Oʻahu are:

OBJECTIVE #1: PROMOTE SUSTAINABLE WATERSHEDS

OBJECTIVE #2: PROTECT AND ENHANCE WATER QUALITY AND QUANTITY

OBJECTIVE #3: PROTECT NATIVE HAWAIIAN RIGHTS AND TRADITIONAL AND CUSTOMARY PRACTICES

OBJECTIVE #4: FACILITATE PUBLIC PARTICIPATION AND EDUCATION, AND PROJECT IMPLEMENTATION

OBJECTIVE #5: MEET FUTURE WATER DEMANDS AT REASONABLE COST

Each of the Watershed Management Plans developed **district-specific SUB-OBJECTIVES** under each of the major OBJECTIVES. These Sub-Objectives were articulated based on the issues and values that emerged for the district from both the technical research work and the stakeholder consultation process.

Water Supply and Watershed Management Projects and Strategies that would respond to and implement these Sub-Objectives were then researched and documented.

ES.5 SUMMARY PROFILE OF THE DISTRICT

Koʻolau Poko is one of the eight planning districts of Oʻahu. This district is located on the windward side of the island, and stretches from Kualoa in the north to Makapuʻu Point in the south, a distance of about 20 miles. Koʻolau Poko is 41,512 acres in size, and had a Census Year 2000 population of approximately 118,000 people.

The largest urbanized areas in the district are Kāneʻohe and Kailua. More rural settlement areas include Waiāhole, Kahaluʻu, Maunawili, and Waimānalo. Four Neighborhood

Boards provide opportunities for community dialogue on various local issues: Kahaluʻu, Kāneʻohe, Kailua, and Waimānalo Neighborhood Boards. It should be noted that the traditional eastern boundary of the *moku* of Koʻolau Poko was Kuliʻouʻou Ridge in Hawaiʻi Kai.

Major arterial roadways serving these communities are Kalanianaʻole Highway, Kamehameha Highway, Pali Highway, Likelike Highway, and H-3 Freeway.

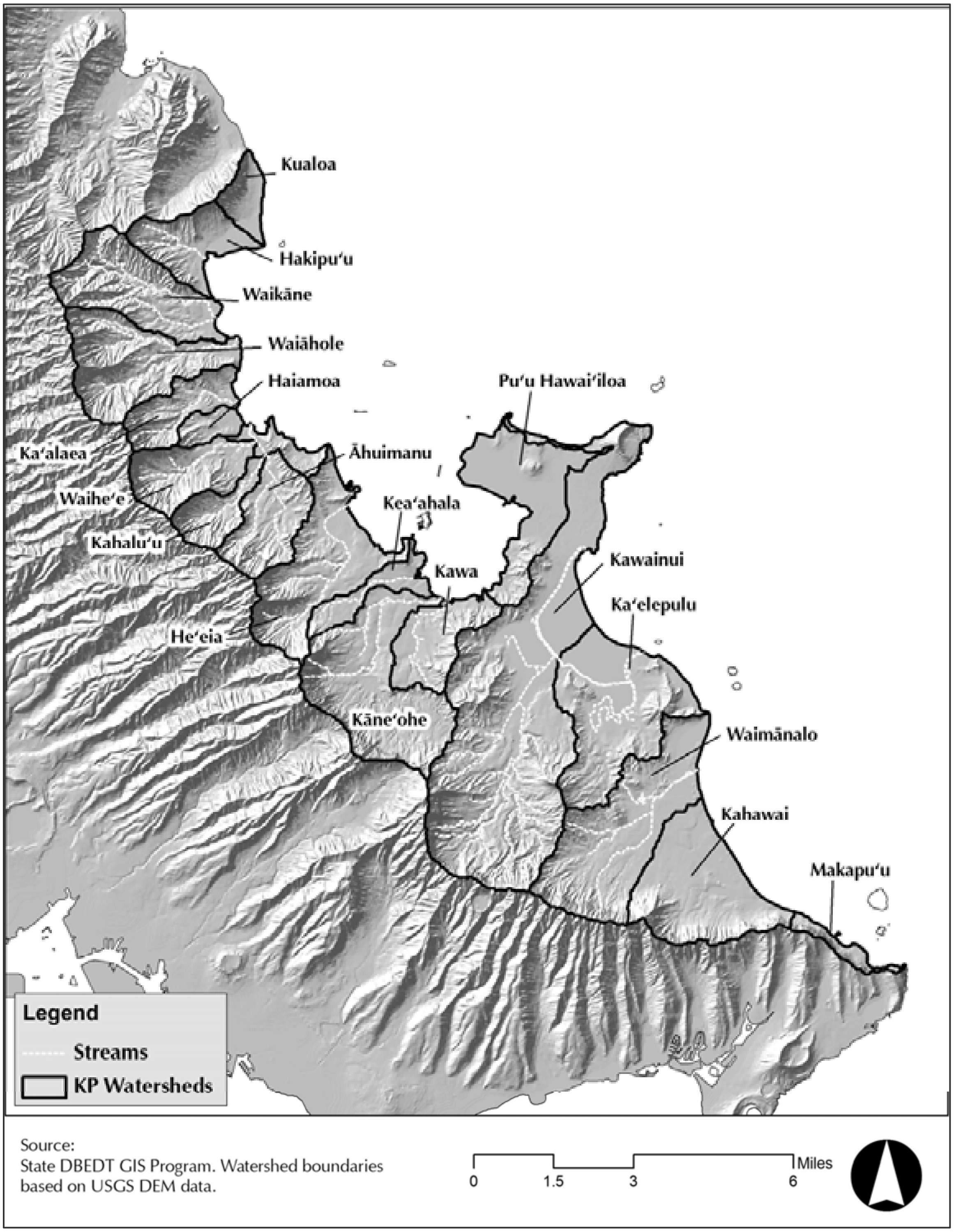
There are a total of 19 watersheds in the district: Kualoa, Hakipuʻu, Waikāne, Waiāhole, Kaʻalaea, Haiamoa, Waiheʻe, Kahaluʻu, ʻĀhuimanu, Heʻeia, Keaʻahala, Kāneʻohe, Kawa, Puʻu Hawaiʻi Loa, Kawai Nui, Kaʻelepulu, Waimānalo, Kahawai, and Makapuʻu. (Figure ES-2)

There are 13 perennial streams in Koʻolau Poko. The median flows of these streams range from about 0.5 cubic feet per second (cfs) for Iolekaʻa Stream to 11 cfs for Kamoʻoaliʻi Stream. These streams are important habitats for native fresh water species as well as important sources of water for local farmers.

A watershed is defined as a drainage basin that catches, collects, and stores water that travels toward the ocean via rivers, streams, or through subterranean springs or seepages.[i] While watersheds and *ahupuaʻa* often have similar boundaries, in Koʻolau Poko, watershed boundaries do not exactly line up with the *ahupuaʻa* boundaries as the *ahupuaʻa* in Koʻolau Poko sometimes have a larger land area than a watershed.

There are two Aquifer System Areas (ASYA) in Koʻolau Poko: the Koʻolau Poko ASYA with a Sustainable Yield of 30 million gallons per day (mgd), and the Waimānalo ASYA with a sustainable yield of 10 mgd. In 2009, the Board of Water Supply provided approximately 16 mgd of potable water to meet this district's needs, of which approximately 6 mgd was imported from Koʻolau Loa. In addition, several millions of gallons of water per day were provided by state and private water systems to farmers from both surface and ground water sources.

Figure ES.2 Ko'olau Poko Watersheds



ES.6 WATER USE AND PROJECTED DEMAND

Ko'olau Poko utilizes a combination of ground, surface, and recycled sources to meet its water demands. In 2000, most of the district's water demand was met by ground water, which provided for both potable and non-potable uses. The Honolulu Board of Water Supply (BWS) provides most (68%) of the water used in Ko'olau Poko, with private sources also providing a significant (28%) quantity of water.

TABLE ES.1 IN-DISTRICT WATER USE BY SOURCE TYPE (CY 2000)

Water Source	Potable/Non-Potable	Estimated Amount (mgd)
Surface Water	Non-Potable	7.650
Ground Water	Potable & Non-Potable	21.794
Recycled Water	Non-Potable	0.550
TOTAL		**29.994**

Future water demands were projected in low-, mid-, and high-growth scenarios through the year 2030. The low-growth demand scenario was selected as the base case scenario, as it was based on City growth policies as reflected in its land use plans. The overall municipal water demand was tied to population, which in the low-demand scenario, was projected to decrease by about 4%. The greatest increase in demand is from a projected increase in agricultural acreage which, in the low-demand scenario, was equal to a 1% increase in agricultural acreage per year.

TABLE ES.2 DISTRICT WATER DEMAND BY WATER USE SECTOR

Ko'olau Poko	2000 (mgd)	2030 (mgd)		
		Low	Mid	High
Municipal	**18.060**	**17.575**	**17.944**	**18.313**
BWS	18.008	17.512	17.881	18.250
State	0.052	0.063	0.063	0.063
Agriculture	**9.700**	**12.185**	**16.990**	**22.622**
Diversified Agriculture	4.217	5.482	6.013	7.609
Kalo	4.882	6.103	10.377	14.412
Aquaculture - Private	0.600	0.600	0.600	0.600
Landscape Irrigation	**1.734**	**2.086**	**2.111**	**2.136**
BWS*	0.847	1.199	1.224	1.249
State	0.042	0.042	0.042	0.042
Federal	0.550	0.550	0.550	0.550
Private	0.295	0.295	0.295	0.295
Total NB Area	**29.494**	**31.846**	**37.046**	**43.071**

*Potable demand does not include 0.5 mgd exported to East Honolulu

ES.7 PROJECTS AND STRATEGIES

The KPWMP provides information on specific Water Supply and Watershed Management **"Projects with Champions,"** and more general information on **"Watershed Management Strategies."** The "strategies" are defined as important concepts that do not yet have "champion" entities that would organize and implement these concepts.

The Projects with Champions are for the most part **specific projects that are being planned and/or that are being implemented by a particular public agency or agencies or by a particular community group or non-profit entity.** Many land use and resource management plans present "projects" that are more or less generic ideas. For Koʻolau Poko, however, there are many place-specific watershed management projects that are already ongoing. The KPWMP thus focuses on these real projects.

The KPWMP presents information on a total of 34 projects with champions, which are organized as follows:

DISTRICT-WIDE PROJECTS AND PROGRAMS

01 BWS Capital Program
02 BWS Water Conservation Program
03 BWS Pumpage Optimization
04 *Ahupuaʻa* Boundary Marker Project
05 Establish Measurable Instream Flow Standards
06 Hawaiʻi Ocean Resources Management Plan and Climate Change Adaptation Framework
07 Hawaiʻi Coral Reef Assessment and Monitoring Program (CRAMP)

PROJECTS AND PROGRAMS IN TWO OR THREE NEIGHBORHOOD BOARD AREAS

08 MCBH Integrated Natural Resources Management Plan
09 Implement Requirements of the TMDL Studies that have been Approved or are in Progress for Koʻolau Poko Streams
10 Expansion of the Waimānalo Forest Reserve
11 Waimānalo Irrigation System Improvements & Conservation
12 Aloha ʻĀina Programs

KAHALUʻU PROJECTS AND PROGRAMS

13 Waiheʻe Ahupuaʻa Initiative
14 Hakipuʻu Learning Center

KĀNEʻOHE PROJECTS AND PROGRAMS

15 Heʻeia Stream Restoration Project
16 Papahana Kuaola
17 Māhuahua ʻAi o Hoi (Heʻeia Wetland Restoration)
18 Management and Stewardship of Heʻeia Fishpond
19 Hydro-Modification Storm Drain Installation Project
20 Halawa-Luluku Interpretive Development
21 Management and Stewardship of Waikalua Loko Fishpond
22 Kokokahi Cultural Learning Center

KAILUA PROJECTS AND PROGRAMS

23 MCBH Water Conservation Program
24 Management and Stewardship of Kawainui Marsh
25 Hāmākua Marsh Ecosystem Restoration Program
26 Purchase of Puʻu o Ehu Hillside
27 Kailua Beach Management Plan
28 Management and Stewardship of Kaʻelepulu Watershed
29 Kaʻelepulu Storm Water Capture

WAIMĀNALO PROJECTS AND PROGRAMS

30 Waimānalo Watershed Project
31 Waimānalo Watershed Analysis Risk Management Framework Study
32 God's Country Waimānalo Programs
33 Bellows Air Force Station Integrated Natural Resource Management Plan
34 Waimānalo Waste Water Treatment Plant Recycled Water Reuse

The KPWMP also presents some basic information on a total of 39 Watershed Management STRATEGIES. "Strategies" are defined here as potential actions that would serve to implement the overall goal, objectives, and sub-objectives of the KPWMP, but that do not currently have a project champion. Many of these strategies could become "Projects" if/when an agency or organization decides to be the champion for that strategy.

DISTRICT-WIDE STRATEGIES

DISTRICT-WIDE SURFACE WATER MANAGEMENT STRATEGIES

01 Establish "Customized" Stream Buffers for Specific Streams
02 Concrete Flood Channel Redesign Projects

DISTRICT-WIDE LAND MANAGEMENT STRATEGIES

03 Comprehensive Koʻolau Poko Litter and Illegal Dumping Mitigation Program
04 Native Plant Propagation Program
05 Establish Alien Plant Control Programs
06 Establish Fencing Exclosures in High Priority Areas for Feral Pig Control
07 Coordinate Pig Hunting Programs
08 Minimize the Impacts of Feral Mammals on Watershed Resources
09 Restrict Off-Road Recreational Vehicles in *Mauka* Areas
10 Convert Cesspools to Septic Tanks to Protect Estuaries and Aquifers
11 Preserve and Restore the Forested Areas Above Groundwater Sources

DISTRICT-WIDE COMMUNITY STRATEGIES

12 Develop an Efficient Alternative Process that Assists the KBRC with Implementation of the Kāneʻohe Bay Master Plan
13 Create and Maintain a "Directory" of Koʻolau Poko Community Organizations and Groups
14 Establish a Stream Signage Program to Educate the Public About Stream Processes and Characteristics

DISTRICT-WIDE CULTURAL RESOURCES / TRADITIONAL PRACTICES STRATEGIES

15 Conduct Koʻolau Poko Oral History Studies
16 Promote *Kalo* Restoration Projects
17 Conduct Periodic Surveys of Active *Loʻi* to Use as Future Baseline Data for Monitoring and Evaluation

DISTRICT-WIDE WATER SUPPLY STRATEGIES

18 Utilize More Surface Water for Agricultural Irrigation
19 Develop Groundwater Wells to Provide Additional Water for Diversified Agriculture
20 Develop an Agriculture Water Conservation Program
21 Implement the Recommendations of the Hawaiʻi Drought Plan
22 Encourage Gray Water Reuse to Reduce the Amount of Ground Disposal of Wastewater
23 Encourage Water Efficient Fixtures in Current and Future Development
24 Encourage Low Impact Development Design Concepts in Future Development
25 Storm Water Reclamation Projects

KAHALUʻU STRATEGIES

26 Management and Stewardship of Mōliʻi Fishpond
27 Kahaluʻu Neighborhood Board Area Long Range Agriculture Expansion Plan
28 Dredge the Kahaluʻu Flood Lagoon
29 Create a Hakipuʻu *Ahupuaʻa* Land Trust
30 HHFDC Repair and Upgrade of the Waiāhole Valley Water System
31 Restoration of *Heiau* in ʻĀhuimanu

KĀNEʻOHE STRATEGIES

32 Restore the Estuary Area near Waikalua Loko Fishpond (presently Bay View Golf Course)
33 Utilize Water from Hoʻomaluhia Reservoir for Irrigation

KAILUA STRATEGIES

34 Increase MCBH WWTP Capacity to Recycle Wastewater to R-1 Water Quality Standards
35 Maintain "Green Spaces" in Kailua

WAIMĀNALO STRATEGIES

36 Waimānalo Long Range Agriculture Expansion Plan
37 Implement the NRCS "Alternatives for Restoration of Waimānalo Stream" Report
38 Establish a Waimānalo Community Composting Facility to Dispose of Animal Wastes
39 Convert the DOA Kailua Reservoir to a Sediment Retention Basin

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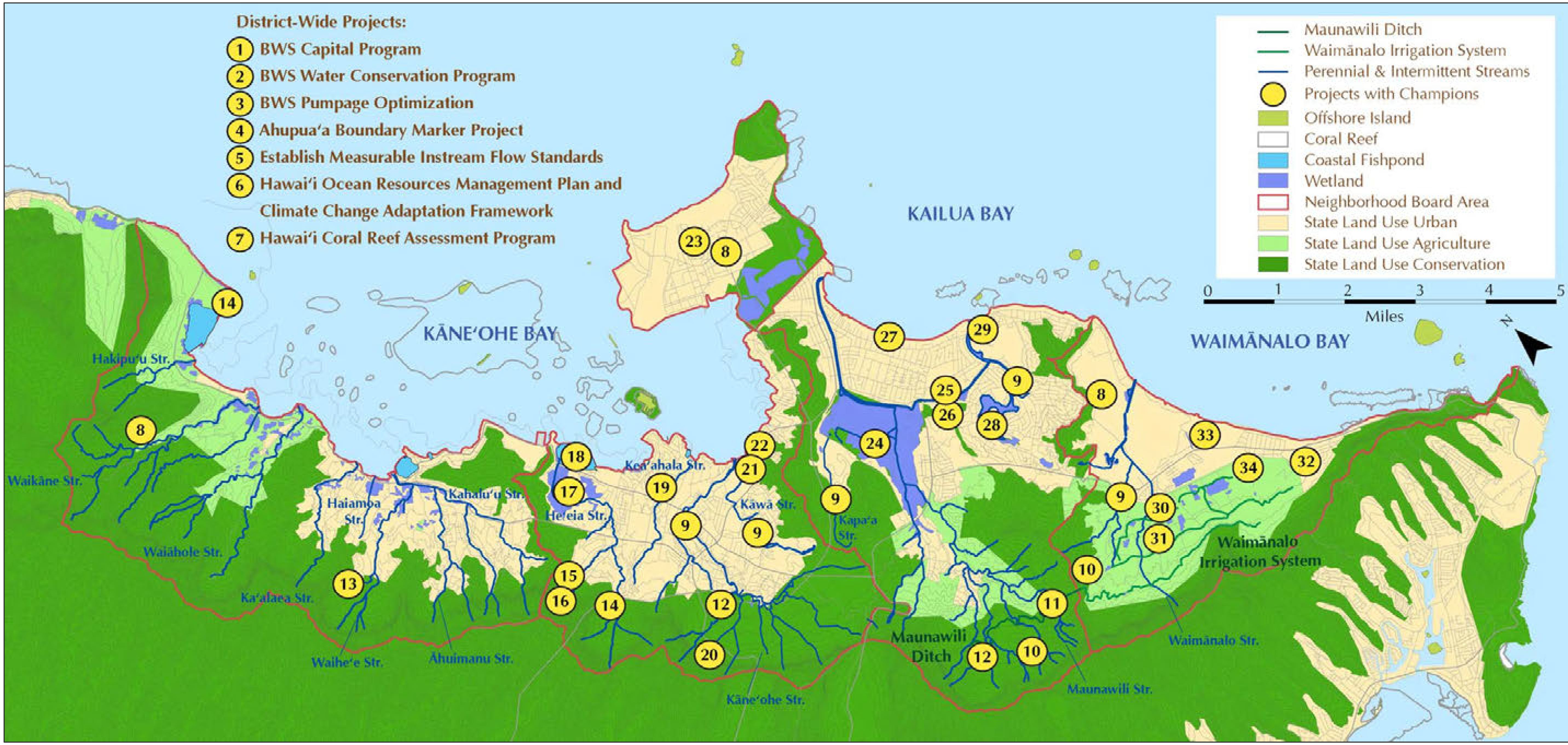
Figure ES.3 Projects with Champions



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ES.8 IMPLEMENTATION OF THE KPWMP

IMPLEMENTATION of the Koʻolau Poko Watershed Management Plan will be a long term, ongoing process involving many project "champions" from public agencies, non-profit entities, community groups, and private land owners and businesses. Chapter 5 of the KPWMP presents the details of the plan implementation agenda.

The Water Use and Development section of the plan is summarized as follows:

- The future growth "scenario" for Koʻolau Poko is the "SCP Policy Scenario," based on population projections developed by DPP. The DPP population projections show a slight decline in the district's population from 2000 to 2030, from117,999 to 113,243 – a decline of about 4%.

- BWS potable water supplied to Koʻolau Poko District in CY 2000 was 19.84 mgd. BWS potable water demand for the district projected to 2030 is 19.035 mgd. BWS existing potable water sources and systems for the district are adequate to meet the current and future projected potable water demand.

- Non-potable water demand for Koʻolau Poko in CY 2000, primarily for agriculture, was 11.434 mgd. Non-potable water demand for the district projected to 2030 is 14.271 mgd. Most of the increased demand is for possible future *kalo* production.

- Future non-potable water demand could be met by an increase in the use of both stream water and ground water for agricultural irrigation. However, regulatory and cost constraints will make it challenging to increase the supply of agricultural water in Koʻolau Poko.

The principal water demand and supply numbers are summarized in the following graph:

Figure ES.4 Ko'olau Poko Projected Water Supply and Demand Policy Scenario

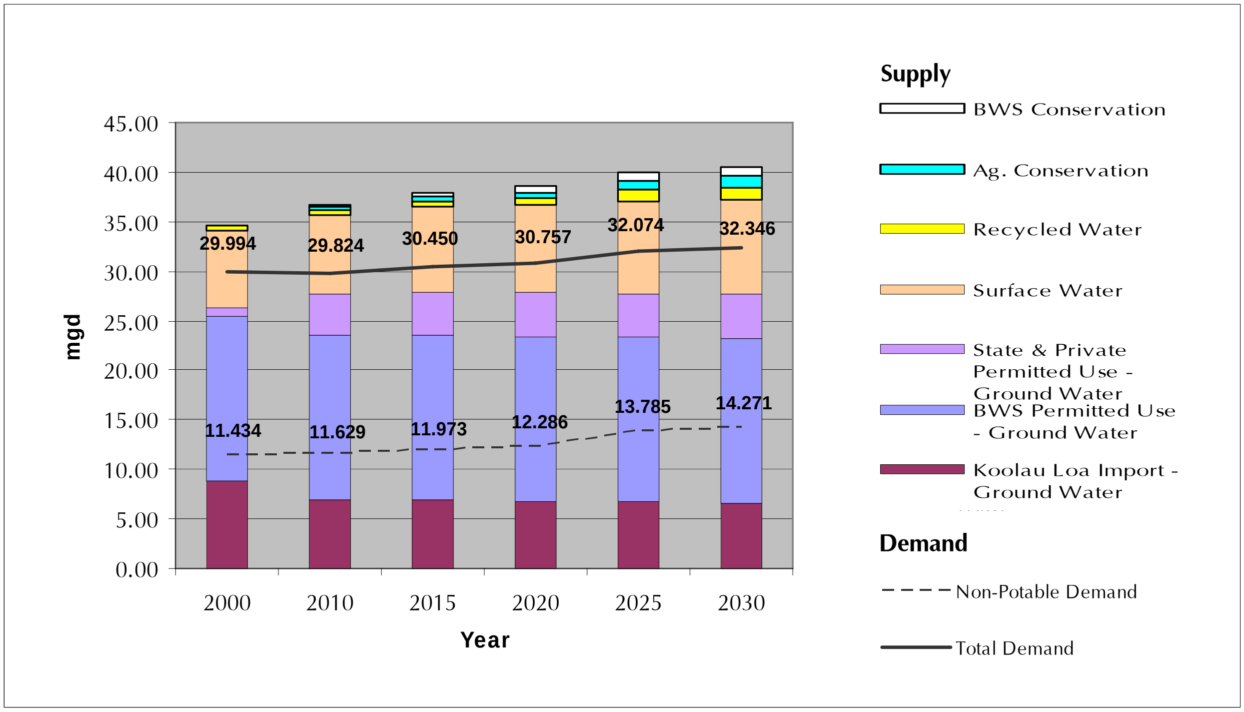

Table ES.3 Ko'olau Poko Projected Water Supply and Demand Policy Scenario

	2000	2010	2015	2020	2025	2030
SUPPLY	**34.569**	**36.404**	**37.702**	**38.335**	**39.672**	**40.551**
Ko'olau Loa Import – Ground Water	8.838	7.000	6.900	6.800	6.700	6.600
BWS Permitted Use – Ground Water	16.595	16.595	16.595	16.595	16.595	16.595
State and Private Permitted Use – Ground Water	0.936	3.942	4.077	4.147	4.222	4.537
Surface Water	7.650	7.894	8.734	8.975	9.215	9.456
Recycled Water	0.550	0.550	0.550	0.550	1.250	1.250
Agricultural Conservation	0.000	0.227	0.455	0.682	0.909	1.137
Conservation	0.000	0.195	0.391	0.586	0.781	0.977
DEMAND	**29.494**	**29.324**	**29.950**	**30.257**	**31.574**	**31.846**
Potable Demand*	18.060	17.695	17.977	17.972	17.789	17.575
Non-Potable Demand	11.434	11.629	11.973	12.286	13.785	14.271

*Potable demand includes 0.5 mgd exported to East Honolulu

Domestic and agricultural demand for ground water can be met with available ground water supplies, as indicated in the following table.

Table ES.4 Koʻolau Poko Existing and Future Ground Water Use – Policy Scenario

Aquifer System Area	Sustainable Yield (mgd)	Use in 2000 (mgd)	Projected Use 2030 (mgd)
Kahana (import from Koʻolau Loa)	15	8.838	6.600
Koʻolau Poko & Waimānalo	40	14.723	16.715
TOTAL	**55**	**23.561**	**23.315**

*Includes 0.5 mgd export to East Honolulu

Phasing and Funding of the 34 "Projects with Champions" is presented in the IMPLEMENTATION chapter in tabular form. The projects are noted as being either "short term" – to be implemented within the next 5 years – or "long term" – requiring more than 5 years to implement. Funding for these projects will potentially be provided by various federal, state, and city programs and agencies, and by private foundations and businesses.

The IMPLEMENTATION chapter also provides a presentation and discussion of CRITICAL WATERSHEDS and CATALYST PROJECTS.

A "critical watershed" is defined as a watershed that: (1) provides various opportunities to promote sustainable watersheds, or (2) needs protection or enhancement of water quality and quantity, or (3) provides many opportunities to protect Native Hawaiian rights and traditional customary practices, or (4) presents special opportunities for organizing and implementing important watershed management actions, or (5) provides significant ground water or surface water supplies to meet current and future demand.

A "catalyst project" is defined as a high priority project within a critical watershed that, when implemented, will provide energy, connectivity, information, and inspiration for other projects and programs within the watershed.

The critical watersheds and catalyst projects were defined as follows:

- **Kahalu'u Neighborhood Board Area**
  Critical Watershed: Waihe'e Stream Watershed – selected because this watershed is the largest single source of potable water for the Ko'olau Poko District (about 5 mgd), and because of the many opportunities for pro-active management projects within the watershed.
  Catalyst Project: Waihe'e Ahupua'a Initiative (WAI) Strategic Plan – Fund and develop a succinct Strategic Plan for the WAI Project that presents the Vision and Mission for WAI, and a 5-Year Action Plan for priority projects and programs.

- **Kāne'ohe Neighborhood Board Area**
  Critical Watershed: He'eia Stream Watershed – selected because of its complex of natural resources and opportunities for cultural and resource management programs, from *mauka* forest lands to streams, the He'eia wetlands, the great He'eia fish pond, and the marine resources of Kāne'ohe Bay.
  Catalyst Project: Māhuahua 'Ai O Hoi (He'eia Wetlands Restoration Project) – Provide technical assistance, funding, regulatory approvals, and resource management programs for this major wetlands restoration/food security project.

- **Kailua Neighborhood Board Area**
  Critical Watershed: Kawai Nui Marsh Watershed – selected both for its importance to the Waimānalo Ditch System and the historical, cultural, and ecological importance of Kawai Nui marsh.
  Catalyst Project: Management and Stewardship of Kawai Nui Marsh – Provide technical assistance, funding, regulatory approvals, and resource management programs for this major wetlands/ecosystem restoration program.

- **Waimānalo Neighborhood Board Area**
  Critical Watershed: Waimānalo and Kahawai Stream Watersheds – selected because the important farm lands of Waimānalo are located within these two stream watersheds.
  Catalyst Project: Increase Water Supplies for Waimānalo Farmers – Provide funding for diverse sources of additional water for diversified agriculture in Waimānalo, including modernization of the Waimānalo water diversion and ditch system, small to moderate yield ground water wells, and reclaimed water from the Waimānalo Waste Water Treatment Plant.

The KPWMP identifies a large number of "Projects with Champions" and "Watershed Management Strategies" that are important for water use and watershed health in Koʻolau Poko. These projects and strategies require various levels of manpower and funding, and can only be implemented to the extent that resources are available from the private and public sectors of the community.

The IMPLEMENTATION chapter concludes with some thoughts on the need for a dedicated funding source that could provide ongoing financial resources for the implementation of important water supply and watershed management projects.

The proposed strategies and projects within this plan are the result of a comprehensive watershed analysis and stakeholder consultation process. The projects may involve various governmental agencies and non-governmental organizations. The implementation and funding of these projects are not the sole responsibility of the Board of Water Supply, City and County of Honolulu, or State of Hawaiʻi. This Plan is intended to guide agencies and organizations in implementing the most important initiatives for Koʻolau Poko watersheds and water resources; however, implementation will depend on budgetary priorities, the availability of grants, and partnering efforts over the long term.

ENDNOTES

[i] Board of Water Supply Water for Life: The History and Future of Water on O‘ahu.

CHAPTER 1 - O'AHU WATER MANAGEMENT PLAN OVERVIEW

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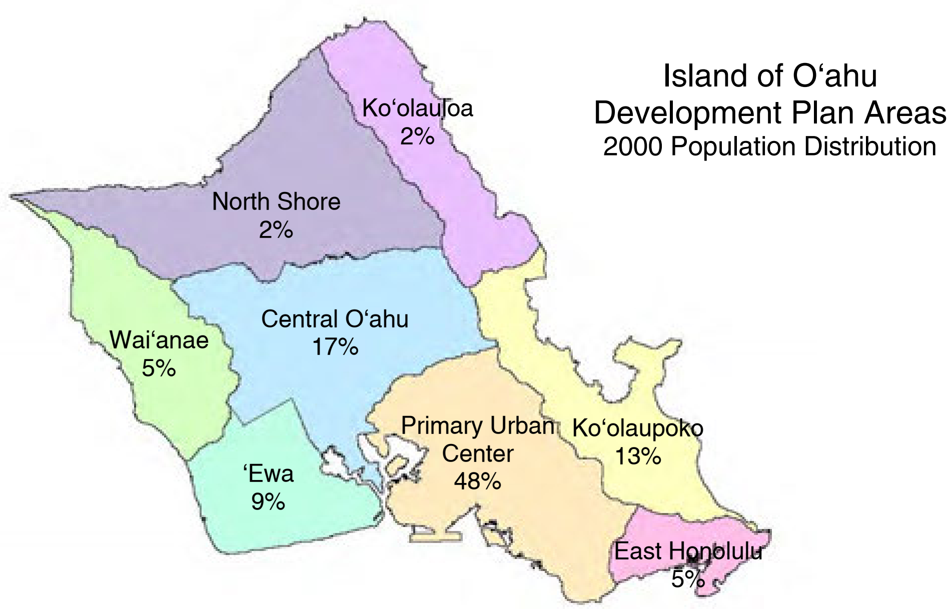
1 O'AHU WATER MANAGEMENT PLAN OVERVIEW

1.1 AUTHORITY AND PURPOSE

The Watershed Management Plans (WMPs) for O'ahu have been prepared in accordance with the requirements of the State Water Code and Revised Ordinances of the City and County of Honolulu, which established the "O'ahu Water Management Plan." The State Water Code, Chapter 174-C protects, controls and regulates the use of the State's water resources for the benefit of its people and the environment. Under the Code, the County is responsible for preparing the water use and development plan for the City and County of Honolulu. In response, Chapter 30 ROH Water Management, established the O'ahu Water Management Plan (OWMP), which has evolved into a framework of regional WMPs by City development plan district to plan for the management of all water resources within each watershed (Appendices A and B). The land use districts are shown in Figure 1.1.

Figure 1. 1 O'ahu Development Plan Areas



The State Water Code's Declaration of Policy recognizes the need for comprehensive water resources planning and establishes the Hawaii Water Plan (HWP) as the guide for developing and implementing this policy. The HWP is intended to serve as a continuing long-range guide for the Commission on Water Resource Management (CWRM) in executing its general powers, duties, and responsibilities assuring economic development, good municipal services, agricultural stability, and environmental protection.

The HWP currently consists of five major components (plans) identified as the: 1) Water Resource Protection Plan, 2) Water Quality Plan, 3) State Water Projects Plan,
4) Agricultural Water Use and Development Plan, and 5) County Water Use and Development Plans.

The Water Code recognizes that the HWP must be continually updated to remain useful and relevant and further specifies that each county shall update and modify its water use and development plans as necessary to maintain consistency with its zoning and land use policies". §174C-31(q) HRS

WATER USE AND DEVELOPMENT PLAN (WUDP)

A separate WUDP is to be prepared by each of the four counties and adopted by ordinance. The objective of the WUDPs is to set forth the allocation of water to land use in that county. Administrative Rule §13-170-31 states that each WUDP shall include, but not be limited to:

(1) Status of county water and related land development including an inventory of existing water uses for domestic, municipal, and industrial users, agriculture, aquaculture, hydropower development, drainage, reuse, reclamation, recharge, and resulting problems and constraints;
(2) Future land uses and related water needs; and
(3) Regional plans for water developments including recommended and alternative plans, costs, adequacy of plans, and relationship to the water resource protection plan and water quality plan.

Additional guidelines for preparing the WUDPs are provided in Administrative Rule §13-170-32:

(1) *Each water use and development plan shall be consistent with the water resource protection plan and the water quality plan.*
(2) *Each water use and development plan and the state water projects plan shall be consistent with the respective county land use plans and policies, including general plan and zoning as determined by each respective county.*
(3) *Each water use and development plan shall consider a twenty year projection period for analysis purposes.*
(4) *The water use and development plan for each county shall also be consistent with the state land use classification and policies.*
(5) *The cost of maintaining the water use and development plan shall be borne by the counties; state water capital improvement funds appropriated to the counties shall be deemed to satisfy Article VIII, section 5 of the State Constitution.*

STATEWIDE FRAMEWORK FOR UPDATING THE HAWAII WATER PLAN

In February 2000, the CWRM adopted the Statewide Framework for Updating the Hawaii Water Plan (Statewide Framework). The objectives of developing and outlining a statewide framework for the Hawaii Water Plan are:

- To achieve integration of land use and water planning efforts that are undertaken by federal, state, county, and private entities so that a consistent and coordinated plan for the protection, conservation and management of our water resources is achieved;
- To recommend guidelines for the HWP update so that the plan and its component parts are useful to the CWRM, other state agencies, the counties, and the general public;
- To develop a dynamic planning process that results in a "living document" for each component of the HWP which will provide county and state decision-makers with well formulated options and strategies for addressing future water resource management and development issues;
- To better define roles and responsibilities of all state and county agencies with respect to the development and updating of the HWP components;
- To describe and outline the techniques and methodologies of integrated resource planning as the basic approach that should be utilized in developing and updating the County WUDPs;
- To facilitate permitting and to identify potential critical resource areas where increased monitoring or baseline data gathering should proceed;
- To establish an overall schedule for phased updating of the HWP; and
- To outline an Implementation Plan for near-term and long-term actions.

The Statewide Framework includes the following recommended plan elements for the County WUDP update process:

- County-Specific WUDP Project Description
- Coordination with CWRM on Water Resource Management
- Stakeholder and Public Involvement
- Development of Policy Objectives and Evaluation Criteria
- Description of Water System Profiles
- Identification of Resource and Facility Options
- Development and Evaluation of Strategy Options
- Implementation Plan

The Statewide Framework further recommends integration of HWP components at the county level.

OʻAHU WATER MANAGEMENT PLAN: 1990 ADOPTION TO PRESENT

The initial HWP, including all component plans, was adopted by the CWRM in 1990. In compliance with the State Water Code, the City and County of Honolulu enacted the Oʻahu Water Management Plan (OWMP) by Ordinance No. 90-62 and codified as Chapter 30, Articles 1, 2 and 3, Revised Ordinances of Honolulu (ROH), 1990, as amended. The OWMP serves as the WUDP for the City and County of Honolulu. The OWMP consists of policies and strategies, which guide the activities of the City and County of Honolulu and advises the CWRM in the areas of planning, management, water development and use and allocation of Oʻahu's natural water resources.

The 1990 OWMP described existing uses of water and contemplated future needs for the island of Oʻahu. The plan highlighted regional water problems and identified major water development projects. It also described the quality of water required for the contemplated uses. Informational needs and data gaps identified in the plan included surface water availability and use and agricultural water demand projections.

The CWRM deferred adoption of the 1992 OWMP update pending additional refinement of plan components. Subsequent updates were complicated because of rapid changes to the water resources situation on Oʻahu with the closing of the sugar plantations and the resulting Waiāhole Ditch Contested Case in 1995.

In 1999, the Honolulu Board of Water Supply (BWS) began the integrated island-wide water planning effort to update the OWMP as recommended by CWRM. However, this approach was met with significant opposition by the public. One of the major concerns expressed by the public was that it is important to have equal focus on resource protection, conservation, and restoration as on water use and development. Communities also desired to be active participants in a community-based planning process. In addition, the communities consulted wanted assurance that there were sufficient water resources within their watersheds before island-wide regional water needs were discussed.

In August 2000, the Hawai'i Supreme Court announced their landmark decision that changed the way Hawai'i's water laws were interpreted. The court drew upon principles of the Public Trust Doctrine and the Precautionary Principle and have over time, identified four public trust uses of water that have priority over other water uses: 1) maintenance of waters in their natural state; 2) domestic water use; 3) the exercise of Native Hawaiian and traditional and customary rights, including appurtenant rights and 4) reservations of water for Hawaiian Home Lands (See Appendix B.5). In response to these Supreme Court decisions, BWS decided to expand the water planning approach to include these principles through a holistic watershed-based approach modeled after the Hawaiian concept of ahupua'a encompassing environmental, economic and social/cultural values. A planning framework for watershed protection and water use and development was established for updating the OWMP that is inclusive of various legal and planning documents with extensive community participation that guide the plan.

On March 17, 2004, the CWRM approved the OWMP framework, scope of work and planning elements for regional watershed management plans as meeting the statutory and statewide framework provisions for updating the County WUDP.

On August 18, 2010, the Honolulu City Council adopted the Wai'anae and Ko'olau Loa Watershed Management Plans, two of eight regional watershed management plans that will, together with islandwide water management policies and strategies in Article 2 of Chapter 30 ROH, form the updated O'ahu Water Management Plan. In areas where a regional watershed plan has not been adopted, Chapter 30, ROH and the Technical Reference Document for the OWMP, dated March 1990 shall serve as the County WUDP.

The Ordinance further states that in conjunction with BWS, the City Department of Planning and Permitting (DPP) shall be responsible for the preparation of the regional watershed management plans for the OWMP. The regional WMPs shall be adopted by ordinance and then submitted to the CWRM for adoption. Each regional WMP shall be updated, at a minimum, in tandem with the respective Development Plans/Sustainable Communities Plans.

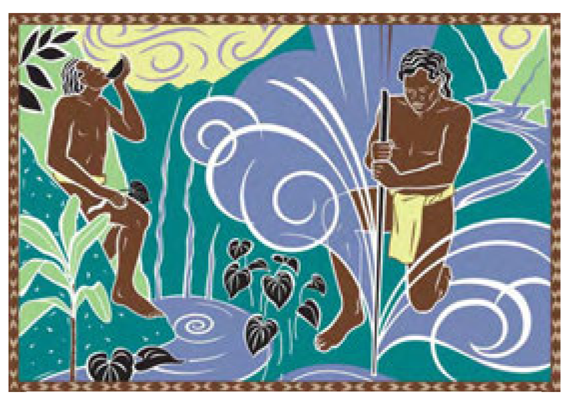
On March 16, 2011, the CWRM adopted the Wai'anae and Ko'olau Loa WMPs into the Hawaii Water Plan. The CWRM approved of the regional, watershed-based approach to water resource management as a viable methodology for the integration of HWP components within the County WUDP.

1.2 OʻAHU WATER MANAGEMENT PLAN FRAMEWORK

The OWMP consists of overall policies and strategies and regional watershed management plans, that will guide the activities of the City and County of Honolulu and will also provide advice to CWRM regarding the planning, management, conservation, use, development, and allocation of Oʻahu's limited surface water and ground water resources for the next 20 years to 2030.

The OWMP shall be consistent with relevant Federal, State, and City laws and policy documents, including:

- Federal Clean Water Act and Safe Drinking Water Act
- Hawaiʻi State Water Plan
- State Water Code
- Statewide Framework for Updating the Hawaiʻi Water Plan
- Hawaiʻi Supreme Court Decisions on the Waiāhole Ditch and the Waiʻola O Molokaʻi contested cases
- State land use classifications and policies
- City and County of Honolulu Chapter 30, ROH establishing the OWMP islandwide polices and strategies and regional WMPs.
- General Plan for the City and County of Honolulu and Development Plans and Sustainable Communities Plans for Oʻahu's eight land use districts
- City Zoning Designations
- BWS Mission of "Water for Life, Ka Wai Ola"



"Water for Life – Ka Wai Ola."

The resulting WMPs are built on the following key planning principles:

- Community-based
- Environmentally holistic
- Based on *ahupua'a* management principles
- Action-oriented
- In alignment with State and County water and land use policies.

The following graphic (Figure 1.2) illustrates the planning framework for the OWMP. The framework identifies the various legal and planning documents that guide the plan. Each of the eight WMPs by O'ahu General Plan land use districts will be organized within this framework and the island overview chapter will provide a consolidating mechanism to place each of the regions into the proper island-wide perspective.

The framework is meant to establish and guide the watershed management objectives and strategies specific to each region. The eight WMPs tie directly into the eight land use plans through common boundaries, vision and policies. A key denominator integrating land use and water planning is the maintenance of a **healthy watershed**. Land use plans and water use and development plans that support growth and existing communities on O'ahu must ensure that watersheds remain healthy through sustainable planning practices, watershed protection projects and best management practices that minimize impacts.

Given these expressed inter-relationships between land and water, Chapter 30 ROH now requires that each regional WMP shall be updated, at a minimum, in tandem with the respective Development Plans/Sustainable Communities Plans. With each iteration, land use and water planning will become increasingly integrated in vision, policies, goals, and objectives, resource protection and management and infrastructure development to achieve a sustainable future.

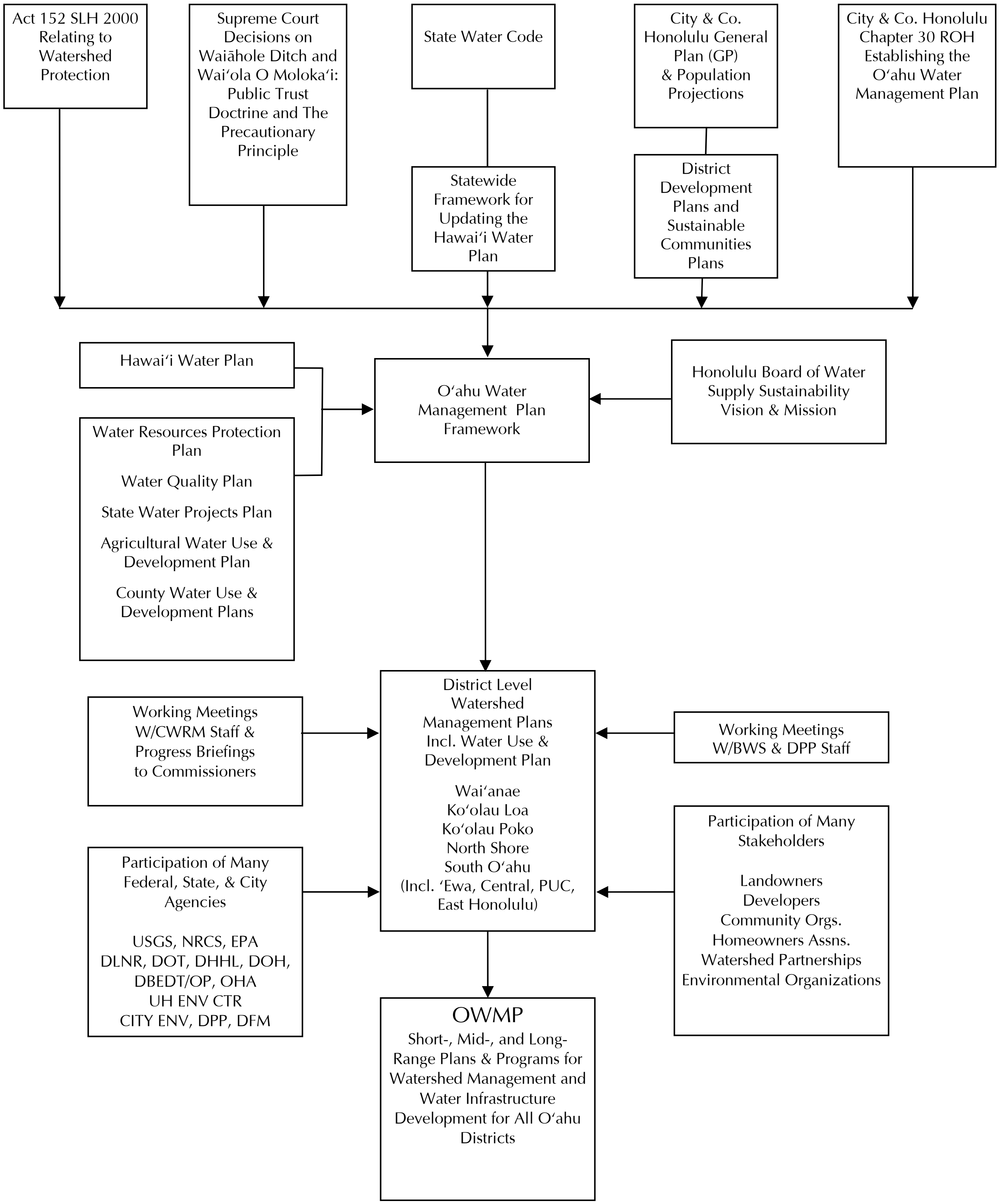


Figure 1. 2 Watershed Management Plans for Oʻahu, State, and County Level Planning Framework Diagram

Based on the planning principles and through a consultation process with community leaders, community groups, public agencies, land owners, and other stakeholders in the watershed management planning process, BWS then developed an overall statement of Goals and Objectives for the OWMP, as follows:

GOAL

To formulate an environmentally holistic, community-based, and economically viable WMP that will provide a balance between: (1) the protection, preservation and management of O'ahu's watersheds, and (2) sustainable ground water and surface water use and development to serve present users and future generations.

OBJECTIVES

1. Promote sustainable watersheds.
2. Protect and enhance water quality and quantity.
3. Protect Native Hawaiian rights and traditional and customary practices.
4. Facilitate public participation, education, and project implementation.
5. Meet future water demands at reasonable costs.

The WMP objectives were derived from an extensive stakeholder consultation process and reflect their values and thinking about water resources. These values and thinking were then consolidated into broad goals and objectives that apply island-wide thus providing the overall guidance, balance and consistency for each of the eight district level WMPs. Each of the eight plans will define more specific sub-objectives, policies, strategies and actions that reflect specific district conditions, issues, and needs and provide a balance among all five plan objectives under the OWMP Framework.

Objective 1. Promote sustainable watersheds

Sustainable watersheds are bio-diverse, renewable, and resource productive land and water ecosystems extending from the mountains to the coral reefs, that meet present needs without compromising those of future generations. In a sustainable watershed, there is a holistic inter-relationship among watershed resources including geologic structures, soil characteristics, forest communities, endemic and indigenous animals, introduced species, ground water aquifers, streams and wetlands, reefs and near-shore waters, traditional and cultural practices, land use and land development. Healthy, sustainable watersheds should be the foundation for both land use and water resources management planning.

Sustainable watersheds can be achieved through the implementation of a comprehensive WMP that promotes a healthy watershed by emphasizing habitat and native species preservation, active forestry management practices, invasive species and pollution controls, resource conservation and demand-side management programs, low-impact development concepts and recycling.

Objective 2. Protect and enhance water quality and quantity

Water is essential to human life and to the health of the environment. As a valuable natural resource, it comprises marine, estuarine, wetlands, freshwater streams and ground water environments, across coastal and inland areas. Water has two dimensions that are closely linked - quality and quantity. Water quality relates to the composition of water as affected by natural processes and human activities. It depends not only on water's chemical condition, but also its biological, physical and radiological condition. Water quantity relates to the amount of renewable ground water supply or base stream flow existing on a sustainable basis in perpetuity. In a healthy environment, water quality and quantity supports a rich and varied community of organisms and protects public health. Water quality and quantity influence the way in which communities use the water for activities such as drinking, swimming, fishing, farming, gathering, or commercial purposes.

Drinking water systems are regularly tested for compliance with EPA Safe Drinking Water Standards and BWS criteria for system operations and resource monitoring. Watershed protection projects and programs will ensure that aquifers and streams are healthy and sustainable. Source water protection programs and the monitoring of hydrologic indicators of rainfall, stream and spring flows, and aquifer water levels will ensure consistently high source water quality.

BWS ensures the health of the ground water aquifers by monitoring the island-wide index and deep monitor wells for water levels and chlorides at the top and mid-point of the fresh water-sea water transition zone. Source water quality can be affected by sea water intrusion or upconing brackish water especially during extended drought. Monitoring also ensures sufficient aquifer recovery during post-drought periods.

In conjunction with CWRM, University of Hawai'i Water Resources Research Center (WRRC) and U.S. Geological Survey (USGS), BWS is advancing analytical methods and modeling tools to increase understanding of recharge and ground water aquifers and streams. The agencies will work together to fund, construct and utilize 3-dimensional solute transport ground water modeling calibrated with new deep monitor wells in basal aquifers to:

- Evaluate individual source yields to prevent upconing and salt water intrusion during normal rainfall and drought events.
- Optimize existing source pumpages to meet water system demands and avoid detrimental impacts to the aquifer's utility (quality and quantity); ensure adequate aquifer recovery after long drought periods.
- Evaluate aquifer sustainable yields as allocations and pumpage approach sustainable yield limits to ensure new sources are sustainable.
- Site and size new wells to develop remaining ground water and minimize impacts to adjacent and down-gradient sources and surface waters.

Objective 3. Protect Native Hawaiian rights and traditional and customary practices

Native Hawaiian water rights are set forth in the State Constitution, Section 221 of the Hawaiian Homes CWRM Act and Section 174C-101 of the State Water Code, providing for: a) Department of Hawaiian Home Lands water; b) traditional and customary gathering rights; and c) appurtenant water rights of *kuleana* and *kalo* lands. Native Hawaiian water uses also include cultural uses for spiritual/religious practices, *kalo* and other traditional agriculture, as well as adequate flows of fresh water into the nearshore water ecosystem.

The Hawaiʻi Supreme Court held that title to the water resources is held in trust by the State for the benefit of its people and established the exercise of Native Hawaiian and traditional and customary practices as a public trust purpose, along with the maintenance of waters in their natural state, domestic water use, and reservation of water for Hawaiian Home Lands. Some of the objectives proposed for implementing the public trust purposes include the provision of adequate stream flows, riparian restoration, and control of alien species. These WMP objectives strive to ensure there are healthy and plentiful water resources available.

Protecting Native Hawaiian rights and traditional and customary practices must be done in conjunction with the setting of measurable instream flow standards (IFS), for all perennial streams and stream segments, balancing in-stream uses, domestic uses, and Native Hawaiian and traditional and customary uses with off-stream reasonable and beneficial uses. In developing those standards a precautionary order, consisting of instream studies such as stream hydrology and bio-assessments for habitat and gathering, is proposed. Studies of water for public trust purposes are also needed and only after completing this evaluation of stream water can a determination of availability of surface water for additional agricultural uses and urban nonpotable uses be accomplished.

Where practical, the WMP will identify the conversion of existing off-stream surface water uses to recycled water and implement conservation measures to create an opportunity for stream restoration. BWS will continue to develop new ground water sources that do not impact surface waters. However, if instream flow standards are established and surface water becomes available, surface water diversions and ground water development that may reduce surface water within the allowances granted by the measurable IFS may be pursued.

Objective 4. Facilitate public participation, education, and project implementation
Planning and managing our island's water and related resources involves a variety of stakeholders from end users, landowners, public and private water purveyors and government agencies. A collaborative process can result in innovative planning and implementation that incorporates local knowledge and directly involves area residents. Public education involving water resource issues can support collaboration with informed stakeholders. Directed water resource curriculum for schools will ensure knowledge and respect for water resources will extend to future generations. Ultimately public participation will result in benefits to the water resources, water users and the related ecosystems.

Several watershed partnerships have been established in both conservation and urban areas with community groups, agencies and organizations with similar objectives. These partnerships pool funding, resources and initiatives toward common objectives of watershed health, education and project funding and implementation.

Objective 5. Meet water demands at reasonable costs
Water is essential to all life. O'ahu's population relies on an abundant and reliable water supply for drinking, irrigation, agriculture, commercial and industrial use and fire protection. O'ahu's residents are educated in watershed management practices; water conservation is not just a message, but a way of life. Efficient water systems promote public health and safety and deliver water to meet current and future demands at reasonable costs. Reasonable costs encompass a balancing of the other plan objectives and are not necessarily the lowest economic costs. Capital improvements and operations and maintenance costs should not place an unreasonable burden on water rate payers. Water systems are flexible yet secure to account for uncertainties, and are expanded concurrent with land use plans and growth forecasts. Withdrawal rates are precautionary with respect to the resource and are well within established sustainable yields and instream flow standards, which protect the long-term viability of the water resource and do not detrimentally impact cultural uses and natural environments.

The allocation of water to land use considers a full range of alternative water sources. Water quality should be matched with appropriate use. Thus, high quality water is used for drinking and lower quality water, such as recycled water, is used for irrigation and industrial processes. New technology allows cost effective, diversified, drought proof water systems that develop ground water, surface water, recycled and seawater resources that meet water demands while balancing the other plan objectives.

The following categories describe the primary water planning elements of this objective:

<u>Water Conservation</u>

- Improving distribution system efficiencies will reduce Operations and Maintenance (O&M) costs and reduce water loss. Infrastructure water loss and efficiency measures include leak detection and repair of existing pipelines and ditch systems and the renewal and replacement of water system facilities (pipelines, ditches, pump stations, reservoirs and treatment systems). Advanced corrosion protection systems will maximize the life of existing and new pipelines.
- Promoting demand-side management programs provides hardware and behavioral modifications on customer water use. Water conservation tips, public service announcements and specific programs tailored to distinct user categories will effectively reduce water use and defer development of new water sources.
- Educational programs promote conservation as a way of life that effects a generational change in thinking that starts with the education of our children. BWS has been promoting water conservation best practices in schools for over 35 years.

Efficient Water Use and New Sources of Supply

- New source development can be deferred with increases in system efficiency, which is more cost effective. New source options must balance economic costs with environmental, cultural and social values.

Growth Projections

- Improving water demand forecasting methodologies will ensure that new sources become available at the appropriate time. The level of accuracy will improve as the calibration of leading indicators and trends improve.

Drought Mitigation

- A diversified and sustainable water system can mitigate drought impacts. The State and Oʻahu County Drought Plans have identified mitigation strategies and projects for water supply, agriculture and wildland fire prevention, to reduce the detrimental impacts of drought on water uses, the economy and the environment.

Operational Flexibility

- An integrated island-wide water system provides operational flexibility, water service reliability, and hydraulic efficiency. A flexible water system maintains level of service standards while allowing planned repair and maintenance. An important element of optimization integrates the operations of the existing water systems with sustainable aquifer pumpage levels.

Water System Reliability, Adequacy and Efficiency

- Water system reliability reflects the ability of the distribution system to consistently deliver water with minimal interruptions during normal and emergency conditions. A diversified water supply system consisting of a combination of ground water, surface water, recycled water, desalinated water and seawater resources maximizes system reliability especially during periods of drought, high growth spurts and impacts from ground water contamination. The municipal water system is expanded and operated as an integrated island-wide water system to enhance system reliability.
- Adequate capacity reflects the ability to deliver an acceptable quantity and quality of water at a suitable pressure and overall responsiveness to customer needs. Water systems are constantly improved to meet BWS Water System Standards providing standby pump capacity, infrastructure redundancy, enhanced security systems and disaster response.
- Water System Efficiency reflects how well water is produced, delivered and used, and how energy is utilized. Efficiency is the ability to deliver water with a minimum of effort, expense or waste. Reliable water systems are energy efficient, have emergency power generation and are supplied with an increasing proportion of renewable energy supplies reducing reliance on imported oil. Elements of this objective include:
    - Reducing water system energy use per mgd produced.
    - Energy efficiency measures in pumping facilities include motors, variable frequency drives, lighting, heating, ventilation and use of photovoltaics.
    - Peak power load reduction using reservoirs and diesel generators to meet peak hour water demand results in lower electric bills.
    - Researching and supporting renewable energy systems such as H-Power, wind, solar, biofuels, OTEC and wave energy will help reduce water pumping power consumption from imported oil, mitigating some of the global energy uncertainties.

Planning for Uncertainty

- Maximize the ability to effectively plan and respond to uncertainties in water supply, forecasting water demand and climate change adaptation.

1.3 OʻAHU WATER USE AND DEVELOPMENT PLAN UPDATE

The OWMP consists of islandwide water management policies and strategies and regional watershed management plans, which guide the activities of the City and County of Honolulu and advises the state CWRM in the areas of planning, management, water development and use and allocation of Oʻahu's limited water resources. The islandwide policies and strategies listed in Article 2, Chapter 30 ROH, and restated below, apply to all City agencies "in the performance of their powers, duties and functions as related to both public and private development." The implementation of the strategies will carry out the policies.

Policy 1. Facilities for the provision of water shall be based on the general plan population projections and the land use policies contained in the development plans and depicted on the development plan land use maps.

Policy 2. System flexibility shall be maintained to facilitate the provision of an adequate supply of water consistent with planned land uses. The municipal water system shall be developed and operated substantially as an integrated islandwide water system.

Policy 3. Close coordination shall be maintained between federal, state and county agencies which are involved in the provision or management of water to ensure optimal distribution of the available water supply.

Policy 4. The quality and integrity of the water supply shall be maintained by providing for the monitoring and protection of the water supply in accordance with the requirements of the state water code.

Policy 5. The development and use of nonpotable water sources shall be maximized in a manner consistent with the protection of the groundwater quality.

Policy 6. Water conservation shall be strongly encouraged.

Policy 7. Alternative water sources shall be developed wherever feasible to ensure an adequate supply of water for planned uses on Oʻahu.

Strategy 1.	Develop water resources in consonance with the general plan population projections and the land use policies contained in the development plans and depicted on the development plan land use maps. Priority shall be given to affordable housing projects shown on the development plan land use maps or processed under HRS Chapter 201E.
Strategy 2.	Continue to safely develop the remaining available groundwater in accordance with the requirements of the state water code.
Strategy 3.	Use surface water more effectively and efficiently.
Strategy 4.	Continue to refine the near and long-term projections of agriculture on the island to more accurately project the future net release of water currently committed to agricultural use.
Strategy 5.	Maintain an ongoing water conservation program through the board, using such approaches as pricing, public information, educational programs, water-saving devices, and use restrictions and allocations.
Strategy 6.	Develop and use nonpotable water sources, wherever feasible, for the irrigation of agricultural crops, parks and golf courses, landscaping and for certain industrial uses.
Strategy 7.	Continue efforts to develop economical methods of demineralizing brackish water and desalting seawater.

Article 2 further states that "based on the findings and projections in the OWMP, provisions for an adequate supply of water to meet islandwide needs for at least twenty years shall be addressed. This shall be determined after evaluating the anticipated demand for water use from municipal, agricultural, military and private users; the available remaining groundwater which can be safely developed; the planned and proposed water source development projects; and alternative water development projects under way." The following update provides this basis.

Water use and development on O'ahu is guided by the City's General Plan and the Development Plans and Sustainable Community Plans for the eight land use districts. These community-based land use plans describe each community's vision of their future and provide land use and infrastructure policies and guidelines. An important aspect of the City's land use plans is the establishment of urban growth and sustainable community boundaries that separate urban, agricultural and conservation lands. These boundaries provide adequate area for urban and rural development, protect important agricultural and conservation lands and facilitate infrastructure master planning.

An essential component of the WMP is the development of region specific watershed management projects and strategies that enhance ground water and surface water supplies, improve land management with respect to water, protect traditional and cultural practices and facilitate plan implementation. Each regional WMP will consist of about 30 to 40 watershed management projects and strategies derived from stakeholder consultation and the strategic plans and capital improvement programs of various Federal, State and City agencies, organizations, communities and watershed partnerships. These projects meet the five WMP objectives of balancing the protection of natural resources and the sustainable use of O'ahu's water supplies.

The following summary of O'ahu's water use and development provides the island-wide context to review and understand the eight regional WMPs. Together, the proposed regional watershed management plans update the OWMP as designed in the OWMP Framework.

As part of the process of initiating the update of the OWMP, and consistent with the guidelines set forth in the Statewide Framework for Updating the Hawai'i Water Plan, BWS has compiled information on existing and projected water demands and sources of supply for the municipal system; State, federal, and private water systems; and prime agricultural lands. In summary, BWS has evaluated the adequacy of the supply to meet future potable and non-potable water needs and through a combination of conservation, diversified water supply development and watershed protection strategies, the City can meet water demands through the 2030 planning period.

1.3.1 City and County of Honolulu Land Use Plans

The General Plan for the City and County of Honolulu is a comprehensive statement of objectives and policies, which sets forth the long-range aspirations of O'ahu's residents and the strategies of actions to achieve them. It is the overarching policy document of a comprehensive planning system that addresses physical, social, economic and environmental concerns affecting O'ahu. This planning system serves as the coordinating structure by which the City provides for the future growth on the island of O'ahu. The General Plan establishes a distribution of residential population among the eight land use districts that directs development to the primary and secondary urban centers and the Ewa and Central O'ahu urban fringe areas to relieve developmental pressures in the remaining urban fringe and rural areas and to meet housing needs. The General Plan can be viewed at the following link: http://www.honoluludpp.org/Planning/OahuGenPlan.asp

The City established regional Development Plans (DP) and Sustainable Community Plans (SCP) for each of the eight land use planning regions of O'ahu. Each community oriented land use plan is intended to help guide public policy, investment, and decision making over the next 20 years. Each plan responds to specific conditions and community values of each region. 'Ewa and the Primary Urban Center are "development plan" areas where growth and supporting facilities will be directed and be the policy guide for development decisions and actions needed to support that growth. The remaining six districts are "sustainable communities" plans, which are envisioned as relatively stable regions in which public programs will focus on supporting existing populations. Each land use district establishes a boundary to contain urban and rural development to protect agriculture and preservation zoned areas. The following table lists the eight land use plans and their website links.

Oʻahu's Land Use Planning Regions	Web Page Links to the DP/SCP Land Use Plans
Waiʻanae	http://www.honoluludpp.org/Planning/DevSust_Waianae.asp
Koʻolau Loa	http://www.honoluludpp.org/Planning/DevSust_Koolauloa.asp
Koʻolau Poko	http://www.honoluludpp.org/Planning/DevSust_Koolaupoko.asp
North Shore	http://www.honoluludpp.org/Planning/DevSust_NorthShore.asp
ʻEwa	http://www.honoluludpp.org/Planning/DevSust_Ewa.asp
Central Oʻahu	http://www.honoluludpp.org/Planning/DevSust_CentralOahu.asp
East Honolulu	http://www.honoluludpp.org/Planning/DevSust_EastHonolulu.asp
Primary Urban Center	http://www.honoluludpp.org/Planning/DevSust_PrimaryUrbanCenter.asp

1.3.2 Population Forecasts and Municipal Water Demand

Table 1.1 shows the DPP population forecast from 2000 to 2030 by land use district accounting for residents, visitors, military and private water systems. Water use and census population in 2000 defines a per capita demand by development plan area that is used to forecast 2030 water demand for the population served by BWS.

In 2004, DPP forecasted an increase in Oʻahu's resident population from about 870,000 in 2000 to about 1.1 million residents in 2030. Subsequent DPP interim forecasts reduced the 2030 resident population by approximately 9%. Note that the next update of the water demand forecast is expected after the 2010 census data is incorporated into the City's population projections. Based on the City's 2004 growth projections evaluating population, visitors, housing and employment factors, BWS forecasts an increase in municipal potable water demand of approximately 52 mgd for Oʻahu from 154.7 mgd in 2000 to 206 mgd in 2030 and represents the mid-growth scenario. Most of the forecasted growth will occur in ʻEwa, PUC, Central Oʻahu, Wai'anae and East Honolulu. Military and private water use is expected to increase by 1.3 mgd in the same time period.

Conservation has reduced the per capita demand by 6% in 2000 from 1990 levels and recent data suggest per capita demand is decreasing further as water conservation programs continue to advance. Per capita demand ranges from a low of 142 gallons per capita per day (gpcd) in Ko'olau Loa to 224 gpcd in Wai'anae due to a drier climate and larger agriculture water use from the municipal system. Note that with all long-range forecasts, a range of variation will occur due to uncertainties such as economics, zoning, population distribution and conservation. The **mid growth scenario** of 52 mgd is within the range of historical linear projections of municipal water demand growth.

Table 1. 1 Oʻahu Population and Water Demand

2000, By Development/Sustainable Communities Plan Area

DP Area	Resident Population	Residents Absent	Visitors Present	Defacto Population	Private/ Military	Population Served	DP area Demand (mgd)	Per Capita Demand (gpcd)
Waiʻanae	42,259	1,718	1,190	41,731	0	41,731	9.34	223.79
ʻEwa	68,696	2,793	916	66,819	5,159	61,660	15.30	223.58 *
East Honolulu	46,735	1,900	867	45,702	0	45,702	10.11	221.3
PUC	419,422	17,053	79,882	482,251	35,137	447,114	76.45	170.98
Central Oʻahu	148,208	6,026	484	142,667	18,213	124,455	19.41	155.96
Koʻolau Poko	117,910	4,794	140	113,256	0	113,256	19.84	175.14
Koʻolau Loa	14,546	591	1,391	15,346	4,936	10,409	1.48	142.47
North Shore	18,380	747	40	17,672	3,234	14,438	2.82	194.97
Total	876,156	35,623	84,911	925,444	66,680	858,766	154.75	

*GENERAL NOTE: The population numbers were taken from projections published by DPP in 2004.

2030, By Development/Sustainable Communities Plan Area

DP Area	Resident Population	Residents Absent	Visitors Present	Defacto Population	Private/ Military	Population Served	DP Area Demand (mgd)	Per Capita Demand (GPCD)
Waiʻanae	50,616	2,044	3,701	52,273	62	52,211	11.68	223.79
ʻEwa	184,612	7,455	22,257	199,415	9316	190,099	42.50	223.58
East Honolulu	51,059	2,062	2,152	51,150	0	51,150	11.32	221.3
PUC	489,389	19,761	93,139	562,767	36188	526,579	90.04	170.98
Central Oʻahu	189,599	7,656	1,756	183,699	18048	165,651	25.83	155.96
Koʻolau Poko	115,357	4,658	1,349	112,048	0	112,048	19.62	175.14
Koʻolau Loa	16,725	675	4,814	20,863	6494	14,369	2.05	142.47
North Shore	19,945	805	1,246	20,386	3212	17,174	3.35	194.97
Total	1,117,302	45,116	130,414	1,202,600	73,320	1,129,280	206.40	

*GENERAL NOTE: The population numbers were taken from projections published by DPP in 2004.

* The ʻEwa District per capita demand reflects a 1.516 mgd adjustment to account for demineralized recycled water use for industrial process water, which reduced potable water use after 2000.

OʻAHU POPULATION AND WATER DEMAND SUMMARY

Development Plan Area	2000 BWS Population Served	2030 BWS Population Served	Estimated Population Increase in 2030	Additional Water Demand in 2030 (mgd)
Waiʻanae	41,731	52,211	10,480	2.34
ʻEwa	61,660	190,099	128,439	27.20
East Honolulu	45,702	51,150	5,448	1.21
PUC	447,114	526,579	79,465	13.59
Central Oʻahu	124,455	165,651	41,196	6.42
Koʻolau Poko	113,256	112,048	-1,208	-0.22
Koʻolau Loa	10,409	14,369	3,960	0.57
North Shore	14,438	17,174	2,736	0.53
Total	858,766	1,129,280	270,514	51.65

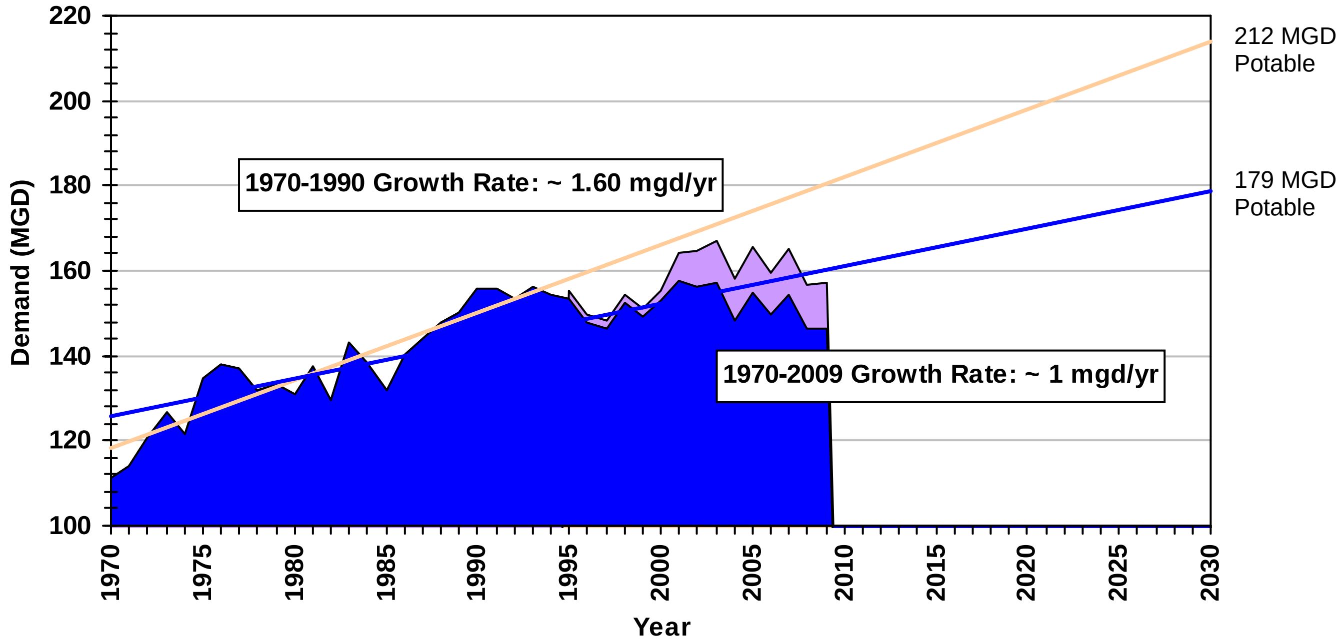


Figure 1. 3 BWS Potable and Nonpotable Water Systems Demands: Actual 1970-2009 and Linear Projection to 2030

Conservation efforts and recycled water have had a significant role in keeping island-wide potable water use at 1990 levels through 2009 at approximately 155 mgd. Figure 1.3 shows BWS potable (blue) and non-potable (purple) water systems historical water demand growth rates from 1970 to 2009. The potable growth rates are linearly projected to 2030 along two slopes ranging from 1.0 mgd/year to 1.60 mgd/year, with 2030 demands of 179 mgd as the **low growth scenario** to 212 mgd as the **high growth scenario**, respectively and represent the range in potable water demand growth expectations over time. The lower slope represents the benefit that conservation and economic factors have on leveling potable water demand growth.

Table 1.2 shows O'ahu's ground water use as of September 2009 totaling 196 mgd including the Waiāhole Ditch and the brackish 'Ewa Caprock aquifer. Municipal ground water use constitutes 76% of the total, with military, agriculture and irrigation and other uses taking up the remainder. Agriculture ground water use includes private wells and the Waiāhole Ditch but overall agriculture groundwater use has decreased post-plantation owing to the availability and use of surface water and the slow rate of diversified agriculture growth.

Table 1. 2 Oʻahu's Ground Water Use Sept 2009

Use Category	Water Used 12-Mo. MAV Sept 2009 (mgd)	Percentage of Total Water Use Sept 2009
Municipal	148	76%
Military	22	11%
Agriculture*	14	7%
Irrigation**	5	3%
Domestic	2	1%
Industrial**	4	2%
Total	196	100%

* Includes Waiāhole Ditch
** Includes Ewa Caprock Brackish aquifer

Table 1.3 summarizes Appendix C by listing Oʻahu's largest permitted uses of fresh ground water by user including Waiāhole Ditch water uses but excluding saltwater and brackish caprock water uses in 2009.

Table 1. 3 Oʻahu's Top Ground Water Users by Permitted Use September 2009

Owner	Permitted Use (mgd)	Owner	Permitted Use (mgd)
1. Honolulu BWS	183.08	9. US Fish & Wildlife	2.91
2. Waialua Sugar	33.48	10. Monsanto	2.64
3. US Navy	28.77	11. Robinson Kunia	2.49
4. D.R. Horton	7.97	12. Dole/Castle & Cooke	2.13
5. US Army	7.29	13. Agribusiness Dev.	2.00
6. Del Monte	5.03	14. Galbraith Estate	2.00
7. Dillingham Ranch	4.10	15. Bishop Estate	1.86
8. HRI/Lāʻie Water Co	3.69	16. Serenity Park	1.54

1.3.3 Department of Hawaiian Home Lands Demands

The Department of Hawaiian Home Lands (DHHL) owns lands in Mākaha, Wai‘anae, Lualualei, Nānākuli, Kalaeloa, Kapolei, Papakōlea, Mō‘ili‘ili, Waimānalo and Ha‘ikū as shown in Figure 1.4. DHHL is currently compiling their O‘ahu master plan and their findings will be incorporated in future WMP's. DHHL projected water demands of 1.7 mgd (State Water Projects Plan 2003) are incorporated into the BWS municipal water demand forecasts using the population based per capita demand method. DHHL holds water reservations in the Waimānalo aquifer of 0.124 mgd and in the Waipahu-Waiawa aquifer of 1.358 mgd for their projects. DHHL will request that CWRM assign their reservations toward new or existing sources as their lands are developed.

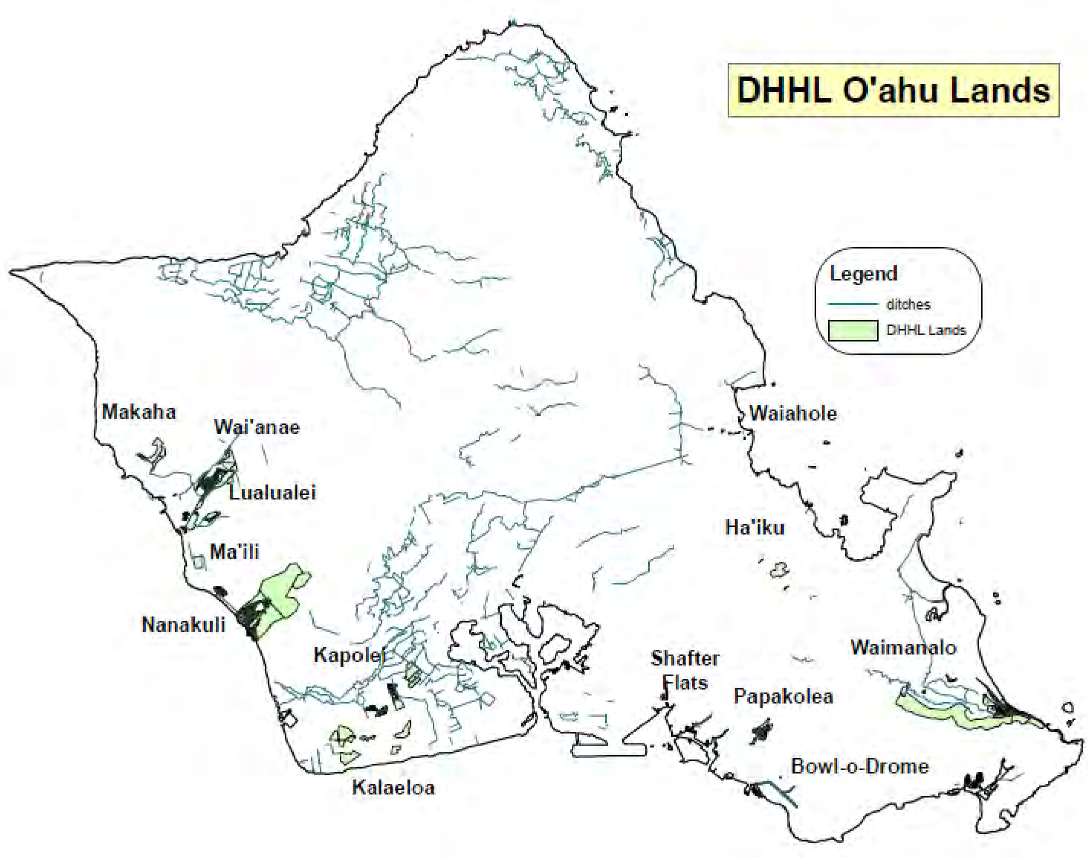


Figure 1. 4 Department of Hawaiian Home Lands on O‘ahu

1.3.4 STATE WATER PROJECTS PLAN WATER DEMANDS

The State Water Projects Plan (SWPP), 2003, identified a total of 24.5 mgd of housing, commercial, industrial, institutional and agricultural water demands for State agencies on O'ahu to the year 2020. Approximately 51% of O'ahu's SWPP demand or 12.5 mgd is non-potable use. The Department of Agriculture's demand of 7.6 mgd, the Department of Business Economic Development and Tourism's demand of 7.2 mgd and the University of Hawaii's demand of 3.1 mgd are the largest water needs.

The SWPP identified several water development strategies to meet their projected water demands including the use of existing State water system capacity; developing new water systems based on development master plans such as East Kapolei and Kalaeloa; utilizing existing BWS water credits from previous source development and pursuing recycled and brackish water for non-potable irrigation constitute approximately 17.9 mgd or 73% of O'ahu's SWPP total. The remaining 6.7 mgd or 27% of State water demand can be obtained from BWS through the payment of Water System Facilities Charges. The BWS municipal water demand forecasts using the population based per capita demand method of assessing State and County land use plans can be assumed to incorporate most of the SWPP's demands except for State owned water systems. An accounting tying specific source names to projected State agency demands would be helpful in the next SWPP update.

The SWPP update should add stronger water conservation and water loss reduction strategies, which were largely absent in the 2003 SWPP. Leak detection and repair projects in aging State water systems, such as agriculture, could reduce new source development, reduce operating and maintenance costs and provide more capacity for drought mitigation. The SWPP is currently being updated and their findings will be incorporated in future WMP's.

1.3.5 AGRICULTURAL WATER DEMAND

The State and City have adopted objectives and policies for the preservation of agricultural lands and for the long-term support of a viable agriculture industry on O'ahu. City land use plans have been adopted with growth boundaries in part to protect prime agricultural lands.

O'ahu's projected agricultural water demands have a wide variation and are uncertain yet important for water use planning because of the substantial quantities consumed for irrigation. Future water demand for agricultural crops depends on the type of crops cultivated, the climate and the number of acres in cultivation. The State Agricultural Water Use and Development Plan, (AWUDP) December 2004,[1] estimated a worst and best case range of 7.6 mgd and 30.4 mgd, respectively, of additional water demand for O'ahu based on population projections, partial replacement of imported produce with locally grown produce and maintaining farm value growth in diversified agriculture. Approximately 13 mgd of the projected best case agricultural demand was assumed to be assigned to private irrigation systems, with the remaining 17 mgd accommodated by the State's Waiāhole Ditch and Waimanalo irrigation systems. The AWUDP focused on maintaining existing State diversified agriculture systems and on transforming plantation water systems to serve diversified agriculture. "With available farm lands and adequate irrigation water, a significant expansion of diversified agriculture is an attainable and economically worthwhile goal which can be achieved largely by: 1) replacing much of Hawai'i's imported produce with locally grown produce, 2) pursuing niche and off-season markets of fruits and vegetables for export, 3) growing new or Asian-based specialty crops for export, and 4) meeting increased demand from the tourism and cruise ship industries for fresh fruits and vegetables." The two irrigations systems studied on O'ahu are the Waiāhole Ditch and Waimānalo irrigation systems. The Kaukonahua ditch system in Central O'ahu and North Shore was not included in the State AWUDP. Based on water metered data from the Lālāmilo system (South Kohala, Hawai'i Island), dry and wet season water use per acre varied between 2,500 gpd/acre to 4,600 gpd/acre. According to the AWUDP, an average of 3,400 gpd/acre is considered the best available estimate and a reliable value for use in planning and forecasting irrigation water demand for Hawai'i's diversified agriculture industry. It should be noted, that 3,400 gpd/acre is considered to be a practical consumptive water use rate which does not include irrigation system water loss.

Figure 1.5 shows the agricultural zoned lands on O'ahu with the four major irrigation systems: Waiāhole Ditch, Kaukonahua, Waimānalo and Punalu'u. Existing stream diversions and distribution systems should be inventoried, leaks and evaporation losses reduced to a reasonable goal and water use verified. Diversion works should include control gates to maintain diverted flows at reasonable and beneficial use plus losses. The practice of diverting maximum stream flow and then releasing unused diverted water into downstream drainage systems or into different streams should be minimized. Improvements to existing ditch systems, such as lining or piping ditches, have the potential to reduce water loss and thereby provide water for the expansion of agriculture without adding new diversions. Cost and benefit considerations should be factored into the feasibility of these improvements and will affect implementation. Significant new surface water diversions require amendments to the IFS, but the studies and processes are cost prohibitive.

Kamehameha Schools has renovated their Punalu'u and Kawailoa irrigation systems with cultural and eco-friendly stream diversion modifications and piped ditch systems to conserve and enhance the availability of stream water, Figure 1.6. The diversions include fish ladders on both stream banks and grated intakes to prevent debris and fish from entering the system. The ditch system was piped to reduce water loss and ditch maintenance and provide a pressurized irrigation system for farmers. The improvements keep unused water in the stream because as irrigation declines during the day or season, the pipe fills up to the intake and diverted flow reduces to zero.

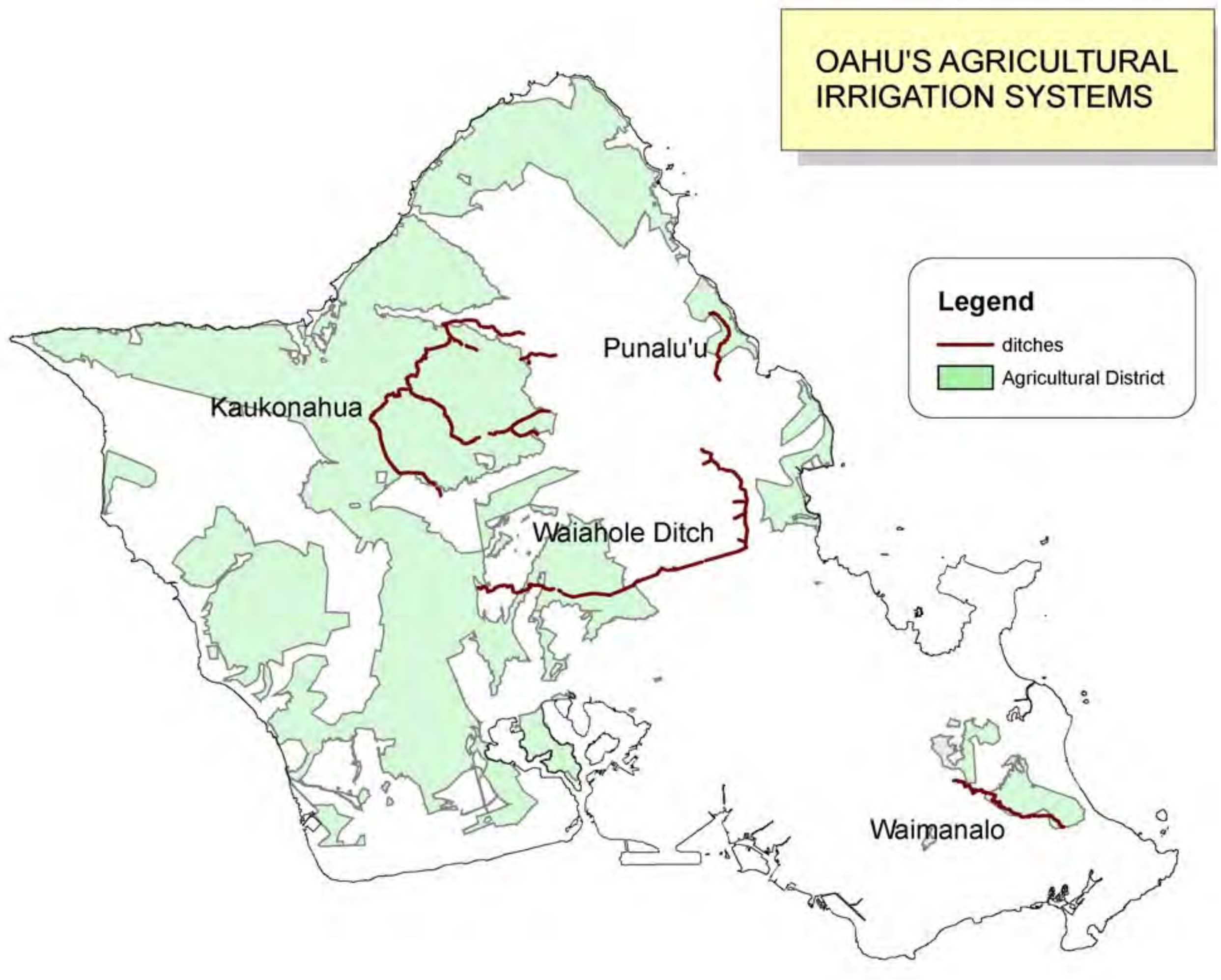


Figure 1. 5 Agricultural Zoned Lands on O'ahu

Figure 1. 6 Punalu'u Stream Diversion and Piped Ditch

There are large tracts of agricultural lands in the 'Ewa, Central O'ahu, North Shore, Ko'olau Loa and Ko'olau Poko districts. The 2004 AWUDP estimated that of the 49,500 acres of prime agriculture lands on O'ahu, 11,000 acres are in monocrop cultivation. The remaining 38,500 acres are idle and available for cultivation. Table 1.4 lists prime agricultural lands as identified in the City's land use plans with an average water use per acre proposed in the State AWUDP and as adjusted for high rainfall.

Table 1. 4 Prime Agricultural Lands on O'ahu

City Land Use District	Prime Agricultural Land Area (acres)	Water Use per Acre (gal/acre-day) (State AWUDP)	Nonpotable Water Demand (mgd)
North Shore	20,000	3,400	68
Central O'ahu	10,350	3,400	35
'Ewa	3,000	3,400	10
Ko'olau Loa	3,000	3,400	10
Ko'olau Poko	1,300	3,400	4
	485	2,500*	1
Total	38,135		128

* Lower demand factor applied for high rainfall areas such as Kahalu'u & Kāne'ohe.

The total prime agricultural lands in these districts could have an average potential diversified agricultural water demand of 128 mgd which will vary between 2,500 gallons per acre day (gpad) during wet seasons and 4,600 gpad during dry seasons. Studies indicate that applied water demands for diversified agriculture in high rainfall areas such as Punalu'u, Waiāhole, Kahalu'u and Kāne'ohe, where rainfall exceeds 60 to 70 inches per year, will require less water, approximately 2,500 gpad.

CWRM in the Waiāhole Ditch contested case, has allocated an average of 2,500 gallons per acre for large-tract Kunia farms allowing for some continuous proportions of fallow and cultivated lands. Small farms do not have the area to fallow their fields and will therefore have higher water demands per acre. Existing systems like the Waiāhole Ditch, Kaukonahua Stream/Wahiawā Reservoir, Kawailoa, Punaluʻu, Waimānalo and the ʻEwa Caprock aquifer system area already provide a portion of this total. Additional potable ground water supplies in these aquifer system areas could provide supplemental agricultural water supply especially during drought. Diversified agricultural water demands in Waiʻanae, PUC and East Honolulu are largely incorporated into the municipal demand forecasts. Ground water development is more costly for agriculture than gravity and surface water sources and may compete with urban uses.

Traditional wetland *kalo* occur in almost all districts but according to various studies, the variability of water demands is large, and inflows can range from approximately 100,000 gpad to 300,000 gpad with temperature as one of the key factors to prevent rot. While net consumptive use (evapo-transpiration and infiltration) averages approximately 50,000 gpad (USGS 2005), the additional water flow, which is returned to the stream, is needed to manage temperature and account for ditch losses. This plan therefore assumes 100,000 gpad for wetland *kalo* water demand estimates. *Kalo's* high water use per acre and limited surface water supplies will limit the expansion and restoration of *loʻi kalo* but because it is important to preserve the remaining traditional *kalo* lands, the lower range of water demand will allow a greater amount of restoration. Water loss reduction strategies in *ʻauwai* and ditch systems (lining and piping) could provide additional water reducing the necessity of constructing additional stream diversions and potentially divert less stream water.

Recent discussion regarding biofuels and ethanol as renewable energy sources have become prominent with the law requiring 10% ethanol additives to gasoline and HECO's new Campbell power plant's ability to accept 100% biofuels. An evaluation of available agricultural lands and water supplies in the North Shore indicate that a biofuel or ethanol industry could be accommodated up to the sustainable limits of the Waialua, Mokulēʻia and Kawailoa aquifer system areas and from the Wahiawā reservoir. According to the State DOA, sugar cane using drip irrigation will require 5,600 gals/acre-day, depending on elevation and climate. Biodiesel crops range in water use, with the most oil efficient crop being oil palm using only 760 gals/acre-day yielding over 5,300 gals of oil/acre.[2] Other crops being studied by the Hawaiʻi Agriculture Research Center are kukui, avocado, coconut and jatropha. Algae are also being researched as a bio-fuel source and will require water to produce.

1.3.6 Ground Water Availability

The table of Sustainable Yield and Ground water Use by Aquifer System Area was provided by the CWRM and BWS for 2009 (Table 1.5). The table shows the seven aquifer sector areas and 26 aquifer system areas on O'ahu with their associated revised sustainable yields adopted in August 2008 by CWRM, water use permits, water use in 2009 and the unallocated sustainable yields. CWRM reduced O'ahu's sustainable yields by 39 mgd in 2008 from 446 mgd to 407 mgd. The table footnotes attempt to qualify the table and additional information on sustainable yields is included in *Appendix D, Overview of O'ahu's Hydrogeology*. A complete listing of the 2009 O'ahu Water Use Permit Index is provided in *Appendix C*.

Overall, there is available water on O'ahu, in comparing permitted use that has been allocated and/or actual withdrawal to sustainable yield. A significant portion of the remaining untapped supplies exist in remote areas of the island where growth is limited, infrastructure does not exist or pumping may affect stream flows and will be subject to future measurable IFS. 2005 was a high rainfall year, in which water use was below normal for both agriculture and urban sources, but in 2009, rainfall was about normal yet water use still decreased by 7 mgd from 2005 data. In general, the Honolulu sector is fully allocated to the adopted sustainable yields. The Pearl Harbor, Wahiawā and North Shore sectors have a significant amount of unallocated sustainable yield, unused or released by the sugar plantations. The Windward sector's unused sustainable yields (Waimānalo, Ko'olau Poko and Kahana) may interact with streams due to dike influences and therefore, availability may be subject to amendments of the interim IFS. Wai'anae's remaining water is small, in remote areas and also subject to interim IFS in dike areas. Due to these land, economic, operational and environmental reasons, BWS has identified the concept of recoverable yield for its own municipal planning purposes. Recoverable yield is an estimate of the amount of ground water that could feasibly be developed for an aquifer system area and is slightly less than the CWRM adopted sustainable yields. BWS has identified Waimānalo, Ko'olau Poko, Kahana, Kea'au, Lualualei and Nānākuli aquifer system areas where recoverable yields are less than or equal to sustainable yields. The concept of recoverable yield allows BWS to plan and respond to uncertainties.

Table 1. 5 Sustainable Yield and Ground Water Use by Aquifer System Area (MGD)

Aquifer Sector	Aquifer System		Sustainable Yield (SY)	Water Use Permits Issued 2009	Unallocated Sustainable Yield	Existing Water Use 12 MAV Sept 2009	SY minus water use
Honolulu	Wai'alae-East		2	0.790	1.210	0.492	1.508
	Wai'alae-West		4	2.797	1.203	0.755	3.245
	Pālolo		5	5.646	-0.646	5.816	-0.816
	Nu'uanu	1	14	15.165	-1.165	13.123	0.877
	Kalihi		9	8.761	0.239	7.941	1.059
	Moanalua	1	16	19.960	-3.960	13.042	2.958
Total Honolulu			50	53.119	-3.119	41.169	8.831
Pearl Harbor	Waimalu		45	46.951	-1.951	32.265	12.735
	Waipahu-Waiawa		104	84.856	19.144	55.389	48.611
	'Ewa-Kunia		16	15.457	0.543	16.333	-0.333
	Makaīwa		0	0.000	0.000	0.000	0.000
Total Pearl Harbor			165	147.264	17.736	103.987	61.013
Central	Wahiawā		23	21.928	1.072	7.047	15.953
Total Central			23	21.928	1.072	7.047	15.953
Wai'anae	Nanakuli	1,2,4	2	0.000	2.000	0.000	2.000
	Lualualei	1,2,4	4	0.000	4.000	0.099	3.901
	Wai'anae	2	3	0.000	3.000	2.418	0.582
	Makaha	1,2	3	0.000	3.000	2.278	0.722
	Kea'au	2,4	4	0.000	4.000	0.000	4.000
Total Wai'anae			16	0.000	16.000	4.795	11.205
North	Mokulē'ia	1	8	8.025	-0.025	0.174	7.826
	Waialua	1	25	30.311	-5.311	2.974	22.026
	Kawailoa	1	29	1.614	27.386	0.385	28.615
Total North			62	39.950	22.050	3.533	58.467
Windward	Ko'olau Loa	1	36	18.589	17.411	10.373	25.627
	Kahana	1,4	15	1.101	13.899	0.000	15.000
	Ko'olau Poko	1,3,4	30	10.312	19.688	9.904	20.096
	Waimānalo	1,4	10	1.631	8.369	0.303	9.697
Total Windward			91	31.633	59.367	20.580	70.420
Total Aquifer Sector			**407**	**293.894**	**113.106**	**181.111**	**225.889**
'Ewa Caprock	Malakole	5	1,000 mg/l	0.603		4.414	
	Kapolei	5	1,000 mg/l	2.033		0.608	
	Pu'uloa	5	1,000 mg/l	13.261		1.426	
Total 'Ewa Caprock				15.897		6.448	
Waiahole Ditch			15	12.440	2.560	8.524	6.476
Total Waiahole Ditch			15	12.440	2.560	8.524	6.476
Grand Total Fresh and Brackish			422	322.231	115.666	196.083	232.365

2009 Recorded about normal rainfall but island-wide aquifer sector pumpage decreased by 7 mgd below 2005 data.

Permanent instream flow standards may reduce available sustainable yield. Withdrawals affecting streams require instream flow standards amendments.

1 2008 Water Resource Protection Plan updates on sustainable yield included.
2 Wai'anae is not a designated water management area, therefore, there is no permitted use.
3 Waihe'e Tunnel & Waihe'e Inclined Wells are not included under 2009 Permitted Uses, but are included under Existing Water Use.
4 BWS Recoverable Yield expected to be lower due to economics, land constraints, small yields, etc. & regulatory actions involving instream flow standards.
5 Brackish Water. Managed by chloride limit of 1,000 mg/l for irrigation wells.

Excludes salt water wells

Source: CWRM and BWS Data. BWS footnotes.

Query date 8/30/10. Based on reported pumpage to CWRM as of 9/09.

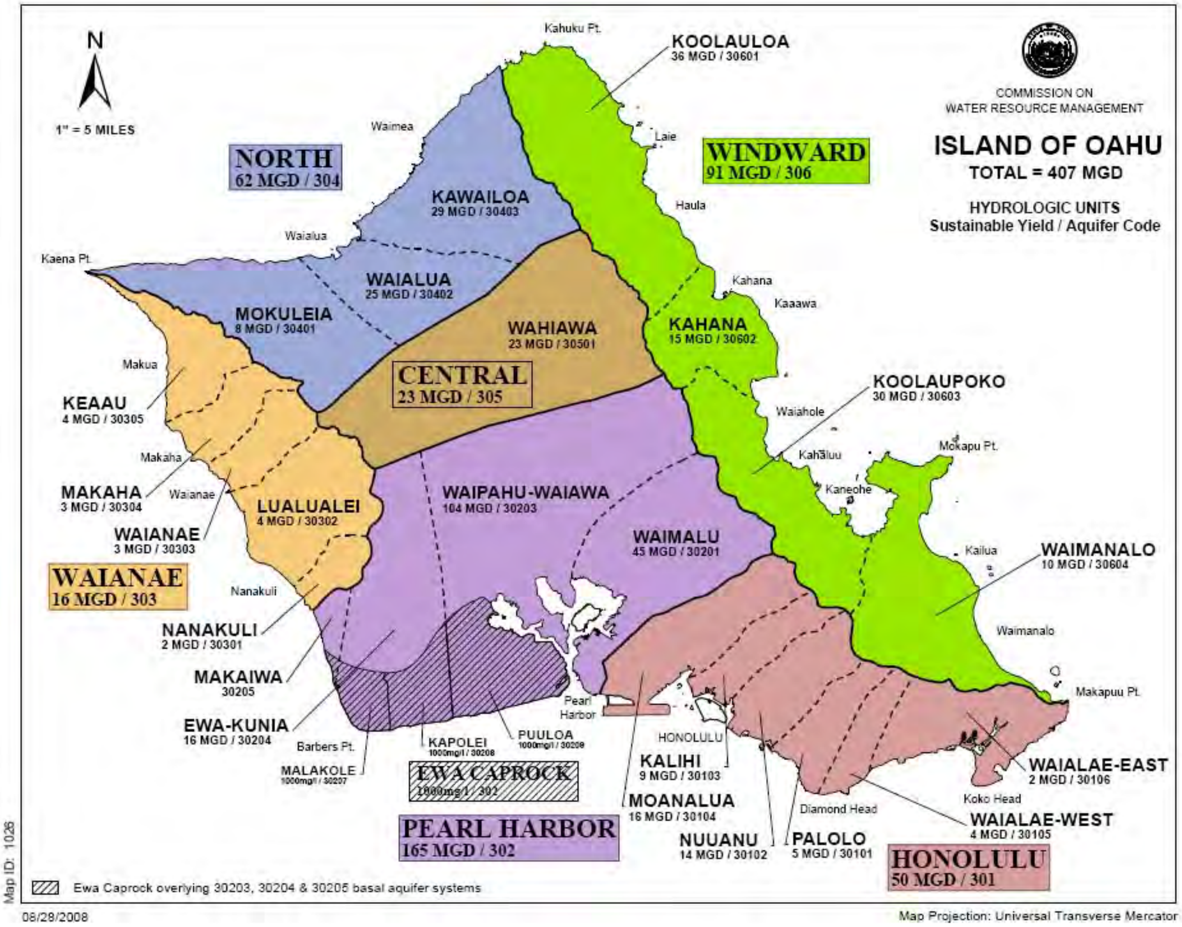


Figure 1. 7 Oʻahu Aquifer System Areas

CWRM has adopted sustainable yields to protect ground water resources and regulate water use by water use permits. The following Table 1.6 summarizes the available ground water by aquifer sector area accounting for the uncertainties of ground water-surface water interaction in dike formations in Windward and BWS operational experience in Waiʻanae.

Table 1. 6 Summary of Available Ground Water by Aquifer Sector Area

Aquifer Sector	Sustainable Yield	Water Use Permits Issued Sept 2009	Unallocated Sustainable Yield (mgd)	Water Use 2009	SY minus Water Use
Honolulu	50	53	-3	41	9
Pearl Harbor	165	147	18	104	61
Central	23	22	1	7	16
Waiʻanae	16	---	16	5	1*
North	62	40	22	4	58
Windward	91	32	59	21	26**
Total	**407**	**294**	**113**	**181**	**171**

* Adjusted: Based on pumping operations and BWS assessed recoverable yields.

** Adjusted: Koʻolau Loa only, (36 mgd SY – 10 mgd use). Excludes the Waiāhole Ditch and the Kahana, Koʻolau Poko & Waimanalo sectors due to possible surface water interactions in dike formations.

***All footnotes in Table 1.5 apply.

On Oʻahu in 2009, a normal rainfall year, about one-third or 113 mgd (294-181) of permitted use was unused. An estimate of available ground water on Oʻahu is approximately 171 mgd, based on CWRM revised sustainable yields for Oʻahu minus water use in 2009, excluding the Keaʻau, Lualualei, Nānākuli, Kahana, Koʻolau Poko and Waimānalo aquifer systems and Waiāhole Ditch. Groundwater use on Oʻahu decreased by about 7 mgd from 2005 to 2009.

1.3.7 Surface Water Availability

IFS are similar to sustainable yields for ground water, in that their establishment provides a management system that protects instream and cultural uses while allowing for possible non-instream water use. CWRM is tasked with setting IFS for Hawaiʻi's streams in accordance with the State Water Code. The code defines instream flow standards as "the quantity or flow of water or depth of water which is required to be present at a specific location in a stream system at certain specified times of the year to protect fishery, wildlife, recreational, aesthetic, scenic, and other beneficial instream uses."[3] These instream flow standards need to consider the best available information in assessing the range of present or potential instream and non-instream uses.

The current instream flow standards for Oʻahu streams are called interim instream flow standards (IIFS) and are based on the "amount of water flowing in each stream on the effective date of the standard without further amounts of water being diverted off-stream through new or expanded diversions". The effective dates are December 10, 1988 for Leeward Oʻahu and May 4, 1992 for Windward Oʻahu.[4] In the Waiāhole Contested Case Hearing, the CWRM recognized that "retaining the status quo (through the adoption of the previous interim standards) helped to prevent any future harm to streams while the scientific basis for determining appropriate instream flow standards is developed and an overall stream protection program put into place."[5] The stream flows and diversions were not quantified in the standard, however users of surface water and ground water were required to register their uses with CWRM.

The CWRM amended the interim instream flow standards for four windward streams - Waiāhole, Waianu, Waikāne and Kahana have been established via the Waiāhole Ditch Combined Contested Case on July 13, 2006.

Table 1. 7 Amended O'ahu Interim Instream Flow Standards

Stream	1960s Streamflow	Amended Interim Instream Flow Standard	Percent Increase
Waiāhole	3.9 mgd	8.7 mgd	124%
Waianu	0.5 mgd	3.5 mgd	600%
Waikāne	1.4 mgd	3.5 mgd	150%
Kahana	11.2 mgd	13.3 mgd	19%

The State Water Resources Protection Plan (WRPP) established surface water hydrologic units and provided an inventory of basic stream data for O'ahu's streams. Table 3-22 of the WRPP lists 87 streams on O'ahu, including the watershed area, number of diversions and stream gages. Diverted stream flows and their uses are not measured or reported and could not be included. The stream diversion inventory process continues and new information will be added to future WMPs. Figure 1.8 shows O'ahu's surface water hydrologic units.

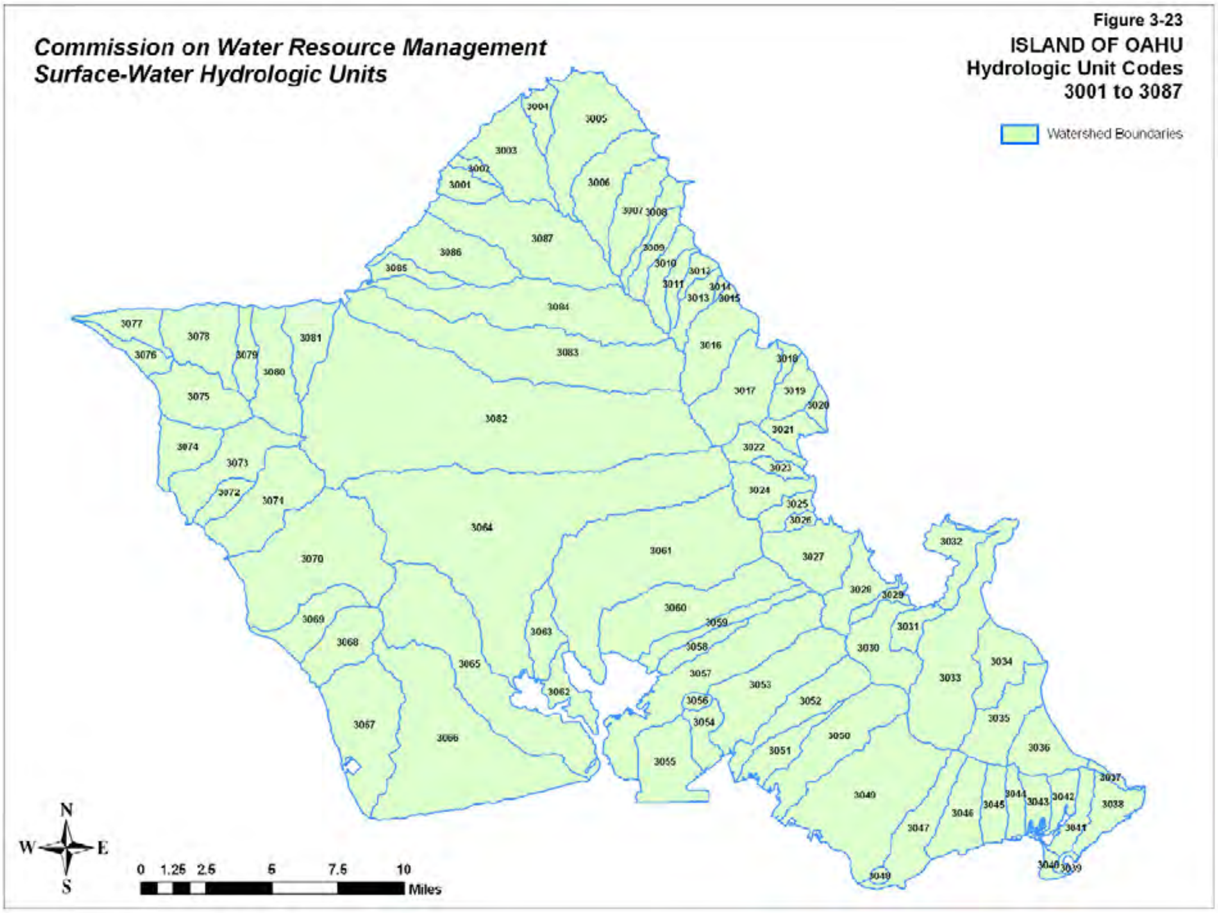


Figure 1. 8 Oʻahu Surface Water Hydrologic Units

The hydrogeology appendix describes the complexity of setting measurable IFS balancing hydrology with instream and non-instream uses. It is difficult to plan for additional non-instream uses of surface water without measurable IFS, because non-instream uses of surface water are an essential IFS component. Punaluʻu Stream and irrigation system studies have cost over $500,000 and therefore, new diversions, while permit-able, are not cost effective unless a simpler methodology for setting measurable IFS is proposed. The planning approach to surface water availability then, is to plan within the diverted amounts existing when the status quo interim IFS were adopted, or as subsequently amended by CWRM. Additional surface water can be provided for non-instream uses through improvements in distribution system efficiency, leakage reduction, crop selection and through efficient irrigation techniques. Significant new stream diversions will require amendments to IFS. In general, a starting point for surface water availability assumes 50% of Q70, stream flowing 70% of the time. Table 1.8 lists some of Oʻahu's largest perennial streams.

Table 1. 8 O'ahu's Largest Streams and Mean Flows (2004 and 2010)

Stream Name	USGS Stream Gage No.	Mean Flow 2004 (CFS / MGD)	Mean Flow 2010 (CFS / MGD)
Kaluanui	16304200	7.5 / 4.8	3.9 / 2.5
Punalu'u (above ditch)	16301050		19.0 / 12.3
Kahana	16296500	53.5 / 34.6	28.1 / 18.1
Waikāne	16294900	19.1 / 12.3	7.9 / 5.1
Waiāhole (Kamehameha Hwy)	16294100	55.0 / 35.6	26.3 / 17.0
Waihe'e	16284200	9.2 / 6.0	5.3 / 3.4
Kahalu'u	16283200	5.1 / 3.2	1.6 / 1.1
Ha'ikū	16275000	3.6 / 2.3	1.8 / 1.2
Kamo'oali'i - Kāne'ohe	16272200	17.5 / 11.3	-- / --
Makawao – Kailua	16254000	7.2 / 4.7	3.2 / 2.1
Mānoa (Kānewai)	16240500	5.9 / 3.8	8.2 / 5.3
Kalihi	16229000	9.2 / 6.0	4.0 / 2.6
North Hālawa	16226200	9.9 / 6.4	2.8 / 1.8
Waiawa	16216000	50.0 / 32.3	-- / --
Waikele	16213000	53.7 / 34.7	24.5 / 15.8
Mākaha	16211600	2.2 / 1.4	0.5 / 0.3
N. Kaukonahua	16200000	19.2 / 12.4	10.4 / 6.7
S. Kaukonahua	16208000	29.6 / 19.1	15.1 / 9.7
'Ōpae'ula	16345000	18.8 / 12.2	11.9 / 7.7
Kamananui - Waimea	16330000	24.7 / 16.0	12.9 / 8.3
Total		**400.9 / 259.2**	**187.4 / 120.9**

Source: USGS Data. Several USGS gages have been discontinued due to cost considerations.
Note: Q70 is less than mean stream flow.

1.3.8 Planned Source Development

New sources recently completed or in various stages of construction and potential potable sources that will provide for future water demands are listed in Table 1.9. Alternative potable and non-potable sources such as recycled water and desalination are listed in Table 1.10.

Table 1. 9 Existing and Potential Ground Water Resources of Potable Water

	New Ground water Sources	Estimated Yield (mgd)	Additional Permitted Use Required (mgd)	CWRM Water Management Area	Potential Development Plan Area(s) Served
1.	Kahuku Wells Pump 3	1.0	1.0	Ko'olauloa	Ko'olauloa
2.	'Ōpana Wells	1.0	1.0	Ko'olauloa	Ko'olauloa
3.	Kaipapa'u or Wailele Well (1)	1.0		Ko'olauloa	Ko'olaupoko
4.	Kaluanui Wells * (1)	1.5		Ko'olauloa	Ko'olaupoko
5.	Ma'akua Wells * (1)	1.0		Ko'olauloa	Ko'olaupoko
6.	Kū'ou Well III *	0.5		Ko'olaupoko	Ko'olaupoko
7.	Waimānalo Well III *##	0.5	0.3	Waimānalo	Ko'olaupoko
8.	'Āina Koa Well II *	0.7		Waialae-West	East Honolulu
9.	Wai'alae Nui Well *	0.7		Waialae-West	East Honolulu
10.	Wahiawā Well III	3.0	3.0	Wahiawā	Central
11.	Waipi'o Heights Wells II and III	2.5	0.65	Waipahu-Waiawa	Central/PUC
12	Mililani Wells IV *	3.0	1.0	Waipahu-Waiawa	Central
13.	Waiawa Wells I-I (2)	6.0	6.0	Waipahu-Waiawa	Central
14	Manana Well *	1.0	0.9	Waipahu-Waiawa	PUC
15	Kunia Wells III *	3.0		Waipahu-Waiawa	'Ewa, Wai'anae
16	Waipahu Wells II *	3.0	1.0	Waipahu-Waiawa	Central
17	Waipahu Wells III *#	3.0		Waipahu-Waiawa	PUC
18	Waipahu Wells IV *	3.0		Waipahu-Waiawa	'Ewa, Wai'anae
19.	'Ewa Shaft *	10.0	3.0	Waipahu-Waiawa	'Ewa
20.	Koa Ridge Makai Wells	2.0	2.0	Waipahu-Waiawa	Central
	Total Potable Resources	**47.4**	**19.85 ****		

Notes:
1) Potential transfer of existing permitted use from Punalu'u Wells to optimize pumpage
2) Waiawa Water Master Plan, Revised Dec 14, 2004.
* Source already has an existing permitted use equal to or a portion of the estimated yield.
** Total does not include transfers of existing permitted use.
# Includes 0.5 mgd water reservation for Department of Hawaiian Home Lands (DHHL)
0.124 mgd water reservation exists for DHHL in the Waimānalo WMA

Table 1. 10 Existing and Potential Alternative Potable and Non-Potable Water Sources

	Resource	Minimum Estimate	Maximum Estimate	Development Plan Area(s) Served
Desalination (potable)				
1	Kapolei Brackish Desalination Plant	0.2	0.5	ʻEwa, Waiʻanae
2	Kalaeloa Seawater Desalination Plant	5.0	15.0	ʻEwa, Waiʻanae
Recycled Water				
4	Wahiawā Recycled Water (1)	2.0	4.0	Central
5	Honouliuli Recycled Water	12.0	20.0	ʻEwa
6	Waiʻanae Recycled Water (2)	2.0	3.0	Waiʻanae
7	Kahuku, Turtle Bay, Lāʻie Recycled Water	0.8	2.6	Koʻolau Loa
8	Waimānalo Recycled Water	0.7	1.0	Koʻolau Poko
Nonpotable Water				
9	Waiāhole Ditch (3)	12.44	15.0	ʻEwa, Central
10	Wahiawā Reservoir (4)	8.5	16.0	North Shore, Central
11	Kalauao Spring	0.5	3.3	PUC
12	ʻEwa Brackish Basal Wells (5)	4.0	5.0	ʻEwa
13	Koʻolau Loa Agricultural Wells (6)	6.3	12.6	Koʻolau Loa
14	Punaluʻu Stream Irrigation System (7)	2.0	7.0	Koʻolau Loa
15	Maunawili Ditch/Waimanalo I	0.4	1.4	Koʻolau Poko
16	Kawailoa Irrigation System (8)	8	8	North Shore
	Total Alternative Resources	**64.84**	**114.4**	

Notes:
1) Wahiawā WWTP avg flow = 2 mgd, Schofield (Army) Avg flow = 2 mgd.
2) Waiʻanae WWTP effluent chlorides at 800-900 mg/l may constrain full expansion.
3) Waiāhole Ditch Min = 2009 CWRM permitted use. 2.43 mgd remains unpermitted.
4) Kaukonahua Streams minimum average month = 8.5 mgd, 2004 mean flow = 31 mgd, 2010 mean flow = 16 mgd. Wahiawā Reservoir storage capacity = 9,200 ac-ft or 3,066 mg.
5) Revised ʻEwa Development Plan. EP2 (1 mgd), EP5&6 (2 mgd), EP10 (1-2 mgd).
6) Sustainable yield exists, but well sites have not been identified.
7) Effects of Surface Water Diversion and Groundwater Withdrawal on Streamflow and Habitat, USGS Report 2006-5153.
8) Approximately 80% is surface water and 20% is groundwater sources

The following table summarizes Tables 1.9 and 1.10 of planned potable ground water sources and alternative potable and nonpotable sources.

Resource	Quantity (mgd)
Ground water – Potable	47
Desalination – Potable (minimum estimate)	5
Recycled Water (minimum estimate)	18
Ground water – Nonpotable	28
Surface water – Nonpotable	38
Total	**134**

Increases in potable and nonpotable demand are offset by water conservation, released agricultural ground water from the close of the sugar plantations, seawater desalination and the development of brackish and recycled irrigation water systems. Surface water is not planned for municipal use until measurable IFS are set and water availability is determined.

Ground water will be developed utilizing available sustainable yield including released agricultural water for agricultural lands rezoned to urban use. Ground water supply evaluations will be conducted to refine available ground water estimates especially as permitted use approaches sustainable yields. New sources of supply will be developed in locations that do not impact streams or other sources.

Recycled water facilities in ‘Ewa and Central O‘ahu are planned for expansion to continue to off-set additional ground water development.

- In 2000, BWS acquired and now operates the 12 mgd Honouliuli Water Recycling Facility supplying irrigation and industrial process water for ‘Ewa. The recycled water distribution system is supplemented with brackish water.
- The Army's Schofield WWTP produces about 2.0 mgd of R-1 recycled water and a distribution system is planned. The City's Wahiawa WWTP is being upgraded to produce 2.0 mgd of R-1 recycled water. A distribution system to Central O‘ahu is possible, but is not being pursued at this time due to funding constraints.

In the mid term, seawater and brackish water desalination plants will be constructed to provide for future demand and off-set additional ground water development and provide a cost competitive alternative to increasing inter-district transfers.

- The Kalaeloa Seawater Desalination Plant is currently planned for construction in the 2020 timeframe and will bring an additional 5.0 mgd of potable water supply to the ‘Ewa and Wai‘anae districts. The plant will be capable of further expansion as needed.
- BWS acquired the State’s demonstration brackish water desalination plant facilities in Kapolei Business Park, which could be renovated at relatively low cost, to produce approximately 0.5 mgd of potable water supply for Kapolei.

Research to develop more economical methods of cold seawater development for municipal purposes using a multiple product approach of distillation, energy production using ocean thermal energy conversion, district cooling and aquaculture has been completed, however, funding constraints limit its development.

1.3.9 Adequacy of Supply and Future Demand and Population Distribution

The 171 mgd of unused ground water available on Oʻahu in 2009 (Table 1.6), adjusted for recoverability, and the existing large irrigation systems [Kaukonahua/Wahiawā Reservoir (16 mgd), Maunawili Ditch (1.4 mgd), Punaluʻu Stream (7.0 mgd), Kawailoa (8 mgd) and the Waiāhole Ditch (15 mgd)] totaling 47 mgd are available to meet the projected high demand scenario for 2030 municipal water demand of 57 mgd (212 mgd – 155 mgd) and the AWUDPs best case of additional agricultural water demand of 30 mgd.

Existing stream diversions will continue to provide for agricultural uses including *kalo*, reducing the need for potable ground water, although supplemental wells are recommended as a drought mitigation strategy. No new stream diversions are planned for non-instream uses until interim IFS are amended to protect and support appurtenant rights, traditional and customary rights in the stream, estuary and nearshore water environments. However, water efficiency improvements in the stream diversion and ditch systems should provide additional surface water for additional agricultural irrigation.

Recycled water is planned to supply a minimum of 18 mgd for urban irrigation. Future seawater desalination could supply 5 to 15 mgd of potable water for ʻEwa and Waiʻanae.

The City's General Plan directs the majority of future growth to ʻEwa and the Primary Urban Center, the two development plan areas where plans and infrastructure investment will support growth. The sustainable communities of Central Oʻahu, Waiʻanae and East Honolulu are relatively stable regions and will realize a lesser amount of expansion. In these five districts, natural and alternative water supplies, such as ground water, recycled water and seawater desalination will be fully integrated. The sustainable communities of North Shore, Koʻolau Loa and Koʻolau Poko will have little change in water demand throughout the planning period. The existing sources and infrastructure in these areas are adequate to provide potable water service through the planning horizon and therefore, additional integration of water supplies between these regions will be limited.

A summary graphic of Oʻahu's estimated population distribution based on the 2000 census, BWS potable water demand in calendar year 2000 and water distribution is provided for the eight land use districts (Figure 1.5). This is essentially the base case of existing water demand and distribution in the BWS system that will be referenced in establishing future regional watershed management plan scenarios.
A second summary graphic (Figure 1.9) of Oʻahu's estimated population distribution based on DPP's 2030 forecast, BWS high demand scenario for potable water demand and water distribution in 2030 is also provided for the eight land use regions. Desalination is included in the ʻEwa district. This graphic represents a conservative future scenario.

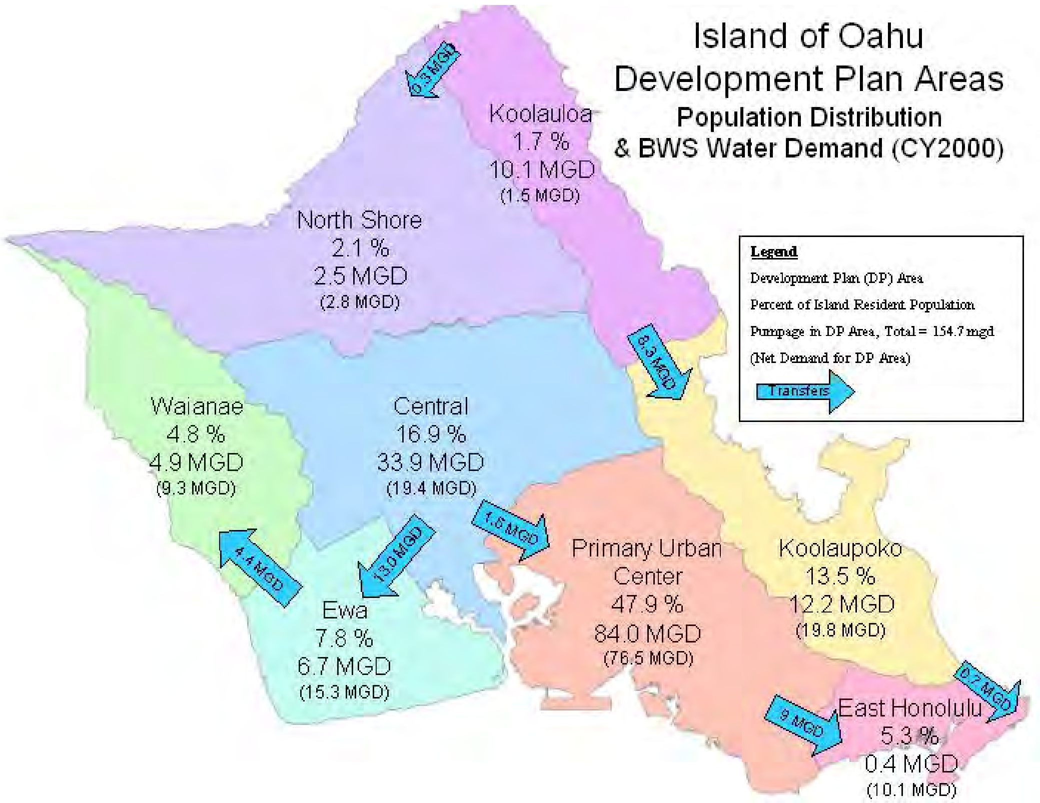


Figure 1. 9 Population and Potable Water Demand Distribution 2000

The following findings summarize Figures 1.9 and 1.10 Population Distribution and Potable Water Demand 2000 and 2030.

- The O'ahu General Plan directs growth to the PUC and Ewa development plan areas allowing Wai'anae, Central O'ahu, North Shore, Windward and East Honolulu to be rural areas with limited growth.
- Projected increase in water demand in 'Ewa, Central O'ahu, PUC and East Honolulu of about 48.4 mgd can be met through a diversified combination of conservation, ground water, existing stream diversions, recycled water and desalination. New potable ground water sources will be developed utilizing released agricultural ground water in the Pearl Harbor aquifer. Brackish 'Ewa Plantation wells will continue to be converted for urban irrigation in 'Ewa to supplement potable ground water. New recycled water system expansions are planned.

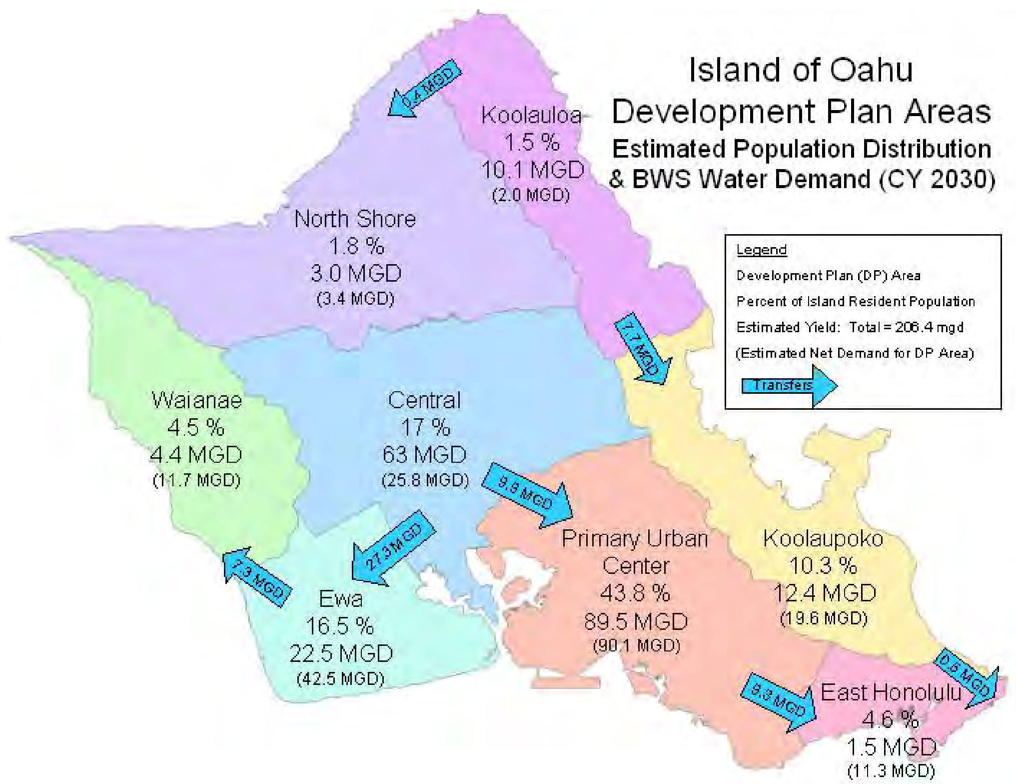


Figure 1. 10 Estimated Population and Potable Water Demand Distribution 2030

- Projected water demand in Waiʻanae of about 2.4 mgd will be met with transfers from the Pearl Harbor aquifer. To sustain the existing watersheds and streams in Makaha and Waiʻanae valleys, source production will be kept at sustainable levels based on long-term operational experience and stream gaging. Over the long term, advanced conservation and recycled water in Waiʻanae may reduce Pearl Harbor transfers, increasing the availability of ground water in ʻEwa
- Projected water demand in Koʻolau Loa of 0.5 mgd can be met with conservation, existing and planned ground water sources and recycled water within the district.
  - Ground water transfers from Koʻolau Loa to Koʻolau Poko are expected to reduce slightly over time due to the forecasted reduction in Koʻolau Poko's population by approximately 1,200 people.
  - Ground water transfers from Koʻolau Poko to East Honolulu, because of geology and drought susceptibility, are expected to remain between 0.5 and 0.7 mgd over time as 0.3 mgd of additional Pearl Harbor aquifer water is directed to East Honolulu.

- The North Shore currently has the largest unused supplies of ground water and existing surface water diversions on O'ahu. Because South O'ahu's water demands will be met with resources within South O'ahu, the North Shore's large water supplies will be available to support diversified agriculture including the potential bio-fuels industry.

This likely scenario of population and potable water distribution in 2030 is based on the best available estimates of supply and demand plus a significant commitment to advanced water conservation and alternative water development. New aquifer studies will continue to refine estimates of sustainable yield and pumpage optimization plans will be adapted to avoid salinity and other water quality impacts.

The most conservative estimates of available remaining ground water sustainable yields, a reasonable accounting of uncertainties, planned ground water source projects, advanced water conservation programs and alternative water source projects, such as recycled water and desalination, will be utilized to accommodate future demands.

1.3.10 Uncertainties and Contingencies

Planning efforts have uncertainties due to assumptions made about existing conditions and future scenarios. Identifying these uncertainties provides an opportunity to plan for a practical range of contingencies. This section highlights the major uncertainties and contingencies of this watershed management plan. Many of the watershed protection projects and water supply options discussed in *Chapter 4: Watershed Management Objectives, Projects and Strategies* and *Chapter 5: Implementation* incorporate contingencies designed to plan for uncertainties in supply and demand.

1.3.10.1 *Ground Water Supply Uncertainties*

Estimating Sustainable Yield

Sustainable yields for all aquifer system areas have been adopted as part of the State Water Code's Water Resources Protection Plan and are used for resource management, protection and development. The current sustainable yields are based on the best available information of hydrologic factors but have acknowledged limitations in estimating rainfall distribution, vegetative transpiration, overland runoff, aquifer leakage to the ocean and to the brackish transition zone and recharge to the various dike, basal, perched and caprock aquifers.

Recoverability of Sustainable Yield

Recoverability is the ability to feasibly extract ground water through wells or tunnels, up to the adopted sustainable yield. Recoverability is a major uncertainty due to surface and ground water interactions, presence of separate hydro-geological formations within an aquifer system area, extended drought, and well location and spacing constraints. There are also regulatory, political, financial and public acceptance uncertainties surrounding additional ground water development and regional transport of water with respect to environmental impacts, local water needs and available supply.

Climate Change

Climate change is expected to cause more severe droughts and floods and as global temperatures increase, sea water levels are expected to rise affecting coastal environments, aquifers and streams. The uncertainties introduced by climate change emphasize the importance of incorporating flexibility, conservation and alternative supplies in the range of planning options. "Although most scientists worldwide agree that our planet's climate is warming, they recognize the uncertainty inherent in assessing climate change impacts. Uncertainties in projected greenhouse gas emissions, limitations of climate models, information loss when climate projections are downscaled to watershed resolution, and imperfections in hydrological models all contribute to the uncertainty."[6]

Ground Water Contamination

Contaminants infiltrating into ground water and spreading through the aquifers places uncertainty in the amount of available water supply. Contamination from agricultural and urban activities has previously occurred in Central O'ahu, Waialua and Honolulu. Contamination could also result from purposeful human activities. The contamination can be mitigated, but treatment is very expensive and time consuming. If treatment is too costly, the well will be shut down and pump capacity will be permanently reduced. Replacement wells are also expensive. Therefore, prevention is the most cost effective measure against ground water contamination.

1.3.10.2 *Recommended Contingency Plans for Ground water Supply Uncertainties*

Ground water sustainable yield estimates provide for resource management and protection but contain uncertainties in water budget, recoverability, climate change and impacts from contamination. The following planning strategies will mitigate the effect of ground water supply uncertainties:

Contingency for Estimating Sustainable Yield

- Periodically update information on rainfall, evapo-transpiration, runoff, leakage and recharge to reflect current hydrologic trends due to climate change.
- Evaluate and account for aquifer boundary conditions recognizing separate geological formations such as dike, basal, alluvial and caprock aquifers within each aquifer system area.

- Construct deep monitor wells in important basal aquifers to provide the ability to monitor water levels, freshwater lens and transition zone thickness and trends in response to pumping.
- Develop advanced numerical ground water models to improve sustainable yield estimates. CWRM with BWS, USGS and the Navy participating, has created the Pearl Harbor Ground water Monitoring Working Group to monitor key indicators such as head, salinity, and transition zone trends, and also to reaffirm the adopted sustainable yields through a milestone framework and optimize pumpage in the Pearl Harbor aquifer sector area. The group is working toward a 3-dimensional solute transport ground water model calibrated to the new deep monitor wells. The work of this group could be a viable model applied to other aquifer sector areas statewide.

Contingency for Recoverability of Sustainable Yield

- Until interim IFS are amended, seek new ground water wells that do not impact surface waters. Develop long-term monitoring plans of stream and watershed indicators.
- Optimize well spacing and pump sizing on an aquifer system area basis to increase recoverability and avoid lens shrinkage, upconing and seawater intrusion. Align water system infrastructure capital plans to more readily accommodate smaller wells spaced throughout the water system when practical.
- During severe, long-term droughts usually greater than 3 years, the full sustainable yield may not be recoverable. Dike source yields will likely drop below permitted use. BWS operational experience accounts for source yields in normal rainfall and drought years. The difference, approximately 14 mgd, is supplemented by the following drought mitigation strategies that will improve the water system's resilience to climate variability:
  - In non-drought years, ensure pumping does not exceed normal rainfall level estimates to preserve sufficient aquifer storage to meet maximum day demands during drought.
  - During drought years, reduce pumping to drought level estimates to protect the freshwater lens. Reducing pumping is difficult, as water demands will increase during drought, therefore:
    - Implement the BWS low ground water plan and other progressively increasing conservation measures to reduce water demands.
    - Develop additional ground water wells to supplement reductions in source yields due to severe drought.
    - Develop alternative, drought-proof water supplies such as recycled water, brackish and seawater desalination facilities.
    - Mandate dual water systems for new large developments to maximize nonpotable water use to conserve the potable water supply.

  - o Ensure sufficient aquifer recovery during post-drought periods by reducing pumpage and implementing the applicable watershed protection projects for the most important and/or impacted watersheds.
- Regulatory, political, financial and public acceptance uncertainties can be addressed by environmental disclosure, cost benefit analysis, public outreach, education, alternative source analyses, and holistic watershed management and integrated resource planning.

<u>Contingency for Rising Sea Levels due to Climate Change</u>
Rising sea levels is a global issue, which may have long-term impacts for Hawai'i. A precautionary approach to mitigating impacts of rising sea levels is to identify the water system's most critical vulnerabilities, then suggest how climate variability and extremes might aggravate those vulnerabilities, and finally to design a range of solutions covering the climate uncertainty.[3] The following contingencies could be evaluated:
- Partially backfilling deep wells to account for rising sea levels. Well capacity may decrease and may have to be supplemented with other wells.
- In areas of thin caprock above mean sea leve, such as in Pearl Harbor, constructed hydraulic barriers could prevent rising sea levels from intruding over the caprock into the freshwater aquifers. This solution is similar to Orange County California's Water Factory 21, recycled water hydraulic barrier injection system.
- Private brackish caprock wells near the coast may become more brackish or unusable and may need to be replaced with alternative supplies, such as recycled water
- Recycled water and seawater desalination could replace capacities lost to rising sea levels.

<u>Contingency for Impacts from Ground water Contamination</u>
- EPA and DOH provide extensive regulatory guidelines to address contamination of drinking water. EPA has developed a list of Best Available Technologies (BAT) to remove various contaminants in drinking water and restore the drinking water source for public consumption.
- Conduct regular water quality samples and track trends of contaminants. If trends are rising toward the maximum contaminant level (MCL), initiate planning and engineering of the recommended BAT so that the treatment system is in place before the MCL is reached.
- Apply DOH Source Water Protection program guidelines to water systems such as conducting sanitary surveys, protecting source water delineation/capture zones above wells and best management practices for potential contaminating activities. Conditions for source water protection should be placed on land use plan approvals.

- Implement the water system vulnerability assessment recommendations and other security measures for well stations and other facilities.
- Seal old, unused wells with cement grout to prevent direct contamination to the aquifer and leakage from the aquifer. Well sealing could be regulated through the building permit application process.

1.3.10.3 ***Surface Water Supply Uncertainties***

Amending Interim Instream Flow Standards
The most significant uncertainty related to the availability of surface water is the lack of measurable IFS for the majority of streams on O'ahu. Other uncertainties relate to the complexity of stream studies (scientific, cultural, economic and environmental) and their potential cost. These uncertainties realistically mean that additional surface water is not available now or for the foreseeable future. The following is a range of possible outcomes:

- If there is additional water available after instream uses are met, water will be available for agricultural use.
- If no additional water is available, status quo instream and non-instream uses will be maintained.
- If there is insufficient water in the stream to meet the measurable IFS, water from existing non-instream uses will need to be returned to the stream, and alternative water sources for agriculture and urban uses may be needed.

Quantifying Stream Flows, Diversions and Use
There is a level of uncertainty in the amount of surface water flowing in O'ahu's streams and stream segments (low, mean, median and peak variations of flows), the number of diversions and the diverted flows and their associated use and non-use. On O'ahu there are 87 surface water hydrologic units containing approximately 232 stream diversions. In order to adequately protect streams and manage surface water use, streams need to be gaged, diversions structures must be inventoried and surface water use reported on a regular basis. As with ground water use, non-instream water use must be reasonable and beneficial, conserved or returned to the stream.

Drought Impacts on Surface Water
Drought impacts instream uses and the availability of surface water, and is another uncertainty. Surface water is supplied by rainfall and ground water leakage as base flow, and is impacted more readily during drought than ground water. Extended drought can have dire implications, especially for agriculture, much of which relies solely on surface water for irrigation.

1.3.10.4 *Recommended Contingency Plans for Surface Water Supply Uncertainties*

Surface water measurable IFS provide for resource management and protection but contain uncertainties because of the complexity in setting measurable IFS, the need for updating inventories of flows, diversions and use, and impacts from drought. The following planning strategies account for surface water supply uncertainties:

Contingency for amending interim IFS

- CWRM identifies high natural quality streams to amend interim IFS using best available information.
- CWRM will be acting on the pending petitions for amending interim IFS and has developed a standardized measurable IFS methodology emphasizing practicality and consistency.
- Until measurable IFS are established, new stream diversions are not recommended in this plan, other than for traditional and cultural practices, such as kalo cultivation. Other surface water users should work within the existing diverted flows, applying conservation and water loss prevention strategies to increase system efficiencies.

Contingency for inventories of stream flow, diversion and use

- Cooperative partnerships such as with USGS, will be expanded to jointly fund the gaging of important perennial streams.
- The 2006 Legislature appropriated $650,000 to conduct statewide field investigations to verify and inventory surface water uses and stream diversions and update existing surface water information. BWS hydro-geologists are conducting field surveys using CWRM survey protocols of stream diversions to supplement CWRM efforts.
- The stream permitting process is being revised to improve the acquisition of pertinent information, and a surface water use reporting system will be established.

Contingency for Drought Impacts on Surface Water

- Alternative sources such as ground water and recycled water should be developed to mitigate drought impacts on agriculture. Barriers to recycled water especially for edible vegetable crops will need to be addressed.
- Water loss strategies will extend existing diverted flows. Agricultural crops could also be modified to use less water, markets permitting.
- Watershed forestation and protection projects will focus on critical watersheds to increase base flows and natural storage supplying streams.

A significant limitation to using surface water is its variability and lack of reliability especially during dry periods and drought. By increasing water storage, or by supplementing surface water with ground water, which is called conjunctive use, additional agricultural lands may be irrigated year-round cost effectively with minimal impact. Figure 1.7 (Seasonal Agricultural Water Use Supplementing Surface Water with Ground water) shows the seasonal relationship between surface water in conjunction with ground water for agricultural irrigation. During dry seasons and drought, when demand increases and limited stream water is available, ground water can supplement surface water, protecting instream uses. Surface water, which is more abundant during the wet season, can be economically used, allowing time for the ground water source to be replenished.

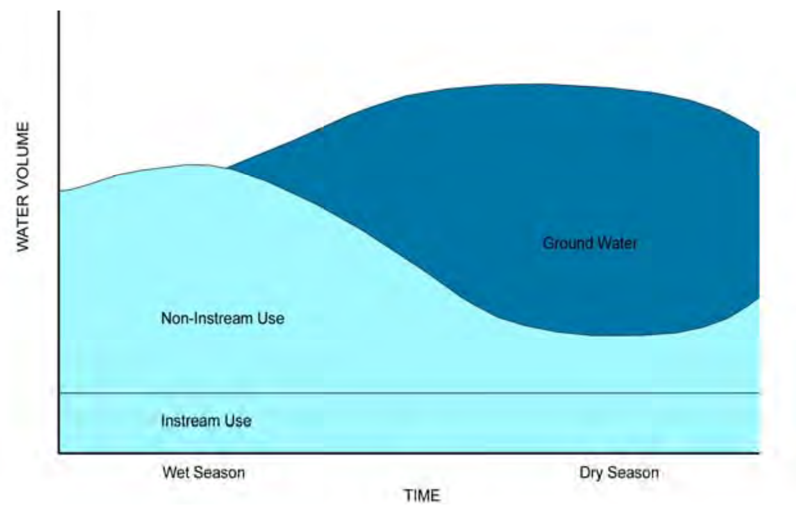


Figure 1. 11 Seasonal Agricultural Water Use Supplementing Surface Water with Ground Water

1.3.10.5 *Demand Projection Uncertainties*

Agricultural Water Demands

Predicting agricultural water demands is challenging because of two categories of information – the agricultural products market and regional crop water demand numbers. While Hawai'i's diversified agricultural production has increased in recent years, the amount of agricultural activity has not yet come close to the former sugar plantation days. Much of the land with agricultural zoning is not in agricultural production. Potential bio-fuel production could put more acreage into active cultivation and increase crop water demands.

Regional crop water demand uncertainties are related to crop types, operational variables for each crop type such as fallow periods and frequency of harvest, and local climatic conditions. Crop water demands are challenging because of the diversity of crops and of the relatively few crop numbers that are geographically specific or agreed upon.

Urban Water Demands

Predicting population growth depends on public policies in the Development and Sustainable Communities Plans, the enforcement of community-based plans and the overall economy. While the urban growth and rural community boundaries are established, within the boundaries there is much area for future residential growth. With a strong economy, the growth within it could happen at a faster than predicted pace – but with a slow economy, growth could occur at a slower than predicted pace. Also, the amount of water that may be conserved and maintained over time is difficult to predict.

1.3.10.6 *Recommended Contingency Plans for Demand Projection Uncertainties*

The following strategies can mitigate the uncertainties in demand forecasting:

- Demand forecasts provide a range of possible future demands (low, mid and high) with associated water supplies. Adjusting the timing of water supply projects will accommodate changes in the rate of demand growth. If growth is slower or faster than predicted, projects can be deferred until needed or developed in a shorter timeframe. Regular updates of this plan will allow course corrections.
- Improved conservation measures and economic forces have slowed both urban and agricultural water demand growth extending existing supplies.
- With the diversified water supply approach of advanced conservation, sustainable ground water and surface water supplies, and new technologies in recycled water and desalination, there should be sufficient water supply to accommodate variability in domestic and agricultural water demand growth.

1.4 PLAN IMPLEMENTATION

The implementation of the watershed management plans will be accomplished by:

1. Guiding public investment in infrastructure through agency functional and facility plans, which are consistent with the sustainable communities and development plans and the WMPs of the City.
2. Including watershed and water supply projects in agency capital improvement programs for short, mid and long-term horizons that balance the five WMP objectives.
3. Incorporating major watershed management strategies and projects through the City's land use planning processes such as the Development Plans, Sustainable Communities Plans, special area plans, land use permitting process for private and public development, and through the Public Infrastructure Map.
4. Creating watershed partnerships of Federal, State and City agencies, landowners, organizations and communities who can pool resources toward common objectives, and creating groups that choose to assume the responsibility or obtain authorization to implement specific watershed projects.
5. Securing sufficient funding sources to support watershed and water supply projects through a combination of appropriations, grants, fees and dedicated funds. Each project is subject to annual budget approval and available funding.
6. Recommending approval, approval with conditions or denial of developments seeking water based on the adequacy and timing of planned water system infrastructure.

Water Allocation and System Development

The OWMP sets forth the allocation of water to land use by identifying new water supplies for the planned urban developments and agricultural lands as designated in O‘ahu's sustainable communities and development plans. The land use plans and watershed management plans will be used as a guide for the review and approval of CWRM water use permit applications and water commitments and land use approvals by the BWS and DPP. CWRM review of Stream Diversion Works Permits and Stream Channel Alteration Permits for new diversions of surface water can also use the plans for guidance. Water use permits are not required for domestic consumption of water by individual users (Chap. 174C-48(a) HRS). Regular updates of the regional land use plans and watershed plans will integrate land use and water planning and with iteration, will improve consistency and ultimately achieve healthy watersheds.

Adequate Facilities Requirement

All land use actions for developments requiring water, including domestic service, irrigation and fire protection from the BWS water systems are reviewed for adequacy of supply and level of service in compliance with *BWS Rules and Regulations, Chapter 1,* *Water and Water System Requirements for Developments and BWS Water System Standards.*

BWS issues water commitments based on an assessment of the adequacy of water supply and water system capacity. There are three categories of available water of which Category 2 currently applies island-wide:

1. Areas with Adequate Water Supply. BWS may issue advance water commitments to proposed developments in areas where the water system has adequate supplies to assume new or additional services.
2. Areas with Limited Additional Water Supply. BWS may restrict the issuance of advance water commitments to proposed developments in areas where the water system has limited additional supplies to assume new or additional services.
3. Areas with No Additional Water Supply. BWS shall not issue water commitments to proposed developments in areas where the water system has no additional supplies to assume new or additional services. The only exceptions shall be the issuance of a single 5/8-inch meter to proposed developments on existing single vacant lots.

BWS assists CWRM with permit reviews for new development. New ground water sources, both public and private, must comply with the State Water Code, Chapter 174C-51, Application for a Permit. Water Use Permits are required for sources of supply in designated water management areas. All areas except Waiʻanae are designated ground water management areas. Chapter 174C-49 Conditions for a Permit, establishes that the proposed use of water:

1. Can be accommodated with the available water source;
2. Is a reasonable-beneficial use as defined in Section 174C-3;
3. Will not interfere with any existing legal use of water;
4. Is consistent with the public interest;
5. Is consistent with state and county general plans and land use designations;
6. Is consistent with county land use plans and policies; and
7. Will not interfere with the rights of the Department of Hawaiian Home Lands.

Review of zoning and other development applications

Before zoning is approved for new residential, commercial and industrial development, the BWS will indicate to DPP that adequate potable and nonpotable water is available or recommend conditions that should be included as part of the zone change approval in order to assure adequacy.

Large developments requiring major new water system infrastructure
BWS requires new large developments to submit potable and nonpotable water master plans for review and approval, showing the necessary infrastructure to accommodate the development. The master plan should provide land use, site layout, phasing, water demands, and infrastructure including proposed source, storage, transmission and treatment facilities with hydraulic analysis. The master plan then guides the review and approval of construction plans, and the installation of infrastructure to be dedicated to BWS in compliance with BWS Water System Standards. Applications for Water Service are contingent upon the fulfillment of these conditions.

Existing lot developments and small subdivisions
BWS capital program expands the water system to accommodate planned growth. Each application for water service is evaluated for system adequacy to provide domestic and fire protection services. Water System Facilities Charges, the BWS impact fees, are applied to all new developments requiring new or additional water service. If water system infrastructure is not adequate, the development can be denied or conditions to ensure adequacy are placed on the development before water service is approved.

BWS Capital Program
The OWMP is the long-range strategic water resource plan for the City and drives the BWS long-range capital program plan of source, storage, transmission, treatment and infrastructure renewal and replacement projects. The capital projects plan is an integral part of the BWS responsibility, authorized by City Charter as the public water system purveyor and water resource manager. The capital projects program is integrated with the BWS long-term financial plan and water rate structure. BWS is authorized by City Charter to set water rates to provide water supply for O'ahu. The capital program accommodates water system expansion and infrastructure renewal and replacement as guided specifically by the strategies in Objective #5 meet demands at reasonable costs while balancing the other plan objectives.

END NOTES

[1] State Agricultural Water Use and Development Plan, Revised 2004, State Department of Agriculture

[2] Hawai'i Agricultural Research Center Report, Bio-diesel Crop Implementation in Hawai'i, Sept. 2006

3 State Water Code Section 174-C 3

4 HAR Section 13-169-49 and 49.1

5 Waiahole Ditch Contested Case

[6] Climate Change and Water Resources: A Primer for Municipal Water Providers by Kathleen Miller and David Yates National Center for Atmospheric Research, American Waterworks Assoc. Research Foundation Publication

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CHAPTER 2 – KO‘OLAU POKO WATERSHED PROFILE

2 KO'OLAU POKO WATERSHED PROFILE

2.1 INTRODUCTION

The Ko'olau Poko Watershed Management Plan (KPWMP) is part of a comprehensive effort of the Honolulu Board of Water Supply (BWS) and the Department of Planning and Permitting (DPP) to plan for future water resource needs of the City and County of Honolulu, as mandated by the State Water Code. Over the years, BWS has recognized the importance of focusing on resource protection, conservation, and restoration, in addition to water use and development. A watershed approach was developed for this plan to understand the inter-relationships among the physical, biological, and human environments. Thus, in order to understand the resources and provide a context for water management, this plan includes an overview of the terrestrial, land use, socio-economic, and water systems resources present in Ko'olau Poko. This chapter provides a summary of the data collected and analyzed.

2.2 METHODOLOGY

This process involved data collection; issues and needs identification, including the identification of data gaps; and identification of potential water resources management opportunities. The primary sources of data were previously conducted studies, plans, and reports done by various agencies, organizations, and academics. These documents provided information on specific topics within Ko'olau Poko and on watershed issues in general. Various individuals, agencies and organizations were then contacted to provide either follow-up details or updated information, and to identify natural resource values, issues, and needs as perceived by Ko'olau Poko residents. A description of the stakeholder consultation process may be found in Section 2.11.

Once the data was collected, it was analyzed to develop an overall assessment of Ko'olau Poko's natural resources and to identify issues and needs. Many of the problems and issues were discussed in the literature, while others were raised through discussions with agencies and stakeholders. Based on the data and the issues and needs identified, water resources management opportunities were identified.

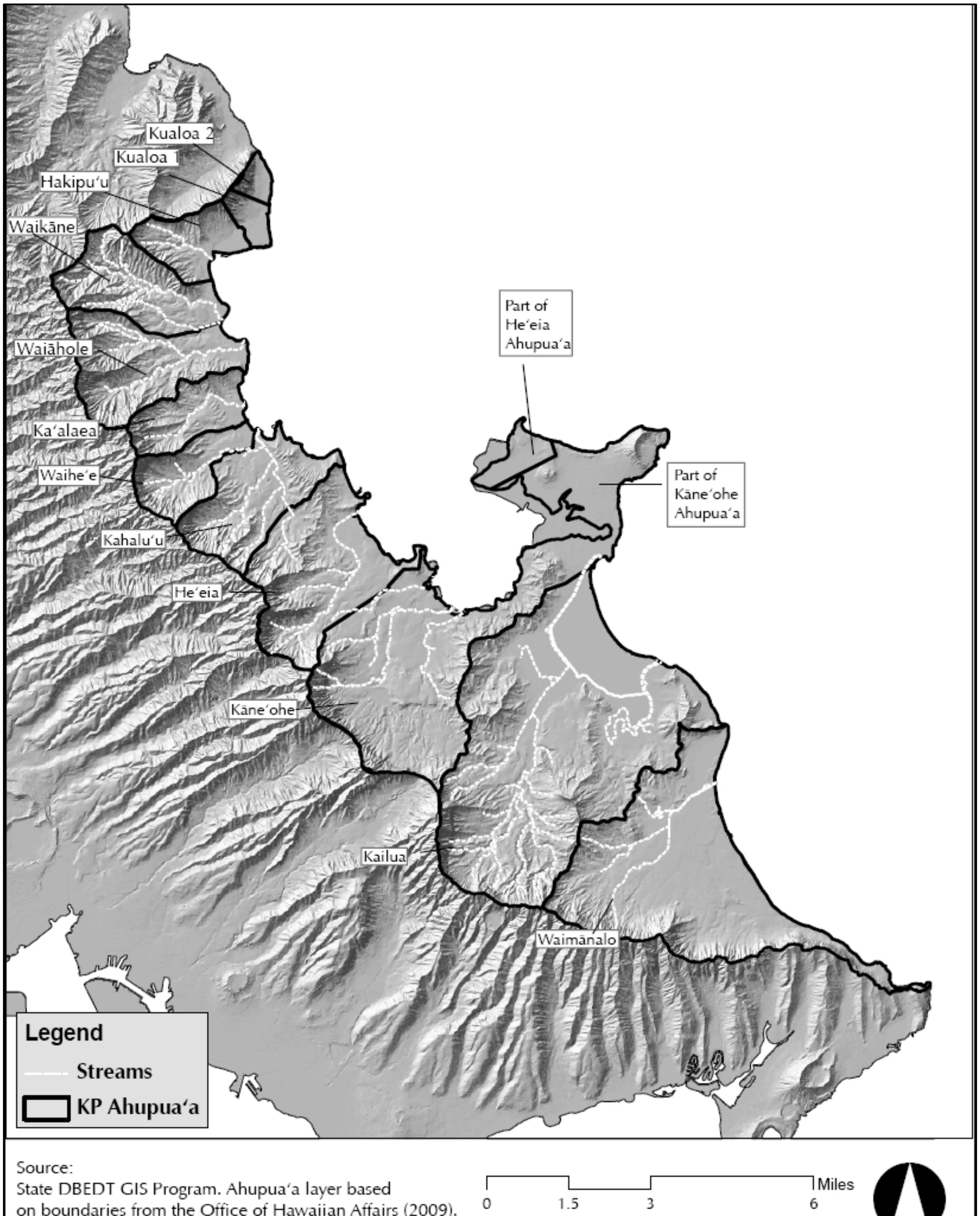
2.3 PHYSICAL SETTING

2.3.1 Overview of the Ko'olau Poko Moku

Moku are historical land divisions that are geographically comparable to the City and County of Honolulu's eight planning districts. The Ko'olau Poko *moku* encompasses lands from Kualoa Point to Makapu'u Point. Encompassing 43,598 acres (68 square miles), Ko'olau Poko makes up approximately 11 percent of O'ahu's land mass. Historically, the *moku* of Ko'olau Poko extended beyond Makapu'u Point to the *ahupua*'a of Kuli'ou'ou on O'ahu's south shore. The region is known for its white sand beaches, rugged mountain backdrops, numerous streams, and wetlands. The Ko'olau Mountain Range forms the inland (*mauka*) boundary of the district. Kōnāhuanui, the tallest peak on the Ko'olau Mountain Range (3,150 feet), is found in Ko'olau Poko.[i]

Ahupua'a were traditional Hawaiian land divisions within *moku* that generally extended from the mountain tops out into the sea to allow their inhabitants access to a full range of resources. With boundaries that often followed ridgelines, *ahupua'a* varied in size and shape, with some that did not include the mountain tops or even the sea. Exchange between *mauka* and *makai* resources allowed most *ahupua'a* to remain fairly self-sufficient. There are 12 *ahupua'a* in Ko'olau Poko as shown in Figure 2.1. The 12 *ahupua'a* range in size, with smaller *ahupua'a* located in the northern portion of the district and larger *ahupua'a* located in the southern portion of the district.

Figure 2. 1 Ko'olau Poko *Ahupua'a*



Source:
State DBEDT GIS Program. Ahupua'a layer based on boundaries from the Office of Hawaiian Affairs (2009).

2.3.2 Watershed Boundaries and Descriptions

A watershed is defined as a drainage basin that catches, collects, and stores water that travels toward the ocean via rivers, streams, or through subterranean springs or seepages[ii]. While watersheds and *ahupua'a* often have similar boundaries, in Ko'olau Poko, watershed boundaries do not exactly line up with the *ahupua'a* boundaries as the *ahupua'a* in Ko'olau Poko typically have a larger land area than a watershed. The Ko'olau Poko district consists of 19 named watersheds (Figure 2.2).

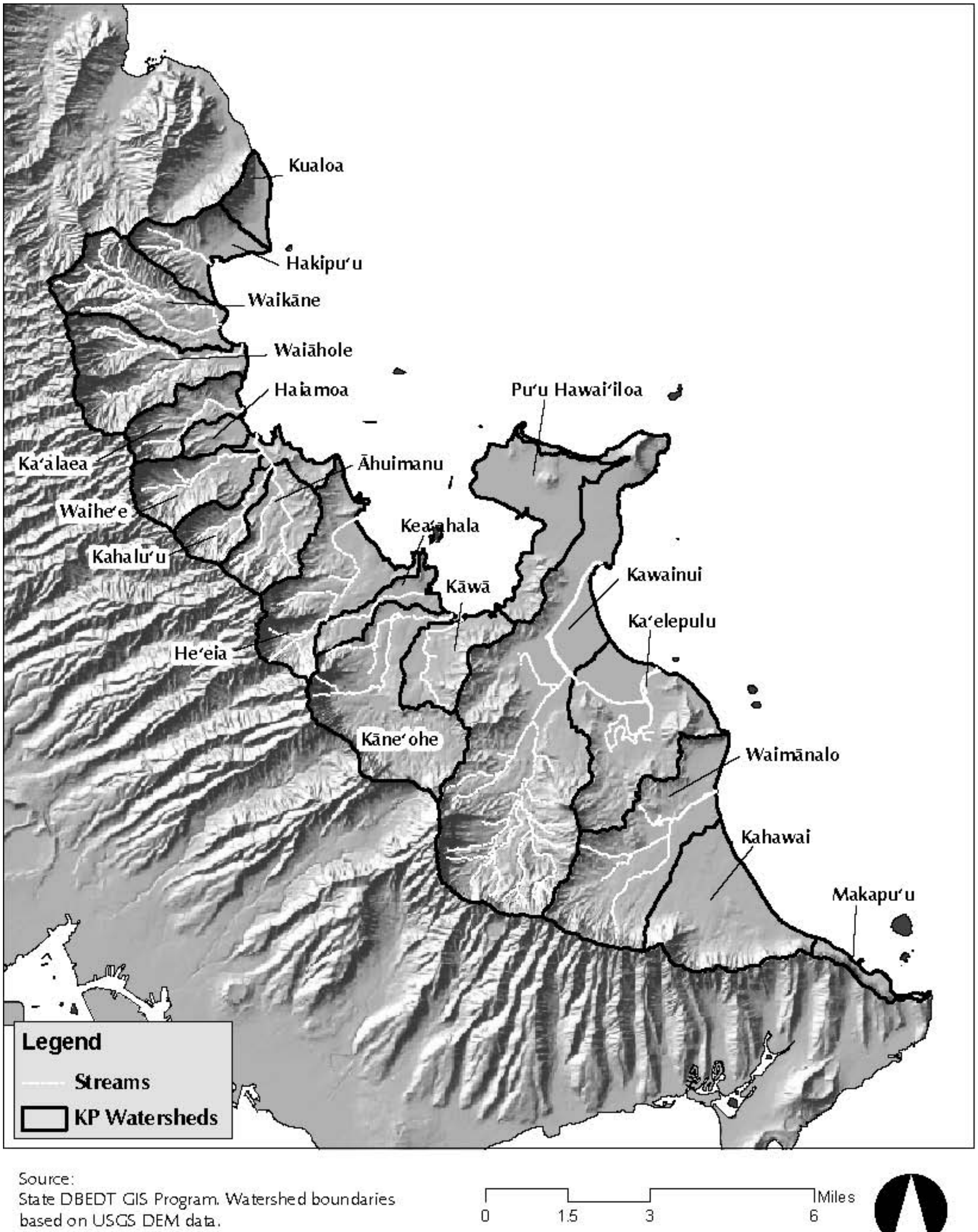
The size and shape of a watershed are important characteristics that determine the way water moves within the watershed. The movement of water, in turn, affects several aspects of water resource management. Most of the watersheds in Ko'olau Poko are categorized by the DLNR Division of Aquatic Resources (DAR) as belonging to the DAR cluster 4 category,[iii] meaning that the watersheds are medium in size, steep in the *mauka* portion, with an embayment (Table 2.1). Medium-sized watersheds with steep *mauka* portions have a greater chance of experiencing "flashy" runoff especially when local rainfall is concentrated over a short period of time.

Table 2. 1 Koʻolau Poko Watersheds

No	Watershed	Watershed Size (Acres)	DAR Cluster[1]
Kahaluʻu Neighborhood Board Area			
1	Kualoa	566	
2	Hakipuʻu	1,324	4
3	Waikāne	1,695	4
4	Waiāhole	2,526	4
5	Kaʻalaea	1,126	4
6	Haiamoa	409	N.D.
7	Waiheʻe	1,543.2	4
8	Kahaluʻu	1,285	4
9	ʻĀhuimanu	1,448.5	4
Kāneʻohe Neighborhood Board Area			
10	Heʻeia	2,843	4
11	Keaʻahala	743	4
12	Kāneʻohe	3,641	N.D.
13	Kāwā	1,336	N.D.
Kailua Neighborhood Board Area			
14	Puʻu Hawaiʻiloa	2,323	
15	Kawainui	9,404	5
16	Kaʻelepulu	3,466	N.D.
Waimānalo Neighborhood Board Area			
17	Waimānalo	3,789	5
18	Kahawai	2,956	N.D.
19	Makapuʻu	325	

[1]DAR Cluster Key:
4 = The watershed is medium in size, steep in upper watershed with embayment;
5 = The watershed is medium size, steep in the upper watershed with little embayment;
N.D. = Not determined

Figure 2. 2 Ko'olau Poko Watersheds



Source:
State DBEDT GIS Program. Watershed boundaries based on USGS DEM data.

2.3.3 Climate

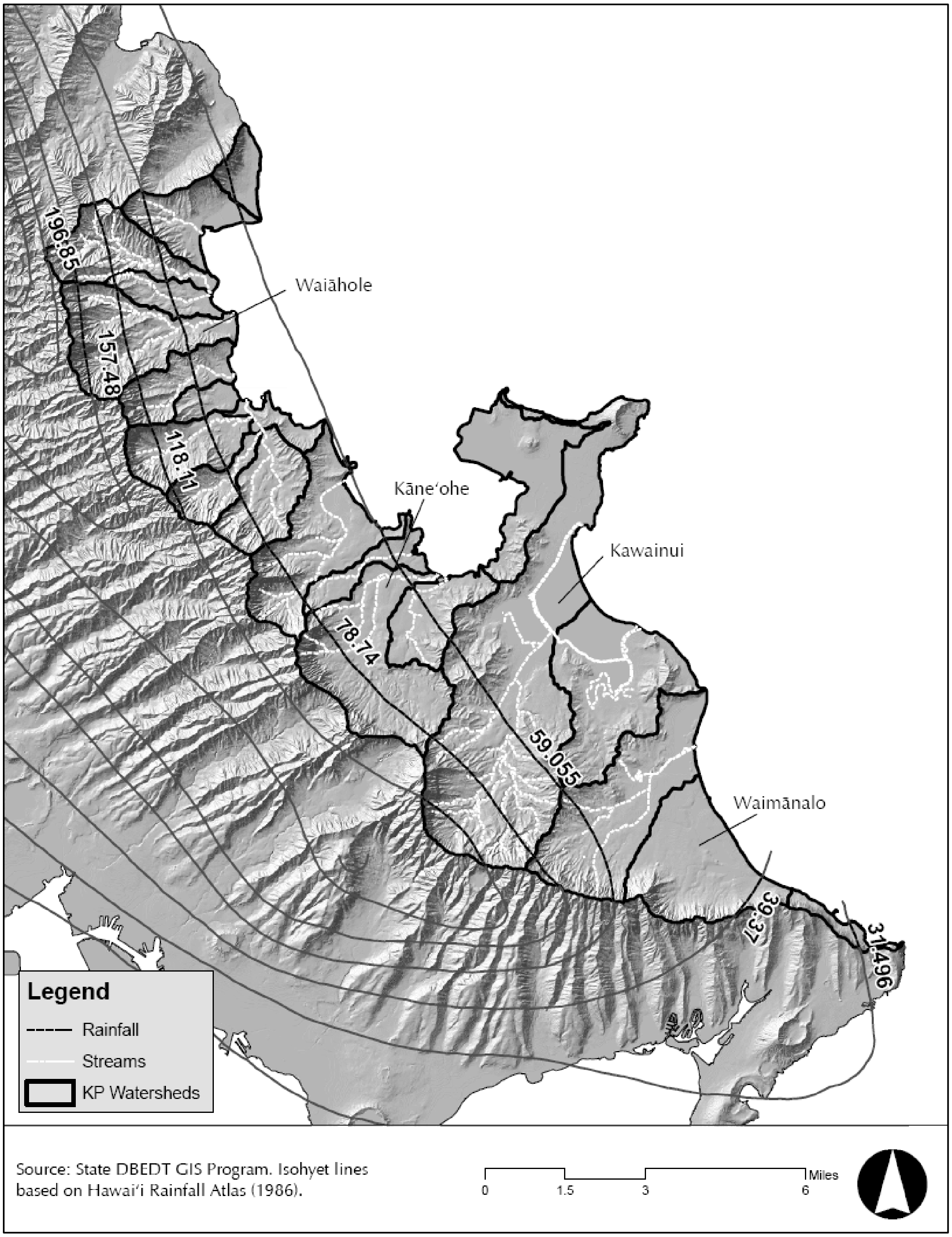
Trade wind patterns have a significant effect on Windward O'ahu's climate. Trade winds blow from the northeast most of the year and bring warm moist air from the ocean onto the land. As the air is deflected up along the Ko'olau Mountains, the air cools, forms clouds, and releases rain onto the land below. The mountain regions of Windward O'ahu experience frequent rainfall and are often covered by clouds. Fog drip at the higher elevations also contributes to overall precipitation. The general climate of the coastal areas and central plains of Windward O'ahu have moderate to frequent rainfall. The highest annual average rainfall in the district (196.85 inches) occurs in the upper portions of the Waiāhole and Waikāne *ahupua'a*. The coastal area of Makapu'u has the lowest annual average rainfall (31.49 inches). Rainfall along Ko'olau Poko's coast decreases progressively from 59.05 inches at Kualoa Point to 25.00 inches at Makapu'u Point. [iv] Figure 2.3 illustrates rainfall patterns in the district of Ko'olau Poko.

Anecdotal observations of some long-time residents in the district suggest that rainfall frequency has decreased over the last couple of decades in certain areas of Ko'olau Poko. The entire State has experienced periods of drought since 2000. The most recent drought period began in summer of 2008. In the first half of 2010, about 88 percent of the State experienced drought conditions, compared to 2009 where 76 percent of the State experienced drought conditions. Waimānalo, in particular, received only 10.2 inches of rain from January to May 2010, which is only 48 percent of typical rainfall levels during those months.[v] Also, from August 2008 to January 2009, BWS asked all Windward water users to voluntarily reduce their individual water use by 10 percent due to levels of below average rainfall.

In July of 2009, the State Legislature established a Climate Change Task Force within the State Office of Planning to scope the impacts of global climate change trends in the State. The Climate Change Task Force developed a framework in which the State should plan for the potential impacts of climate change. The framework identified 15 areas of planning that are likely to be affected by climate change, including the potential impacts climate change may have on water supply, coastal zone management, storm and wastewater management, agriculture, natural resources/environmental protection, and flood control.

Solar radiation is often used as an indicator of an area's agricultural productivity, as most crops grown commercially rely on high levels of sunshine. Solar radiation levels in Ko'olau Poko are higher in the *makai* regions of the district compared to the *mauka* regions of the district. Also, solar radiation levels increase progressively from Kualoa to Makapu'u Point. The Kahalu'u areas and Kāne'ohe areas experience between 0 - 300 solar calories per square centimeter per day while the Kailua area experiences between 0 - 350 solar calories per square centimeter per day. The Waimānalo area experiences between 300 - 350 solar calories per square centimeter per day.

Figure 2. 3 Ko'olau Poko Average Annual Rainfall



KEY FINDINGS:

- Koʻolau Poko experiences frequent rainfall. However, the district has experienced recent periods of drought over the last decade.
- Solar radiation levels indicate that the Kailua and Waimānalo areas of the district receive more sunlight than the Kāneʻohe and Kahaluʻu areas of the district.

2.3.4 Geology and Soils

Koʻolau Poko is the remnant of the deeply eroded Koʻolau shield volcano. The Koʻolau volcanic eruptions occurred approximately 2 million years ago and left basaltic lava flows that layered upon each other to form a gently sloping lava dome.[vi] These flows were fed by magma pouring out of fissures in the volcano. When molten rock solidifies in the narrow cracks that are under pressure, the rock that is created is much denser and much less permeable than the surrounding porous lava flows. These dense, usually vertical geological structures are known as volcanic dikes. Over the course of time, erosion caused by rain, surface water flow, wind, and fluctuations in sea level have shaped the volcanic dome into the valleys and gentle sloping coastal plains of the present day.

The center of the Koʻolau Volcano formed a massive caldera that was about eight miles long and four miles wide and extended from Waimānalo to Kāneʻohe. Rock formations within these areas were dense and less permeable due to their exposure to the extremely hot temperatures from the center of the eruption and rising volcanic gasses. An example of this can be seen from the dense rocks that were extracted at the Kapaʻa Quarry in Kailua. Volcanic dikes can be found throughout the rift zone. The density of the volcanic dikes is greater in the *mauka* areas than the *makai* areas. In windward Oʻahu, volcanic dikes are especially dense along the stretch between the Kahaluʻu and Punaluʻu watersheds. Within Koʻolau Poko, both the caldera rocks and the dike zones are less favorable for water development because of their density and low permeability.

Soil order categorizations are useful to determine agricultural and construction values of the soils. There are three general soil associations in Koʻolau Poko: Kaʻena-Waialua, Iolekaʻa-Waikāne, and Rock land-Stony steep land associations[vii]. The Kaʻena-Waialua association makes up the coastal lands, talus slopes and drainageways. This association is described as deep, gently sloping, poorly drained to excessively drained soils consisting of fine to coarse subsoil or underlying material. The Iolekaʻa-Waikāne association occupies much of the uplands in Koʻolau Poko and is described as deep, nearly level to very steep and well drained soils that have dominantly fine-textured subsoil. The Rock land-Stony steep land association makes up the Koʻolau range crest and is described as steep to precipitous, well-drained to excessively drained, rocky and stony land. Table 2.2 shows the most common soil orders found in Koʻolau Poko.

Table 2. 2 Common Soil Orders in Koʻolau Poko

Soil Order	Dominant Characteristics	Location
Ultisols	Very acidic soils formed from strongly weathered parent material.	Common in moderate altitude locations in Kahaluʻu, Kāneʻohe, Kailua and Waimānalo Neighborhood Board (NB) Areas
Inceptisols	Usually found in river valley with flood plain. Inceptisols are developed from volcanic ash, and are generally moist, and strongly weathered.	Along most of the streams of Kahaluʻu, Kāneʻohe, Kailua and Waimānalo NB Areas
Vertisols	Usually black and gray in color, high in clay and develop large cracks when dry. Difficult to manage for farming and construction uses.	Common in areas east of Kaʻelepulu Pond in Kailua and in Waimānalo
Mollisols	Generally have moderate to strong granular structure. Mollisols typically developed under grass vegetation.	Common in Waimānalo and Mōkapu Peninsula
Entisols	Sandy, excessively drained soils that have changed very little from the parent material.	Common on the *makai* side of Kaʻelepulu canal in Kailua Town and Bellows AFB in Waimānalo

KEY FINDINGS:

- The geology of Koʻolau Poko consists of rock formations that are not very permeable.
- Koʻolau Poko soils vary by proximity to the coast or mountain

2.4 WATER RESOURCES

2.4.1 Regional Hydrology

The general hydrology of the island of Oʻahu is described in some detail in "Appendix D – Overview of Oʻahu Hydrogeology." In Koʻolau Poko, fresh water comes entirely from precipitation along the Koʻolau Mountain Range. Rainfall infiltrates through the mountain's rock layers and is impounded within the dike compartments along the Koʻolau Mountain Range. As these dike compartments become filled with water, the water begins to surface as springs or seepages. There are numerous springs spread throughout the entire district. Most of the springs in Koʻolau Poko are located in the *mauka* areas of the district, many of which feed the streams. One of the largest concentrations of *mauka* springs can be found in Maunawili Valley, where the Kailua Historical Society documented more than 50 springs. However, according to community sources, a number of springs throughout the district have dried up.

As noted in the previous section, the density of the dike compartments on the windward side of the island tends to be higher in *mauka* areas than in *makai* areas. In Koʻolau Poko, the volcanic dikes are closely spaced to each other. These closely spaced volcanic dikes, called dike complexes, contain small compartments of water that are often difficult to access and are generally economically unfeasible to develop as a municipal water source. Between the Kualoa and Kahaluʻu areas, there are several dike zones that store a sufficient amount of high level ground water to allow for the development of municipal water sources. However, the caldera rocks that are found in Kāneʻohe and Kailua are unfavorable for water development.

There are some areas in the district where ground water withdrawal has had an effect on surface water quantity and stream flow. Therefore, water development options are more limited in these areas. Several streams known to be directly affected by upland ground water withdrawals in Koʻolau Poko are the Waiheʻe Stream and the Waiāhole and Waikāne Streams.[viii]

2.4.2 Ground Water Resources

2.4.2.1 Ground Water Quantity

Koʻolau Poko ground water occurs as high level dike water in the upper elevations of the Koʻolau Mountain Range and as dike basal water in the lower elevations. The majority of developable ground water in Koʻolau Poko is high level dike water in the Kahaluʻu and Kāneʻohe Neighborhood Board (NB) areas. Smaller amounts of ground water can be found in Waimānalo along with small amounts of brackish ground water in Waimānalo coastal locations. [ix] The CWRM indentified three aquifer system areas (ASYA) in the district – (1) Kahana ASYA (sliver of); (2) Koʻolau Poko ASYA; and (3) Waimānalo ASYA. ASYAs are areas within an Aquifer Sector Area that show ground water hydraulic continuity. The island of Oʻahu is delineated into six Aquifer Sector Areas based on broad geological and hydrological continuity. The ASYAs in the Koʻolau Poko district belong to the Windward Aquifer Sector Area.

Sustainable Yield is "the maximum rate at which water may be withdrawn from a water source without impairing the utility or quality of the water source."[x] The sustainable yield (SY) of each ASYA is reported in Table 2.3 except for the SY of Kahana ASYA. Primary ground water development from the Kahana ASYA occurs in the Koʻolau Loa district and is therefore not included in Table 2.3. The Koʻolau Poko ASYA has more than three times the amount of water than the Waimānalo ASYA. CWRM has classified the Waiāhole Ditch System as a separate ASYA for ease of management. The Waiāhole Ditch system has a SY of 15 mgd.

Table 2. 3 Aquifer System Areas in Ko'olau Poko

Aquifer System Area	Sustainable Yield (mgd)
Ko'olau Poko	30
Waimānalo	10
Total	40

2.4.2.2 Ground Water Quality

Ko'olau Poko ground water quality is generally considered high. BWS' 2008 Consumer Confidence Report found that all of the ground water that it provides to Ko'olau Poko meets the Federal and State drinking water standards. BWS and the State DOH regularly monitor drinking water quality for traces of more than a 100 different types of natural and human-induced contaminants. All tests are performed at the water source. Monitoring of certain types of contaminants such as coliform bacteria is conducted throughout the distribution system. Contaminants that may enter drinking water as a result of water flowing through the water delivery system, such as lead and copper, are tested both at the source and also at the consumer's tap.

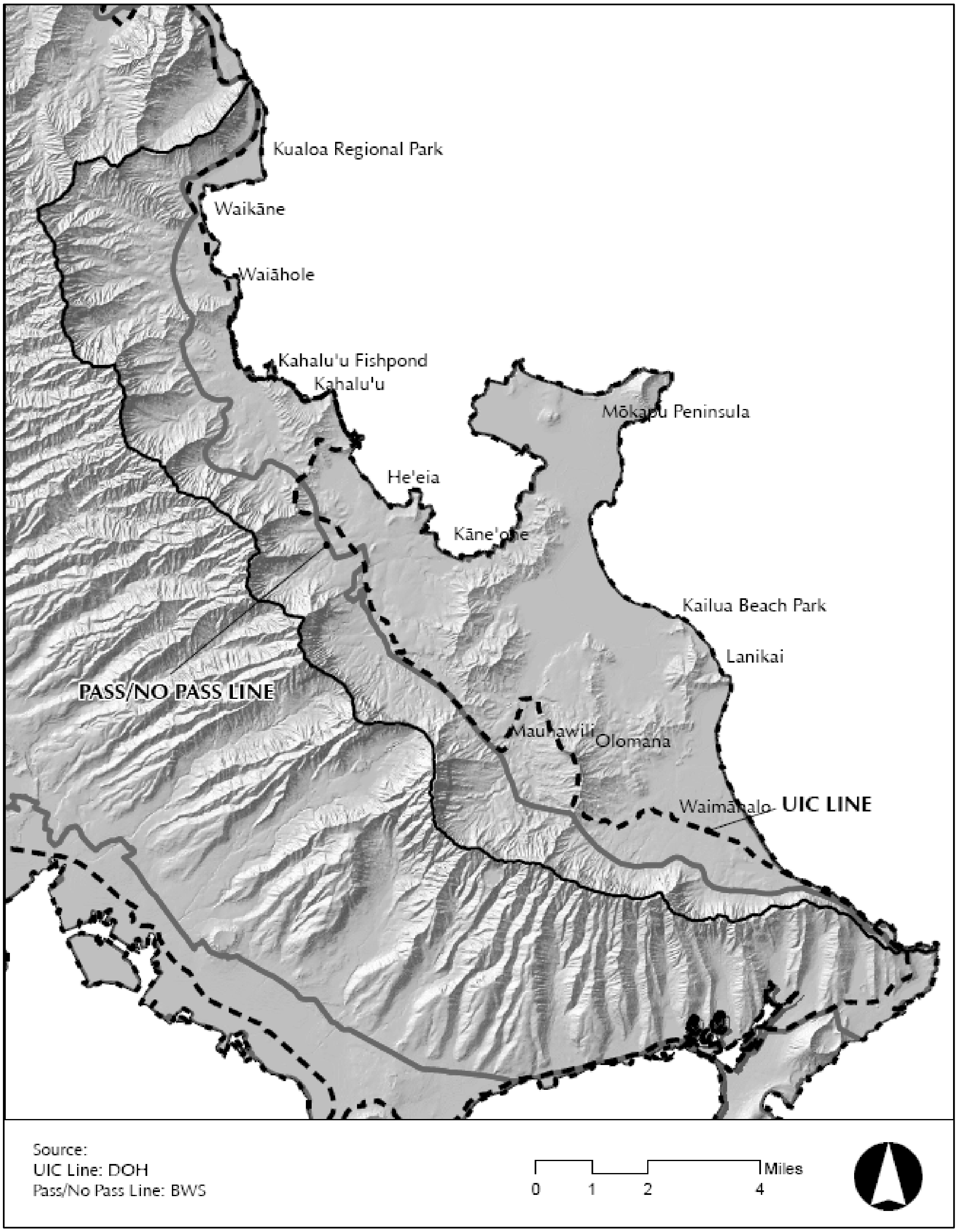
To further safeguard drinking water sources from contamination, BWS, DOH, and the Federal Environmental Protection Agency (EPA) have several other monitoring and treatment programs. Table 2.4 contains information on some of the programs and their related findings in Ko'olau Poko.

Table 2. 4 Ground Water Quality Protection Programs

Program (Agency)	Program overview	Program Activities in Koʻolau Poko
Hazard Evaluation and Emergency Response – HEER (State DOH)	Compiles records of released hazardous substance at sites throughout the State.	Reported accidents in 2008: dumped oil, assortment of potentially hazardous trash such as fluorescent light bulbs and lead shot, excessive PCE and lead concentration of soils in several locations.
Ground Water Contamination Maps – GWCMs (State DOH)	Identify locations where organic and non-organic contaminants have been detected and confirmed in drinking water wells, select non-potable wells, and fresh water springs throughout the State	One BWS well in Waimānalo was identified as contaminated from alachlor (herbicide substance) (GWCM – 2005). This well, however has been inactive for more than a decade and has since been transferred to DOA for non-potable irrigation use.
Hawaiʻi Source Water Assessment and Protection Program – HISWAP (State DOH)	Identifies potential for contamination of drinking water sources in Hawaiʻi	Sources that are the most susceptible to contamination[1]: Luluku, Kuou, Waimānalo wells. Least susceptible sources[1]: Haʻikū, Iolekaʻa, Kahaluʻu, Waiheʻe wells
Comprehensive Environmental Response, Compensation and Liability Act – CERCLA (Federal EPA)	Identifies, investigates and cleans up uncontrolled or abandoned hazardous waste sites throughout the nation	No CERCLA sites exist in Koʻolau Poko. See Oʻahu Inactive Landfill for information on some of the "brownfields."
Oʻahu Inactive Landfills Relative Risk Evaluation (BWS)	Evaluation of inactive landfill sites (mostly those established prior to State and Federal waste laws enactment).	Eleven inactive landfills: 2 former military and 9 former municipal landfills. None is found in the Kahaluʻu NB area. One former municipal landfill in Waimānalo is located *mauka* of the DOH's UIC line.
Underground injection control – UIC (State DOH)	Demarcates areas where injections of fluids are prohibited. The UIC line was drawn in the 1970s.	See Figure 2.4
Pass/No Pass Line (BWS)	Regulates disposal of wastewater and other sources of contamination. The Line was determined based on the rock formations of an area.	See Figure 2.4

[1]Preliminary results. Also, some of the BWS sources have not been assessed for Potential Contamination Activities (PCA).

Figure 2. 4 Ko'olau Poko Pass/No Pass and UIC Lines



KEY FINDINGS:

- The majority of Koʻolau Poko ground water sources are located in the Koʻolau Poko ASYA, of which the greatest source of developable water is high level dike water located along the Koʻolau Mountain Range in the Kahaluʻu and Kāneʻohe NB areas.
- Koʻolau Poko ground water resources are limited due to its dike aquifers. Dike aquifers cannot hold large amounts of ground water.
- In certain areas of Koʻolau Poko, ground water withdrawal has had an effect on surface water quantity and stream flow.

2.4.3 Surface Water Resources

Stream resources, as well as other man-made waterways such as agricultural ditches and diversions, play an important role in the socio-economic and ecological health of the district and therefore warrant a more detailed analysis. The discussion on Koʻolau Poko's stream resources is organized by Koʻolau Poko's four Neighborhood Board areas.

The following paragraphs provide descriptions of the general characteristics of Koʻolau Poko's stream resources. The description of streams by neighborhood board area follows this general information.

2.4.3.1 Attributes Used to Characterize Koʻolau Poko Streams

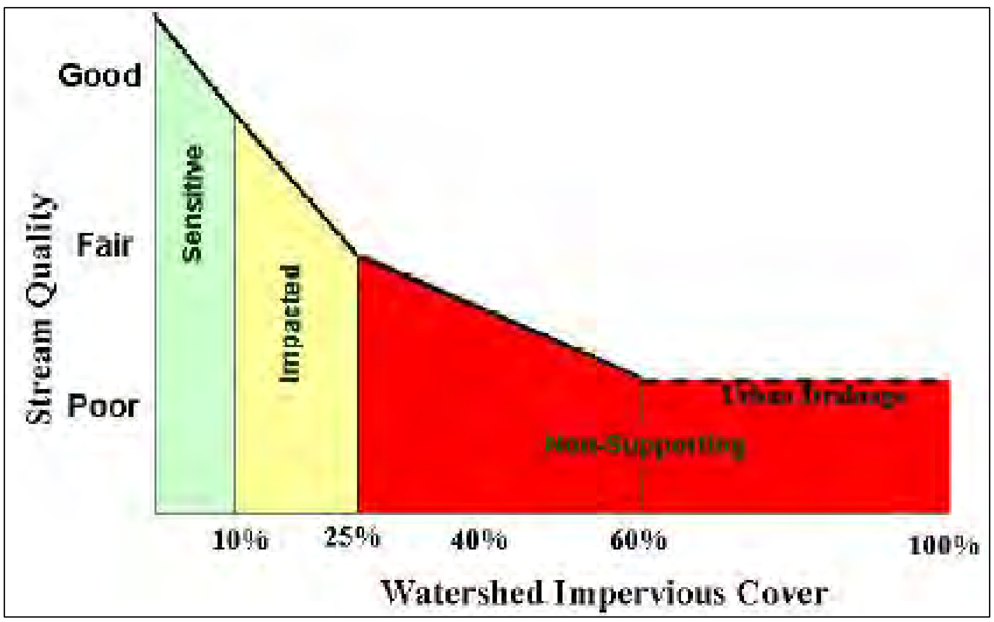
Numerous streams in Koʻolau Poko were created from erosion that exposed dike compartments in the rock layers, leaking water to the surface. Over the aeons, water has carved its way into the land forming well defined natural stream courses.

Perennial streams are those streams with year-round flow in all or part of their courses.[xi] The existence of perennial streams depends on sufficient levels of rainfall as well as the geological characteristics of an area that allows water to flow on its surface. Numerous perennial streams can be found in Koʻolau Poko. All of these streams are fed by dike ground water that originates from the upland areas in the back of the valleys as well as seepage along the stream water courses.

The streams of Koʻolau Poko are discussed in terms of stream length, stream slope gradient, and other applicable stream characteristics including stream drainage area and level of imperviousness within the stream drainage. Stream length is a general indicator of a stream's capability to assimilate pollutants as well as a stream's value as habitat for aquatic biota. Longer streams have better flow fluctuation regimes, higher pollution assimilation capacity, and provide more habitats for aquatic biota. Stream slope gradient determines the way runoff and stream water move within the watershed. Steeper watersheds, depending on the pattern of rainfall, are more prone to flash floods. Drainage area determines the amount of runoff flowing into the streams. Larger drainage basins tend to produce greater runoff.

The level of imperviousness of the drainage basins is another important stream-related characteristic. Higher impervious cover leads to higher runoff volume, more rapid peak volume of runoff, lower amount of infiltration into the aquifer, and an increase in the stream’s bankfull flow. All of these factors alter the natural condition of the stream. At a certain point, the natural watercourse acts merely as an urban drainage feature. The level of imperviousness can also be an indicator for stream water quality. A study on hundreds of small and medium watersheds throughout the western and pacific regions of the U.S. produced the “Impervious Cover Model,” a generalized graph that links level of watershed impervious cover with stream water quality.

Figure 2. 5 Impervious Cover and Stream Water Quality



Source: Center for Watershed Protection, Impacts of Impervious Cover on Aquatic Systems, 2003

Agricultural waterways such as agricultural ditches, flumes, and agricultural reservoirs are discussed under stream modification.

<u>Stream Modifications</u>
Stream modifications are manmade alterations to natural stream channels and/or manmade alterations to stream flow. Common stream modifications in the Ko‘olau Poko district are stream channelization, dam or reservoir construction, and diversion of stream water. Stream channelization is done through the widening, straightening, or deepening of the natural course of a stream. Usually streams are modified in order to mitigate flooding by increasing the flow capacity of streams.[xii] Stream channelization mostly occurs in urbanized areas.

Like many other alterations to the natural condition of any system, stream modifications have both positive and negative impacts associated with them. Stream channelization minimizes flood hazards and when coupled with stream hardening allows for more stable stream beds and banks and helps reduce erosion along streams. However, several negative impacts to both surface and ground water have been attributed to stream channelization, including:[xiii]

- Increases in a stream's slope contribute to an increase in flow velocity. Higher flow velocities wash sediment and pollutants more rapidly to the nearshore waters and affect the habitat of aquatic biota in the stream
- Where segments of the streams have not been modified, upstream stream channelization may increase the rate of erosion and sedimentation as a result of increased velocity in stream flow
- Shorter stream channel length due to the straightening of natural stream curves
- Loss of pools and riffles that provide habitat for native aquatic species along the stream
- Loss of riparian wetlands and reduction of ground water recharge especially when channelization is coupled with concrete hardening of streams
- Removal of logs and boulders that function as fish habitat
- Reduction of a stream's aesthetic value.

Reservoir construction can be employed together with stream channelization to help mitigate flooding. Reservoirs hold runoff from upper parts of the stream and reduce the rate at which runoff flows downstream. For example, the Kahalu'u Flood Control Reservoir located adjacent to Kahalu'u Regional Park has been reported to reduce floods along the Kahalu'u and Waihe'e tributaries of the stream system.[xiv] Reservoirs, however, may impact water movement, morphology, and the ecosystem of a stream. The adverse impacts of reservoirs vary depending on individual site and physical conditions.

Stream diversion is defined in the State Water Code as "the act of removing water from a stream into a channel, pipeline, or other conduit." Stream diversion can be employed to provide water for various purposes but is commonly employed on O'ahu to provide irrigation water. In Ko'olau Poko, stream flow has been diverted to both locations near and far. Stream diversions provide agricultural water for both modern and traditional agricultural operations. Stream diversions from different eras in Hawai'i's history can still be found throughout the Ko'olau Poko District. In Hawai'i, water has been diverted from the streams for many generations primarily for wetland *kalo* cultivation and inland fishponds. During the 19th century, sugar plantations constructed extensive networks of irrigation ditches diverting ground and surface water over many miles.

The State CWRM maintains a database of stream diversions that were in existence before enactment of the State Water Code. This database is based on declarations of water use mandated by HRS §174C-26. The database includes some diversions that were abandoned at the time of the declarations, but were intended to be reopened in the future. In many cases, field verification of diversions are incomplete due to funding constraints.

The BWS Hydrology-Geology Section conducted a field survey of Koʻolau Poko Streams between 2008 and 2011. This survey documented 109 stream diversions in Koʻolau Poko, as well as 24 in Kahana and Kaʻaʻawa. A summary of the surveyed diversions may be found in appendix F.

Table 2. 5 Stream Diversions

Neighborhood Board	Number of Diversions (BWS Inventory)[1]
Kahaluʻu	77
Kāneʻohe	14
Kailua	10
Waimānalo	8
TOTAL	109[2]

1 Number of Diversions is taken from the 2008-2011 BWS stream diversion inventory survey

2 A total of 133 diversions were surveyed by BWS, but 24 of them are in the Koʻolau Loa Neighborhood Board area. Waiāhole Ditch system intakes 1 through 19 are in the Kahana hydrologic unit, but were included in the BWS survey because they are integral to the Waiāhole Ditch System. Five diversions in Kaʻaʻawa Valley were also included although that hydrologic unit is not within the Koʻolau Poko district.

Stream Flow

Rainfall, runoff, and ground water seepage contribute to the flow of streams. Rain water may fall directly into the streams. Runoff may enter streams within minutes to days from the original rainfall event. Ground water seepage into streams may take months or even decades from the original rainfall event. As previously discussed in the section describing Koʻolau Poko ground water resources, aquifers throughout the Koʻolau Poko district are primarily dike structures. Dike ground water typically takes months to years to surface in streams.[xv]

The instream flow standard (IFS) designation is the primary mechanism by which the CWRM carries out its duties to protect and promote various public trust purposes related to surface water. The IFS is defined by the State Water Code as the "quantity or flow of water or depth of water which is required to be present at certain specified times of the year to protect fishery, wildlife, recreational, aesthetic, scenic, and other beneficial instream uses." To date, measurable Interim IFS (IIFS) have been established for all or portions of 34 streams in Hawaiʻi. For other streams that do not have a measurable IIFS, the CWRM adopted a "status quo" policy. IIFS were established based upon the amount of water flowing in each stream at the time the administrative rules governing the IFS designation were adopted in 1988 and 1989. Future diversions of stream water cannot be made without first amending the IIFS and obtaining a diversion permit from the CWRM.

In Hawai'i, at least two types of stream flow are calculated for surface water resources planning purposes:

- **Average flow** is determined by dividing the sum of all stream flow measurements for a particular stream by the number of stream flow measurements taken.

- **Median flow** is the rate of discharge of a stream for which there are equal numbers of greater and lesser flow occurrences. In Hawai'i, due to the flashy characteristics of streams, especially during storm events, measurement of stream flows often records very large peak flows. These large peak flows may affect the calculation of the stream average flow making it a less accurate measure of "normal" times. When a stream has a relatively large average flow when compared with its median flow, this may indicate that the stream experiences flash flooding.

Information on a stream's base flow is also important. Base flow is the portion of stream flow that originates from ground water. It is therefore the amount of flow in streams during prolonged dry periods, when there are negligible contributions from rainfall and runoff.[xvi] Information on base flow is particularly useful in the determination of measurable IFS.

The United States Geological Survey (USGS) operates and maintains most of the stream gaging stations in Hawai'i. There were over 100 operating stream gages in Ko'olau Poko prior to 1950, but over the last 50 years, the number of gages has dramatically declined, mainly due to declines in funding.[xvii] In fiscal year 2009, there were only 17 USGS stream gaging stations in the district. Thus, in many instances, there are no data available for streams in Ko'olau Poko.

Stream Water Quality

The Federal Clean Water Act (CWA) of 1972 established a regulatory framework for the nation's surface water quality protection. The CWA calls for a bi-annual surface water quality assessment in each state. Those surface water bodies found to be in violation of State standards must be reported pursuant to § 303(d) of the CWA. The list of impaired water bodies is usually referred to as the 303 (d) list. The 303(d) list contains information on the types of pollutants that are impairing the water quality of a stream. Additionally, the list identifies priorities for Total Maximum Daily Load (TMDL) development.

A TMDL development process identifies in much greater detail the causes of pollution and calculates the maximum daily amount of pollutant load that can enter water bodies without violating water quality standards. TMDL calculations are performed for both point and non-point source pollutants. Point sources are those from which the discharge of pollutants requires an NPDES permit. Examples of point sources of pollution are pollutants originating from industrial discharges, sewage treatment plants or municipal storm water drainages. Non-point source pollutants are all other pollutants, including pollutants that are carried by rainfall that move over and through the land. The calculated maximum pollutant loads are then divided and assigned among the identified sources of pollution.

The State DOH assesses several types of water quality parameters including nutrients, turbidity, total suspended solids (TSS), bacteria, heavy metals, pesticides, herbicides and other potentially harmful substances. While there are many variations in terms of the sources of water quality degradation in streams, excess pollutants in Ko'olau Poko streams mostly consist of nutrients, turbidity, and TSS. The following is a brief overview of these three major sources of pollution.

- **Nutrients** in a water quality context refers specifically to nitrogen and phosphorous, two essential substances for the growth of aquatic biota. At an elevated level, nutrients cause accelerated growth of phytoplankton that leads to an increase in turbidity. There are many sources of nutrient pollution.
- **Turbidity** refers to the cloudiness of water. High levels of turbidity are considered unfavorable in a stream because it hampers sunlight from reaching the bottom of the stream, which in turn inhibits the growth of aquatic biota.
- **Total Suspended Solids (TSS)** is a measure of particulate matter in water, usually as a result of dissolution of solid particles from eroded soils.

Stream Biotic Resources

The ability of a stream to sustain aquatic life reflects the condition of a stream's chemical and physical characteristics. The presence or lack of aquatic species in a stream is thus an indicator of a stream's overall health. In particular, the presence of native aquatic species are key indicators of stream health in Hawai'i as introduced non-native aquatic species tend to be better able to tolerate degraded stream conditions.

Native fresh water species possess several unique characteristics that make them a good indicator of a stream's ecological health. These characteristics include: (1) native fresh water species are uniquely adapted to the "flashy" characteristics of Hawai'i's streams and are dependent upon streams with large flow volumes for their reproductive success; (2) native fresh water species have an amphidromous life cycle. Native aquatic species lay eggs in fresh water; their larvae drift downstream into the ocean and mature; juveniles leave the ocean and return to fresh water environments, swimming upstream to live their adult lives. This life cycle requires an unimpeded connection between the upper reaches of a stream and the ocean; (3) native fresh water species require well-oxygenated water and are sensitive to a changing environment.

The assessment of biotic resources in Ko'olau Poko streams in this section is based on the 2008 Atlas of Hawaiian Watersheds. The Atlas of Hawaiian Watersheds assigns a standardized score from one to ten with one being the lowest and ten being the highest for the biological resources of the streams. The biological resources rating is a combination of the Native Species Rating, Introduced Genera Rating, and All Species Rating.

The Native species rating reflects the presence of nine native aquatic species. There are six species of fish: 1) *Awaous guamensis ('o'opu nākea)* 2) *Eleotris sandwicensis ('o'opu okuhe* or *'o'opu akupa)*, 3) *Kuhlia xenura* or *Kuhlia sp*. prior to name change (*aholehole*), 4) *Lentipes concolor ('o'opu alamo'o* or *'o'opu hi'ukole)*, 5) *Sicyopterus stimpsoni ('o'opu nopili*), 6) *Stenogobius hawaiiensis* (*'o'opu naniha*). There are three species of crustacean: 1) *Atyoida bisulcata ('ōpae kala'ole)*, 2) *Macrobrachium grandimanus ('ōpae 'oeha'a)*, and 3) mollusk *Neritina granosa (hīhīwai or wī)*. Watersheds with insufficient survey data are unranked.

The Introduced Genera Rating reflects the presence of non-native introduced aquatic species. Common non-native aquatic species that are observed in Hawai'i Streams include: tilapia, various varieties of cichlids, catfish, tahitian prawns, and Louisiana crayfish.[xviii] Watersheds with insufficient survey data are unranked.

All species score rating is based on several parameters – (1) the presence of endangered or candidate endangered species; (2) the presence of native species (3) the presence of introduced species. Watersheds with insufficient survey efforts are unranked.

DAR's Stream Biotic Importance Criteria are also used to assess the biological resources in Ko'olau Poko's streams. DAR uses the following stream characteristics when determining a stream's existing biological importance:

- 19 or more different types of native insect species can be found in the stream
- 5 or more different types of native macrofauna can be found in the stream
- Absence of priority 1 introduced species in streams
- Abundance of any native species in streams
- Presence of candidate endangered species in streams
- Endangered Newcomb's Snail habitat

The assessment of biotic resources in Ko'olau Poko Streams can also be accomplished using the Hawai'i Stream Visual Assessment Protocol (NRCS, 2001) and the Hawai'i Stream Bioassessment Protocol, HSBP (Kido, 2001), which is also keyed to presence and absence of native species, among other factors. DOH conducts the HSBP as part of the TMDL development process, and the City and County of Honolulu has conducted it as a component of its NPDES-associated monitoring program. Stream bioassessment reports are available for Waimānalo Stream (Stream Bioassessment Program, 1998), Kāwā Stream (Burr, 2001) and Kāne'ohe Stream (Burr, 2003). The development of the HSBP was funded and otherwise encouraged by EPA to help DOH (1) determine the habitat quality and biotic integrity of streams, and (2) identify the location, severity, and causes of aquatic life use impairment.

2.4.3.2 Kahaluʻu Neighborhood Board Area Streams

Kahaluʻu Neighborhood Board Area General Stream Characteristics

The Hawaiʻi Stream Assessment lists eight perennial streams in the Kahaluʻu NB area: Hakipuʻu, Waikāne, Waianu, Waiāhole, Kaʻalaea, Waiheʻe, Kahaluʻu, and ʻĀhuimanu. Three of these perennial streams, Kahaluʻu, ʻĀhuimanu, and Waiheʻe Streams, form a "stream system," i.e. streams with two or more major tributaries that extend from different valleys and converge on a coastal plain.

Stream length varies among the perennial streams in the Kahaluʻu NB area but is generally considered short (less than 10 miles long). The Kahaluʻu Stream System has the longest length of approximately 9.8 miles. The shortest perennial stream in Kahaluʻu NB area is Hakipuʻu Stream, at 2.4 miles. Similar to many other streams in Hawaiʻi, streams in the Kahaluʻu NB area are generally straight and steep. Except for Kahaluʻu Stream System, all other streams in Kahaluʻu NB area drain areas that have a relatively low percentage of impervious surface.[xix] Kahaluʻu Stream drains through an area that is 13.06 percent impervious surface. As previously noted, a higher percentage of impervious surface adversely impacts a stream's hydrological characteristics.

Kahaluʻu Neighborhood Board Area Stream Flows

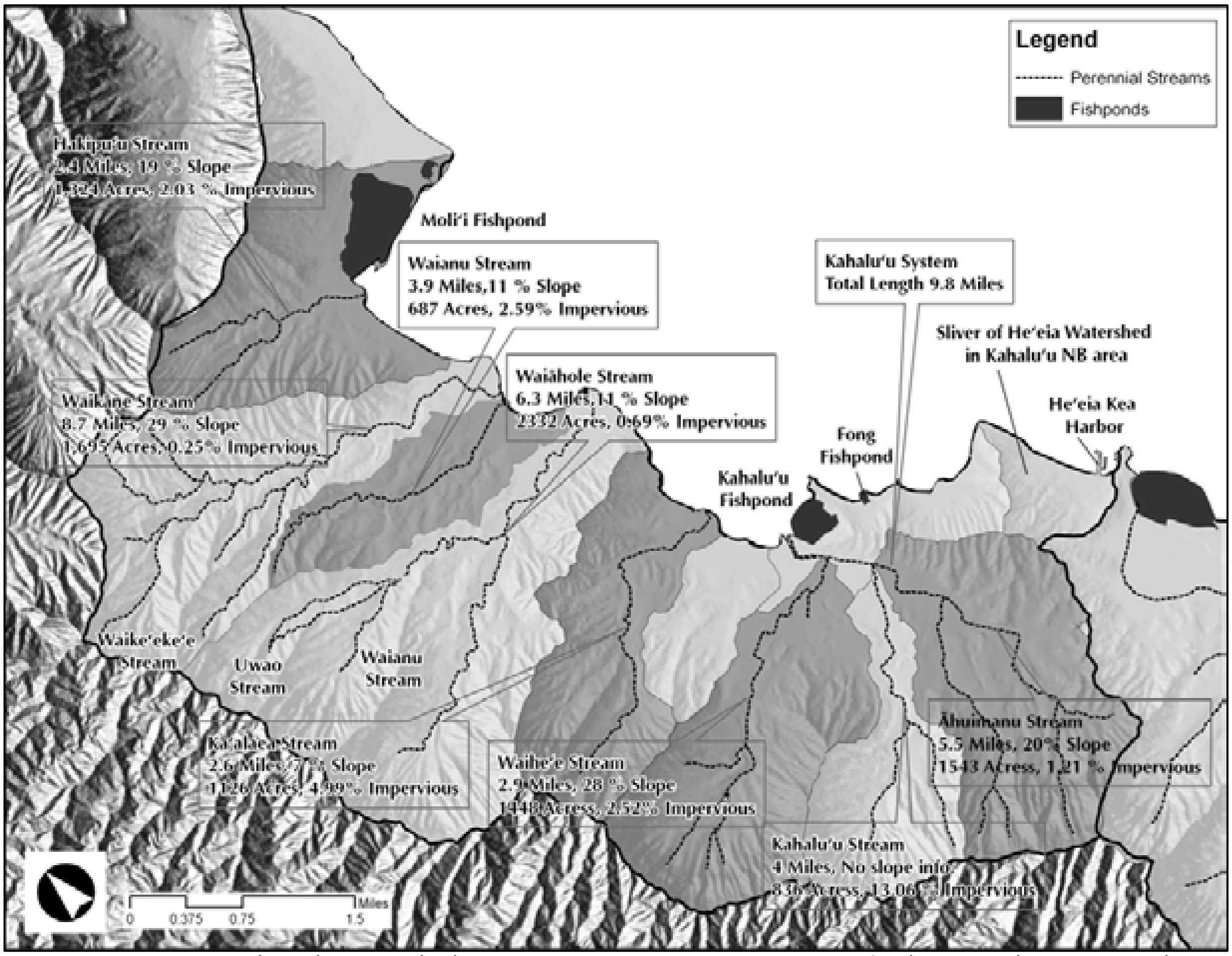
Table 2.6 contains flow information for those streams with gaging stations in the Kahaluʻu NB area. The median and average flows reported for Waikāne and Waiāhole Streams are estimates calculated from data available after water was returned to these streams as a result of the 2006 Waiāhole Ditch Contested Case Hearing Decision and Order.

Table 2. 6 Perennial Streams in Kahaluʻu

Stream Name	Median Flow[1] (cfs/mgd)	Average Daily[1] Flow (cfs/mgd)	Base Flow[2] (cfs/mgd)
Hakipuʻu	1/0.6	1.8/1.2	0.64/0.41
Waikāne	4.7/3.0	9.0/5.8	2.2/1.4
Waiāhole	Not Available	10.7/6.9	6.0/3.9
Waianu[3]	Not Available	1.9/1.2	0.8/0.5
Waiheʻe	5.2/3.4	5.4/3.5	4.7/3.07
Kahaluʻu	2.6/1.7	3.3/2.1	1.4/0.90

[1]Calculated from stream flow data available from the USGS, except for Waiāhole and Waianu streams. Location and time period vary for each stream.
[2]Source: USGS.[xx] Baseflow equals Q_{70} .
[3]Waianu tributary of Waiāhole stream.

Figure 2. 6 Kahalu‘u NB Area General Stream Characteristics



Source: Ko‘olaupoko Watershed Restoration Action Strategy, June 2007 (Kailua Bay Advisory Council and Hawai‘i State Department of Health.

Kahalu‘u Neighborhood Board Area Stream Modifications

The streams in the Kahalu‘u NB area have been modified to various degrees. Kahalu‘u and ‘Āhuimanu Streams are both channelized in the middle and lower reaches where they flow through urbanized areas. Waihe‘e Stream is concrete lined in limited segments. Ka‘alaea Stream is channelized throughout most of its course. There are few modifications to streams in the more rural areas of the NB area along Waiāhole and Waikāne Streams usually where the streams cross roadways. Hakipu‘u Stream remains unchannelized throughout its entire course.

The BWS survey of surface water diversions listed numerous stream and spring diversions in the Kahalu‘u NB area. The database records the presence of diversions along almost all of perennial streams in the NB area. The streams with the most documented diversions are the Ka‘alaea and Waihe‘e Streams. Two of the more notable stream diversion systems in the area include the Waiāhole Ditch and McCandless Pipe System. The Waiāhole Ditch diverts water from various sources in Koʻolau Poko and Koʻolau Loa and conveys the water to the Central and ʻEwa Districts. The Waiāhole Ditch system spans a distance of about 25 miles. The McCandless Pipe system provides irrigation water to farmers in Waiāhole Valley. The McCandless System diverts water from the Waianu tributary of the Waiāhole Stream. More detailed information regarding the amount of water use for these diversion systems can be found in Chapter 3: Water Use and Projected Demand.

The 28-acre Kahaluʻu Flood Control Lagoon is located *mauka* of Kahekili Highway behind the Hygienic Store in Kahaluʻu. The lagoon was built between 1976 and 1980 to mitigate flood damage in the area. A smaller retention basin can also be found along Kahaluʻu Stream at the end of Hio Place road.

<u>Kahaluʻu Neighborhood Board Area Stream Water Quality</u>

All streams in the neighborhood board area except for Hakipuʻu Stream were on the State's 2006 list of impaired water bodies approved by the EPA. However, all of the streams on the list were considered a low priority for TMDLs. DOH prioritization for TMDL development is based on seven factors, including (1) the severity of pollution in a stream and (2) uses of the waters.

Table 2. 7 Kahaluʻu NB Area Streams on the 2006 303 (d) List

Stream	TMDL Priority	Pollutant in Excess
Waikāne	Low	Nutrients
Waiāhole	Low	Nutrients
Kaʻalaea	Low	Nutrients, Turbidity
Waiheʻe	Low	Nutrients
Kahaluʻu	Low	Nutrients, Turbidity
Āhuimanu	Low	Turbidity
Waiola	Low	Turbidity

As can be seen from Table 2.7, excess pollutants in these streams on the 2006 303(d) list mostly consisted of nutrients and turbidity. The sources of pollutants in streams include leakage from antiquated sewer lines or leaching from cesspools in those areas not yet served by sewer infrastructure[xxi]. Turbidity is thought to be the result of erosion occurring in *mauka* conservation lands, stream banks, and agricultural lands.[xxii] The 1990 HSA identified the presence of non-native invasive plants and feral pigs that also threaten the riparian resources of the streams.

Kahalu'u Neighborhood Board Area Stream Bioassessment

The conditions of streams in the Kahalu'u NB area can be considered "above average" for providing habitats for native species. Most of the streams in the Kahalu'u NB area scored between two and six for their biological resources according to the Atlas of Hawaiian Watersheds. Only Haiamoa stream is not ranked due to lack of data. Waikāne, Waiāhole, and Ka'alaea have scores of six, five, and five respectively. Comparatively, the majority of streams on the island of O'ahu score lower than 5 for biological resources. However, the condition of stream habitats in the area is still far from pristine as no stream was rated higher than a six out of ten. Important biological resources found in these streams are summarized in Table 2.8.

Table 2. 8 Kahalu'u NB Area Stream Aquatic Resources

Stream	Stream Biological Rating[1]	Important Biological Resources Found in Streams[2]
Hakipu'u	2	Diversity of native insect
Waikāne	6	Diversity of native macrofauna, Presence of candidate endangered species
Waiāhole	5	Diversity of native insect, Diversity of native macrofauna, Abundance of any native species, Presence of candidate endangered species
Ka'alaea	5	Presence of candidate endangered species
Kahalu'u System	4	Diversity of native macrofauna, Abundance of any native species, Presence of candidate endangered species

[1]Source: The Atlas of Hawaiian Watersheds. Scoring is from zero to ten with zero being the lowest and ten being the highest.
[2]Based on stream's attainment of DAR Decision Rule Criteria

Based on the native fresh water biota and the DAR Decision Rule Criteria, streams in the Kahalu'u NB area have habitats that are in moderately good condition for native species compared to other areas in Ko'olau Poko and O'ahu. No stream in the Kahalu'u NB area has undergone a TMDL study.

KEY FINDINGS FOR KAHALU'U AREA STREAM RESOURCES:

- Several streams in this area are relatively un-channelized and have not been significantly altered when compared to other streams in the district.
- All streams in the neighborhood board area are on the Federal 303 (d) impaired water bodies list. However, all of the streams in the neighborhood board area are low in priority for TMDL development, which may indicate that stream water quality is not as degraded as it is in other streams in the district, or that water quality does not impair uses as much as in other areas.
- The current biotic resources of the streams in the area are in fair condition. However, the Hakipu'u Stream received a low rating (2 out of 10) for its biotic resources by the Atlas of Hawaiian Watersheds.

2.4.3.3 Kāneʻohe Neighborhood Board Area Streams

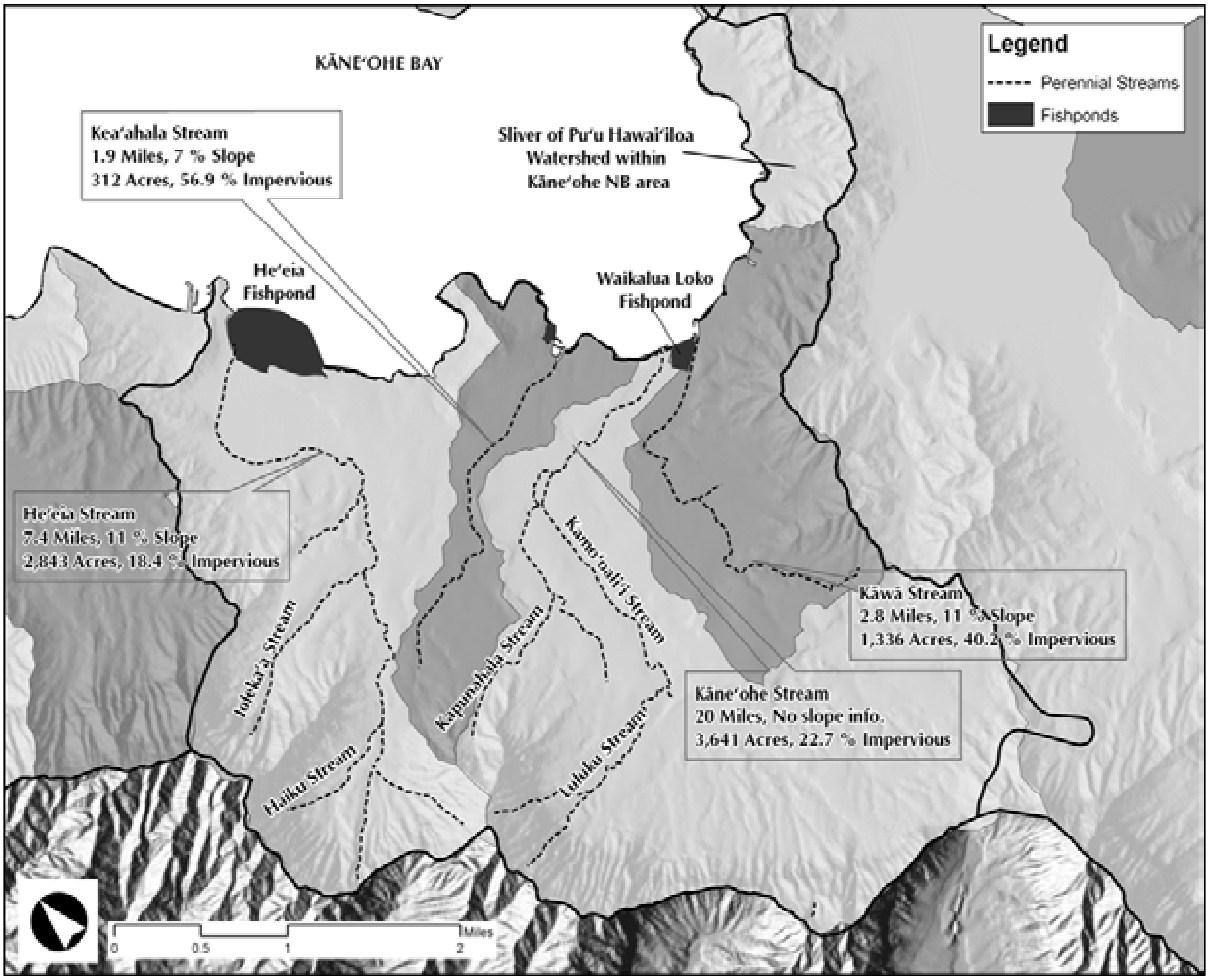
Kāneʻohe Neighborhood Board Area General Stream Characteristics

The HSA lists four perennial streams in the Kāneʻohe NB area: Heʻeia, Keaʻahala, Kāneʻohe, and Kāwā streams. Stream length varies greatly in Kāneʻohe. Kāneʻohe Stream is about 20 miles long and is one of the longest streams in the district. On the other hand, Kāwā stream at the southeastern end of the NB area is a short stream with a run of only 2.8 miles.

Keaʻahala Stream drains through an area that is 57 percent impervious surface. The Impervious Cover Model notes that those streams draining through areas with impervious coverage of 60 percent or more tend to function more as an urban drainage system rather than a natural ecological system. Another stream that drains through an area that has a high percentage of impervious surface is Kāwā Stream, at 40 percent. Heʻeia and Kāneʻohe Stream watersheds both flow through areas that are less than 25 percent impervious surface.

All of these perennial streams, except Heʻeia stream, drain into the southern embayment of Kāneʻohe Bay. Figure 2.7 illustrates the streams within the Kāneʻohe Neighborhood Board area along with stream length, stream slope, and the percent of the watershed that is impervious surface.

Figure 2. 7 Kāneʻohe NB Area General Stream Characteristics



Source: Koʻolaupoko Watershed Restoration Action Strategy, June 2007 (Kailua Bay Advisory Council and Hawaiʻi State Department of Health.

Kāneʻohe Neighborhood Board Area Stream Flows

Table 2.9 gives the estimated amount of median flow, average flow and base flow for streams in the Kāneʻohe NB area. No USGS gaging station is located along Kāwā Stream, however, the Kāwā Stream Bioassessment estimated that approximately one mgd of water continuously flows into Kāneʻohe Bay from Kāwā Stream.[xxiii] Stream flow information is not available for Heʻeia, Kapunahala, Keaʻahala, Kāneʻohe, and Luluku Streams.

Table 2. 9 Perennial Streams in Kāne'ohe

Stream Name	Median Flow[1] (cfs/mgd)	Average Flow[1] (cfs/mgd)	Baseflow[2] (cfs/mgd)
Ioleka'a	0.5/0.3	0.7/0.5	0.40/0.26
Ha'ikū	1.8/1.2	2.6/1.7	1.4/0.90
He'eia	No Data	No Data	No Data
Kamo'oali'i	11 / 7.11	14.4/9.3	7.9/5.10

[1]Calculated from stream flow data available from the USGS. Location and time period vary for each stream.
2Source: USGS. Baseflow equals Q70 .

Kāne'ohe Neighborhood Board Area Stream Modifications

Kea'ahala, Kāne'ohe, and Kāwā streams have been substantially channelized. The lower 90 percent of Kea'ahala Stream runs through an urbanized landscape and has been concrete lined in its lower reaches. Only 10 percent of Kea'ahala Stream is still a natural watercourse, primarily in the stream's upper reaches. Channelization in Kāne'ohe Stream occurs along most of its segments that flow through urbanized areas. Concrete lining also occurs along the segments of Kapunahala and Kamo'oali'i Streams that flow through urbanized areas. Almost the entire length of Kāwā Stream has been channelized and concrete lined.[xxiv] The channelization of Kāwā Stream has reduced the original Kāwā Stream length by about 650 feet through the straightening of the stream's natural sinuosity. Concrete alignment along Kāwā Stream starts *mauka* of Mokulele Drive and extends close to the Bay View Golf Park.[xxv] Other surface water modifications in Kāne'ohe include the 26 acres Waimaluhia Flood Control Reservoir built *makai* of Ho'omaluhia Botanic Garden. Waimaluhia Reservoir was completed in 1981 to collect stream flow and runoff from the upper reaches of Kamo'oali'i Stream.

The BWS survey of surface water diversions identified limited diversions along Kāne'ohe streams. Ten diversions were documented in Kāne'ohe, with most of them on the He'eia Stream system.

Kāne'ohe Neighborhood Board Area Stream Water Quality

The water quality of streams in Kāne'ohe is severely impacted by urbanization. Three of Kāne'ohe's streams have undergone TMDL development. Revised TMDLs for Kāwā Stream were approved in 2005. TMDLs for Kāne'ohe and Kamo'oali'i Streams were approved in 2010. Two other streams in the NB area, He'eia and Kea'ahala are also on the 303(d) list although they are low in priority for TMDL development.

Kāwā stream suffers from elevated nutrients, turbidity, and TSS while excess nutrients and turbidity are found in Kāneʻohe and its Kamoʻoaliʻi tributary. Dieldrin, a form of pesticide, has also been found at high levels in Kāneʻohe Stream. Dieldrin was widely employed in agricultural practices before it was banned in 1974. However, its use as a termite control chemical was allowed until 1987.

Table 2. 10 Kāneʻohe Streams on the 2006 303 (d) List

Stream	TMDL Priority	Pollutant in Excess
Heʻeia	Low	Nutrients, Turbidity
Keaʻahala	Low	Nutrients, Turbidity, Trash
Kāneʻohe	TMDL approved in 2010	Nutrients, Turbidity, Pesticide
Kamoʻoaliʻi	TMDL approved in 2010	Nutrients, Turbidity
Kāwā	TMDL approved in 2005	Nutrients, Turbidity, TSS

For those streams with approved TMDLs, a more detailed assessment of the source of the pollutants found in these streams is provided in Table 2.11. For the Heʻeia and Keaʻahala Streams, agricultural activities along with current residential fertilizer use are the likely source of the nutrients that are found in these streams[xxvi]. For Keaʻahala Stream, cesspool systems and antiquated sewer infrastructure are also thought to add to higher nutrient levels in the streams. Construction runoff and non-point source pollutants from impervious surface run-off contribute to the pollutants found in Keaʻahala Stream.[xxvii]

Table 2. 11 Kāneʻohe NB Areas Streams TMDL Findings

Stream	Pollutant Source	
	Point Source	Non-point Source
Kāneʻohe and Kamoʻoaliʻi	State and Municipal MS4 discharges originated from State highways, municipal streets, residential storm drain systems, public schools, and State and City cemeteries and parks.	Historic uses for pesticide, run-off residential and commercial areas, run-off from conservation and agricultural lands
Kāwā	MS4 discharges originated from public schools, State highways, municipal streets, residential storm drain systems, and State and City parks	Temporary grading projects, pets and feral animals, run-off from residential areas, sewer leakage, conservation lands, stream bank erosion

Kāne'ohe Neighborhood Board Area Stream Bioassessment

In general, the biotic resources of the streams in the Kāne'ohe NB area are severely degraded. None of the streams in Kāne'ohe that were rated by the Atlas of Hawaiian Watersheds received a rating higher than a 4 on a 10 point scale. Kāne'ohe Stream received a rating of 2. Important biological resources found in the He'eia and Kāne'ohe Streams include the diversity of native macrofauna and the presence of candidate endangered species. Important biological resources found in the Kea'ahala and Kāwā Streams include the diversity of native macrofauna.

Table 2. 12 Kāne'ohe NB Area Stream Aquatic Resources

Stream	Stream Biological Rating[1]	Important Biological Resources Found in Streams[2]
He'eia	4	Diversity of native macrofauna, Presence of candidate endangered species
Kea'ahala	4	Diversity of native macrofauna
Kaneohe	2	Diversity of native macrofauna, Presence of candidate endangered species
Kāwā	4	Diversity of native macrofauna

[1]Source: The Atlas of Hawaiian Watersheds. Scoring progressed from zero to ten with zero being the lowest and ten being the highest.
[2]Based on stream's attainment of DAR Decision Rule Criteria

Stream bioassessments were conducted to support Kāwā and Kāne'ohe Stream TMDL development. Several sites along the streams were assessed including four sites along Kāwā Stream. Three sites along Kāne'ohe Stream were assessed including sites along the Kapunahala and Kamo'oali'i tributaries. The bioassessment for Kāwā and Kāne'ohe Streams found non-supporting habitats in the lower reaches of the streams to partially supporting habitats for native species in the middle and upper segments of the streams. Evaluation of aquatic life found different degrees of biotic impairment but all of them are considered far from optimal conditions.

In general, factors that have contributed to the impairment of the native habitat in Kāwā and Kāne'ohe Streams are the surrounding urbanized land uses and major modifications of these two streams. Kāwā Stream is a small stream that has been substantially modified and flows through a heavily urbanized area. Because of the surrounding urbanization, the stream functions more like a storm drain that rapidly transports polluted runoff from the watershed into Kāne'ohe Bay, rather than a natural stream.[xxviii]

Kāne'ohe Stream, on the other hand, is a relatively large stream with numerous tributaries that could potentially support a larger ecosystem of native fresh water biota. Factors contributing to the loss of habitat in the lower segments of Kāne'ohe Stream that were studied include hardening of channels, stream bank erosion, and loss of riparian vegetation. The Kāne'ohe Stream Bioassessment also suggested that the presence of non-native predatory fish in the Waimaluhia Reservoir may also hinder native amphidromous fish and crustaceans from moving to and from the upper reaches of Kamo'oali'i Stream where there are more suitable habitats. This condition likely contributes to the relatively low population of native fish in the upper reaches of Kamo'oali'i Stream.

KEY FINDINGS FOR KĀNE'OHE STREAM RESOURCES:

- Many of Kāne'ohe's Streams have been significantly modified from their original natural condition. Stream channelization has increased the velocity of stream flow and has contributed to impaired water quality.
- Most streams in Kāne'ohe have been significantly impaired by urbanization. TMDLs have been approved for three of the streams in Kāne'ohe.
- The lower and middle reaches of most streams in Kāne'ohe provide very poor habitats for native aquatic species. Consequently, few native species have been observed in these parts of the stream.
- Compared to the other streams in Kāne'ohe, He'eia Stream has not been significantly modified and the water quality of the stream may not be as impaired as other streams in Kāne'ohe.

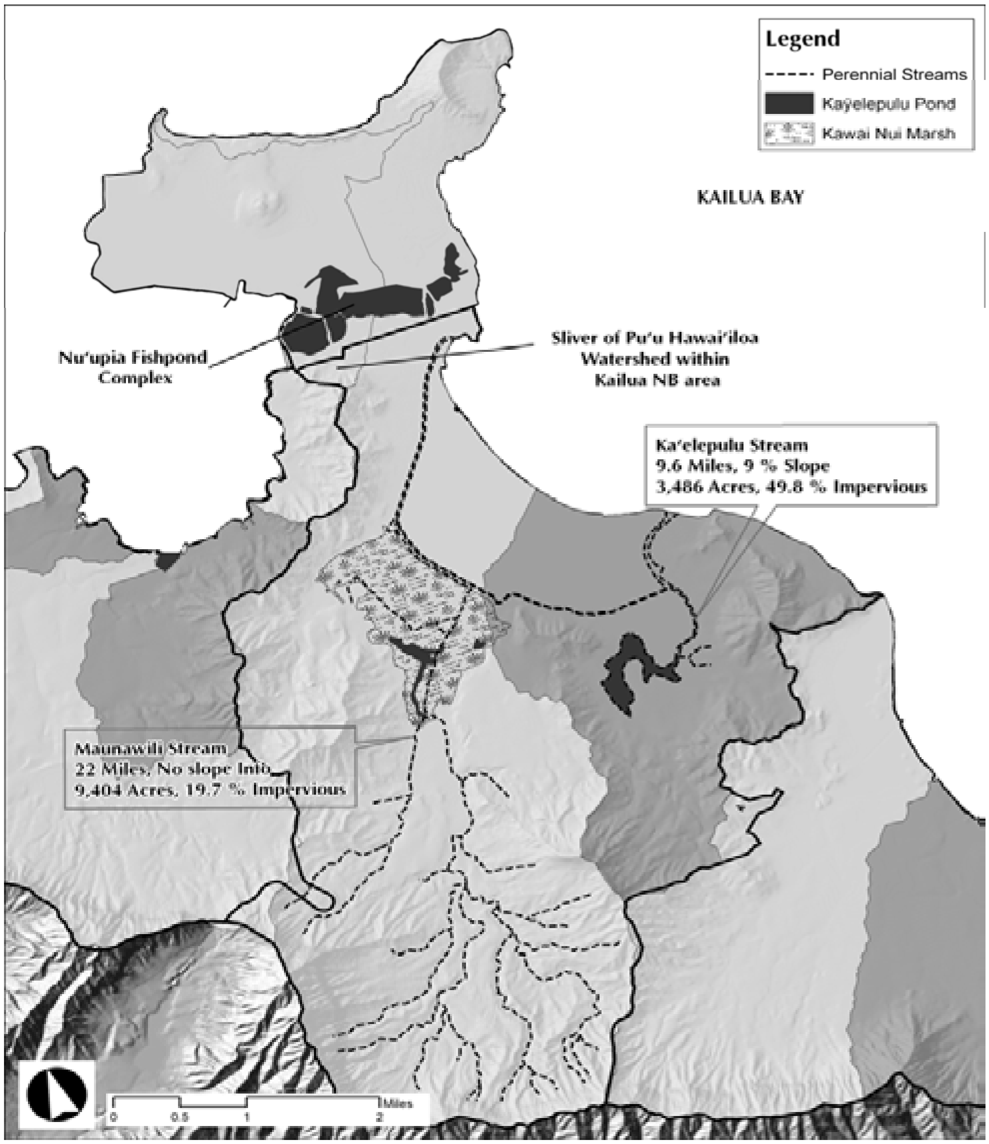
2.4.3.4 Kailua Neighborhood Board Area Streams

Kailua Neighborhood Board Area General Stream Characteristics

The HSA lists two perennial streams in the Kailua NB area: Maunawili and Ka'elepulu Streams. At a run of 22 miles, Maunawili Stream is the longest Stream in the Ko'olau Poko district. It is comprised of a network of many smaller tributaries. More than 50 intermittent and perennial springs have been documented in the back of Maunawili Valley, most of which feed Maunawili Stream and its tributaries.[xxix] Maunawili Stream and two other smaller intermittent streams, Kahana Iki Stream, and Kapa'a Stream, drain into Kawainui Marsh. The Maunawili Stream watershed has 19.7 percent impervious surface.

Ka'elepulu Stream originates at the foot of Mount Olomana. Ka'elepulu Stream drains into Kailua Bay. Fifty percent of the surrounding area near Ka'elepulu Stream consists of impervious surfaces.

Figure 2. 8 Kailua NB Area General Stream Characteristics



Source: Ko'olaupoko Watershed Restoration Action Strategy, June 2007 (Kailua Bay Advisory Council and Hawai'i State Department of Health.

Kailua Neighborhood Board Area Stream Flows

Stream flow information is only available for Maunawili Stream, its Makawao tributary and the Maunawili Ditch. No stream flow information is available for Ka'elepulu Stream. Table 2.13 illustrates the stream flow data.

Table 2. 13 Perennial Streams in Kailua

Stream Name	Median Flow[1] (cfs/mgd)	Average Flow[1] (cfs/mgd)	Baseflow[2] (cfs/mgd)
Maunawili	7.9/5.1	14.5/9.4	5.6/3.62

[1]Calculated from stream flow data available from the USGS. Location and time period vary for each stream.
[2]Source: USGS. Baseflow equals Q_{70} .

Kailua Neighborhood Board Area Stream Modifications

More recent modifications done to the natural waterways of Maunawili Stream include various drainage improvements and channelization to minimize flooding in areas of the stream that flow near residences in Maunawili Valley.[xxx] Major drainage improvements around Kawainui Marsh include the installation of a weir by Kāne'ohe Ranch in the early 1950s, the construction of Kawainui Canal in 1966, and the construction of Oneawa Canal in 1966. These improvements blocked the flow of water from the marsh to the southern part of Kailua Bay. Instead, marsh water now flows through the Oneawa Canal and enters the Bay at the northern end of Kailua Bay near Castle Point.

The Maunawili Ditch system diverts water from Maunawili Stream to the Waimānalo Irrigation system. The ditch system diverts 1.4 mgd on average from the stream to the irrigation system. More information on the Maunawili Ditch System and Waimānalo Irrigation system can be found in Chapter 3: Water Use and Projected Demand.

Similar to Maunawili Stream, Ka'elepulu Stream has been substantially modified to accommodate residential development and mitigate flooding of residences. There are many single family residences that have been constructed right along the stream bank.

Kailua Neighborhood Board Area Stream Water Quality

Two Kailua surface water bodies either have a TMDL or are currently undergoing TMDL development. TMDLs for Kapa'a Stream were approved in 2007 and TMDLs are being developed for Ka'elepulu inland waters. The Maunawili Stream is a medium priority for future TMDL development. Table 2.14 describes the pollutants found in excess in Kailua's streams.

Table 2. 14 Kailua Streams on the 2006 303 (d) List

Stream	TMDL Priority	Pollutant in Excess
Kapa'a	(TMDL approved in 2007)	Nutrients, Turbidity, TSS, Metals[3]
Maunawili	Medium	Nutrients, Turbidity, Trash
Ka'elepulu	(TMDL in progress)	Nutrients, Turbidity

[1]Kapa'a stream was listed high in priority for TMDL development in 2004 303(d) list therefore a TMDL was developed.

Pollutants in the Kapa'a Stream may have adverse impacts on both the stream and Kawainui Marsh. The Kapa'a Stream TMDL identifies runoff from City and State facilities, Ameron Quarry, and the light industrial area as the sources of pollutants in the stream. The Kapa'a TMDL calculated the total maximum daily load for all of the pollutants identified on the 303 (d) list except for heavy metals. A subsequent analysis found that traces of heavy metals did not exceed the State's standards. The TMDL, however, recommends additional monitoring for copper and cautions about the potential accumulation of metals in the aquatic biota that live in the stream[xxxi].

TMDL development for Ka'elepulu inland waters began in 2004. a report to the legislature was completed in 2008, along with wastewater and nutrient source tracking surveys conducted by USGS. Water quality sampling is ongoing. The Ko'olau Poko Watershed Restoration Action Strategy identified excess nutrients and bacteria as the pollutants of concern in Ka'elepulu stream. According to anecdotal accounts, pollution entering Ka'elepulu may be the result of leakages from sewer lines in the residential area and also a storm water drain near the Old Kalaniana'ole Highway.

Kailua Neighborhood Board Area Stream Bioassessment

Of the streams in the Kailua NB area, only Maunawili Stream has information on its biological resources. The Atlas of Hawaiian Watersheds assigns a total biological rating of 4 out of 10 for Maunawili Stream. The DAR Stream Biotic Importance Criteria recognized Maunawili Stream for its "Diversity of Native Macrofauna" and "Presence of Candidate Endangered Species." Currently, there is no information on the biological resources of Ka'elepulu Stream.

Table 2. 15 Kailua NB Area Stream Aquatic Resources

Stream	Stream Biological Rating[1]	Important Biological Resources Found in Streams[2]
Maunawili	4	Diversity of native macrofauna, Presence of candidate endangered species
Ka'elepulu	Insufficient data to assign a rank	

[1]Source: The Atlas of Hawaiian Watersheds. Scoring progressed from zero to ten with zero being the lowest and ten being the highest.
[2]Based on stream's attainment of DAR Decision Rule Criteria

KEY FINDINGS FOR KAILUA STREAM RESOURCES:

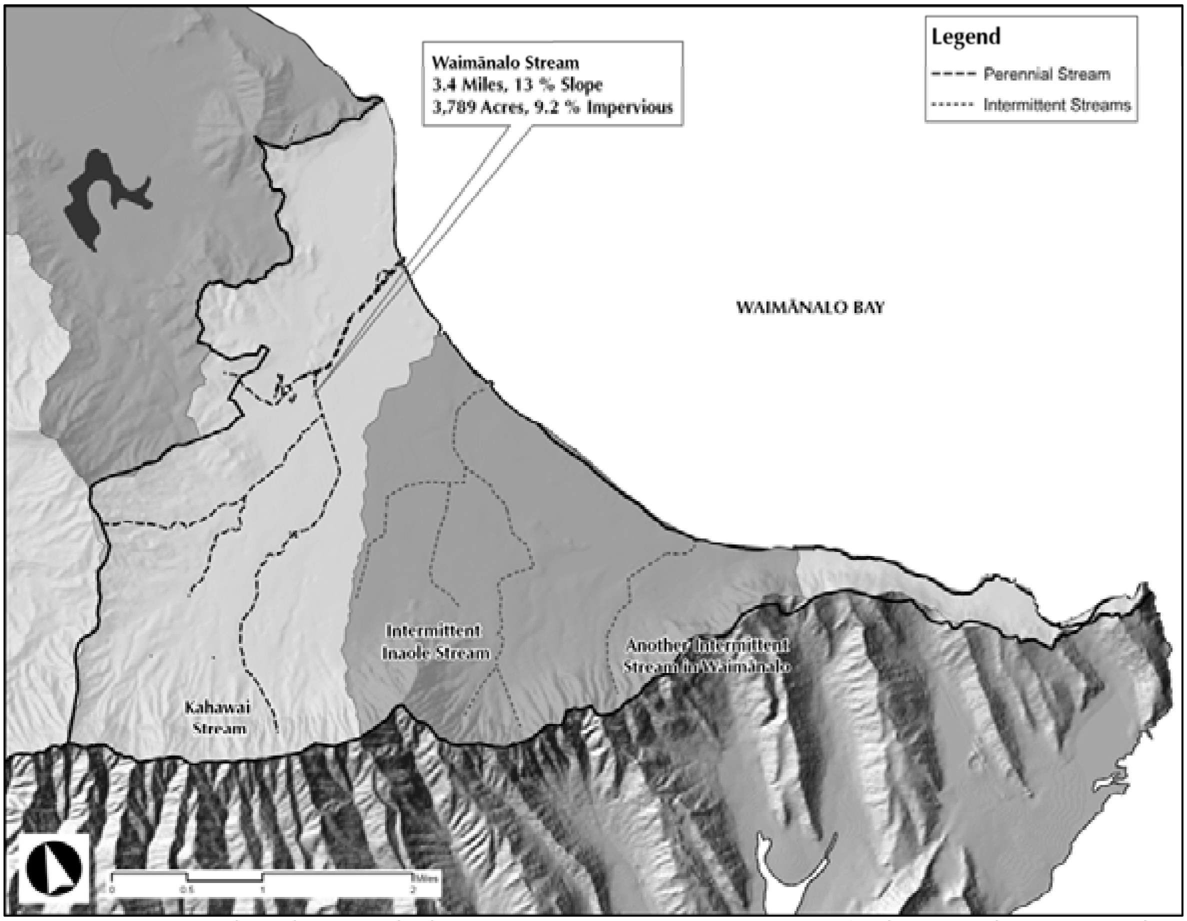
- Stream flow for Maunawili Stream is relatively high when compared to the flow of other streams in Ko'olau Poko.
- Maunawili Stream's average flow is almost twice its median flow, suggesting the stream experiences regular episodes of flashiness.
- Urban encroachment has significantly altered the natural condition of Maunawili and Ka'elepulu Streams. Both Maunawili Stream and Ka'elepulu Stream water quality have been severely affected by urbanization.
- Kapa'a Stream is the only stream in the district where traces of heavy metals have been detected.
- Relatively long, Maunawili Stream can potentially support substantial levels of native species. However, the biotic resources of Maunawili Stream rate a little below average (4 out of 10).

2.4.3.5 Waimānalo Neighborhood Board Area Streams

Waimānalo Neighborhood Board Area General Stream Characteristics

Waimānalo Stream is the only perennial stream in the Waimānalo NB area. Originating at the foot of the Ko'olau Mountain Range, the stream takes the shape of the letter "Y" with the southeastern fork named Kahawai Stream and the northeastern fork identified as Waimānalo Stream. The Waimānalo fork and Kahawai fork merge at a point just south of Olomana Golf Course. The stream enters the ocean at the northern end of Waimānalo Bay. Waimānalo Stream drains through an area that is 9.17 percent impervious surface.

Figure 2. 9 Waimānalo NB Area General Stream Characteristics



Source: Ko'olaupoko Watershed Restoration Action Strategy, June 2007 (Kailua Bay Advisory Council and Hawai'i State Department of Health.

Waimānalo Neighborhood Board Area Stream Flows

Table 2.16 presents stream flow information for Waimānalo Stream. The estimated average flow of Waimānalo Stream is more than two times the estimated median flow. This suggests that there are frequent occurrences of large peak flows in Waimānalo Stream. No stream flow data are available for other streams in Waimānalo.

Table 2. 16 Perennial Streams in Waimānalo

Stream Name	Median Flow[1] (cfs/mgd)	Average Flow[1] (cfs/mgd)	Baseflow[2] (mgd)
Waimānalo	2/ 1.3	4.9/ 3.2	1.0/0.65

[1]Calculated from stream flow data available from the USGS. Location and time period vary for each stream.
[2]Source: Various USGS reports when available. Baseflow equals Q_{70} .

Waimānalo Neighborhood Board Area Stream Modifications

Waimānalo Stream and its Kahawai tributary are both channelized in portions that run through urban areas. Concrete lining can be found along the segment of Waimānalo and Kahawai Streams that run immediately *mauka* of Kalaniana'ole Highway and near Hawaiian Homelands property.[xxxii]

The Waimānalo Irrigation system transports water from Maunawili Stream and its tributaries to approximately 100 Waimānalo farms. In 1993, a 60 million gallon reservoir was constructed at the *mauka* end of Mahailua Street, as an important element of this irrigation system. The BWS stream diversion survey for Ko'olau Poko (Appendix F) identifies eight stream diversions in Waimānalo.

Waimānalo Neighborhood Board Area Stream Water Quality

The Waimānalo Stream TMDL Implementation Plan was completed in 2001. The Waimānalo Stream TMDL identified nutrients and turbidity as the main sources of pollutants that impair stream water quality. Elevated nutrients in the stream were thought to originate from fertilizer use on farms, animal waste, and leachate from antiquated septic systems and cesspools in the area. Elevated turbidity levels seem to be periodic occurrences that are related to large storm events in the area.[xxxiii] Consultation with long term residents in Waimānalo suggests a history of erosion and sediment runoff in the stream during large storm events. Current amounts of excess turbidity in the stream are thought to relate to erosion from dirt roads, driveways, and bare roadsides.

Waimānalo Neighborhood Board Area Stream Bioassessment

The Atlas of Hawaiian Watershed assigned a rating of four out of ten for the condition of the biological resources in Waimānalo Stream. Some of the important biological features found in Waimānalo Stream include the presence of candidate endangered species. The Atlas of Hawaiian Watersheds rated Inaole Stream three out of ten for the condition of the stream's biological resources. Also, no "priority 1" introduced species were surveyed in Inaole Stream.

Table 2. 17 Waimānalo NB Area Stream Aquatic Resources

Stream	Stream Biological Rating[1]	Important Biological Resources Found in Streams[2]
Waimānalo	4	Presence of candidate endangered species
Inaole	3	Absence of priority 1 introduced species

[1]Source: The Atlas of Hawaiian Watersheds. Scoring progressed from zero to ten with zero being the lowest and ten being the highest.
[2]Based on stream's attainment of DAR Decision Rule Criteria

A stream bioassessment was conducted in three locations along Waimānalo Stream to support TMDL development. Results from the stream bioassessment were generally consistent with previous research conducted on sites throughout the stream where soil erosion, stream alteration, and overgrown vegetation were found to be severely impacting habitats along Waimānalo stream.[xxxiv] The stream bioassessment found non-supporting habitats in the lower and middle reaches of the stream. A large number of introduced species was also observed in the lower reaches of the stream. A lack of natural habitats in the lower reaches can be attributed to the hardening of the stream bottom. Habitat impairment in the middle reaches was due to stream bank erosion. Storm water runoff from area farms with high nutrient loads may also be impacting the stream.

KEY FINDINGS FOR WAIMĀNALO STREAM RESOURCES:

- Waimānalo Stream is naturally flashy, therefore, increased sediment and runoff to Waimānalo Bay during large storm events can be considered "natural." However, surrounding land uses have exacerbated the "natural" levels of run-off into the bay.
- The biotic resources of Waimānalo and Inaole Streams are considered low. Several factors have been identified that contribute to this condition, including the concrete lining of stream beds and degraded stream water quality.

2.4.3.6 Flooding

Floods are the temporary inundation of land from excessive rainfall or wave action and typically occur on lowland areas or flood plains. There is a higher potential for flooding to occur in Ko'olau Poko due to the district's natural characteristics. Rainfall is frequent and concentrated during short time periods while Ko'olau Poko soils have relatively low infiltration capacity since the soils are often saturated because of the frequent rainfall.

Historical Flood Events in Ko'olau Poko

Before the completion of the Kahalu'u Flood Control Lagoon in 1980, floods often occurred along the Kahalu'u and Waihe'e Streams. Two of the most damaging floods were recorded on February 4 and May 2, 1965. The two floods caused substantial property damage as bridges, homes, and agricultural crops were destroyed.[xxxv]

Numerous floods have also occurred in the Kāne'ohe NB area. One of the largest Kāne'ohe floods happened in 1969 when the Kamo'oali'i and Kāne'ohe Streams flooded. This flood damaged property, livestock, and claimed lives.[xxxvi] The Waimaluhia flood control reservoir, located along the Kamo'oali'i stream *makai* of Ho'omaluhia Botanical Garden was constructed as a result of this flood event.

On December 31, 1987, a large rain storm struck East O'ahu, flooding areas of Ko'olau Poko. The greatest amount of flood damage occurred in the Coconut Grove area of Kailua. The Coconut Grove area was inundated with up to five feet of water at the peak of the flood. The area was severely flooded due to the inability of the existing flood canals to contain excessive runoff from large storm events.[xxxvii]

The Lanikai area in Kailua is one of the residential areas on O'ahu with a high frequency of flooding. Between 1948 and 1985, as many as 21 floods were recorded in this area. The greatest damage was reported in 1984 and 1985.[xxxviii] Waimānalo is also subject to severe floods, especially during storm events. More than ten major storms have inundated Waimānalo between 1941 and 1983. The most damaging flood in Waimānalo in recent memory occurred in 1958. During the 1958 flood, water was three feet deep along Kalaniana'ole Highway and crops and other property were destroyed.[xxxix]

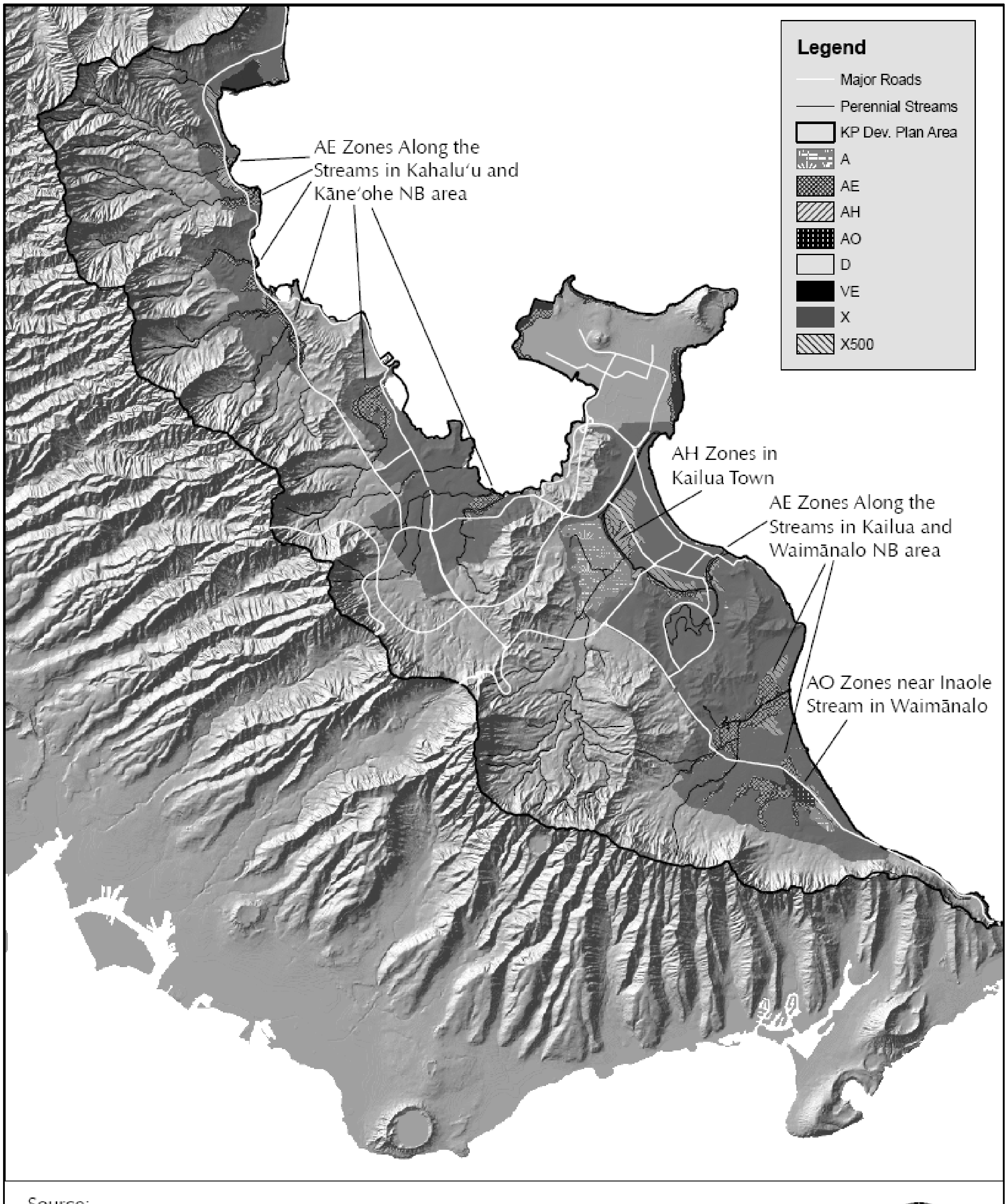
Flood Insurance Map

Figure 2.10 illustrates the 2005 FEMA Flood Insurance Rate Maps (FIRM) for Ko'olau Poko. The FIRM maps delineate areas of flooding for different sources, magnitudes, depth of inundation, and average frequency. The one percent annual probability of flooding is the national standard on which flood plain management and insurance requirements are based. Areas that fall under the codes that start with an "A" (A, AE, AH, AO) are areas with a one percent annual chance of flooding. These areas are considered to have a high potential for flooding.

Table 2. 18 Flood Zones Description

ZONE	DESCRIPTION
A	Areas with a 1% annual probability of flooding and a 26% probability of flooding over the life of a 30-year mortgage determined through approximate methods.
AE	Areas with a 1% annual probability of flooding and a 26% probability of flooding over the life of a 30-year mortgage determined through detailed analyses.
AH	Areas with a 1% annual probability of shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 ft
AO	Stream flood hazard areas, and areas with a 1% or greater probability of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet determined through detailed analyses.
D	Areas with possible but undetermined flood hazards.
VE	Coastal areas with a 1% or greater probability of flooding and an additional hazard associated with storm waves determined through detailed analyses.
X	Areas outside the 1% annual probability floodplain, areas of 1% annual probability sheet flow flooding where average depths are less than 1 foot, areas of 1% annual probability of stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 1% annual probability flood by levees.
X500	Areas with 0.2% annual probability flood hazard (500 Year Floodplain)

Figure 2. 10 Ko'olau Poko Flood Zones



Source:
State DBEDT GIS Program. Flood hazard layer based on boundaries from Federal Emergency Management Agency (FEMA).

Most of the valleys on Oʻahu, to a varying degree, are subject to a one-percent annual probability of flooding. However, unlike the rest of Oʻahu, riverine floods have been determined to be a serious problem in Koʻolau Poko[xl]. Riverine floods occur when the flow of storm water runoff exceeds the capacity of a stream, causing it to overflow to the surrounding areas. This problem is clearly illustrated on Figure 2.10 where sizeable areas near streams are in flood zones. Much of the areas falling under the one-percent annual probability of flooding are considered a medium risk for chance of flood. Lanikai and most of the Waimānalo NB area are at higher risk for flooding.[xli]

Within the Kahaluʻu NB area, those areas marked under the one-percent annual probability of flooding are limited to open areas on the lower sides of the Streams with the exception of an A zoned area on the upper part of Waiheʻe Stream and an AE zoned area along the lower Kahaluʻu System *mauka* of Kahekili Highway. Within the Kāneʻohe NB area, areas marked under the one-percent annual probability of flooding are limited to open areas on the lower portion of Heʻeia and Kāwā and Kāneʻohe Streams.

In the Kailua NB area, the extensive drainage networks that have been built near Kawainui Marsh and the Coconut Grove area have reduced the size of areas designated with one-percent annual probability of flooding. However, a significant portion of Kailua Town near the Kawainui Canal falls under the AH zone. In the Kaʻelepulu watershed, a larger inland ponding previously existed around Kaʻelepulu Pond, however, channelization of Kaʻelepulu stream has reduced the size of ponding and opened lands for development.[xlii] The channelization has also reduced the AE zoned areas along Kaʻelepulu Stream.

In Waimānalo, besides the extensive AE zoned areas along Waimānalo and Inaole streams, a sizeable open area *mauka* of Kalanianaʻole Highway along Inaole stream is determined as areas with potential for sheet flow flood (AO). Sheet flow floods are shallow floods covering a wide and flat area and typically do not have a well-defined channel or watercourse. Sheet flow floods can be dangerous due to the difficulty of determining when an area is subject to this type of flooding. No other areas in Koʻolau Poko district have been determined to possess risk from sheet flow floods. Some properties in Waimānalo are also subject to significant local flooding from the overflow of old abandoned irrigation ditches during rainstorms. These local flooding issues should be addressed with the assistance of agencies like NRCS.

KEY FINDINGS:

- Much of the flooding problems in Koʻolau Poko's urbanized areas have been mitigated by stream channelization and other flood mitigation projects. However, as previously noted in the surface water resources section, some of these flood mitigation projects have had an adverse effect on the health of streams.
- A significant amount of land in Koʻolau Poko is within flood zones. These flood zones are generally associated with potential riverine flood events.

2.4.3.7 Wetlands

Wetlands are areas that are regularly wet or flooded throughout most of the year and are often characterized by specific plant associations and soil types. Wetlands provide habitat for fish, birds, and other wildlife as well as serve two major hydrological functions - (1) as an interceptor for runoff that lessens the impact of flooding; and (2) as a sediment and pollutant absorber that traps sediment and pollutants in runoff. From an aesthetic point of view, wetlands also provide natural places with recreational opportunities.

The State GIS database records more than 150 USFWS-identified wetlands in the Koʻolau Poko district. The wetlands range in size from 5 acres or less to those as large as 800 acres. The majority of the wetlands sized 5 acres or less are concentrated along the lower reaches of the streams in the Kahaluʻu NB area while larger sized wetlands can be found in Kāneʻohe, Kailua and Waimānalo NB areas. The 830 acre Kawainui Marsh, located in Kailua, is the largest fresh water marsh left in Hawaiʻi.

According to a 1982 DOFAW study, five wetlands in the Koʻolau Poko district still function as important water bird habitats; Kaʻelepulu Pond, Kawainui Marsh, Heʻeia Marsh, Hāmākua Wetlands, and the marshlands at Bellows Air Force Base (Table 2.19). [xliii] Kawainui marsh is also an area of primary importance for native waterbirds. Five out of seven native waterbirds are known to nest and feed in the marsh. The native waterbirds are Hawaiian stilt, Hawaiian coot, Hawaiian gallinule, black-crowned night heron and Hawaiian duck. In 2005, Kawainui Marsh along with the neighboring Hāmākua Marsh was designated as Ramsar Wetlands of International Importance.[xliv]

Table 2. 19 Important Waterbird Wetlands in Koʻolau Poko

	Native Waterbird	Migratory Waterfowl and Shorebirds	Size (Acres)
Kaʻelepulu Pond	Nesting and feeding ground	Habitat	79
Kawai Nui Marsh	Nesting and Feeding ground	Habitat	830
Heʻeia Marsh	Feeding and Nesting ground	Habitat	411
Hāmākua Wetlands	No Information	No Information	??
Marshland at Bellows AFB	No Information	No Information	23 acres

Many aspects of Kawainui Marsh remain unknown. For instance, there is not much information on water circulation patterns within the marsh, thus it is hard to predict the extent of impacts polluted water entering the marsh has on the ecosystem.[xlv] The impact of reduced amounts of water entering Kawainui Marsh due to the diversion of water by the Maunawili Ditch System is also unknown. Further studies of the marsh's physical and ecological conditions are needed in order to guide future restoration and preservation of Kawainui Marsh's ecological resources.

Hāmākua Marsh is a 22-acre wetland located to the southeast of Kawainui Marsh. The flow of water from Kawainui Marsh into Hāmākua Marsh has been reduced as flood control canals have redirected some of the natural flow of water into Hāmākua marsh from Kawainui Marsh. Flood control canals have redirected water from Kawainui Marsh to the northern end of Kailua Bay instead. The impact that reduced amounts of flow has had on the health of the marsh's ecosystem has not been studied in detail. Hāmākua Marsh is home to several native birds including four out of seven native waterbirds: the Hawaiian stilt, Hawaiian duck, Hawaiian gallinule, and Hawaiian coot.

KEY FINDINGS:

- Wetlands continue to play major hydrological functions as interceptors of runoff and flood retention basins in Ko'olau Poko.
- Kawainui Marsh and Hāmākua Marsh serve as important habitats for native birds.
- The proximity to urban development may threaten the ecological integrity of Kawainui Marsh and Hāmākua Marsh.

2.4.4 Nearshore Waters

Three major embayments make up the nearshore waters of Ko'olau Poko: Kāne'ohe Bay, Kailua Bay, and Waimānalo Bay

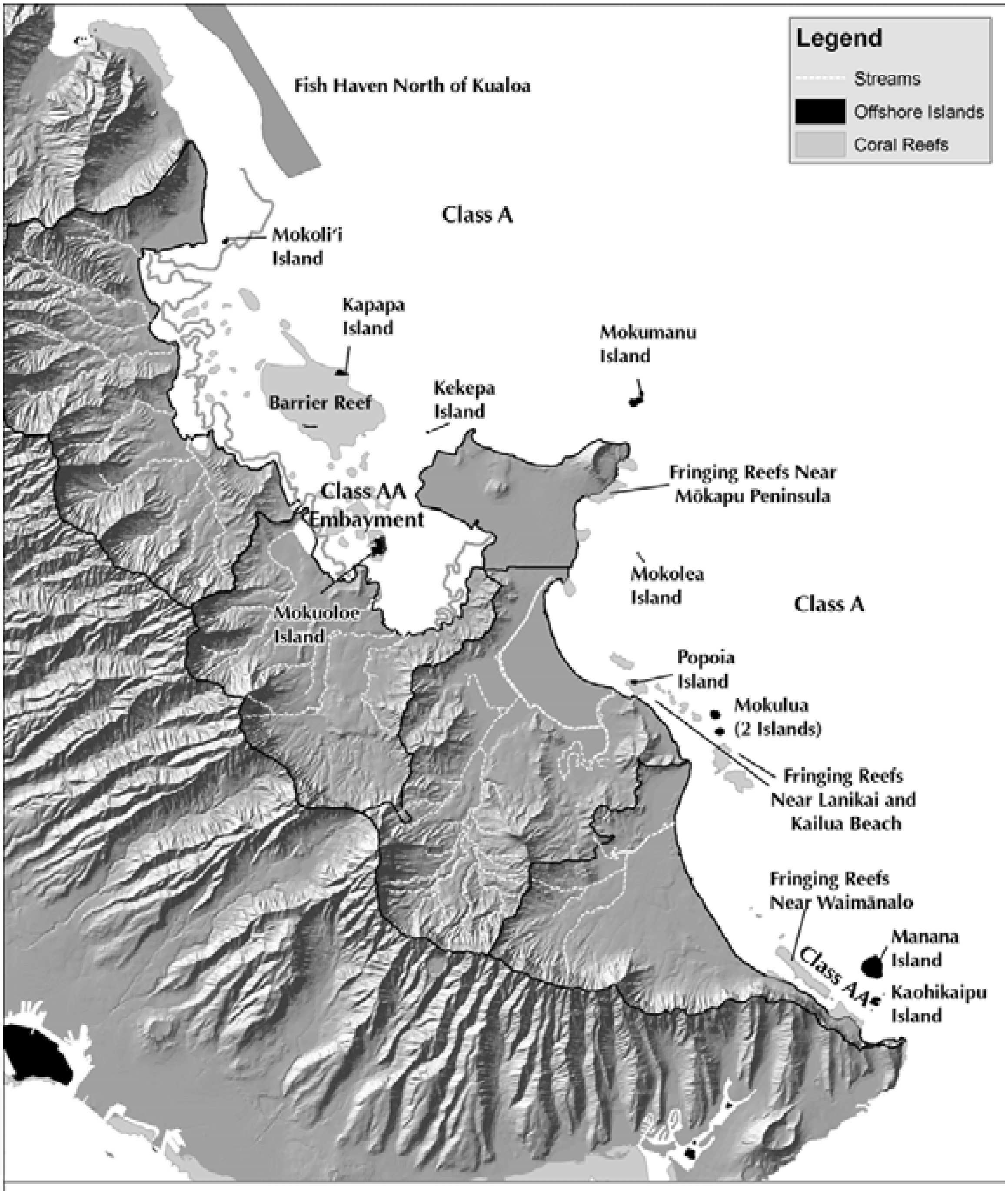
Kāne'ohe Bay and a portion of the waters near Makapu'u point are designated under Hawaii Department of Health water quality standards as class "AA" waters (Figure 2.11). Class AA waters are those waters that must remain as close as possible to their natural pristine state. No discharge of effluent is allowed within these waters. The rest of the near-shore waters in Ko'olau Poko are designated as class "A" waters. The State DOH mandates that Class "A" waters be protected for recreational purposes and aesthetic enjoyment. A limited discharge of approved effluents is allowed within class "A" waters.

There are 11 small islets in the near shore waters of the Ko'olau Poko district. The islands range in size from less than half-an-acre to more than 65 acres. All except Moku o Lo'e Island (Coconut Island) in Ko'olau Poko are considered biologically significant. Most of these islands are designated as a seabird sanctuary by the State. Access to the bird sanctuaries is by permit only. Besides providing habitats for seabirds, the offshore islands also provide habitats for several native coastal animal, insect, and plant species. In Ko'olau Poko, important native species that have been identified on the offshore islands include the insect *kapapa (Rhyncogonus)* that is only found on Kapapa Island, the *akoko* plant (*Chamaesyce degeneri*) found only on Kekepa Island, the *kuwaleana* plant (*Chamaesyce*) found on Mokumanu and the Mokulua Islands, the *maiapilo* plant (*Capparis sandwichania*) a rare endemic plant found on Popoia Island, and the endangered *ohai* plant recently rediscovered on Kaohikaipu Island.[xlvi] Table 2.20 lists Ko'olau Poko's offshore islands as well as their acreage and current use. Figure 2.11 illustrates some of Ko'olau Poko's nearshore characteristics and resources.

Table 2. 20 Offshore Islands in Ko'olau Poko

Name	Acreage	Current Use
Mokoli'i (Chinaman's Hat)	12.5	No designation
Kapapa	9.5	No designation
Kekepa (Turtle Rock)	2	State Seabird Sanctuary
Moku o Lo'e (Coconut Island)	24	UH Laboratory
Mokumanu	21	State Seabird Sanctuary
Mokolea	0.4	State Seabird Sanctuary
Popoi'a (Flat Island)	4	State Seabird Sanctuary
Mokulua (2 islets)	24	State Seabird Sanctuary
Manana (Rabbit Island)	67	State Seabird Sanctuary
Kāohikaipu	11	State Seabird Sanctuary

Figure 2. 11 Marine Resources in Ko'olau Poko



Source:
State DBEDT GIS Program. Coral reef layer based on field survey (1994); Fish haven layer based on NOAA Nautical Chart; Offshore island layer based on boundaries from USGS.

2.4.4.1 Estuaries

Estuaries are bodies of water formed where fresh water from streams mixes with ocean water, creating a brackish water environment that supports unique ecosystems that are different from salt water or fresh water ecosystems. Estuaries are often important breeding and feeding grounds for native juvenile aquatic fauna, as these waters tend to be rich in nutrients. Kaʻelepulu, Kahaluʻu and the ponds on Kāneʻohe Marine Corps Base Hawaiʻi are the only natural estuaries in Koʻolau Poko,

Estuaries in Hawaiʻi are experiencing tremendous pressure from different directions. Fragmented landownership, water quality degradation, habitat loss, beach erosion, and encroachment from recreational uses create a web of problems that are not easily mitigated.[xlvii] In addition to these issues, the estuaries of Kāneʻohe Bay also have been impaired by the reduced quality and quantity of fresh water entering the bay. As mentioned in the previous section, the water quality of streams in Kāneʻohe has been significantly impaired. These waters flow into Kāneʻohe Bay. While there are no historical data on the quantity of fresh water entering Kāneʻohe Bay, anecdotal accounts suggest that the return of stream water from the Waiāhole Ditch to windward streams has improved the condition of Kāneʻohe Bay's estuaries.[xlviii] However, anecdotal accounts also suggest that despite the return of water to windward streams, the present day quantity of fresh water entering Kāneʻohe Bay is not nearly as high as it once was prior to the 20th Century.[xlix]

2.4.4.2 Marine Ecosystems and Fisheries

The main Hawaiian Islands have more than 400,000 acres of living coral reef, which is more than the landmass of Oʻahu. The reef ecosystems provide habitat for a diverse marine biota as well as protect the shoreline from wave actions, thus mitigating sand erosion and helping to preserve Hawaiʻi's famous sandy beaches. In Koʻolau Poko, extensive coral reefs can be found throughout Kāneʻohe Bay while smaller fringing reefs are located offshore from the Mōkapu Peninsula, Lanikai, and southern Waimānalo Bay (Figure 2.11).

Kāneʻohe Bay has three reef zones: a fringing reef zone, a lagoon zone, and a barrier reef complex.[l] Fringing reefs are present along most of the shoreline, except where fresh water streams enter the Bay or where the reefs have been dredged. A large barrier reef covers the middle portion of Kāneʻohe Bay, channeling the movement of water from the open ocean into the northern Mokoliʻi Passage and southern Sampan Channel. This barrier reef protects the Bay from tradewind swells, making the Bay conducive for extensive coral reef development.[li] The southernmost embayment of Kāneʻohe Bay is home to extensive coral reefs which provide important breeding areas for fish and other marine life. The southern basin of Kāneʻohe Bay is isolated from direct exchange of water with the open ocean, [lii] thus pollutants are trapped in the southern area of Kāneʻohe Bay for longer periods of time than other areas of the bay.

The fisheries in Koʻolau Poko have historically been known for their abundance. According to data collected in 2006, approximately 447,090 pounds of fish were reported to have been caught in Kāneʻohe Bay, Kailua Bay and Waimānalo Bay. Of the total catch, 85 percent of the fish came from Kāneʻohe Bay while 15 percent came from Kailua and Waimānalo Bay. The 447,090 pounds made up about 2.4 percent of the total pounds of fish caught offshore of Oʻahu in 2006.[liii] It is important to note that DAR has been documenting the amount of fish caught off of Oʻahu since 1998. However, in 2005, DAR changed their method of recording fish catch amounts. Since 2005, DAR records *where fish were reported to have been caught*. Prior to 2005, DAR reported fish catch amounts based on *the location of where fishing boats docked.* Prior to 2005, if a fishing boat docked in Kāneʻohe Bay, then the fish reported caught on that boat was recorded as having been caught in Kāneʻohe Bay regardless of whether or not the fishing boat actually fished in the bay. Thus, it is difficult to determine an accurate multi-year trend in the yield of Koʻolau Poko's fisheries.

There are no restricted fishing areas in Koʻolau Poko. However, there is a 1,700 acre area north of Kualoa that is designated as a "fish haven." Fish havens are areas where artificial reefs were developed in an effort to increase the population and diversity of fisheries. The Kualoa fish haven was installed in 1972. Additionally, three fish aggregating devices (FADs) can be found more than 9 miles offshore of Mōkapu Point, Makapuʻu, and Kāneʻohe. In 2006, it was reported that slightly over 24,000 pounds or about five percent of the total Koʻolau Poko catch were caught from these three FADs.

2.4.4.3 Nearshore Water Quality

Several areas of Koʻolau Poko's coastal waters are listed on the 2006 303(d) list for nearshore waters (Table 2.21).

Table 2. 21 Nearshore Water Quality in Koʻolau Poko

Near-Shore Water	TMDL Priority	Pollutant
Kāneʻohe Bay		
Kualoa Sugar Mill Beach[1]	--	--
Kualoa Community Regional Park	Low	enterococci
Heʻeia Kea Small Boat Harbor	Low	Enterococci, Total N
Kāneʻohe Bay at the mouths of Kāneʻohe and Kāwā Streams	Low	Nutrients, Turbidity, TSS
Kāneʻohe Bay Central Region	Low	Nutrients, Turbidity
Kāneʻohe Bay Northern Region	Low	Nutrients, Turbidity
Kāneʻohe Bay Southern Region	Low	Bacteria, Nutrients, Turbidity
Kāneʻohe Bay (Kokokahi Pier)	Low	Bacteria, Nutrients, Turbidity
Kailua Bay		
Kailua Beach Park	Low	Nutrients, Turbidity, Chlorophyll-a
Kaʻelepulu Stream – Kailua Beach	High	Bacteria, Nutrients, Turbidity, Chlorophyll-a
Waimānalo Bay		
Bellows Field Beach Community Park at Waimānalo Stream mouth	Low	Bacteria
Bellows Field Beach Community Park at north runway	Low	Bacteria
Waimānalo Beach Community Park (South)	Medium	Bacteria

[1]Nearshore waters identified as require monitoring for attainment of Standards.

As shown in Table 2.21, common nearshore water pollutants in Koʻolau Poko are nutrients, turbidity, and bacteria. Nutrients and turbidity in nearshore waters are often the result of stream run-off flowing into nearshore waters. Excess bacteria levels found in nearshore waters are often the result of direct waste water discharges.

KEY FINDINGS:

- Kāneʻohe Bay is susceptible to nearshore water pollution due to the poor water circulation in the Bay.
- The current conditions of nearshore waters in Koʻolau Poko reflect the degradation of local stream water.
- More information regarding Koʻolau Poko's fisheries is needed in order to better assess their health.

2.5 TERRESTRIAL ECOSYSTEMS

Since the arrival of the first human settlers on the islands over 1,500 years ago, Hawai'i's forests have changed dramatically. Prior to human contact, the forest resources of Ko'olau Poko consisted of lowland dry and mesic forest, woodland, and shrub land.[liv] Significant changes to terrestrial ecosystems in Hawai'i began in the 19th century when cattle and other introduced livestock were allowed to range relatively freely throughout the islands. Unchecked cattle grazing caused the loss of biodiversity and soil erosion in many places throughout the State. Subsequent reforestation programs were counterproductive as much of the plant species that were planted were non-native and replaced native forest cover. Currently, researchers estimate that over 90 percent of the original dry and mesic forest cover has disappeared in Hawai'i, leaving native forests only on mountain ridges and summits.[lv]

2.5.1 Critical Habitats

A critical habitat is defined as an area "with the physical and biological features essential to the 'conservation' of a threatened or endangered species, and that may require special management considerations or protection.[lvi] There are more than forty USFWS-designated critical habitat areas in Ko'olau Poko supporting a total of 24 endangered and threatened plant species and several animal species. These critical habitat areas overlap with each other and are generally found on the summits of the Ko'olau Mountain range.

Table 2. 22 Endangered and Threatened Species and Critical Habitat

ENDANGERED AND THREATENED SPECIES	COMMON NAME
Flora	
Chamaesyce deppeana	*'Akoko*
Chamaesyce rockii	*'Akoko*
Cyanea acuminata	*Haha*
Cyanea crispa	Plant, no common name
Cyanea humboldtiana	*Haha*
Cyanea koolauensis	*Haha*
Cyanea st.-johnii	No information
Cyanea truncata	*Haha*
Cyrtandra polyantha	*Ha'iwale*
Cyrtandra subumbellata	*Ha'iwale*
Cyrtandra viridiflora	*Ha'iwale*
Labordia cyrtandrae	*Kamakahala*
Lobelia gaudichaudii ssp. koolauensis	Plant, no common name
Lobelia oahuensis	Plant, no common name
Lysimachia filifolia	Plant, no common name
Phlegmariurus nutans	No information
Phyllostegia parviflora	Plant, no common name
Plantago princeps	*Laukahi kuahiwi*
Platanthera holochila	Plant, no common name
Pteris lidgatei	Fern, no common name
Sanicula purpurea	Plant, no common name
Tetraplasandra gymnocarpa	*'Ohe'ohe*
Trematolobelia singularis	Plant, no common name
Viola oahuensis	Plant, no common name
Fauna	
Chasiempis sandwichensis ibidis	*'Elepaio*
Himantopus mexicanus knudseni	*Ae'o*
Fulica alai	*'Alae ke'oke'o*
Gallinula chloropus sandvicensis	*'Alae 'Ula*

2.5.2 Ecosystem Threats

Feral ungulates and alien plant species have been identified as the most damaging factors to Hawai'i's forests.[lvii] In Ko'olau Poko, native vegetation is extremely fragmented and invasive non-native vegetation is common along the ridges and in the valleys[lviii]. The presence of invasive species in the streams and waterways also impacts native aquatic species. Alien tree species are especially noticeable along the Pali and Likelike Highways, including species such as Java plum (*Syzygium cumini*), octopus/umbrella tree (*schefflera actihophylla*), fiddlewood (*Citharexylum spinosum*), and paperbark (*Melaleuca quinquenervia*). Early reforestation species include silk oak (*Grevillea robusta*) and Norfolk pine (*Araucaria heterophylla*).

The O'ahu Invasive Species Committee (OISC) identified several invasive plant species within the Ko'olau Poko district. They include miconia, bush beardgrass, and fountain grass. Table 2.23 provides more detail about the potential threats posed by these invasive plant species and their location in Ko'olau Poko.

Table 2. 23 Species Targeted By the OISC in Ko'olau Poko

Common Name (Scientific Name)	Threat	Location
Miconia (*Miconia clavescens*)	Shades out native plants, takes over moist and wet forests, shallow rooted, and can create erosion problems	Ko'olau mountain range
Bush beardgrass (*Schizachyrium condenstum*)	Thick growth displaces native plants, grows along roadsides, dry grass promotes fires	Temple Valley Kahalu'u, and on the town side of H-3 freeway
Fountain grass (*Pennisetum setaceum*)	Outcompetes other plants for water and soils, degrades the quality of pasturelands, especially in drier areas	Lanikai

Feral pigs are a major concern in Ko'olau Poko as they are found throughout the district. Feral pigs erode soils and cause biodiversity loss.[lix] Even in small numbers, feral pigs may cause great harm in ecologically sensitive areas.[lx] To date, there has been no inventory data collected on the pig population in Ko'olau Poko. Thus it is hard to determine if the feral pig population has been increasing or decreasing over time. However, anecdotal evidence suggests that the feral pig population in Ko'olau Poko may be increasing as there have been several accounts from windward residents of pigs being sighted in residential subdivisions. The Ko'olau Mountain Watershed Partnership is gathering hunting data from hunters in several areas along the Ko'olau Mountain Range.

Other harmful mammals in Koʻolau Poko include feral cats (*Felis catus*), dogs (*Canis familiaris*), mongoose (*Herpestes aruopunctatus*), and rats (*Rattus rattus, R. exulans*). Similar to feral pigs, rats have also been observed in the district's forested areas.[lxi] Rats in the *mauka* areas of the district are a concern because rats may feed upon the eggs of native birds. Rats have also been known to feed on parts of native plants as well as native plants' fruits and seeds which prevent these plants from thriving and reproducing. Also, rat urine is the primary source of leptospirosis in surface water.[lxii] Recreational hiking may also impact forests. Hikers may unintentionally facilitate the spread of disease, invasive plants, or small pests.[lxiii]

KEY FINDINGS:

- Native forests are currently limited to inaccessible areas on the highest summits and ridges.
- Alien invasive species, feral pigs and other harmful mammals continue to pose threats to the terrestrial resources of the district.

2.6 TRADITIONAL PRACTICES AND CULTURAL RESOURCES

Hawaiʻi nui a kea

Loaʻa Oʻahu he wohi	*Oʻahu begotten of wohi rank*
He wohi na Ahukinialaʻa	*A chief of Ahu kini a Laʻa*
Na Laʻamealaʻakona, he wahine	*Of Laʻamealaʻakona, a woman*

This genealogical account of the chiefly birth of Oʻahu communicates not only the godly creative forces that gave birth to the Hawaiian archipelago but more importantly, describes the familial relationship shared between the Hawaiian people and their beloved lands.

The birth of the Hawaiian archipelago is credited to Papa and Wākea. Wākea, the upper province of the sky, is symbolic of the region from which descends sunshine and rain to fertilize the earth. Papa, the warm upper layer of earth, is where fertilized seeds await maturity to spring into life. Papa and Wākea are also credited as being the first parents of human life on earth. Through the birth of Hāloa, born from Wākea's own daughter, the first living child was named for "the long stalk" (*hā loa*), manifest as the original *kalo* that grew from the place where an earlier stillborn child, Hāloanakalaukapalili, was buried beside their house.

Thus, Papa and Wākea are the first parents of human life on earth as well as the plant life and animal life that feed upon it. These origins define the responsibility that rests with future generations to care for the elder Oʻahu, born of chiefly parents.

2.6.1 Traditional Cultural Practices

"Hawaiians, more than any of the other Polynesians, were a people whose means of livelihood, whose work and interests, were centered in the cultivation of the soil. The planter and his life furnish us with the key to his culture." [lxiv] Understanding how Hawaiians worked with their surrounding environment to produce food provides keys to understanding their culture as a whole. These customs and practices distinguish Hawaiians as a people and their continued existence in an island environment.

Major aspects of Hawaiian lifestyle are embodied in customs and practices surrounding the cultivation of food including community life, family life, spirituality, stewardship, and the use of natural and cultural resources.[lxv] Thus, to the Hawaiian mind, the natural elements -- land, water, and ocean -- form the basis of subsistence, cultural and religious beliefs, customs, and practices. *'Ohana* living, or the presence of multiple generations in the extended family, ensured that ancestral knowledge of practices, customs, and traditions was passed down from generation to generation. Legends and chants that record the names of winds, rains, and prominent environmental features are sources of ancestral knowledge. Culturally prescribed behavior such as *aloha 'āina*, and its companion expression of conservation through *mālama 'āina*, ensures the sustainability of resources for present and future uses. The activities that are central to traditional and customary practices are dependent upon having access to and being able to care for and use natural and cultural resources of the land, ocean, air, and water.

Basic principles of Hawaiian stewardship and the use of natural and cultural resources recognize the *ahupua'a* as the most common unit of resource management. Geographically, an *ahupua'a* is typically a wedge-shaped land section that encompasses an area of land from the mountains to the sea. Mountain ridges also typically defined the boundaries of most *ahupua'a*. The land area of individual *ahupua'a* depended upon the availability of natural resources in that area.

Fresh water was one of the most coveted natural resources because of its life giving force, hence the origin of the saying *wai ola* "water is life." Hawaiians viewed water as a symbol of wealth and prosperity.[lxvi] Thus in most instances, drier regions were split into larger *ahupua'a* to compensate for the relative lack of fresh water, while water rich regions were divided into smaller *ahupua'a*.[lxvii] Healthy stream flow from *mauka* to *makai* provided drinking water, supported self-sustaining food cultivation activities including agriculture and aquaculture, and helped to create estuaries with abundant fisheries. Because water was viewed as a life force with spiritual connotations, water was not viewed as a resource that could be commoditized or privately owned; instead it was managed as a resource for the benefit of the entire community.[lxviii]

Culturally, the concept of *ahupua'a* management recognized the interdependency and interconnectedness among the natural elements of land, air, water, and ocean as well as between people and place. Spiritually connected to their natural surroundings, Hawaiians depended on both the land and sea for survival. The system of *ahupua'a* management reinforced an extensive set of traditional practices and spiritual beliefs to protect the *ahupua'a's* natural resources from degradation and to ensure that the quality and quantity of these resources remained in abundance for future generations.[lxix]

Traditional practices varied throughout the different areas of an *ahupua'a*. The following section outlines how Hawaiians viewed the different sections of an *ahupua'a* and the associated traditional and customary practices associated with these areas. While this discussion is not meant to be exhaustive, it touches upon some of those elements necessary for traditional and customary practices.

WAO

The most *mauka* regions of an *ahupua'a* were known as *wao.* The word *wao* refers to a place that is wild and distant and not often visited by man and consisted of the upper forested mountain areas of an *ahupua'a* up to the mountain peaks or ridgelines. There are several divisions within the *wao.* The *wao la'au* is the inland forested region. The *wao kanaka,* are the areas of the *wao* that are most accessible to man. In both the *wao la'au* and *wao kanaka,* Hawaiians gathered *koa* wood for various uses such as canoes, utensils, and spears. *Lau hala* was also gathered for thatch and mats, bark of the *mamaki* tree for *kapa*, *kukui* for oil. Above the *wao la'au* and *wao kanaka* at the highest elevations of the *ahupua'a* was the *wao akua* – forest of the gods. These areas were seldom accessed by Hawaiians and were considered extremely sacred, as the *wao akua* were thought to be the realm of the gods and possessed both good and evil supernatural elements. Use of the land and resources in the *wao* was very limited as Hawaiians did not reside in this region of the *ahupua'a* and accessed these mountain forests only for the gathering of essential resources.[lxx]

KULA

Below the *wao,* is the *kula* area. *Kula* consisted of the areas in the *ahupua'a* of sloping land between mountain and sea. Most *kula* consisted of great stretches of *pili* grass that were used in the construction of *hale*. The areas of the *kula* closer to the ocean were called *ko kula kai* and those areas closer to the mountains were called *ko kula uka.* Cultivation of crops took place in the *kula*, although at a smaller scale when compared to the *kahawai* areas of the *ahupua'a*, as the *kula* areas were not the prime areas for crop cultivation. *Kula* areas in most *ahupua'a* on all islands are characterized by red dirt. Sugar cane and sweet potato grew well in this type of soil. Trees also existed in the *ko kula uka* regions, although the trees in this region were not as tall or dense as the trees found in the *wao*. The *ko kula uka* region provided Hawaiians with medicinal plants and herbs as well as wood for various uses.[lxxi]

KAHAWAI

Kahawai literally means "the place of having fresh water" which most often included the areas of land in close proximity to the streams that flowed along valley floors. Thus, the *kahawai* areas of an *ahupua'a* were of prime importance to Hawaiians for this was where the most intensive cultivation of food crops took place. Unlike the red soils of the *kula* areas, the soils of the *kahawai* areas consisted of dark soils good for wetland *kalo* cultivation. It is in this region of the *ahupua'a* that the majority of *lo'i* terraces and *'auwai* existed. Hawaiians had their main dwellings in the *kahawai* areas or maintained temporary shelters there during periods of extensive cultivation.[lxxii]

KO KAHA KAI

The *ko kaha kai* areas consist of the coastal lands of the *ahupua'a*. The word *kaha* was used to refer to areas that were near the shore but were not good for planting. Activities that took place in this area were associated with the sea. These activities included fishing, navigation, and housing of canoes. In addition to these activities, fishing villages also existed in the *ko kaha kai* of some *ahupua'a*.[lxxiii]

KAI

To Hawaiians, the *kai* (ocean) was as an integral part of the *ahupua'a*. Fishing and gathering of *limu* were some the most common activities associated with this area of the *ahupua'a*. Hawaiians named different areas of the sea for their varied characteristics. *Pu'eone* (literally heaps of sand) indicated the areas of the sea closest to land including, inshore dunes and outer sandbars. The *po'ina nalu*, also called *kai po'i* (literally sea breaking) was the area further out from shore where waves break. The portion of the sea that is inside the reefs where lagoons existed was called *kai kohola. Kai pualena* referred to the areas where streams entered the sea. *Kai ele* referred to the dark sea and *kai uli* refers to the deep blue sea.[lxxiv] In Ko'olau Poko, the construction of *loko i'a* (fishponds), was commonly associated with the *kai pualena* areas of the *ahupua'a* as Hawaiians recognized and harnessed the natural productive energy of Kāne'ohe Bay's brackish water estuaries.[lxxv]

2.6.2 Cultural Resources

Ko'olau Poko is blessed with numerous cultural resources and *wahi pana*. *Wahi pana*, are sacred sites or significant places such as *heiau*, shrines, churches, prominent *pōhaku* or stones, burial caves, geographic features, and natural features and phenomena associated with deities or significant events. In Ko'olau Poko, over 150 *wahi pana* have been documented.[lxxvi] Extensive volumes of information have been collected for each of these unique and treasured resources including their historical, cultural, and spiritual significance. Because of the wealth of information associated with the many cultural resources in Ko'olau Poko, an extensive and detailed account of each and every cultural resource is not possible in the context of this watershed profile. Readers who are interested in more detailed information about Ko'olau Poko's cultural resources are encouraged to consult other books such as *Sites of O'ahu* or *Nā Wahi Pana o Ko'olau Poko.*

Several of Ko'olau Poko's cultural resources and *wahi pana* are associated with water related resources and food production. Some of the more common cultural resources and *wahi pana* that have been documented in the district include agricultural terraces, 'auwai systems, and *loko i'a*. Remnants of old agricultural terraces and the *'auwai* systems that irrigated these terraces can be found throughout the district. Many of the agricultural terraces in Ko'olau Poko were used to cultivate wetland *kalo.* Unfortunately, most terraces in the district were destroyed due to various forms of development. Large concentrations of well preserved historic agricultural terraces can still be found in Luluku Valley in Kāne'ohe as well as in Maunawili Valley in Kailua. Ko'olau Poko was home to numerous *loko i'a*. Anecdotal accounts indicate that approximately 30 fishponds once existed in Ko'olau Poko.[lxxvii] A variety of *loko i'a* were once found in the district, including *loko i'a kalo* (lo'i terraces that also raised fish), *loko wai* (fresh water fishpond fed by 'auwai), *loko pu'uone* (saltwater fishpond isolated by a mound of sand that runs parallel to the sea) and *loko 'umeiki* (walled fishponds with no gates). Some of the more well preserved and notable fishponds in the district were *loko kuapā* (brackish water walled fishponds with gates). A large concentration of *loko kuapā* existed in Kāne'ohe Bay. Several of the more notable existing fishponds in Kāne'ohe Bay include Moli'i Fishpond, He'eia Fishpond, Waikalua Fishpond, Nu'upia Fishpond, and Kahalu'u Fishpond. Kawainui Marsh was also once a very large fishpond.

Many of these cultural resources have legendary accounts and *mo'olelo* (stories) associated with them. For the purposes of planning, it is also important to note the mundane and every day uses associated with these stories in addition to the supernatural deeds that these stories capture. These mundane and everyday uses associated with *wahi pana* give insight into how the resources of the area were used and managed. The everyday uses associated with these resources also provide insights on what the physical conditions of an area may once have been. While many of the *mo'olelo* associated with Ko'olau Poko's *wahi pana* involve supernatural beings, many of the other characters in these *moʻolelo* are farmers and fishermen who interacted with them. The presence of the farmers and fishermen in many of Koʻolau Poko's *moʻolelo* as well as the number of old *loʻi* terraces and fishponds indicate that farming and fishing activities were very extensive in the district's past.

KEY FINDINGS:

- Native Hawaiians viewed fresh water as a source of wealth and prosperity
- Different areas of the *ahupuaʻa* were designated for different uses and activities by Native Hawaiians, but at the same time, each *ahupuaʻa* was treated as one holistic unit
- Many *loʻi* and fishponds once existed in Koʻolau Poko which indicates that significant agriculture and aquaculture activities were common in the district at one point in time.

2.7 SETTLEMENT HISTORY

It is estimated that Hawaiians first settled the windward coast of Oʻahu as early as 1,500 to 2,000 years ago.[lxxviii] Harnessing the plentiful sources of fresh water that naturally existed in the many streams and springs, Hawaiians developed Koʻolau Poko into a major food producing area. *Loʻi* dominated the landscape of the region while *loko iʻa* were common features along the district's coastlines. Eventually, because of the abundance of food that was produced in the area, Koʻolau Poko became one of the major population centers of the Hawaiian archipelago. Several of Oʻahu's ruling chiefs resided in the district including Olopana, Kahekili, and Kamehameha the Great. Prior to western contact, the population of Koʻolau Poko was estimated to be between 20,000 to 25,000 people.[lxxix]

Similar to the rest of Hawaiʻi during the 1800s, Koʻolau Poko experienced severe declines in population due to widespread epidemics and outbreaks of various diseases. Table 2.24 illustrates Koʻolau Poko's estimated population during the 1800s.

Table 2. 24 Koʻolau Poko Population 1831-1900

YEAR	POPULATION	% CHANGE
1831	4,987	---
1835	4,636	-0.7
1849	2,813	-39.3
1860	2,318	-17.6
1872	2,028	-12.5
1878	2,402	18.4
1884	2,621	9.1
1890	2,499	-4.6
1900	2,844	13.8

Over the course of four decades, Koʻolau Poko's population declined by about 50 percent from 4,987 people in 1831 to 2,082 people in 1872. Taking into consideration that Koʻolau Poko's estimated population prior to western contact was between 20,000 to 25,000 people, the district's population decreased by over 90 percent from the late 18th Century to 1872. The population of Koʻolau Poko began to recover at a modest rate during the latter part of the 19th Century as immigrant laborers from other countries began to settle in the district.

1850 – 1900

The dramatic decline in population combined with the introduction of the western concept of private land ownership after the Māhele of 1848 precipitated changes in the district's settlement patterns, land use, and water use during the latter half of the 19th Century and into the 20th Century. The 1848 Māhele divided all lands in Hawaiʻi into one of three categories: Crown Lands, Government Lands, and Konohiki Lands. As a result of the Mahele, over 18,000 acres were awarded to 25 chiefs and their agents in Koʻolau Poko.[lxxx] Several of the more notable awards in the district included 3,737 acres to Abner Paki (father of Bernice Pauahi Bishop) in the *ahupuaʻa* of Heʻeia and over 10,000 acres of land awarded to Queen Kalama (wife of Kamehameha III) in the *ahupuaʻa* of Hakipuʻu, Kāneʻohe, and Kailua.

The Kuleana Act of 1850 gave land awards to commoners. However, in comparison to the amount of land awarded to the chiefs, the total amount of land awarded to commoners was quite small. Land parcels awarded to commoners were no larger than two or three acres. Often these *kuleana* parcels were completely surrounded by larger private landowners, which in most instances, prevented commoners from accessing vital natural resources which made it impossible for most commoners to continue the perpetuation of the subsistence lifestyle that they were accustomed to. In Koʻolau Poko, a total of 659 Land Commission Awards (LCA) were made to commoners.[lxxxi] While some of these *kuleana* parcels were sold to other interests, several of the lineal descendants of the original Land Commission Awardees still live on these *kuleana* parcels and still retain many of the rights associated with these lands, including appurtenant rights to water.

Many of the chiefs who were awarded lands during the Mahele sold or leased large areas of their lands to foreign businessmen. Up until the middle of the 1800s, Native Hawaiian land use practices dominated the landscape. From the middle of the 19th Century into the early 20th Century, the landscape of Koʻolau Poko underwent a transformation as various large monocrop agricultural ventures cultivated large areas of lands in the district. Three predominant commercial agricultural crops were grown in Koʻolau Poko during this period: 1) sugar, 2) rice, and 3) pineapple. Live stock and ranching activities also became one of the major entrepreneurial ventures during this period. In addition, apple banana became a popular crop that was grown in the Luluku area of Kāneʻohe.

There were nine sugar plantations in Koʻolau Poko between the years 1864 to 1947; eight plantations existed in the Kāneʻohe Bay region while one plantation was located in Waimānalo. The Kualoa Sugar Plantation was the first sugar plantation in the district, beginning its operations in 1864. At the height of sugar production in the Kāneʻohe Bay region, sugar plantations controlled 11,865 acres of land, of which 1,035 acres were cultivated.[lxxxii] During this period of time, sugar operations destroyed many of the *loʻi* fields as land was cleared for sugar cultivation. Sugar's reign in the Kāneʻohe Bay region lasted only four decades as the last plantation in the region closed in 1903.

The Waimānalo Sugar Plantation operated for 70 years between 1878 and 1947. Founded by John A. Cummins in 1877, the Waimānalo Sugar Plantation consisted of approximately 3,000 acres of land that was cultivated at the height of the plantation's sugar production. The plantation ran for about six miles along the Waimānalo coast line and extended four miles inland to the base of the Koʻolau Mountain Range. In 1885, control of the plantation passed on to W.G. Irwin. About a decade later, Irwin began construction of a ditch system in Maunawili Valley to convey water to the Waimānalo Sugar Plantation. The Maunawili Ditch became the main source of water for the Waimānalo Sugar Plantation. The ditch diverted water from the Maunawili Stream and Maunawili springs. Irwin and his predecessors also oversaw construction of several reservoirs, including the Kailua Reservoir which was completed during the first decade of the 20th Century. The water systems that were created by the Waimānalo Sugar Plantation still service current agriculture operations in Waimānalo and are the primary source of water for many farmers.

Unlike the other areas of Koʻolau Poko, Kailua did not have a sugar plantation. During this time period, Kailua was more influenced by the rice industry. Several rice plantations and a rice mill existed around the Kawainui Marsh area. These rice plantations converted old *loʻi* terraces into rice paddies and in many instances opened up new areas of rice cultivation with the use of oxen. While there were no sugar plantations in Kailua, the sugar industry did have an effect on Kailua agricultural operations. As previously mentioned, water that would normally flow into Kawainui Marsh from the Maunawili Stream was diverted to Waimānalo. This significantly reduced the amount of water available to irrigate rice in the marsh.[lxxxiii]

In the Kāneʻohe Bay region the cultivation of rice co-existed with the cultivation of sugar. The first rice company in the region began operations in 1880. Similar to rice operations in Kailua, rice operations in the Kāneʻohe Bay area converted the *loʻi* terraces that were not destroyed by sugar cultivation into rice paddies. In many cases, *loʻi* were expanded and new irrigation systems were constructed to supplement the existing *ʻauwai* systems. In 1892, approximately 700 acres were cultivated for rice in the areas that surround Kāneʻohe Bay.[lxxxiv] Major rice operations in the Kāneʻohe Bay area ended in the 1920s.

1900 - 1950

While sugar grown in the district had an effect on the district's development, sugar plantations outside of Koʻolau Poko on Oʻahu's Central and Ewa Plains had a direct effect on Koʻolau Poko's water sources as well. At the beginning of the 20th Century, U.S. businessman Lincoln McCandless bought approximately 6,000 acres in the Waiāhole and Waikāne valleys in anticipation of diverting water from the windward side to leeward sugar plantations. His vision was realized with the construction of the Waiāhole Ditch System. Construction of the ditch system started in 1913 and was completed in 1916. The diversion of windward water via the Waiāhole Ditch System reduced windward stream flows and impacted the ecosystems that depended upon those flows.

Pineapple was cultivated in the Kāneʻohe Bay area between the years 1910 to 1925. It was estimated that 2,500 acres of pineapple were cultivated in Windward Oʻahu, of which a large percentage was in the Kāneʻohe Bay region.[lxxxv] Pineapple cultivation was relatively short lived in Koʻolau Poko compared to sugar and rice. As pineapple operations ceased, much of the pineapple lands reverted back to pasture areas.

Livestock and cattle was also a major land use in Koʻolau Poko throughout the mid 1800s and early 1900s. Two of the larger landowners currently in the district are Kāneʻohe Ranch and Kualoa Ranch. Kāneʻohe Ranch was established during the 1890s. In 1917, Harold K.L. Castle purchased the ranch's properties which included 12,000 acres of land that extended from Waimānalo to Hauʻula in Koʻolau Loa.[lxxxvi] Castle also purchased the *ʻili* of Mōkapu and utilized the area for cattle grazing as well.[lxxxvii] Kualoa Ranch began operations in 1850. Ranch land holdings included lands in the *ahupuaʻa* of Kaʻaʻawa, Kualoa, and Hakipuʻu. In 1925, the Campos family began operation of one of the district's first dairies. The dairy included 2,000 acres of land for cattle grazing and was located near the present day Kailua Town Center.

Cattle and ranching activities in Koʻolau Poko were not without its drawbacks. Feral cattle and overgrazing by ranch livestock led to severe losses of vegetation and forested areas in the district. This caused massive amounts of erosion and threatened the district's sources of potable water. In response to this problem, the Territorial Government of Hawaiʻi established forest reserve areas in the *mauka* areas of Koʻolau Poko during the 1920s and 1930s. The Waiāhole Forest Reserve (7,395 acres) extends from Kahaluʻu to Kaʻaʻawa. The Waimānalo Forest Reserve included *mauka* lands in Waimānalo, Kailua, and southern Kāneʻohe. The Kāneʻohe Forest Reserve was the last forest reserve area to be established in the district and included forest lands in Kāneʻohe that were not included in the Waimānalo Forest Reserve. Today, nearly all forest areas in Koʻolau Poko are in forest reserve.

Access into Waimānalo significantly improved after the completion of the Kailua-Waimānalo Road in 1924. Prior to the completion of the road, access into Waimānalo was only through two foot trails. Shortly after the completion of the road, residential growth in Waimānalo followed. The first Hawaiian Homes development in Waimānalo occurred in 1925 and the first Waimānalo beach lot homes were built a year later.

The U.S. military also played a significant role in the district's settlement history with the establishment of the Marine Corps Base Hawai'i on the Mōkapu Peninsula and the Bellows Air Force Station in Waimānalo. The military first developed the Mōkapu Peninsula in 1918 after condemning land from Harold Castle and establishing the Kuwa'aohe Military Reservation. In 1939, the Navy began development of the Kāne'ohe Bay Naval Air Station on the peninsula. It was during this time that the military conducted massive dredging of Kāne'ohe Bay. The dredging of the bay and removal of major portions of coral reef destroyed significant portions of the bay's marine habitats.[lxxxviii] The Navy controlled the Peninsula through WWII up until 1950. Jurisdiction of the military installations on Mōkapu was eventually transferred to the U.S. Marine Corps. In 1917, land was acquired along the Waimānalo coast for the Waimānalo Military Reservation. Construction of this Military facility was completed in 1938. The name of the Waimānalo military installation was changed to Bellows Air Force Station in honor of Second Lieutenant Franklin B. Bellows, a World War I officer who died in combat. Today the Bellows Air Force Station is primarily used as a military recreational facility and periodically used for U.S. Marine Corps training activities.[lxxxix]

1950 - Present

The settlement patterns of Ko'olau Poko were for the most part uniform throughout the entire district up until the mid 20th Century, as land use within the district was shaped primarily by agrarian activities. However, this would start to change as the district began to experience major development and population booms. During the latter half of the 20th century, the development patterns within the district varied distinctly within Ko'olau Poko's communities as Kāne'ohe and Kailua became very large population centers. Below, Ko'olau Poko's population from 1900-2000 is illustrated.

Table 2. 25 Ko'olau Poko Population 1900-2000

YEAR	POPULATION	% CHANGE
1900	2,844	---
1910	3,251	14.3
1920	4,035	24.1
1930	6,385	58.2
1940	9,006	41.0
1950	20,779	130.7
1960	60,238	190.0
1970	92,219	53.0
1980	109,373	18.6
1990	117,694	7.6
2000	117,999	0.2

As can be seen in Table 2.25, the population growth of Koʻolau Poko during the middle decades of the 20th Century was quite large. Between 1940 and 1960, Koʻolau Poko's population increased by 570 percent. Several factors contributed to Koʻolau Poko's population and development boom. With the decline of Hawaiʻi's agriculture industry after World War II, several of Koʻolau Poko's large landowners began to subdivide their landholdings in order to lease or sell these parcels for residential or commercial use. This resulted in many of the present day residential subdivisions and commercial areas that exist within the district. The completion of the Pali Tunnels in 1957 and the Wilson Tunnels in 1960 improved access to the windward side from Honolulu and further spurred the transformation of Kāneʻohe and Kailua from small rural communities into suburban population centers. The completion of several municipal water supply projects also contributed to development and growth in the district during the same time period. The first public water works system in Koʻolau Poko began servicing Kāneʻohe in 1927. During the 1940s and 1950s three tunnel systems were developed to service the windward municipal water system and future development. The Haʻikū Tunnel was built in 1940 and diverted water from Iolekaʻa Stream, a tributary of Heʻeia Stream. The Kahaluʻu Tunnel System was developed in 1946 and diverted water from the Kahaluʻu Stream. The Waiheʻe Tunnel System was developed in 1955, diverting water from the Waiheʻe Stream.

Kailua was transformed from a sleepy rural community into the second most populous community in the islands outside of urban Honolulu. Several of Kailua's residential subdivisions were built during the 1950s including the Olomana, Pohakupu, and Kukuhono subdivisions. The Kailua town center began to take shape during the 1950s as well with the construction of the Kailua Shopping Center. The shopping center included stores such as Foodland and Liberty House. The rate of development in Kailua peaked during the 1960s. In 1961, construction began on the Enchanted Lakes subdivision around Kaʻelepulu Stream. The construction of the Enchanted Lakes Shopping Center followed later in the decade. Other Kailua subdivisions were developed during the 1960s including Maunawili Estates, Aikahi Park, and Coconut Grove. The Castle Medical Center, the largest medical facility in the district, was completed in 1963. [xc]

Kāneʻohe experienced similar rates of development during the 1950s and 1960s. Castle High School first opened its doors in 1949 and was the first public high school in Koʻolau Poko. Large residential developments occurred throughout Kāneʻohe as thousands of new homes were built. Many Kāneʻohe Bay fishponds were filled in to accommodate residential developments that occurred along the coastline. Today only twelve fishponds remain. Windward Shopping Center, completed in 1961, was the first significant commercial development in Kāneʻohe. The Kāneʻohe Bay Shopping Center opened a decade later in 1972. Windward Mall, the last major commercial development in Kāneʻohe was completed in the early 1980s.

Unlike Kailua and Kāne'ohe, the Kahalu'u and Waimānalo areas retained much of their rural character over the latter half of the 20th Century. While urbanization did occur in Waimānalo and Kahalu'u to some degree, large acreages of active agriculture still exist in these areas. In the Kahalu'u area, several of the larger urban developments that occurred in the latter half of the 20th Century include several residential subdivisions, the Valley of the Temples Cemetery, and the Temple Valley Shopping Center.

After the closure of the Waimānalo Sugar Plantation in 1947, much of the plantation's lands were passed on to the Territorial and eventual State government. The State converted about 121 acres of these lands into the State Waimānalo Agricultural Park. Initially, the DLNR managed the agricultural park. DOA was given the responsibility of management of the park in the 1980s and made improvements to the irrigation system, including the construction of a large 60 mg reservoir.

The pace of development and population growth in Ko'olau Poko slowed considerably during the last decades of the 20th Century. However, several notable legal issues arose in the district with regards to water use. In 1976, a group of taro farmers filed suit seeking to enjoin the BWS from exporting water from Waihe'e Valley as the farmers argued that the BWS Waihe'e Tunnels reduced the amount of water from the stream that they were entitled to. As a result of the suit, BWS was required to reduce the water it takes from the Waihe'e Tunnels if the flow of the Waihe'e Stream falls below 2.7 mgd.[xci]

During the 1990s, one the largest legal battles over water in the State's history occurred over the water in the Waiāhole Ditch. With the closure of the O'ahu Sugar Company on the leeward side of the island in 1995, a series of water use petitions was made to the CWRM over the water in the Waiāhole Ditch that would no longer be used by O'ahu Sugar Company.

The petitioners for Waiāhole Ditch water can be divided into two main groups, leeward petitioners and windward petitioners. The leeward petitioners requested that the water that had been allocated to the O'ahu Sugar Company continue to be transported to the Leeward side, while the windward petitioners wanted the water to be returned to windward streams. Because of the complexity of the case and the numerous parties involved, CWRM conducted a contested case hearing over the Waiāhole Ditch water use petitions in 1995. The Waiāhole Contested Case hearing lasted for almost two years with hundreds of hours of testimony from each side. In 1997, CWRM issued its Decision and Order on the contested case and returned a significant amount of water from the Waiāhole Ditch to windward streams.[xcii]

However, the 1997 CWRM Waiāhole Contested Case Decision and Order was appealed to the Hawai'i Supreme Court twice and as a result CWRM has amended the original Decision and Order twice. The most recent CWRM Decision and Order in 2006 regarding Waiāhole Water returned 12 mgd to windward streams and allocated 12.57 mgd to leeward users. The 2006 CWRM Decision and Order on the matter was remanded back to CWRM by the State Intermediate Circuit Court of Appeals.[xciii] The Decision and Order was affirmed in all aspects except for one issue on appeal – Pu'u Makakakilo's water use permit. In 2011, Pu'u Makakilo withdrew its water use permit application.

KEY FINDINGS:

- Prior to the middle of the 20th Century, agriculture in various forms, dominated the district's settlement patterns
- Ko'olau Poko experienced major population and development booms between 1950-1980

2.8 DEMOGRAPHIC CHARACTERISTICS

As discussed previously, Ko'olau Poko experienced a significant increase in population over the last half of the 20th Century. In 2000, Ko'olau Poko's population was 117,994 people. Table 2.26 shows the population of Ko'olau Poko from 1980 to 2000 in comparison with the population of the entire City and County of Honolulu. Between 1990 and 2000, Ko'olau Poko's population grew by only 0.2 percent, compared to a 4.8 percent increase in O'ahu's overall population during the same time period. Ko'olau Poko's share of the entire island's population has remained fairly constant between 1980 and 2000. In 2000, Ko'olau Poko accounted for 13.47 percent of O'ahu's total population, a slight decrease from 14.34 percent in 1980.

Table 2.26 also shows the City and County of Honolulu's population projections for Ko'olau Poko to the year 2035. The City and County of Honolulu Department of Planning and Permitting uses population projections from the State Department of Business, Economic Development, and Tourism and the land use policies established in each of the City and County's Development / Sustainable Community Plan areas to project future population growth and distribution. DPP's population projections estimated that Ko'olau Poko's 2035 population will decrease by about 3,900 people from its 2000 population. DPP's population projections also estimated that Ko'olau Poko's population will only be 10.2 percent of O'ahu's overall population by 2035. These population projections reflect the growth and development policies that are set forth in the Ko'olau Poko SCP which suggest that Ko'olau Poko's population growth will slow in relation to the rest of O'ahu over the next two decades.

Table 2. 26 Population and General Plan Projected Populations

	ACTUAL POPULATION			GENERAL PLAN PROJECTED POPULATION				
	1980	**1990**	**2000**	**2010**	**2020**	**2025**	**2030**	**2035**
Ko'olau Poko	109,373	117,694	117,999[1]	119,852	119,569	118,064	116,676	114,134
O'ahu	762,565	836,231	876,156	952,640	1,037,250	1,078,050	1,117,322	1,113,620
% of O'ahu	14.34%	14.07%	13.47%	12.58%	11.53%	10.95%	10.4%	10.2%

[1]Note, 2000 U.S. Census lists Ko'olau Poko's population as 117,994

Table 2.27 presents population and housing characteristics for Ko'olau Poko and its neighborhood board areas. In 2000, the average household size was a little larger in Ko'olau Poko (3.17 persons per household) than for O'ahu as a whole (2.95 persons per household). There were approximately 37,000 total housing units in Ko'olau Poko, of which 4.12 percent were vacant. Ko'olau Poko's four neighborhood board areas have distinct variations within certain demographic statistics. The Kailua and Kāne'ohe neighborhood board areas account for almost 80% of the district's population and 82% of the district's housing units. The Waimānalo neighborhood board area has almost one more person per household compared to the other neighborhood board areas and the vacancy rate for available housing is higher in the Waimānalo neighborhood board area when compared to the other neighborhood board areas.

Table 2. 27 2000 Ko'olau Poko Population and Housing Characteristics

	Population[xciv]	**Persons per Household**[xcv]	**Housing Units**[xcvi]	**Total Vacant Units**[xcvii]	**Available Housing Vacancy Rate**
Kahalu'u NB Area	14,391	3.26	4,587	218	4.75%
Kāne'ohe NB Area	40,013	3.19	13,116	529	4.00%
Kailua NB Area[1]	53,434	3.02	16,686	642	3.70%
Waimānalo NB Area	10,161	4.08	2,575	133	5.10%
Ko'olau Poko Total	**117,999**	**3.17**	**36,136**	**1,522**	**4.12%**
O'ahu	876,156	2.95	315,988	29,538	9.35%
% of O'ahu	13.47%	N/A	11.70%	5.15%	N/A

[1]Kailua NB Area includes data for Marine Corps Base Hawai'i

KEY FINDINGS

- The rate of population growth in Ko'olau Poko has been slowing in the last two decades and the district's future 2035 population is predicted to slightly decline.
- The majority of Ko'olau Poko's population and housing units are in Kailua and Kāne'ohe.

2.9 LAND USE

State land use is differentiated into four broad categories: Urban, Rural, Agriculture, and Conservation. Almost half of the land in Ko'olau Poko is designated Conservation, which primarily encompasses the steep, mountainous ridges and upper valleys of the Ko'olau Mountain Range and various wetland areas in the district. Agricultural lands make up only 13.8 percent of Ko'olau Poko's lands, and are generally found on the more gently sloping valley floors. Urban lands account for almost 40 percent of the land area in the district. There are no State Land Use District "Rural" lands in Ko'olau Poko. Table 2.28 displays the acreage and percentage of total Ko'olau Poko lands that are in each State Land Use District.

Table 2. 28 State Land Use Designations in Ko'olau Poko

LAND USE	ACRES	% OF TOTAL
Conservation	19,880	47.8
Agriculture	5,760	13.8
Urban	15,990	38.4
TOTAL	**41,630**	**100**

Note: These numbers were estimated in-house using GIS, thus total acreage for State Land Use Districts does not equal total acreage for City and County Zoning

At the City and County level, the three largest zoning districts in Ko'olau Poko are Preservation, 51.7 percent of the land area, Residential 13.8 percent, and Military/Federal, 10.6 percent. Table 2.29 displays the acreage and percentage of total Ko'olau Poko lands that are zoned by the City and County.

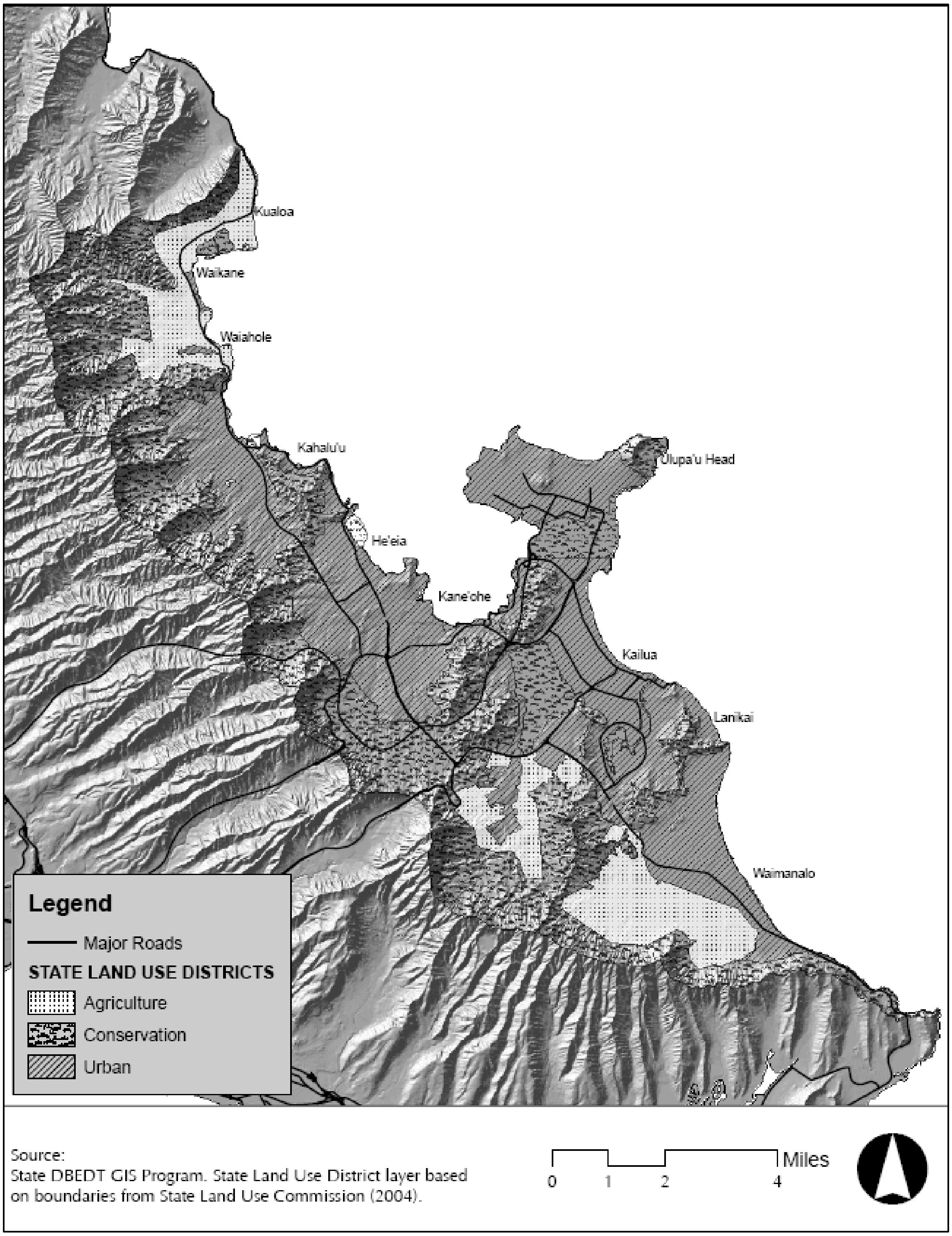
Table 2. 29 County Zoning in Ko'olau Poko

ZONED USE	ACRES	% OF TOTAL
Preservation	21,840	51.7
Agriculture	8,515	20
Residential	5,820	13.8
Military/Federal	4,490	10.6
Country	1,020	2.5
Commercial	225	0.6
Apartment	200	0.5
Industrial	90	0.3
TOTAL	**42,200**	**100**

Note: These numbers were estimated using GIS, thus total acreage for State Land Use Districts does not equal total acreage for City and County Zoning

Figure 2.12 illustrates the State Land Use Designations in Ko'olau Poko.

Figure 2. 12 Ko'olau Poko State Land Use Districts



Source:
State DBEDT GIS Program. State Land Use District layer based on boundaries from State Land Use Commission (2004).

2.9.1 Land Ownership

There are eight landowners that own 500 or more acres in Ko'olau Poko: State of Hawai'i (10,960 acres), U.S. Federal Government, (4,880 acres), City and County of Honolulu (4,730 acres), Kualoa Ranch (1,570 acres), Royal Fountain (1,470 acres), the Kamehameha Schools (700 acres), and Kāne'ohe Ranch (510 acres), Department of Hawaiian Home Lands (500 acres).[xcviii] Together these landowners own approximately 60 percent of Ko'olau Poko's 41,500 acres. The remaining 40 percent of land in the district is owned by various small private landowners and individuals.

2.9.2 Agriculture

Of the 8,515 acres of land zoned as "Agriculture" by the City and County, approximately 2,350 acres are considered "Prime" and 5,250 acres are considered "Other," in the Agricultural Lands of Importance to the State of Hawai'i (ALISH) Soil Ratings adopted by the State Board of Agriculture in 1977. Aerial photo analysis and field verification conducted by the planning team in August of 2008 indicated that approximately 1,870 acres or 22 percent of all land designated as "Agriculture" by the City and County in Ko'olau Poko, is currently being cultivated.

The majority of agricultural activities in the district are located in the Kahalu'u and Waimānalo Neighborhood Board Areas. In Waiāhole Valley, the State of Hawai'i Housing Finance and Development Corporation owns and manages the Waiāhole Valley Agricultural Park which consists of 590 acres and 143 agricultural and residential lots. Other agricultural activities in the neighborhood board area occur on small privately owned farms. Based on aerial photo analysis and field verification, about 480 acres are utilized for diversified agriculture crops, 45 acres are utilized for wetland *kalo* cultivation, and 17 acres are utilized for in-land aquaculture operations. Kualoa Ranch conducts ranching and livestock operations on its lands in the *ahupua'a* of Hakipu'u and Kualoa. The ranch also owns lands in Ko'olau Loa in the neighboring *ahupua'a* of Ka'a'awa.

The State Department of Agriculture owns and manages the 121-acre Waimānalo Agricultural Park. The Waimānalo Agricultural Park has 14 lots. DLNR plans to transfer its agricultural lands in Waimānalo to DOA as DOA is better suited to handle these lands.[xcix] DLNR currently leases lands in Waimānalo to tenant farmers. Based on aerial photo analysis and field verification conducted by the planning team in August 2008, approximately 1,100 acres of Waimānalo agricultural lands are currently being utilized for diversified agriculture, including nursery and ornamental crops. There are several livestock and ranching operations in Waimānalo as well.

There are small pockets of agriculture in the Kāne'ohe and Kailua areas. In Kāne'ohe, banana cultivation is located in the area near Luluku Valley, the H-3 Freeway, and Likelike Highway. In Kailua, there is small scale livestock grazing on portions of Kawainui Marsh and ranching along Auloa Road. There is also a small amount of wetland *kalo* cultivation in Maunawili Valley.

2.9.3 Military

Koʻolau Poko is home to Marine Corps Base Hawaiʻi (MCBH). The base consists of approximately 2,615 acres and occupies the entire Mōkapu Peninsula.[c] In the year 2000, the MCBH housed approximately 12,000 servicepersons and their families.[ci] MCBH plans to add 2,000 new housing units in two phases of construction over a 20 year period. However, all of these new housing units will replace old military housing. At the end of the second phase of construction, MCBH anticipates a net decrease of 65 housing units over the current housing inventory.[cii] In addition to military operations, the base also has several commercial establishments and the Klipper Golf Course.

The other major military installation in the district is the Bellows Air Force Station in Waimānalo. The Bellows Air Force Station occupies approximately 900 acres[ciii] along the northern end of Waimānalo Bay. In recent years, the Air Force station primarily served as a recreational retreat for servicepersons and their families. There are approximately 100 retreat cabins currently on the Air Force Station with plans to build 16 more cabins within the near future. There are also 60 campsites at Bellows Beach. Civilians are also permitted access to the area on weekends.

The military is currently engaged in Formerly Used Defense Site (FUDS) clean up activities in Waikāne Valley as the valley was utilized as a live-fire training area earlier in the 20th Century. The project site is about 875 acres. Earlier sweeps of the area conducted between 1976 and 1984 recovered over 40,000 pounds of training ordnance.[civ]

2.9.4 Residential

The 2000 Census reported 36,134 housing units in Koʻolau Poko, an increase of four percent from 1990. In comparison, Oʻahu as a whole increased its housing stock by about 10 percent during the same time period. The majority of the housing units were located in Kāneʻohe (13,116 units) and Kailua (16,686 units)[1]. The Kahaluʻu Neighborhood Board Area and Waimānalo had 4,587 housing units and 2,575 housing units respectively. Approximately 80 percent of the housing units in Koʻolau Poko were single family dwelling units in 2000.[cv]

Approximately 99.3 percent of residentially zoned lands in Koʻolau Poko have been built out. According to the Koʻolau Poko Sustainable Communities Plan, the City and County of Honolulu does not intend to re-designate additional lands in the district for residential

[1] Includes housing units on Marine Corps Base Hawaiʻi

use.[cvi] However, in Waimānalo, the Department of Hawaiian Home Lands has three planned residential development projects. There are 52 single family homes planned for the Kumuhau Street Residential Development project and 50 single family homes planned for the Kakaʻina Street Residential Development project. Construction for both of these projects is currently underway. The third planned DHHL residential development will occur on the existing Wong Farm parcel TMK (1) 4-1-8:79. DHHL plans to construct 200 residential units on the parcel.[cvii]

In the Kahaluʻu area, there is a proposal to build approximately 40 residential units. The proposed residential development, "The Woods at ʻĀhuimanu" would be developed on 15.4 acres near existing residences in the ʻĀhuimanu area.[cviii]

2.9.5 Industrial and Commercial Land Use

Industrial and commercial zoned lands in Koʻolau Poko account for less than one percent of all lands in the district. Most industrial operations in Koʻolau Poko involve light industrial activities such as auto repair services, skilled crafts, and warehouses. Industrial lands in the district are located in Kāneʻohe and Kailua. In Kāneʻohe, most of the light industrial activities are located on Kahuhipa Street near Windward Mall. In Kailua, most light industrial activities are located along Hāmākua Drive near the Hāmākua Marsh.

In Kailua, there is also light industrial activity in the vicinity of Kawainui Marsh adjacent to Kapaʻa Quarry Road consisting of the municipal Kapaʻa Refuse Transfer Station and green waste handling and processing facilities. There is also 195,000 square feet of existing warehouse space in the area owned by Kapaʻa III LLC. Kapaʻa III LLC has proposed to expand the amount of warehouse space to 660,000 square feet over the course of four construction phases with the first phase of construction scheduled to be completed in 2011 and the final phase of construction scheduled to be completed in 2026. The project also includes the creation of a 15 acre wildlife sanctuary (currently being developed) and a storm run-off and collection system that features three detention ponds that have a capacity of 123,500 cubic feet. All planned structures will be designed to meet the LEED Silver certification requirements.[cix] It should be noted that groups that are active in the preservation and restoration of Kawai Nui Marsh oppose this expansion.

In Waimānalo, DHHL and the Waimānalo Hawaiian Homesteads Association (WHHA) are planning to develop a "Community Technology, Telehealth, and Employment Training Center" (CTTETC) in a larger planned Economic and Technology Zone. The CTTETC will be a multi-use facility that will serve as a gateway for community learning, health information and related services, employment training, and e-commerce development. The larger Economic and Technology Zone will include a retail business center, retail spaces, multi-media studio, light industrial crafts shop, and office space.[cx]

The majority of commercial activity in Koʻolau Poko is also located in Kāneʻohe and Kailua as the two areas account for about 200 acres of the district's 225 total acres of commercially zoned lands. Koʻolau Poko commercial activities are mostly in the form of small businesses that service the local community. Kāneʻohe has three major shopping centers: the Windward Shopping Center, Kāneʻohe Bay Shopping Center and the Windward Mall. Most of the commercial activities and businesses in Kāneʻohe are located along Kamehameha Highway. In Kailua, the majority of commercial activity is located near the Kailua Town Center. The Aikahi Park Shopping Center and the Enchanted Lakes Shopping Center are other nodes of commercial activity in Kailua.

In Kahaluʻu, the Temple Valley Shopping Center is the major commercial area. There are several other roadside country stores located along Kamehameha Highway in this neighborhood board area including the iconic Hygenics Store. Waimānalo also has one shopping center. There are also several other smaller stores and eateries located along Kalanianaʻnole Highway in Waimānalo. Sea Life Park is located near Makapuʻu Point. Sea Life Park features attractions centered on marine life and includes a large aquarium and several holding pools for marine wildlife, including seals and dolphins.

2.9.6 Recreational Use

Koʻolau Poko has approximately 1,900 acres of park lands.[cxi] Table 2.30 lists Koʻolau Poko's parks and their corresponding acreages. Nature parks and botanical gardens account for approximately two-thirds of all park land in the district while beach and shoreline parks account for almost one-quarter of all park land in Koʻolau Poko.

Table 2. 30 Ko'olau Poko Parks

PARK NAME	ACRES		PARK NAME	ACRES
'Āhuimanu District Park	4.0		Kāne'ohe Civic Center Park	4.2
Aikahi Community Park	4.0		Kāne'ohe Beach Park	1.1
Bayview Neighborhood Park	15.7		Kapunahala Neighborhood Park	3.9
Enchanted Lake Community Park	5.8		Kawainui Neighborhood Park	4.8
Kahalu'u Regional Park	34.6		Kaupo Beach Park	8.2
Kahalu'u Community Park	5.6		Keolu Hills Neighborhood Park	6.3
Kāne'ohe District Park	31.4		Kea'alau Neighborhood Park	3.7
Kāne'ohe Park & Senior Center	2.0		Laenani Neighborhood Park	1.4
Kāne'ohe Community Park	5.5		Makapu'u Beach Park	46.9
Kualoa Regional Park	153.4		Maunawili Neighborhood Park	4.2
Bellows Field Beach Park	54.2		Maunawili Valley Neighborhood Park	8.1
He'eia State Park	18.5		Pohakupu Mini Park	3.5
He'eia Neighborhood Park	4.0		Puohala Neighborhood Park	3.9
Ka'elepulu Mini Park	1.6		Waiāhole Beach Park	14.9
Kailua Beach Park	35.2		Waimānalo Bay Beach Park	74.8
Kailua District Park	18.7		Waimānalo Beach Park	37.6
Kaiona Beach Park	4.3		Waimānalo District Park	25.3
Kalama Beach Park	4.3		Waihe'e Valley Nature Park	150
Kalaheo Neighborhood Park	1.4		Haiku Valley Cultural Park	230
Kaluapuhi Neighborhood Park	5.8		Waikāne Nature Preserve	503
Kawainui Nature Preserve	746.7		Ho'omaluhia Botanical Garden	211

There are seven golf courses in Ko'olau Poko, 1) Bay View Golf Course, 2) Pali Golf Course, 3) Ko'olau Golf Course, 4) Mid-Pacific Golf Course, 5) Luana Hills Country Club, 6) Olomana Golf Course, and 7) Klipper Golf Course. The Klipper Golf Course is the only golf course in the district that utilizes recycled wastewater for irrigation. The Pali Golf Course is a municipal golf course. The other golf courses in the district are privately owned. Together, these golf courses (including club houses, ancillary facilities, and parking lots) account for approximately 1,280 acres in the district.[cxii] None of the golf courses in the district have future expansion plans. Furthermore, the KPSCP states: "[The KPSCP] does not propose development of additional golf courses in the Koolaupoko region or the continuation of land use and other development entitlements for proposed golf courses that had not been built as of the end of 1998."[cxiii]

2.9.7 Colleges and University

Several higher education campuses and programs are located in Koʻolau Poko. The University of Hawaiʻi (UH) Windward Community College Campus, located in Kāneʻohe, consists of 64 acres. Hawaiʻi Pacific University's (HPU) Hawaiʻi Loa Campus consists of 130 acres. HPU has plans to add additional student housing (400 beds) on its Hawaiʻi Loa Campus and is also planning to build a new academic center, student center, recreational facilities, and offices.[cxiv] The UH Hawaiʻi Institute of Marine Biology (HIMB) is located on Moku o Loʻe (Coconut Island) in Kāneʻohe Bay and includes research facilities and enclosed lagoons that are used to keep organisms in captivity for study. HIMB is a part of the UH School of Ocean Earth Science and Technology (SOEST). SOEST has one other modest research facility in Koʻolau Poko, the Hawaiʻi Undersea Research Laboratory near Makapuʻu Point. The UH College of Tropical Agriculture and Human Resources (CTAHR) also has a research station in Waimānalo. The CTAHR Waimānalo Research Station includes a modest cluster of buildings that house an office, laboratory, general storage, and chemical storage.

KEY FINDINGS

- Almost half of the district's lands are in the State Conservation Land Use District or the City and County's Preservation Zone
- Government (Federal, State, and City and County) owns about half of all land in Koʻolau Poko
- The amount of designated land for urban use in Koʻolau Poko is nearly all built out.
- 1,870 acres of agricultural land were in cultivation, per 2005 air photos. Most of this cultivated agricultural land was "Prime."
- There are still some 400+ acres of "Prime" land and 5,000+ acres of "Other" agricultural land that could be cultivated in the future.

2.10 PREVIOUS RELEVANT PLANS

There have been several notable water use or watershed management related planning efforts that have previously occurred statewide or in Koʻolau Poko that are relevant to this planning process. This section provides a brief summary of some of these plans. The Hawaiʻi State Water Code requires that the County Water Use and Development Plans incorporate the Hawaiʻi Water Resources Protection Plan, Hawaiʻi Water Quality Plan, State Water Projects Plan, Agriculture Water Use and Development Plan, county land use plan, and DHHL planned developments. These required plans are indicated by an asterisks mark (*).

Other plans not required by the State Water Code to be incorporated into the Koʻolau Poko Watershed Management Plan were referenced for this planning process. These plans were important resources of information for this planning process and are also summarized below.

Hawai'i Water Resource Protection Plan*
CWRM (2008)

CWRM is responsible for the preparation of the Water Resource Protection Plan (WRPP), which is a key component of the Hawai'i Water Plan. The objective of the WRPP is to protect and sustain ground and surface water resources, watersheds, and natural stream environments statewide. Such protection requires a comprehensive study of occurrence, sustainability, conservation, augmentation, and other resource management measures. One of the key components in the 2008 version of the WRPP is the identification of hydrologic units and their characteristics, including the quantity and quality of available resources, and requirements for beneficial in stream uses and environmental protection.

Hawai'i Water Quality Plan*
DOH (1990)

The Water Quality Plan outlines the regulations, standards, and resource management policies that define the quality to be maintained in ground and surface water resources and includes federal/state/county goals, objectives, and policies related to water quality. The plan also identifies water quality monitoring requirements and enforcement provisions. DOH is currently undertaking numerous program efforts that will contribute to the update of the Water Quality Plan. Such programs include the Source Water Assessment Program (SWAP), and various other water quality management and water pollution control efforts, including the identification of impaired water bodies and the development and implementation of TMDLs. Results of these ongoing program efforts, such as SWAP, will be incorporated in an updated Water Quality Plan. The Water Quality Plan, together with the WRPP, establishes the overall protection framework for our State's water resources.

State Water Projects Plan*
DLNR Engineering Division (2003)

The purpose of the State Water Projects Plan (SWPP) is to provide a framework for planning and implementation of water development projects to meet projected demands for State projects over a 20-year planning horizon. The objective of the SWPP is to review current and future state water projects to ensure orderly authorization and development of the state's water resources. Each State department is surveyed to inventory existing and proposed State sponsored projects, associated water requirements by island and hyrdrologic unit, and proposed sources to meet the demand. Agency plans for future source development should be coordinated with DLNR and integrated within the County Water Use and Development Plans.

Agricultural Water Use and Development Plan*
DOA (2004)

The major objective of the Agricultural Water Use and Development Plan (AWUDP) is to develop a long-range management plan that assesses state and private agricultural water use, supply, and irrigation water systems. The plan is intended to be a master irrigation inventory plan which identifies system rehabilitation needs and prioritizes system repair. Agricultural lands are extensive and can require significant quantities of water to maintain productivity. The AWUDP is intended to promote the agricultural self-sufficiency of the State and maintain important agricultural water systems.

Ko'olau Poko Sustainable Communities Plan*
DPP (2000)

The City and County of Honolulu Charter requires that a development plan or sustainable communities plan be developed for each of O'ahu's eight districts. Together with the General Plan, the regional sustainable communities plans or development plans guide population and land use growth over a 20+ year time span. As part of the annual city budget process, all capital improvement projects are reviewed to determine if they are consistent with the respective regional plan. These regional plans are intended to guide City land use approvals and permits and influence private sector investment decisions.

The Ko'olau Poko Sustainable Communities Plan (KPSCP) seeks to preserve the district's, natural, scenic, cultural, historical, and agricultural resources, and to protect the residential environment of its neighborhoods. The KPSCP calls for adaptation of the traditional "*ahupua'a*" concept as a basis for land use and natural resources management. The plan articulates a "low growth development" land use policy for Ko'olau Poko over the 20 year planning horizon.

Ko'olaupoko Watershed Restoration Action Strategy
Kailua Bay Advisory Council, DOH (2007)

The purpose of the KWRAS was to assess the state of watershed health in Ko'olau Poko and propose actions to improve the health of all watersheds in Ko'olau Poko. The KWRAS utilized the nine priority elements established by the EPA's Clean Water Act. Additionally, since this WRAS was approved, all included projects are eligible for funding through the State's 319(h) program, which was established in accordance with the Clean Water Act. The KWRAS included analyses of pollutants found in the Ko'olau Poko watershed's four major basins and recommended possible infrastructure improvements and programs to reduce pollutants.

Kahalu'u Community Master Plan
DPP (2007)

The purpose of the Kahalu'u Community Master Plan is to "provid[e] a framework to guide the future development of Kahalu'u." (Executive Summary) More specifically, the plan formalizes the community vision of keeping Kahalu'u rural; prioritizes a list of 42 capital improvement projects in line with the vision; and develops guidelines for future development.

Kāne'ohe Bay Master Plan
State Office of Planning (1992)

The Kāne'ohe Bay Task Force was created by Act 208 of 1990 with the purpose of developing and implementing a Master Plan for the Bay. The purpose of the Master Plan was to plan for the preservation and protection of Kāne'ohe Bay as a natural and cultural resource, to resolve conflicts among recreational users, and to gauge the environmental impacts of activities in the bay. The need for these guidelines was in response to the impacts of urbanization and subsequent pollution and impacts caused by human actions.

Issues of land use development, public open space and access, water quality, fishing, commercial recreation, and fishpond restoration were identified. Recommended solutions and guidelines were developed to address these issues. Long range planning issues were also presented. The Kāne'ohe Bay Regional Task Force was created to assist with the implementation of the plan.

Kāne'ohe-Kahalu'u Stream Restoration and Maintenance: A Community Guidebook
Department of Design and Construction (2003)

The purpose of this report was to develop a framework to guide the community in the preservation, restoration and maintenance of streams in Kāne'ohe and Kahalu'u. The framework of the guidebook was based on traditional *ahupua'a* management perspectives, which focused on integrated management of cultural and natural resources. This report focused on the streams in the Kāne'ohe and Kahalu'u Neighborhood Board areas.

This report presented the historical and cultural backgrounds of every *ahupua'a* that has a stream that drains into Kāne'ohe Bay. Physical data and current usages were also presented. A summary of recent and planned projects and initiatives (including dredging, Clean Water Act 303(d) list status, and master plan development) was included for each stream.

Kawainui Marsh Master Plan
DLNR (1994)

DLNR prepared the Kawainui Marsh Master Plan for the Kawainui Marsh and vicinity to preserve, protect, and enhance the natural and cultural resources of the marsh. A variety of resource management concerns hinder the potential of the marsh as a wildlife habitat, flood storage basin, cultural and educational asset, and recreational area. To address these concerns, the plan includes recommendations for enhancement and management of the marsh in three areas: Preservation Actions, Master Plan Improvements, and Management Actions.

Preservation Actions included recommendations to create a wildlife sanctuary, include Kawainui Marsh on the National Register of Historic Places, and create conservation easements for areas of contiguous wetland *mauka* of Kailua Road. Master Plan Improvements included developments within the marsh that would help increase education and awareness about the marsh and its unique natural and cultural characteristics. Management Actions included recommendations for the long-term maintenance activities needed to ensure the protection of the marsh's preservation values.

Waimānalo Regional Plan*
DHHL (2007)

The Department of Hawaiian Home Lands' (DHHL) mission is to manage effectively the Hawaiian Home Lands Trust and to develop and deliver lands to Native Hawaiians. DHHL works in partnership with other government agencies, private sector entrepreneurs, and non-profit organizations to carry out this mission. This work includes collaborative visioning, long-range planning, resource allocation, and project-specific joint ventures. DHHL believes that these partnerships benefit not only its Native Hawaiian beneficiaries but the larger community as well.

The Waimānalo Regional Plan was prepared to facilitate the work of such partnerships as DHHL continues to develop its lands in Waimānalo. The plan was intended to: identify opportunities for partnerships with DHHL for further development of its Waimānalo lands; provide information essential to the planning of projects, services, and entrepreneurial ventures; identify issues and opportunities affecting regional development and area improvements; assist in the efficient allocation of resources by DHHL and its partners; and identify priority projects that are essential to moving development and community improvement projects forward.

Waimānalo Watershed: Watershed Plan and Environmental Impact Statement
NRCS, City and County of Honolulu (1981)

The report described the formulation, implementation, and effects of a local – federal cost-shared project to solve problems with inefficient use of water and related resources and severe limitations on the production of crops in Waimānalo. The project also studied and recommended various solutions to enhance the agricultural use of prime and important farmlands. Land treatment, improved irrigation water management, irrigation use of treated sewage effluent and rehabilitation and expansion of the existing irrigation system were investigated in formulating alternative plans including a no-action plan.

2.11 STAKEHOLDER CONSULTATION

2.11.1 Goals and Objectives of the Stakeholder Consultation Process

The Stakeholder Consultation process emphasized a community-based approach through extensive discussion and consultations with residents, community leaders, community organizations, land owners, business owners, public agencies and elected officials. Interested and active public and private stakeholders provided valuable insights during the course of the planning process regarding:

- Defining aspects of Koʻolau Poko that people value
- Defining key water use and watershed related issues in Koʻolau Poko
- Development of policies, actions, and strategies for this plan
- Evaluation of proposed policies, actions, and strategies

The stakeholder consultation process included over 40 small group and individual one-on-one "talk story" meetings with elected officials, community groups and individual community members, two rounds of "sub-district" meetings in each of Koʻolau Poko's four Neighborhood Board areas (four sub-district meetings total), and three district-wide community meetings. Koʻolau Poko's four neighborhood boards were also updated periodically about the plan's process and content. Board of Water Supply staff also met with ten government agencies at the City, State, and Federal level.

The planning team coordinated other activities in an effort to encourage broad community involvement in the development of the Koʻolau Poko Watershed Management Plan. These activities included: development of project factsheets, attending various community events and other community sponsored meetings including Hui o Koʻolaupoko Talk Story Meetings, the February 2009 Ramsar World Wetlands Day at Kawainui Marsh, and the June 2009 OHA Kalo Task Force meeting in Kāneʻohe. The Board of Water Supply also hosts a Watershed Management Plan web page that includes information on the Koʻolau

Poko Watershed Management Plan as well as the adopted Waiʻanae and Koʻolau Loa Watershed Management Plans.

2.11.2 Stakeholder Identification

Stakeholders represented a broad range of community members, organizations, and public agencies that are interested in, are affected by, or could affect activities related to the development of the Koʻolau Poko Watershed Management Plan. Three resources were used to identify potential stakeholders; 1) Koʻolau Poko Sustainable Communities Plan database; 2) referrals from community members; 3) referrals from government agencies and elected officials.

In 2000, the City and County of Honolulu Department of Planning and Permitting completed the Koʻolau Poko Sustainable Communities Plan. During this planning process, a database of community members' names and contact information was compiled. Information from this database was used to identify stakeholders. During initial outreach meetings with stakeholders, stakeholders were asked "who else should we talk to?" This process identified additional community members that should be consulted. Government agencies and elected officials also helped the Board of Water Supply to identify stakeholders both within the Koʻolau Poko community as well as within other agency departments or divisions.

2.11.3 Consultation Process

2.11.3.1 Small Groups and Individual "Talk Story" Meetings

The initial consultation process involved small group and individual meetings with elected officials, various community organizations, land owners, government agencies, and respected individuals in Koʻolau Poko's communities. The purpose of these meetings was to inform people about the plan and the planning process and to identify community values and issues. A summary of the community values and issues is included at the end of this chapter.

COMMUNITY ORGANIZATIONS AND INDIVIDUALS

Between the months of December 2008 and August 2009, a total of 40 small group and individual meetings was conducted that involved approximately 120 individuals. Table 2.31 displays the community organizations, individuals, and landowners that were consulted during this process.

Table 2. 31 Stakeholders Consulted

Aloha ʻĀina Programs
ALU LIKE Inc.'s Ke Ola Pono Na Kūpuna Program
Cynthia Wahinekapu – Waimānalo Neighborhood Board
Dr. Charles Burrows – ʻAhahui Mālama I ka Lōkahi
Charlie Reppun
Daniel Bishop
Dr. Clyde Tamaru – Windward Community College
Dr. Paul Brennan – Kailua Historical Society
God's Country Waimānalo
Hakipuʻu Learning Center
Hālawa-Luluku Interpretive Development
Herb Lee -- Pacific American Foundation
Hoʻolaulima ia Kawainui
Hui Ku Maoli Ola
Hui o Koʻolaupoko
Just Add Water Farms (Waimānalo)
Kanoe Fukumitsu
Kahaluʻu Neighborhood Board Representatives
Kailua Hawaiian Civic Club
Kailua Neighborhood Board Representatives
Kaipo Faris
Kakoʻo Ōʻiwi
Kāneʻohe Ranch
Kapua Sproat
KEY Project
Kim Kalama
Koʻolau Mountain Watershed Partnership
Koʻolaupoko Hawaiian Civic Club
Kualoa Ranch
Lisa Ferentinos
Mark Stride
Paepae o Heʻeia
Paul Reppun
Ulalia Woodside
Waimānalo Agriculture Association
Waimānalo Hawaiian Civic Club
Waimānalo Hawaiian Homes Association
Wali Camvel – Kaʻailehua
William Sager – Kāneʻohe Neighborhood Board
Wong's Taro Leaf Farm (Kahaluʻu)

ELECTED OFFICIALS

The Board of Water Supply notified Koʻolau Poko's 10 elected officials about the plan and planning process and met with most of them, including:

- City Councilmember Ikaika Anderson
- City Councilmember Donovan Dela Cruz
- State Senator Clayton Hee
- State Senator Jill Tokuda
- State Representative Pono Chong
- State Representative Ken Ito
- State Representative Chris Lee
- State Representative Cynthia Thielen
- State Representative Jessica Wooley

GOVERNMENT AGENCIES

The Board of Water Supply met individually with ten government agencies at the Federal, State, and City and County levels. These agencies included:

Federal Agencies

- United States Geological Survey (USGS)
- Natural Resources Conservation Service (NRCS)
- Marine Corp Base Hawaiʻi (MCBH)
- Bellows Air Force Station Environmental Program

State Agencies

- Division of Forestry and Wildlife (DOFAW)
- Coastal Zone Management Program (CZM)
- Commission on Water Resources Management (CWRM)
- Department of Agriculture (DOA)
- Department of Health (DOH)

City & County Agencies

- Department of Planning and Permitting (DPP)
- Department of Environmental Services (ENV)

<u>Summary of Agency Values and Concerns</u>

Each agency reported its current and near-term planned activities in Koʻolau Poko. In addition, each agency shared issues and concerns that they have encountered while working in the district. The issues that agencies identified are included together with the issues that were identified by community members on pages 2-84 to 2-97. In addition to identifying common issues, several common values were identified by these agencies as well. The common values and concerns that were identified by the agencies are discussed briefly below.

Public Trust
Each of the agencies expressed that gaining the public's trust is critical to successfully working with community members. Agencies also talked about public trust in the context of resource management, the idea that certain resources are preserved for public use for current and future generations.

Liability
Liability can mean something that is a hindrance or puts an individual or minority group at an unfair disadvantage. When managing public resources, agencies must choose a course of action that benefits the majority of the population, but in a way that does not unfairly cause harm to an individual or minority group.

Health and Public Safety
Ensuring general public safety is another value that guides agency management of a resource. Public safety involves the prevention of and protection from events or actions that could endanger the safety of the general public from significant danger, injury, or harm.

Regulatory Compliance
Public agency actions are also guided by existing rules and regulations. Regulatory compliance refers to the goal that public agencies must ensure that their management actions are consistent with federal, state, and county rules and regulations.

Funding
The existence of or lack of sources of reliable funding also guides agency resource management decisions. Agencies can only implement management actions that have reliable sources of funding.

Infrastructure Cost and Maintenance
Related to funding is the agency issue of infrastructure cost and maintenance. Agencies must also weigh the long-term cost of maintaining existing and proposed new infrastructure before deciding to add new infrastructure. Assets that are not consistently maintained may pose a greater threat to the public than not having that particular infrastructure asset at all.

2.11.3.2 Sub-District Meetings

The second method of outreach that was used during this planning process was "sub-district meetings". Due to the unique attributes of Ko‘olau Poko's different neighborhood board areas, the Board of Water Supply decided to conduct two or three rounds of sub-district meetings. Each round would consist of one meeting in each of the district's four neighborhood board areas (Kahalu‘u, Kāne‘ohe, Kailua, and Waimānalo). These sub-district meetings would be held in addition to larger district-wide meetings in order to better identify and address the needs and issues of each specific neighborhood board area.

The first round of sub-district meetings was conducted in April and May of 2009. During this first round, the planning team presented a summary of "WHAT WE'VE HEARD" during the initial small group and individual "talk story" meetings. The summary included key community values, issues, and suggested strategies that were specific to each neighborhood board area. Meeting participants were asked to verify whether or not the Board of Water Supply had accurately captured their concerns and ideas. Several new ideas and comments were collected as a result of these meetings. A total of 51 individuals participated in these four sub-district meetings.

The second round of sub-district meetings was conducted in May of 2010. During the second round, the planning team presented preliminary watershed management projects and strategies that were specific to each neighborhood board area as well as several district-wide watershed management projects and strategies. These watershed management projects and strategies (presented in Chapter 4) were developed based on the issues and values identified during the initial outreach process. At the May 2010 sub-district meetings, community members were given the opportunity to provide comments and feedback on these ideas. A total of 47 individuals participated in these four sub-district meetings.

In addition to hosting sub-district meetings, the planning team also conducted a district-wide public informational meeting on current water use and projected future water use in Ko‘olau Poko. The meeting was held in February of 2010. The purpose of the meeting was to inform community members about current and future water use in the district (information presented in Chapter 3). A total of 30 individuals attended the public informational meeting. A second public informational meeting was held in January 2011 to present the Public Review Draft of the KPWMP. The four neighborhood boards were also briefed on the Plan. A third and final public informational meeting was held in September 2011 to present the pre-final draft KPWMP.

2.11.4 Summary of Community Values

While many of the discussions during the community outreach process focused on identifying water related issues and problems in Ko‘olau Poko, the communities of Ko‘olau Poko also identified aspects of their areas that they value and treasure. The following is a summary of the values that were identified during the outreach process. Presented first are the common values that were mentioned by the different communities in Ko‘olau Poko.

2.11.4.1 District-Wide Community Values

Promote the cultivation of more locally-grown food and the concept of food security
In each of Koʻolau Poko's communities, food security and locally grown food was one of the most commonly cited values by people. Community members expressed the desire to preserve existing agricultural areas in the district. Several community members also expressed the desire to return areas in the district that were historically used for agriculture back to cultivation.

Kāneʻohe Bay has potential for abundance
Related to the value of food security and locally grown food, community members in the Kahaluʻu and Kāneʻohe neighborhood board areas noted Kāneʻohe Bay's potential for food production. In particular, the bay's fishponds were valued for their potential to provide food once again. *"Fishponds in Kāneʻohe Bay take advantage of the natural estuary that already exists in the bay. The fishponds used to harness the natural productive energy of the estuary."* In addition, community members stated that "*we would like to restore the fishponds that we do have, but we would also like to see the development of new fishponds as well.*" Many types of *limu* were once abundant in the bay. *"The huluhuluwaena* [a particular type of limu]*, where fresh water meets sea water, we have that in abundance here."*

Koʻolau Poko's water resources are treasured
Not surprisingly, each of Koʻolau Poko's different communities said that they valued the water resources of their particular area. In some areas, water was valued for its quality. *"Water in Waimānalo was cold and clean. It was sweet."* In other areas, water was valued for its abundance and life giving ability. *"Maunawili Valley was rich in water resources. It was like an umbilical cord which allowed the birthing of life down below."* Fresh water flowing into the sea was of particular value to community members living near Kāneʻohe Bay. *"The Waiāhole Case was a big learning opportunity. Before the case, stream water flowing into the ocean was considered a waste of water. Now stream water flowing into the ocean is not considered a waste and we now know it serves a very important use. As water returned to the streams, there was almost an instantaneous improvement in the health of estuaries."*

Place names and cultural knowledge are valued
The place names of an area are significant. In several meetings, community members reminded BWS about the significance and importance that the place names of an area have with regards to natural resource management. Place names often describe the physical, natural, or spiritual significance of an area. For example, a community member in Waimānalo stated: *"Any place that starts with 'wai' was named because of its water resources."*

Place-based natural resource management and cultural education programs are valued
"Children do not need walls and a desk to learn about the world. They need to be out in the world to learn about the world. They need more opportunities to be in the dirt, in the streams." Ko'olau Poko has many groups, organizations, and community-government partnerships currently engaged in providing educational programs centered on natural resource management and cultural education. These types of programs can be found throughout the district and at various locations in the *ahupua'a,* from *lo'i* terraces in *mauka* areas to programs located at *makai* fishponds. There is a strong desire in the community to continue to expand these types of programs.

Through the community outreach process, BWS documented 13 place-based natural resource management and cultural education programs that currently exist in the district or that are being planned for in the near future. These program providers are listed below:

Ko'olau Poko Place-Based Education Programs

- Kualoa Ranch – *Lo'i* programs
- KEY Project / Waihe'e Ahupua'a Initiative
- God's Country Waimānalo
- Hakipu'u Learning Center
- Kāko'o Ōiwi - Māhuahua Ai o Hoi
- Aloha 'Āina
- Ko'olau Foundation – Ha'ikū Valley Cultural Preserve
- Paepae o He'eia
- Ke Kula O Samuel Kamakau Charter School
- Pacific American Foundation – Waikalua Loko Fishpond activities
- Papahana Kuaola
- Ka'ailehua – *Lo'i* restoration
- Aha Hui Mālāma I ka Lokāhi
- Hui Mālāma I Ke Kai

2.11.4.2 Neighborhood Board Area Specific Values

The following section describes the values that were mentioned by community members that are unique characteristics of their respective neighborhood board areas.

KAHALU'U NEIGHBORHOOD BOARD AREA VALUES

Rural character
Community members often said that the rural character of the Kahalu'u was a characteristic that they valued. *"There is a long history of rural tradition and activities [in Kahalu'u] that needs to be perpetuated."* In addition, community members pointed out that the Kahalu'u's rural character is unique because: *"Kahalu'u is unique compared to other areas because of the presence of agriculture, especially wetland kalo cultivation and aquaculture."*

Natural healthy streams
Community members repeatedly spoke of the health of the streams in the Kahaluʻu area as something they valued. While Kahaluʻu streams are not in a completely pristine condition and have been altered to some degree by human activity, the community recognizes that the condition of their streams is much better than the condition of streams in other areas of the district. A community member said, "*Waiheʻe Stream and all of the streams north of Kahaluʻu are not concrete lined or channelized. They are still 'natural.'*"

KĀNEʻOHE NEIGHBORHOOD BOARD AREA VALUES

The Heʻeia a*hupuaʻa* has abundant natural, cultural, and educational resources
The *ahupuaʻa* of Heʻeia was noted by several members of the Kāneʻohe community as a special area that possesses many different types of resources. Several of the characteristics people noted about Heʻeia included: *"The ahupuaʻa of Heʻeia is unique in the sense that there are restoration and stewardship activities taking place in different areas of the ahupuaʻa"* and *"I heard legends that told a story that Heʻeia was one of the wettest places in the islands. There were so many springs that they did not need the streams for the loʻi."*

KAILUA NEIGHBORHOOD BOARD AREA VALUES

Koʻolaupoko watershed restoration action strategy
Kailua community members valued the work that has been already completed by Hui o Koʻolaupoko in the form of the Koʻolaupoko Watershed Restoration Action Strategy. They would like to see the ideas that were developed in the report incorporated into the KPWMP. *"The one thing that is different about Kailua from the other communities in Koʻolau Poko is that Kailua already has a watershed management plan, the "KWRAS" created by [Hui o Koʻolaupoko]. We want this document to be incorporated into the KPWMP. There is no need to reinvent the wheel."* It should be noted that the KWRAS includes actions and projects for all areas of Koʻolau Poko in addition to Kailua.

Kailua's wetlands are valued for their unique ecological diversity, cultural resources, and educational resources
Many members of the Kailua community that were involved in the small group meetings spoke of the importance of Kailua's wetlands. Both the Kawainui Marsh and Hāmākua Marsh provide habitats for rare native wetland birds. In addition to being suitable habitats for native wetland birds, community members value Kailua's wetlands as places that the community can enjoy for education and culture. *"Kawainui is a cultural kipuka preserved from development. What we do here with the students will serve as 'seeds' for generations to come."*

Kailua's *makai* areas provide recreational and ecological value
Community members are proud of Kailua's beaches and offshore islands. *"Kailua has the best beaches in the world. They are enjoyed by many people each year. We need to preserve them for future generations."* Community members have also said that Kailua's offshore islands provide habitats for seabirds and are enjoyed by many people for recreational purposes.

WAIMĀNALO NEIGHBORHOOD BOARD AREA VALUES

Rural character
Like Kahalu'u, Waimānalo community members value Waimānalo's rural characteristics. Specific rural characteristics that community members mentioned included *"the feeling of being close-knit"* and *"the presence of active farming within the community."*

2.11.5 Summary of Water Use and Watershed Related Issues and Suggested Strategies Identified by Community Members and Government Agencies

2.11.5.1 District-Wide Issues
The following is a summary of district-wide water use and watershed management related issues that were identified in two or more neighborhood board areas in Ko'olau Poko by community members and/or government agencies. Although not specifically mentioned, management and removal of **invasive plants** and **feral pigs** is related to many place specific watershed issues. Also not specifically mentioned, but associated with many watershed related issues in Ko'olau Poko, is **private property ownership** which in some instances prevented access to resources and the coordination of comprehensive watershed management activities.

The resolution of the issues discussed in this section will require cooperation and coordination among Ko'olau Poko's different communities and also cooperation and coordination between community and government agencies.

Listed below these issues are **preliminary strategies** that were suggested by either community members or agencies to address the issues.

A. Population growth and development impairs watershed health and may jeopardize future ground water sustainability

Community members throughout Koʻolau Poko expressed concern about the future sustainability of the district's ground water sources and that the district's aquifer systems may be irreparably damaged if they are over pumped due to increased water demand caused by more population growth and more development. Several community comments included:

- "As an island as a whole, but in Koʻolau Poko in particular, we really ought to make sure that we are being extremely precautionary in terms of managing sustainable yield."
- "We have the same amount of water as we did before, but we have a lot more people. We are taking water out of the ground faster than water is being put back in."
- "The basics are this, human beings, when we start using water, we immediately impact the optimum state of nature."
- "It will be hard to convince people to voluntarily conserve water if people see more and more new homes being built. People will ask, 'why should I conserve more water if new homes are being built?'"

Community members were also concerned that population growth and additional development in other areas of Oʻahu may result in a need to export Koʻolau Poko's water resources to those areas. *"If the other areas on the island keep on growing, they are eventually going to take windward water. That is the danger of continual population growth."* Many community members said that they would like to see *"windward water stay windward."* Community members stated that keeping windward water on the windward side is not just for *"selfish reasons."* Preventing export of windward water to other areas on the island benefits everyone on the entire island in several ways. *"Fresh water into Kāneʻohe Bay is good for food; it is good for recreation; fresh water for windward agriculture is beneficial for everyone."*

Community members also expressed specific concern about the *"hidden populations"* in the district that occur when multiple families live in a single family residence. Community members have observed that more and more families in Koʻolau Poko have been living under one roof. Planning for future water use should take into consideration *"hidden population"* growth. A community member commented: *"You cannot just count the number of water connections per house. You need to take into account how many people live in a single house and because of that, these houses are using more water than they were before."*

Existing development was also a concern for community members, as they perceived existing development as the major source of watershed related problems. A community member remarked: *"Watershed problems are caused by development. Our problems are caused by land use. We need to change our land use policy."*

Suggested strategies to address issue:

- Ensure that the low-growth land use policies of the Koʻolau Poko Sustainable Communities Plan are enforced.
- The KPWMP should have policies that clearly state that BWS will not be developing additional ground water wells and will not increase the amount of water it exports from Koʻolau Poko to other areas of the island.
- The KPWMP should incorporate the concept of "carrying capacity" in its policies; if there are insufficient amounts of water, then there should be no additional development.
- Integrate water use and watershed management policies of KPWMP with land use policies of KPSCP.
- Include a policy in the KPWMP and KPSCP that requires any future development in the district to incorporate "green infrastructure" in order to conserve water: rain catchment systems, low flush toilets, dual gray water and potable water systems etc. Future development should be "low-impact' and have a smaller "water foot-print."

B. Koʻolau Poko is not as wet as it once was

Residents in the district have commented that the current amount of water is noticeably less than what it was in the past. Several accounts are noted below:

- "Near Heʻeia Kea Bridge, kapa used to be produced in the area which suggests that there was plenty of water in the area because you need a lot of water to pound kapa."
- "Waimānalo used to have lots of water. There used to be water falls in all of the crevices on the mountain. We do not see that anymore."

Suggested strategy to address issue:

- The KPWMP policies and projects should take into account the possibility of long term climate change and anticipate more frequent and longer drought periods.

C. Return more fresh water to streams, wetlands, and estuaries to ensure enough water for agricultural, cultural, and environmental purposes

Across the district, community members have noted the importance of having sufficient amounts of fresh water in streams for cultural and environmental uses. There are two instances where returning fresh water to a particular stream would affect multiple neighborhood board areas in Koʻolau Poko including:

- **Returning water to Waiheʻe Stream** – The Waiheʻe Tunnels are the largest BWS sources of potable water in Koʻolau Poko. The diversion of water from the dike system to the Waiheʻe Tunnels has reduced the amount of stream flow for Waiheʻe Stream and has negatively impacted *kalo* farmers who get their water from the stream. A *kalo* farmer in Waiheʻe reported that water temperature in his *loʻi* is warmer due to lower stream flow. The warmer temperature has resulted in some of his *kalo* rotting. The diversion of water from Waiheʻe Stream also reduces the amount of fresh water flowing into Kāneʻohe Bay. However, decreasing the amount of water being diverted by the Waiheʻe Tunnels may have significant impacts on residents in the district who receive their water from BWS for their homes or businesses.
- **Returning water to Maunawili Stream** – The Maunawili Ditch System diverts water from Maunawili Stream and transports the water to Waimānalo farms. The water from Maunawili Stream is the primary source of water for many Waimānalo farms. Several members of the Kailua community would like to see the amount of water diverted from Maunawili Stream decreased so that more fresh water will flow into Kawainui Marsh. More fresh water flowing into the marsh would help to restore the marsh's ecosystems as well as allow the Kawainui Marsh area to become *"a food producing area once again."* However, decreasing the amount of water being diverted from Maunawili Stream to Waimānalo would have an adverse impact on Waimānalo agricultural operations.

Koʻolau Poko residents would like to make sure that there is enough water available for agricultural uses. A community member commented: *"More priority for water should be given for traditional and non-traditional agriculture uses and for food sustainability when making water allocation decisions."* This also includes making sure that there is sufficient amounts of fresh water flowing into the district's fishponds.

Suggested strategies to address issue:

- Conduct the necessary studies needed to establish measurable in-stream flow standards for Koʻolau Poko Streams.
- Verify and register all current surface water use in Koʻolau Poko in order to inform better decision making. We need to know what is currently being used in order to determine how much water is available in the future.
- Remove invasive plant species along stream banks. Invasive plants soak up a lot of water. Plant more native species.

D. Surface water quality is degraded

The water quality of the district's surface waters was raised as an issue in each of Koʻolau Poko's neighborhood board areas. The source of stream pollutants varies across the different areas of the district. Specific surface water quality issues and suggested strategies are further detailed later in this section under individual neighborhood board areas.

E. Nearshore water quality is degraded

Community members across the district expressed concern about the nearshore water quality in their respective areas. Specific nearshore water issues and suggested strategies are addressed under the issues and concerns of each neighborhood board area. It should be noted that improving the nearshore water quality of Kāneʻohe Bay will require inter-district cooperation and coordination between the communities in Kāneʻohe and Kahaluʻu.

F. Stream channelization

Community members also noted their concern that the concrete channelization of streams has significantly impaired the aquatic environments for most streams in the district. The channelization of streams was done to mitigate flood damage to surrounding residences and private property. Community members would rather see alternative solutions for flood mitigation other than stream channelization. A community member stated: *"Stream channelization is bad. We need to let the streams meander. We need to plan around the streams."*

Suggested strategies to address issue:

- Establish specific buffer areas for specific streams. Make sure these buffer areas are reflected in the KPSCP.
- The KPWMP should include a policy that prevents streams that have not been concrete lined from being concrete lined in the future. Make sure this policy is reflected in the KPSCP.
- Restore *loʻi* in key areas. *Loʻi* can help to mitigate flood damage.

G. Concern about previous government management of water and natural resources

Given the previous history of water issues and legal battles over water and development in the district, some residents do not trust government's management of water and of other natural resources. A community member commented during one of the small group meetings: *"It seems to me that BWS's mission is just to provide water for more development. Any data that BWS produces may be biased towards allowing for more development."* Other community members felt that despite previous missteps by government in the past, agencies should be given a chance to prove their good intentions. *"We should not lock BWS into their past position. We need to give BWS a chance to change."*

Suggested strategies to address issue:

- Make sure current and future BWS planning processes are open and transparent.
- Involve community in the *implementation* of the plan, not just the creation of the plan.
- The plan should identify community/government partnerships (currently existing partnerships or possible future partnerships) needed to help BWS implement the KPWMP.

- Establish partnerships with the community to help with monitoring and data collecting.
- BWS should be more proactive in educating the community about Koʻolau Poko's hydrology and geology and how BWS pumpage impacts the natural environment.

H. Improved management of storm water is needed

The relatively high degree of urbanization in Kāneʻohe and Kailua in particular and the large amounts of impervious surfaces in these areas has created problems with the disposal of storm water. Rain water that would normally percolate into the ground, instead collects in storm drains and carries with it chemical pollutants from pavements and roadways. Eventually most storm water flows into streams and ends up in the ocean.

Suggested strategies to address issue:

- Impose a special building permit fee based on the amount of impervious surface planned for the property. Funds generated by these fees would go towards costs associated with storm water management. A fee might also discourage the creation of excessive impervious surfaces.
- Install hydro-modification devices that filter out pollutants from storm water.

I. Illegal dumping

Throughout the district there have been many reported incidences of illegal dumping. Common places where large bulky items can be found include several of the district's stream beds. There are certain areas in the district that community members have mentioned where illegal dumping is particularly bad. In the back areas of Waiāhole Valley, a large amount of debris and trash can be found. Trash and debris can also be found in Waiheʻe Valley. Large bulky items, including abandoned vehicles can be found along Kapaʻa Quarry Road in Kailua and in the back areas of the Waimānalo farm lots. Several community groups have regularly organized community work days to remove debris. For instance, the Windward *Ahupuaʻa* Alliance has conducted work days along Kapaʻa Road and the Waimānalo Hawaiian Homestead Association conducts work days periodically to clear out debris in Waimānalo's streams. However, there are some regulatory obstacles that community groups have encountered when conducting clean up days. Groups have had to pay City dumping fees to dispose of the trash that was collected and there are several permits that are required to conduct clean up days. These regulatory obstacles sometimes deter community groups from organizing and conducting work days. Private land ownership and access issues are other obstacles that deter community groups from organizing work days.

Suggested strategies to address issue:

- Install video cameras in locations where illegal dumping is especially bad.
- Revise relevant rules and permitting requirements to make it easier for community groups to conduct work days.

- Establish new community led clean-up work days in areas in the district where there are none.

2.11.5.2 Neighborhood Board Area Specific Issues

The following section describes water use and watershed management issues that were mentioned by community members and/or agencies that are unique issues for the respective neighborhood board area.

KAHALU'U NEIGHBORHOOD BOARD AREA ISSUES

A. Flooding in the Kahalu'u area

There are several areas within the Kahalu'u Neighborhood Board Area where residents are concerned about flooding. Specific areas of flood concern that were mentioned include areas near Waikāne Bridge and areas near the Kahalu'u Flood Control Pond.

- "There is a lot of flooding around the Waikāne Bridge. The bridge is really low, so it does not take much for it to flood. We need to remove the sedimentation that builds up around that bridge."
- "The Kahalu'u Flood Control Pond is poorly managed. It is going to be a problem again because it is not cared for."

Suggested strategies to address issue:

- Address the "head cutting" occurring at Waihe'e Stream. Implement the community fish ladder project.
- Regularly maintain the Kahalu'u Flood Lagoon and other drainage areas such as the Waikāne Bridge.
- Implement flood mitigation recommendations found in the Kahalu'u Community Master Plan.

B. Restoration of Moli'i Fishpond

Community members would like to see Moli'i Fishpond restored so that it can once again raise fish to feed people. A community member mentioned several issues that threaten the pond. Mangrove that grows along the edges of the pond is destroying the pond walls. Also, the amount of fresh water feeding the pond is not as much as it was in the past because the flow of Hakipu'u Stream, which drains into the pond, has been reduced. Community members feel that visitor activities that currently take place in the fishpond threaten its condition; some tourists walk along the walls of the pond and may inadvertently damage the walls. Kualoa Ranch, the owner of the fishpond, would like to restore the fishpond, but currently does not have the resources to do so.

Suggested strategies to address issue:

- Work with the land owner to develop best management practices for the fishpond.
- Identify funding and possible private/public/community partnerships to restore the fishpond.

C. Cesspools may be contaminating streams

Because much of the Kahalu'u Neighborhood Board Area is rural, many residences have cesspools and are not connected to the City's sewer system. Some residents are concerned that cesspools may leak into streams. A community member stated: *"There are no sewers in Kahalu'u, there are only cesspools. We should examine if the leakages from the cesspools are causing major harm to the environment. We should know the amount of leakage from cesspools in the district."*

Suggested strategies to address issue:

- Conduct water quality studies to determine if cesspools are impacting streams.
- Devise alternative wastewater treatment strategies for small coastal communities, in lieu of cesspools.

KĀNE'OHE NEIGHBORHOOD BOARD ISSUES

A. Health of streams in Kāne'ohe is poor

Residents have observed that the urbanization of Kāne'ohe has impacted its streams. Concrete channels have destroyed native aquatic habitats. Community members have observed that the water quality of streams has been affected by urban non-point source pollutants. In particular, Kāne'ohe's light industrial area near Windward Mall has contributed to non-point source pollution. Residents have also commented that stream health is affected by a lack of watershed management in the *mauka* areas of the neighborhood board area.

The suggested strategies to address the issue "Health of Streams in Kāne'ohe" are listed under the issue "Health of Kāne'ohe Bay" as the two issues are directly related to each other.

B. Health of Kāne'ohe Bay needs to be improved

Kāne'ohe residents have noted that the health of Kāne'ohe Bay has been affected by several factors, including the poor water quality of streams flowing into the bay, reduced quantity of fresh water flowing into the bay, previous dredging of the bay which destroyed large portions of the bay's coral reefs and the introduction of invasive species into the bay such as guerilla *limu*. Community members have reported that the fisheries of the bay have been depleted significantly. Also, the presence of edible *limu* in the bay has disappeared.

Suggested strategies to address issue:

- Remove invasive plant species along portions of the streams that are not concrete channelized
- Improve habitats for native aquatic species in streams with concrete bottoms by constructing low flow channels or other features that help to lower stream water temperature and reduce evapotranspiration
- Implement the management strategies that are identified in the Kawa Stream TMDL study and current on-going Kāne'ohe Stream TMDL study
- Implement policies in the previously completed Kāne'ohe Bay Master Plan

KAILUA NEIGHBORHOOD BOARD AREA ISSUES

A. Ka'elepulu Stream water quality is poor

The water quality of Ka'elepulu Stream was one of the more common issues reported by Kailua residents. Urban development around Ka'elepulu Stream has had adverse impacts on the stream's water quality. A community member recalled the condition of Ka'elepulu before Kailua became more urbanized, *"I used to swim in Ka'elepulu Stream. We used to fish in the stream and eat the fish from the stream. But now there are no more fish in the stream."* The condition of the stream has been severely degraded, the stream *"smells bad."* Some residents have even reported that the odor from the stream *"hurts their eyes."* DOH completed a study of the stream in 2007, and concluded that many different factors contributed to the streams' current degraded condition, including pollution from storm water and sewer systems and non-point source pollutants from both the surrounding urban areas and from conservation and agricultural lands in *mauka* areas.[cxv] In addition, private property ownership around Ka'elepulu Stream by many different individuals makes restoration and future stewardship of Ka'elepulu Stream very difficult.

Suggested strategies to address issue:

- Minimize non-point source pollution from roadways and storm drains
- Install pollutant control mechanisms in storm drains that drain into the stream
- Minimize sedimentation run-off from *mauka* areas
- Minimize sewage leakage into the streams
- Dredge the stream
- Increase flow and circulation in the stream
- Incorporate recommendations from the Ka'elepulu Stream TMDL study into the KPWMP.
- Coordinate City stream mouth dredging to maximize tidal exchange within the system.

B. Maunawili Valley watershed management needs to be improved

Residents would like to have several watershed related issues in Maunawili Valley addressed, including: removing invasive plant species along streams, reducing feral pig populations, and protecting the numerous springs that exist in the valley. Private land ownership in the valley has been a barrier to implementing watershed management activities in the past.

Suggested strategies to address issue:

- Prevent further development from occurring in Maunawili Valley
- Work with large land owners to coordinate access for feral pig hunting programs.
- Remove invasive plants along streams and re-vegetate stream banks with native plants.

C. More access to Mōkapu Peninsula fishponds

Members of the Kailua community desire more access to the fishponds of Mōkapu. Currently, the fishponds are under the jurisdiction of Marine Corps Base Hawai'i. Some community members have said that they would like to have more access to fishponds. MCBH has noted that the fishponds of Mōkapu are a single wildlife management area for native wetland birds and because of the regulations associated with wildlife management areas, very little access is permitted to the area. MCBH has been actively managing the fishponds, including removing mangrove and invasive plant species, trapping predators that prey on native birds and their eggs, and annually churning the water in the fishponds to bring nutrients to the surface as a source of food for the birds. MCBH has also partnered with groups such as the Sierra Club to conduct monthly community workdays and has expressed interest in the possibility of partnering with other community groups in a similar fashion.

Suggested strategies to address issue:

- Continue existing MCBH community work days at fishpond
- Identify other community groups or organizations that would be interested in participating in community work days at the fishponds.
- Work with MCBH to possibly expand the community work day program to allow for more community groups and additional workdays at the pond. Also explore with the MCBH possible cultural educational programs that could be associated with the fishpond.

D. Kailua Beach erosion should be mitigated

Community members have identified the erosion at Kailua Beach as a major issue. Erosion near the boat ramp is particularly severe. Members in the community disagree on whether the erosion is a natural phenomenon or if Kailua Beach erosion is manmade. Community members have cited several manmade causes that may contribute to beach erosion, including encroachment of residential development along the coastline.

Suggested strategies to address issue:

- Implement a temporary construction moratorium along Kailua Beach
- Conduct further study and analysis of Kailua Beach erosion to better understand the factors that cause erosion.

E. Kailua Beach nearshore water quality needs to be improved

Nearshore water quality along Kailua's coastline was raised as an issue by community members. Coastal areas near the mouth of Kaʻelepulu Stream after storm events are significantly contaminated after heavy rains. DOH found the sand near the mouth of Kaʻelepulu Stream to be contaminated and deemed it a health hazard. Consequently, the sand near the mouth of Kaʻelepulu Stream has been removed periodically by City ENV.

Suggested strategies to address issue:

- Support Hui o Koʻolaupoko preliminary design work for the restaurant parking lot near the mouth of Kaʻelepulu Stream which includes installation of bioswales, landscaping with native vegetation, and a possible buffer set-back.
- Improve the water quality of Kaʻelepulu Stream. (See suggested strategies for improving the Health of Kaʻelepulu Stream)

F. Improve the health of Kawainui Marsh

One of the primary concerns for Kailua residents is the health of Kawainui Marsh. Several of the threats that residents mentioned that the marsh faces includes the invasive plants that *"choke out"* native plants and native habitats, storm drain run-off into the marsh, the poor water quality of Kapaʻa Stream that flows into the marsh, and *"meadowed"* development of portions of the marsh for cattle grazing. Also as previously noted, residents have said that more water needs to flow into Kawainui Marsh to restore native habitats and make Kawainui a *"food producing area once again."*

Suggested strategies to address issue:

- Increase fresh water flow into Kawainui Marsh by:
  - Repair and upgrade the Maunawili Ditch and Waimānalo Irrigation Systems to minimize water loss along these systems.
  - Remove invasive plants along streams that flow into the marsh and re-vegetate stream banks with native plants.
- Remove invasive plant species from the marsh to create open water areas for bird habitat
- Update the 1994 Kawainui Marsh Master Plan
- Analyze and study the impact of storm drain flow into the marsh
- Implement the recommendations of the Kapaʻa Stream TMDL Study
- Minimize the environmental impacts of future industrial activities on the marsh
- Support the DOFAW/USACE Kawainui Marsh native wetland bird habitat restoration project.

WAIMĀNALO NEIGHBORHOOD BOARD AREA ISSUES

A. Agriculture water shortage
Recent drought conditions forced DOA to implement 30% *mandatory* water conservation for farmers on the Waimānalo Irrigation System from July 2008 to January 2009. This measure suggests that the irrigation system is just about *"maxed out"* in terms of supplying water to users. Waimānalo farmers lack a reliable supply of irrigation water, especially during times of drought, due to the serious disrepair of the Maunawili Ditch which is the primary source of irrigation water for most Waimānalo farms. Waimānalo farmers have worked with DOA to line certain portions of the ditch with plastic to help reduce leakages from the ditch. DOA estimated that at least 40% of the water diverted from Maunawili Stream via the Maunawili Ditch is lost and never reaches the Waimānalo Reservoir.

Suggested strategies to address issue:
- Repair and upgrade the Maunawili Ditch and Waimānalo Irrigation Systems to minimize water loss from these systems.
- Encourage more farms to irrigate their non-edible crops with recycled wastewater from the Waimānalo Wastewater Treatment Plant.
- Create incentives to make recycled water more affordable for farmers.
- Utilize drip irrigation to conserve water.

B. Infrastructure improvements to BWS systems may be needed
Some community members felt that *"Waimānalo has been low on the totem pole for infrastructure funding."* Community members also felt that infrastructure is not being maintained. A community member remarked, *"It seems like water mains break every week over here."* Another anecdotal account by a community member with regards to drinking water quality was: *"Waimānalo has the same old pipe system. BWS has never changed it. I noticed these little flakes in the water."*

The Waimānalo Hawaiian Homestead Association also expressed the need to increase water pressure in the water mains that will service the proposed WHHA and DHHL "Community Technology, Telehealth, and Employment Training Center" (CTTETC) from 1,800 psi to 2,100 psi.

Suggested strategies to address issue:
- Make infrastructure improvements in Waimānalo a funding priority.

C. Breaching of Kailua Reservoir
The DOA breached the Kailua Reservoir shortly after the 2006 Kaloko Dam Breach on Kauai for safety and precautionary purposes. However, community members have stated that the Kailua Reservoir acted as more than just a water supply for irrigation. A community member commented: *"Over the 100 years [the Kailua Reservoir] was in existence, the surrounding environment adapted to it. The climate back there was really*

nice because of the reservoir. Since the breach, the temperature has changed and the environment has changed."

Breaching of the reservoir has also made residents feel more vulnerable to flooding. *"[Since DOA breached the reservoir], we are now vulnerable to flooding. The reservoir had a spillway that released water in a controlled manner. The stream had a controlled flow."* According to residents, the reservoir also acted as a sediment retention basin. Since it was breached, residents have observed that ocean waters off of Bellows Air Force Station are now browner after heavy rains.

Suggested strategies to address issue:

- Convert the reservoir to a flood detention basin and *loʻi*.
- The Kailua Reservoir should be returned to DLNR.
- DOA DLNR should work with community members to form a public/private partnership to share stewardship responsibilities of the reservoir and address flood control and polluted runoff.

D. There is a potential for Waimānalo Stream to flood

The potential flooding of Waimānalo Stream is a major concern for Waimānalo residents, especially for homes near the stream. *"There are so many homes by the streams. One big rain and they are all going to get wiped out, the [Waimānalo] Stream is a thoroughfare of destruction."* Also, residents are concerned that a large flood may cut off emergency access to Waimānalo and close the main highway into the area. *"If it rains, and if it is high tide, the river will back up. There will be no access to this side if it floods. Kalanianaʻole Highway will be cut off."*

Suggested strategies to address issue:

- Convert Kailua Reservoir to a flood retention basin
- Establish specific buffer areas for specific streams. Make sure these buffer areas are reflected in the KPSCP
- Regularly maintain streams channels – clear out debris and obstructions – especially near the bridge
- Reduce the steepness of the stream's gradient

E. Water quality of streams in Waimānalo is poor

Residents have observed that the water quality and overall health of streams in Waimānalo are affected by many factors including:

- The Waimānalo Stream in some areas has very steeply eroded banks that have turned into *"mini cliffs."* Erosion has been getting worse over the years.
- Concrete lined stream segments have destroyed aquatic habitats for native species.
- Invasive plant species are prevalent along most stream banks.
- The cesspools of private residences along the stream may be leaking into streams

- Native aquatic species have not been seen in streams for some time
- Fertilizer, pesticides, and animal feces enter the streams after heavy rains
- Illegal dumping in streams; segments of streams have been filled illegally to extend property boundaries.
- Private ownership along streams prevents comprehensive stream restoration efforts.

Suggested strategies to address the water quality of streams in Waimānalo are listed under the issue of Waimānalo near shore water quality since the two issues are directly related.

F. Nearshore water quality of Waimānalo Bay is poor

Waimānalo residents have reported that the water quality of near shore waters has been degraded, due mostly to the poor water quality of Waimānalo Streams. Residents have reported that the color of coastal waters ranges from *"chocolate milk"* to *"Mountain-Dew green"* after heavy rains.

Suggested strategies to address issue:

- Remove invasive plant species along portions of the streams that are not too steep; and replant native plants
- Stabilize stream banks with coconut fiber rolls or more permanent rock or concrete vegetation toe protection
- Improve habitats for native aquatic species – low flow channels or other features that help to lower stream temperature
- Replace cesspools that are near streams with septic tanks
- Create a community composting facility to properly dispose of animal wastes
- Implement the management strategies that are identified in the Waimānalo Stream TMDL study
- Implement the Agricultural BMPs that will be identified in the Waimānalo Watershed Management Project

G. Injection Wells may have Adverse Impacts on the Nearshore Environment

Some Waimānalo residents expressed concern that the Waimānalo Waste Water Treatment Plant may impact nearshore water or ground water. A community member also feared that the CTAHR research station disposes of its waste via these injection wells as well. However, DOH water quality monitoring of Waimānalo near shore waters has not detected pollutants that can be attributed to the injection wells or CTAHR waste products.

Suggested strategies to address issue:

- Continue monitoring of near shore waters to detect pollutants that can be attributed to injection wells or CTAHR waste products.

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CHAPTER 3 – WATER USE AND PROJECTED DEMAND

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3 WATER USE AND PROJECTED DEMAND

3.1 WATER AVAILABILITY AND USE IN THE KOʻOLAU POKO DISTRICT

A combination of surface water, ground water, and recycled water supply the Koʻolau Poko district's water needs (Table 3.1). Ground water comes from various facilities owned and operated by City and State agencies as well as several small private water users. Surface water is diverted from the district's 13 perennial streams by private and public water users. A limited amount of recycled water is produced by a water reclamation facility that services Klipper Golf Course at the Marine Corps Air Station Kāneʻohe Bay.

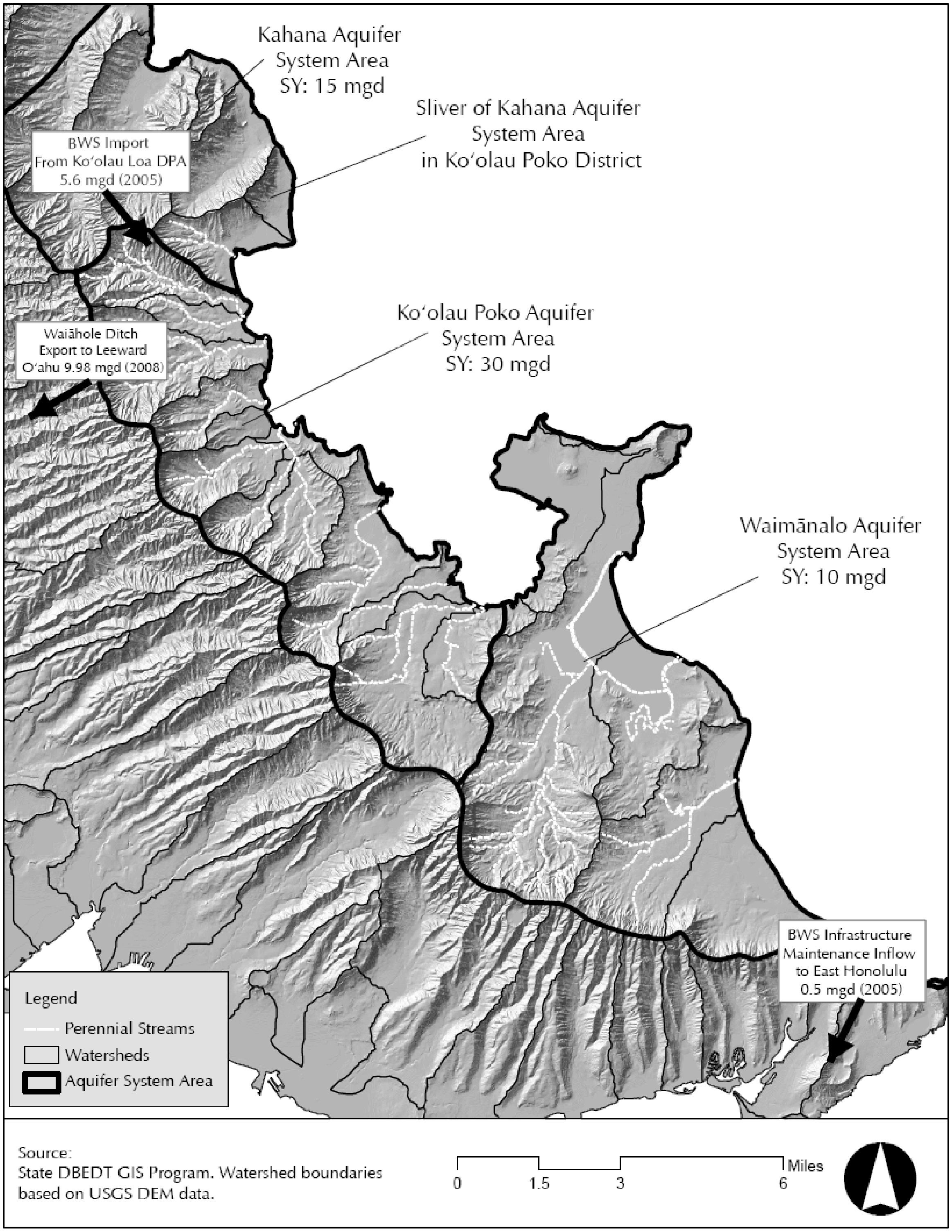
Water is also imported from the Koʻolau Loa district into the Koʻolau Poko district, while water is exported out of Koʻolau Poko to two other areas (Figure 3.1). The Waiāhole Ditch transports water from Koʻolau Poko to Central and Leeward Oʻahu and BWS water lines transport water from Koʻolau Poko to East Honolulu.

Table 3-1 In-District Water use by Source Type (CY 2005)

Water Source	Potable/Non-Potable	Estimated Amount (mgd)[1]
Surface Water	Non-Potable	7.650 [1]
Ground Water	Potable & Non-Potable	23.004 [2]
Recycled Water	Non-Potable	0.550 [3]

[1] Estimated amount of surface water diversions from streams in Koʻolau Poko. See Stream Table in Appendix E for detailed calculations.
[2] Calculated from production data obtained from CWRM. This number does not include Waiāhole Ditch Water which is derived from ground water. See Section 3.1.4 for information on Waiāhole Ditch Irrigation system.
[3] Daily average of recycled water used by the Klipper Golf Course at the Marine Corps Air Station Kāneʻohe Bay

Figure 3.1 Ko'olau Poko Aquifer System Areas, Water Imports and Exports



3.1.1 Ground Water Availability and Use

The aquifer systems in the Ko'olau Poko district are designated ground water management areas (GWMA). A water management area is defined by the State Water Code as "a geographic area which has been designated as requiring management of the ground or surface water resource, or both."[i] Within a GWMA, ground water resources could be threatened by existing or proposed water withdrawals, therefore, any use of ground water, with the exception of domestic consumption by individual users, requires a water use permit from CWRM.

The State Water Code defines the term "sustainable yield" as the "maximum rate at which water may be withdrawn from a water source without impairing the utility or quality of the water source as determined by the commission (CWRM)."[ii]. While sustainable yield (SY) numbers are only estimates and should not be considered as the exact amount of ground water that can be safely utilized, extracting amounts of ground water greater than the SY may irreparably damage the aquifer. Figure 3.2 illustrates the sustainable yield of Ko'olau Poko's two aquifer system areas (ASYAs). As can be seen in Figure 3.2, the majority of the ground water in the district is in the Ko'olau Poko ASYA.

Figure 3.2 Sustainable Yield By Aquifer System Area

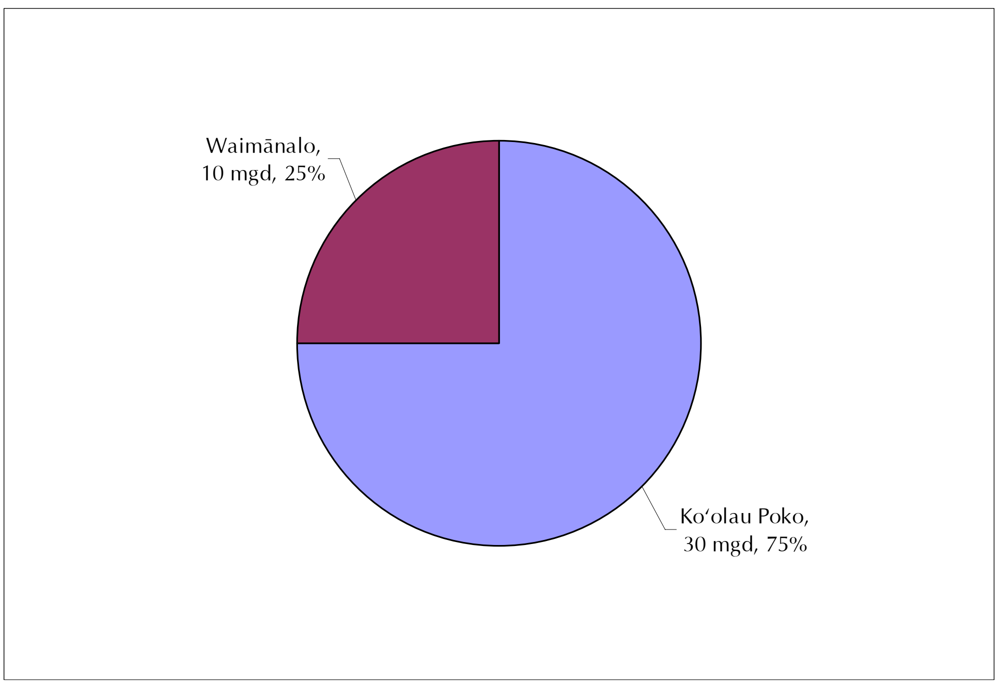


Table 3.2 shows the permitted use and the reported ground water production for BWS, State agencies, and private water users for the aquifer system areas in the Koʻolau Poko district. Currently, there is no use permit or withdrawal reported for federal ground water systems in the area. Table 3.2 also shows the sustainable yield for each aquifer system area and available yield for each ASYA. Available yield is the difference between the sustainable yield and the current permitted use in the aquifer system area. The amount of ground water currently permitted to be produced for the Koʻolau Poko ASYA and Waimānalo ASYA is well within the sustainable yield for those systems. In the Koʻolau Poko ASYA and Waimānalo ASYA, the BWS system pumps the most ground water when compared to State, Federal, and private water systems.

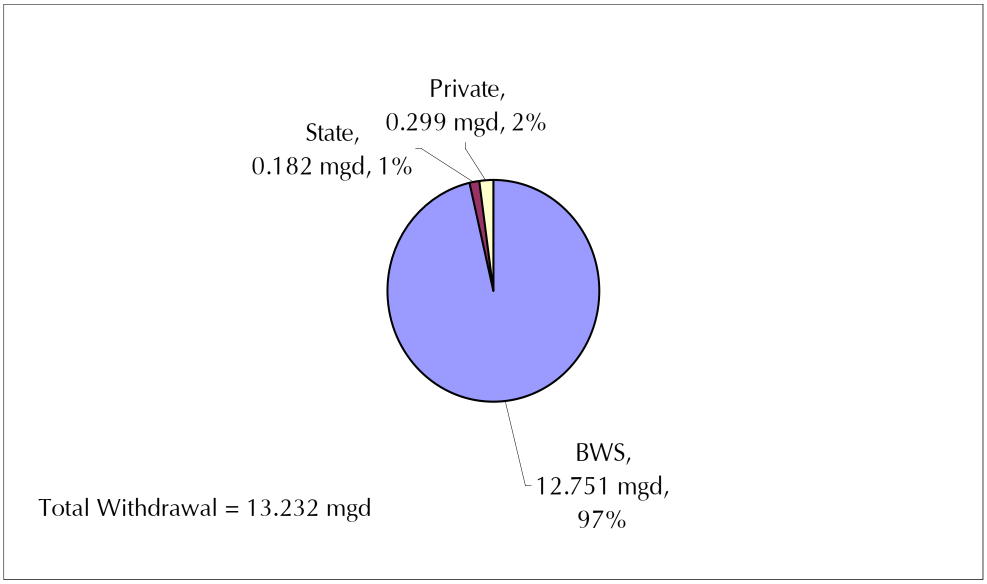
Table 3-2 Ground Water Production by Producers (CY 2005)

Aquifer System Area	BWS		City		State		Private		Total		SY[3] (mgd)	Available Yield (mgd)[4]
	WUP[1] (mgd)	Prod.[2] (mgd)	WUP[1] (mgd)	Prod.[2,6] (mgd)	WUP[1] (mgd)	Prod.[2,6] (mgd)	WUP[1] (mgd)	Prod.[2] (mgd)	WUP[1] (mgd)	Prod.[2] (mgd)		
Koʻolau Poko	14.943[5]	12.317	0.000	0.000	0.163	0.182[6]	0.206	0.199	15.312	12.698	30	14.688
Waimā-nalo	1.652[7]	0.434	0.025	0.000	0.124	0.000	0.155	0.100	1.956	0.534	10	8.044
TOTAL	**16.595**	**12.751**	**0.025**	**0.000**	**0.287**	**0.182**	**0.361**	**0.299**	**17.268**	**13.232**	**40[8]**	**22.732**

[1] Water Use Permit (WUP) numbers are from the July 8, 2008—Does not include two wells permitted after 2005 in Waimānalo: DLNR DOFAW (0.202 mgd) and Roman Catholic Church (0.010 mgd). Permitted uses account for fresh and brackish water wells, but not salt water wells.
[2] Except otherwise noted, production data are calculated from CWRM's database of ground water production for CY 2005. In some cases, there are no records of production.
[3] Sustainable yields are based on estimates reported in the Water Resource Protection Plan (August 2008) and account for freshwater and brackish water withdrawal.
[4] Available Yield = Sustainable Yield – Total Permitted Use.
[5] Includes 5.0 mgd of BWS' assessed yield for the Waiheʻe inclined wells and Waiheʻe Tunnel. Water Use Permits for these wells are pending approval from CWRM.
[6] Estimated production for State Waiāhole Valley Water System and ground water wells supplying the Hawaiʻi State Veterans Cemetery.
[7] Includes 0.3 mgd of additional yield for BWS's Waimānalo Well III. A Water Use Permit for this well is pending approval from CWRM
[8] The total does not include the Kahana aquifer system area sustainable yield because the Kahana ASYA's primary region for withdrawal is Koʻolau Loa.

As can be seen in Figure 3.3, nearly all of the ground water withdrawals in the district are from the BWS systems. State systems and private systems account for very little of the ground water withdrawals in the district.

Figure 3.3 Ko'olau Poko District Ground Water Withdrawals by Producer (CY 2005)

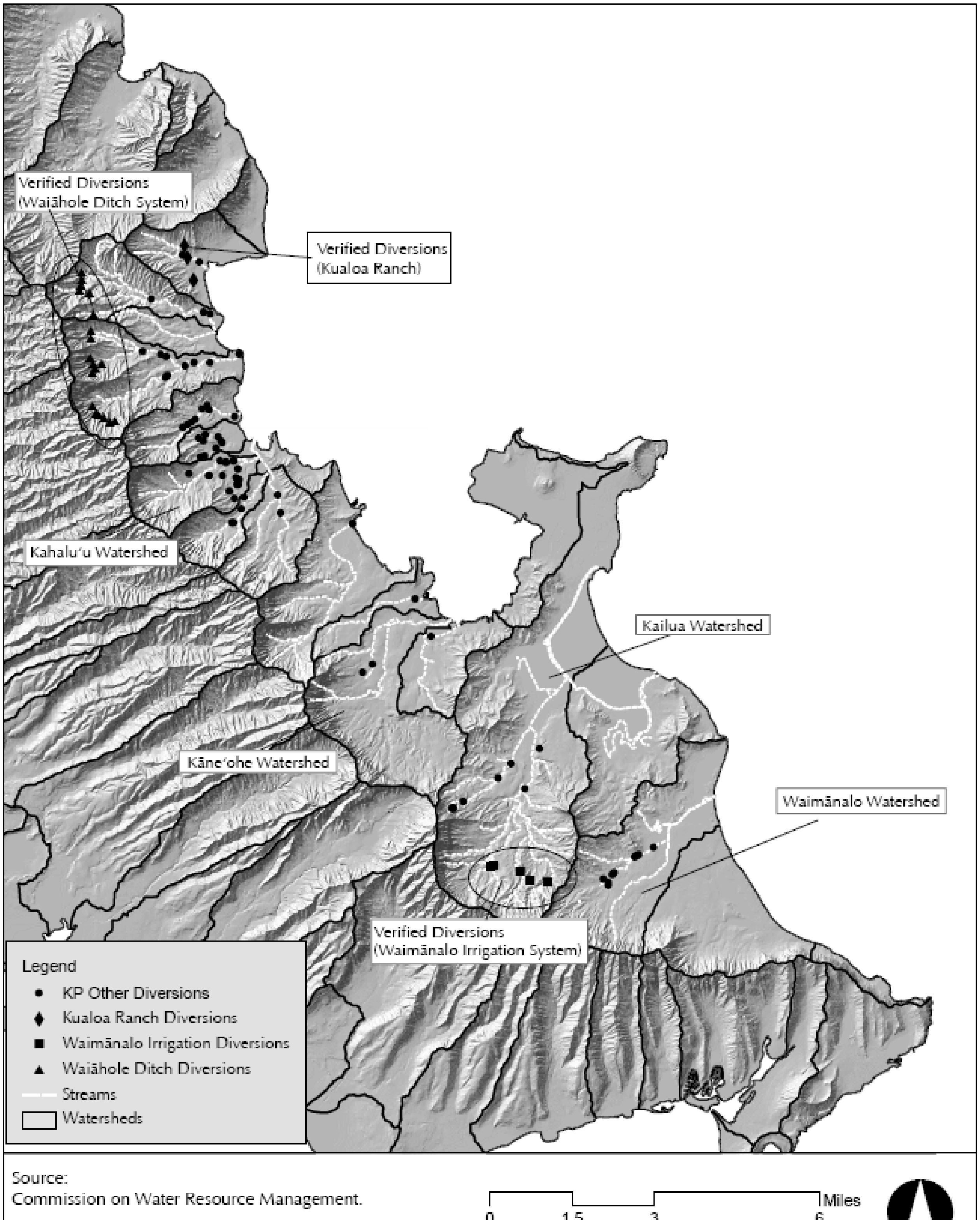


3.1.2 Surface Water Availability and Use

There are 19 watersheds and 13 perennial streams in Ko'olau Poko. CWRM maintains a database of surface water use consisting of stream and spring diversions. However, this database was populated with data from a voluntary survey of surface water users in the district conducted between 1989 and 1992. These surface water data are thus incomplete and outdated.

The CWRM database of stream diversions lists more than 100 reported stream diversions in Ko'olau Poko (Figure 3.4). Of the reported diversions, CWRM has verified those owned by Kualoa Ranch, and the State Waiāhole Ditch and Waimānalo Irrigation Systems.

Figure 3.4 Surface Water Diversions



Source:
Commission on Water Resource Management.

It was estimated that half of base stream flow (defined as Q70, the volume of daily mean stream flow present in the stream 70 percent of the time) would potentially be available for off-stream uses. Where streams were ungaged, the Q70 was estimated based on watershed size and adjacent streamflow (see Appendix E for calculations).

The estimated amount of stream water available for additional use was calculated by subtracting the estimated amount of stream water in use in 2005 from half of base flow. The calculations were done for each stream and summed for each Neighborhood Board area. Table 3.3 lists the estimated amount of stream water available for additional use. See Appendix E for more complete methodology and calculations.

Table 3-3 Estimated Amount of Stream Water Available for Additional Use

Neighborhood Board Area	Half of Base Stream Flow (mgd) [1]	Estimated Stream Water Use in 2005 (mgd) [2]	Estimated Amount of Stream Water Available for Additional Use (mgd) [3]
Kahaluʻu	6.75	6.11	2.97
Kāneʻohe	4.59	1.06	3.85
Kailua	2.48	0.08	2.39
Waimānalo	0.52	0.40	0.32
TOTAL	**14.34**	**7.65**	**9.53**

1 Base stream flow estimated from stream gage records and estimates, when available. For ungaged streams, flow was estimated based on watershed size and flow in adjacent, gaged streams.

2 Stream water use was estimated based on acres of agriculture served. Acres of diversified agriculture, kalo, and aquaculture were estimated from 2005 aerial photos, with a sample ground-checked in 2009. Water use was estimated based on typical water use factors for each type of agriculture.

3 Estimated amount of stream water available for additional use was calculated for each stream by subtracting the estimated stream water used from half of base stream flow. Where diversion amounts exceeded stream flow, estimated amounts of stream water available for additional agricultural use equaled zero. Where diversion amounts for individual streams exceeded half of base flow for that stream, the Neighborhood Board area total amount of stream flow available for additional use did not equal half of base stream flow minus the estimated stream water use over the entire Neighborhood Board area.

3.1.3 Recycled Water Availability and Use

Recycled water can be used for non-potable uses such as landscape irrigation and, in some instances, for agriculture irrigation. Recycled water is former wastewater that has been treated to remove solids and other chemical impurities. In Koʻolau Poko, there are three wastewater treatment plants servicing the district: the Kailua Regional Wastewater Treatment Plant (RWWTP), the Waimānalo Wastewater Treatment Plant (WWTP) and the WWTP at the MCBH. The following table presents a summary of the three wastewater treatment plants in Koʻolau Poko. Recycled water from the MCBH WWTP is the only recycled water that is currently being re-used for irrigation. Waimānalo WWTP has the ability to recycle water to an R-2 level of water quality. However, recycled water produced at this WWTP is not being used and is currently being disposed of via injection wells. The Kailua WWTP plant does not have recycled water treatment capacity. There are no future plans to upgrade the Kailua WWTP with recycled water capacity because the salinity level of the wastewater at the WWTP is high due to sea water infiltration. Wastewater at the Kailua WWTP would need to undergo desalinization in addition to undergoing recycled water treatment and this process would be cost prohibitive.

Table 3-4 Wastewater Treatment Plants in Koʻolau Poko[1]

Wastewater Treatment Plant	Wastewater Treated	Current Recycled Water Use (2009)
Kailua WWTP[2]	12.67 mgd	None
Marine Corps WWTP	1.50 mgd	0.50 - 1.00 mgd
Waimānalo WWTP	0.70 mgd	None

[1]Except as otherwise noted, data are from the Draft Islandwide Non-Potable Water Master Plan, Oʻahu Hawaiʻi (2006).
[2]Wastewater treated in FY 2009 as reported on the City's Department of Environmental Services' website.

3.1.4 Waiāhole Ditch Irrigation System

The Waiāhole Ditch system taps both ground and surface water sources from the Koʻolau Loa, Koʻolau Poko, and Waipahu-Waiawa districts. Water from stream diversions and tunnels is transmitted through the Koʻolau Mountains via the Trans Koʻolau Tunnel to leeward area farms. The Waiāhole Ditch System can transmit as much as 27 mgd to the leeward side of Oahu.

The 2006 CWRM Decision and Order returned 12 mgd of the Waiāhole Ditch Water to windward streams. For Waiāhole, Waianu, Waikāne, and Kahana Streams, 4.8 mgd, 3.0 mgd, 2.1 mgd, and 2.1 mgd, were returned respectively to these streams. [iii]

Table 3-5 summarizes the water use allocations for the Waiāhole Ditch System.

Table 3-5 Waiāhole Irrigation Ditch System Water Use Allocation (2009)

USE	ALLOCATION (mgd)
(Total Water returned to Windward Streams 12 mgd)	
Waiāhole Stream	4.8
Waianu Stream	3
Waikāne Stream	2.1
Kahana Stream	2.1
(Total Permitted Uses 12.57 to 11.96 mgd)[1]	
Campbell Estate[2]	3.98
Robinson Estate	2.49
Nihokai	0.48
Dole / Castle	2.13
Kamehameha Schools	0.17
Agricultural Development Corporation[1]	2.03 / 1.42
Unpermitted / Available Water[2]	2.43 / 3.04

[1] Water allocation will decrease when ADC completes repairs to the ditch system
[2] Campbell Estate WUPs have been reallocated to various entities.
[3] Uncommitted water will increase when ADC completes repairs to the ditch system

3.2 Water Supply Systems in Koʻolau Poko

3.2.1 BWS System

BWS provides most of the water for municipal uses in Koʻolau Poko. Municipal water uses consist of residential, commercial, City, State, and Federal water uses. A limited amount of water for agricultural use is also supplied by BWS.

The BWS delivery of potable water in Koʻolau Poko is via the Windward Water System which transmits water over a distance of approximately 26 miles from Hauʻula to Makapuʻu. There are six smaller BWS systems that interconnect with the Windward Water System. The BWS Windward Water System consists of 19 wells, 5 tunnels, and 11 reservoirs. In Koʻolau Poko, BWS has water supply sources in the Kahaluʻu, Kāneʻohe, and Waimānalo Neighborhood Board areas. There are no sources of BWS water in the Kailua Neighborhood Area.

Several of the smaller water systems that are interconnected with the larger Windward Water System include the Waimānalo Water System, the Kailua Heights Water System, the Kuou Water

System, the Luluku Water System, the ʻĀhuimanu - Haʻikū - Maunawili Water System, and the Waiheʻe Water System.

The Waimānalo Water System supplies the Waimānalo community with water from two wells and four tunnels. The system also includes three reservoirs, and one booster station.

The Kailua Water System is a fairly large water system supplying the Kailua community. Two reservoirs and a booster station make up the system. The booster station pumps water that is supplied from the larger Windward Water System into the two reservoirs. The Kailua Water System does not include its own wells or tunnels.

The Kāneʻohe Water System supplies the Kāneʻohe community. Similar to the Kailua System, the Kāneʻohe System is supplied from the larger Windward Water System.

The Kuou system is connected to the larger Windward Water System. The water source for the Kuou system consists of three wells.

The Luluku Water System consists of a well, a tunnel and a reservoir. It services a small portion of Kāneʻohe.

The ʻĀhuimanu - Haʻikū - Maunawili Water System is a fairly large system that spans across these three areas. The water sources for this system include three wells and two tunnels. Both the wells and tunnels are located in Haʻikū and ʻĀhuimanu. Four reservoirs also service the system, with one reservoir in Maunawili, two in Haʻikū, and one in ʻĀhuimanu. Two booster stations are also located within the system, helping to supply water to higher elevation residences in Maunawili and ʻĀhuimanu.

The Waiheʻe Water System is small, consisting of only a 1 million gallon reservoir and a booster station. The water system exclusively services the Waiheʻe community.

Figure 3.5 illustrates the main features of BWS Systems in Koʻolau Poko. Permitted use for BWS sources in Koʻolau Poko are summarized in Table 3.6.

Figure 3.5 Main Features of BWS Systems in Ko'olau Poko

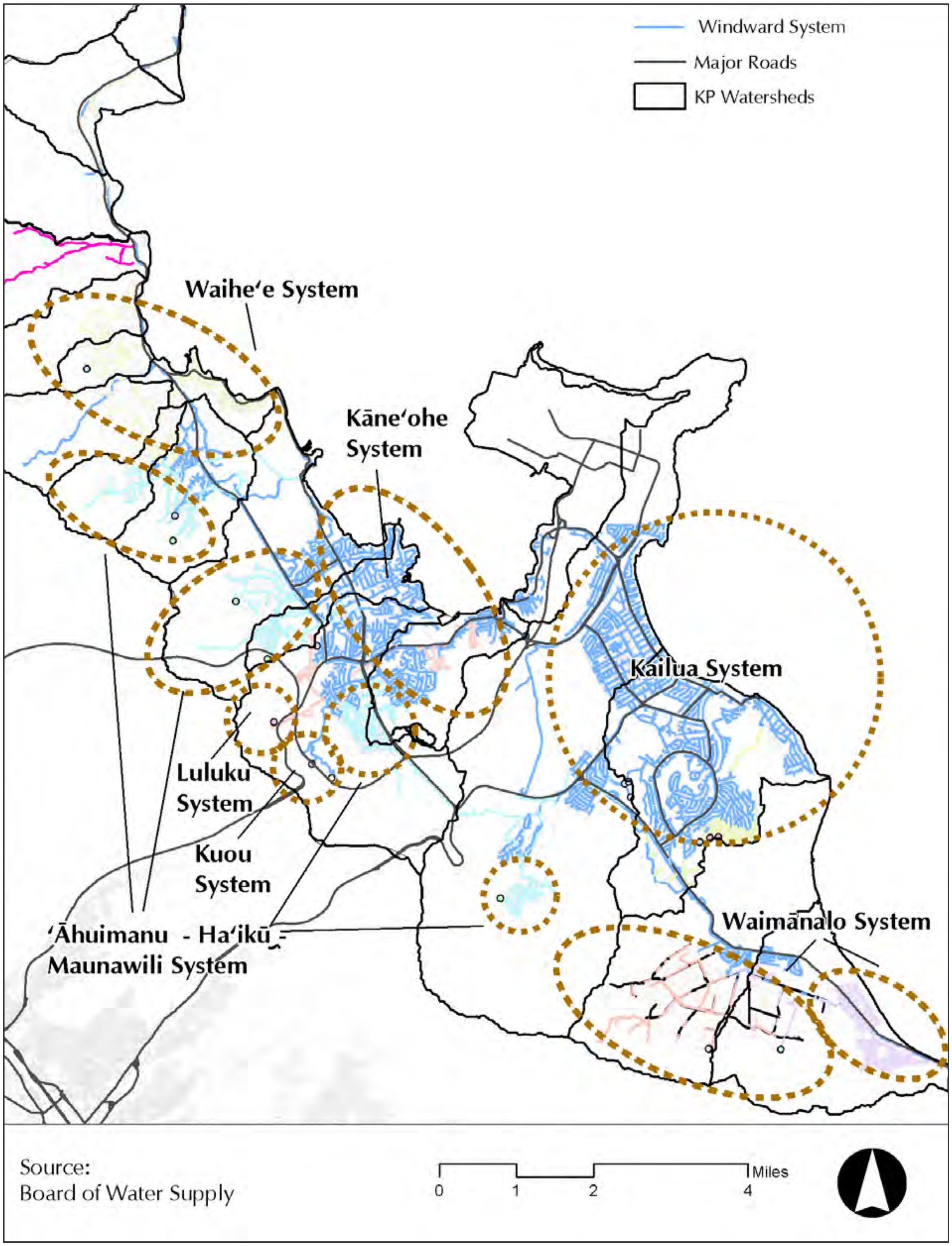


Figure 3.6 Sustainable Yields, BWS Water Use Permits and BWS Ground Water Production in Ko'olau Poko (CY 1994-2009)

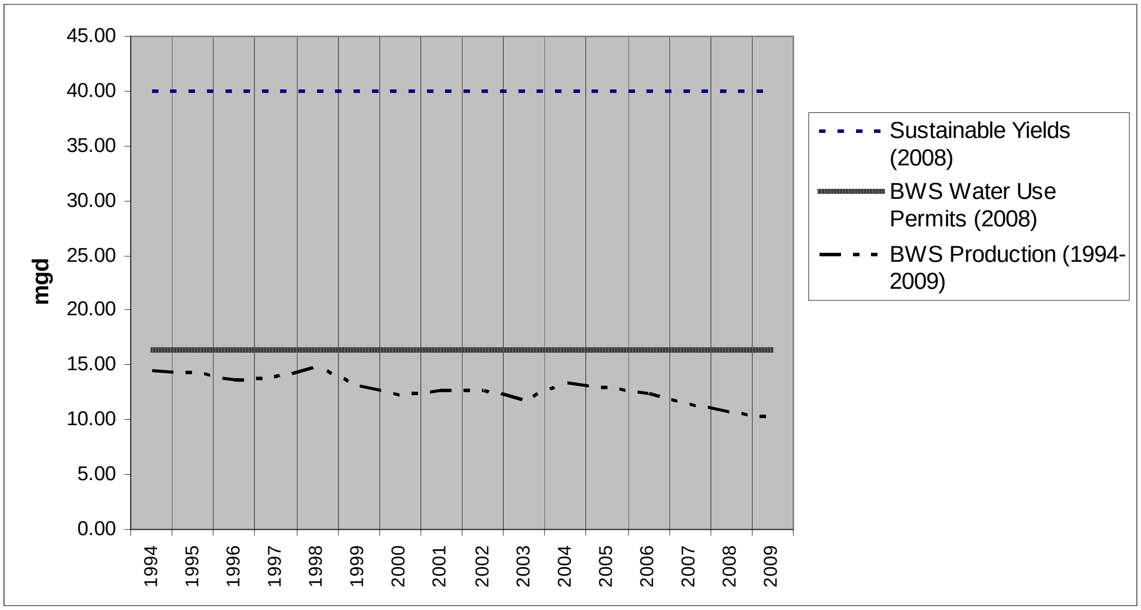
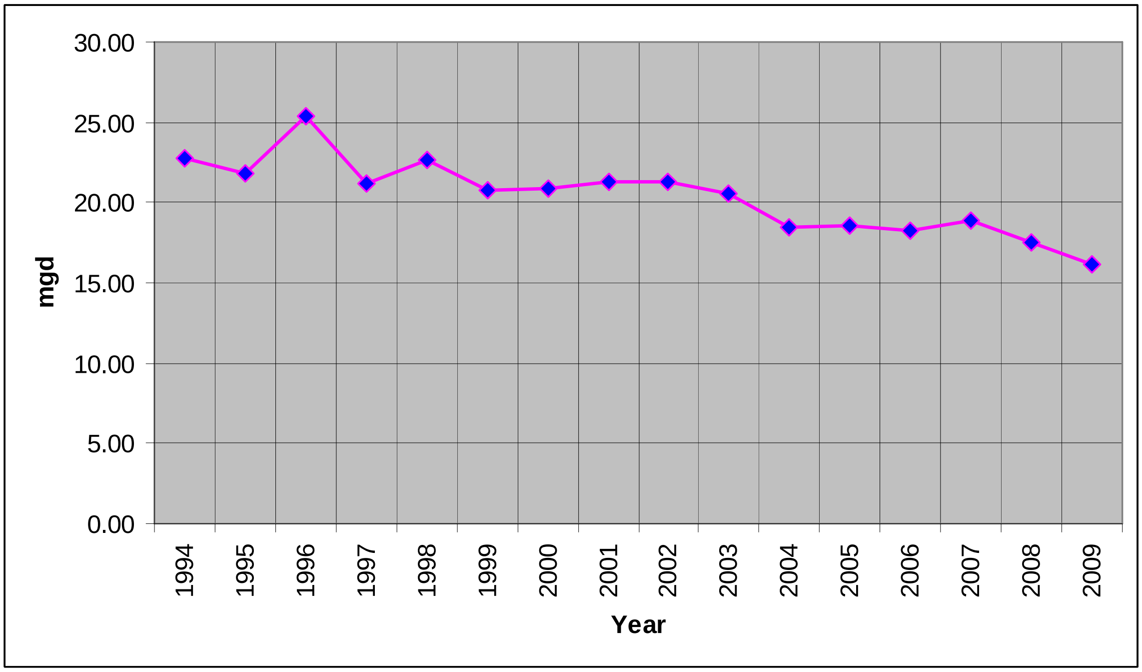


Figure 3.6 above illustrates BWS ground water production in Ko'olau Poko between the years 1994 to 2009. As can be seen in the figure, BWS ground water production has been fairly consistent over this 13 year period and has been trending slightly downward since 1994. The highest BWS ground water production occurred in 1998, when 14.73 mgd was pumped, while the lowest production occurred in 2009, when about 10.10 mgd was pumped. As can be seen from the above figure, BWS production between 1994 and 2009 was well within the BWS' total permitted ground water withdrawals of 16.295 mgd. Factors that influence BWS ground water production include climatic conditions – with more production required during dry years and less in wet years – and the positive results of the BWS water conservation programs.

The following figure shows BWS historical Windward (Ko'olau Loa and Ko'olau Poko Districts) ground water production between 1994 and 2009.

Figure 3.7 BWS Historical Windward Ground Water Pumpage



The "Windward Ground Water Pumpage" data illustrated above is for the Koʻolau Poko and Koʻolau Loa Districts combined, from Hauula to Makapuʻu.

BWS in-district withdrawals averaged 12.0 mgd for the years 2000-2009. In that same time period, an average of 6.9 mgd was imported from the Koʻolau Loa district into the Koʻolau Poko district. Table 3.6 shows the "Permitted Use" for BWS ground water resources in Koʻolau Poko. Table 3.7 illustrates the total BWS water use in the Koʻolau Poko district from 2000-2009.

Table 3-6 BWS Permitted Use – Koʻolau Poko Sources (2005)

Well Name	Permitted Use (mgd)
Haʻikū	0.457
Haʻikū Tunnel	1.340
Ioleka'a	0.153
Kahaluʻu	0.927
Kahaluʻu Tunnel	2.128
Waiheʻe Tunnel[1]	5.000
Waiheʻe Inclined Well[1]	
Total Kahaluʻu	10.005
Kuou I	2.969
Kuou II	0.010
Kuou III	0.196
Luluku	1.050
Luluku Tunnel	0.713
Total Kāneʻohe	4.938
Waimānalo II	0.452
Waimānalo Tunnels (1-4)	0.700
Waimānalo III[3]	0.500
Total Waimānalo	1.652
Total KP[2]	**16.595**

[1] Waiheʻe Tunnel and Waiheʻe Inclined Well combined Permitted Use of 5.000 mgd are pending CWRM approval.
[2] BWS does not have wells/tunnels in Kailua NB area
[3] Waimānalo III has 0.200 mgd of existing Permitted Use. An additional 0.300 mgd of Permitted Use is pending CWRM approval.

Table 3-7 BWS Koʻolau Poko Water Consumption and BWS Water Import from Koʻolau Loa to Koʻolau Poko (CY 2000-2009)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	10-Yr Aver-age
In-District Production (mgd)[1]	12.2	12.7	12.5	11.8	13.2	12.8	12.4	11.4	10.7	10.1	12.0
Koʻolau Loa Import (mgd)	8.3	8.6	8.1	8.2	4.8	5.6	5.7	7.4	6.7	5.8	6.9
Total BWS Production (mgd)	**20.5**	**21.3**	**20.6**	**19.9**	**18.0**	**18.4**	**18.1**	**18.8[2]**	**17.4**	**16.00**	**18.9**

[1] Production does not include a small amount of BWS water for export to East Honolulu for facility maintenance.

Besides the transfer of water from Koʻolau Loa into Koʻolau Poko, water is also transported among watersheds within the Koʻolau Poko district. Table 3.8 shows the amount of BWS water demand for each neighborhood board area in Koʻolau Poko and the amount of water BWS produces in each neighborhood board area. In 2005, watersheds in Kahaluʻu accounted for the majority of BWS water production in Koʻolau Poko while the Kailua Neighborhood Board Area accounted for half of the district's water demand.

Table 3-8 BWS In-district Water Transfer (CY 2005)

Neighborhood Board Area	BWS Water Demand (mgd)	% Demand	BWS Water Production (mgd)	% Production	Water Balance (mgd)
Kahaluʻu	1.566	9%	8.217	64%	6.649
Kāneʻohe	5.057	29%	4.100	32%	-0.956
Kailua	6.855	37%	0.000	0%	-6.855
MCBH	2.048	12%	0.000	0%	-2.048
Waimānalo	2.340	13%	0.434	3%	-1.906
Total	**17.867[1]**	**100%**	**12.751**	**100%**	**-5.116 [1]**

[1] Total district water balance was met with imported Koʻolau Loa water.

Figure 3.8 Ko'olau Poko BWS Metered Consumption by Sector (CY 2009)

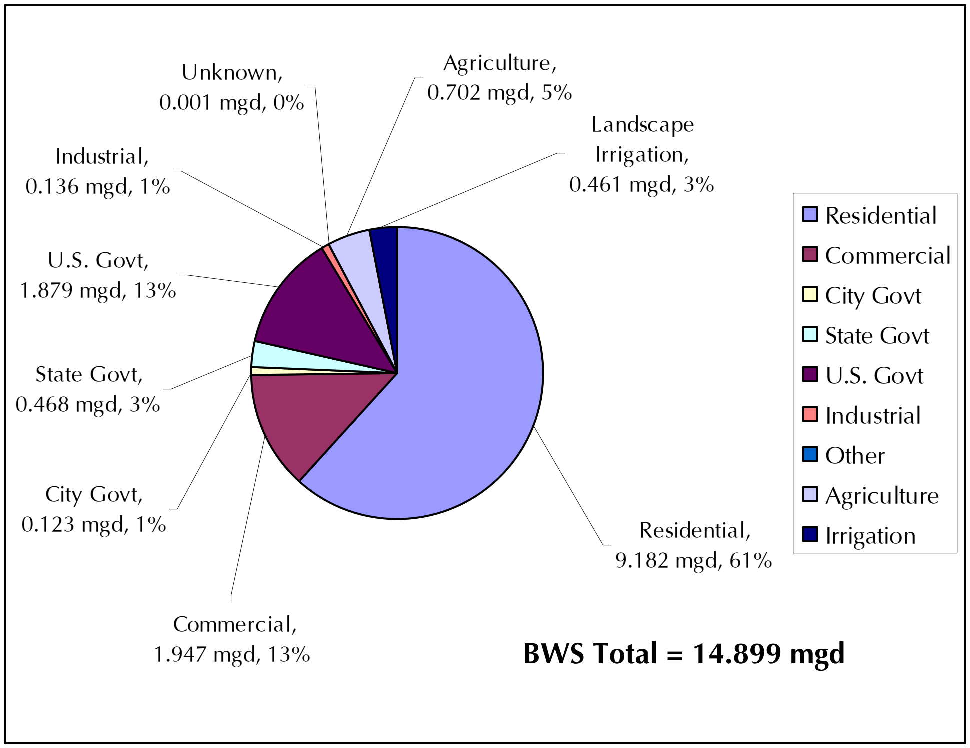


Figure 3.8 illustrates the breakdown of water consumption for various BWS water use sectors in Ko'olau Poko in 2009. The largest user of BWS water in Ko'olau Poko was the residential sector with an average use of 9.182 mgd. Government users, including City and County Government, State Government, and Federal Government, were the second largest consumers of BWS water in the district. Together, City, State, and Federal governments consumed approximately 2.470 mgd. The commercial and agricultural sectors were the third and fourth largest consumers, respectively, of BWS water in the district. The commercial sector consumed 1.947 mgd and the agricultural sector consumed 0.702 mgd. The 2009 daily average for all BWS metered users in the entire district was 14.899 mgd.

Table 3.9 illustrates BWS water use in 2009 based on CWRM's categories of water use.

Table 3-9 BWS Water Use by CWRM Categories in Koʻolau Poko (CY 2009)

CWRM Water Use Categories	2009
Municipal	
Domestic Residential (potable and nonpotable)	*9.182*
Domestic Non-Residential (potable and nonpotable)[1]	*4.417*
Industrial	*0.136*
Other/Unknown	*0.001*
Agriculture	
Agriculture	*0.702*
Landscape Irrigation	
Irrigation[2]	*0.416*
Total	**14.899**

[1] Domestic Non-Residential category includes commercial and government facilities water
[2] Landscape Irrigation category includes commercial (e.g. golf course, cemetery) and government irrigation water use (e.g. City and State parks)

Table 3.10 illustrates the top 10 individual users of BWS water in the district. The Marine Corps Air Station Kāneʻohe Bay was the largest user of BWS water. Several golf courses, including the Mid Pacific Country Club, Olomana Golf Links, and the City's Pali Golf Course were also among the largest users of BWS water in Koʻolau Poko. Other large users of water included in Table 3.9 are Hawaiian Memorial Park Cemetery, Blue Stone Apartment Complex, and the Puʻu Aliʻi Community Association. The Hawaiian Memorial Park Cemetery was the seventh largest user of water in the district. The Blue Stone Apartment complex near Mid Pacific Golf Course was the eighth largest user. The Puʻu Aliʻi Community Association is located near Windward Mall in Kāneʻohe and consists of condominium housing units. The community association was the tenth largest user of water in the Koʻolau Poko district.

Table 3-10 BWS Largest Metered Water Consumers (CY 2009)

BWS Customer	Average Daily Consumption in 2009 (mgd)
Commanding General KMCAS	1.698
Mid Pacific Country Club	0.128
Kailua Regional WWTP	0.128
Sea Life Park	0.104
Olomana Golf Links	0.064
Hawaiʻi State Hospital	0.070
Hawaiian Memorial Park Cemetery	0.052
Pali Golf Course	0.044
Blue Stone Apartment Complex, Kailua	0.045
Puʻu Aliʻi Community Association, Kāneʻohe	0.047

BWS Conservation Programs

The BWS has actively promoted water conservation since its inception in 1929. The BWS "Water Conservation Program" is currently organized as follows:

- Public Education and Outreach
- Leak Detection, Repair and Maintenance
- Large Water Users Programs
- Regulation
- Alternative Source Development, Recycling & Conservation Alternatives

The principal elements of these five program clusters are summarized in the following table. Specific programs within each of these categories that have been major contributors to water conservation savings are summarized below.

Public Education and Outreach

The primary objective of the public education and outreach efforts is to influence consumer water use habits. A variety of programs target homes, schools and businesses including Public Service Announcements, poster contests, features in the newspaper, water saving tips on the internet, xeriscape demonstrations, detect-a-leak week, educational booths, and a water waste hotline. Water saving measures and devices that property owners can use include checking and repairing drips and leaks; installing low flow toilets, faucets, and shower heads; water-efficient washing machines and dish washers; rain barrels; rain gardens; water efficient irrigation systems; xeriscape landscaping; and porous pavement for driveways.

Large Water Users Programs

Large water user programs target organizations and businesses with high water consumption. These organizations often have the capacity to facilitate change from within the organization or agency. Every year, BWS reminds the top 300 water users on their system to conserve water, especially during the dry summer months. Additionally, existing agreements with City and State agencies target parks, schools, golf courses, roadway landscaping, and other governmental facilities to be more efficient in their water use. The State Department of Land and Natural Resources has also conducted an audit of its usage to determine opportunities for saving water.

Leak Detection, Repair, and Maintenance

Water loss accounting is a measure of water distribution efficiency that can also indicate potential targets for specific water conservation measures. The Board of Water Supply recently began a targeted conservation program by identifying and fixing system water losses to reduce water lost between production from the ground and delivery into homes. A portion of water loss is due to leakage; other causes of water loss can be from pipe, reservoir, and hydrant flushing operations, illegal unmetered water taps, and meters requiring calibration. Some water loss may be from calculation deviations.

On the mainland, municipal water loss averages are between 10-15%. Here on O'ahu, the island-wide BWS goal is to reduce water loss to less than 10%. In 2005, the entire BWS System experienced 12.8% water loss. Windward District water loss was estimated at 20% prior to 2004. After 2004, the estimated water loss for the Windward District was 16%. The BWS program for leak detection repair, and maintenance is ongoing. In Ko'olau Poko, waterline replacement needs include 110,000 linear feet of water mains. In particular, numerous water main breaks near the Enchanted Lakes and Keolu Hills area in Kailua have occurred over the years due to the corrosive nature of the soils in the area.[iv]

Table 3-11 BWS Conservation Programs

PUBLIC EDUCATION & OUTREACH	LEAK DETECTION, REPAIR & MAINTENANCE	LARGE WATER USER PROGRAMS	REGULATION	ALTERNATIVE SOURCE DEVELOPMENT, RECYCLING & CONSERVATION ALTERNATIVES
• **Schools** – Educational Material – Curriculum Development–Student Tours – Annual Poster Contest – Hawaii State Science Fair • **Tours** – Fred Ohrt Museum – Hālawa Xeriscape Garden – Nu'uanu Watershed – Water Reclamation Plant • **Water Conservation / Education Publications** • **Water Conservation Calendar** • **Video Library** • **Year Round Conservation Media Campaign** • **Speakers' Bureau** • **Water Conservation Information/Complaints** • **Communications** – News Releases / Advisories on Water Emergencies / High Water Usage / Community Concerns / Public Meetings / News Conferences • **Landscape Water Conservation Classes** • **Special Events** – Detect-A-Leak Week – Water Conservation Week – Trade Shows/Exhibitions – Hālawa Xeriscape Garden Open House& Plant Sale – Community Events	• **Leak Detection and Repair (within BWS distribution system and storage facilities)** • **Pipeline Corrosion Protection Program** • **Flow Transmitter Maintenance** • **Repair and / or Replacement** of valves, fire hydrants, water distribution mains and service line leaks and fractures • **Enforcement** of unauthorized use of water • **Meter Maintenance Program** • **Maintenance/Repair and Replacement** of aging service laterals and hydrants • **Meter-Reading / Water Bill Monitoring** (Identify high water use due to undetected leakage; report seepages, leaks, or other signs of possible water leaks) • **Water Audits** and development of internal water use efficiency practices and programs • **Cathodic Protection** Monitoring and Maintenance – flow transmitter maintenance – pipeline corrosion programs	• **Visitor Industry** – Conservation Education – Linen Reuse placard • **Government Agencies** – Conservation Partnership Projects • **Business/ Commercial** – Conservation Education – Low-Flow Fixture Incentives – Restaurant placard, water served only upon request • **Irrigation System Submetering and moisture controllers**	• **BWS Low Ground water (Drought) Plan** • **BWS Rules** – Governing wasteful water use practices (Empowering department to discontinue water service) – Use of non-potable water for irrigation of large landscaped areas, golf courses, parks, highways, school playgrounds – Restaurant water service, water served only upon request – Restricted irrigation program (Applicable to periods of low rainfall and high consumption) • **County legislation requiring low-flush toilets, and low-flow showerheads and faucet fixtures** • **Conservation Rate Structure (Inverted Block Rate)** • **New Construction Regulations (Future)** – Dual Water Systems – Low-Flow Fixtures	• **Nonpotable Water System Standards and Master Plans** • **Residential Toilet Rebate Program** • **Nonpotable Source Development** – Caprock – Brackish – Surface Springs • **Wastewater Reuse** – Honouliuli Water Recycling Facility – Wahiawa/ Central Oahu – Distributed Reuse using Membrane Bioreactors • **Desalination Plants** – Kalaeloa Seawater – Kapolei Brackish Water • **Seawater District Cooling** • **Future Studies** – Evapotranspira-tion Study – Evaluation of Water-Saving Fixtures – Rain Catchments for nonpotable irrigation – Rebates for water efficient appliances

3.2.2 State Systems

The State owns four water systems in the district: the Waiāhole Ditch Irrigation System, Waiāhole Valley Water System, the Waimānalo Irrigation System, and the Harano Tunnel system. The Waiāhole Ditch System utilizes ground water resources from the Kahana and Koʻolau Poko aquifer system areas while the other three water systems use in-district waters (Table 3.12). The State also owns the water systems for the Hawaiʻi State Hospital in Kāneʻohe and the Hawaiʻi Youth Correctional Facility in Kailua. However, these two State-owned wells are inactive. Water for both of these systems is provided by BWS.

Table 3-12 State Water Systems

System Name (Agency Owner)	Potable/Non-Potable	Type of Use	Area Served
Waiāhole Ditch Irrigation System (ADC)	*Non-Potable*	*Irrigation*	*Leeward Oʻahu*
Waiāhole Valley Water System (HHFDC / DBEDT)	*Potable*	*Municipal & Irrigation*	*Waiāhole Valley*
Waimānalo Irrigation System (DOA)	*Non-Potable*	*Irrigation*	*Waimānalo Agricultural Farm lot Subdivision*
Harano Tunnel Water System (DOT)	*Non-Potable*	*Other*	*Harano Tunnel and DOT's Operation and Maintenance Facility nearby*

3.2.2.1 Waiāhole Ditch System

The Waiāhole Ditch system is supplied by ground water from Koʻolau Loa and Koʻolau Poko districts. The system was constructed as a means to transport water from windward Oʻahu through the Koʻolau Mountains to central and leeward Oʻahu. The total length of the system is approximately 25 miles[v]. More specific water use details for the Waiāhole Ditch System are discussed in section 3.1.4.

3.2.2.2 Waiāhole Valley Water System

The State of Hawaiʻi Housing Finance and Development Corporation (HHFDC) operates and maintains the Waiāhole Valley Water System. The system is located in Waiāhole Valley. The Waiāhole Valley Water System provides water to 167 residential and agricultural lessees in the Waiāhole Valley Agricultural Park, 22 kuleana lots, 20 DHHL lessees, and the Waiāhole Elementary School. The system also provides water for fire safety devices within the subdivisions.

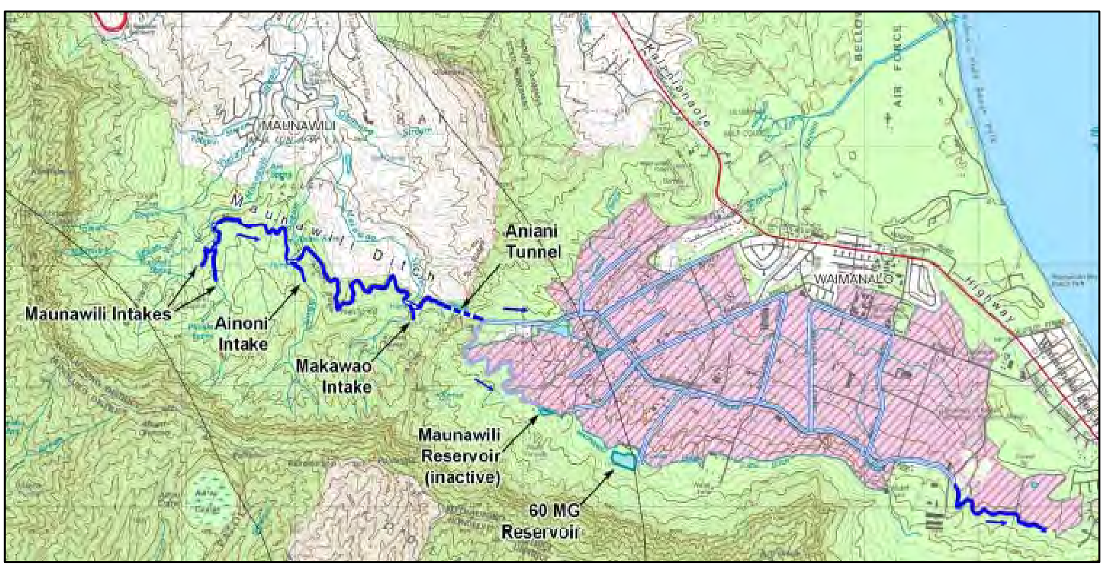
Water from the well is chlorinated and then transmitted to a 1.0 mg (million gallon) steel reservoir. From the reservoir, water is distributed to system users via 8 inch water lines. The system was reported to produce 0.139 mgd of water in 2006.[vi]

The Waiāhole Valley Water System has experienced several maintenance problems and breakdowns over the years. These maintenance problems affect the quantity and quality of the potable water supply in the area[vii]. The current condition of the system requires major repair. Funding has been requested through the State's Capital Improvement Program for the fiscal year 2008-2009 to repair and improve the system.[viii] However, funding for the Waiāhole Water System CIP request was not released for the 2008-2009 fiscal year.

3.2.2.3 Waimānalo Irrigation System

The Waimānalo Irrigation System consists of three surface water intakes located at Maunawili, Ainoni, and Makawao streams. In 2003, these intakes collected 1.48 mgd. However, the system experiences significant water losses as only 0.4 mgd of the 1.48 mgd that is diverted flows into the 60 MG Waimānalo reservoir. From the reservoir, the water is then transmitted to the farm lots via transmission lines. The irrigation system services 164 users and approximately 1,170 acres of diversified agriculture.

Figure 3.9 Waimānalo Irrigation System



The Waimānalo Irrigation System only provides non-potable water for its customers. BWS system provides potable water and fire protection to the irrigation system users.[ix] DOA estimates that the Waimānalo Irrigation System provides non-potable water to about 75%-80% of the farms in Waimānalo. Other farms, including most nurseries, are on BWS water systems.[x] In July 2008, the State DOA issued a Phase III – Mandatory Conservation Measure for all users of the irrigation system due to the prolonged drought conditions in the area. Water users were required to reduce their water consumption by 30%. Water service was limited to only three days a week and only during specific hours on those days.[xi]

3.2.2.4 Harano Tunnel Water System

The Harano Tunnel, the H-3 highway tunnel, is equipped with a dedicated on-site water supply, storage, and drainage system due to its remote location. The Harano Tunnel Water System is owned and operated by the State DOT. The system consists of one well (Haiku well, capable of producing 0.288 mgd.[xii] The water system provides non-potable water for fire suppression, emergency suppressions, washing the tunnel walls, and domestic purposes such as toilets. DOT reports that in the 11 years that the system has been in operation, the system has only used 7 million gallons of water. This amount is approximately 630,000 gallons per year, which is approximately 0.002 mgd.[xiii]

3.2.2.5 State Water Conservation Program

The Commission on Water Resource Management recognizes that water conservation and water use efficiency measures can be cost-effective strategies to stretch existing water supplies and forestall capital development costs. The Commission is currently developing a statewide water conservation program with three key objectives: (1) develop a coordinated statewide water conservation planning strategy and policy framework, (2) establish a water conservation association of water purveyors and stakeholders, (3) develop a statewide water conservation program to implement the planning and policy framework. CWRM established a water conservation advisory group comprised of key stakeholders in order to accomplish these objectives in a collaborative manner. All major water use sectors showing the greatest potential for water savings and will include policy recommendations and implementation and funding strategies.

3.2.3 Federal Water System

There are no federal ground or surface water sources in the district. U.S. Military facilities received 1.877 mgd from the BWS system in 2009.

The Marine Corps Air Station Kāne'ohe Bay owns a water reclamation facility that is producing 1.5 mgd of R-2 recycled water. On average, 0.55 mgd of this water is used to irrigate the Klipper golf course located on the base. The remaining treated water is discharged into the ocean.

A detailed plan has been developed to upgrade the reclamation facility. Planned improvements will allow the facility to produce a higher quality of recycled water. With upgrades, the facility will be able to produce R-1 quality water. Higher quality recycled water is more desirable due to health concerns related to the amount of impurities in recycled water. The spraying technique used to irrigate the golf course may potentially spray water to areas outside of the golf course including nearby buildings and coastal areas. However, at the time of this writing, the construction phase of the plan had not been funded.[xiv]

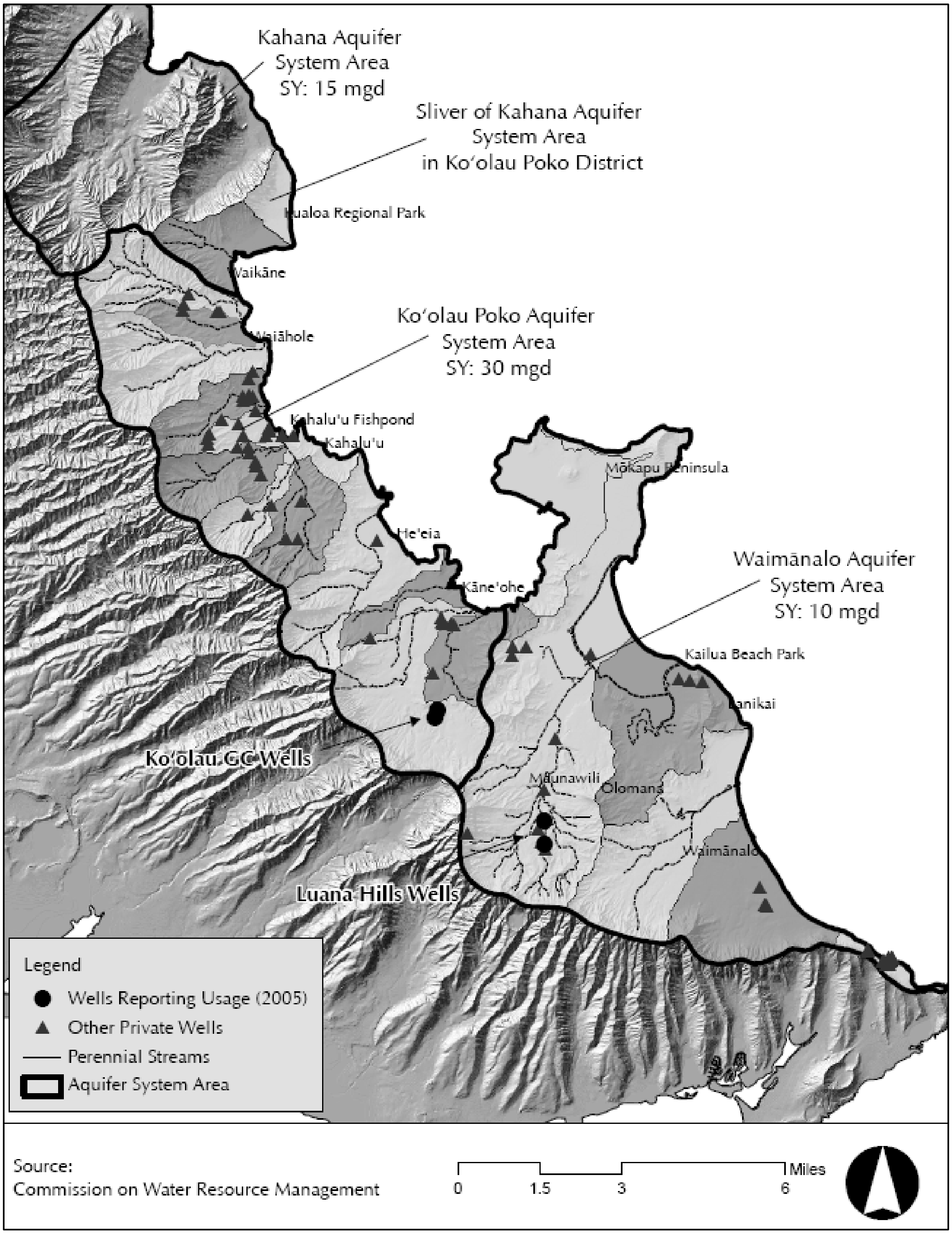
3.2.4 Private Water Systems

There were approximately 60 existing private wells in Koʻolau Poko, based on the well database maintained by the CWRM.[xv] Approximately half of these wells were reported to be unused. Of the wells thought to be in operation, only two small private water systems reported usage in 2005. The Koʻolau Golf Partners' water system has two wells that used a total of 0.050 mgd in 2005. The other active private water system in Koʻolau Poko is owned and operated by the Royal Hawaiian Valley Corporation. This system has two wells that pumped a total of 0.100 mgd in 2005. Both of these small private water systems provide water for golf course irrigation. Other registered privately owned wells in Koʻolau Poko include wells that are owned by the Valley of the Temples Cemetery and wells owned by the Bay View Golf Park. There may be additional unregistered privately owned wells in the district. These unregistered wells may be exempt from reporting if they produce less than 0.0017 mgd.

Another existing private ground water system in Koʻolau Poko is the McCandless Pipe System. Even though the McCandless system diverts water from Waianu Stream, water in the system is considered ground water because it originates from the Waiāhole tunnels. The McCandless Pipe System can provide up to 0.5 mgd of non-potable water to some of the farmers in Waiāhole Valley. Currently, some farmers are using McCandless water for irrigation. However, because the system is not metered, there is no information on the current number of users and the amount of water they consume.

Private surface water systems consist mainly of individually owned stream diversions for irrigation purposes. CWRM maintains a database of stream diversions populated through a survey conducted in the early 1990s. For the Koʻolau Poko district, there are 106 reported stream diversions in this database (Figure 3.4). Of the 106 reported diversions, about 80 percent were private diversions.

Figure 3.10 Private Wells in Koʻolau Poko



Surface water diversions by private users may provide significant amounts of water for agricultural water use in the district. However, there are no reliable sources of information on the exact amount of surface water that is currently being diverted from streams for agricultural water use. The previously reported 7.65 mgd of surface water use in 2005 (Table 3.1) is estimated based on the acreage of agricultural lands in the district, and not on observed or recorded flows. It should be further noted that the above amount accounts for *lo'i kalo* cultivation, aquaculture, and limited diversified agriculture, while other types of surface water use may exist in Ko'olau Poko.

3.3 PROJECTING FUTURE WATER DEMAND

3.3.1 Three Future Water Demand Scenarios

In order to adequately plan for Ko'olau Poko's future water needs, district water demand was projected through the year 2030. These projections suggest how much water might be needed over the next 20 years, and when increased demands might require infrastructure improvements. The projections are also meant to provide guidance for responsible land and water use decisions in the future.

The Statewide Framework recommends including "a range of forecasts of the amount of water required over the planning horizon…Among the scenarios are the base case [Mid-Growth] scenario, a High-Growth Scenario and a Low-Growth Scenario." Water demand was not only forecasted for municipal use, but for Federal, State, and private uses as well. The Statewide Framework for Updating the Hawaii Water Plan (Statewide Framework) requires that the City Water Use and Development Plans (WUDP) "…shall also include forecasts of water requirements of federal and private sector purveyors."

3.3.2 Projecting Future Water Demands Methodology and Major Assumptions

Water demand was estimated for four different types of water uses: (1) Municipal; (2) Diversified Agriculture; (3) *Kalo*; and (4) Landscape Irrigation (including parks and golf courses). Summaries of specific assumptions for projected future water demand for each neighborhood board area are provided in Section 3.3.3 "Water Demand by Neighborhood Board Area."

3.3.2.1 Municipal Water Use

Municipal Water Use includes Residential, Commercial, Industrial, Government, and Military water uses. Most Municipal water uses require potable water. The Per Capita methodology was used to calculate Municipal water demand in the low growth, mid growth, and high growth scenarios.

The calculations for Municipal Demand are based on the City and County of Honolulu's population projections for the year 2030 (dated September, 2009) and on the policies of the

GENERAL PLAN of the City and County of Honolulu. These DPP population forecasts for Ko'olau Poko were in turn based on the land use policies in the "Ko'olau Poko Sustainable Communities Plan," the City and County of Honolulu's long-range land use plan for the district. The Ko'olau Poko SCP calls for minimal future development and minimal population growth in the district. Large scale future residential and commercial developments in Ko'olau Poko are not likely as the land currently designated for urban development and urban use has nearly all been built out.

A "hybrid" methodology was used to calculate projected water demand. This methodology is a combination of the "Per Capita" and "End Use Inventory" methodologies. The Per Capita methodology calculates a per person water demand number by dividing Ko'olau Poko water use by the population that is served. Future projected increases in population are then multiplied by the per person water demand number to estimate future water demand. The End Use Inventory methodology assigns per acre water demand numbers for different types of land uses such as agriculture, park irrigation, or golf course irrigation.

Table 3-13 BWS Per Capita Demand in Ko'olau Poko

KP Resident Population (2000)[1]	BWS Population Served (2000)[2]	KP Demand in 2000 (mgd)	Per Capita Demand (gpcd)[3]
117,999	113,256	19.84	175

[1] KP Resident Population is from DPP's population projections, published in November 2007.
[2] For calculation of BWS Population Served, see Table 1.1 in Chapter 1, O'ahu Water Management Plan Overview.
[3] 175 gpcd is applied to BWS population served in the low, mid, and high growth scenarios to calculate 2030 water demand.

The *Per Capita* water demand factor of 175 gpcd was applied to population projections for the low-, mid-, and high-growth scenarios to calculate future BWS water demand. DPP's Population Projections for Ko'olau Poko show a population share of 10.3%, which represents a significant decline from the District's 2000 population share of 13.5%. These projections were thus used for the calculation of Municipal Water Demand for the low growth scenario. The high-growth scenario assumed that Ko'olau Poko would account for 11.6% of O'ahu's population by the year 2025, as is stated in Honolulu's General Plan. Municipal Water Demand for the mid-growth scenario was estimated at the mid-point between the low-growth and the high-growth demand.

3.3.2.2 Diversified Agriculture and Kalo

Future agricultural activity in Ko'olau Poko could increase significantly, given that there are large acreages of unutilized agricultural lands in the district that could potentially be cultivated. Future agricultural activity is also assumed to be one of the main variables for future water use based on consultation with community members that have stated that the concepts of "food sustainability", "food security", and "food self-sufficiency" will become all the more critical in the coming years given the continued rise of energy and shipping costs to and from Hawai'i over the last couple of decades (See Chapter 2.10 Stakeholder Consultation). To project for future water use for agriculture, agricultural activities were categorized into three major types: diversified agriculture, wetland *kalo* cultivation, and aquaculture. Each of the three major types of agricultural activities was assigned a different water use coefficient per acre because they have very different water demands. Table 3.14 presents the water use coefficients used to project demands for the three different types of agricultural activities, the type of coefficient, and the data source(s) that the coefficients were drawn from.

Table 3-14 Agricultural Water Use Coefficients

Agricultural Activity	Water Use Coefficient (gad)	Type of Water Coefficient	Data Source
Diversified Agriculture	2,500 for wetter areas of KP (Kahaluʻu and Kāneʻohe) 3,400 for drier areas of KP (Kailua and Waimānalo)	Average per acre water use for Diversified Agriculture activities NOTE: does not include irrigation system water losses	Water use studies for diversified agriculture in Punaluʻu *ahupuaʻa* (wet); Water demand factor used by the CWRM to calculate potential demand from diversified agriculture in ʻEwa Kunia in the Waiāhole Ditch Case The State AWUDP uses 3,400 gad
Loʻi Kalo	100,000 to 300,000	Per acre water inflow into *Loʻi Kalo* System	Consultation with windward *kalo* farmers and available *kalo* water use studies[1]
Aquaculture	145,000	State-wide average water use for aquaculture activities	State's AWUDP, 2004.

1 Available kalo water use studies include USGS 2007 "Report on Water Use in Wetland Kalo Cultivation in Hawaiʻi"; Office of Planning 1995 "Preliminary Assessment of Potential Water Demand for Economic and Instream Uses in the Waiāhole-Kualoa Region," and the "Agricultural Water Use and Development Plan" produced by the State DOA, Penn, D.C. 1997 dissertation on "Water and Energy Flows in Hawaii Taro Pondfields," Watson, L. J. 1964 "Observations made with respect to irrigation and growth of taro at certain patches at Waiāhole and Kahaluu, and Miles, K. 1931 "Report on study of water requirements of taro in Hanapēpē Valley, cooperative study by the Territory of Hawaiʻi and McBryde Sugar Company: ʻEleʻele, Hawaiʻi.

Aerial photo analysis (2005 air photos) and field verification (2009) were used to estimate the amount of agricultural lands that were currently in diversified agriculture, *kalo*, or aquaculture production. At the time of the analysis, of the 1,647 acres in agricultural cultivation, 96.7 percent of those lands was in diversified agriculture (1,594 acres), three percent was in *kalo* production (49 acres), and 0.3 percent (4 acres) was in inland aquaculture production.

For the "Low-Growth" demand scenario, the number of acres of diversified agriculture existing in 2005 was assumed to increase by 1% each year. This was determined to be a reasonable and realistic increase in agriculture, given the current statewide promotion of food security and food sustainability.

The Agricultural Lands of Importance to the State of Hawai'i (ALISH) Study was used to estimate **the amount of potential future agricultural lands** that could be developed for the Mid-Growth and High-Growth water demand scenarios. The ALISH study identified three classes of agriculturally important lands: "Prime," "Unique," and "Other." **In Ko'olau Poko, there are approximately 2,206 acres of ALISH designated lands available for agricultural expansion.**

In addition to the ALISH study, the planning team used the GIS data produced from the 2009 TNC study entitled "*Opportunities and Constraints for Intensive Agriculture in the Hawaiian Archipelago Prior to European Contact*" to estimate the amount of agricultural lands that were historically cultivated for wetland *kalo* cultivation. The 2009 TNC study identified land areas across the State that were likely to have been in *kalo* cultivation prior to western contact through an "iterative process" that compared physical geographic characteristics (i.e. proximity to natural sources of water, elevation, slope, riparian corridors, and soil type) with archaeological studies that "influenced [the authors of the study's] notions about where the development of intensive agriculture was possible." For Ko'olau Poko, **the 2009 TNC GIS-modeling study identified up to 5,004 acres of lands that *may* have once been in historic wetland *kalo* cultivation.**

Previous studies on the amount of water needed to support healthy *kalo* fields document a wide range of inflow volumes.[1] These studies, as well as discussions with several *kalo* farmers, indicate that a general range of 100,000 to 300,000 gad of inflow is needed. Some of the factors that affect *lo'i kalo* water demand include:

- Temperature of the water in the stream at the point of diversion
- Time of year (season)
- Acres of *kalo* in each particular stage of growth: fallow, recently planted, growing, and ready to harvest
- Location and size of other diversions upstream of a particular user

Of these factors, water temperature is one of the most critical. Water temperature is itself affected by several factors, including the volume of water in the stream, the length of the stream, the location along the stream, and riparian vegetation cover.

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[1] Available *kalo* water use studies include the USGS 2007 "Report on Water Use in Wetland *Kalo* Cultivation in Hawai'i"; Office of Planning 1995 "Preliminary Assessment of Potential Water Demand for Economic and Instream Uses in the Waiāhole-Kualoa Region," the "Agricultural Water Use and Development Plan" produced by the State DOA, Penn, D.C. 1997 dissertation on "Water and Energy Flows in Hawaii Taro Pondfields," Watson, L. J. 1964 "Observations made with respect to irrigation and growth of taro at certain patches at Waiāhole and Kahaluu, and Miles, K. 1931 "Report on study of water requirements of taro in Hanapēpē Valley, cooperative study by the Territory of Hawai'i and McBryde Sugar Company: 'Ele'ele, Hawai'i.

The Ko'olau Poko Watershed Management Plan recognizes the range of 100,000 gad to 300,000 gad is needed for *kalo* cultivation. However, for simplicity, it used 100,000 gad as the water demand factor for to use for planning purposes in estimating future water demands for Ko'olau Poko. While a flow of 300,000 gad is ideal for ensuring healthy *kalo*, several factors, including appropriate water management, could reduce the needed water flow to 100,000 gad.

Availability of Water for Future Agricultural Cultivation in Ko'olau Poko

The limiting factor for future increases in agricultural water use is the availability of current and future water supplies. Projected future agricultural water demands presented in this report assume that future agricultural water demand *cannot* exceed future potential agricultural water supply. A preliminary assessment of existing sources of agricultural water was conducted. The sources that were assessed include the BWS system, the State Waiāhole Valley Water System, State Waimānalo Irrigation System, McCandless pipeline, private shallow alluvial and deep ground water wells, private surface water systems, and recycled water from wastewater treatment plants.

Table 3.15 outlines those major factors that were considered for each of the systems and includes preliminary assumptions of the system's potential to supply additional agricultural water in the future.

Table 3-15 Agricultural Water Sources in Koʻolau Poko

Agriculture Water Source	Factors Considered	Preliminary Assumptions
BWS	Sustainable pumpage level and current expansion plans	Up to five percent of total BWS water supplied for the district may be available for current and future agricultural demand
State Waiāhole Valley Water System	Plans for repairs and expansion.	Current proportion of agricultural and municipal demand will remain the same in the future. Expected request for increased permitted use by 2015.
State Waimānalo Irrigation System	Current plans for repairs	Additional agricultural water may be available in the future because of improved system reliability from planned repairs and upgrades to the irrigation system and Maunawili Ditch
McCandless Pipeline	Existing users and potential for future additional supply	No additional agricultural water will be available in the future
State/City/ Federal Recycled water	Current plans for recycled water system development	Up to 0.7 mgd of R-1 water may be available from Waimānalo Waste Water Treatment Plant in the future
Private shallow alluvial wells	Existing untapped sources and feasibility for future development	There is limited viability for small farmers.
Private or DOA deep ground water wells	Existing unallocated sustainable yields and feasibility for future development	It was assumed that additional agricultural water may be available from private or DOA deep ground water systems in the future. The development of new deep ground water wells will be constrained by the relatively high cost/yield ratio of constructing ground water wells as well as relatively high costs related to installing and operating a distribution system
Surface water	Median stream flows, existing usage, and regulatory framework regarding the use of stream water	For the purpose of these demand projections, it was assumed that up to 50 percent of "Q70" (flows equaled or exceeded 70% of the time) stream flows in the district could be diverted for *loʻi kalo.* It should be noted that *loʻi kalo* water diversion does not actually "consume" large volumes of water. Most of the water diverted for *loʻi kalo* cultivation is returned to the stream.

3.3.2.3 Landscape Irrigation Water Use

The Landscape Irrigation water use includes golf course, park, and cemetery water uses in Ko'olau Poko. The baseline water consumption number for the irrigation of golf courses, parks, and cemeteries was calculated based upon available BWS and CWRM water consumption records. Irrigation demand from BWS systems was assumed to be 11% of the total municipal demand for each demand scenario, based on the percent of total BWS water demand that went to irrigation island-wide in 2005. Future irrigation water demand for State, Federal, and private systems was assumed to remain constant through 2030.

Table 3.16 summarizes the discussion in the previous sections describing the assumptions for each water use sector in which future water demand was projected for each of the three future growth scenarios.

Table 3-16 Ko'olau Poko Water Demand Projections Scenario Assumptions

Water Use Sector	2030 Growth Scenarios		
	Low Growth	Mid Growth	High Growth
Municipal	Decrease in projected district population share leads to decrease in future demand (Based on DPP Projections)	Population will be mid-way between the Low and High Growth numbers.	General Plan Population share of 11.6% of the Population of O'ahu.
Div. Agriculture and *Kalo*	Increase in projected agricultural acreage (Based on a 1% increase in agricultural acreage every year)	Increase in agricultural acreage mid-way in between the Low and High-Growth Scenarios	Further increase in projected agricultural acreage (Assumed that all ALISH-designated lands that are not currently developed or in the Conservation District will be converted to agriculture)
Landscape Irrigation	BWS demand is proportional to population. State, Federal, and private demand is constant	BWS demand is proportional to population. State, Federal, and private demand is constant	BWS demand is proportional to population. State, Federal, and private demand is constant

3.3.3 Water Demand by Neighborhood Board Area

The following sections present a breakdown of district water demand projections by Koʻolau Poko's four NB areas: Kahaluʻu, Kāneʻohe, Kailua and Waimānalo.

3.3.3.1 Kahaluʻu NB Area

The Kahaluʻu NB area is characterized mainly by low density single family housing in areas neighboring the Kāneʻohe NB area and small scale farms and rural house lots in areas that extend from ʻĀhuimanu to Kualoa.

Water demand for the Kahaluʻu NB area was projected for the Low, Mid, and High Growth Scenarios. Population is projected to remain relatively stable in the low growth scenario and increase by 5% in the high growth scenario.

Increases in water demand for the Mid and High Growth Scenarios were projected based on the availability of potential future agricultural lands as well as the potential availability of agricultural water in the Kahaluʻu NB area. Existing *kalo* cultivation makes up a small proportion of agricultural acreages in the Kahaluʻu NB area. However, because *kalo* cultivation uses significantly more water for every acre of cultivation, even small increases in the acreages of *kalo* resulted in much higher projected future water demands for the Kahaluʻu NB area. Aquaculture water use is a minor use, so it was assumed to remain unchanged. The Kahaluʻu NB area is the only NB area in Koʻolau Poko with existing aquaculture activities. Table 3.17 presents a summary of the major assumptions for the three scenarios for water demand in Kahaluʻu. Table 3.18 then provides the actual water demand numbers that flow from these assumptions.

Table 3-17 Summary of Water Demand Factors for Kahaluʻu[1] NB Area

Water Use Sector	Baseline Data (2000)	Low Growth Scenario (2030)	Mid Growth Scenario (2030)	High Growth Scenario (2030)	Methodology
Municipal – BWS	13,323 People[2]	-14 People[2]	+275 People[2]	+565 People[2]	Per Capita
Municipal - State	300 People[2]	+65 People[2]	+65 People[2]	+65 People[2]	Per Capita
Diversified. Agriculture	320 acres	+ 80 acres	+ 262 acres	+523 Acres	End Use Inventory
Wetland Kalo[3]	47 acres	+12 acres	+21 acres	+30 acres	
Aquaculture	4 acres	+0 acres	+0 acres	+0 acres	
Landscape Irrigation[4]	0.016 mgd	+0.001 mgd	+0.001 mgd	+0.001 mgd	Proportional to Increase in BWS Municipal Demand+ no change in private, State, and Federal demand

[1] Kahaluʻu NB area includes the community of Kahaluʻu as well as the communities of Waiāhole, Waikāne, Waiheʻe, Hakipuʻu, and part of Kualoa.
[2] De Facto Population is the actual population served in the district. See Appendix E for calculation methodology.
[3] Increase in future acres of kalo is restricted by available stream flow in the high demand scenario.
[4] Consists of City and State parks, and the Valley of the Temples water uses

NOTE: See Appendix E for Water Demand Methodology

Table 3-18 Projected Kahaluʻu Water Demand by Water Use Sector

Kahaluu NB Area	2000 (mgd)	2030 (mgd)		
		Low	Mid	High
Municipal				
BWS	1.555[1]	2.143	2.189	2.236
State	0.052	0.063	0.063	0.063
Total Municipal	1.607	2.206	2.252	2.299
Agriculture				
Diversified Agriculture	0.448	0.648	1.102	1.756
Div. Ag. - BWS	0.236	0.175	0.178	0.182
Div. Ag. - State	0.087	0.076	0.076	0.076
Div. Ag. - Private	0.125	0.398	0.848	1.498
Kalo (using 100,000 gad)	4.711	5.889	6.785	7.681
Aquaculture (145,000 gad)	0.600	0.600	0.600	0.600
Total Agriculture	5.760	7.138	8.487	10.037
Golf Course				
BWS	0.000	0.000	0.000	0.000
Private	0.000	0.000	0.000	0.000
Federal	0.000	0.000	0.000	0.000
Total Golf Course	0.000	0.000	0.000	0.000
Landscape Irrigation (Parks, Cemetery)				
BWS	0.011	0.012	0.012	0.012
State	0.000	0.000	0.000	0.000
Federal	0.000	0.000	0.000	0.000
Private	0.005	0.005	0.005	0.005
Total Landscape & Irrigation	0.016	0.017	0.017	0.017
Total NB Area (mgd)	**7.383**	**9.360**	**10.757**	**12.353**

1 BWS year 2000 water demand is actual use for Kahaluʻu, and may not be equal to the BWS-served population times the Koʻolau Poko-wide per capita water demand factor of 175 gpcd.

All water demand is expected to increase, with the exception of golf course water use, which is expected to remain at zero because there are no existing or future golf courses planned for the area.

3.3.3.2 Kāne'ohe NB Area

In contrast with the Kahalu'u NB area, the Kāne'ohe NB area is characterized by low to medium density development occupying almost all of the urban zoned lands in the area. There are few farms here. Most of the current agricultural lands in Kāne'ohe are in Luluku. Other types of crops are also present in limited number, including *kalo* and nursery plants. Table 3.19 summarizes the major assumptions that the Kāne'ohe future water use projections were based upon.

Table 3 - 19 Summary of Water Demand Factors for Kāne'ohe[1] NB Area

Water Use Sector	Baseline Data (2000)	Low Growth Scenario (2030)	Mid Growth Scenario (2030)	High Growth Scenario (2030)	Methodology
Municipal	38,124 People[2]	-2,206 People[2]	-1,446 People2	-685 People[2]	Per Capita
Div. Agriculture	82 acres	+21 acres	+45 acres	+89 acres	End Use Inventory
Kalo[3]	0.96 acres	+0.24 acres	+21 acres	+40 acres	
Landscape Irrigation[4]	0.071 mgd	+0.448 mgd	+0.158 mgd	+0.468 mgd	Proportional to Increase in BWS Municipal Demand + no change in private, State, and Federal demand

[1] Kāne'ohe NB area includes the community of Kāne'ohe as well as the communities of Ha'ikū and He'eia.
[2] De Facto Population is the actual population served in the district. See Appendix E for calculation methodology.
3 Not including cultivation of wetland *kalo* in wetland areas like the He'eia wetlands, which can support additional acreage without diverting water from the streams. Increase in future acres of kalo is restricted by available stream flow in the high demand scenario.
[4] Consists of golf courses (Ko'olau Golf Club and Pali Golf Course), City and State parks, and cemeteries (Hawaiian Memorial Park Cemetery and Hawai'i State Veterans Cemetery) water uses
NOTE: See Appendix E for Water Demand Methodology

Table 3.20 presents the breakdown of Kāneʻohe water demand by water use sector. Municipal, agricultural, and landscape irrigation demand are expected to increase, but golf course irrigation is expected to remain the same, as there are no plans for future expansion in Kāneʻohe.

Table 3-20 Projected Kāneʻohe Water Demand by Water Use Sector

Kaneohe NB Area	2000 (mgd)	2030 (mgd)		
		Low	Mid	High
Municipal				
BWS	4.959[1]	5.783	5.905	6.028
State	0.000	0.000	0.000	0.000
Total Municipal Demand	4.959	5.783	5.905	6.028
Agriculture				
Total Div. Ag	0.015	0.066	0.126	0.238
Div. Ag. - BWS	0.015	0.016	0.016	0.017
Div. Ag. - State	0.000	0.000	0.000	0.000
Div. Ag. - Private	0.000	0.050	0.110	0.221
Kalo - State	0.076	0.076	0.076	0.076
Kalo - Private (using 100,000 gad)	0.020	0.044	2.077	3.870
Aquaculture (145,000 gad)	0.000	0.000	0.000	0.000
Total Agriculture	0.111	0.186	2.279	4.184
Golf Course				
BWS: Pali	0.010	0.010	0.010	0.010
Private: Koolau, Bay View	0.190	0.190	0.190	0.190
Federal	0.000	0.000	0.000	0.000
Total Golf Course	0.200	0.200	0.200	0.200
Landscape Irrigation (Parks, Cemetery)				
BWS	0.029	0.477	0.487	0.497
State: HI State Veteran's Cemetery	0.042	0.042	0.042	0.042
Federal	0.000	0.000	0.000	0.000
Private	0.000	0.000	0.000	0.000
Total Landscape & Irrigation	0.071	0.519	0.529	0.539
Total NB Area (mgd)	**5.341**	**6.688**	**8.914**	**10.951**

1 BWS year 2000 water demand is actual use for Kāneʻohe, and may not be equal to the BWS-served population times the Koʻolau Poko-wide per capita water demand factor of 175 gpcd.

3.3.3.3 Kailua NB Area

Future water demand projections for the Kailua NB area identifies water demand from the Marine Corps Air Station Kāneʻohe Bay on the Mōkapu Peninsula separately. Similar to Kāneʻohe, land use in the Kailua NB area is characterized by low to medium density residential uses. Limited agricultural activities can be found in Maunawili Valley.

The following table presents a summary of the major assumptions for the scenarios for water demand calculations in Kailua.

Table 3-21 Summary of Water Demand Factors for Kailua[1] NB Area

Water Use Sector	Baseline Data (2000)	Low Growth Scenario (2030)	Mid Growth Scenario (2030)	High Growth Scenario (2030)	Methodology
Municipal-Civilian Municipal - Military	39,403 People[2] 11,232 People[2]	-851 People[2] -663 People [2]	-54 People[2] -439 People[2]	+743 People[2] -215 People[2]	Per Capita
Div. Agriculture	92 acres	+23 acres	128 acres	+256 acres	End Use Inventory
Kalo	0.75 acres	+0.19 acres	+13 acres	+25 acres	
Landscape Irrigation[3]	0.142 mgd	-0.097 mgd	-0.086	-0.075	Proportional to Increase in BWS Municipal Demand+ no change in private, State, and Federal demand

[1]Kailua NB area includes the community of Kailua as well as the communities of Maunawili and The Marine Corps Air Station Kāneʻohe Bay on Mōkapu Peninsula
[2]De Facto Population is the actual population served in the district. See Appendix E for calculation methodology.
[3]Consists of golf courses (Luana Hills Golf Course, Klipper Golf Course and Mid Pacific Country Club), and City and State Parks water uses
NOTE: See Appendix E for Water Demand Methodology

As shown in Table 3.22, there is a decrease in projected water demand in Kailua for the Low Growth Scenario for municipal water use, due to a projected decline in population, including a decrease in population at the Marine Corps Air Station Kāne'ohe Bay. Increases in overall water demand were projected in Kailua. These increases are based on the assumption that agricultural activities in Kailua could expand.

Table 3 - 22 Projected Kailua Water Demand by Water Use Sector

Kailua NB Area	2000 (mgd)	2030 (mgd)		
		Low	Mid	High
Municipal				
BWS	10.014[1]	7.909	8.073	8.237
Civilian	6.888	6.207	6.335	6.463
Military	3.126	1.702	1.738	1.774
State	0.000	0.000	0.000	0.000
Total Municipal	10.014	7.909	8.073	8.237
Agriculture				
Diversified Agriculture	0.014	0.092	0.449	0.883
Div. Ag. - BWS	0.014	0.013	0.013	0.013
Div. Ag. - State	0.000	0.000	0.000	0.000
Div. Ag. - Private	0.000	0.079	0.435	0.870
Kalo (using 100,000 gad)	0.075	0.094	1.279	2.465
Aquaculture (145,000 gad)	0.000	0.000	0.000	0.000
Total Agriculture	0.089	0.186	1.728	3.348
Golf Course				
BWS - Mid Pacific	0.482	0.482	0.482	0.482
Private - Luana Hills	0.100	0.100	0.100	0.100
Federal - Klipper	0.550	0.550	0.550	0.550
Total Golf Course	1.132	1.132	1.132	1.132
Landscape Irrigation (Parks, Cemetery)				
BWS	0.142	0.189	0.203	0.217
State	0.000	0.000	0.000	0.000
Federal	0.000	0.000	0.000	0.000
Private	0.000	0.000	0.000	0.000
Total Parks	0.142	0.189	0.203	0.217
Total NB Area (mgd)	**11.377**	**9.416**	**11.136**	**12.934**

1 BWS year 2000 water demand is actual use for Kailua, and may not be equal to the BWS-served population times the Ko'olau Poko-wide per capita water demand factor of 175 gpcd.

Municipal and landscape irrigation water demand is expected to decrease in all three scenarios, while agricultural water demand is expected to increase. Golf course irrigation is expected to remain the same.

3.3.3.4 Waimānalo NB Area

The Waimānalo NB Area is characterized by low density residential development in areas along Kalaniana'ole Highway and small to medium scale farms and rural house lots extending from the *mauka* side of Kalaniana'ole Highway. Diversified agriculture makes up most of the agricultural activities yielding a wide range of products, most notably nursery flowers, landscaping plants and fruits. The 127-acre University of Hawai'i agricultural research station is also located here. The following table presents a summary of the major assumptions for the future water demand scenarios in Waimānalo.

Table 3-23 Summary of Water Demand Factors for Waimānalo[1] NB Area

Water Use Sector	Baseline Data (2000)	Low Growth Scenario (2030)	Mid Growth Scenario (2030)	High Growth Scenario (2030)	Methodology
Municipal	9,925 People[2]	+ 500 People[2]	+721 People[2]	+942 People[2]	Per Capita
Diversified Agriculture	1,100 acres	+275 acres	+146.00 acres	+292 acres	End Use Inventory
Kalo	0.00 acres	+0.00 acres	+1.60 acres	+3.20 acres	
Landscape Irrigation[3]	0.057 mgd	-0.144 mgd	-0.143 mgd	-0.085 mgd	Proportional to Increase in BWS Municipal Demand + no change in private, State, and Federal demand

[1] Waimānalo NB area includes the community of Waimānalo as well as the community of Bellows Air Force Station.
[2] De Facto Population is the actual population served in the district. See Appendix E for calculation methodology.
[3] Consists of Olomana Golf Links and City and State parks water uses
NOTE: See Appendix E for Water Demand Methodology

For Waimānalo, water demand is projected to increase for the Low, Mid and High Growth Scenarios respectively as shown in Table 3.24. These increases are attributed to increases in agricultural water demands. The City population projections for Waimānalo include projected increases in the number of native Hawaiians living on Hawaiian "homestead" lands. State law sets aside water sources specifically for homestead developments that are built by the Department of Hawaiian Home Lands (DHHL). For DHHL homestead development in Waimānalo, potable water is provided by BWS.

Table 3-24 Projected Waimānalo Water Demand by Water Use Sector

Waimanalo	2000 (mgd)	2030 (mgd)		
		Low	Mid	High
Municipal				
BWS	1.480[1]	1.678	1.714	1.750
State	0.000	0.000	0.000	0.000
Total Municipal	1.480	1.678	1.714	1.750
Agriculture				
Total Div. Ag	3.740	4.675	4.336	4.733
Div. Ag. - BWS	0.719	0.117	0.119	0.122
Div. Ag. - State Waimanalo Irr. Syst.**	0.400	0.400	0.400	0.400
Div. Ag. - State DOA & ENV (Recycled Water)***	0.000	1.378	0.297	0.394
Div. Ag. - Private	2.621	2.780	3.519	3.817
Kalo - Private (using 100,000 gad)	0.000	0.000	0.160	0.320
Aquaculture (145,000 gad)	0.000	0.000	0.000	0.000
Total Agriculture	3.740	4.675	4.496	5.053
Golf Course				
BWS - Olomana	0.116	0.116	0.116	0.116
Private	0.000	0.000	0.000	0.000
Federal	0.000	0.000	0.000	0.000
Total Golf Course	0.116	0.116	0.116	0.116
Landscape Irrigation (Parks, Cemetery)				
BWS	0.057	-0.087	-0.086	-0.085
State	0.000	0.000	0.000	0.000
Federal	0.000	0.000	0.000	0.000
Private	0.000	0.000	0.000	0.000
Total Parks	0.057	-0.087	-0.086	-0.085
Total NB Area (mgd)	**5.393**	**6.383**	**6.239**	**6.833**

1 BWS year 2000 water demand is actual use for Waimānalo, and may not be equal to the BWS-served population times the Koʻolau Poko-wide per capita water demand factor of 175 gpcd.

As seen in Table 3-24, increases in water demand were projected for the Low, Mid and High Growth Scenarios for Municipal uses in Waimānalo. The Mid-growth scenario for diversified agriculture is lower than the Low-Growth scenario because half of the available ALISH lands (Mid-Growth scenario) is less than a one percent increase in agricultural lands each year (Low-Growth scenario).

3.3.4 District-Wide Water Demand

A summary of district-wide water assumptions for future water demand is presented in Table 3.25. The water demands presented in this table are the cumulative totals of the water demands that were calculated separately for the four NB areas in the district.

Table 3-25 Summary of Water Demand Factors for Ko'olau Poko

Water Use Sector	Baseline Data (2000)	Low Growth Scenario (2030)	Mid Growth Scenario (2030)	High Growth Scenario (2030)	Methodology
Municipal	112,307 People[1]	- 3,234 People	-942 People	+1,349 People	Per Capita
Div. Agriculture	1,594 acres	+398 acres	+580 acres	+1,160 acres	End Use Inventory
Kalo	49 acres	+12 acres	+55 acres	+95 acres	
Aquaculture	4.14 acres	+0.00 acres	+0.00 acres	+0.00 acres	
Landscape Irrigation	1.734 mgd	+0.208 mgd	+0.230 mgd	+0.252 mgd	Proportional to Increase in BWS Municipal Demand + no change in private, State, and Federal demand

[1] De facto population in Ko'olau Poko. De facto population is the actual population residing in the district. See Appendix E for calculation methodology.

Table 3.26 shows the projected district-wide demand by water use sector. Municipal water demand is not expected to increase significantly in all three growth scenarios. *Kalo* cultivation is projected to be the dominant future water use in all three growth scenarios. Besides municipal and agricultural water uses, other future water uses in the district were projected to remain constant or increase minimally.

Table 3-26 District Water Demand by Water Use Sector

Water Use	2000 (mgd)	2030 (mgd)		
		Low	Mid	High
Municipal				
BWS*	18.008	17.512	17.881	18.250
Civilian	14.882	15.811	16.144	16.477
Military	3.126	1.702	1.738	1.774
State[1]	0.052	0.063	0.063	0.063
Total Municipal	18.060	17.575	17.944	18.313
Agriculture				
Diversified Agriculture	4.217	5.482	6.013	7.609
Div. Ag. - BWS	0.984	0.320	0.327	0.334
Div. Ag. – State[2]	0.487	1.854	0.773	0.870
Div. Ag. - Private	2.746	3.308	4.912	6.405
Kalo - State	0.076	0.076	0.076	0.076
Kalo - Private	4.806	6.027	10.301	14.336
Aquaculture - Private	0.600	0.600	0.600	0.600
Total Agriculture	9.700	12.185	16.990	22.622
Golf Course				
BWS	0.608	0.608	0.608	0.608
Private	0.290	0.290	0.290	0.290
Federal	0.550	0.550	0.550	0.550
Total Golf Course	1.448	1.448	1.448	1.448
Landscape Irrigation (Parks, Cemetery)				
BWS	0.239	0.591	0.616	0.641
State	0.042	0.042	0.042	0.042
Federal	0.000	0.000	0.000	0.000
Private	0.005	0.005	0.005	0.005
Total Landscape Irrigation	0.286	0.638	0.663	0.688
Total NB Area	**29.494**	**31.846**	**37.046**	**43.071**
Total NB Area, incl. export to E. Honolulu	**29.994**	**32.346**	**37.564**	**43.571**

[1]State demand includes 0.011 mgd demand for DHHL units in Waiāhole Valley

[2]State diversified agriculture demand includes lands that are to be supplied with water from the City's Waimānalo WWTP

NOTE: See Appendix E for calculation methodology

Figure 3.11 illustrates the future water demand by water use sector for the three different water use scenarios. As can be seen, agricultural water use increases dramatically over the Low, Mid, and High Growth Scenarios. All other types of water uses increase minimally or remain fairly constant across the three different scenarios.

Figure 3.11 Water Demand By Water Use Sector

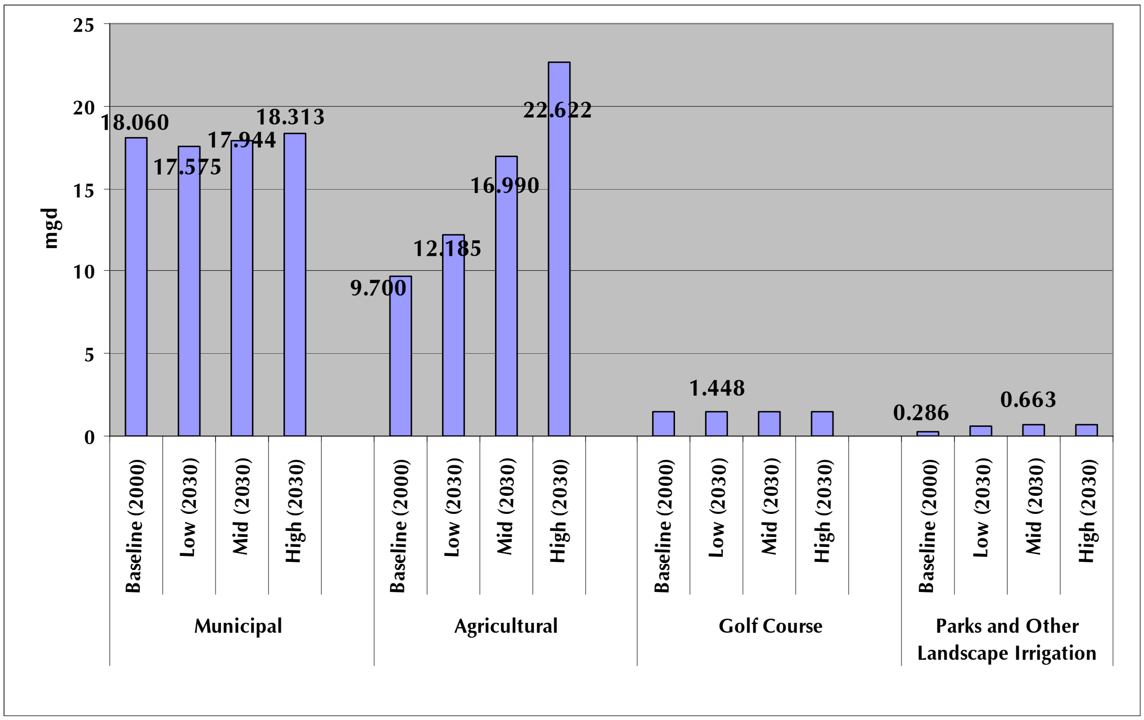


Figure 3.12 allows for a comparison of projected water demand by Neighborhood Board area. The Kailua NB Area has the highest projected water demand, followed by Kahaluʻu. The largest increases in water demand tended to be for potential diversified agriculture and *kalo* cultivation, as population is not expected to increase significantly by the year 2030. Population is in fact, expected to decrease in both the Low-Growth and Mid-Growth scenarios.

Figure 3.12 Water Demand by NB Area

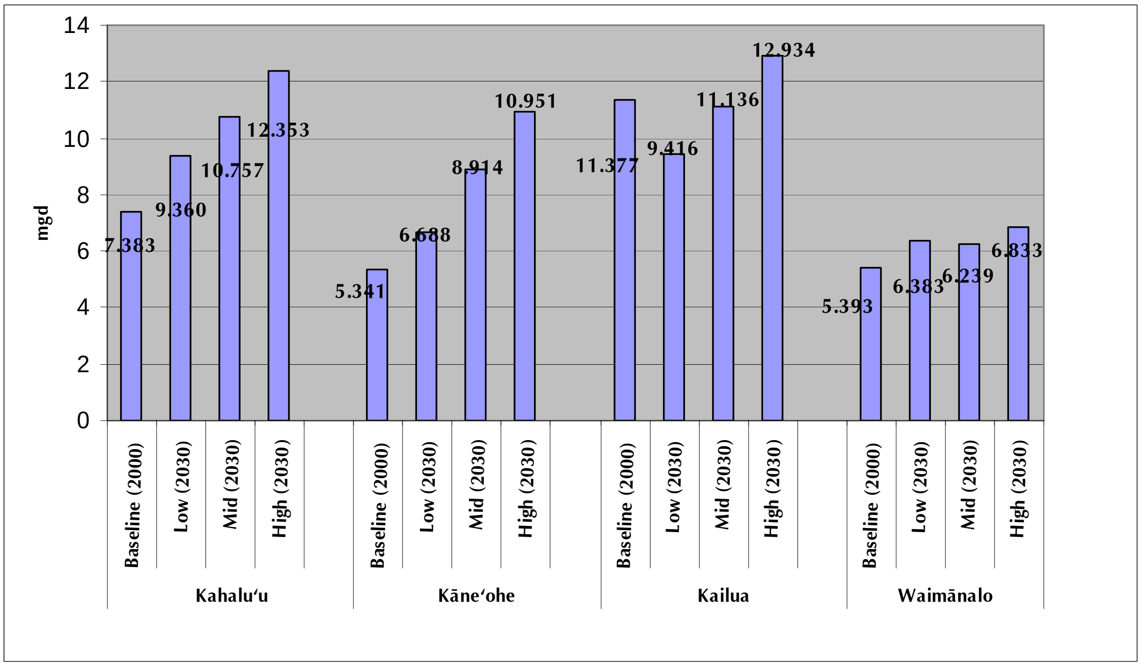


Figure 3.13 illustrates future water demand by water purveyor and private users. Private users are projected to have the highest increase in water demand. This increase can be mainly attributed to the increase in *kalo* cultivation. It is assumed that most of the water that will be used for *kalo* cultivation will be provided by stream diversions. Water supplied by BWS systems is also projected to increase somewhat in the Mid and High Growth Scenarios. The increase in demand for BWS water can be attributed to increases in population and corresponding increases in Municipal water use. There may also be increased ground water produced by private or public entities.

Figure 3.13 Ko'olau Poko Water Demand by Water Producer

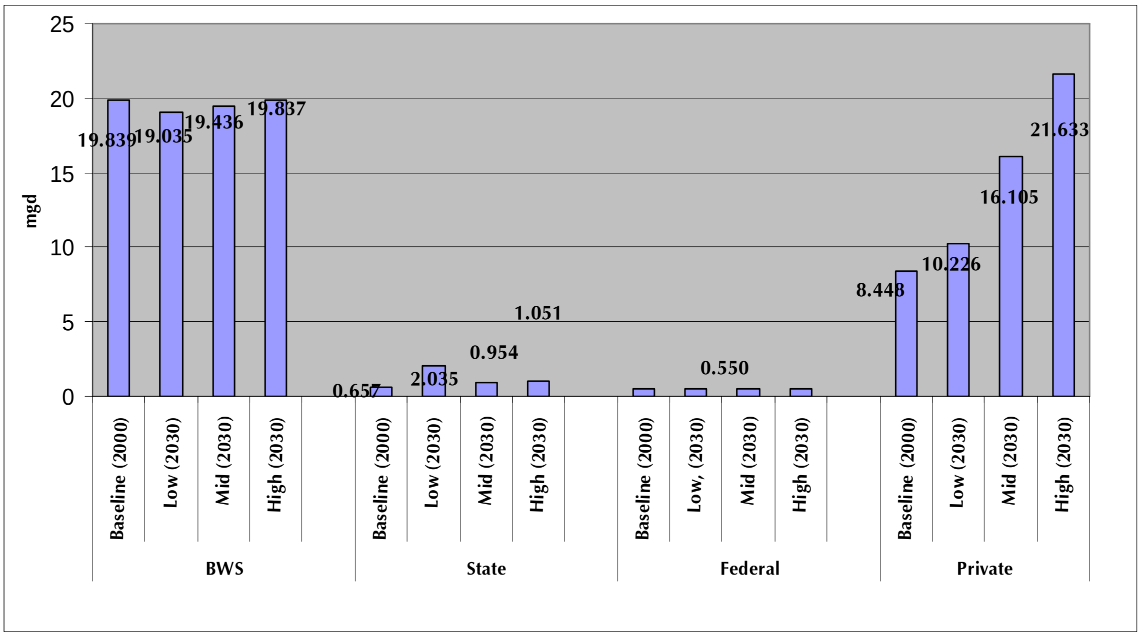


Table 3 - 27 Ko'olau Poko Water Demand by Water Producer

Water Producer	2000 (mgd)	2030 (mgd)		
		Low	Mid	High
BWS*	**19.839**	**19.035**	**19.436**	**19.837**
Municipal	18.008	17.512	17.881	18.250
Civilian	14.882	15.811	16.144	16.477
Military	3.126	1.702	1.738	1.774
Diversified Ag	0.984	0.324	0.331	0.338
Kalo	0.000	0.000	0.000	0.000
Aquaculture	0.000	0.000	0.000	0.000
Golf Course	0.608	0.608	0.608	0.608
Irrigation	0.239	0.591	0.616	0.641
State	**0.657**	**2.035**	**0.954**	**1.051**
Municipal	0.052	0.063	0.063	0.063
Diversified Ag	0.487	1.854	0.773	0.870
Kalo	0.076	0.076	0.076	0.076
Aquaculture	0.000	0.000	0.000	0.000
Golf Course	0.000	0.000	0.000	0.000
Irrigation	0.042	0.042	0.042	0.042
Federal	**0.550**	**0.550**	**0.550**	**0.550**
Municipal	0.000	0.000	0.000	0.000
Diversified Ag	0.000	0.000	0.000	0.000
Kalo	0.000	0.000	0.000	0.000
Aquaculture	0.000	0.000	0.000	0.000
Golf Course	0.550	0.550	0.550	0.550
Irrigation	0.000	0.000	0.000	0.000
Private	**8.448**	**10.226**	**16.105**	**21.633**
Municipal	0.000	0.000	0.000	0.000
Diversified Ag	2.746	3.304	4.909	6.401
Kalo	4.806	6.027	10.301	14.336
Aquaculture	0.600	0.600	0.600	0.600
Golf Course	0.290	0.290	0.290	0.290
Irrigation	0.005	0.005	0.005	0.005
Total NB Area	**29.494**	**31.846**	**37.046**	**43.071**
Total NB Area, incl. export to E. Honolulu	**29.994**	**32.346**	**37.546**	**43.571**

More detailed water use categories are used by the CWRM to further classify types of water demand. The following table breaks down the district water use sector according to categories specified by the CWRM. As can be seen from this table, "Domestic Residential" water use and "Agricultural" water use are two types of major water uses in Ko'olau Poko. "Domestic Residential" includes all potable and non-potable water supplied for residential users while "Agricultural" water use includes all potable and non-potable water supplied for irrigation of crops.

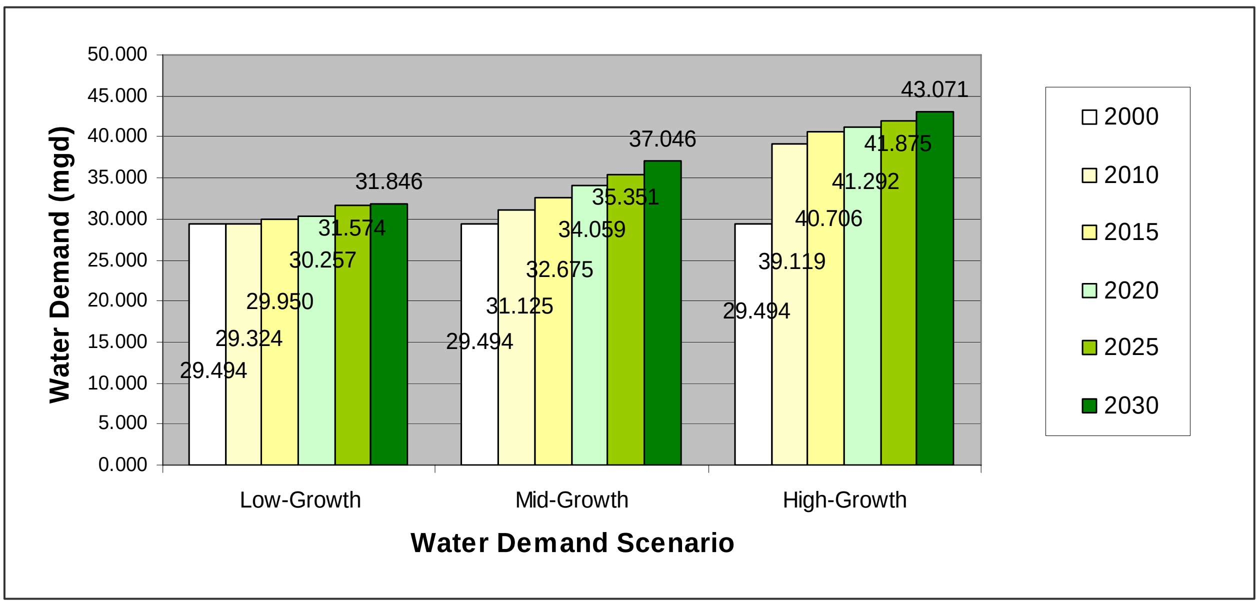
Table 3-28 District Water Demand by CWRM's Water Use Categories

		2030		
	2000	**Low**	**Mid**	**High**
KPWMP Water Use Sector				
CWRM End Use Category				
Municipal	18.560	18.075	18.444	18.813
Domestic Residential (includes potable and nonpotable water needs)	*11.837*	*11.519*	*11.761*	*12.003*
Domestic Non-Residential (includes potable and nonpotable water needs)	*5.996*	*5.835*	*5.958*	*6.080*
Industrial	*0.227*	*0.221*	*0.226*	*0.230*
Export to E. Honolulu	*0.500*	*0.500*	*0.500*	*0.500*
Agriculture	9.700	12.185	16.990	22.622
Agriculture	*9.700*	*12.185*	*16.990*	*22.622*
Irrigation	1.734	2.086	2.111	2.136
Irrigation	*1.734*	*2.086*	*2.111*	*2.136*
Total - All Purveyors	**29.994**	**32.346**	**37.546**	**43.571**

3.4 SELECTED DEMAND SCENARIO

The Statewide Framework recommends that a "base case" scenario be developed to serve as the basis for developing future water development options. In line with this recommendation, one demand scenario was selected as the "base scenario". The Low Growth Scenario which was based upon the DPP's Socio-Economic Policy Projections, was chosen as the "base scenario" in order to comply with requirements found in the State Water Code and the Statewide Framework. The State Water Code mandates that "Each water use and development plan….. be consistent with the respective City land use plans and policies," and the Statewide Framework requires that "….demand forecasts shall be consistent with development plans and/or community plans."

Figure 3.14 Projected Demands over the Planning Period for Different Growth Scenarios



Selecting the Low Growth Scenario as the base case scenario, however, does not rule out the possibility that one of the other demand Scenarios could take place in the future. Increases in agricultural water demand could result from situations other than an increase in acreage, for example, a more intensive use of existing agricultural acreages. To plan accordingly, flexibility for providing expanded water supplies should be one of the considerations in developing water resource options.

3.5 IMPLICATIONS FOR WATER SUPPLY PLANNING

The following summary identifies the implications for water supply planning that have been identified through the analysis of current and future water use. Overall water supply issues for Koʻolau Poko may be succinctly summarized as follows:

- Almost two-thirds of the district's BWS ground water use is for residential uses. Active domestic water conservation programs can help to reduce the district's total BWS ground water demand and help to reduce BWS transfer of water between watersheds. **Every gallon of water conserved is one more gallon of water that can remain in Koʻolau Poko's aquifers or streams.**
- Surface water systems supply a significant portion of agricultural water use. In the future, there could be a need to amend interim instream flow standards to allow for expansion of surface water use.
- Until measureable instream flow standards have been determined for each stream in Koʻolau Poko, existing diversions should be used as efficiently as possible.

More detailed considerations are presented in sections 3.5.1 through 3.5.8 below.

3.5.1 BWS Projected Demand and Water Conservation

Future water demand for the BWS system is projected to decrease by approximately 0.804 mgd in the Low-Growth Scenario, 0.403 mgd in the Mid-Growth Scenario and 0.002 mgd in the High-Growth Scenarios. Further efforts toward more efficient water distribution have the potential to meet future demand should any of the Scenarios materialize. Water conservation efforts in Koʻolau Poko may also lead to a reduction in the amount of water that needs to be imported to Koʻolau Poko from Koʻolau Loa.

3.5.2 Agricultural Water Demand

For the entire district, future water demand increases are mainly attributed to increases in agricultural water demand. *Kalo* water demand is assumed to be the largest agricultural water demand in the future. Surface water will most likely be the main source for *kalo* water. In the future, there could be a need to amend interim instream flow standards to allow for expansion of surface water use. Until measurable instream flow standards have been determined for each stream in Ko'olau Poko, existing diversions should be used more efficiently.

3.5.3 Diversification of Water Supply

In most instances, agricultural water demand can be supplied by non-potable water sources. The development of non-potable water sources, including wastewater reclamation facilities in the Waimānalo NB area and further expansion of surface water use in other NB areas, should be considered. It was estimated that in the year 2009, approximately 0.7 mgd of wastewater passed through the Waimānalo wastewater treatment plant.

3.5.4 More Information on Stream Water Flow is Needed

The calculated total base stream flow in Ko'olau Poko, based on the data available, is 28.68 mgd. This amount, however, may be lower than the actual total base stream flows in the district as some of the streams in the area do not have the long term historical data needed to reliably estimate the stream flow. In the future, more information on stream flows is needed to better estimate the availability of stream water for agricultural uses.

3.5.5 Instream Flow Standards

Surface water uses cannot practically be planned for until measurable instream flow standards are set. The current "status quo" interim IFS requires a lengthy permitting process in which each permittee must show that their use will not negatively impact other stream uses. Measurable IFS would help plan for the expansion of stream-irrigated agriculture on a holistic level.

3.5.6 Transfer of the Waiāhole Valley Water System from HHFDC to BWS

The Waiāhole Valley Water System is currently operating with significant water losses due to leaks in the storage tank and distribution system. Further expansion of water supply from this system is possible if the system is repaired. In the State FY 2009 Supplemental Budget, HHFDC made a CIP request for $2.8 million to repair the Waiāhole Valley Water System. However, funding for the project has not been released. The WVWS would need to be upgraded to BWS standards before it would consider accepting the system. Funding for these types of improvements has not been secured yet.

3.5.7 More Information is Needed on the McCandless Pipe System

The McCandless Pipe System can provide up to 0.5 mgd of non-potable water to some of the farmers in Waiāhole Valley. Currently, some farmers are using McCandless water for irrigation. However, there is no information on the current number of users and the volume of water they consume.

3.5.8 Improvement of the Waimanalo Irrigation System

Most nursery farmers in Waimānalo irrigate their crops with water that is supplied by BWS and the State Waimānalo Irrigation System. The amount of water that the Waimānalo Irrigation System supplies to farmers could be increased if repairs are made to the system and the system is properly maintained. More water supplied by the Waimānalo Irrigation System to Waimānalo farms would mean that less water would be needed by the farmers from the BWS system. According to the 2004 AWUDP, repairs to the system include land treatment, improvement of the water collection system, and modification of the old irrigation ditch and restoration of the three abandoned reservoirs. These improvements to the Waimānalo Irrigation System were estimated to cost $5.5 million. In 2008, the State DOA was appropriated $6 million to repair the Waimānalo Irrigation System. Currently, the State DOA is scheduled to complete the design phase of the improvements to the irrigation system by the beginning of 2010 with actual construction and repairs scheduled to begin in the summer of 2010. It should be noted that the capital cost estimates for this work in the 2004 AWUDP are out of date and need to be revised.

ENDNOTES

[i] Commission on Water Resource Management, Water Resource Protection Plan: Final Plan adopted August 2008, p. 5-3.
[ii] State of Hawai'i, Hawai'i Revised Statutes §174C-3.
[iii] Commission on Water Resource Management (July 13, 2006). *Findings of Fact, Conclusions of Law and Decision and Order: In the Matter of Water Use Permit Applications, Petitions for Interim Instream Flow Standards Amendments and Petitions for Water Reservations for Waiāhole Ditch Combined Contested Case Hearing.*
[iv] CH2M Hill. July 2006. Needs Assessment and Capital Plan Report. Honolulu Board of Water Supply. (p. 3-5)
[v] SWPP p. 2-12
[vi] Bills Engineering, October 19, 2007, *Waiāhole Valley Water System Assessment*.
[vii] Department of Business, Economic Development, and Tourism. Supplemental Budget Request Fiscal Year 2008-2009.
[viii] Department of Business, Economic Development, and Tourism. Supplemental Budget Request Fiscal Year 2008-2009.
[ix] Commission on Water Resource Management. February 2003. State Water Projects Plan Volume 5. p. 2-13
[x] Phone Interview July 28, 2008. Randy Taruya of Department of Agriculture.
[xi] http://hawaii.gov/hdoa/arm/arm_irrigation/arm_Waimānalo July 25, 2008.
[xii] Commission on Water Resource Management. July 2008. Aquifer System Area Use Permit Index.
[xiii] Phone Interview August 29, 2008. Joe DeRego of Department of Transportation.
[xiv] Commission of Water Resource Management, 2004. 2004 Hawaii Water Reuse Survey and Report, p. 65.
[xv] CWRM GIS database

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CHAPTER 4 – PLAN OBJECTIVES, WATER SUPPLY AND WATERSHED MANAGEMENT PROJECTS AND STRATEGIES

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4 PLAN OBJECTIVES, WATER SUPPLY AND WATERSHED MANAGEMENT PROJECTS AND STRATEGIES

4.1 OVERALL GOAL, OBJECTIVES, AND SUB-OBJECTIVES OF THE KPWMP

This Chapter documents three elements of the Ko'olau Poko Watershed Management Plan:

1. Overall Goal, Objectives and Sub-Objectives of the KPWMP

2. Watershed Management Projects and Programs with "Project Champions"

3. More general Watershed Management Strategies

WATERSHED MANAGEMENT OBJECTIVES AND SUB-OBJECTIVES

In order to provide planning consistency, all of the O'ahu Watershed Management Plans have the same general GOAL and the same five MAJOR OBJECTIVES. The overall GOAL and the major OBJECTIVES are based on the framing federal, state, and city laws and policies that are listed in Chapter 1 of this plan. More detailed SUB-OBJECTIVES, derived from an analysis of watershed issues and stakeholder values, reflect the unique resources and needs of each planning district.

The overall GOAL of the O'ahu Watershed Plans is: *"To formulate an environmentally holistic, community-based, and economically viable watershed management plan that will provide a balance between: (1) the preservation and management of Oahu's watersheds, and (2) sustainable ground water and surface water use and development to serve present users and future generations."*

The five MAJOR OBJECTIVES that are common to all of the O'ahu Watershed Management Plans are:

1. PROMOTE SUSTAINABLE WATERSHEDS
2. PROTECT AND ENHANCE WATER QUALITY AND QUANTITY
3. PROTECT NATIVE HAWAIIAN RIGHTS AND TRADITIONAL AND CUSTOMARY PRACTICES
4. FACILITATE PUBLIC PARTICIPATION, EDUCATION, AND PROJECT IMPLEMENTATION
5. MEET FUTURE WATER DEMANDS AT REASONABLE COST

The Ko'olau Poko-specific SUB-OBJECTIVES then provide the planning framework for organizing specific water supply and watershed management PROJECTS and PROGRAMS, which are presented in some detail in this chapter. The five MAJOR OBJECTIVES and corresponding SUB-OBJECTIVES are listed below. A brief description of each SUB-OBJECTIVE is also given.

OBJECTIVE #1: PROMOTE SUSTAINABLE WATERSHEDS

Sub-Objective 1.1 Promote the cultivation of more locally grown food and the concept of "food security." Community members expressed that a major component of becoming a sustainable watershed is the ability to produce food in order to feed the people that reside in the watershed. Community members as well as several government agencies noted that Ko'olau Poko has future potential for more food production.

Sub-Objective 1.2 Protect and restore Ko'olau Poko wetlands and streams for their ecological, cultural, and recreational values. Ko'olau Poko is blessed with numerous streams and large wetland areas. Community members value Ko'olau Poko streams and wetlands for their ecological, cultural, and recreational values. Several of these streams and wetlands have been altered to mitigate flood damage to urbanized areas and as a result, their natural functions have been diminished. Community groups in partnership with government agencies have initiated several projects associated with protecting and restoring some of these resources.

Sub-Objective 1.3 Prevent and mitigate the impacts of litter and illegal dumping in Koʻolau Poko. Community members across the district have reported that litter and illegal dumping have degraded streams and waterways. Coordinated efforts to prevent as well as remove unwanted debris need to be implemented in the district.

Sub-Objective 1.4 Remove invasive species and increase areas of healthy native forests in Koʻolau Poko. Invasive plants and animals contribute to soil erosion and sediment run-off as well as harm native plant species. Replanting these areas with native plants would mitigate erosion and run-off. Healthy native forests also enhance groundwater recharge, as native plants typically need less water for their survival than invasive plants.

Sub-Objective 1.5 Adapt to and plan for climate change and sea level rise. Community members have commented that there are areas in Koʻolau Poko that have received noticeably less rainfall than in the past. A prudent watershed management plan should take into account potential changes in climate such as longer periods of drought as well as potential impacts of sea level rise.

OBJECTIVE #2: PROTECT AND ENHANCE WATER QUALITY AND QUANTITY

Sub-Objective 2.1 Recognize the connection between land and sea by improving stream water, ground water, and coastal water quality through a reduction in land-based sources of pollution. Both agencies and community members have expressed that the interrelationships among natural resources from *mauka* to *makai* is critical to improving the health of natural resources and in particular the water quality of surface and nearshore waters. Efforts that help to improve environmental quality in the *mauka* areas of the district will improve the conditions of *makai* areas.

Sub-Objective 2.2 Restore and enhance fresh water to Koʻolau Poko streams, wetlands, and estuaries to ensure enough water for agricultural, cultural, environmental, and ocean purposes. Fresh water plays an important role in streams, estuaries, and wetland ecosystems. Insufficient amounts of fresh water flowing into these ecosystems can impair these habitats and reduce the number of wildlife species in these ecosystems.

Sub-Objective 2.3 Establish measurable in-stream flow standards. Establishing measurable in-stream flow standards will help to protect stream resources and water rights, and ensure long-term sustainable uses of those resources.

Sub-Objective 2.4 Ensure that the export of water from Koʻolau Poko will not be detrimental to Koʻolau Poko. The rate and quantity of withdrawals from the Koʻolau Poko Aquifer System Area and Waimānalo Aquifer System Area are within CWRM established permitted uses and sustainable yields and the water code allows inter-basin transfers. However, it is the expressed intent of the Koʻolau Poko community that water not be exported out of Koʻolau Poko but be returned to enhance streams, wetlands, estuaries, and the ocean. Only if necessary, should water be exported out of Koʻolau Poko and if so, then the export of water should not be detrimental to Koʻolau Poko and the exported water shall be used wisely and not be wasted.

OBJECTIVE #3: PROTECT NATIVE HAWAIIAN RIGHTS AND TRADITIONAL CUSTOMARY PRACTICES

Sub-Objective 3.1 Provide support to place-based natural and cultural resources management and Native Hawaiian cultural educational programs in Koʻolau Poko. There are many educational programs with curricula that emphasize natural and cultural resource management based upon Native Hawaiian values and principles. Community members would like to see these programs supported and the creation of more like minded educational opportunities.

Sub-Objective 3.2 Incorporate traditional Hawaiian values and cultural practices into the modern context. Traditional values and practices reflect the understanding and close relationship Hawaiian communities had with interrelationships and functions of the natural resources. Modern practices and knowledge have developed new ways of understanding and interacting with the natural environment and integrating these two ways of understanding can be an effective way of promoting environmental policies and practices that address biological sustainability and human well-being.

Sub-Objective 3.3 Restore and utilize *kalo* lands and the fishponds of Kāneʻohe Bay for food production and cultural educational use. Community members have often commented that Koʻolau Poko was known for its food abundance, which was created in part by the development of extensive acreages of *loʻi* complexes and development of the numerous fishponds that once existed in Kāneʻohe Bay. These resources should be restored and utilized where feasible for future food production and cultural educational programs.

Sub-Objective 3.4 Plan for the enhancement of Native Hawaiian water rights and cultural and traditional uses. The amount of water available for Native Hawaiian rights depends in part on how well the water resource in general is managed. The projects and strategies under this sub-objective have a direct effect on water availability.

OBJECTIVE #4: FACILITATE PUBLIC PARTICIPATION, EDUCATION, AND PROJECT IMPLEMENTATION

Sub-Objective 4.1 Promote public participation in planning and implementation of watershed management projects and programs. Public participation is critical to the success of any watershed management project or program as these types of projects and programs involve interrelated resources that can support many individuals and/or groups.

Sub-Objective 4.2 Foster community-government partnerships to help with plan implementation. Government agencies and community groups often have complementary watershed objectives. The creation of more partnerships will help with coordinating like-minded actions and maximize efficient use of resources to implement watershed management projects.

Sub-Objective 4.3 Increase public awareness and educational efforts regarding "where Koʻolau Poko's water comes from" and how human water use impacts Koʻolau Poko's natural environment. Often times, people engage in behavior that can be harmful to the environment because they are not aware of the consequences human actions may have on natural resources, or may not be aware of the inter-relationships of natural resources in a watershed or *ahupuaʻa*. Efforts to increase public awareness can help to change an individual or group's behavior and result in actions that are more environmentally sensitive.

OBJECTIVE #5: MEET FUTURE WATER DEMANDS AT REASONABLE COSTS

Sub-Objective 5.1 Explore various options to diversify Koʻolau Poko's municipal water supply. Koʻolau Poko's primary source of municipal water is from ground water sources. The sustainability of ground water sources can be put at risk by prolonged periods of drought. Exploring other options to diversify Koʻolau Poko's water sources would help to protect the long-term sustainability of Koʻolau Poko's ground water sources, especially during drought periods.

Sub-Objective 5.2 Develop alternative water sources for agriculture. Koʻolau Poko's primary source of agriculture water is from streams. Surface water sources can be severely reduced during extended periods of drought. Diversifying Koʻolau Poko's agriculture water sources will help to mitigate the effects of surface water shortages, especially during times of prolonged drought.

Sub-Objective 5.3 Promote advanced water conservation programs. The economic value of water conservation measures are savings referred to as "cost avoidance." If enough water is saved, this may deter, prevent, or downsize new water source development, and reduce customer costs.

Sub-Objective 5.4 Develop strategies to deal with longer periods of drought that may occur from climate change. Koʻolau Poko's dike aquifers are smaller and store less water than larger basal aquifers found in other areas of Oʻahu, thus Koʻolau Poko aquifers are more susceptible to water shortages during periods of drought. Future water supply projects and strategies need to account for Koʻolau Poko's smaller aquifers as well as the potential for less rainfall in the area as a result of future climate change.

Sub-Objective 5.5 Maintain and improve BWS island-wide system reliability, adequacy and efficiency. A reliable water delivery system can minimize the frequency, magnitude and duration of water shortages and ensure a consistent supply of high quality water to customers.

4.2 WATERSHED MANAGEMENT PROJECTS AND PROGRAMS WITH "PROJECT CHAMPIONS"

The tabular summary of projects and programs that is presented in Section 4.2 is organized according to:

- The 5 MAJOR OBJECTIVES;
- Important Community and Agency Values or Issues that were documented during the stakeholder consultation process;
- Koʻolau Poko-specific SUB-OBJECTIVES that flow from an understanding of these Values and Issues and reflect desired outcomes specific to the district.
- A column for "DISTRICT-WIDE" Projects and Strategies;
- Separate columns for Projects and Strategies by Neighborhood Board Area:
  - Kahaluʻu
  - Kāneʻohe
  - Kailua
  - Waimānalo
- Specific Projects and Strategies are then listed by Sub-Objective and by NB Area.

Several "Projects with Champions" and "Watershed Management Strategies" accomplish more than one objective and sub-objective and are thus listed multiple times in the table.

Through the stakeholder outreach and consultation process (See Chapter 2.10 "Stakeholder Consultation"), the planning team discovered that one of Ko'olau Poko's unique resources is the amount and diversity of on-going projects and programs that are related to natural and/or cultural resource management. These Watershed Management Projects and Programs with "Project Champions" include various projects and programs in Ko'olau Poko that an agency and/or community group is actively pursuing.

Immediately following the tabular summary of projects and strategies is a **brief description of each "Project with Champion"** that summarizes the project's **location**, **champion(s)**, **partner(s)**, KPWMP Objective(s) that the project fulfills, project **goals**, and project **desired outcomes** (measurable results from accomplishing the project's goals). Also included in the project description is a brief description of the **project background** and a description of the current **project status** and progress to date. Projects are grouped into six categories by geographic location: 1) District-wide projects, 2) Projects in two to three neighborhood areas, 3) Kahalu'u Neighborhood Board Area Projects, 4) Kāne'ohe Neighborhood Board Area Projects, 5) Kailua Neighborhood Board Area Projects, and 6) Waimānalo Neighborhood Board Area projects.

As distinct from "Projects with Champions," "**Watershed Management Strategies**" are defined as ideas for action that would help to achieve KPWMP sub-objectives and objectives. However, at the current time, these watershed management strategies do not have a project champion.

A **Watershed Management Projects Map** is included on page 4-13. The map graphically illustrates the approximate location of specific "projects and programs with champions" in Ko'olau Poko. District-wide projects and programs with champions are not mapped because these projects do not have a specific location. Instead these projects are listed at the top of the map.

KO‘OLAU POKO WATERSHED MANAGEMENT PROJECTS AND PROGRAMS WITH “PROJECT CHAMPIONS”

DISTRICT-WIDE PROJECTS AND PROGRAMS

01 BWS Capital Program
02 BWS Water Conservation Program
03 BWS Pumpage Optimization
04 *Ahupua‘a* Boundary Marker Project
05 Establish Measurable Instream Flow Standards
06 Hawai‘i Ocean Resources Management Plan and Climate Change Adaptation Framework
07 Hawai‘i Coral Reef Assessment and Monitoring Program (CRAMP)

PROJECTS AND PROGRAMS IN TWO TO THREE NEIGHBORHOOD BOARD AREAS

08 MCBH Integrated Natural Resources Management Plan
09 Implement Requirements of the TMDL Studies that have been Approved or are in Progress for Ko‘olau Poko Streams
10 Expansion of the Waimānalo Forest Reserve
11 Waimānalo Irrigation System Improvements & Conservation
12 Aloha ‘Āina Programs

KAHALU‘U PROJECTS AND PROGRAMS

13 Waihe‘e Ahupua‘a Initiative
14 Hakipu‘u Learning Center

KĀNE‘OHE PROJECTS AND PROGRAMS

15 He‘eia Stream Restoration Project
16 Papahana Kuaola
17 Māhuahua ‘Ai o Hoi (He‘eia Wetland Restoration)
18 Management and Stewardship of He‘eia Fishpond
19 Hydro-Modification Storm Drain Installation Project
20 Halawa-Luluku Interpretive Development
21 Management and Stewardship of Waikalua Loko Fishpond
22 Kokokahi Cultural Learning Center

KOʻOLAU POKO WATERSHED MANAGEMENT PROJECTS AND PROGRAMS WITH "PROJECT CHAMPIONS" (continued)

KAILUA PROJECTS AND PROGRAMS

23 MCBH Water Conservation Program
24 Management and Stewardship of Kawainui Marsh
25 Hāmākua Marsh Ecosystem Restoration Program
26 Purchase of Puʻu o Ehu Hillside
27 Kailua Beach Management Plan
28 Management and Stewardship of Kaʻelepulu Watershed
29 Kaʻelepulu Storm Water Capture

WAIMĀNALO PROJECTS AND PROGRAMS

30 Waimānalo Watershed Project
31 Waimānalo Watershed Analysis Risk Management Framework Study
32 God's Country Waimānalo Programs
33 Bellows AFS Integrated Natural Resource Management Plan
34 Waimānalo Waste Water Treatment Plant Recycle Water Reuse

KOʻOLAU POKO WATERSHED MANAGEMENT STRATEGIES

DISTRICT-WIDE STRATEGIES

District-wide Surface Water Management Strategies

01 Establish "Customized" Stream Buffers for Specific Streams
02 Concrete Flood Channel Redesign Projects

District-wide Land Management Strategies

03 Comprehensive Koʻolau Poko Litter and Illegal Dumping Mitigation Program
04 Native Plant Propagation Program
05 Establish Alien Plant Control Programs
06 Establish Fencing Exclosures in High Priority Areas for Feral Pig Control
07 Coordinate Pig Hunting Programs
08 Minimize the Impacts of Small Mammals on Watershed Resources
09 Restrict Off-Road Recreational Vehicles in *Mauka* Areas
10 Convert Cesspools to Septic Tanks to Protect Estuaries and Aquifers
11 Preserve and Restore the Forested Areas Above Groundwater Sources

KOʻOLAU POKO WATERSHED MANAGEMENT STRATEGIES (continued)

District-wide Implementation Strategies

12 Develop an Efficient Alternative Process that Assists the KBRC with Implementation of the Kāneʻohe Bay Master Plan
13 Create and Maintain a "Directory" of Koʻolau Poko Community Organizations and Groups
14 Establish a Stream Signage Program to Educate the Public About Stream Processes and Characteristics

District-wide Cultural Resources / Traditional Practices Strategies

15 Conduct Koʻolau Poko Oral History Studies
16 Promote *Kalo* Restoration Projects
17 Conduct Periodic Surveys of Active *Loʻi* to Use as Future Baseline Data for Monitoring and Evaluation

District-wide Water Supply Strategies

18 Utilize More Surface Water for Agricultural Irrigation
19 Develop Groundwater Wells to Provide Additional Water for Diversified Agriculture
20 Develop an Agriculture Water Conservation Program
21 Implement the Recommendations of the Hawaiʻi Drought Plan
22 Encourage Gray Water Reuse to Reduce the Amount of Ground Disposal of Wastewater
23 Encourage Water Efficient Fixtures in Current and Future Development
24 Encourage Low Impact Development Design Concepts in Future Development
25 Storm Water Reclamation Projects

KAHALUʻU STRATEGIES

26 Management and Stewardship of Mōliʻi Fishpond
27 Kahaluʻu Neighborhood Board Area Long Range Agriculture Expansion Plan
28 Dredge the Kahaluʻu Flood Lagoon
29 Create a Hakipuʻu *Ahupuaʻa* Land Trust
30 HHFDC Repair and Upgrade of the Waiāhole Valley Water System
31 Restoration of *Heiau* in ʻĀhuimanu

KĀNEʻOHE STRATEGIES

32 Restore the Estuary Area near Waikalua Loko Fishpond (presently Bay View Golf Course)
33 Utilize Water from Hoʻomaluhia Reservoir for Irrigation

KAILUA STRATEGIES

34 Increase MCBH WWTP Capacity to Recycle Wastewater to R-1 Water Quality Standards
35 Maintain "Green Spaces" in Kailua

WAIMĀNALO STRATEGIES

36 Waimānalo Long Range Agriculture Expansion Plan
37 Implement the NRCS "Alternatives for Restoration of Waimānalo Stream" Report
38 Establish a Waimānalo Community Composting Facility to Dispose of Animal Wastes
39 Convert the DOA Kailua Reservoir to a Sediment Retention Basin

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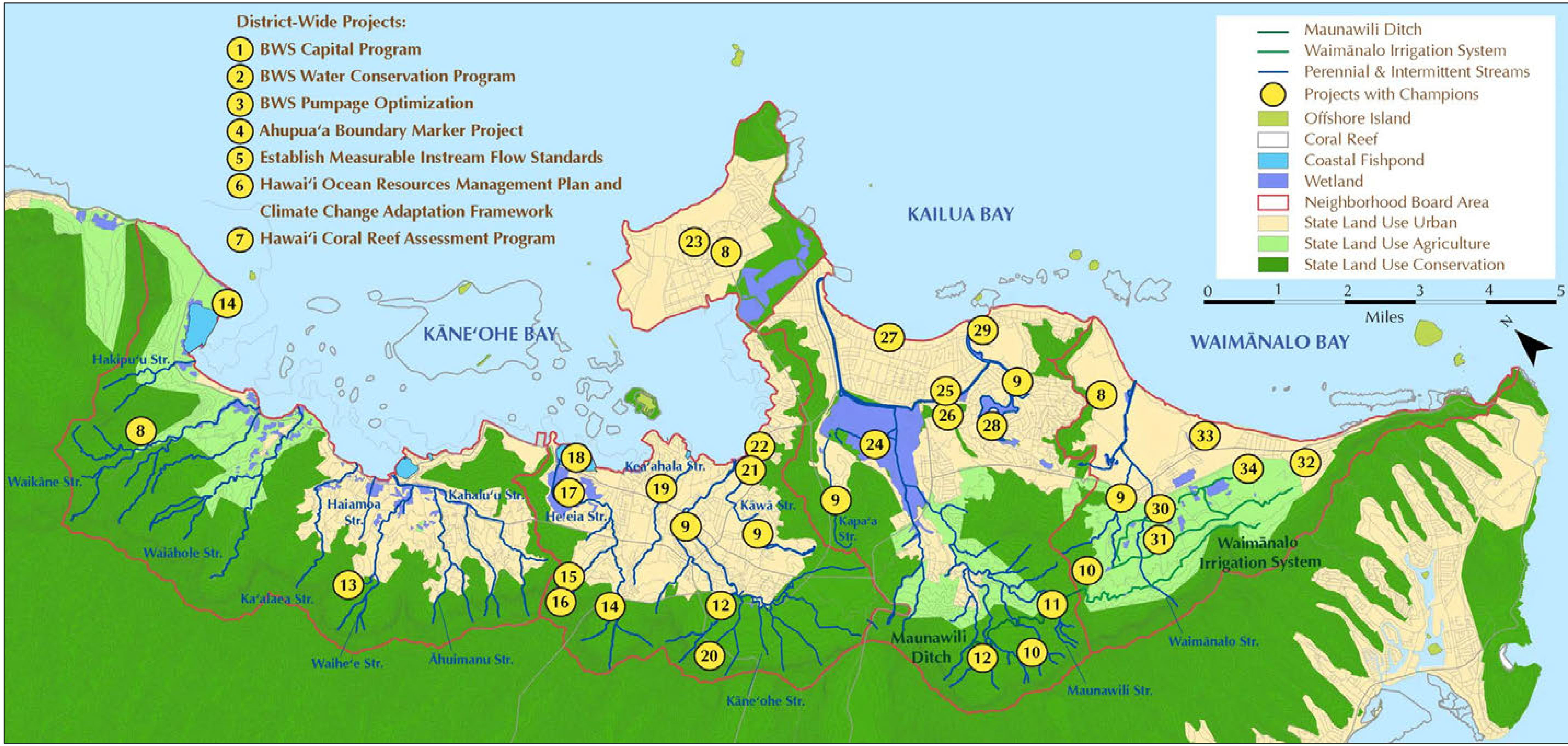
Figure 4.1 Koʻolau Poko Watershed Management Projects and Programs with "Project Champions"



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OBJECTIVE #1: PROMOTE SUSTAINABLE WATERSHEDS

Bold text = Watershed Management Projects or Programs with "Champions"; Gray text = Watershed Management Strategies

Community or Agency Value or Issue	**Sub-Objective**	**District-Wide** 3 Projects; 13 Strategies	**Kahaluʻu Neighborhood Board** 1 Project; 4 Strategies	**Kāneʻohe Neighborhood Board** 6 Projects; 1 Strategy	**Kailua Neighborhood Board** 9 Projects ; 1 Strategy	**Waimānalo Neighborhood Board** 5 Projects; 1 Strategy
Promote the cultivation of more locally grown food and the concept of food security — Kāneʻohe Bay has potential for abundance — Restoration of Mōliʻi Fishpond	1.1 Promote the cultivation of more locally grown food and the concept of "food security."	#16 Promote *kalo* restoration projects #18 Utilize more surface water for agricultural irrigation #19 Develop groundwater wells to provide additional water for diversified agriculture #20 Agricultural Water Conservation Program	#26 Management and Stewardship of Mōliʻi Fishpond #27 Kahaluʻu Long Range Agriculture Expansion Plan	**#12 Aloha ʻĀina Programs** **# 16 Papahana Kuaola** **#17 Heʻeia Wetland restoration project (Māhuahua ʻAi o Hoi)** **#18 Management and Stewardship of Heʻeia Fishpond** **#20 Halawa-Luluku Interpretive Development** **#21 Management and Stewardship of Waikalua Loko Fishpond**	**#11 Waimānalo Irrigation System Improvements & Conservation** **#12 Aloha ʻĀina Programs** **#24 Management and Stewardship of Kawainui Marsh**	**#11 Waimānalo Irrigation System Improvements & Conservation** **#32 God's Country Waimānalo** **#34 Waimānalo WWTP Recycle Water Reuse** #36 Waimānalo Long Range Agriculture Expansion Plan
The Heʻeia Ahupuaʻa has abundant natural, cultural, and educational resources — Wetlands are valued for their unique ecological diversity, cultural resources, and educational resources	1.2 Protect and restore Koʻolau Poko wetlands and streams for their ecological, cultural, and recreational values	#1 Establish "customized" stream buffers for specific streams #2 Concrete flood channel redesign projects	**#8 MCBH IRMP** #28 Dredge the Kahaluʻu Flood Lagoon	**#17 Heʻeia Wetland restoration project (Māhuahua ʻAi o Hoi)** #32 Restore the estuary area near Waikalua Loko Fishpond	**#8 MCBH IRMP** **#24 Management and Stewardship of Kawainui Marsh** **#25 Hāmākua Marsh Ecosystem Restoration Program** **#28 Kaʻelepulu Watershed Management**	**#33 Bellows AFS INRMP**
Illegal dumping is a major problem!	1.3 Prevent and mitigate the impacts of litter and illegal dumping in Koʻolau Poko	#3 Comprehensive Koʻolau Poko litter and illegal dumping mitigation program				
Maunawili Valley watershed management needs to be improved — Invasive plants and animals — Increase areas of healthy native forests	1.4 Remove invasive species and increase areas of healthy native forests in Koʻolau Poko	#4 Native plant propagation program #5 Establish alien plant control programs #6 Establish pig control fencing exclosures in high priority areas #7 Coordinate pig hunting programs #8 Minimize the Impacts of Small Mammals on Watershed Resources #9 Restrict Off-Road Vehicles	#29 Create a Hakipuʻu Ahupuaʻa Land Trust		**#10 Expansion of Waimānalo Forest Reserve** **#26 Purchase of Puʻu O Ehu hillside behind Hāmākua Marsh** #35 Maintain "Green Spaces" in Kailua	**#10 Expansion of Waimānalo Forest Reserve** **#33 Bellows AFS INRMP**
Climate change & sea level rise — Koʻolau Poko is not as wet as it once was	1.5 Adapt to and plan for climate change and sea level rise	**#3 BWS Pumpage Optimization** **#6 Hawaiʻi Ocean Resources Management Plan and Climate Change Adaptation Framework** **#7 Coral Reef Assessment and Monitoring Program**		**#17 Heʻeia Wetland restoration project (Māhuahua ʻAi o Hoi)**	**#27 Kailua Beach Management Plan**	

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OBJECTIVE #2: PROTECT AND ENHANCE WATER QUALITY AND QUANTITY

Bold text = Watershed Management Projects or Programs with "Champions"; Gray text = Watershed Management Strategies

Community or Agency Value or Issue	Sub-Objective	District-Wide Projects & Strategies 4 Projects; 14 Strategies	Kahaluʻu Neighborhood Board Projects & Strategies 2 Projects; 1 Strategy	Kāneʻohe Neighborhood Board Projects & Strategies 4 Projects; 1 Strategy	Kailua Neighborhood Board Projects & Strategies 8 Projects; 1 Strategies	Waimānalo Neighborhood Board Projects & Strategies 5 Projects; 2 Strategies
Surface water quality and nearshore water quality are degraded Cesspools may be contaminating streams Improved management of storm water is needed	2.1. Recognize the connection between land and sea by improving stream and coastal water quality through a reduction in land-based sources of pollution.	**#1 BWS Capital Program** **#7 Coral Reef Assessment and Monitoring Program** #4 Native plant propagation program #5 Establish Alien Plant Control Programs #6 Establish pig control fencing exclosures in high priority areas #7 Coordinate pig hunting programs #9 Restrict Off-Road Vehicles in *Mauka* Areas #10 Convert Cesspools to Septic Tanks to Protect Estuaries and Aquifers #22 Encourage Graywater Reuse to Reduce the Amount of Ground Disposal of Wastewater #24 Encourage LID Concepts in Future Development #25 Stormwater Reclamation Projects	**#8 MCBH IRMP** **#13 Waiheʻe Ahupuaʻa Initiative** #28 Dredge the Kahaluʻu Flood Lagoon	**#9 Implement DOH TMDL permit requirements for Koʻolau Poko streams** **#15 Heʻeia Stream bank restoration project** **#17 Heʻeia Wetland restoration project (Māhuahua ʻAi o Hoi)** **#19 Hydro-modification Storm Drain Installation Project** #32 Restore the estuary area near Waikalua Loko Fishpond	**#8 MCBH IRMP** **#9 Implement the DOH TMDL permit requirements for Koʻolau Poko streams** **#11 Waimānalo Irrigation System Improvements & Conservation** **#24 Management and Stewardship of Kawainui Marsh** **#25 Hāmākua Marsh Ecosystem and Restoration Program** **#28 Kaʻelepulu Watershed Management** **#29 Kaʻelepulu Storm Water Capture** #30 Maintain "Green Spaces" in Kailua	**#9 Implement the DOH TMDL permit requirements for Koʻolau Poko streams** **#30 Waimānalo Watershed Project** **#31 Waimānalo WARMF Study** **#33 Bellows AFS IRMP** #37 Implement the NRCS "Alternatives for Restoration of Waimānalo Stream" report. #39 Convert the DOA Kailua Reservoir to a sediment retention basin
Return more fresh water to streams, wetlands, and estuaries Health of Kāneʻohe Bay Population growth and development impairs watershed health and may jeopardize future ground water sustainability	2.2 Restore and enhance fresh water to Koʻolau Poko streams, wetlands, and estuaries to ensure enough water for agricultural, cultural, environmental, and ocean purposes.	**#2 BWS Conservation Program** **#5 Establish measurable in-stream flow standards for Koʻolau Poko Streams** #23 Encourage water efficient fixtures	**#13 Waiheʻe Ahupuaʻa Initiative**	**#17 Heʻeia Wetland restoration project (Māhuahua ʻAi o Hoi)**	**#11 Waimānalo Irrigation System Improvements & Conservation** **#23 Marine Corps Base Hawaiʻi Water Conservation Program**	**#34 Waimānalo WWTP Recycle Water Reuse**
	2.3 Establish measurable in-stream flow standards	**#5 Establish measurable in-stream flow standards for Koʻolau Poko Streams** #15 Conduct Koʻolau Poko Oral History Studies #17 Conduct Periodic Surveys of Active *Loʻi* to Use as Future Baseline Data for Monitoring and Evaluation				
	2.4 Ensure that the export of water from Koʻolau Poko will not be detrimental to Koʻolau Poko	**#1 BWS Capital Program** **#2 BWS Conservation Program** **#5 Establish measurable in-stream flow standards for Koʻolau Poko Streams** #11 Preserve and restore the forested areas above groundwater sources #20 Agriculture Water Conservation Program				

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OBJECTIVE #3: PROTECT NATIVE HAWAIIAN RIGHTS AND TRADITIONAL CUSTOMARY PRACTICES

Bold text = Watershed Management Projects or Programs with "Champions"; Gray text = Watershed Management Strategies

Community or Agency Value or Issue	Sub-Objective	District-Wide Projects & Strategies 2 Projects; 3 Strategies	Kahaluʻu Neighborhood Board Projects & Strategies 2 Projects; 3 Strategies	Kāneʻohe Neighborhood Board Projects & Strategies 7 Projects; 0 Strategies	Kailua Neighborhood Board Projects & Strategies 2 Projects; 0 Strategies	Waimānalo Neighborhood Board Projects & Strategies 2 Projects; 0 Strategies
Place-based natural resource management and cultural education programs are valued ——— Place names and cultural knowledge are valued	3.1 Provide support to place-based natural and cultural resource management and Native Hawaiian cultural educational programs in Koʻolau Poko. 3.2 Incorporate traditional Hawaiian values and cultural practices into the modern context	**#4 Ahupuaʻa Boundary Marker Project** #15 Conduct Koʻolau Poko Oral History Studies #16 Promote *kalo* restoration projects #17 Conduct Periodic Surveys of Active *Loʻi* to Use as Future Baseline Data for Monitoring and Evaluation	**#13 Waiheʻe Ahupuaʻa Initiative** **#14 Hakipuʻu Learning Center** #29 Create a Hakipuʻu Land Trust #31 Restoration of Heiau in ʻĀhuimanu	**#12 Aloha ʻĀina Programs** **#16 Papahana Kuaola** **#17 Heʻeia Wetland restoration project (Māhuahua ʻAi o Hoi)** **#18 Management and Stewardship of Heʻeia Fishpond** **#20 Halawa-Luluku Interpretive Development Project** **#21 Management and Stewardship of Waikalua Loko Fishpond** **#22 Kokokahi Cultural Learning Center**	**#12 Aloha ʻĀina Programs** **#24 Management and Stewardship of Kawainui Marsh**	**#32 God's Country Waimānalo Programs** **#33 Bellows AFS INRMP**
	3.3 Restore and utilize the fishponds of Kāneʻohe Bay for food production and cultural educational use.		#26 Management and Stewardship of Mōliʻi Fishpond	**#18 Management and Stewardship of Heʻeia Fishpond** **#21 Management and Stewardship of Waikalua Loko Fishpond**		
More access to the natural resources of the district ——— Return more fresh water to streams, wetlands, and estuaries to ensure enough water for agricultural, cultural, and environmental purposes	3.4 Plan for the enhancement of Native Hawaiian water rights and cultural and traditional uses	**#5 Establish measurable in-stream flow standards for Koʻolau Poko Streams** #16 Promote *kalo* restoration projects #17 Conduct Periodic Surveys of Active *Loʻi* to Use as Future Baseline Data for Monitoring and Evaluation				

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OBJECTIVE #4: FACILITATE PUBLIC PARTICIPATION, EDUCATION, AND PROJECT IMPLEMENTATION

Bold text = Watershed Management Projects or Programs with "Champions"; Gray text = Watershed Management Strategies

Community or Agency Value or Issue	Sub-Objective	District-Wide Projects & Strategies 3 Projects; 4 Strategies	Kahaluʻu Neighborhood Board Projects & Strategies 2 Projects; 1 Strategy	Kāneʻohe Neighborhood Board Projects & Strategies 6 Projects; 0 Strategies	Kailua Neighborhood Board Projects & Strategies 4 Projects; 0 Strategies	Waimānalo Neighborhood Board Projects & Strategies 2 Projects; 0 Strategies
Government management of water and natural resources	4.1 Promote public participation in planning and implementation of watershed management projects and programs	#12 Develop an Alternative Process to assist KBRC #13 Create and maintain a directory of Koʻolau Poko community groups	**#13 Waiheʻe Ahupuaʻa Initiative**	**#15 Heʻeia Stream bank restoration project** **#17 Heʻeia Wetland restoration project (Māhuahua ʻAi o Hoi)** **#18 Management and Stewardship of Heʻeia Fishpond** **#20 Halawa-Luluku Interpretive Development Project** **#21 Management and Stewardship of Waikalua Loko Fishpond**	**#24 Management and stewardship of Kawainui Marsh** **#25 Hāmākua Marsh Ecosystem and Restoration Program**	**#30 Waimānalo Watershed Project** **#33 Bellows AFS INRMP**
	4.2 Foster community/ government partnerships to help with plan implementation	**#6 Hawaiʻi Ocean Resources Management Plan and Climate Change Adaptation Framework** #11 Develop an Alternative Process to assist KBRC	**#13 Waiheʻe Ahupuaʻa Initiative** **#14 Hakipuʻu Learning Center** #26 Management and Stewardship of Mōliʻi Fishpond	**#15 Heʻeia Stream restoration project** **#17 Heʻeia Wetland restoration project (Māhuahua ʻAi o Hoi)** **#18 Management and Stewardship of Heʻeia Fishpond** **#19 Halawa-Luluku Interpretive Development Project** **#20 Management and Stewardship of Waikalua Loko Fishpond**	**#8 MCBH IRMP** **#24 Management and stewardship of Kawainui Marsh** **#25 Hāmākua Marsh Ecosystem and Restoration Program** **#29 Kaʻelepulu Storm Water Capture**	**#30 Waimānalo Watershed Project** **#33 Bellows AFS INRMP**
	4.3 Increase public awareness and educational efforts regarding "where Koʻolau Poko's water comes from" and how human water use impacts Koʻolau Poko's natural environment	**#2 BWS Conservation Program** **#4 Koʻolau Poko Ahupuaʻa Boundary Marker Project** #14 Establish a stream signage program to educate the public about stream processes and characteristics				

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OBJECTIVE #5: MEET FUTURE WATER DEMANDS AT REASONABLE COSTS

Bold text = Watershed Management Projects or Programs with "Champions"; Gray text = Watershed Management Strategies

Community or Agency Value or Issue	Sub-Objective	District-Wide Projects & Strategies 5 Projects; 5 Strategies	Kahaluʻu Neighborhood Board Projects & Strategies 0 Projects; 1 Strategy	Kāneʻohe Neighborhood Board Projects & Strategies 0 Projects; 1 Strategy	Kailua Neighborhood Board Projects & Strategies 1 Project; 1 Strategy	Waimānalo Neighborhood Board Projects & Strategies 2 Project; 0 Strategies
Population growth and development may jeopardize future ground water sustainability ——— Agriculture water shortage ——— Return more fresh water to streams, wetlands, and estuaries ——— Koʻolau Poko is not as wet as it once was	5.1 Explore various options to diversify Koʻolau Poko's municipal water supply	**#5 Establish measurable in-stream flow standards for Koʻolau Poko Streams** #18 Utilize more surface water for agricultural irrigation #22 Encourage gray water reuse to reduce ground disposal of wastewater #25 Stormwater Reclamation Projects		#33 Utilize Water from Hoʻomaluhia Reservoir for Irrigation	#34 Increase MCBH WWTP capacity to recycle wastewater to R-1 Quality Standards	**#34 Waimānalo WWTP Recycled Water Resuse**
	5.2 Develop alternative water sources for agriculture	**#5 Establish measurable in-stream flow standards for Koʻolau Poko Streams** #18 Utilize more surface water for agricultural irrigation #19 Develop groundwater wells to provide additional water for diversified agriculture #25 Stormwater Reclamation Projects	#30 HHFDC Repair and Upgrade of the Waiāhole Valley Water System			**#11 Waimānalo Irrigation System Improvements & Conservation**
	5.3 Promote advanced water conservation programs	**#2 BWS Conservation Program** #22 Encourage Water Efficient Fixtures in Current and Future Development	#30 HHFDC Repair and Upgrade of the Waiāhole Valley Water System		**#23 Marine Corps Base Hawaiʻi Water Conservation Program**	
	5.4 Develop strategies to deal with longer periods of drought that may occur from climate change	**#3 BWS Pumpage Optimization** **#6 Hawaiʻi Ocean Resources Management Plan and Climate Change Adaptation Framework** #21 Implement the recommendations of the Hawaiʻi Drought Plan.				
	5.5 Maintain and improve BWS island-wide system reliability and flexibility	**#1 BWS Capital Program**				

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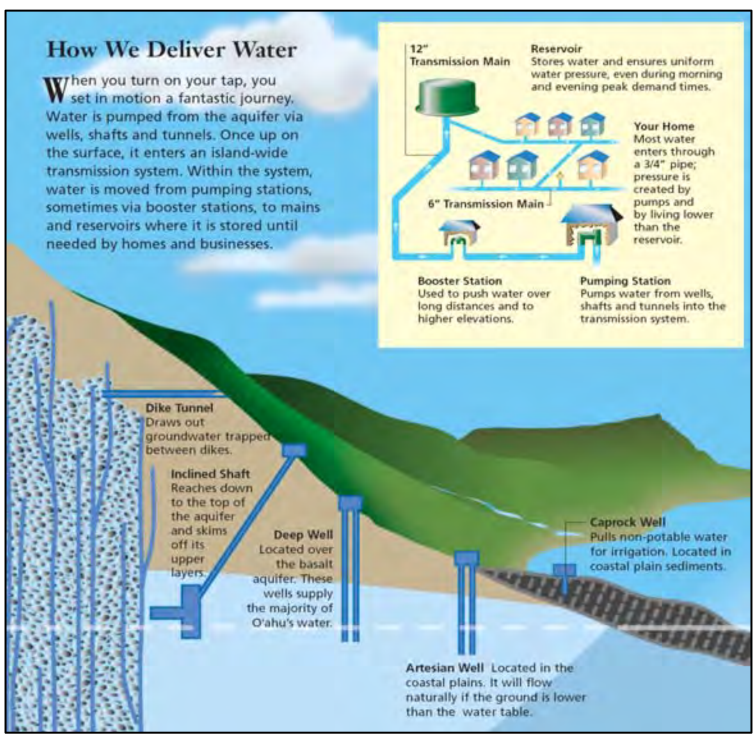
PROJECT #01: Board of Water Supply Capital Program

Project Location: Island-wide

Project Champion: Board of Water Supply

Project Background: BWS water systems are a complex configuration of many different components interacting to meet the needs of its customers in almost every geographic setting on the island. Since its beginning in 1929, the BWS has managed O‘ahu's municipal water resources and distribution system in order to provide customers with a safe and dependable water supply. BWS is the largest municipal water utility in the State, serving almost one million customers on O‘ahu with approximately 150 mgd of potable water, approximately 10 mgd of recycled water and 1 mgd of brackish water. The BWS water systems are comprised of 94 active potable water sources, four non-potable water sources, 91 booster pump stations, 170 reservoirs, and more than 2,000 miles of pipeline serving over 160,000 customer accounts.

To keep the water flowing to nearly every community on O‘ahu, BWS must carefully and proactively manage and invest in its complex system. The BWS Capital Program consists of repairing and replacing aging infrastructure, expanding the system to accommodate planned growth and maintaining and updating the various tools and resources support systems that are critical to delivering water. The components of BWS water systems can be organized under four main categories: 1) Source, 2) Pipeline, 3) Storage, and 4) Treatment. Transmission and distribution pipelines constitute the bulk of the BWS water system's assets.



BWS funds the capital program through a combination of water rates, revenue bonds and impact fees. BWS periodically conducts a water rate study to evaluate the necessity of increasing rates and fees to support growing infrastructure, power and miscellaneous costs.

KPWMP Objectives Project Addresses:
- Objective #2: Protect and enhance water quality and quantity
- Objective #5: Meet future water demands at reasonable costs

Project goals:
- Meet all system demand conditions
- Meet maximum day and emergency storage requirements
- Proactively replace pipelines at design life to minimize the number of water main breaks
- Meet Safe Drinking Water Act water quality requirements
- Achieve BWS's objectives of *Adequacy* (sufficient infrastructure capacity), *Reliability* (limit service interruptions), and *Efficiency* (minimize operation and maintenance costs)

Project desired outcomes:
- Keep 90 percent of island-wide pumping unit inventories in service at all times.
- Keep the number of island-wide main breaks to 400 per year or less.
- Meet Department of Health safe drinking water requirements at all times.
- Ensure emergency preparedness and facility security

Project status: In Koʻolau Poko, the Manulani Street and Mowai Street 8-inch Main project (Keolu) was completed in February 2009. Kuou Well III was completed in 2009. Currently, construction of the Kamehameha Highway 8 inch Main project (Kāneʻohe) and the Waimanalo Well III are in progress.

Near Term Plans (1-5 Years)
There are several BWS Koʻolau Poko capital projects scheduled for the next five years. The table below identifies the project title, estimated total cost, and tentative construction schedule for these projects.

Table 4.1 BWS Koʻolau Poko Capital Improvement Projects

Project	Estimated. Total Cost (millions of dollars)	Tentative Construction Schedule (FY)
Haʻikū Well Renovation	$1.3	2012
Kahaluʻu Well Renovation	$1.17	2012
Hui Ulili Street 12 inch, 8 inch, 4 inch Mains (Kāneʻohe)	$1.24	2014
Anoi Road Water System Improvements (Kāneʻohe)	$6.56	2013
Auloa Road and Ulukahiki Street 12 inch Main (Kailua)	$5.44	2016
Total Estimated Cost	**$15.71**	

Also, as part of the BWS Conservation Program (see Project #2), BWS conducts its Leak Detection, Repair, and Maintenance Program once every two years in Koʻolau Poko.

References: BWS "Get Well" Plan Assessment of Capital and Operating Needs 2009; BWS Needs Assessment and Capital Plan Report, 2006

PROJECT #02: BWS Water Conservation Program

Project Location: Island-wide

Project Champion: Board of Water Supply

Project Background: BWS has been actively promoting water conservation since its inception in 1929 and created a Conservation Section in 1990 to implement specific conservation programs to reduce potable water use. The effort has been successful. From 1990 to 2000, O'ahu's population grew by almost 40,000 people (4 percent increase) and the number of O'ahu households increased by 21,000 households (8 percent increase). However, while growth and development on the island did occur, island-wide BWS water use remained stable during the same time period. BWS water use in the districts of 'Ewa and Central O'ahu increased by about 10 mgd from 1990 to 2009. However, during that same time period, BWS water use in O'ahu's Primary Urban Center decreased by about 8 mgd and Ko'olau Poko decreased by about 2 mgd. Thus, despite the growth and development that has occurred on O'ahu in recent years, BWS water use has not dramatically increased, due in large part to the BWS Water Conservation Program.

Water conservation can be defined as practices, techniques, and technologies that eliminate waste and improve the efficiency of water use. Water conservation is a fundamental component of effective water resource management. This conservation ethic is applicable to those who deliver water as well as those who consume water.

Water conservation is often equated with temporary restrictions on water use and is a useful tool during times of service disruptions or drought. However, water conservation programs can emphasize lasting everyday improvements in water use efficiency. The development of new water sources is traditionally how growth in water demand is met. However, water conservation programs can reduce current and future water demands, to the benefit of BWS, the community, and the environment.

Rain barrel workshop conducted by BWS staff

The economic value of these conservation measures is direct savings to consumers water and sewer bills through reduction in consumptive water use and savings to BWS referred to as "cost avoidance." If enough water is saved, it may defer, prevent, or downsize new water source development. At a general development cost of $6/gallon, for example, a savings of 0.5 to 1.0 mgd would translate to a cost avoidance of about $3 million to $6 million. Water conservation provides savings through decreased operational costs for the following: 1) Treatment costs (chemicals and testing) 2) Pumping costs (BWS electricity) 3) Potable water is conserved and that means less water needing waste water treatment 4) Cost to develop new water sources (i.e. wells, tunnels, pumps, distribution mains).

The environmental value of water conservation in Ko'olau Poko will directly benefit the health of the district's watersheds. Almost two-thirds of Ko'olau Poko's BWS water use is for residential uses. Each day, every household has the opportunity to improve the health of the district's watersheds by making conscious efforts to reduce its daily water consumption. **In Ko'olau Poko, every gallon of water conserved by a household is one more gallon of water that will remain in Windward aquifers and streams.** A proactive water conservation program is a fundamental element of long-term sustainable watershed management.

KPWMP Objectives Project Addresses:

- Objective #1: Promote sustainable watersheds
- Objective #2: Protect and enhance water quality and quantity
- Objective #4: Facilitate public participation, education, and project implementation
- Objective #5: Meet future water demands at reasonable costs

Project Goals:

- Reduce the amount of inefficient and wasteful uses of potable water
- Influence consumers to be more conscientious about their everyday water use
- Work with large water users to develop programs for more efficient water use
- Diversify the island's water supply
- Benefit the environment by removing less water from watersheds, thereby restoring aquifers and stream flows and reducing water transfers between districts.
- Provide for long-term economic savings for BWS through decreased water production costs

Project Desired Outcomes:

- Reduce BWS system water loss to less than 10 percent.
- Reduce the amount of water BWS must transfer from Ko'olau Loa to Ko'olau Poko.
- Reduce the amount of water BWS must produce from its Ko'olau Poko sources, especially from its Waihe'e Tunnel System.

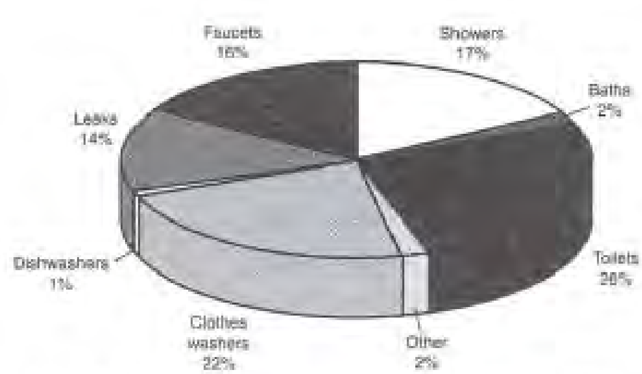
Project Status: The BWS "Water Conservation Program" is currently organized as: 1) Public Education and Outreach 2) Leak Detection, Repair, and Maintenance 3) Large Water Users Program 4) Regulation 5) Alternative Source Development, Recycling, and Conservation Alternatives. The principal elements of these five program clusters are described in detail in Chapter 3 under the description of the BWS system.

BWS encourages water conservation across the entire district of Koʻolau Poko to reduce imported water from Koʻolau Loa, to reduce pumping costs required for long distance transmission, and to conserve Windward aquifers. Conservation projects and programs that BWS would like to further pursue in Koʻolau Poko include but are not limited to: rain barrel workshops, water conservation education and awareness, water loss best management practices, and promoting additional use of recycled water and dual water systems where such systems are cost effective.

Recent Accomplishments

A Water Efficiency Program Social Marketing Survey and Measure Saturation Evaluation was completed in 2009, which established a baseline and understanding of how water is being used on Oʻahu in order to determine where the next level of conservation savings can be achieved. Identifying water conservation opportunities for each type of user provides a starting point for water savings. Residential and nonresidential water use constitutes about 55 percent and 45 percent respectively of the BWS water use. In Koʻolau Poko, residential water use constitutes almost two-thirds of BWS water use in the district. The chart shows typical indoor usage for single family homes in the U.S. In addition to identifying local indoor versus local outdoor water use, it is important to understand the island's geographical and seasonal variations and their effects on water consumption. For instance in Koʻolau Poko communities, Kailua and Waimānalo residents *may* use more water to water their lawns than Kāneʻohe and Kahaluʻu residents because Kāneʻohe and Kahaluʻu receive more rainfall than Kailua and Waimānalo.

The market research was used to develop a *Water Efficiency and Saturation Evaluation* for about 15 prescreened water efficiency measures. The social marketing survey tested messaging, willingness to pay and key motivators for voluntary water conservation and possible acceptability of any potentially mandated incentives to water efficiency or waste prohibition enforcement.



Source: *Guide to Preparing Urban Water-Use Efficiency Plans*, Water Resources Series No. 83, United Nations (2003)

A Water Efficiency Program Benefit Cost Model was developed to assess the cost and savings of implementing water efficiency measures. The benefit cost model evaluates the costs and savings of the 15 new water efficiency measures derived from the market survey. Conservation programs typically involve up-front costs, including revenue losses from a reduction in water use. The model provides the basis of a business case evaluation of the most effective conservation measures that achieve a cost-effective benefit. The measures that were screened and evaluated determined the most appropriate measures to be included in the implementation strategy.

The beneficial measures targeted emerging technologies for outdoor water use, measures for indoor water use, and also measures applicable to the commercial, industrial, and institutional sectors. The conservation measures will be bundled into incrementally more aggressive conservation programs using criteria and professional experience with successful conservation program measures elsewhere in the nation that may be applicable to the island of O'ahu. The potential measures for screening purposes will be based on the following four criteria: 1) Technology/market maturity, 2) Water saving potential matching, 3) Customer acceptance/equity, 4) Best available measure of long-term sustainable purposes.

Near-Term Plans (1-5 years)

Expand partnerships with community organizations and agencies for promoting water conservation. Many community organizations and agencies have missions that also support the goal of water conservation. By partnering with them, greater gains can be made in promoting conservation messages and implementing water saving practices. In Ko'olau Poko, BWS has worked with MCBH (see project #22) on their water conservation program. MCBH is currently the district's largest BWS water user. BWS is currently working with KEY Project on large rain catchments for community garden irrigation.

Continue and expand water conservation education and incentive programs. Current programs have been effective particularly for the residential sector and should be continued. Programs have included Detect-a-Leak week, school education programs and the Hālawa Xeriscape Garden and the Unthirsty Plant Sale. In Ko'olau Poko, BWS could host joint water conservation demonstration events and programs. In particular, BWS could partner with Hui o Ko'olaupoko at the Kaha Garden in Kailua to conduct a xeriscape garden demonstration workshop and "how to make your own rain barrel" workshops.

1. Develop a wide range of new conservation programs for Ko'olau Poko. Based upon the results of the BWS conservation program development study and subject to available funding, a wide range of new conservation programs will be developed and tailored toward specific classes of users in each district. Water loss control program of leak detection and repair of the BWS Windward water system.

2. Public Awareness Program includes school educational programs, water conservation poster and poetry calendar contest, printed literature, tours of BWS facilities, Halawa Xeriscape Garden events, Detect a leak week, restaurant table tents, toilet flappers and dye tablets, Neighborhood Board messages, Public Service Announcements, commercials and articles in the newspaper on water conservation.
3. Indoor and outdoor water use surveys of commercial businesses, government facilities, hotels and multi-family residential developments to determine current hardware, irrigation and water uses, including water budgets with recommendations for savings. BWS will monitor baseline and post-retrofit uses.
4. Residential and commercial rain barrel workshops where customers will learn to construct and install their own rain barrels.
5. Weather-based irrigation system controllers where large irrigation systems are retrofitted with cost effective weather stations to fine-tune water application rates to weather and landscaping needs.
6. Food service incentives consisting of a restaurant survey of water fixtures, equipment and practices based on the State's Green Program guidelines.

Reference: Board of Water Supply staff.

PROJECT #03 : BWS Pumpage Optimization

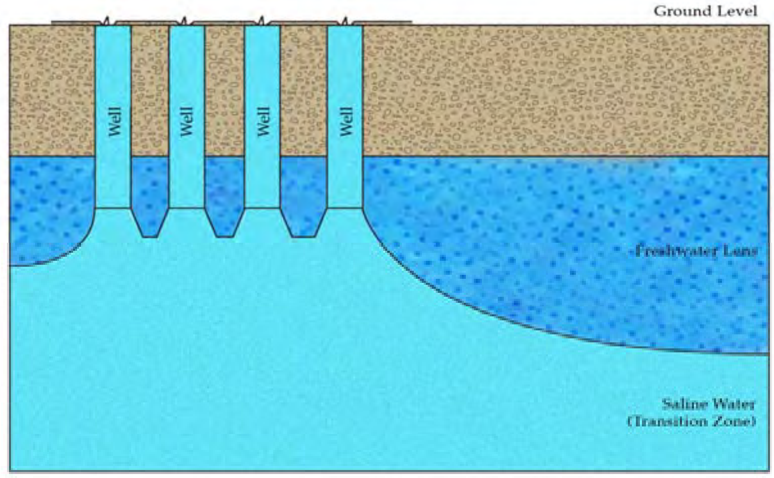
Project Location: Windward Oahu

Project Champion: Board of Water Supply

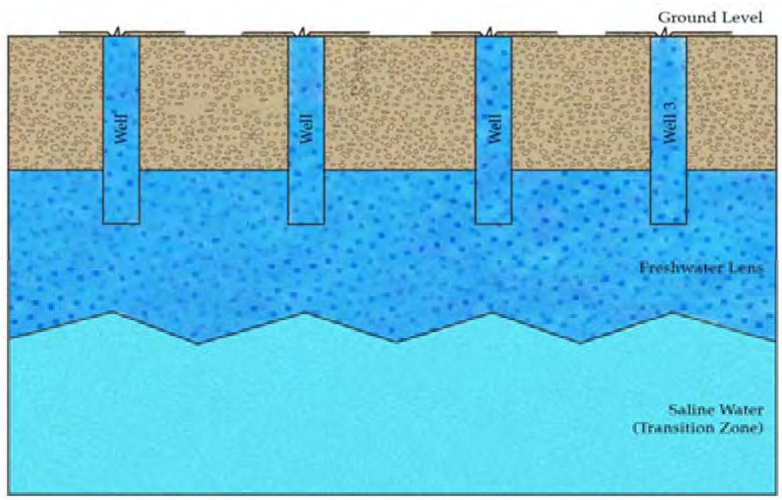
Project Partners: Commission on Water Resource Management

Project Background: Groundwater withdrawal from the aquifers in Koʻolau Loa and Koʻolau Poko and the regional transport of water into and out of Koʻolau Poko requires optimization to ensure pumping levels can be sustained with no detrimental impacts to watersheds, for drought mitigation and to manage the high costs of transporting water over 25 miles into Kāneʻohe, Kailua and Waimānalo.

Pumpage optimization is spreading out and reducing source production among several sources as close to the areas of demand as possible rather than concentrating pumping to a few large sources. Optimization is applicable to both the sustainability of the aquifer and the management of operation and maintenance (O&M) costs from pumping and distributing water within the potable water system. Concentrated pumping can cause seawater intrusion into the aquifer and loss of storage needed for drought. With respect to the water system, O&M costs are reduced if pumpage occurs within the area of demand, rather than transporting water from far away.



Clustered Well with Saline "Upconing"



Distributed Wells: ***No*** *Significant Saline "Upconing"*

During the six year drought period from 1998 through 2003, source yields from dike sources within Koʻolau Poko dropped below permitted uses, increasing Koʻolau Poko's dependence on Koʻolau Loa's basal aquifer sources to meet demand. BWS Punaluʻu wells experienced decreasing groundwater levels and rising chlorides and Waiheʻe Tunnel and stream experienced lower water levels despite production within State permitted use. Koʻolau Poko's hydrogeology does not support large water sources. Dike compartments are small except in Waiheʻe and Waiāhole, and tapping dike water here usually impacts stream flows. Koʻolau Loa sources are therefore needed to support the Kāneʻohe, Kailua and Waimānalo communities.

Punaluʻu Wells and Waiheʻe Tunnel each supply one quarter of Windward's drinking water; however, based on the long-term drought experience, BWS hydrologists recommend production be reduced to build back aquifer storage and be distributed to other smaller wells, in addition to conservation measures and diversification of alternative water supplies in Koʻolau Poko.

In response to the drought, BWS focused its leak detection and repair crews on Windward transmission mains. In two years of work, approximately 1.0 mgd of leaks were repaired, which benefited the aquifer and reduced BWS pumping costs. The leak repairs helped reduce Punaluʻu and Waiheʻe production and allowed the aquifers to recover in a shorter period of time. In time and as pipelines age, other leaks will occur. Leak detection and repair is a continuous process; there are about 2,000 miles of BWS pipelines on Oʻahu that require regular maintenance.

Reducing concentrated production from Punaluʻu Wells and Waiheʻe Tunnel can occur especially during wet weather periods by using smaller sources throughout the system and advanced water conservation strategies to reduce demand. Reducing production during wet months allows the sources to increase storage and reduces aquifer impacts during drought.

The Koʻolau Loa and Koʻolau Poko communities have expressed concerns about the amount of water being transferred from their watersheds to supply the other areas of Koʻolau Poko and East Honolulu. The transport of water out of these areas should not be detrimental to these areas and should be used wisely and not wasted. Each community should strive for sustainability of their region's natural resources. Groundwater withdrawal from BWS sources in Koʻolau Loa and Koʻolau Poko and the transport of water into the communities of Kāneʻohe, Kailua, and Waimānalo requires optimization to ensure pumping levels can be sustained with minimal detrimental impacts and to manage the high costs of transporting water over 25 miles.

The regional transport of water increases BWS O&M costs. It is more cost effective to pump sources within the areas of demand, but not enough source capacity exists in Koʻolau Poko. Distributing pumping from Punaluʻu wells and Waiheʻe Tunnel to other sources will incur capital costs of constructing new wells to replace existing capacity. But long-term sustainability justifies the additional capital investment.

KPWMP Objectives Project Addresses:

- Objective #1: Promote sustainable watersheds
- Objective #5: Meet future water demands at reasonable costs

Project Goals:

- Increase the long-term sustainability of BWS water sources in the Koʻolau Loa and Koʻolau Poko districts, especially during extensive periods of drought.
- Reduce operational and maintenance costs of the BWS Windward Water System

Project Desired Outcomes:

- Production from Punaluʻu Wells and Waiheʻe Tunnel have been reduced
- Koʻolau Loa and Koʻolau Poko have become less vulnerable to drought

Project Status: BWS has adopted the following pumpage optimization strategies for groundwater management and drought mitigation in Koʻolau Loa and Koʻolau Poko:

(1) Evaluate ways to reduce O&M costs by fully utilizing Koʻolau Poko's sources before importing water from Koʻolau Loa. Full utilization of groundwater sources in Koʻolau Poko will need to address impacts to surface waters.

(2) Pursue advanced water conservation programs, recycled water and new Koʻolau Poko wells such as Kūʻou Well III and Waimānalo Well III, which do not impact streams.

(3) Conduct regular leak detection and repairs of major transmission mains to reduce pumping in Koʻolau Loa and Koʻolau Poko.

(4) Water conservation, specifically the conversion to ultra low-flow toilets and water loss control in BWS pipelines has reduced the average pumpage in Windward Oahu by 2.0 mgd over the last 15 years, from 21 mgd to 19 mgd.

(5) Transfer a portion of Punaluʻu Permitted Use to other wells within the Koʻolau Loa Ground Water Management Area, e.g., Maʻakua Well and Kaluanui Well.

(6) Reduced pumping in Punaluʻu will allow sufficient aquifer storage in anticipation of drought and allow adequate aquifer recovery post drought.

(7) Conduct regular monitoring of the Waihe‘e Stream gage and adjust the operation of the Waihe‘e Tunnel and Inclined Wells to ensure Waihe‘e stream flows do not decrease below the court ordered 2.7 mgd.

(8) Improve the management of electrical power demand by operating smaller sources at steady state, with larger sources and reservoir storage used for meeting peak hour demands.

(9) If the above strategies do not reduce production from Punalu‘u Wells and Waihe‘e Tunnel, pursue the development of new wells, such as Wailele or Kaipapa‘u Well.

Reference: Personal communications with BWS staff.

PROJECT #04: Koʻolaupoko *Ahupuaʻa* Boundary Marker Project

Project Location: District-wide

Project Champions: Koʻolaupoko, Kailua, and Waimānalo Hawaiian Civic Clubs

Project Partners: City and County of Honolulu Department of Transportation Services (DTS), State Department of Transportation (HDOT), Harold K. Castle Foundation, Office of Hawaiian Affairs (OHA)

Project Background: The Koʻolaupoko *Ahupuaʻa* Boundary Marker Project is a collaborative effort among three Hawaiian Civic Clubs in Koʻolaupoko. The Koʻolaupoko, Kailua, and Waimānalo Hawaiian Civic Clubs all believe that the key to helping residents and visitors understand Native Hawaiian culture would be to identify Hawaiian practices of land and resource management by *ahupuaʻa* units. Impetus for this project began in 2009. Serving on this project's steering committee are representatives of the Waimānalo, Kailua, Kāneʻohe, and Kahaluʻu Neighborhood Boards and State and City and County transportation officials.

KPWMP Objectives Project Addresses:

- Objective #3: Protect Native Hawaiian rights and traditional customary practices
- Objective #4: Facilitate public participation, education, and project implementation

View toward Kailua from Olomana Mountain.

Project Goals:

- Educate and raise public awareness as to the number and variety of *ahupuaʻa* located in Koʻolau Poko.
- Educate and raise public awareness about Hawaiian traditional land boundaries, and how Hawaiians sustained themselves through wise land management and conservation practices.

Project Desired Outcomes:

- The traditional boundaries of Koʻolau Poko's *ahupuaʻa* are identified and marked
- An appropriate Hawaiian symbol as a boundary marker is designed
- Ahupuaʻa boundary markers that identify the beginnings and ends of each of the 11 *ahupuaʻa* of the Koʻolau Poko *moku* (district) at approximately 16 locations alongside State or City and County roads are installed.
- Brochures on each of the *ahupuaʻa*, giving brief histories and/or *moʻolelo* (stories) and an explanation of how the ahupuaʻa system worked in ancient times, are distributed. Materials are distributed to libraries, the civic clubs (for educational programs), government agencies, the visitor industry and the general public.

Project Status: To date, the project steering committee has convened 10 times since 2009, including one site visit for community representatives and a second site visit for State and City and County officials. The project has received funding from the Harold K. Castle Foundation and will receive matching funds from OHA. Sixteen preliminary sites have been identified as locations for *ahupuaʻa* boundary markers. The project steering committee has agreed on an appropriate Hawaiian symbol for the *ahupuaʻa* boundary markers, a steeple-column of stones traditionally called "*ahu,*" and will be using this symbol on signage with the names of each *ahupuaʻa*. The State DOT will be responsible for installing the actual stacked stone *ahu* markers. The project steering committee is also in the process of developing educational information for each *ahupuaʻa*. The steering committee will also extend invitations to the Maunalua Hawaiian Civic Club, Hawaiʻi-Kai Neighborhood Board, and representatives of area Outdoor Circle chapters to serve on the steering committee.

A subsequent project, not yet funded, would involve establishing teams of *kūpuna* and college students from each of the *ahupuaʻa* to conduct community awareness programs to educate their *ahupuaʻa* on the cultural and natural resources of their area and share Hawaiian sustainability practices to *mālāma* these resources.

Reference: Koʻolaupoko Hawaiian Civic Club March 2010 meeting handouts.

PROJECT #05: Establish Measurable Instream Flow Standards

Project Location: District-wide

Project Champion: Commission on Water Resource Management (CWRM)

Project Partners: BWS, United States Geological Survey (USGS), State of Hawai'i Department of Land and Natural Resources Division of Aquatic Resources (DAR), State of Hawai'i Department of Health (DOH), and Department of Agriculture (DOA)

Project Background: Instream flow standards (IFS) protect the public interest in the waters of the State. In formulating standards, the Commission must weigh the importance of present or potential instream values with the importance of present or potential uses of water from the stream for non-instream purposes, including the economic impact of restriction of such uses. Currently, Interim Instream Flow Standards (IIFS), are based on the "amount of water flowing in each stream on the effective date of the standard (1988 for Leeward Oahu and 1992 for Windward Oahu) without further amounts of water being diverted off-stream through new or expanded diversions" (see the *Oahu Water Management Plan Overview*).

Instream Flow Standards (IFS) are defined by the State Water Code as the "quantity or flow of water or depth of water which is required to be present at a specific location in a stream system at certain specified times of the year to protect fishery, wildlife, recreational, aesthetic, scenic, and other beneficial instream uses."

It is the responsibility of the CWRM to establish IFS to protect the public interest in the waters of the State. Stream flows should be expressed in terms of variable flows of water necessary to protect fishery, wildlife, recreational, aesthetic, scenic, or other beneficial instream uses. In formulating IFS, the CWRM must weigh the importance of the present or potential uses of water from the stream for non-instream purposes, including the economic impact of restriction of such uses [174C-71(1)(E)]. When preserving, enhancing, or restoring instream values, the CWRM must consider water exchanges, alternative sources, or any other solutions in order to avoid or minimize the impact on existing uses [174C-71(1)(E)].

Waihe'e Stream in Kahalu'u NB area

Setting IFS is a collaborative process where the CWRM, with input from interested parties and agencies, must determine and weigh present or potential instream values with present or potential non-instream uses, while protecting the public interest and avoiding or minimizing the impact on existing uses. In setting the IFS, CWRM is required by the State Water Code to consult with and consider the recommendations of the DOH, the aquatic biologist from DLNR, the Natural Area Reserves System Commission, the University of Hawaiʻi Cooperative Fishery Unit, the U.S. Fish and Wildlife Service, and other agencies with an interest in or information on the stream.

Decisions regarding establishing IFS in Koʻolau Poko will also need to be made in light of the Public Trust Doctrine. The four public trust purposes identified by the Hawaiʻi Supreme Court are: (1) maintenance of water in its natural state; (2) domestic water use of the general public (particularly drinking water); (3) the exercise of Native Hawaiian and traditional and customary rights, including appurtenant rights; (4) reservations of water for Hawaiian Home Lands. The Precautionary Principle, in cases where there is not scientific certainty, also applies.

Because of its relatively wet climate and the presence of many perennial streams, Koʻolau Poko has traditionally been one of the important *kalo* and aquaculture production areas on Oʻahu. Currently, the district also produces tropical fruits, vegetables, cut flowers and ornamental plants. Agricultural operations in Koʻolau Poko consist primarily of small farms.

The planning team conducted a preliminary analysis of the potential availability of good agricultural lands in Koʻolau Poko and found that there could be significant acres available for expansion of farming activities in the district (see Chapter 3, Water Use and Projected Demand for more information on the potentially available agricultural acreage in Koʻolau Poko). Expansion of farming activities largely depends on the availability of water. Instream Flow Standards (IFS) should be established to identify the availability of surface water for future agricultural activities in Koʻolau Poko.

KPWMP Objectives Project Addresses:

- Objective #2: Protect and enhance water quality and quantity
- Objective #3: Protect Native Hawaiian rights and traditional customary practices
- Objective #5: Meet future water demands at reasonable costs

Project Goal: Better management of the district's surface water resources.

Project Desired Outcomes: IFS for Koʻolau Poko streams have been established

Project Status: To date, CWRM has established measurable interim IFS for all or portions of 32 streams in the state. CWRM in the Waiāhole Ditch Contested Case, has amended the IIFS for Waikāne, Waiāhole, and Waianu Streams with measurable median stream flows of 3.5 mgd, 8.7 mgd, and 3.5 mgd respectively. (The IIFS for the Kahana Stream in Koʻolau Loa was also amended by CWRM in the Waiāhole Ditch Contested Case.) In addition to streams affected in the Waiāhole Ditch Contested Case, the Hawaiʻi Supreme Court has also directed CWRM to take immediate steps to assess stream flow characteristics and develop measurable IIFS for other streams statewide. CWRM recently established IIFS for several streams on Maui and is in the process of implementing and evaluating them.

CWRM at its December 2006 Meeting modified the process to amend the status quo IIFS (i.e., "amount of water flowing in each stream on the effective date of the standard without further amounts of water being diverted off-stream through new or expanded diversions") by directing its staff to seek agency review and hold public fact-gathering meetings to support the establishment of measurable IIFS. Agency review and public fact-gathering meetings are not required by the State Water Code to amend the IIFS, however, CWRM recognized the need to involve the public to gather the best available information and keep them informed in the process of amending the IIFS. Involving the public early on will also be beneficial when CWRM eventually starts establishing the IFS. Establishing the IFS requires CWRM to hold a public hearing, therefore, having an involved and informed public will help to mitigate potential conflicts that may arise in the process.

Stream hydrology, existing and potential instream uses as well as existing and potential non-instream uses should be considered when establishing the IFS. Therefore, studies, surveys, and other methods of collecting best available information are the first step in the process to establish the IFS. In 2008, CWRM in collaboration with BWS began a stream diversion inventory survey to verify registered diversions in Koʻolau Poko. BWS hydrogeology staff visited diversions listed in the 1992 database and also collected additional information from observation, measurements, and interviews with diversion operators and owners. As of March 2010, BWS had verified the registered diversions in the Kahaluʻu and Kāneʻohe neighborhood board areas except for those located within the Waiāhole Agricultural Park. Most of the diversions verified were actively delivering water for commercial and culturally related farming activities. A limited number of diversions supplied water for landscape irrigation. The stream inventory study provided a valuable inventory of non-instream uses in Koʻolau Poko.

Other studies that *should* be conducted to establish an IFS include:

- Conducting a *kuleana* lands inventory survey to identify *kuleana* lands where their land owners may have appurtenant rights;
- Biological assessment of streams and nearshore waters
- Monitoring and recording stream flow
- Conducting a survey of traditional and customary practices, including the exercise of gathering rights in streams and near shore waters.

Due to its limited staff and resources, CWRM cannot establish IFS for all streams in Koʻolau Poko in the near term. There is a need to prioritize which Koʻolau Poko streams' IFS should be established first. Establishing IFS for Koʻolau Poko streams should be based on the following suggested criteria:

- Perennial streams
- Streams with the most stream diversions
- Streams that currently have a significant amount of water being diverted
- Streams located in areas that have high potential for future expansion of agricultural activities that will require additional water supplies

Based on the above criteria, the following Koʻolau Poko streams should be priorities for CWRM to establish IFS: Waiheʻe Stream, Maunawili Stream, and Heʻeia Stream. The Kailua Neighborhood Board's top priorities for IFS are Maunawili Stream and Kahanahāiki Stream.

References: HRS §174C-71; State of Hawaiʻi Commission on Water Resource Management, Hawaiʻi Water Plan: Water Resource Protection Plan (June 2008); Personal communications with CWRM.

PROJECT #06: Hawaiʻi Ocean Resources Management Plan and Climate Change Adaptation Framework

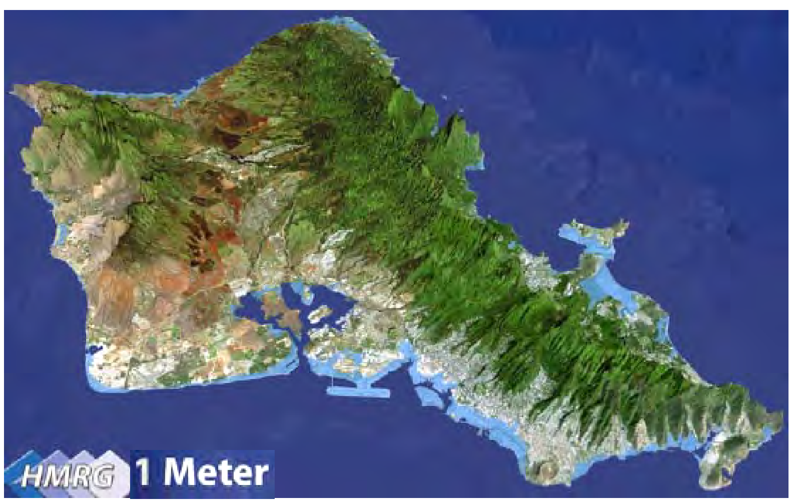
Project Location: Statewide program

Project Champions: Hawaiʻi Coastal Zone Management Program

Project Partners: UH Center for Island Climate Adaptation and Policy (ICAP), Ocean Resources Management Plan Policy and Working Groups (CZM, BWS; the Planning Departments of Oahu, Hawaiʻi, Maui and Kauai Counties; DOA; DOH; DLNR; DOT; OHA; Marine and Coastal Zone Advocacy Council, NOAA; U.S. USACE; U.S. Coast Guard; UH School of Ocean and Earth Science and Technology, UH Sea Grant College Program,)

Project Background: The people of Hawaiʻi depend on the ocean's resources for food, subsistence, cultural practices, recreation, jobs, and tourism. While a vibrant and healthy ocean environment is essential to our quality of life, Hawaiʻi faces significant challenges in preserving the health of ocean resources from use of the land degrading coastal water quality and coral reef ecosystems. Intensified ocean recreational and commercial uses are creating resource use conflicts and over-exploitation of fisheries. Impacts from global climate change create new challenges such as ocean and atmospheric warming, acidification, sea level rise, coastal zone erosion, increased frequency and severity of storm surges, floods and drought. These climate change impacts will have adverse effects to public health and safety, infrastructure, economic development, environment, agriculture, and social and cultural resources. Coordinated actions to adapt to climate change over the next 50 to 100 years must be initiated and pursued by various organizations.

The Hawaiʻi Ocean Resources Management Plan (ORMP) is a statewide plan mandated by HRS Chapter 205A and was updated by the Office of Planning Coastal Zone Management Program in 2006. The ORMP is an integrated, place-based approach to management of ocean resources, building upon the recognition of the ecological connections between land and sea, the links between human activities and environment and the need for improved collaboration and stewardship in natural resources governance.



The ORMP Working Group and ICAP developed A Framework for Climate Change Adaptation in Hawaiʻi dated November 2009. The framework provides meaningful and consistent statewide context for a number of key areas that climate change will continue to affect, such as shoreline erosion, coastal development, coastal hazards, and the preservation of our natural and cultural resources. The climate change framework promotes an open and collaborative adaptation planning process that is based on a common vision for Hawai'i's future, remains flexible to the State's ever changing characteristics, and lays out a step-by-step process by which the State of Hawai'i may begin to develop plans and make informed decisions on climate change adaptation.

KPWMP Objectives Project Addresses:

- Objective #1: Promote sustainable watersheds
- Objective #2: Protect and enhance water quality and quantity
- Objective #3: Protect Native Hawaiian Rights and Traditional and Customary Practices
- Objective #4: Facilitate public participation, education, and project implementation
- Objective #5 Meet future water demand at reasonable costs

Project Goal:

- Connecting Land and Sea
  - Improve coastal water quality by reducing land-based sources of pollution and restoring natural habitats
  - Protect beaches, wetlands, and coastal communities from shoreline erosion and other coastal hazards
  - Improve and ensure maintenance and appropriate use of environmental infrastructure
- Preserving our Ocean Heritage
  - Improve coastal water quality by reducing marine sources of pollution
  - Improve the health of coastal and ocean resources for sustainable traditional, subsistence, recreational and commercial uses
  - Enhance public access and appropriate coastal dependent uses of the shoreline
  - Promote appropriate and responsible ocean recreation and tourism that provide culturally informed and environmentally sustainable uses for visitors and residents
  - Encourage cutting edge and appropriate ocean science and technology with safeguards for ocean resource protection
- Promoting Collaboration and Stewardship
  - Apply integrated and place-based approaches to the management of natural and cultural resources
  - Institutionalize integrated natural and cultural resources management

Project Desired Outcomes:

- Collaboration – Collaboration among agencies, organization, local communities and all stakeholders
- Education – Education and awareness to develop ownership and affect behavior change
- Sustainability – Awareness and balance in natural resource management
- Funding – Increased buy in supports funding, people and information directed toward key values and priorities in the ORMP
- Political Will – Political will and leadership at all levels for achieving a positive vision that sees environmental issues as equal to other issues

Project Status:
Following the climate change adaptation framework, the ORMP group has identified relevant planning areas, such as infrastructure, natural resources, coastal zones, economic development, and agriculture and emergency management, that are likely to be affected by climate change. The ORMP group plans to partner with the US Army Corps of Engineers through its Planning Assistance to States Program to develop a Climate Change Vulnerability and Risk Assessment to determine and prioritize the most vulnerable planning areas to climate change impacts. Infrastructure agencies can then initiate and implement adaptation planning over the long term.

In alignment with the climate change framework, the Office of Planning and the ORMP Policy and Working Groups in 2011-12, plan to pursue a statewide policy that will guide the development and implementation of more specific climate change policies, regulations, and guidance in the state.

The new statewide climate change policy is proposed to become a "priority guideline" under Part III, *Priority Guidelines*, of the Hawaii State Planning Act (HRS Chapter 226). The purpose of the Hawaii State Planning Act is to achieve the following:

- Serve as a guide for the future long-range development of the state,
- Identify the goals, objectives, policies, and priorities for the state,
- Provide a basis for determining priorities and allocating limited resources, such as public funds, services, human resources, land, energy, water, and other resources,
- Improve coordination of federal, state, and county plans, policies, programs, projects, and regulatory activities, and
- Establish a system for plan formulation and program coordination to provide for an integration of all major state and county activities.

Reference:
Hawaiʻi Ocean Resources Management Plan, Dec. 2006.
http://hawaii.gov/dbedt/czm/ormp/ormp.php

A Framework for Climate Change Adaptation in Hawaiʻi, November 2009
http://hawaii.gov/dbedt/czm/ormp/reports/climate_change_adaptation_framework_final.pdf

The Hawaii CZM Program Status Report to the Legislature 2009 and 2010

PROJECT #07: Hawaiʻi Coral Reef Assessment and Monitoring Program (CRAMP)

Project Location: Statewide program

Project Champion: Hawaiʻi Institute of Marine Biology (HIMB)

Project Partners: Bishop Museum, Division of Aquatic Resources (DAR), UH Oceanic Institute

Project Background: The Hawaiian Archipelago contains vast reef resources (approximately 132 islands, reefs and shoals) strewn along its length of 1500 miles. Hawaiʻiʻs valuable reefs are increasingly experiencing environmental stresses. One of the greatest obstacles to environmental managers in Hawaiʻi has been the lack of information on mechanisms responsible for reef decline and lack of an integrated coral reef research and monitoring program. CRAMP was created during 1997 and 1998 by leading coral reef researchers, managers and educators in Hawaiʻi. The initial task was to develop a state-wide network consisting of over 30 long-term coral reef monitoring sites and an associated data base. Upon completion of the monitoring network the focus was expanded to include rapid quantitative assessments and habitat mapping on a state-wide spatial scale. Today the emphasis is on using these tools to understand the ecology of Hawaiian coral reefs in relation to other geographic areas. CRAMP is based on the islet of Moku o Loʻe in Kāneʻohe Bay.

Two threats that reefs in Koʻolau Poko nearshore waters face are sediment from storm run-off and the presence of the invasive seaweed species *Gracilania salicormia*.

Aerial view of Moku o Loʻe in Kāneʻohe Bay

KPWMP Objectives Project Addresses:

- Objective #1: Promote sustainable watersheds
- Objective #2: Protect and enhance water quality and quantity
- Objective #4: Facilitate public participation, education, and project implementation

Project Goals:

- Identify the controlling factors, both natural and anthropogenic, that contribute to the stability, decline, or recovery of Hawaiian reefs.

Project Desired Outcomes:

- A standard statewide coral reef assessment and monitoring methodology has been developed.

Project Status: CRAMP has several on-going projects statewide. In Koʻolau Poko, CRAMP is currently involved in the following projects:

Kahaluʻu Project: The Kahaluʻu Project includes evaluation of the ecological status of coral reef resources at the Kahaluʻu end of Kāneʻohe Bay in relation to human use. There are four major components of this work: mapping, assessment, monitoring, and education.

UH UMEB Internship Program: The University of Hawaiʻi Undergraduate Mentoring in Environmental Biology Program was located at Moku o Loʻe in the summer of 2008. During that summer, program participants studied the effects that sediment has on coral growth and conducted manipulative experiments in mesocosms (artificially created marine systems in laboratories with a water volume ranging from 1 to 10,000 cubic meters) at Moku o Loʻe to understand the effects of climate change on coral reefs. Current climate change studies on coral are conducted in HIMB laboratories. In 2011 -2012, the coral reef climate change studies are planned to expand to field studies in Kāneʻohe Bay.

Reference: http://cramp.wcc.hawaii.edu/CRAMP_Information/overview.htm; Personal communications with CRAMP staff

Project #08: Marine Corps Base Hawaiʻi Integrated Natural Resources Management Plan (INRMP)

Project Location: Marine Corps Base Hawaiʻi (MCBH) installations. There are three MCBH installations in Koʻolau Poko: Marine Corps Air Station Kāneʻohe Bay, Marine Corps Training Area Bellows, and Waikāne Valley Impact Area.

Project Champion: Marine Corps Base Hawaiʻi (MCBH)

Project Partners: United States Fish and Wildlife Service (USFWS), United States National Marine Fisheries Service and Department of Land and Natural Resources (DLNR)

Project Background: The Federal Sikes Act Improvement Amendments passed in 1997 required all military installations with significant natural resources to prepare, implement and regularly update Integrated Natural Resources Management Plans (INRMPs). The INRMP objectives include conservation of the installations' lands and waters to support military readiness while complying with federal laws that govern natural resources management and protection, and public access to the resources. The MCBH INRMP (2000-2011) proposes 123 environmental management actions across seven categories: 1) Fish and Wildlife, 2) Wetlands, 3) Watersheds, 4) Coastal and Marine Resources, 5) Ground Maintenance and Landscape Management, 6) Outdoor Recreation and Quality of Life, and 7) Resources Information.

KPWMP Objectives Project Addresses:

- Objective #1: Promote sustainable watersheds
- Objective #2: Protect and enhance water quality and quantity
- Objective #4: Facilitate public participation, education, and project implementation

Project Goal: Improve the sustainability and native biological diversity of the MCBH ecosystem while supporting its military mission.

Project Desired Outcome:

- Healthy fish and wildlife populations are maintained by managing protected species and habitats.
- Wetlands are protected, enhanced, or restored.

Nuʻupia Pond in Mōkapu

- Ecosystem-based watershed
- approaches to manage and enhance water quality, mitigate flooding, and enhance shoreline and marine resources are used.
- Sustainable grounds maintenance and landscaping practices are utilized.
- Appropriate natural resource-based outdoor recreational experiences consistent with natural resource conservation are provided
- Natural resource information management tools that assist with implementing the INRMP and that support integrated natural resources management are developed.

Project Status: The INRMP was first adopted by MCBH in 2002 and had a four year outlook (2002-2006). Most of the management actions specified in the 2002 INRMP have been implemented or are currently in progress. In November 2006, the MCBH updated the INRMP (2007-2011). The 2006 INRMP includes management actions listed in the 2002 INRMP that were in progress or were not yet completed.

References: Marine Corps Base Hawaiʻi Integrated Natural Resources Management Plan and Environmental Assessment (2002 -2006); Final Marine Corps Base Hawaiʻi Integrated Natural Resources Management Plan Update (2007 -2011).

Project # 09: Implement Requirements of the TMDL Studies for Koʻolau Poko Streams

Project Location: Kāneʻohe Stream, Kāwā Stream, Kapaʻa Stream, Kaʻelepulu Stream, and Waimānalo Stream

Project Champion: Department of Health, Clean Water Branch (CWB)

Project Partners: State Office of Planning Coastal Zone Management (CZM), City Department of Environmental Services (ENV)

Project Background: Section 303(d) of the Clean Water Act requires states across the nation to identify water bodies not meeting applicable water quality standards. For these polluted waterbodies, the states are required to develop Total Maximum Daily Loads (TMDLs). TMDLs represent the maximum amount of point and nonpoint source pollutants that can enter a waterbody without violating the water quality standards. Point source pollutants originate from identifiable sources such as municipal separate storm sewer systems (MS4s) while nonpoint source pollutants originate from many diffused sources, for example, pollutants picked up by runoff. The point source pollution requirements are addressed through the National Pollutant Discharge Elimination System (NPDES) permitting program administered by the CWB. CWB addresses the nonpoint source requirements through applicable nonpoint source pollution reduction plans developed by landowners/land managers and plans developed in partnership with the CZM. To help coordinate and support these efforts, the CWB Polluted Runoff Control Program (PRC) administers the EPA 319(h) grant program that provides funds for planning, public education, and best management practice (BMP) programs. Additionally, the DOH Wastewater Branch administers the State Water Pollution Control Revolving Fund that provides low interest loans to county and state agencies to construct point source and nonpoint source water pollution control projects.

KPWMP Objectives Project Addresses:
- Objective #2: Protect and enhance water quality and quantity

Project Goal: Improve the water quality of streams for which TMDLs have been established.

Project Desired Outcomes:
- Point source requirements for entities with NPDES permits have been implemented
- Nonpoint source requirements through public education and application of Best Management Practices (BMPs) in critical areas as identified by applicable plans have been implemented

Project Status: Kāneʻohe Stream, Kāwā Stream, Kapaʻa Stream, and Waimānalo Stream in Koʻolau Poko have an approved TMDL. For Kāneʻohe, Kāwā, and Kapaʻa Streams, there are six NPDES permit holders and two NPDES permit applicants with point source requirements. In addition, there is one facility with assigned point source requirements for which implementation responsibility is uncertain. As a prerequisite for renewal or approval of the permits, CWB requires the permittees/applicants to submit their implementation and monitoring plans. The PRC Program funded a variety of educational, planning, and BMP projects in Koʻolau Poko between Fiscal Years 2000 and 2008. The State Revolving Fund program financed the sewer reconstruction project at Wanaʻao Road/Keolu Drive in Kailua. Construction of this project started in October 2007 and is almost complete. The sewer reconstruction project is deemed necessary to prevent future failure of the sewer system within the project limits. Sewer failure in Kailua area could lead to severe contamination of Kailua Bay.

References: TMDL decision documents for Kāneʻohe, Kāwā, Kapaʻa, Kaʻelepulu and Waimānalo Streams published by the State of Hawaiʻi Department of Health Environmental Planning Office on http://hawaii.gov/health/environmental/env-planning/wqm/wqm.html; Personal communication with DOH.

Enchanted Lake/Kaʻelepulu Pond in Kailua

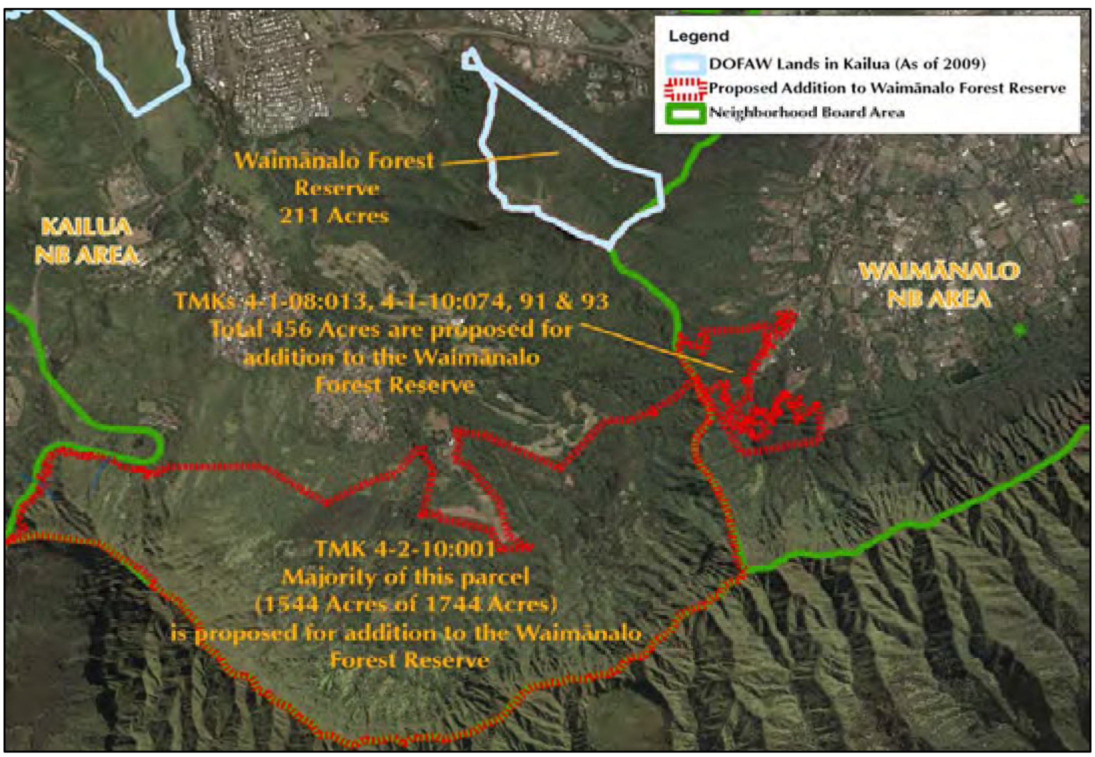
Project #10: Expansion of the Waimānalo Forest Reserve

Project Location: TMKs 4-1-08:013, 4-1-10:074, 91, 93, 4-2-10:001 (portion of) in Maunawili and Waimānalo

Project Champion: Department of Land and Natural Resources (DLNR) – Division of Forestry and Wildlife (DOFAW)

Project Partner: DLNR – Land Division

Project Background: The Territorial Government of Hawaiʻi created the Hawaiʻi Forest Reserve System in 1903 in response to widespread forest degradation that threatened the fresh water sources of the islands. The Hawaiʻi Forest Reserve System has since evolved in terms of land boundaries and ownership. Originally consisting of public and privately-owned lands, the system currently includes only public lands that are managed by DOFAW. In 2009, DOFAW managed 1770 acres in Koʻolau Poko in the Hawaiʻi Forest Reserve System. The Waimānalo Forest Reserve, one of the forest reserves in the Hawaiʻi Forest Reserve System, consists of 211 acres of land in Kailua. In March 2009, DOFAW proposed expanding the Waimānalo Forest Reserve by an additional 2,000 acres. The proposed expansion lands are currently under the jurisdiction of the DLNR Land Division.



Additional lands to be included in the Waimānalo Forest Reserve

KPWMP Objectives Project Addresses:

- Objective #1: Promote sustainable watersheds

Project Goal: Conservation, management and restoration of forest lands in Maunawili Valley for current and future generations.

Project Desired Outcomes:

- Maunawili Falls trail will be included in the forest reserve
- Recreational activities including hiking, biking, horseback riding, and hunting have been implemented and are managed by DOFAW
- Invasive species control on portions of the lands has been implemented

Project Status: DOFAW and the Land Division held a public hearing on May 26, 2009 for the proposed transfer of lands from the Land Division to DOFAW. The Land Division has conducted clean ups of illegal dumping sites that have occurred on these lands. DOFAW is currently working with the Land Division and some lessees on portions of TMK 4-2-10:001 to determine how to subdivide the TMK parcel into lands that will go into the forest reserve and lands that will remain as agricultural lots that are managed by the Land Division.

References: Personal communications with DOFAW; DOFAW, Recommendation Memo to the Board of Land Natural Resources, August 28, 2009.

Project #11: Waimānalo Irrigation System Improvements and Conservation

Project Location: Maunawili and Waimānalo

Project Champion: State of Hawaiʻi

Project Partners: USACE, DOA, CWRM, ENV, BWS

Project Background: The Waimānalo Irrigation System is composed of several features. The Maunawili Ditch is a 100 year old ditch system that delivers water to the Waimānalo Irrigation System. The Maunawili Ditch was constructed in order to provide water for the old Waimānalo Sugar Plantation. Although the sugar plantation ceased operations in 1947, the ditch still remained in operation and is currently the primary source of water for the Waimānalo Irrigation System which serves approximately 164 farm accounts on 1,174 acres. The ditch consists of lined and earthen ditches, tunnels, and elevated pipe siphons. The ditch still maintains most of its original design elements and has not received a major upgrade despite advancements in irrigation technology over the last century. The system's gravity-fed ditch flows are transported from Maunawili Valley to Waimānalo Valley through a short unlined tunnel (Aniani Nui Tunnel). A short ditch directs water from the Aniani Nui Tunnel exit into a network of pipelines which connect to the Waimānalo farming community and a 60 mg earthen reservoir. The 60 mg reservoir serves as the distribution point for the system.

Because access to most of the collection system is by four wheel drive vehicles, system maintenance is labor intensive and as a result the ditch has not been regularly maintained on a consistent basis and is now in serious disrepair. The most recent repair work to the ditch occurred in 1993. The repair work included replacement of the old wood flumes with pipe siphons. Since 1993, only emergency repairs and maintenance work have been made to the ditch system. Soil erosion and overgrown vegetation have damaged

Temporary upgrades of the Waimānalo Irrigation System the old earthen structures. The current condition of the Maunawili Ditch greatly affects the ditch's ability to deliver water.

In 2003, Maunawili Ditch diverted 1.48 mgd from Maunawili, ʻAinoni, and Makawao Streams in Maunawili Valley. Of this amount, approximately 0.4 mgd was distributed to farmers on the Waimānalo Irrigation System. DOA estimates that the Waimānalo Irrigation System maximum daily demand is 0.65 mgd during dry summer periods. Recent drought conditions along with the significant amount of leakages along the Maunawili Ditch have created severe water shortages for Waimānalo farms. DOA has enacted mandatory water conservation measures that require all water users to reduce their consumption by only using water three days a week over eight hour periods. During the first half of August 2010, water volumes in the 60 mg reservoir were only between 4.2 and 4.9 mg.

The diversion of water from Maunawili Stream to Waimānalo farms may have had an impact on Kawainui Marsh in Kailua. The diversion has resulted in less fresh water flow into Kawainui Marsh. The reduction in flow may impact the natural ecological functions of the Marsh and may also impact the future long-term plans of Kawainui Marsh community groups to restore portions of the marsh for food production. It should also be noted that the Kailua Neighborhood Board has expressed a concern that repair of the ditch system will result in less water leaking into areas of the Maunawili-Kawai Nui watershed, which may in turn negatively impact the watershed and Kawai Nui Marsh.

KPWMP Objectives Project Addresses:

- Objective #1: Promote sustainable watersheds
- Objective #2: Protect and enhance water quality and quantity
- Objective #5: Meet future water demands at reasonable costs

Project Goals:

- More efficient delivery of water from the Maunawili Ditch to farms on the Waimānalo Irrigation System
- Make agricultural water service more reliable by developing alternative sources of water for the Waimānalo Irrigation System
- Restoration of more water to Maunawili and Kawainui Marsh

Project Desired Outcomes:

- Leakage and water loss along the ditch have been reduced to a minimum, reasonable level
- Water supply is more reliable for farmers on the Waimānalo Irrigation System, especially during periods of drought
- Less water is diverted from Maunawili Stream, increasing stream flow into Kawainui Marsh
- A repaired ditch will require less manpower to upkeep and maintain

Project Status: In 2008, DOA received $6 million in CIP funding to repair and upgrade the Maunawili Ditch. Repairs to the ditch system are to include:

- Repairing the most dilapidated segments of the ditch
- Installation of two siphons that by-pass long open ditch segments
- Improve access to the ditch to minimize repair time for maintenance
- Installation of meters with Supervisory Control and Data Acquisition (SCADA)

When the meters and repairs are completed, DOA will be able to monitor ditch flows and determine water loss between various segments of the Maunawili Ditch. The data will allow DOA to prioritize future improvements to the system. DOA is currently developing a project scope of work for construction.

Long-term possible actions if funding were available would be to pipe the ditch and add control valves to the diversion structures so when the reservoir is full, a signal could be sent to regulate the valves, allowing stream water to remain in the Maunawili streams instead of being diverted to Waimānalo. Also, a closed piped system, similar in design to the Kamehameha Schools' Punaluʻu ditch upgrade, is more efficient, has less water loss due to evaporation, and is pressurized for spray irrigation. The Punaluʻu closed piped system also includes design elements such as fish ladders that prevent native species from getting trapped in the system. There is also less maintenance of the ditch system with a closed pipe, should debris fall onto the ditch, the debris will not clog the system. The Punaluʻu closed-pipe ditch system would be a good model for upgrading other old ditch systems.

DOA has no current plans to expand its water service area in Waimānalo and therefore does not anticipate a need for new water sources at this time. DOA believes that repairs to the ditch system should be enough to cover the existing water needs of its service area for a majority of the time. However, water use restrictions during severe drought are unavoidable.

Although DOA does not anticipate the need for additional new water sources for its Waimānalo Irrigation System, there are a couple of possible future alternative sources of water that could be utilized should more water sources be needed in the future. ENV and USACE are in the process of conducting a feasibility study to treat Waimānalo WWTP wastewater to an R-1 level. (See Project #34). Future R-1 water could be used as a possible additional alternative source of irrigation water for some Waimānalo farms.

BWS has transferred its Waimānalo Well I to DOA. Waimānalo Well I can provide up to 0.25 mgd. At the current time, DOA utilizes Waimānalo Well I for emergency use only and does not utilize Waimānalo Well I as a part of its normal operations, supplemental or other. Use of this well is constrained by the high cost of electrical power needed to operate the pumps.

Future proactive agriculture water use conservation programs (see Strategy #20) could also reduce the amount of future water that is used and help to mitigate the effects of long-term drought conditions.

References: State of Hawaiʻi Department of Agriculture, *Agricultural Water Use and Development Plan*, December 2003; State of Hawaiʻi Department of Land and Natural Resources Commission on Water Resources Management, *State Water Projects Plan*, February 2003; Personal communications with Department of Agriculture.

PROJECT #12: Aloha ʻĀina Agri-Cultural Learning Center

Project Location: Luluku and Maunawili

Project Champion: Aloha ʻĀina Health Center

Project Partners: Luluku Farmers Association, Ke Kula ʻo Samuel M. Kamakau Laboratory Public Charter School, Hakipuʻu Learning Center, Kamehameha Schools, OHA, ʻAha Hui Mālāma i ka Lōkahi

Project Background: "Aloha ʻĀina" means "expressing love for that which nourishes, sustains, and provides the context for our lives," or more simply, "love for the land." The Aloha ʻĀina Health Center is a non-profit, 501(c) (3) native Hawaiian based organization located on two small farms in Maunawili and Luluku. The mission of Aloha ʻĀina Health Center is to build a healthy community through holistic nutrition and healthy lifestyle programs. Its program started in 1999 and initially focused on adolescents who were having difficulties in school. Those youth were invited to the farm in Luluku to learn and experience life on a traditional Hawaiian farm. The Luluku farm is located *mauka* of the Hoʻomaluhia Botanical Garden and is about 3 acres. The farm land is leased from Koʻolau Land Partners, a private land owner. Activities at the Luluku site have focused on restoring *loʻi kalo* and increasing food output using student and community participants.

The Maunawili farm is referred to as Pikoakea due to its proximity to the Pikoakea Spring. Water from Pikoakea Spring irrigates an ancient wetland kalo complex that has been restored by Aloha ʻĀina. The farm is 2.5 acres located in the far upper reaches of Maunawili Valley. It is part of a larger area leased by the State of Hawaiʻi to a farmers' cooperative.

Children learn to plant kalo at the Learning Center

At this site, numerous community based groups and organizations have been able to learn about the *ahupuaʻa* system of resource management and the importance of preserving agricultural lands for future generations through hands-on experiences at the farm.

KPWMP Objectives Project Addresses:

- Objective #1: Promote sustainable watersheds
- Objective #3: Protect Native Hawaiian rights and traditional customary practices
- Objective #4: Facilitate public participation, education, and project implementation

Project Goals:

- Re-establish the *ahupuaʻa* as the means of identifying and connecting the community to the ʻāina
- Re-establish Native Hawaiian farming practices
- Enhance the Maunawili-Luluku farmers' cooperative
- Demonstrate a model of flourishing, community supported small farm food production and learning centers
- Support and expand a community constituency to protect culturally and agriculturally important lands

Project Desired Outcomes:

- Pikoakea has been developed as a community learning and healing center
- Relationships among youth and *kūpuna* around the subjects of health, traditional foods, and the Hawaiian healing arts have been fostered
- Food production at the Luluku and Pikoakea farmlands to provide organic, mineral-rich produce to families, schools, and the community has been increased
- Aloha ʻĀina resources and programs with similar projects and sites in the Kailua *ahupuaʻa* have been integrated
- The number of schools and youths participating in the food and farm programs has increased
- Community-based agriculture and food production in Koʻolau Poko has increased
- Sustainable funding sources with limited dependence on cyclical grant funding have been developed
- Evaluation mechanisms and processes to document successes and experiences to enhance the ability of others to learn from and through Aloha ʻĀina's experience have been developed

Project Status: To date, about 20 *loʻi* have been put back into *kalo* production at the Pikoakea farm. At its Luluku Farm, Aloha ʻĀina has partnered with Samuel Kamakau Charter School and a Community Supported Agriculture Program (C.S.A.) to develop a "farm-to-cafeteria" program for Windward Oʻahu families. Aloha ʻĀina and Samuel Kamakau Charter School collaborative activities have also benefited from receiving funding from a DOH Healthy Hawaiʻi Initiative grant.

Future activities Aloha ʻĀina would like to undertake include funding an Ahupuaʻa Education Coordinator that would be responsible for scheduling, outreach, and coordination of supervision, curriculum development, and instruction at Pikoakea. The *Ahupuaʻa* Education Coordinator would be a shared position with other groups in the *ahupuaʻa* with similar needs and programs. This sharing would allow a pooling of resources to fund the position and to promote the integration of the *ahupuaʻa* as the unit of identification and education.

Other activities Aloha ʻĀina would like to pursue in the future at its Pikoakea and Luluku farms include site improvements such as development of a *halau* for educational activities, outdoor kitchen, composting toilets, improvement of trails and other visitor infrastructure. Aloha ʻĀina would also like to develop a seed banking and native species propagation program for other restoration efforts in the *ahupuaʻa*. Aloha ʻĀina would like to open additional *loʻi* at its Pikoakea farm and start a farm apprentice development program.

Other active restoration projects with which Aloha ʻĀina collaborates include:

- Alala Point native re-vegetation of a scenic point along Kailua beach by Kamakau LPCS students
- Ulupō Heiau-restoration, interpretive, and cultural activities
- Various educational and restoration projects related to Kawainui Marsh
- Restorative work at Na Pōhaku o Hauwahine and Holomakana Heiau

Reference: 2005 Aloha ʻĀina Strategic Plan; Personal communications with Aloha ʻĀina

PROJECT #13: Waiheʻe Ahupuaʻa Initiative

Project Location: Waiheʻe

Project Champions: Waiheʻe *Ahupuaʻa* Initiative (WAI) Partners (KEY Project/BWS)

Project Partners (For Fish Passage Project Only)**:** USFWS, USGS, DAR, Hui o Koʻolaupoko, CWRM, Department of Parks & Recreation; Various public and private educational providers

WAI Background: In recent times, Waiheʻe has gained recognition as a place of critical conflicts over water allocation and management issues. This *ahupuaʻa* has been the subject of intense debate, litigation, constitutional and legislative deliberation and most importantly, a keen interest in understanding its precious water resources and the responsibilities of stewardship by both government agencies and community members. A significant proportion of land in the Waiheʻe *ahupuaʻa* is publicly owned.

In 1955, the Waiheʻe Tunnel System was constructed. BWS assumed ownership of the tunnel in 1959. Currently, the Waiheʻe Tunnel System is BWS's largest source of water in Koʻolau Poko, producing approximately 5 mgd, or about one-third of all water produced by BWS in the district. From the standpoint of providing drinking water, the Waiheʻe watershed is Koʻolau Poko's most critical watershed.


Waiheʻe Waterfall

Since the Waiāhole Ditch Case, BWS has embraced its dual role of being both a water purveyor as well as being a steward of the island's water resources. BWS has realized that its actions can sometimes have unintended consequences to the surrounding natural resources and has taken proactive steps to be better stewards of the environment. As one of its proactive measures, BWS entered into a Memorandum of Understanding (MOU) with the Waiheʻe based non-profit, Kahaluʻu-Heʻeia Ecumenical Youth (KEY) Project in 2003. The Waiheʻe Ahupuaʻa Initiative (WAI) was formed through a 2003 MOU, in which BWS and KEY Project agreed to participate in cooperative management and education activities in the Waiheʻe *ahupuaʻa*. The WAI partnership also recognized the need to be inclusive and include all parties that demonstrate a willingness to contribute positively to the goals of the WAI. Several other agencies and groups have participated in the WAI since it was first formed.

KPWMP Objectives Project Addresses:

- Objective #1: Promote sustainable watersheds
- Objective #2: Protect and enhance water quality and quantity
- Objective #3: Protect Native Hawaiian rights and traditional customary practices
- Objective #4: Facilitate public participation, education, and project implementation

Project Goals:

- Preserve, protect, restore, enhance, and interpret the unique natural and cultural heritage of Waiheʻe for future generations by fostering knowledge of relevant history, culture, local economy and science such that an understanding of the elements that are critical to *ahupuaʻa* restoration becomes widespread;
- Protect endangered tropical forest(s), wetlands, riparian, coastal, estuarine, and marine habitat through promotion of environmental policies and practices that address biological sustainability and human well being. This will be accomplished, in part, by integrating current Western management strategies with traditional Hawaiian resource stewardship models – each of which is now better understood;
- Develop natural resource stewardship models that respect Native Hawaiian rights and those of an island community while helping to re-establish a corresponding acceptance of civic responsibilities attached to those rights;
- Increase the number of WAI partners that participate in the partnership

Current WAI Activities:

Waiheʻe Stream Fish Passage Project. WAI participants have been meeting since October 2007 regarding the construction of a fish passage in Waiheʻe Stream near the "Ice Pond" and the old abandoned USGS gage. The fish passage would provide native aquatic species, such as the oʻopu, with

Old USGS gage looking upstream

passage to the upper reaches of the stream to lay and fertilize their eggs. The old USGS gage in Waiheʻe Stream which currently blocks such passage will need to be modified.

In 2009, the project received a $45,000 grant through the Hawaiʻi Fish Habitat Partnership which is administered by BWS. It is a reimbursable award that has a 1:1 non-federal fund match (including in-kind services.) USFWS and BWS entered into a cooperative agreement to administer the funds from this grant. The grant funding is good for two years and can be extended at no cost for a maximum of up to six years.

WAI has also received partial funding from a $40,000 HTA grant. The funding from the HTA grant can cover part of the costs of this project as well as other WAI projects. WAI partners also identified a $60,000 NOAA grant as a possible future source of funding for this project.

DAR has been in the process of conducting a stream survey of aquatic species present in the Waiheʻe Stream. The stream survey will provide baseline data on the amount and variety of species currently in Waiheʻe Stream prior to the construction of the fish passage. The baseline data will be used to assess the effectiveness of the fish passage.

Periodic Volunteer "Work Trips". KEY Project has coordinated several community volunteer "work trips" in the *mauka* areas of the Waiheʻe *ahupuaʻa*. Volunteers include both student groups as well as other community members. Large work groups range from 50-70 people and are conducted on a regular basis. During the 2010 Hawaiʻi public school spring break week, 200 students did volunteer work days in Waiheʻe. During the summer of 2010, KEY Project hosted students from Kamehameha Schools' Extension Education Program and utilized the *ahupuaʻa* as an "outdoor classroom." Much of the volunteer efforts are focused on removing large bulky items and invasive plant species along the access road to the upper valley.

Pilot Native Plant Nursery. A portion of the $40,000 HTA grant that was mentioned previously was used to fund a small pilot native plant nursery at KEY Project. The plant nursery is located on the *mauka* side of the KEY Project building and will be used to provide educational opportunities as well as grow native plant seedlings.

Future WAI Plans and Cost Estimates

Vegetative Cover Mapping. To better understand the resources of the *ahupuaʻa*, maps that illustrate the vegetative cover of the *ahupuaʻa* need to be developed, especially in the riparian zone along the Waiheʻe Stream. Vegetative cover mapping along with stream data could be used to better understand the relationship between stream flow/water temperature and vegetative cover. The vegetative cover mapping project should take into consideration the data collected by 2007 BWS botanical survey of accessible areas in Waiheʻe. **Cost Estimate:** $5,000 to $10,000.

Waiheʻe Ahupuaʻa Strategic Plan. The 2003 MOU specified the development of a strategic plan for the WAI. The development of a strategic plan would benefit the long-term management of the *ahupuaʻa* by outlining steps that need to be taken for better water resources management, development/restoration of cultural, environmental, and educational resources and opportunities for sustainable community-based economic development. The plan would also identify additional partnerships that may be needed to support the goals of the WAI. **Cost Estimate:** $20,000 to $30,000.

Water Resources Information Room. KEY Project would like to convert one of its classrooms into a community repository for water resources information. The repository would include large informational maps of the area's water resources as well as various water resources reports, plans, and legal decisions. Community members could access the room on a regular basis. **Cost Estimate:** $2,000 to $5,000.

Waiheʻe Access Improvements. Hundreds of users enter the mauka areas of Waiheʻe on a monthly basis. The Department of Parks and Recreation owns the gate that allows access to the upper watershed area, including access to BWS Waiheʻe lands. This project would need to resolve public access issues such as public safety and liability between the BWS, DPR, and other WAI partners. An internal agreement pertaining to access should be created between the two agencies. WAI partners would also like to erect educational "Welcome to the *Ahupuaʻa*" signage near the gate entrance. The signage would include information about the importance of the Waiheʻe *ahupuaʻa* and how users should interact with those resources in a non-detrimental way. The sign could also explicitly state non-permitted activities that would be harmful to the watershed. **Cost Estimates:** Interpretive Signage $1,000 to $3,500; Access Agreements staff time.

KEY Project Demonstration Rain Catchment System. Also commonly known as "rain harvesting," a rain catchment system is used to collect and store water from rainfall for various types of future use. KEY Project would install a rain catchment system that could provide water for non-potable uses. Basic components of a rain catchment system for non-potable water uses would include: a **catchment area** (usually the roof of a building or paved terrace) to collect water, **filters** to prevent the passage of debris from entering the c**onveyance system** (gutters or leaders), and **storage** (usually rain barrels). In addition to reducing KEY Project's potable water use, the rain catchment system would be utilized as a demonstration project to educate and encourage community members about the economic and environmental benefits of utilizing this particular water conservation method. **Cost Estimate:** $1,500.

Riparian Zone Outdoor Learning Center. WAI partners have envisioned a Riparian Zone Outdoor Learning Center in the *mauka* area of Waiheʻe. Preliminary ideas for the learning center would have an *ʻauwai* that flows through the site to irrigate *loʻi kalo* as well as other diversified crops. Various other outdoor learning spaces and a green house for native plants are also envisioned. The preliminary site chosen for the Riparian Zone Outdoor Learning Center is on Department of Parks and Recreation land. An agreement with Parks and Recreation needs to be worked out to use that site. A site plan which includes a comprehensive site analysis and detailed program for the Riparian Zone Learning Center needs to be developed as well. **Cost Estimates:** Site Plan $50k - $100k; Permitting $25k-$50k; Design Work $50k - $100k; Construction $500k - $1M

References: WAI 2003 Memorandum of Understanding; WAI meeting minutes 2006-2009.; Personal communications with KEY Project

PROJECT #14 : Hakipuʻu Learning Center

Project Location: Haiku, Hakipuʻu, Kualoa

Project Champion: Hakipuʻu Learning Center (HLC)

Project Partners: WCC, DPR (Kualoa Regional Park), Kamehameha Schools, OHA, Harold K.L. Castle Foundation., Kualoa Ranch, DAR, NOAA, DOH, PAF, HIMB,

Project Background: Hakipuʻu and Kualoa *ahupuaʻa* were traditionally known as places of learning and leadership training. Hakipuʻu was a place given to *kāhuna*. Kualoa to the north of Hakipuʻu was known as an *aliʻi* training area and a *puʻuhonua*. Traditional voyaging and celestial navigation training also took place at Kualoa. In honor of Kahaʻi, one of the accomplished voyagers from Hakipuʻu who is credited with bringing the *ulu* to Hawaiʻi (Hakipuʻu in particular), even Kamehameha would lower his sails as he passed by Hakipuʻu and Kualoa. In modern times, the voyaging canoe Hokuleʻa launched its maiden voyage from Kualoa Beach in 1976 and has returned to Hakipuʻu from many of her key voyages. The Mōliʻi Fishpond in Hakipuʻu is the last fishpond to be in continuous commercial operation from pre-contact to contemporary times. It was still utilized for aquaculture up until the 1990s before it fell into disrepair and now is used primarily for commercial tours and activities not related to its traditional design and purpose.

In the late 1970s, several Hakipuʻu families organized to restore *loʻi* in Hakipuʻu. However, there was insufficient stream flow in Hakipuʻu Stream to restore *loʻi* and the community found that, despite relatively consistent rainfall, the stream level had significantly decreased from traditional flows. For the first time in the community's memory, the stream would cease to flow for weeks and even months at a time. Kualoa Ranch, a major land owner in the *ahupuaʻa*, had diverted the stream flow out of the *ahupuaʻa* for its ranching operations. This led to disagreements between the land owner and Hakipuʻu families over water availability in the *ahupuaʻa*. While all of the disagreements have not been resolved

Children learn to plant kalo at Hakipuʻu Learning Center between the ranch and the families, there has been more collaboration between the ranch and the families of Hakipuʻu since the 1980s with the establishment of the State Water Commission.

Since the late 1990s, both the Hakipuʻu families and Kualoa Ranch have explored the possibility of establishing Hakipuʻu as a land trust for natural and cultural resource management and education programs. The discussions between the ranch and the families are still on-going. In part, from these discussions, Hakipuʻu families came to the realization that there was a large need for more "project-based" learning programs related to natural and cultural resource stewardship that recognized the unique history of the area as well as programs that help to address current resource management issues. Project-based learning encourages students "to-do" natural and cultural resource management projects rather than only learning "about" natural and cultural resources. Project-based education recognizes that education and learning goes hand and hand with "doing."

Rather than simply offering one-time field trip experiences for students, Hakipuʻu families envisioned creating a full time educational program for students. In 1999, an opportunity presented itself to create a full time project-based educational program when the Legislature amended the charter school law through Act 62 to allow new start-up charter schools. In 2001, the Hakipuʻu and Koʻolau communities applied for and received a charter. In September of 2001, the Hakipuʻu Learning Center (HLC) opened its doors for the first time.

During its first academic year, HLC had an enrollment of 39 students in grades 7 and 8. Since 2001, HLC has expanded to grade levels 5-12 and has had annual enrollments of 70-80 students and celebrated its fifth high school graduating class in SY 2009-10. HLC has become 1 of 5 schools in the nation that has been recognized for its "visionary project based learning" by EdVisions Schools. The HLC main campus is located near the Windward Community College Campus. HLC also has a *mauka* educational site in Haʻikū, Heʻeia and a *makai* site that encompasses portions of Hakipuʻu and Kualoa.

KPWMP Objectives Project Addresses:

- Objective #1: Promote sustainable watersheds
- Objective #2: Protect and enhance water quality and quantity
- Objective #3: Protect Native Hawaiian rights and traditional customary practices
- Objective #4: Facilitate public participation, education, and project implementation

Project Goals:

- Become a "*piko*" of educational knowledge that radiates out to Koʻolau Poko, Oʻahu, and beyond.
- Plant the seeds of knowledge in future generations to solve current and future natural and cultural resource management issues.
- Provide students with opportunities to contribute to finding solutions to real world challenges.
- Empower students to be individual stewards of their community's natural and cultural resources.
- Reinvest all income derived from local resources and opportunities back into the place and local community

Project Desired Outcomes:

- A preschool through post-high school program has been developed and implemented.
- Educational opportunities for entire families are provided.
- Students have gained "real world" knowledge about project management related to environmental and cultural advocacy through engaging in "real world" practices.
- Learners are prepared for success in the 21st century
- A voyaging center near Hakipuʻu and Kualoa has been established.

Project Status: A significant amount of HLC's current educational activities is located at its two "Moʻomona" outdoor laboratories. HLC created the term "Moʻomona" because the term reflects Kāneʻohe Bay's history of abundance. (The word *momona* is used to describe lands that are "fat", "rich", and "abundant" in resources. The word *moʻo* refers to both the ongoing lineage of people and place and the *aumakua* that were guardians of Kāneʻohe Bay as well as guardians of fresh water.) HLC has a *mauka* Moʻomona lab in Haʻikū and a *makai* Moʻomona lab that encompasses coastal areas in both Hakipuʻu and Kualoa. While there are two separate locations for these labs, students are taught to view each environment (*mauka* and *makai*) as a single connected, interrelated environment rather than two separate environments. The programs at the *mauka* Moʻomona lab include lessons and projects related to wetland *kalo* cultivation as well as native forest restoration.

Programs at the *makai* Moʻomona lab include ocean programs that are related to water management and contributing to healthy marine ecosystems. In recent years, Kualoa Regional Park was closed to the public due to water pollution originally attributed to the wastewater system of the park. HLC decided to integrate learning with actual water quality sampling and monitoring. HLC students received training on how to monitor water quality. Students conducted weekly water quality monitoring and shared those results with the Park and the DOH. Future activities that HLC would like to pursue at the *makai* Moʻomona lab include partnering with DAR, NOAA, TNC, HIMB, community practitioners, and others to conduct coral reef monitoring in near shore waters off of Hakipuʻu and Kualoa and help with overall fisheries management. HLC is also seeking to create partnerships with DAR and NOAA in order to develop a fish catch data collection program for Kāneʻohe Bay. Students would collect data on style of fishing, catch sizes, what types of fish are being caught, and why fishes are being caught (i.e. commercial, subsistence, or recreation). In the future, HLC would also like to work with the Polynesian Voyaging Society and DPR to develop a voyaging educational center near Kualoa Regional Beach Park and Hakipuʻu.

Other activities that HLC is currently involved with include native species propagation and invasive species eradication on Mokoliʻi island and throughout the nearshore area. In particular, ants have been disturbing wetland birds when the birds nest. HLC has also been planting *kalo* in the wetland area *mauka* of Mōliʻi Fishpond. The school also hosts regular family and community educational camps.

Reference: Personal communications with Hakipuʻu Learning Center and May 2010 "Hakipuʻu Learning Center News Letter."

PROJECT #15: He'eia Stream Restoration Project

Project Location: Ha'iku and He'eia

Project Champions: Hui o Ko'olaupoko, Hui Ku Maoli Ola Native Plant Nursery, Hawai'i Pacific University;
Project Partners: Kamehameha Schools, DOH Clean Water Branch, U.S. Environmental Protection Agency

Project Background: Recent water quality monitoring of He'eia Stream has shown elevated levels of nitrates and nitrites, possibly from excessive fertilizer and pesticide use, and high turbidity due to stream bank erosion and a dominance of non-native vegetation. The He'eia Stream Restoration Project will address these issues by restoring sections of the stream banks and nearby forest with native vegetation, installing erosion control material and conducting workshops to educate area residents about proper fertilizer and pesticide use and education about useful native plants.

KPWMP Objectives Project Addresses:
- Objective #2: Protect and enhance water quality and quantity
- Objective #4: Facilitate public participation, education, and project implementation

Volunteers working on the restoration project

Project Goals:

- Improve the water quality of He'eia Stream
- Provide educational opportunities

Project Desired Outcomes:

- 2,000 linear feet of stream bank restored with 9,000 native plants
- 400 linear feet of soft bio-engineering structures installed
- 2,000 volunteer hours participating in native vegetation planting
- 50 resident/homeowners participating in fertilizer and pesticide workshop
- At a minimum, 400 volunteers will have hands-on education throughout the process

Project Status: In January of 2010, the first volunteer workday was conducted at He'eia Stream. In the early stages, workdays will focus on native Hawaiian plant identification and propagation and also clearing invasive plant species along the stream areas. Volunteers will help to grow all of the native plants that will be out-planted into these cleared areas in later project phases. The project is focusing on clearing non-native vegetation in small sections, installing erosion control then planting with native plants before moving to the next area. The restoration of the stream banks is expected to be completed in 2011.

Reference: Retrieved online at http://www.huihawaii.org/ February 25, 2010. Personal communications with Hui o Ko'olaupoko

PROJECT #16: Papahana Kuaola

Project Location: Heʻeia

Project Champion: Papahana Kuaola

Project Partners: Hui Ku Maoli Ola Native Plant Nursery, Kamehameha Schools, Paepae O Heʻeia

Project Background: Papahana Kuaola is a multi-faceted, 501(c) (3) non-profit organization founded to provide community education programs that are fully integrated with traditional Hawaiian knowledge. The program was founded in 2005. Papahana Kuaola's programs have focused on environmental restoration and economic sustainability and have provided opportunities for program participants to actively connect and re-connect in regard to their relationships and *kuleana* (responsibility) to *akua* (God), *ʻāina* (land), *kai* (sea), and each other. Papahana Kuaola is based on a 63 acre parcel of land owned by the Kamehameha Schools as well as a 2 acre *kuleana* parcel owned by a private land owner. The organization provides educational services and programs on the island of Molokaʻi as well.

KPWMP Objectives Project Addresses:

- Objective #1: Promote sustainable watersheds
- Objective #2: Protect and enhance water quality and quantity
- Objective #3: Protect Native Hawaiian rights and traditional customary practices
- Objective #4: Facilitate public participation, education, and project implementation

Loʻi at the Papahana Kuaola site

Project Goals:

- Restore relevant aspects of the *kauhale* system of human and natural resource management and use this model in the development of curricula and the implementation of educational programs.
- Take the lessons of Papahana Kuaola to the wider community, with emphasis on restoration projects that improve ecological, cultural, and physical health and well-being.
- Produce and implement educational programs and curricula that emphasize modern issues and problem-solving skills through Hawaiian knowledge.
- Provide a model of innovative economic development that is environmentally sustainable and culturally minded.

Project Desired Outcomes:

- Additional acreages of invasive plants have been removed and replaced with native plant species
- Additional acreages of *lo'i kalo* have been restored
- Additional acreages of other appropriate food crops have been cultivated
- The number of participants in its educational programs has increased
- Cultural resources on the project site and surrounding site have been properly cared for
- Papahana Kuaola revenue from its Hanaloa programs has increased

Project Status: Papahana Kuaola has several on-going projects and programs:

'Ili'ilikauhale – This program is Papahana Kuaola's base project. It is the *piko* (core, center) of its educational and community programming, administration center, a test site for economic sustainability projects, and the future site of a *kauhale* (house, building). *Mālāma* (care) of special places and spiritually significant sites in the *ili* (land section, smaller than an *ahupua'a*) of Waipao are on-going with *kokua* (assistance) from community volunteers, interns, and partners. Among its current projects is the construction of a *kahua* (open space) to support the practice of *hula* and native species, and perpetuate Hawaiian varieties of various "canoe plants." These gardens and the neighboring Native Hawaiian plant nursery, Hui Kū Maoli Ola, provide an excellent outdoor classroom and multitude of learning opportunities.

'Ili'ilikauhale's educational programs are as varied as the ages and types of groups served. Programs, activities, and workshops are designed to engage preschool, elementary, high school, college students, and adults. Target audiences include: Native Hawaiian students, families, cultural groups, community organizations, and other Hawai'i residents.

Lelekamanu – Lelekamanu is Papahana Kuaola's outreach education program and it has staff members on the islands of O'ahu and Moloka'i. This program's services are available to public, private, charter and home school environments. On O'ahu, *nā papa* and *nā* *huaka'i* (classes and field trips) have been developed to serve elementary school students and teachers, and are aligned to 3rd and 4th grade level Hawai'i Content and Performance Standards III. Interested teachers at other grade levels are welcome to apply. Lelekamanu programs on Moloka'i differ slightly in that services are offered in response to specific community requests and needs, and are not limited by grade level or age.

Hanaola – The Hanaola program is a sustainable economic development program. Its aim is to reach a broad market with unique products while providing Hawai'i's economy with much needed diversification. The program will serve as a model of innovative economic development that is environmentally sustainable and culturally-minded. In the long-term, Papahana Kuaola would like the Hanaola program to economically sustain its other program operations. Some of the products Papahana Kuaola would like to develop include: 1) herbal teas from Hawaiian plants such as *ko'oko'olau*, *makaki*, *liko*, *lehua*, *'uhaloa*, and *'awa*; 2) market bound produce and greenery including *hō'i'o* fern shoots, *'inamona*, breadfruit, *kalo,* bananas, ferns, *liko*, and flowers for lei; 3) team building retreats that could be marketed to corporations locally and internationally as a means of fostering unity and a cooperative spirit through culture and service focused activities.

Kupualau – Focusing on curricula and program development, the Kupualau program will apply traditional Hawaiian knowledge to modern issues and problem-solving in order to achieve a healthy and well-educated Hawai'i. Curriculum development is key to the educational experience. Papahana Kuaola has established general educational goals that are age specific and cater to a variety of contact situations including intensive daily contact over a short period of time, once a week involvement, monthly workdays and one-time fieldtrips. As part of the Kupualau Program, Papahana Kuaola hopes to move forward with the following programs: a university level internship program, speaker discussion series, provide a setting for visiting artists to practice and gather natural materials, and provide *hula* facilities.

Reference: 2005 Papahana Kuaola Strategic Plan; Personal communications with Papahana Kuaola

PROJECT #17: Māhuahua ʻAi o Hoi (Heʻeia Wetland Restoration)
(Catalyst Project)

Project Location: Heʻeia

Project Champion: Kākoʻo ʻŌiwi

Project Partners: Many partners including Koʻolaupoko Hawaiian Civic Club, The Nature Conservancy, Hawaiʻi Community Development Authority (HCDA), U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration

Project Background: The Heʻeia Wetlands, once a major food producing area, has become overgrown with invasive plants which reduce the amount of fresh water flow into Heʻeia Fishpond and Kāneʻohe Bay and also reduce the amount of suitable habitat area for native wetland species. The 420-acre property, located in the Heʻeia Watershed in Kāneʻohe, is currently under the ownership of the Hawaiʻi Community Development Authority (HCDA). The community-based non-profit organization Kākoʻo ʻŌiwi recently negotiated a 38-year lease with HCDA for the planning and restoration of these lands.

KPWMP Objectives Project Addresses:
- Objective #1: Promote sustainable watersheds
- Objective #2: Protect and enhance water quality and quantity
- Objective #3: Protect Native Hawaiian rights and traditional customary practices
- Objective #4: Facilitate public participation, education, and project implementation

Project Goals:
- Restore the cultural connection between Heʻeia ahupuaʻa and the community.
- Restore the native wetland ecosystem and extensive *loʻi kalo*.
- Develop new farm-to-market strategies for local food crops.
- Provide economic sustainability for the communities of Koʻolau Poko.


He'eia
State Park
Ko'olau
Center
He'eia Fishpond
S.W. King
Intermediate
School
Legend
He'eia Stream
Hoi Project Area
Māhuahua ʻAi o Hoi
Hoi (Heʻeia Wetland), Koʻolaupoko, Oʻahu
April 2010
Feet
0 500 1,000 1,500 2,000
N

Project Desired Outcomes:
- A land management program to restore 70% or more of the property into organic *kalo* fields and sustainable food crops has been established.
- Stream channels are regularly maintained to reduce flooding.
- Native wetland flora and fauna are restored.
- Place-based educational programs related to Hawaiian farming practices and customs are in place.
- A community gathering place for learning, celebration, and healing is established.
- A research program to study and document how traditional Hawaiian loʻi and fishpond aquaculture benefit the Kāneʻohe Bay ecosystem (flood mitigation, run-off mitigation, habitat re-creation for native wetland species and mitigation of climate change effects) is established.

Project Status: In 2010, Kākoʻo ʻŌiwi signed a 38 year long-term lease agreement with HCDA to restore the wetland and to cultivate agricultural products. A site of about one acre has been cleared and is being used as a demonstration site for wetland *kalo* cultivation. Since June of 2009, monthly community work days at this demonstration site have been organized. Kākoʻo ʻŌiwi has secured funding from the State Coastal Zone Management Program to develop a strategic plan for this project. The strategic plan was completed in August of 2010.

Future Near-Term Plans (1-5 years):

Create and foster partnerships. Kākoʻo ʻŌiwi will seek to partner with the community to develop support for the project and to ensure that the needs of the community are met. The group will also partner with researchers and regulatory agencies to gather needed data to design and evaluate an efficient, effective project that can receive the required approvals and permits in a timely manner.

Planning and Permitting. Kākoʻo ʻŌiwi will develop a master plan that presents the long-range vision for the project and describes the process for implementation. They will also complete all of the necessary Federal, State, and City and County permits that are required for the project to move forward.

Continue and Expand Demonstration Projects. Kākoʻo ʻŌiwi will continue with its current demonstration project and monthly workdays, and will expand these programs in the future. Possible expansion of demonstration projects include the creation of a 20-acre *loʻi* complex, the planting of 10-acres of dry land crops (*ʻulu, ʻuala,* and *awa*), and the creation of educational programs that involve local schools.

Stewardship Projects. Kākoʻo ʻŌiwi will pursue projects that will increase its ability to properly manage and care for the Heʻeia Wetland. They plan to construct a temporary on-site caretaker's facility to provide immediate security for the property. The caretaker's facility would also serve as a temporary base of operations and provide storage for equipment. They plan to eventually construct an on-site office to serve as a permanent base of operations for program coordination. Kākoʻo ʻŌiwi will also develop and implement protocols for access and use of the property that protect health and safety, community investments in the property, neighboring land owners' privacy and security, and are respectful of the land. As part of its stewardship efforts, Kākoʻo ʻŌiwi will also seek to secure financial resources for the project's on-going operational expenses and future plan implementation.

Reference: Various personal communications with Kākoʻo ʻŌiwi 2009-2010; Strategic Plan.

PROJECT #18: Management and Stewardship of Heʻeia Fishpond

Project Location: Heʻeia

Project Champion: Paepae o Heʻeia

Project Partners: Kamehameha Schools, Papahana Kuaola

Project Background: One of the few remaining fishponds in Kāneʻohe Bay, the Heʻeia Fishpond was once a very productive source of food for Koʻolau Poko. However, over the course of the 20th Century as development and human activities changed the surrounding landscape, the fishpond fell into a state of disrepair and is now no longer fully functional. Heʻeia Fishpond restoration work began during the late 1990s. The restoration work was mostly done by volunteers. In 2001, the non-profit 501(c)3 entity "Paepae o Heʻeia" was formed. Since then, Paepae o Heʻeia has been working with fishpond owner Kamehameha Schools on management and stewardship of the fishpond.

KPWMP Objectives Project Addresses:
- Objective #1: Promote sustainable watersheds
- Objective #3: Protect Native Hawaiian rights and traditional customary practices
- Objective #4: Facilitate public participation, education, and project implementation

Aerial View of Heʻeia Fishpond

Project Goals:

- Foster values and concepts of traditional fishpond management.
- Restore the *kuapā* (fishpond wall) in order to preserve the integrity of the fishpond
- Engage participants, pre-school thru *kūpuna* (elders), in culturally relevant and academically rigorous studies aimed at bridging traditional and contemporary knowledge systems.
- Develop the knowledge necessary to manage He'eia Fishpond in a sustainable manner.

Project Desired Outcomes:

- The *kuapā* is completely restored.
- The He'eia Fishpond has become a fully functional fishpond.
- Education program participants have gained a deeper understanding of traditional and contemporary knowledge systems from their time spent at the fishpond.
- Paepae o He'eia programs have become more self-sufficient through its community based economic development activities.

Project Status: Paepae o He'eia has three active primary programs.

Kū Hou Kuapā (Let the Wall Rise Again) – This program focuses on the physical maintenance and revitalization of He'eia Fishpond in order to preserve this culturally significant site. *Kū Hou Kuapā* utilizes community workdays and volunteers to help restore the wall. It is estimated that in two years time, the original inhabitants of the He'eia Ahupua'a were able to construct this 1.3 mile fishpond wall completely encircling an 88-acre brackish water environment. Mangrove has been removed from several sections of the wall, but there are several significant sections along the wall where mangrove remains. The fishpond cannot be fully functional until the entire wall is repaired. Repairs to a portion of the wall have been stalled because permits are required to complete the repair work.

'Āina Momona (Land of Abundance and Plenty) – This program is a community-based economic development program focused on creating and highlighting various products and services from the fishpond and making them available to local residents and stakeholders. Paepae o He'eia sells or gives away a variety of products associated with the fishpond including fish (current annual *moi* harvest is about 700 pounds), *limu* (*Gracilaria salicornia*), and mangrove wood and mangrove seedlings.

Ka'ai Kamaha'o (The Sustenance of the Land) – This program utilizes He'eia Fishpond as an outdoor classroom and includes various eco-cultural education projects consisting of *'ike 'āina*, *mālāma* applied stewardship, and ecological based studies that foster values and concepts of traditional fishpond management. The projects engage participants, pre-school thru *kūpuna*, in culturally relevant and academically rigorous studies aimed at bridging traditional and contemporary knowledge systems. Three charter schools utilize the fishpond as an outdoor classroom: 1) Hālau Kū Mana 2) Hakipuʻu Learning Center 3) Samuel Kamakau Charter School. In addition to the charter schools, students in Kamehameha Schools' programs utilize the fishpond for educational activities. College students and researchers also utilize the fishpond as a laboratory. About 3,000 people visit the pond per year, the majority of whom are students. Researchers and scientists have also utilized the pond as an outdoor laboratory. Six previous research projects as well as six on-going research projects have been conducted at Heʻeia Fishpond.

In addition, POH has partnered with Papahana Kuaola to offer educational opportunities through the Heʻeia Ahupuaʻa Internship Project. Participants have spent the majority of their time at two sites: Heʻeia Fishpond and Waipao (Heʻeia Mauka). Interns learn about *mauka*/*makai* ahupuaʻa relationships by working at the two sites. The Heʻeia Ahupuaʻa Internship Project began in 2008. To date, the internship program has had 36 interns. Funding for the Heʻeia Ahupuaʻa Internship Project is made possible through a grant sponsored by the Harold K.L. Castle Foundation, the Hawaiʻi Community Foundation's Youth Matters Initiative, and Kamehameha Schools.

Reference: Personal communications with Paepae o Heʻeia and the website: http://www.paepaeoheeia.org/

PROJECT #19: Hydro-Modification Device Installation in Kahuhipa Street Storm Drain

Project Location: Kāneʻohe

Project Champion: Hui o Koʻolaupoko

Project Partners: City and County Department of Environmental Services, Oʻahu Metropolitan Planning Organization, University of Hawaiʻi

Project Background: Several light industrial businesses are located along Kahuhipa Street in Kāneʻohe, including auto repair and auto body shops. These light industrial activities as well as daily vehicular traffic on Kahuhipa Street may unintentionally deposit pollutants that find their way into storm drains that empty into Keaʻahala Stream. The Keaʻahala Stream is on the State Department of Health 303(d) "Impaired Water Bodies" list, although the amount of pollutants found in the stream only warrants a low priority for a TMDL study. In 2009, Hui o Koʻolaupoko received a contract from the City and County Department of Environmental Services for design work and funding from the Oʻahu Metropolitan Planning Organization to install a hydro-modification device in a Kahuhipa Street storm drain near the Keaʻahala Stream. The hydro-modification device is designed to filter out pollutants from run-off that enters the storm drain, thus preventing pollutants from entering Keaʻahala Stream.

KPWMP Objectives Project Addresses:
- Objective #2: Protect and enhance water quality and quantity

Project Goals:
- Improve the water quality of Keaʻahala Stream
- Conduct pre and post project water quality monitoring

Project Desired Outcomes:
- The effectiveness of retrofitting hydro-modification devices into urban areas to improve water quality by trapping pollutants has been measured and determined

Kahuhipa Street storm drain

- Successful results from this project can provide an impetus to install additional hydro-modification devices in other areas of the district
- Water quality of Keaʻahala Stream has been improved

Project Status: As of March 2010, the City and County of Honolulu was working through the NEPA process of the Federal Highway Transportation Funds (via OMPO) and the final designs were being reviewed by the various participants. Project construction is expected to start in Fall 2010.

References: Personal communications with Hui o Koʻolaupoko

PROJECT #20: Hālawa-Luluku Interpretive Development

Project Location: Luluku

Project Champions: Hālawa-Luluku Interpretive Development LLC (HLID), Office of Hawaiian Affairs (OHA), Hawai'i State Department of Transportation (HDOT), Federal Highway Administration (FHWA)

Project Background: In 1987, the FHWA, State Historic Preservation Division (SHPD), and the Advisory Council on Historic Preservation (ACHP), with concurrence by OHA and the HDOT, executed a Memorandum of Agreement (MOA) to mitigate adverse impacts resulting from the construction of the H-3 Highway. In 1999, the H-3 Cooperative Agreement was signed between the HDOT and OHA to undertake a project that would preserve and interpret the cultural resources located from North Hālawa Valley to the ili of Luluku in Kāne'ohe. Funds amounting to $11 million were set aside for this project. In 2000, the Hālawa-Luluku Interpretive Development (HLID) Project commenced with the hiring of a Project Coordinator under the auspices of OHA. As a result, the Luluku Agricultural Terraces, one of four HLID focus areas, will be restored through the perpetuation of culturally appropriate science, engineering, and agricultural practices.

KPWMP Objectives Project Addresses:

- Objective #1: Promote sustainable watersheds
- Objective #2: Protect and enhance water quality and quantity
- Objective #3: Protect Native Hawaiian rights and traditional customary practices
- Objective #4: Facilitate public participation, education, and project implementation

Project Goals:

- **"Healing of the 'Āina"** – Implement to: a) preserve cultural and historic sites through site stabilization; b) implement preservation and restoration plans to protect existing resources by designating kapu areas; c) communicate the significance of the cultural landscape and features through an interpretive program.

Part of the Luluku Agricultural Terrace

- **Sustainability** – Establish and utilize sustainable practices that demonstrate how the host Hawaiian culture cares for the land.
- **Access** – Develop facilities and implement programs and strategies that provide access for individuals' (and groups') pursuit of traditional Hawaiian cultural practices.

- **Natural/Ecological Resources** – Implement actions that promote ecological balance of the environment and perpetuate both the knowledge and practice of Native Hawaiian culture.
- **Education Programs** – Develop educational programs, materials, and facilities to interpret the historic and cultural resources of the project area to a wider audience by reconnecting the people with the *ʻāina*.
- **Recreational Programs** – Identify and develop culturally sensitive outdoor recreational pursuits which promote sharing the *ʻāina* and complement Hawaiian history, culture and the traditions of these lands and people.
- **Fiscal Responsibility** – Ensure fiscal responsibility with project funds. Procure resources in a prudent manner. Establish a sound accountability system with checks and balances.
- **Communication** – Establish channels of communication that help build positive relationships.

Project Desired Outcomes:

- Completion of the "Plan to Plan" document -- a document which describes the process that HLID will utilize in the development of its Interpretive Development Plan.
- Completion of the Strategic Plan document – a document that interprets cultural landscapes and identifies mitigation actions.
- Completion of the Interpretive Development Plan – a document that represents the culmination of several years of research, dialog and planning to arrive at a plan for the mitigation of impacts that resulted from construction of the Interstate H-3; this is a guide for the implementation of mitigation measures proposed by the public as interpreted by the project's Working Group.
- Completion of Phase II – Design and Development. The developed concepts of Phase II have been constructed and are used by stewarding organizations.

Project Status: As of February 2010, HLID was in the process of transitioning into the Design and Development phase (Phase 2) from the Plan phase (Phase 1) which included approval of the HLID Strategic Plan in January 2006 and approval of the Interpretive Development Plan (IDP) in May 2009. This transition includes ensuring that HLID staff capacities and resources are adequate and sufficient for Phase 2 and Phase 3 (Implementation phase). Additionally, procurement and coordination of the architectural and engineering team will commence, enabling the team to develop IDP concepts and HDOT approved projects. Support processes like permit applications, government approval meetings and other pre-construction processes will also be timed appropriately throughout Phase 2.

Reference: Various personal communications with Hālawa-Luluku Interpretive Development and website: http://www.hlid.org/goals.html

PROJECT #21: Management and Stewardship of Waikalua Loko Fishpond

Project Location: Kāneʻohe

Project Champion: Waikalua Loko Fishpond Preservation Society (WLFPS)

Project Partners: Pacific American Foundation (PAF), Windward Community College, UH Sea Grant, Bay View Golf Course, Hawaii Institute of Marine Biology, U.S. Fish and Wildlife Service (USFWS), U.S. Department of Housing & Urban Development (HUD), Hawaii Department of Education, Kamehameha Schools, Minami Foundation, Atherton Foundation, U.S. Department of Education, Kokokahi YWCA.

Project Background: Urban development during the 20th Century has either destroyed or severely degraded the numerous fishponds that once existed in Kāneʻohe Bay. Waikalua Loko Fishpond is one of the few remaining fishponds in Kāneʻohe Bay. It is located on the southern shore of the Bay, situated between two streams (Kāneʻohe and Kawa Streams) that drain more than 5,000 acres of urbanized land extending from the Koʻolau Mountain Range to the sea. Historical information indicates that this fishpond has been in existence for at least 350 years. In 1995, The WLFPS was founded to manage and implement a preservation plan for the Waikalua Loko Fishpond. Former owners of the Bay View Golf Course in partnership with community members played a major role in the formation of the WLFPS.

KPWMP Objectives Project Addresses:

- Objective #1: Promote sustainable watersheds
- Objective #3: Protect Native Hawaiian rights and traditional customary practices
- Objective #4: Facilitate public participation, education, and project implementation

Waikalua Loko Pond

Project Goals:

- Preserve, stabilize, and beautify the Waikalua Loko Fishpond
- Educate the Windward Oʻahu Community about ancient Hawaiian and modern Hawaiian fishpond practices
- Provide an educational resource to be made available for use by educational institutions and community organizations with respect to ancient and modern Hawaiian fishpond practices.

Project Desired Outcomes:

- The preservation and restoration of the Waikalua Loko Fishpond has been active since 1995 with increasing community participation.
- The fishpond has become one of the principal training sites for a new culture-based education model to train teachers and students in math, science, language arts and social studies in the context of the pond and its surrounding environment.
- Stewardship of the pond combined with traditional and western knowledge has created opportunities to develop new culture-based K to 12 curricula, mentoring and leadership programs, career planning and development and research utilizing both ancient and modern techniques toward 21st century sustainability models.

Project Status: The WLFPS has been conducting periodic community work days at the fishpond for over 15 years. Community workdays involve activities such as mangrove clearing and replanting of native plant species. Currently, there are five community workdays each year at the pond that are open to the public. In addition, both public and private schools conduct field classrooms at the pond weekly to implement the curricula developed for the site and surrounding *ahupuaʻa*. Nearly 5,000 students visit the pond each year to supplement their learning in class.

In December 2007, the Pacific American Foundation received a "partners in education" award from the Hawaiʻi Department of Education for its Kahea Loko and Aloha ʻAina curriculum projects based on the Waikalua Loko Fishpond and Kāneʻohe *ahupuaʻa*. PAF has trained over 1,200 teachers statewide in culturally-based curricula. (See Hawaiʻi digital Library – ulukau.org)

In 2009, WCC, in partnership with PAF and HIMB, received an $800k federal grant from the U.S. Department of Housing and Urban Development to help preserve the pond and support the education and enrichment programs that are related to the pond.

The WLFPS, WCC, and PAF have been working together to purchase the fishpond from Bay View Golf Course and the group hopes to gain title to the pond within the next year. Three-fourths of the grant is set aside for the purchase of the pond and the remaining fourth to continue support of programs for three years. The group has also expressed interest in acquiring the dog park area that is adjacent to the fishpond parcel from Bay View Golf

Course. The dog park area would be integrated with the fishpond parcel and together both parcels would be utilized as an educational learning complex.

References: Personal correspondences with the PAF; November 11, 2009 **Midweek** article "Money Flowing into Waikalua Loko Fishpond 'University'";
Website: http://www.waikalualokofishpond.org/

PROJECT #22: Kokokahi Cultural Learning Center

Project Location: Kāneʻohe

Project Champions: Waikalua Loko Fishpond Preservation Society, Pacific American Foundation, Ke Kula ʻO Samuel Kamakau Hawaiian Charter School, Halau Mohala Ilima, Kokokahi YWCA, Punana Leo Hawaiian Language School.

Project Background: The Kokokahi YWCA in Kāneʻohe is an 11 acre property situated on the southern shoreline of Kāneʻohe Bay. Several Hawaiian cultural organizations and schools utilize the facilities of the Kokokahi YWCA campus on a regular basis. The campus of the Ke Kula ʻO Samuel M. Kamakau Charter School is located on the YWCA campus and Hula Halau Mohala Ilima holds its practices at the YWCA as well. The YWCA campus also shares a common border with the Waikalua Loko Fishpond property. The Waikalua Fishpond hosts a variety of culturally based education activities and programs (See Project #20). These various Kokokahi groups have envisioned a cultural learning center on the Kokokahi YWCA property where students and practitioners can come together and share knowledge.

KPWMP Objectives Project Addresses:

- Objective #3: Protect Native Hawaiian rights and traditional customary practices
- Objective #4: Facilitate public participation, education, and project implementation

Project Goal:

- Create a hub of cultural awareness, learning, and collaboration for all cultures on the Windward side.

View toward the ocean from the Kokokahi YWCA

Project Desired Outcomes:

- The Kokokahi Cultural Learning center has become one of the premiere centers of cultural knowledge on the windward side.
- Appropriate facilities for the learning center have been developed.
- Cultural knowledge is shared with those who have an interest in the culture.

Project Status: The idea originated out of a mutual interest by the YWCA and the Waikalua Loko Fishpond Preservation Society to collaborate in a creative way to maximize learning opportunities for the community. Approximately five years ago the YWCA engaged with the Samuel Kamakau Hawaiian Charter School, Punana Leo Hawaiian language school and Halau Mohala Ilima to begin the transition toward an active cultural learning center. On the Waikalua Loko side, the Society, the Pacific American Foundation, Windward Community College and the Hawai'i Institute of Marine Biology in partnership, received a HUD grant to acquire the Waikalua Loko fishpond in September 2009 and continue the development of education and career related programs at the site. Once the pond is acquired, it will provide an opportunity for further collaboration between the Kokokahi Cultural Learning Center and the Waikalua Loko partners to broaden and connect to other natural and cultural resources of Windward O'ahu and beyond.

References: Personal correspondences with Herb Lee, Pacific American Foundation Executive Director and Waikalua Loko Fishpond Preservation Society board member.

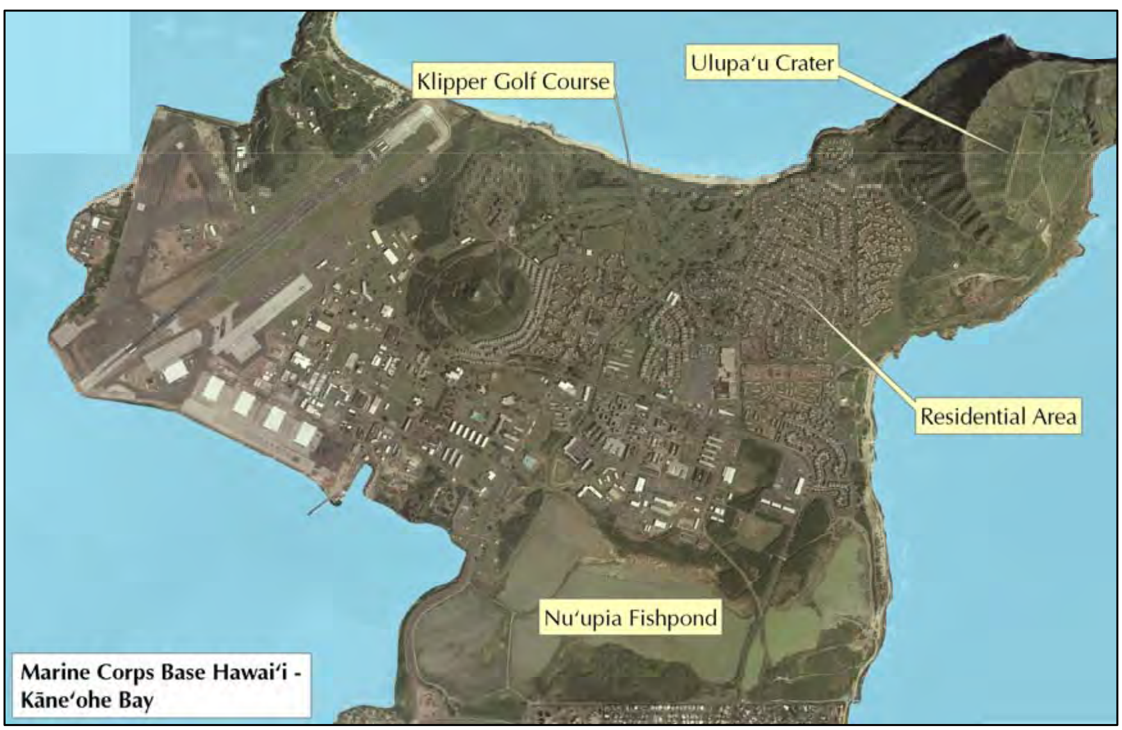
Project #23: Marine Corps Base Hawaiʻi Water Conservation Program

Project Location: Marine Corps Base Hawaiʻi (MCBH) installations in Hawaiʻi with primary emphasis on the Marine Corps Air Station Kāneʻohe Bay

Project Champion: MCBH

Project Partner: Board of Water Supply

Project Background: The Marine Corps Air Station Kāneʻohe Bay uses approximately 2 mgd of potable water, which accounts for 10 percent of all BWS Koʻolau Poko water demand. It is the single largest water user in the district. In January 2007, the President of the United States signed US Executive Order No. 13423 "Strengthening Federal Environmental, Energy, and Transportation Management." As part of the Executive Order, Federal agencies are required to reduce their potable water consumption by two percent annually to reach a 16 percent mandatory water use reduction by the end of 2015. Reductions are to be met through applicable and cost effective measures at each facility. The MCBH plans to meet this requirement by simultaneously implementing several water conservation measures and programs.



Aerial view of the Marine Corps Base Hawaiʻi

KPWMP Objectives Project Addresses:

- Objective #1: Promote sustainable watersheds
- Objective #2: Protect and enhance water quality and quantity
- Objective #5: Meet water demands at reasonable costs

Project Goal: More efficient water use at MCBH

Project Desired Outcome: MCBH annual water use in 2015 is 16 percent less than its annual water use in 2007.

Project Status: The Facilities Department at the MCBH is coordinating water system repairs, replacement, and other programs needed to achieve the desired outcome. Currently, construction is taking place to replace approximately 1,500 aging homes at the Marine Corps Air Station, Kāne‘ohe Bay. As of March 2010, approximately 400 new homes had been constructed. New homes have been equipped with energy and water-efficient fixtures such as low-flow shower heads. The Facilities Department has also submitted a $76,000 funding request to conduct a leak detection study. The Facilities Department conducts monthly on-site training as well as quarterly meetings with MCBH Utility Conservation Managers and Building Energy Managers to discuss water conservation issues and requirements. The department promotes water and energy conservation awareness to the general public periodically through events such as the annual Earth Day (in April) and Energy Awareness Month (in October). The department plans to continue using recycled water from the wastewater treatment plant at Marine Corps Air Station, Kāne‘ohe Bay to irrigate the on-base Klipper Golf Course. Long range plans include an upgrade to R-1 recycled water to fully utilize recycled water on base. The Facilities Department is optimistic that MCBH is on track to meet its 2015 water conservation desired outcome.

References: Various email communications with the MCBH Facilities Department staff; Marine Corps Base Hawai‘i Water Conservation Program (Power Point Presentation), August 2008.

PROJECT #24: Management and Stewardship of Kawainui Marsh
(Catalyst Project)

Project Location: Kailua

Project Champions: Kawainui Heritage Foundation, Lani-Kailua Outdoor Circle, ʻAhahui Mālama I Ka Lōkahi, Kailua Hawaiian Civic Club, Ameron Hawaiʻi, Hawaiʻi Audobon Society, Hawaiʻi's Thousand Friends, Kailua Historical Society, Castle Foundation, Division of Forestry and Wildlife, Division of State Parks

Project Partners: U.S. Army Corps of Engineers, USFWS, NRCS, Hui o Koʻolaupoko, Windward Ahupuaʻa Alliance, DOA

Project Background: This 1,000 acre marsh (244 acres are covered by a floating mat of vegetation) is the largest remaining wetland in the State of Hawaiʻi and provides a habitat for four species of native wetland birds, native fish, and numerous species of migratory shorebirds and waterfowl. Kawainui Marsh is also a significant Hawaiian cultural complex. From a broader historical perspective, the cultural complex of Kawainui encompassed the 850 acre wetland area as well as the streams and springs in the upper reaches of Maunawili that fed the wetland. Water was the element that connected the upper valley with the lower wetland. Three of the ten documented *heiau* in Kailua are in close proximity to the wetland area, and all 10 of Kailua's *heiau* lie in a prominent relationship to Kailua's water bodies. The entire Kawainui complex was once a fertile food producing area for Native Hawaiians. Agricultural terraces as well as fishponds were once common in this area and are presently beneath the vegetation mat. Kawainui Marsh also provides critical flood control for the Kailua community and sediment filtration that benefits the entire Kailua Bay ecosystem.

Kawainui experienced many changes during the late 19th and 20th Centuries. In the 1890's, the original "Kāneʻohe Ranch" built earthen dikes, abandoned Hawaiian methods of controlling upland contributing waters and abandoned lowland water utilization for taro and other agriculture uses on Kailua Plains. Also, rice was introduced in old *loʻi kalo*

View of the Ulupō Heiau

in lower Maunawili Valley up to the boarders of the Kawainui Fishpond. In the mid-1900's Kāne'ohe Ranch owners planted California grass in and around old *lo'i.* This created today's floating mat. In the 1970s the City and County's Kapa'a landfill and the privately owned Kapa'a Quarry were developed. These uses have both contributed to pollutants that run off into the marsh and into Kailua Bay via the Oneawa Channel. Other sources of pollutants to the marsh occur from ranching activities and animal wastes that presently occur on portions of the marsh.

The natural hydrology of the marsh was altered during USACE flood mitigation projects during the 1960s which included the construction of the Oneawa Canal. The construction of a larger flood control levee in the 1990s after the 1987 New Years Eve Coconut Grove flood also affected the natural flow of water through the marsh. Thus, despite the marsh's value, over the years it has suffered from neglect, alien species invasion, poor water quality, limited public access, and almost no publicly supported interpretive and educational programs.

Various community groups began different types of restoration activities in the 1960s. A master plan was prepared by DLNR with community input for Kawainui Marsh in 1994 that identified various actions and projects for the marsh including the need for an interpretive education center. Kawainui and Hāmākua Marshes were designated as Ramsar World Wetlands of Importance in 2005. In 2007, the City and County of Honolulu transferred its ownership of a portion of the marsh to the State of Hawai'i, which has allowed the State to move forward with restoration projects. The various project champions listed above formed an umbrella group, Ho'olaulima Ia Kawai Nui. For the past five years, this group has met regularly to initiate the planning for interpretation activities including an interpretive center and to coordinate the various stewardship activities around the marsh.

KPWMP Objectives Project Addresses:
- Objective #1: Promote sustainable watersheds
- Objective #2: Protect and enhance water quality and quantity
- Objective #3: Protect Native Hawaiian rights and traditional customary practices
- Objective #4: Facilitate public participation, education, and project implementation

Project Goals:
- Provide comprehensive and coordinated management for existing and future land and water uses associated with Kawainui Marsh
- Recognize the natural and cultural connection between Maunawili Valley and Kawainui Marsh.
- Protect, maintain, and enhance wildlife species, their habitats, and related ecological systems of the marsh

- Protect, preserve, and enhance cultural, educational, and recreational values at Kawainui Marsh
- Improve water quality within the marsh and in Kapaʻa Stream.

Project Desired Outcomes:

- The acreage of restored habitat for native wetland birds is increased
- Public awareness about the natural and cultural resources associated with Kawainui Marsh and Maunawili Valley is increased
- More community members, schools, and education groups participate in natural resource and cultural resource educational programs associated with Kawainui Marsh and Maunawili Valley

Project Status: DOFAW, in partnership with three federal agencies, is undertaking three separate wetland bird habitat restoration projects in Kawainui Marsh. In 2009, DOFAW and USACE completed a supplemental environmental assessment to restore wetland bird habitat at Kawainui Marsh. The proposed wetland bird habitat restoration project includes construction of two main pond systems that will encompass 24 acres of open pond area. The two pond systems will consist of eleven terraced ponds with source water for each pond supplied through rainfall supplemented by individual shallow groundwater wells with solar powered pumps. Factoring in estimated rainfall, the constructed wetlands will need an estimated 0.2 mgd. CWRM has approved the water use permit for the proposed groundwater wells. A perimeter predator control fence around the pond area as well as the implementation of a year round trapping program will help protect wetland birds from predators. The construction of two access roads to construct, operate, and maintain the pond system will also be built. The entire project area will encompass 37.8 acres. Currently, the project is in the final design and permitting phase. Construction is expected to begin in summer of 2011.

In 2006 DOFAW received a USDA NRCS Wildlife Habitat Incentives Program grant to enhance approximately 8 acres of wetland habitat in the vicinity of Kahana Iki Stream by clearing the overgrowth in the area to provide habitat suitable for endangered water birds. Native plants will be planted in the area to aid in soil stabilization. A predator control program will also be developed to protect wetland birds. This project should be completed by the end of 2010.

In 2006 DOFAW received a USFWS Pacific Islands Coastal Program grant matched with funding from the Harold K.L. Castle Foundation, to create 60 acres of wetland and stream bank habitat for endangered water birds. The project will also involve clearing 20 acres of upland forest and grading slopes in the area to provide erosion control measures to decrease runoff velocity, minimize contamination from the roadway and redirect the runoff in a way that will enhance wildlife habitat quality. Native plants will be planted in the areas that are graded and where invasive vegetation was removed. A predator control program will also be developed for the project area. Planning work has already begun on this project. An environmental assessment for this project is expected to be completed in spring of 2011 and implementation of the project is expected to begin in fall of 2011.

Periodic community work days and educational activities at various sites around the marsh have been organized. The Kailua Hawaiian Civic Club and ʻAhahui Mālama I Ka Lōkahi are the co-curators of the Ulupo Heiau and conduct monthly service projects to restore the ethno-botanical landscape and cultural features associated with the *heiau* site. ʻAhahui Mālama I Ka Lōkahi signed an MOA with the State DLNR to be the lead non-profit for education and service projects related to Kawainui Marsh. ʻAhahui Mālama I Ka Lōkahi is also the co-curator with the DLNR Division of Parks of Nā Pōhaku O Hauwahine and conducts monthly work days at the Nā Pōhaku O Hauwahine. The group also hosts local as well as mainland high school and college students on field studies at Ulupo Heiau, Nā Pōhaku O Hauwahine, and Kaha Garden. ʻAhahui Mālama I Ka Lōkahi also recently restored a 1 acre *loʻi* site near Ulupo Heiau. The Kailua Hawaiian Civic Club and Ameron Hawaiʻi are the curators of the Pahukini Heiau and have sponsored projects to maintain, preserve, and educate others about this cultural resource. Hui o Koʻolaupoko hosts monthly community work days at the Kaha Garden site. Volunteers have maintained the native plant landscape and weed invasive species from the garden.

In 2008, 2009, and 2010 Hoʻolaulima Ia Kawainui hosted three annual Ramsar World Wetland Day events. Activities at the Ramsar World Wetland Days included guided bus and walking tours of various sites around the Kawainui and Hāmākua Marsh Complex as well as informational booths hosted by both government agencies and community groups. These World Wetland Days were open to the public and are meant to educate and inform people about the importance of Kawainui and Hāmākua Marshes and how the community can get involved in restoration and stewardship activities of these resources. Interpretative Ramsar Wetland signs are expected to be posted around the marsh in December 2010.

ʻAhahui Mālama I Ka Lōkahi and several of the cultural descendents of Kailua have been working on a plan for a Kawainui Marsh cultural center. Planning concepts are only preliminary at this time. The groups have identified several possible sites around the marsh to locate a cultural learning center, however, a preferred location has not yet been determined.

The Windward Ahupuaʻa Alliance has conducted numerous community clean-up days along the Kapaʻa Quarry Road that borders the marsh. The clean-up days have helped to remove debris along the roadways including large bulky items.

A Kawainui Stream flow restoration engineering study has been funded by the State. The Kawainui Stream, often referred to as the Hāmākua Canal, was cut off from the majority of the watershed in 1966 by the completion of the Kawainui flood control levee and alternate outflow channel to the ocean via the Oneawa Channel. The Kawainui Stream now dead-ends at the base of the flood control levee at the head of the Oneawa drainage channel, but is not connected either to the canal or to the Kawainui Marsh. The $250,000 study has two primary goals: 1) Determine the appropriate rate of flow and most efficient way to transmit this flow from the Kawainui Marsh past the levee to Kawainui Stream without decreasing the flood prevention capacity of the levee and 2) Assess the probable impact of this action on the marsh, stream, Kailua waterways, and ocean outfall. The study will conclude with an Environmental Assessment that identifies a recommended solution and conceptual design plans for that solution. A portion of this study will incorporate a field trial in which water (1-3 cfs) will be siphoned from the marsh, over the levee, and into Kawainui Stream approximately a quarter of a mile north of the Pali Highway. The project should begin in early 2011 and be completed within a year.

In 2009 and 2010, State Senator Jill Tokuda (Kailua, Kāneʻohe) coordinated three community meetings that brought together the various community groups, agencies, and individuals that are interested in restoring and managing Kawainui Marsh. The Senator worked with her colleagues in the Legislature to secure $800,000 to update the 1994 Kawainui Marsh Master plan. A portion of the funding can be used to implement some of the projects that will be included in the updated plan. The plan update is expected to begin in the first half of 2011.

The DOA is planning to repair and upgrade its Maunawili Ditch system. (See Project #11) Repairs and upgrades made to the ditch may periodically reduce the amount of water that is diverted from Maunawili Stream to Waimānalo as the repairs will reduce leakages along the ditch and make the ditch more efficient. Less water may need to be diverted from Maunawili Stream, meaning more water can remain in the stream and flow into Kawainui Marsh.

The Kailua Neighborhood Board and the Kailua Chapter of the Outdoor Circle have gone on record regarding limiting the physical structures, roads, and other projects on lands within or near the marsh that could negatively impact water quality, air quality, or view planes. Specifically, the Kailua Neighborhood Board opposes the construction of any structures on State-owned lands within Kawai Nui Marsh that are not directly related to flood and pollution control or the propagation of native flora or fauna.

References: 1994 Kawai Nui Marsh Master Plan. Various personal communications with members of Hoʻolaulima ia Kawainui.

Project #25: Hāmākua Marsh Ecosystem Restoration Program

Project Location: TMK 4-2-03:030 in Kailua

Project Champion: Department of Land and Natural Resources - Division of Forestry and Wildlife (DOFAW)

Project Partners: Kāneʻohe Ranch, Hoʻolaulima Ia Kawainui, Ahahui Mālama I ka Lōkahi, USFWS, Castle Foundation, Kailua Urban Design Task Force, Learning Education Technology (LET), Lanikai Charter School.

Project Background: Hāmākua Marsh is a 22.7 acre wetland located east of the larger Kawainui Marsh, in close proximity to commercial and industrial land uses in Kailua. The marsh is primarily managed for the endangered Hawaiian Coot, Moorhen, and Stilt. The marsh provides feeding, nesting, and resting sites for these species. The Hāmākua Marsh Ecosystem Restoration Program is an on-going program consisting of efforts to address the main causes of habitat loss in the marsh including invasive species, predatory animals, polluted runoff and lack of sufficient brackish water flow into the marsh.

KPWMP Objectives Project Addresses:

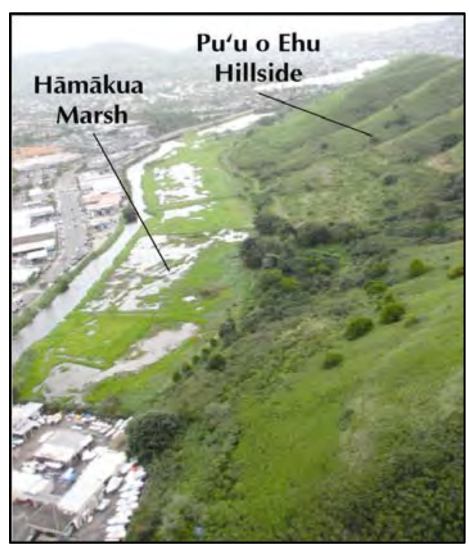
- Objective #1: Promote sustainable watersheds
- Objective #2: Protect and enhance water quality and quantity
- Objective #4: Facilitate public participation, education, and project implementation

Project Goal:

- Enhance wildlife habitat in Hāmākua Marsh.

Project Desired Outcomes:

- Population of the native species that inhabit the marsh are increased
- Habitat areas are increased
- Predator control has been improved
- Brackish water supply has been restored
- Water quality has been improved



Project Status: Periodic community workdays are held on the marsh to remove invasive species and plant native plants. Lanikai Charter School contracted with the LET, a non-profit organization providing technology training for Hawaiʻi teachers and students, to develop the Hāmākua Marsh website (http://hamakuamarsh.com). In the near future, DOFAW hopes to secure State funding to plan for the restoration of fresh water flows to Hāmākua Marsh. Additionally, DOFAW hopes to further improve the habitat conditions of Hāmākua Marsh through its acquisition of Pu‘u o Ehu, a hillside directly *mauka* of the marsh. More information on this project can be found in Project #25 description.

References: Ducks Unlimited, *Final Environmental Assessment, Enhancement and Management Plans for the Hāmākua Wetland Protection and Enhancement Project Kailua, Honolulu County, Hawai‘i*, Prepared for U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, State of Hawai‘i, City and County of Honolulu, July 1993; Various personal communications with DOFAW.

Project #26: Purchase of Puʻu o Ehu Hillside in Kailua

Project Location: TMK 4-2-03:017 in Kailua

Project Champion: Department of Land and Natural Resources – Division of Forestry and Wildlife (DOFAW)

Project Partners: USFWS, Castle Family Ltd Partnership (current landowner)

Project Background: The Puʻu o Ehu parcel is a 65 acre hillside located directly *mauka* of Hāmākua Marsh in Kailua. Livestock grazing on the lower slopes of the hill are impacting the quality of runoff flowing into the marsh and the nearby Kawainui Stream. Hāmākua Marsh and Kawainui Stream lie downstream from Kawainui Marsh, the largest remaining wetlands in the State. Water from Kawainui Marsh used to flow through Kawainui Stream and Hāmākua Marsh on its way into Kailua Bay. However, in the early 1960s, Kawainui Marsh water was redirected away from Kawainui Stream and Hāmākua Marsh through the construction of Oneawa Canal that connects the larger marsh and Kailua Bay. Since then, Hāmākua Marsh has been dependent on runoff from surrounding lands. Polluted runoff greatly affects the water quality of the marsh while stagnant Kawainui Stream has minimal water turnover resulting in anaerobic conditions that affect water quality entering Kailua Bay. DOFAW acquisition of Puʻu o Ehu will be followed with implementation of appropriate management measures designed to improve the quality of runoff flowing from the hill.

Puʻu o Ehu hillside from Hāmākua Marsh

KPWMP Objectives Project Addresses:

- Objective #1: Promote sustainable watersheds

Project Goal: Improvement of habitat conditions in Hāmākua Marsh and Kawainui Stream.

Project Desired Outcomes:

- The amount of pollutants flowing into Hāmākua Marsh and Kawainui Stream is reduced
- Local recreational and educational resources through trail construction and installation of educational signage are increased
- Opportunities are provided for a more comprehensive and permanent management of the Kawainui-Hāmākua Marsh wetland complex

Project Status: The total acquisition cost of Pu'u o Ehu is $ 1,235,000. Federal grants from the Federal Recovery Lands Acquisition Program will be used to cover sixty percent of that cost. The other source of funding to purchase the hillside is the State of Hawai'i Legacy Lands Fund. DOFAW hopes to finalize the purchase agreement with the Castle Family Ltd Partnership in 2011.

References: State of Hawai'i Department of Land and Natural Resources Division of Forestry and Wildlife, *Hāmākua Marsh Watershed Protection and Habitat Restoration Project*, August 2007.

Project #27: Kailua Beach Management Plan

Project Location: Kailua Beach

Project Champions: UH Sea Grant College Program, UH School of Ocean & Earth Science Technology, OCCL, NOAA

Project Partners: N/A

Project Background: Kailua Beach is approximately 2.5 miles in length and is exposed to strong trade winds and bi-modal waves that approach from an acute angle. This wave setup generates alongshore currents (dominantly to the north) ensuring that sand is shared along the length of the beach over the course of most years. Because the system is dominated by alongshore sand transport, it is important to manage the dune, beach, and offshore environments as a single, sand-sharing entity. Erosion stemming from sand deficiencies or interruptions in one part may affect sand availability throughout the entire length of the beach.

The beach faces several threats including: beach erosion due to poor sand management practices related to clearing of Ka'elepulu Stream mouth; loss of recreational beach and sand impoundment due to aggressive vegetation growth on the dunes and beach; unauthorized landscaping and loss of access to the shoreline area; accreted land claims, subdivision, and new development *makai* of existing improvements; insufficient construction setbacks to guarantee conservation and hazard mitigation.

The UH Sea Grant College Program, in partnership with the DLNR Office of Conservation and Coastal Lands (OCCL), has developed a beach and dune management plan for Kailua Beach. The plan is intended to provide long-term recommendations and guidelines for adapting to climate change, including potential coastal hazards such as sea-level rise.

Eroded portion of Kailua Beach

KPWMP Objectives Project Addresses:

- Objective #1: Promote sustainable watersheds

Project Goals:

- Enhancement and protection of a healthy sand-movement system for Kailua Bay
- Protection of cultural and natural resources of the coastal dunes which may include land use rules on urban encroachment.
- Mitigation of coastal hazard exposure to abutting landowners

Project Desired Outcomes:

- Coastal processes and land uses that are negatively impacting the beach and dune ecosystem have been documented
- Potential impacts of sea level rise on Kailua Beach are better understood
- Effectiveness of Federal, State, and County's Coastal Zone Management laws and policies as well as community plans for beach conservation have been assessed
- Potential beach management and restoration strategies have been identified
- Recommendations regarding land use regulation BMPs that are identified in the Kailua Beach Management Plan have incorporated as amendments to existing Revised Ordinances of Honolulu (ROH) related to coastal land management.
- Public education on appropriate shoreline land uses have been conducted
- A system of rewards for landowners who proactively take appropriate steps for beach conservation has been developed

Project Status: The plan was expected to be completed by March 2010 and will include recommendations for land use controls for development as well as recommendations for best management practices for the beach and dune in Kailua.

References: UH Sea Grant College Program & Department of Land and Natural Resources Office of Conservation and Coastal Lands Coastal Lands Program. *Request for Proposals for Development and Production of a Kailua Beach and Dune Management Plan*, October 2008; http://hawaii.gov/dlnr/occl/projects/kailua-beach-management-plan

PROJECT #28: Management and Stewardship of Ka'elepulu Watershed

Project Location: Kailua

Project Champions: Enchanted Lake Residents Association (ELRA) and the owners of the Ka'elepulu Wetland

Project Partners: City Department of Environmental Services (ENV) State Clean Water Branch (CWB), US Army Corps of Engineers (USACE)

Project Background: The Alexander Map of 1884 and the War Department Map of 1943 show Ka'elepulu Pond with a water area of 190 acres and an additional marsh or wetland area of 90 acres. There was an outlet to the sea at Kailua Beach and the pond was defined by natural contours and earth embankments. The pond was fed by fresh water flowing into it from Kawainui Marsh and Ka'elepulu Stream. Wetland areas as well as *lo'i* used to exist in close proximity to Ka'elepulu Pond. Ancient Hawaiians used the pond as a fishpond and worked to keep it clean. A variety of fish, including *awa*, *ahole*, and *o'opu* were found in the pond in addition to *limu* and large oyster beds. The wetlands surrounding Ka'elepulu were home to a variety of native wetland birds.

Extensive residential development and urbanization around the pond and in the adjacent wetland areas began in 1964 when the majority of the pond and surrounding lands were leased by the Bishop Estate to a private developer. The developer filled portions of the pond to create home sites and dredged remaining areas of the pond to a depth of about 15 feet. With the development, the pond was renamed Enchanted Lake and reduced to 79 acres. In 1966, construction of the Kawainui flood control levee by the USACE permanently diverted fresh water that once flowed into Ka'elepulu Pond from Kawainui Marsh.

During the past two decades, there has been extensive shoaling near large storm drain outlets and a significant deterioration of ecological quality of the pond. The waters of Ka'elepulu contain sediments, nutrients and bacterial contaminants. Occasional fish die-offs were associated with periods of stagnant odoriferous pond water prior to the removal of large stands of non-native mangrove from the pond.

Part of Ka'elepulu watershed

In addition to water quality related issues such as storm water runoff and non-point source pollution, Kaʻelepulu also faces environmental threats from invasive plant species, introduced predators, and trash. The water quality of Kaʻelepulu Pond and Stream directly impacts the water quality of Kailua Bay.

Currently there are 3,515 residences, 73 City and County storm drains, and 24 miles of City and County streets in the Kaʻelepulu watershed. The pond has filled with sediment over the years and now the deepest areas are only about 9 feet with most of the pond significantly shallower.

Ownership of the pond is divided between the ELRA and the private individual owners of the adjacent 13 acre wetland area *mauka* of the pond. ELRA is a non-profit organization that holds title to and manages a 79.471 acre portion of Kaʻelepulu Pond. The board of the ELRA and the private individual owners of the Kaʻelepulu Wetland have taken a pro-active role in the management and environmental stewardship of the pond and wetland.

KPWMP Objectives Project Addresses:

- Objective #1: Promote sustainable watersheds
- Objective #2: Protect and enhance water quality and quantity

Project Goals:

- Restore Kaʻelepulu to support diverse fisheries resources and recreational activities
- Improve water quality in the pond and to the ocean
- Create a healthy wetland where Hawaii's endangered wetland bird population will be able to thrive

Project Desired Outcomes:

- A section of Kawainui Canal is dredged to restore water exchange with the ocean
- Monthly stream mouth openings with tides to minimize labor and expense while maximizing water exchange are coordinated
- New sources of sediment are prevented from entering Kaʻelepulu waterways
- Storm water that enters waterways is substantially free of pollutants and sediment is diverted to suitable detention areas
- Street sweeping is more effective
- All mangroves have been removed from Kailua waterways
- The wetland has been dredged and restored to maximize edge habitat for endangered water birds
- Oyster beds have been restored to enhance water quality
- Kawainui water flows are restored to improve exchange and regulate lake level
- Opening of *muliwai* near Buzz's Steakhouse and Kailua Beach is maintained
- BMPS recommended in *"Storm Water Best Management Practices (BMP) Plan For Four Major Outlets at Kaʻelepulu Pond"* November 2008, prepared for the City and County of Honolulu, Department of Environmental Services are practiced.

Project Status: 140 single-family residences and 110 Kukilakila townhouse residences are members of ELRA through a provision in the "Declaration of Protective Provisions" which is a part of each property's deed. Residents not adjacent to Ka'elepulu, but with canal access can join as associate members. There is an annual maintenance fee (now $150 per year) that is used to pay for the bi-weekly lake cleanup crew, insurance costs, administrative costs, and miscellaneous costs. Funds are also being set aside to finance major projects that may come up such as dredging portions of the pond.

In 2002 ELRA received an EPA/DOH water-quality grant to remove mangrove from the pond. Over a period of almost three years all adult mangroves and seedlings were removed. Following removal of the mangrove, the annual summer malodorous conditions stopped. The pond has, with one major exception, been odor free ever since.

A water quality monitoring report (Bourke, 2006) analyzed samples associated with five storm events collected from the Ka'elepulu watershed from 2002 to 2006. Analyses of sediment loads from these samples showed that the large majority of sediments were derived from open soils associated with construction and steep upslope areas with heavy erosion.

In 2004, DOH began developing TMDLs for Ka'elepulu inland waters. (See Project #9 "Implement Requirements of TMDLs that have been approved or are currently in progress for Ko'olau Poko Streams.")

In 2011, the State will be studying the environmental impacts of restoring flow from Kawainui Marsh to Ka'elepulu Stream. Impacts to Kawainui Marsh as well as Ka'elepulu Stream will be studied. Historically, water from Kawainui Marsh flowed into Ka'elepulu Stream and helped to "flush" pollutants from Ka'elepulu Stream into the ocean. Restoration of flow from Kawainui Marsh to Ka'elepulu could improve the water quality of Ka'elepulu. The study is expected to begin in early 2011 and take one year to complete. (See Project #24 for additional details).

Two individuals assumed ownership of Ka'elepulu Wetland in 2004. Since that time, the owners have removed several thousand mangrove plants and many truckloads of other types of invasive plants from the wetland. Ongoing and future work will focus on the continuation of invasive plant removal, native plant propagation, predator control programs, periodic trash removal, and creation of more mudflat areas for wetland bird habitats. An ongoing project is the planting of a native plant education garden on the bank alongside the public viewing area.

The majority of this work has been privately financed by the owners and the Ka'elepulu wetland trust fund. An NRCS Wildlife Habitat Incentives Program (WHIP) grant was obtained in 2006 to enhance several acres of the wetland. A major project in the wetland is the control and eventual removal of an aggressive variety of seashore paspalum that threatens to choke the waterways and moats around the wetland. The USACE also supervises work in portions of the wetland.

Future Actions

The wetland owners are particularly concerned about the following issues and would like to work with the City and County Department of Environmental Services to implement the following actions:

Make street sweeping more effective, including all curb areas. Currently, street sweepers go around parked cars, and do not sweep close to the curb where most of the gravel and street dirt collect. They also do not go down side streets. The wetland (and lake) have numerous gravel bars that have built up from street gravel deposited by storm drain outlets. These deposits create land bridges to the wetland islands which allow predators access. They also constrict the flow of water through the wetland, creating areas of stagnant water.

Install a BMP Collection at the end of the lined channel of Ka'elepulu Stream (near outlet #42 at end of Akumu Street). This hardened channel provides drainage for 425 acres of upslope land in Enchanted Lake and Norfolk. This drainage system brings a significant percentage of the trash, sediments and gravel that enter Ka'elepulu Pond. A large portion of these sediments are deposited into the wetland, filling waterways and compromising the wetland. This is an ideal location for a collection BMP with easy access for accumulated sediment removal.

Reroute Akumu Street storm drain (WKIP 43) to empty into hardened portion of Ka'elepulu Stream. This storm drain line starts in Norfolk, runs under Kalaniana'ole Hwy. and through parts of Enchanted Lake, then down a portion of Akumu Street, before it makes a 90-degree turn running through a single family home's property before emptying into a swale at the back of the wetland owner's property. This drain line is responsible for tens of tons of sediment deposits during every storm event. Rerouting this drain to use the above listed BMP will enable the City to comply with Clean Water Act requirements.

Restore and maintain opening at the muliwai between Ka'elepulu Stream (by Buzz's) and Kailua Bay. A maintained opening to the sea for Ka'elepulu Pond would prevent the periodic flooding of the wetland islands during storms which destroys nests and drowns baby chicks. This would also provide access to the pond for fish that need brackish water as part of their propagation, such as mullet, milkfish and papio, and at the same time provide a healthier environment for the wetland birds. Note: Ka'elepulu Steam was always open to the bay before the flood control project in Kawainui marsh.

References: Information retrieved online http://Ka'elepuluwetland.com/ April 8, 2010; Information retrieved online http://www.Ka'elepulupond.org April 8, 2010;
Bourke, R.E. "Water Quality in Ka'elepulu Pond, Results and Summary of Sampling from Five Storms" June 2006.

PROJECT #29: Ka‘elepulu Stream Storm Water Capture

Project Location: Kailua

Project Champion: Hui o Ko‘olaupoko

Project Partners: Hawai‘i Department of Health, Clean Water Branch, EPA, Hawai‘i Tourism Authority, City and County of Honolulu Department of Parks and Recreation

Project Background: Ka‘elepulu Stream water quality is seriously degraded. The stream empties into the nearshore waters of Kailua Beach. While there are many sources of pollution that enter Ka‘elepulu up-stream, a major source of pollution may be storm run-off near the mouth of the stream. This project will improve 24,000 sq. ft. of an existing parking lot owned by City and County of Honolulu Parks Department. The project includes two BMPS: 1) installing pervious concrete to allow storm water infiltration and 2) a vegetated bio-swale to capture any additional runoff, planting of native vegetation and a vehicle setback from the stream of approximately 12-15 ft.

KPWMP Objectives Project Addresses:
- Objective #2: Protect and enhance water quality and quantity
- Objective #4: Facilitate public participation, education, and project implementation

Ka‘elepulu Stream

Project Goals:

- Improve the water quality of Ka'elepulu Stream and near shore waters of Kailua Beach
- Demonstrate the effectiveness of Low-Impact Development techniques

Project Desired Outcomes:

- Urban run-off entering Ka'elepulu Stream has been decreased
- Community education and awareness of watershed issues has increased

Project Status: The project is currently being designed and is tentatively scheduled for construction in the Fall of 2010.

References: Personal communications with Hui o Ko'olaupoko

PROJECT #30: Waimānalo Watershed Project

Project Location: Waimānalo

Project Champions: Oʻahu Resource Conservation and Development Council, Hui o Koʻolaupoko.

Project Partners: Windward Oʻahu Soil and Water Conservation District, Department of Health, USDA-Natural Resources Conservation Service, Farmers and Ranchers.

Project Background: The Waimānalo Watershed has many small farms. The main natural fresh water resource within the watershed is the Waimānalo Stream and its tributary, the Kahawai Stream. These streams flow through conservation and agricultural lands, residential areas, and military property before entering Waimānalo Bay. Along its course, sediments, nutrients and various other chemicals and debris enter the stream. A TMDL study was completed for Waimānalo Stream in 2001 and a variety of projects have focused on addressing water quality problems. By working with farmers and ranchers through a voluntary process, this project plans to reduce nutrients and sediment entering the streams in the Waimānalo Watershed.

KPWMP Objectives Project Addresses:
- Objective #2: Protect and enhance water quality and quantity
- Objective #4: Facilitate public participation, education, and project implementation

View toward Waimānalo and Bellows Beach

Project Goal: Improve the water quality of Waimānalo Streams and nearshore waters

Project Desired Outcomes:

- Conservation plans that address soil erosion and water resources have been developed.
- Financial assistance to farmers to implement conservation practices that reduce erosion and protect water quality is provided. Examples include grassed waterways, buffer strips, ground cover, mulch, and composting facilities.
- The community is involved through watershed clean-ups and field days.

Project Status: The project began in 2009 and currently has funding through 2011. Efforts to date have focused on developing and updating conservation plans. O'ahu RC&D, NRCS, and the Windward Soil and Water Conservation District have been able to work with about 46 farms in the Waimānalo watershed to develop conservation plans. Applications are being accepted for financial assistance, and the first phase of conservation practices will be implemented in summer 2010.

Reference: Phone Interview with O'ahu RC&D, March 10, 2010.

PROJECT #31: Waimānalo Watershed Analysis Risk Management Framework Study

Project Location: Waimānalo

Project Champions: Systech Water Resources Inc., ENV

Project Partners: UH, USGS, NOAA, NRCS, DOT-Highways Division, DPP, DOH

Project Background: The Watershed Analysis and Risk Management Framework (WARMF) is a comprehensive watershed modeling and decision support system that provides water managers with a tool to assess a wide range of "what if" scenarios. WARMF includes dynamic rainfall-runoff modeling to simulate changes in surface and near-surface hydrology (water quantity) and water quality modeling to simulate changes in the concentration of many chemical and physical constituents including sediment, nutrients, dissolved solids, organic carbon, and more.

As a case study to investigate the potential of WARMF as a tool for watershed management and adapting to change in island regions, WARMF was applied in the Waimānalo watershed in Oʻahu, Hawaiʻi. Characterized by steep mountainous terrain in the headwaters and a mixed land use coastal plain, the Waimānalo watershed is listed as impaired by the State of Hawaii due to excess nutrients, turbidity, and suspended sediment. WARMF was used to investigate the potential of alternative development designs for existing and future infrastructure to improve current water quality and mitigate further degradation.

Systech Water Resources, Inc. and ENV are conducting the Waimānalo WARMF study. Systech Water Resources, Inc., a private California-based company, has provided funding for the entire study. Systech approached the City and County to use the Waimānalo watershed as a test case in the use of the WARMF model on smaller scale watersheds in sub-tropical climates and will be presenting the results of the study at an American Water Resources Association (AWRA) Tropical Hydrology Conference in the fall 2010.

Waimānalo Stream

KPWMP Objectives Project Addresses:
- Objective #2: Protect and enhance water quality and quantity

Project Goals:
- Validate that the WARMF model is a useful tool for water quality management in sub-tropical climates and small scale watersheds
- Improve water quality through implementation of best management practices that are based on WARMF generated analysis
- Increase public awareness about where pollutants originate within the Waimānalo watershed (urban as well as non-urban sources)
- Encourage stakeholder involvement and collaboration from other agencies and private entities to improve water quality

Project Desired Outcomes:
- The quantity of surface water pollutants has been calculated in order to determine if they are in line with State DOH TMDL calculations and Waste Load Allocations for Waimānalo Stream
- Locations of pollutant sources (urban and non-urban) are identified in order to better allocate resources and identify key stakeholders in order to improve surface water quality in the Waimānalo watershed
- WARMF is utilized as a tool that will be an additional part of ENV's monitoring program that evaluates the City and County's effectiveness in improving surface water quality
- The Waimānalo WARMF study will justify future studies and water quality data collection that will refine and calibrate the model's outputs to match what is occurring in the field

Project Status: ENV and other government agency partners have contributed to the study by providing available data that will be used towards running the model. Systec is anticipating finalizing the model in the summer of 2010. After the model is finalized, a technical paper describing the model's results will be prepared with the City and County providing any needed technical reviews. As mentioned previously, the technical paper will be presented by Systech at the AWRA Tropical Hydrology Conference in the fall of 2010.

Once the results have been published, ENV will evaluate the results of the study to determine whether to continue with the use of the WARMF model. Future use of the WARMF model will also be dependent upon any additional funding that ENV can obtain for further studies.

Reference: Personal communications with ENV staff

PROJECT #32: God's Country Waimānalo Programs

Project Location: Waimānalo

Project Champion: God's Country Waimānalo (GCW)

Project Partners: OHA, DHHL, Waimānalo Hawaiian Homes Association (WHHA)

Project Background: God's Country Waimānalo is a community-based non-profit 501(c)(3) organization whose mission is to perpetuate all things Hawaiian and to create a learning environment predominantly for youth of Hawaiian ancestry, and residents within the Waimānalo community. GCW was incorporated in August of 2005 after recognizing that the needs of some of the youth of the Waimānalo community were not being met. At that time, there were some after-school activities on the Waimānalo school grounds but they were only for fifth and sixth graders. There was a similar need for youth transitioning to intermediate school, but no programs were available. GCW is currently organized exclusively for charitable and educational purposes, specifically to be a learning advocate and provide programs for Native Hawaiians from *keiki* (children) to *kūpuna* (seniors) through cultural education, economic development and interactive activities.

KPWMP Objectives Project Addresses:

- Objective #1: Promote sustainable watersheds
- Objective #3: Protect Native Hawaiian rights and traditional customary practices
- Objective #4: Facilitate public participation, educational, and project implementation

Project Goals:

- Support the development of a healthy community through the empowerment of knowledge and experience of Hawaiian culture.
- Recover knowledge and skills associated with Hawaiian culture

Project Desired Outcomes:

- Educational opportunities are provided to Native Hawaiian participants

Agricultural activities at the God's Country Waimānalo

Project Status: In 2008, GCW helped start an organic garden mental health program "E Mahiʻai No Ke Ola Pono" on WHHA lands. The program applied for and received funding from the state's Mental Health Transformation State Incentive Grant program. The backyard garden project has helped 23 Waimānalo families learn how to become more self-sufficient and produce some of their own food for consumption.

GCW has also been actively involved with its "Aquaponics in Action" backyard program. It has helped to construct four backyard aquaponic gardens for four families in Waimānalo with plans to construct 25 more aquaponic gardens in the backyards of other Waimānalo families. GCW applied for and is awaiting grant funding from the Hawaiʻi Community Foundation and DHHL to fund construction of these additional aquaponic gardens. The aquaponic gardens are a combination of hydroponic gardens and aquaculture and allow individual families to cultivate both plants and fish in a re-circulating environment. The typical size aquaponic garden that GCW has constructed consists of a 180 gallon fish tank. Families have raised a variety of fish and food plants including *kalo*.

GCW is also currently in the process of securing funding for its "He Moku, He Waʻa, He Waʻa, He Moku" program ("the island and the canoe are one and the same"). This program will be a series of continuous 8 week mini classes that touch on Ke Kai (ocean), Ka \`Āina (land), Moʻolelo (traditional stories associated with the local area), and Ka Waʻa (canoe). The *waʻa* (canoe) will be used as the focal point to teach program participants lessons related to natural and cultural resource management. GCW estimates the cost of this program at $200,000 over a two year period and is seeking funding from OHA to cover a portion of the program costs. GCW estimates that 700 people would be served as a result of the "He Moku, He Waʻa, He Waʻa, He Moku" program.

Reference: Personal communications with God's Country Waimānalo.

PROJECT #33: Bellows Air Force Station Integrated Natural Resource Management Plan

Project Location: Waimānalo

Project Champion: Bellows Air Force Station

Project Partners: USFWS, DLNR, Hui Mālāma I Ke Kai, Waimānalo Hawaiian Civic Club

Project Background: The Federal Sikes Act Improvement Amendments passed in 1997 required all military installations with significant natural resources to prepare, implement, and regularly update Integrated Natural Resources Management Plans (INRMPs). The purpose of the Bellows AFS INRMP is to provide a foundation or "road map" for Air Force actions in order to promote the conservation and management of the natural resources on Bellows AFS. The INRMP integrates an interdisciplinary approach to ecosystem management with planning for its military mission. The INRMP includes a series of management actions across nine categories: 1) Land Use, 2) Threatened and endangered species and critical habitats, 3) Wetlands, 4) Watershed protection, 5) Fish and wildlife management, 6) Grounds maintenance and urban forestry, 7) Outdoor recreation and public access, 8) Coastal resources, and 9) Resources data base.

KPWMP Objectives Project Addresses:

- Objective #1: Promote sustainable watersheds
- Objective #2: Protect and enhance water quality and quantity
- Objective #3: Protect Native Hawaiian rights and traditional customary practices
- Objective #4: Facilitate public participation, education, and project implementation

Project Goal:

- Bring together and integrate all management activities in a way that sustains, promotes, and restores the health and integrity of ecosystems and that enhances the human environment at Air Force installations in Hawaiʻi

Portion of Waimānalo Beach located mauka of Bellows AFS

Project Desired Outcomes:

- Natural resources on Air Force installations are managed and utilized in a manner that is consistent with the Air Force mission
- Threatened and endangered species and habitat critical to their survival are protected
- Wetlands are protected from loss or degradation to the maximum extent possible that is compatible with the military mission
- Water quality in streams, canals, and coastal waters are protected, maintained, and improved
- Game and non-game fish and wildlife species are managed within the Department of Defense guidelines of ecosystem management
- Grounds and trees are managed to optimize protection of existing ecosystems, and maintain visually attractive landscapes on Air Force installations visited by the public
- Outdoor recreation opportunities that promote the mental, physical, and social well-being of base personnel for both military and civilians are provided
- Marine resources and coral reefs are protected, maintained, and improved
- Natural resources maps and databases are created, regularly updated, and utilized

Project Status: The Air Force INRMP was first completed in 1997. The Air Force Integrated Natural Resources Management Plan has also been updated twice since 1997 in 2003 and most recently in 2008. From 2003 to 2007, several INRMP plan projects have been implemented including: incidental take permits, monitoring surveys, turtle protection sign installations, interpretive signs addressing local ecosystems have been installed along trails and new aerial imagery of Bellows AFS has been incorporated into the Air Force resource management database.

The Bellows Air Force Station environmental program manager is currently pursuing wetland restoration along the lower reaches of Waimānalo Stream. The wetland restoration work will be completed in two phases. Phase I work will involve the removal of mangrove and other invasive species such as pickle weed. Funding for mangrove removal from DoD is expected to be granted by 2012 or 2013. Phase II would involve wetland engineering with the goal of restoring more native wetland habitat.

Bellows AFS also has a cultural resource management plan in place. Elements of the plan include a burial crypt as well as a climate controlled curator facility. Burials encountered during restoration work are placed in the crypt after consultation with the lineal descendents of the area and the State Historic Preservation Division burial council. Native Hawaiian artifacts that are discovered at the AFS are placed in the curator facility for safekeeping. Bellows AFS has also been partnering with the Hui Mālāma I Ke Kai after school program. The program's students are taking care of a native plant garden area on the AFS. The Waimānalo Hawaiian Civic Club and Bellows AFS are partnering to organize a Waimānalo *makahiki* in November of 2010. In the future, Bellows AFS would like to provide more opportunities for more community involvement and educational programs.

Reference: Bellows Air Force Station INRMP 2008-2012. Personal communications with Bellows Air Force Station Environmental Program Manager.

PROJECT #34: Waimānalo Waste Water Treatment Plant Recycled Water Reuse

Project Location: Waimānalo

Project Champion: ENV

Project Partners: USACE, DLNR, DOA, DOH

Project Background: The Waimānalo Waste Water Treatment Plant (WWTP) currently treats its waste water to an R-2 level of water quality and disposes the treated waste water via injection wells. The existing WWTP has a capacity of 1.1 mgd. Its current average flow is 0.7 mgd.

The idea of utilizing recycled water from the Waimānalo WWTP for irrigation was first proposed in the 1980 NRCS "Waimānalo Watershed Plan and EIS." Recycled water reuse from the Waimānalo WWTP was also mentioned as a recommendation in the 1999 "Waimānalo Wastewater Facilities Plan" and 2006 "BWS Island-wide Non-potable Water Master Plan." Potential demand for non-potable water from the Waimānalo WWTP would come from: DOA farm lots, Olomana Golf Course, Waimānalo Polo Field, Waimānalo Beach Park, Waimānalo Bay State Recreation Area, Waimānalo District Park, Hawai'i Job Corps, National Guard Armory, and the WWTP itself.

KPWMP Objectives Project Addresses:

- Objective #1: Promote sustainable watersheds
- Objective #5: Meet future water demands at reasonable costs

Waimānalo WWTP facility

Project Goals:

- Conserve potable water resources by utilizing recycled non-potable water for irrigation and other appropriate non-potable water uses
- Reduce hydraulic loading of the WWTP injection wells and nutrient loading on near shore waters

Project Desired Outcomes:

- A new reliable source of non-potable water for non-potable water uses has been developed
- The amount of waste water being disposed of via injection wells has decreased

Project Status: Ownership of the Waimānalo WWTP is still in the process of being transferred to ENV from DLNR. The transfer of ownership should be completed within the next year.

ENV and the USACE are jointly funding a $300,000 planning study ($150,000 federal funds and $150,000 City funds) to address full R-1 compliance. Some of the considerations that the study will look at include UV disinfection, increasing existing storage capacity for recycled water, and an EIS update. In 2006, BWS completed its "Island-wide Non-Potable Water Master Plan". Part of the 2006 BWS plan estimated the potential cost for various non-potable water supply projects on O'ahu. The Waimānalo WWTP was identified in the plan as a potential future source of non-potable water supply. The plan estimated the cost to upgrade the WWTP and construct a distribution system at $4.5 million.

Also as a part of the ENV and USACE planning study, a market use survey will be conducted to better gauge potential customer acceptance of utilizing R-1 recycled water. In the past, DOA investigated the possibility of integrating recycled water into its system. The previous DOA proposal received strong concerns from Waimānalo farmers. The farmers fear that their sales may diminish if they begin using recycled water to grow their crops as potential customers such as restaurants or stores may have a negative perception of crops that are irrigated with recycled wastewater. The study is expected to begin in December 2010 and take one year to complete.

References: 2006 Honolulu Board of Water Supply Island-wide Non-potable Water Master Plan O'ahu, Hawai'i; personal communications with ENV and USACE staff

4.3 WATERSHED MANAGEMENT STRATEGIES

The following section outlines and describes **watershed management strategies.** Generally, a "strategy" is a series of actions that help to achieve a common objective. These strategies are similar to the "Projects with Champions." The strategies help to achieve KPWMP sub-objectives and objectives. However, watershed management strategies do NOT currently have a project champion. These strategies were developed from community and agency consultations (See Chapter 2.9 "Stakeholder Consultation") as well as from the planning team's numerous coordination meetings with BWS and DPP. Like the "Projects with Champions," the watershed management strategies are grouped by geographic location. However, the majority of the watershed management strategies presented below are applicable to all areas of Ko'olau Poko.

DISTRICT-WIDE STRATEGIES

District-wide Surface Water Management Strategies

Strategy # 01: Establish "Customized" Stream Buffers for Specific Streams. A no-build set-back or buffer should be established for streams that currently have no development near their banks. Each set-back area should be "customized" and specific for each stream because the extent of flooding for each stream is unique. "Customized" stream buffers are also needed because impacts on stream health and water quality from human activity vary depending upon the type of activity near each stream. This strategy would help to mitigate flood damage to private property as well as mitigate human impacts on stream health. **Possible Champions and/or Partners:** Private landowners, DPP, DDC, DFM

Strategy # 02: Concrete Flood Channel Redesign Projects. Streams in urbanized areas of Ko'olau Poko were channelized with concrete to mitigate flood damage to private property, prevent stream bank erosion and sedimentation, and reduce maintenance costs. However, concrete stream banks and stream beds have had adverse impacts on natural habitats for aquatic species. Native aquatic species in particular have been severely impacted by concrete stream channels as the concrete lining eliminates the pools, runs, and riffles that native fish and invertebrates prefer as habitat and the flat wide bottoms spread out stream flow reducing oxygen content and raising water temperatures. Local biologists and agencies have suggested several best management practices be considered for concrete channel redesign projects: permeable linings, natural bottoms, vegetated stream banks, low flow channels, public access and safety, ability to accommodate adequate flood capacity, maintenance considerations (cost and access). **Possible Champions and/or Partners:** DDC, DFM, DAR, USFWS, USACE

District-wide Land Management Strategies

Strategy # 03: Comprehensive Koʻolau Poko Litter and Illegal Dumping Mitigation Program. Throughout the district, there have been many reported incidences of illegal dumping. Several community groups have regularly organized community work days. These work days have removed large quantities of litter and debris. However, there are areas in the district where regular clean ups do not occur and particular areas where dumping frequently occurs. Also groups that have done work days have had to deal with regulatory obstacles such as obtaining permits and paying fees. A comprehensive litter mitigation program should include strategies that prevent litter and illegal dumping, promote community work day clean ups, as well as proposed legislative amendments to help reduce regulatory obstacles. The City and County's "Adopt a Stream" Program is a good resource for community members who are interested in starting clean-up days in their area of the district. A reduction in illegal dumping and litter would mitigate the impacts illegal dumping has on the district's watersheds. **Possible Champions and/or Partners:** ENV, DOT, DTS, DPR, elected officials

Strategy # 04: Native Plant Propagation Program. The planting of native plants is crucial to most watershed restoration and management activities. A healthy forest may be better at "catching" precipitation and fog drip, allowing water to drain to streams as surface flow, or percolate into the ground. Native plants are also more effective in preventing soil erosion in forest areas and along stream corridors than non-native plants. Koʻolau Poko is fortunate to have a native plant nursery that is located in the district (Hui Kū Maoli Ola). This nursery has supplied native plants in many watershed restoration efforts throughout the district and the State. However, there are hundreds of acres of forest, stream corridors, wetland, and coastal areas that would benefit from replanting with natives. While large area native plant reforestation projects are not very feasible or effective, small area replanting projects have been effective in other areas of the island. Landscaping urbanized areas with native plants is also beneficial for water conservation as native plants tend to need less water than non-native plants. More native plants need to be propagated. **Possible Champions and/or Partners:** DOFAW, Koʻolau Mountain Watershed Partnership, DPP, DPR

Strategy #05: Establish Alien Plant Control Programs. Invasive alien plants are a problem throughout the district's watersheds. Future alien plant control programs should consider the following basic types of approaches to control invasive alien plants: 1) *Mechanical control* – the physical removal of invasive plants through pulling, digging, chopping or girdling; 2) *Chemical control* – the application of herbicides to kill invasive plants; and 3) *Biological control* – the use of predators or disease organisms of invasive pests to eradicate targeted weeds.[i] Different types of alien plants in different types of environments need to be controlled through different types of methods or through a combination of different methods as each method has inherent positive and negative aspects. Also, if improperly implemented, a control method may not be effective or may even cause additional unintended damage to ecosystems. **Possible Champions and/or Partners:** DOFAW, Koʻolau Mountain Watershed Partnership, Oʻahu Invasive Species Council

Strategy #06: Establish New Fencing Exclosures in High Priority Watershed Areas for Feral Pig Control. Fencing is an effective method of feral pig control in high priority watershed areas such as riparian zones, critical habitats for endangered species, and native forests. Fence projects would help to prevent water quality degradation of streams, protect threatened and endangered plants, reduce soil compaction, and maintain soil productivity.[ii] Fenced exclosures should prevent pigs from entering critical watershed areas, but the design of a fenced exclosure could allow people to access these areas. Latched gates could be a design consideration for a fenced exclosure. **Possible Champions and/or Partners:** DOFAW, Koʻolau Mountain Watershed Partnership

Strategy # 07: Coordinate Pig Hunting Programs. Feral pigs contribute to soil erosion and loss of native forests as herds destroy vegetated areas and create areas of barren soil. Feral pigs have also been sighted in agricultural areas and *mauka* residential areas. Pig populations in the district have been increasing according to anecdotal accounts from residents. There are several private land owners in the district such as Kualoa Ranch that have allowed pig hunters access to their lands. Hunting programs are an effective method for reducing pig populations. However, hunting programs need to coexist with other *mauka* activities such as hiking or gathering in a safe coordinated manner for the benefit of all. Coordinated pig hunting programs will reduce pig populations and help encourage the growth of healthy native forests. **Possible Champions and/or Partners:** DOFAW, Koʻolau Mountain Watershed Partnership, Kualoa Ranch

Strategy #08: Minimize the Impacts of Small Mammals on Watershed Resources. Rats, cats, and mongoose pose threats to watershed health, especially to native bird species. Appropriate small mammal control methods include traps, bait, toxicants, repellants and barriers. These types of control methods are most effective in areas that are in close proximity to habitats for native species.[iii] **Possible Champions and/or Partners:** DOFAW, Koʻolau Mountain Watershed Partnership

Strategy #09: Restrict Off-Road Recreational Vehicles in *Mauka* Areas. The use of recreational off-road vehicles in the *mauka* areas of the district's watersheds contribute to soil erosion and increase run-off into streams. Frequent use of off-road recreational vehicles may also damage the root systems of plants and destroy existing areas of vegetation. In the Kahaluʻu NB Area, there have been recent reports of off-road vehicles "mud-bogging" in area streams. This activity in particular is very destructive to stream eco-systems as these vehicles destroy stream bottoms and banks with their use. **Possible Champions and/or Partners:** DOCARE, HPD, private landowners, neighborhood watch organizations

Strategy #10: Convert Cesspools to Septic Tanks to Protect Estuaries and Aquifers. There are several residential areas in Ko'olau Poko that are not connected to the City and County municipal wastewater system. These residences are located in the district's rural areas and a significant number of homes utilize cesspools to dispose of wastewater which may contribute to surface water or ground water contamination as wastewater may leach into fresh water sources that are in close proximity to cesspools. Septic tanks would reduce the possibility of wastewater from leaching into fresh water sources. **Possible Champions and/or Partners:** ENV, DOH

Strategy #11: Preserve and Restore the Forested Areas Above Groundwater Sources. BWS has established "pass" areas where sedimentary caprock is thick enough to prevent contaminants from leaching into the underlying basalt; thus, waste disposal into the ground is allowed in these areas. Waste disposal is not allowed in "no pass" zones. A related DOH program, the Source Water Assessment and Protection (SWAP) Program requires the State to delineate the boundaries of areas providing source waters for public water systems and identify the origins of regulated and unregulated contaminants in the delineated area to determine the susceptibility of public water systems to such contaminants. Fortunately in Ko'olau Poko, contamination of drinking water sources has not been a major issue as all of the BWS ground water sources in the district are located near the base of the Ko'olau Mountain Range in conservation areas and away from developed lands. Since there is a low risk of future ground water contamination in Ko'olau Poko and Ko'olau Poko ground water *quality* is already very high, future emphasis should be placed on efforts to not only preserve existing forest areas, but also restore areas of native forest in order to enable more ground water recharge and enhance water *quantity*.

District-Wide Implementation Strategies

Strategy #12: Develop an Efficient Alternative Process that Assists the Kāne'ohe Bay Regional Council with Implementation of the Kāne'ohe Bay Master Plan. The Kāne'ohe Bay Regional Master Plan was adopted by the Office of State Planning (now known as the Office of Planning) in 1992. The plan outlined actions and strategies that should be implemented to improve the health of Kāne'ohe Bay. Major recommendations in the plan centered around two resource management areas: 1) Land use influences on riparian and marine water quality and 2) In water uses of Kāne'ohe Bay. The Kāne'ohe Bay Regional Council (KBRC), an advisory council consisting of two DLNR staff and seven community members, created by the plan to assist with plan implementation, was nearly dissolved by the Legislature in 2009. Subsequent legislation passed by the Legislature in 2010 has preserved the KBRC but limits the KBRC to only one meeting per year, making it very difficult for the KBRC to implement elements of the plan. An alternative process that supports agency and community implementation and updating of the master plan needs to

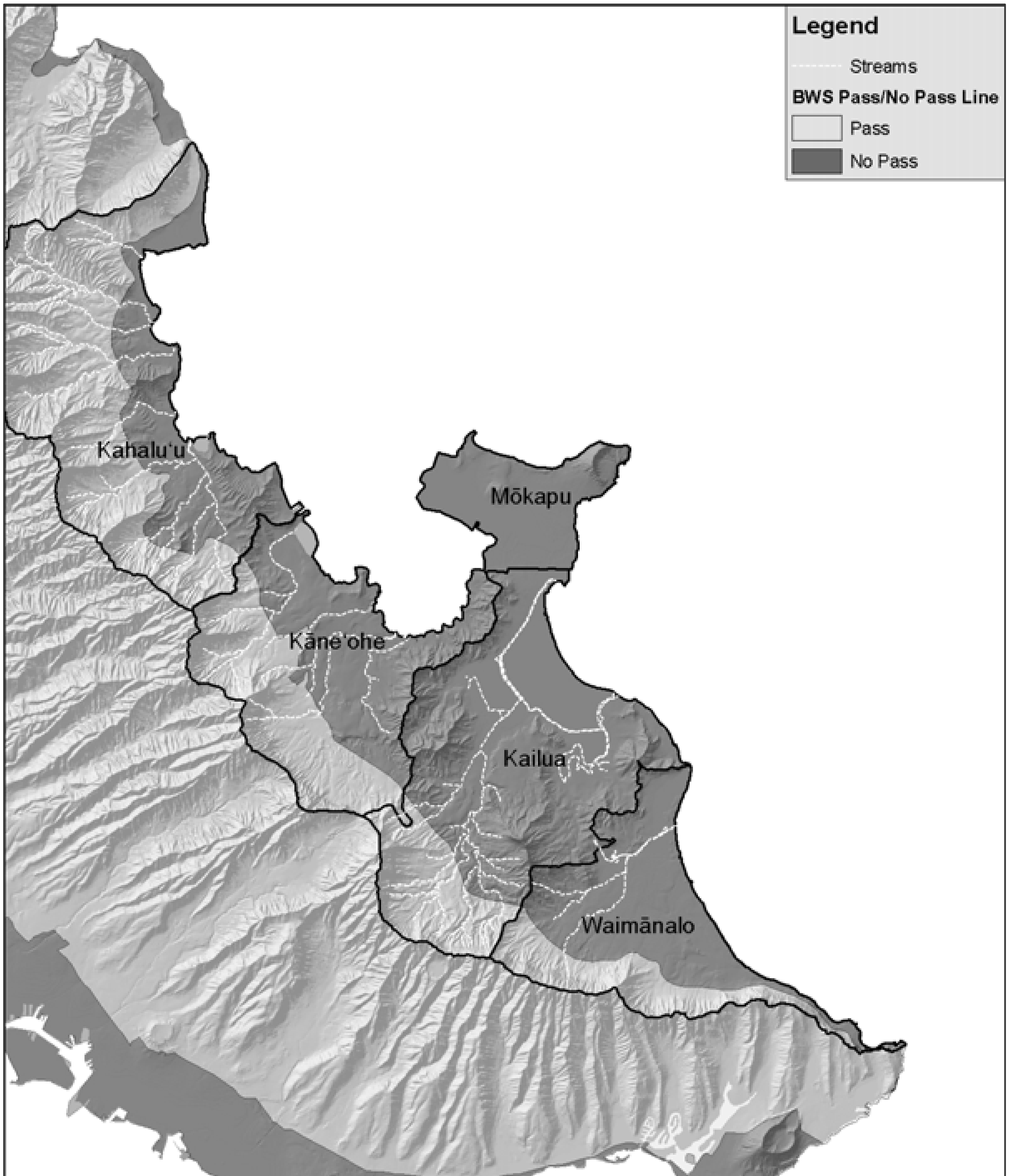


Figure 4.2 BWS Pass/No Pass Areas

Source:
Honolulu Board of Water Supply (2005).
Pass/No Pass line defined in the 1970s.

be developed in order to assist the KBRC with its duties. **Possible Champions and/or Partners:** Friends of Kāneʻohe Bay, DLNR, elected officials

Strategy #13: Create and Maintain a "Directory" of Koʻolau Poko Community Organizations and Groups. One of Koʻolau Poko's unique resources is the many community organizations and groups that are actively involved in management and stewardship of the district's natural and cultural resources. A regularly maintained "directory" of community groups that describes each group's mission and current activities as well as contact information for the organization or group would be a useful resource for both community members who would like to participate in these group activities as well as government agencies that seek community partners or community input on cultural and natural resource management projects or programs. CZM's 2010 "Community Stewardship Directory" would be a good template for a Koʻolau Poko specific community organization directory. **Possible Champions and/or Partners:** Office of Planning CZM Program, community groups

Strategy #14: Establish a Stream Signage Program to Educate the Public About Stream Processes and Characteristics. Similar to the goals of the *Ahupuaʻa* Boundary Marker Project (see Project #4), a stream signage program would help to educate the general public about the particular characteristics of the major streams in the district, threats that may impact a particular stream, and simple strategies or best management practices that community members can implement to mitigate those threats. Stream signage could also include contact information for groups or agencies that are involved in stream stewardship for those interested in joining stream stewardship efforts. **Possible Champions and/or Partners:** DAR, ENV, DPR, DPP, DTS, DOT, USGS

District-wide Cultural Resources / Traditional Practices Strategies

Strategy #15: Conduct Koʻolau Poko Oral History Studies. Watershed or *ahupuaʻa* management by Native Hawaiians involved information acquired during a relationship with the *ʻāina* (land) that developed over hundreds of years. In more recent history, families that worked the plantations also had an intimate understanding of the landscape. Much of the knowledge and information may be lost with the passing of older generations and elders. Recording the oral histories of Koʻolau Poko will provide an opportunity to utilize local knowledge for sound decision making in resource management while preserving the legacy and traditions of its people and places. **Possible Champions and/or Partners:** OHA, Koʻolaupoko Hawaiian Civic Club, Kailua Hawaiian Civic Club, Waimānalo Hawaiian Civic Club, Windward Community College, SHPD, UH Center for Hawaiian Studies, UH Center for Oral History

Strategy #16: Promote *Kalo* Restoration Projects. In several Koʻolau Poko communities, there are active areas of *kalo* cultivation. There are also several groups and organizations that are interested in restoring more areas for *kalo* cultivation in the district. Opportunities exist to open small, manageable plots for food production, cultural, and educational purposes. Many groups have moved into the educational aspect of *kalo*, coupling agricultural work with educational programs. However, interested farmers may lack land ownership and/or access to existing *kalo* fields on either private or public lands or may lack access to adequate water supply for irrigation. Land owners, agencies, and interested farmers should work towards finding feasible solutions to these barriers in order to promote *kalo* restoration. **Possible Champions and/or Partners:** OHA, DOA, CTAHR, private land owners

Strategy #17: Conduct Periodic Surveys of Active *Loʻi* to Use as Future Baseline Data for Monitoring and Evaluation. Aerial photo analysis and "ground truthing" were used in this plan to estimate existing acreages of *loʻi kalo* cultivation. Similar surveys conducted periodically would help to monitor future growth or decline of *kalo* cultivation in Koʻolau Poko and better assess the viability and success of *kalo* restoration projects in the district. **Possible Champions and/or Partners:** Office of Planning, DPP, DOA, CTAHR, OHA

District-wide Water Supply Strategies

Strategy #18: Utilize More Surface Water for Agricultural Irrigation. Koʻolau Poko has 13 perennial streams. There is some potential to utilize Koʻolau Poko stream water as a future water supply for agriculture such as wetland *kalo* cultivation, particularly in areas that are within close proximity of streams. However, Instream Flow Standards must be established prior to any major new diversions of stream water being permitted (except for users with appurtenant rights) in order to ensure that the surface water use is not detrimental to the ecosystems that are dependent upon an adequate level of stream flow (see Project #5). **Possible Champions and/or Partners:** CWRM, DOA, Private farmers

Strategy #19: Develop groundwater wells to provide additional water for diversified agriculture. Koʻolau Poko has two aquifer system areas. The Koʻolau Poko ASYA has a sustainable yield of 30 mgd. Currently, CWRM permits ground water use in the Koʻolau Poko AYSA up to 15.312 mgd. The Waimānalo ASYA has a sustainable yield of 10 mgd. and CWRM currently permits groundwater use in the Waimānalo ASYA up to 1.631 mgd. There is potentially a significant amount of groundwater available in Koʻolau Poko's two aquifer system areas to meet some of the future agriculture water demand for diversified agriculture. (See table 3.2) However, developing a groundwater well and distribution system can be cost prohibitive for a small farm. The large capital cost of a groundwater well and distribution system would probably need to be covered by government funding in order to make it more affordable for private farmers. Also, studies should be conducted to make sure that any future proposed groundwater well will not adversely impact area streams. **Possible Champions and/or Partners:** USDA, DOA, CWRM, Private farmers

Strategy #20 Develop an Agriculture Water Use Conservation Plan. Water conservation is often equated with temporary restrictions on water use and is a useful tool during times of service disruptions or drought. However, water conservation programs and plans should also emphasize lasting everyday improvements in water use efficiency and good water management. Benefits of agriculture water conservation plans include: more effective use of available water supply, reduced operating costs for farmers, improved crop yields, improved system and water supply reliability, and reduced impacts from drought. In 2000, the U.S. Bureau of Reclamation developed a guidebook for preparing agricultural water conservation plans "Achieving Efficient Water Management." The guidebook outlines potential planning processes and common agricultural water management BMPs. The guidebook would be a good starting point for a Ko'olau Poko or O'ahu Agriculture Water Use Conservation Plan. **Possible Champions and/or Partners:** USDA, DOA, Windward Soil and Water Conservation District, O'ahu RC&D, CWRM, BWS, Private farmers.

Strategy #21: Implement the Recommendations of the Hawai'i Drought Plan. CWRM updated the Hawai'i Drought Plan in 2005. The plan is intended to serve as a framework within which State and local entities can work together to proactively implement mitigation measures and appropriate response actions during periods of drought for State, County, and private entities. The specific recommended strategies in the drought plan focus on these broad areas: 1) Statewide Water Resources Monitoring and Impact Assessment 2) Development of New and Alternative Water Sources 3) Water Conservation Practices 4) Public Education Awareness and Outreach 5) Watershed Protection Partnerships 6) New drought mitigation legislation and 7) Land use planning drought mitigation policies. **Possible Champions and/or Partners:** CWRM, BWS, DOA, DOFAW, NRCS

Strategy#22: Encourage Gray Water Reuse to Reduce the Amount of Ground Disposal of Wastewater. In 2009, the DOH prepared "Guidelines for the Reuse of Gray Water." DOH has supported water reuse, provided public health is not compromised. Gray water is wastewater that is discharged from showers, washing machines, and sinks that are not used to dispose of food preparation matter or toxic waste. The guidelines were prepared as an informational source for homeowners, land users, contractors, and engineers on the use of gray water in the State. The primary benefit of gray water reuse would be to reduce the amount of water collected in individual waste water systems, reducing the rate at which individual waste water systems reach storage capacity. This would help to mitigate leaching of wastewater from individual waste water systems into fresh water sources. Reuse of gray water would reduce the demand for potable water that may be used for outdoor irrigation and would be another positive benefit of this strategy. The reuse of gray water should be limited to residences on individual wastewater systems. Also, a possible water supply pilot project could be to design a gray water reuse system that uses gray water from beach park showers to irrigate beach park landscaping. A demonstration pilot project could be implemented at one of the district's beach parks. If successful, the project could be applied to other beach parks in the district. **Possible Champions and/or Partners:** DOH, BWS, ENV, DPR

Strategy #23: Encourage Water Efficient Fixtures in Current and Future Development. The BWS toilet low flush rebate program is an example of a successful program that encouraged the use of a more water efficient household fixture. Future programs should continue to provide incentives like the BWS toilet rebate program in order to replace other types of older appliances with newer more water efficient appliances such as shower heads, washing machines, dishwashers, and faucets. Future building codes and design standards should require new development to incorporate appliances that receive high water efficiency ratings. **Possible Champions and/or Partners:** BWS, DPP

Strategy #24: Encourage Low Impact Development Design Concepts in Future Development. Low impact development (LID) is an approach to land development that works with nature to manage storm water as close to its source as possible, thus reducing the amount of polluted run off from entering into storm drains or stream by allowing rainwater runoff from impervious surfaces such as roofs, driveways, walkways, and parking lots the opportunity to be absorbed rather than run-off into streams or storm drains, thus reducing the amount of polluted run-off infiltrating into natural waterways. Future development or re-development in the district should incorporate LID elements into their designs. Common LID design elements include rain gardens, rain barrels, pervious concrete (a.k.a. porous pavement), and bioswales. As a secondary benefit LID also contributes to ground water recharge as more storm water is trapped on land and is absorbed into the ground. Educational demonstration LID projects, such as rain gardens, should also be encouraged. **Possible Champions and/or Partners:** DPP, BWS

Strategy #25: Stormwater Reclamation Projects. In 2008, CWRM developed a handbook for stormwater reclamation and reuse best management practices. The purpose of the handbook was to guide homeowners, developers, and planners for managing stormwater as a resource rather than a nuisance to be discharged to our streams and coastal waters. According to the handbook, the potential capture from a 1,000 square foot stormwater reclamation device could be as much as 46,400 gallons per year depending upon annual rainfall. If several of the BMPs in the handbook were to be required and/or implemented, stormwater could be a potential significant source for non-potable water uses. **Possible Champions and/or Partners:** CWRM, BWS, DPP, ENV, DFM, DDC, DOA, private landowners

KAHALU'U STRATEGIES

Strategy #26: Management and Stewardship of Mōli'i Fishpond. Previously mentioned in the stakeholder outreach section (Chapter 2.10.5.2), Kualoa Ranch, the owner of the fishpond, would like to restore the fishpond, but currently does not have the resources to do so. Suggested strategies to manage the fishpond include identifying community groups or agencies to work with Kualoa Ranch to develop best management practices for the fishpond and also identify private/public/community partnerships to manage the pond. He'eia Fishpond and Waikalua Loko Fishpond management regimes are possible models that could be considered for future Mōli'i Fishpond management. Better management and stewardship of the fishpond could provide opportunities for cultural education programs as well as enhance the district's food security. **Possible Champions and/or Partners:** Kualoa Ranch, Hakipu'u Learning Center, DPR, OHA

Strategy #27: Kahalu'u Neighborhood Board Area Long Range Sustainable Agriculture Plan. Successful sustainability of agriculture in Hawaii is not just dependent upon the preservation of agriculture land and a reliable supply of water. Securing financial capital as well as addressing an aging workforce are other issues future agricultural operations must face. A long range agriculture plan for the Kahalu'u area should outline Kahalu'u specific steps and strategies to address issues that may impede expansion of agricultural activity in the area. The agriculture plan should also include Kahalu'u specific -strategies to ensure that agriculture can successfully operate in harmony with the surrounding environment. An agricultural expansion plan would enhance the district's food security. **Possible Champions and/or Partners:** DOA, CTAHR, NRCS, Windward Soil and Water Conservation District, CWRM, DPP

Strategy #28: Dredge the Kahalu'u Flood Lagoon. Sediment build-up in the Kahalu'u Flood Control Pond is noticeable from the highway. Dredging the pond would help to mitigate future flood events in the area. **Possible Champions and/or Partners:** DFM, DDC, ENV, NRCS, USACE

Strategy #29: Create a Hakipu'u *Ahupua'a* Land Trust. The majority of land in the Hakipu'u Ahupua'a is privately owned by Kualoa Ranch. Several community members would like to be able to access and utilize more of the resources in the *ahupua'a* including *mauka* resources and Mōli'i Fishpond. There is also strong interest from both the community and Kualoa Ranch to develop more natural resource and cultural educational programs in the *ahupua'a*. Agreements such as Memoranda of Understanding between community groups and the land owner that would be beneficial to both the land owner and community members that seek access to improve and or maintain the natural and cultural resources of the *ahupua'a* as well as utilize the resources for educational purposes should be developed. **Possible Champions and/or Partners:** Kualoa Ranch, HLC, OHA

Strategy #30: HHFDC Repair and Upgrade the Waiāhole Valley Water System. The State Hawai'i Housing Finance and Development Corporation (HHFDC) operates and maintains the Waiāhole Valley Water System (WVWS). The system is located in Waiāhole Valley and provides water to residential and agricultural lessees in the Waiāhole Valley Agricultural Park, several other privately owned parcels in Waiāhole, Hawaiian Home Lands lessees, and the Waiāhole Elementary School. The system was originally built in 1989 and is in need of major repairs. Several deficiencies were detected during a system assessment conducted by HHFDC in 2006. Major system deficiencies include insufficient size of the well control tank, problems with the booster pump operation along the northern end of the Waiāhole Valley Road, and leaks in the main reservoir. In addition, the well pumps are almost 20 years old and are susceptible to malfunctioning. Water conservation could be achieved if water delivery becomes more efficient and water loss along the system is reduced. **Possible Champions and/or Partners:** HHFDC, BWS

Strategy #31 Restoration of Heiau and *Lo'i* Terraces in 'Āhuimanu. Community members have reported that there is a *heiau* above the 'Āhuimanu subdivision that is *mauka* of Hui Kelu Street and between Heno Place and Lile Place. The community would like to see this *heiau* restored. Also located in close proximity to the *heiau*, is the site of the "Kahalu'u Taro *Lo'i*", a site on the National Register of Historic Places. The *lo'i* are 900 feet west of the west end of Hui Kelu Street. Efforts to restore the *heiau* should also be combined to restore the *lo'i*. **Possible Champions and/or Partners:** OHA, SHPD, local community organizations

KĀNE'OHE STRATEGIES

Strategy #32: Restore the Estuary Area Near Waikalua Loko Fishpond (presently Bay View Golf Course). Kawa Stream and Kāne'ohe Stream empty into Kāne'ohe Bay near Waikalua Loko Fishpond. The water quality of Kawa and Kāne'ohe Streams has been severely compromised by urbanization and in turn affects the water quality of Kāne'ohe Bay and Waikalua Loko Fishpond. A conservation easement agreement would need to be worked out with the golf course owners. Restoring the estuarine area that water from the two streams can flow into first prior to entering the bay may help to filter out pollutants and improve the near shore water quality. **Possible Champions and/or Partners:** Bay View Golf Course, Pacific American Foundation, Waikalua Loko Preservation Society

Strategy #33: Utilize Water from Ho'omaluhia Reservoir (a.ka. Kāne'ohe Dam) for Irrigation. The reservoir was originally built in the 1960 as a flood mitigation solution and was designed to detain storm waters and prevent flooding downstream. The Ho'omaluhia Reservoir has a storage capacity of 4,500 acre-feet or about 1470 mg. However, storm events have never caused the reservoir to reach full capacity since it was constructed. The Ko'olau Golf Course and Pali Golf Course are situated within 2 miles of the reservoir that could utilize its water for irrigation. The Veterans Cemetery, the Hawaiian Memorial Park Cemetery, and the HPU campus could also potentially use water from the reservoir for non-potable irrigation. Also, there are potential agricultural lands *mauka* of the reservoir and could possibly utilize its water for irrigation. However, even within this distance, the cost to design and construct a system to transport water from the reservoir to these sites may be high. This project would cost (including design and construction) about $4.4 million and would include the following components: 10,000 linear feet of 8 inch PVC pipe; two 700 gpm (1 mgd) pumps; concrete structure to house pumps and control center; electrical equipment and sensors, 50,000 gallon storage tank, and four water meter installations. A more thorough feasibility analysis and market analysis should be conducted to examine potential costs, benefits, and future interest in using water from the Hoʻomaluhia Reservoir for irrigation. **Possible Champions and/or Partners:** BWS, DPR, DDC, DFM, DPP, CWRM, DOH, private land owners

KAILUA STRATEGIES

Strategy #34: Increase MCBH WWTP Capacity to Recycle Wastewater to R-1 Water Quality Standards. The MCBH WWTP currently recycles 0.5 mgd of water at a R-2 level of water quality. The recycled water is used to irrigate the Klipper Golf Course. Recycled R-1 waste water from the MCBH WWTP facility could be used to supplement other MCBH non-potable water needs and would allow for spray irrigation of common areas. R-2 restrictions limit use to only sections of the golf course that have large buffer areas from other activities. **Possible Champions and/or Partners:** MCBH

Strategy #35: Maintain "Green Spaces" in Kailua. Large "green space" open areas in Kailua provide valuable ecological contributions to the area. Green open areas provide habitats for native plants and animals as well as allow rain water to collect and percolate into the ground rather than run-off into storm drains or streams. Notable specific "green spaces" that should remain open include the eastern side of Puʻu o Ehu, the slopes of Mount Olomana, and the undeveloped areas of Maunawili Valley. The eastern side of Puʻu o Ehu is a poor site for development because it has unstable soils. Recent construction and grading activities on the *makai* slopes of Mount Olomana have contributed significant amounts of sediment run-off into Kaʻelepulu Pond, turning the pond red after storm events. No further development should be allowed on the slopes of Mount Olomana. "Gentlemen estate" developments have been proposed in Maunawili Valley. If constructed, these "gentlemen estates" could greatly impact the natural watershed functions of the Maunawili Valley and its stream systems which would cause a related negative impact on Kawainui Marsh as the health of the marsh is dependent upon the health and well-being of the *mauka* areas of Maunawili. **Possible Champions and/or Partners:** DPP, Lani-Kailua Community, Kailua Outdoor Circle.

WAIMĀNALO STRATEGIES

Strategy #36: Waimānalo Long Range Sustainable Agriculture Plan. A long range sustainable agriculture plan is needed. The creation of a Waimānalo Long Range Agriculture Plan should outline specific steps to address preservation of agriculture land, securing reliable and adequate water sources, securing financial capital, and address developing an adequately trained future workforce. The Waimānalo Long Range Agriculture Plan should include Waimānalo specific steps and strategies that address issues that may impede agricultural activity in the area. **Possible Champions and/or Partners:** DOA, CTAHR, NRCS, Windward Soil and Water Conservation District, CWRM, DPP, Waimānalo Agricultural Association

Strategy #37: Implement the NRCS "Alternatives for Restoration of Waimānalo Stream" Report. The 2005 NRCS report included 10 preliminary suggestions for areas to concentrate future Waimānalo Stream restoration efforts including: 1) Grade stabilization at specific points in the stream; 2) Localized bank stabilization; 3) Obstruction removal; 4) Maintenance of culverts at specific points in the stream; 5) Establish setbacks and buffers (similar to Strategy #1); 6) Trash removal; 7) Sediment load reduction; 8) Native fish and invertebrate habitat restoration; 9) Kailua reservoir modification/restoration (see Strategy #29) and 10) Installation of low flow channels, vanes, or other roughness features in concrete channelized sections of the stream. Implementation of the recommendations from this report would help to improve the water quality and overall health of Waimānalo Stream. **Possible Champions and/or Partners:** Private land owners, DFM, DDC, ENV, DOH, DAR, NRCS

Strategy #38: Establish a Waimānalo Community Composting Facility to Dispose of Animal Wastes. Livestock are common in Waimānalo's agricultural areas. However, the streams and the near shore waters of Waimānalo Bay have excessive amounts of nutrients, some of which can be linked to animal feces. Anecdotal accounts from community members report that heavy rains wash "piles of animal feces" left in open fields or along roadways into streams which drain into the bay. Establishing a community composting facility to deposit animal waste would mitigate this problem. People could dispose of the animal wastes and other people would then have access to fertilizer. This strategy may help to reduce the amount of pollutants from animal wastes entering Waimānalo's streams and nearshore waters. **Possible Champions and/or Partners:** ENV, DOA, Waimānalo Agricultural Association

Strategy #39: Convert the DOA Kailua Reservoir to a Sediment Retention Basin. This reservoir could be returned to DLNR. The reservoir could be restored as a sediment basin which would help reduce sedimentation and run-off into the bay. However, the conversion of the reservoir into a sediment basin will not solve all of the streams' erosion or flooding problems. In particular, flooding problems associated with Waimānalo Stream will not be significantly mitigated by conversion of the Kailua Reservoir into a sediment retention basin because the reservoir's capacity is too small to handle large storm events. Other mitigation measures that are suggested in the NRCS "Alternatives for Restoration of Waimānalo Stream" report (see Strategy #29) need to be a part of the solution to improve the water quality and health of Waimānalo Stream. **Possible Champions and/or Partners:** DOA, DLNR

END NOTES

[i] Ko'olau Mountain Watershed Partnership. 2002. Ko'olau Watershed Partnership Management Plan. p. 45-46.
[ii] Ko'olau Mountain Watershed Partnership. 2002. Ko'olau Watershed Partnership Management Plan. p. 48.
[iii] Ko'olau Mountain Watershed Partnership. 2002. Ko'olau Watershed Partnership Management Plan. p. 50

CHAPTER 5 – IMPLEMENTATION

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5 IMPLEMENTATION

5.1 INTRODUCTION

This final chapter of the *Ko'olau Poko Watershed Management Plan* provides guidance on how to implement many of the important elements of the KPWMP.

The material in this chapter is selective in nature; the intent was NOT to compile a comprehensive, exhaustive inventory of implementation tools and techniques. The KPWMP will be updated and revised from time to time. These periodic updates will provide opportunities to revise and refine watershed data, analysis of important trends and issues, water demand projections, and implementation strategies.

This Chapter thus presents implementation guidance for the KPWMP in 4 sections:

5.2 Water Use and Development Plan
5.3 Phasing and Funding of "Projects with Champions"
5.4 Watershed Management – Critical Watersheds and Catalyst Projects
5.5 Implementation and Funding: Sources and Strategies

The section on "Implementation and Funding" includes a discussion of a **"Dedicated Funding Source" for watershed projects and programs**. This material is preliminary in nature, and is intended to stimulate discussion and debate on how best to provide significant resources for implementing management projects and strategies for critical watersheds throughout the State of Hawai'i.

Implementation of complex plans like the KPWMP faces many challenges, including:

- Limited legal and jurisdictional authority of the many public agencies that need to be involved in implementing elements of the plan;

- Institutional barriers and a resulting need for increased inter-agency and inter-governmental coordination for more meaningful watershed management actions;

- Lack of land control for most of the non-profit organizations that are champions for specific resource management and ecosystem restoration projects;

- Limitations of funding from both public and private funding sources;

- Need for more information and awareness within the community about the complex interaction of land and water resources and land and water uses.

These challenges will not be overcome within the next 5 or 10 or even 20 years. However, there is a growing awareness among public agencies, elected officials, educators, and the general public of the critical importance of learning how to be good stewards of our precious land and water resources.

This kind of awareness – and resulting natural resources conservation and restoration ACTIONS – is especially critical for a small, isolated, island state like Hawai'i. Our fresh water resources are limited to the rains that fall on our few thousand square miles of land. Careful stewardship of our precious land and water resources is essential for a sustainable Hawai'i.

5.2 WATER USE AND DEVELOPMENT PLAN

The "WATER USE AND DEVELOPMENT PLAN" that is presented in the following pages is based on the natural and cultural resources information contained in Chapter 2 of the KPWMP, and on the "WATER DEMAND PROJECTIONS" that are detailed in Chapter 3.

The WATER USE AND DEVELOPMENT PLAN section of the KPWMP thus includes:

- A tabular presentation of THREE SCENARIOS for future water demand and water supply: "Low Growth," "Mid-Growth," and "High Growth." The "Low Growth" scenario is based on population and job projections developed by DPP that reflect the City's "low growth" policies for Ko'olau Poko. The "low growth" scenario is the "preferred scenario" for the KPWMP. The reader is referred to Chapter 3 and to Appendix E for a detailed discussion of how the water demand numbers for the three scenarios were calculated. Some of the water supply numbers were presented in Chapter 2 of the KPWMP; other water supply numbers are presented for the first time in this section.

- A narrative section that explains some of the key assumptions that were used to develop the three demand/supply tables.

Table 5.1 summarizes the following three tables that show water demand and supply under the Low-Growth (Table 5.2), Mid-Growth (5.3), and High-Growth (5.4) scenarios.

Table 5. 1 Summary of Koʻolau Poko Water Demand and Supply
Note: water quantities are in million gallons per day (mgd)

	"Existing" (2000)	Low Growth (Selected Demand Scenario) 2030	Mid Growth 2030	High Growth 2030
Demand: BWS System	20.339[1]	19.535	19.936	20.337
Demand: Non-BWS Systems	9.655[2]	12.811	17.609	23.234
Supply: BWS System	25.433	24.172	24.192	24.212
Supply: Non-BWS Systems	9.373	16.379	22.753	28.843
Supply vs. Demand: BWS	**+5.094**	**+4.637**	**+4.256**	**+3.875**
Supply vs. Demand: non-BWS	**-0.282**	**+3.568**	**+5.144**	**+5.609**

[1]BWS metered consumption. Includes 0.5 mgd exported to East Honolulu
[2] Estimated demands

The overall conclusions from the analysis of future water demands and potential future water sources/supplies are that:

- There is adequate water resource supply to meet the selected Low Growth Demand Scenario as well as the Mid and High Growth Scenarios to the year 2030. There is adequate ground water sustainable yield to meet BWS system demands, diversified agriculture demand, and streamflow to meet significant *kalo* cultivation expansion demands. Additional *kalo* acreage may be deemed developable as further studies are done to refine data for specific stream system flows, *kalo* water demands, and land use affecting available streamflow.

Table 5. 2 Ko'olau Poko Low-Growth Scenario: Projected Demand and Supply Options

DEMAND (all units in mgd)	2000	2010	2015	2020	2025	2030
BWS System	**20.339**	**19.665**	**19.972**	**19.966**	**19.767**	**19.535**
Potable Demand (ground water)	18.008	17.632	17.914	17.909	17.726	17.512
Non-Potable Demand (ground water)	1.831	1.533	1.558	1.557	1.541	1.523
Potable Export to E. Honolulu (ground water)	0.500	0.500	0.500	0.500	0.500	0.500
State Systems	**0.657**	**0.657**	**0.657**	**0.657**	**1.854**	**2.035**
Potable Demand (ground water)	0.052	0.063	0.063	0.063	0.063	0.063
Non-Potable Demand (ground & surface water)	0.605	0.594	0.594	0.594	1.791	1.972
Federal Systems	**0.550**	**0.550**	**0.550**	**0.550**	**0.550**	**0.550**
Potable Demand (no potable systems)	0.000	0.000	0.000	0.000	0.000	0.000
Non-Potabke Demand (recycled water)	0.550	0.550	0.550	0.550	0.550	0.550
Private Systems	**8.448**	**8.952**	**9.271**	**9.584**	**9.903**	**10.226**
Potable Demand (no potable systems)	0.000	0.000	0.000	0.000	0.000	0.000
Non-Potable Demand (ground & surface water)	8.448	8.952	9.271	9.584	9.903	10.226
TOTAL DEMAND	**29.994**	**29.824**	**30.450**	**30.757**	**32.074**	**32.346**
SUPPLY (all units in mgd)	**2000**	**2010**	**2015**	**2020**	**2025**	**2030**
BWS System	**25.433**	**23.790**	**23.886**	**23.981**	**24.076**	**24.172**
BWS Permitted Use (ground water)[1]	16.595	16.595	16.595	16.595	16.595	16.595
KL Import (Long-Term SY Goal)	8.838	7.000	6.900	6.800	6.700	6.600
BWS Conservation[2]	0.000	0.195	0.391	0.586	0.781	0.977
Balance = Supply - Demand	**5.094**	**4.125**	**3.914**	**4.015**	**4.309**	**4.637**
State Sources	**0.551**	**0.592**	**1.292**	**1.333**	**2.074**	**2.352**
Ground Water[3]	0.075	0.075	0.135	0.135	0.135	0.372
Surface Water[4]	0.476	0.476	1.076	1.076	1.076	1.076
Recycled Water[6]	0.000	0.000	0.000	0.000	0.700	0.700
Water Conservation[7]	0.000	0.041	0.081	0.122	0.163	0.204
Balance = Supply - Demand	**-0.106**	**-0.065**	**0.635**	**0.676**	**0.220**	**0.316**
Federal Systems	**0.550**	**0.550**	**0.550**	**0.550**	**0.550**	**0.550**
Recycled Water	0.550	0.550	0.550	0.550	0.550	0.550
Balance = Supply - Demand	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Private Systems	**8.035**	**11.472**	**11.974**	**12.471**	**12.972**	**13.478**
Ground Water - Permitted Use	0.861	0.861	0.861	0.861	0.861	0.861
Ground Water - Future permit(s) required	0.000	3.006	3.081	3.151	3.226	3.304
Surface Water - Existing use	7.174	7.174	7.174	7.174	7.174	7.174
Surface Water-Future IFS amendments req for kalo[8]	0.000	0.244	0.484	0.725	0.965	1.206
Water Conservation[9]	0.000	0.187	0.373	0.560	0.746	0.933
Balance = Supply - Demand	**-0.413**	**2.520**	**2.703**	**2.886**	**3.069**	**3.252**
TOTAL SUPPLY	**34.569**	**36.404**	**37.702**	**38.335**	**39.672**	**40.551**
Balance = Supply - Demand	**4.575**	**6.580**	**7.252**	**7.577**	**7.598**	**8.205**

Table 5.2 Footnotes

1 BWS PU includes pending permit requests for Waiheʻe Tunnel (4.5 mgd) and Inclined Wells (0.5 mgd), and Waimānalo III well (0.3 mgd)
2 BWS conservation goal = 5% of 2030 demand by the year 2030
3 From June 2010 Island Water Use Permit Index (non-saltwater caprock). Withdrawals (0.87 mgd) currently exceed SY (0.75 mgd). Expect that the recommendation that PU for WVWS be increased to 0.135 mgd will occur by 2015.
4 Due to water loss, only 0.4 mgd flows into the WIS reservoir; planned repairs by 2015 are expected to increase supply by 1.0 mgd. State Hospital diverts Keaʻahala Stream for their *loʻi* – recorded demand is from BWS survey (2009).
5 State conservation goal = 10% of 2030 demand by the year 2030.
6 Future IFS amendment = increase in surface water demand over existing use (2000)
7 Ag conservation goal = 10% of 2030 private diversified agriculture and kalo demand by the year 2030.
8 Future IFS amendment = increase in surface water demand
9 Agricultural conservation goal = 10% of 2030 private diversified agriculture and kalo demand (using 100,000 gad) by 2030.

Figure 5. 1 Koʻolau Poko Projected Water Supply and Demand – Low-Growth Scenario

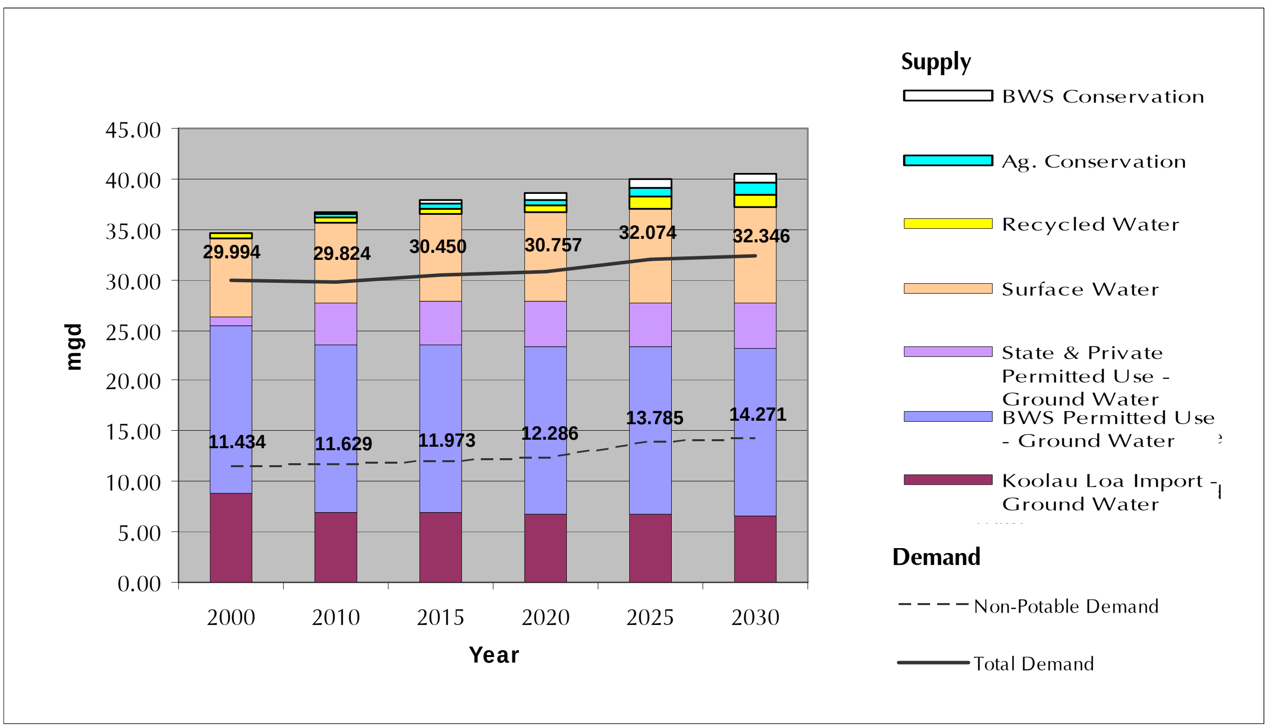


Table 5. 3 Ko'olau Poko Mid-Growth Scenario: Projected Demand and Supply Options

DEMAND (all units in mgd)	2000	2010	2015	2020	2025	2030
BWS System	**20.339**	**19.872**	**20.016**	**19.925**	**19.778**	**19.936**
Potable Demand (ground water)	18.008	17.822	17.955	17.871	17.736	17.881
Non-Potable Demand (ground water)	1.831	1.550	1.561	1.554	1.542	1.555
Potable Export to E. Honolulu (ground water)	0.500	0.500	0.500	0.500	0.500	0.500
State Systems	**0.657**	**0.657**	**0.657**	**0.657**	**0.756**	**0.954**
Potable Demand (ground water)	0.052	0.063	0.063	0.063	0.063	0.063
Non-Potable Demand (ground & surface water)	0.605	0.594	0.594	0.594	0.693	0.891
Federal Systems	**0.550**	**0.550**	**0.550**	**0.550**	**0.550**	**0.550**
Potable Demand (no potable systems)	0.000	0.000	0.000	0.000	0.000	0.000
Non-Potabke Demand (recycled water)	0.550	0.550	0.550	0.550	0.550	0.550
Private Systems	**8.448**	**10.546**	**11.952**	**13.427**	**14.767**	**16.105**
Potable Demand (no potable systems)	0.000	0.000	0.000	0.000	0.000	0.000
Non-Potable Demand (ground & surface water)	8.448	10.546	11.952	13.427	14.767	16.105
TOTAL DEMAND	**29.994**	**31.625**	**33.175**	**34.559**	**35.851**	**37.546**
SUPPLY (all units in mgd)	**2000**	**2010**	**2015**	**2020**	**2025**	**2030**
BWS System	**25.433**	**23.794**	**23.894**	**23.993**	**24.092**	**24.192**
BWS Permitted Use (ground water)[1]	16.595	16.595	16.595	16.595	16.595	16.595
KL Import (Long-Term SY Goal)	8.838	7.000	6.900	6.800	6.700	6.600
BWS Conservation[2]	TBD	0.199	0.399	0.598	0.797	0.997
Balance = Supply - Demand	**5.094**	**3.922**	**3.878**	**4.068**	**4.314**	**4.256**
State Sources	**0.551**	**0.570**	**1.249**	**1.268**	**1.987**	**2.243**
Ground Water[3]	0.075	0.075	0.135	0.135	0.135	0.372
Surface Water[4]	0.476	0.476	1.076	1.076	1.076	1.076
Recycled Water[6]	0.000	0.000	0.000	0.000	0.700	0.700
Water Conservation[7]	0.000	0.019	0.038	0.057	0.076	0.095
Balance = Supply - Demand	**-0.106**	**-0.087**	**0.592**	**0.611**	**1.231**	**1.289**
Federal Systems	**0.550**	**0.550**	**0.550**	**0.550**	**0.550**	**0.550**
Recycled Water	0.550	0.550	0.550	0.550	0.550	0.550
Balance = Supply - Demand	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Private Systems	**8.035**	**13.184**	**14.894**	**16.673**	**18.317**	**19.960**
Ground Water - Permitted Use	0.861	0.861	0.861	0.861	0.861	0.861
Ground Water - Future permit(s) required	0.000	3.745	4.053	4.429	4.669	4.909
Surface Water - Existing use	7.174	7.174	7.174	7.174	7.174	7.174
Surface Water-Future IFS amendments req for kalo[8]	0.000	1.099	2.198	3.297	4.396	5.495
Water Conservation[9]	0.000	0.304	0.608	0.913	1.217	1.521
Balance = Supply - Demand	**-0.413**	**2.638**	**2.942**	**3.246**	**3.550**	**3.855**
TOTAL SUPPLY	**34.569**	**38.098**	**40.587**	**42.485**	**44.947**	**46.945**
Balance = Supply - Demand	**4.575**	**6.473**	**7.412**	**7.926**	**9.096**	**9.399**

Table 5.3 Footnotes

[1] BWS PU includes pending permit requests for Waiheʻe Tunnel (4.5 mgd) and Inclined Wells (0.5 mgd), and Waimānalo III well (0.3 mgd)
[2] BWS conservation goal = 5% of 2030 demand by the year 2030
[3] From June 2010 Island Water Use Permit Index (non-saltwater caprock). Withdrawals (0.87 mgd) currently exceed SY (0.75 mgd). Expect that the recommendation that PU for WVWS be increased to 0.135 mgd will occur by 2015.
[4] Due to water loss, only 0.4 mgd flows into the WIS reservoir; planned repairs by 2015 are expected to increase supply by 1.0 mgd. State Hospital diverts Keaʻahala Stream for their *loʻi* – recorded demand is from BWS survey (2009).
[5] State conservation goal = 10% of 2030 demand by the year 2030.
[6] Future IFS amendment = increase in surface water demand over existing use (2000)
[7] Ag conservation goal = 10% of 2030 private diversified agriculture and kalo demand by the year 2030.
[8] Future IFS amendment = increase in surface water demand
[9] Agricultural conservation goal = 10% of 2030 private diversified agriculture and kalo demand (using 100,000 gad) by 2030.

Figure 5. 2 Koʻolau Poko Projected Water Supply and Demand – Mid-Growth Scenario

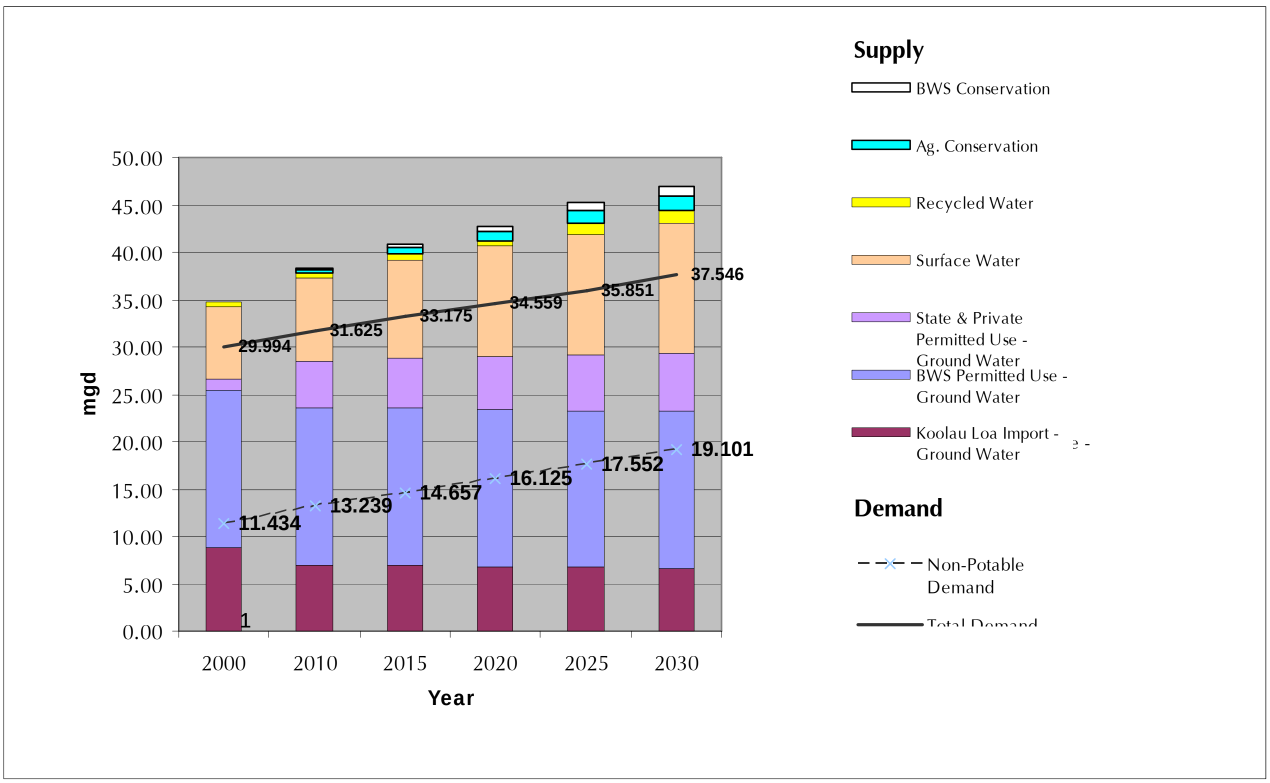


Table 5. 4 Ko'olau Poko High-Growth Scenario: Projected Demand and Supply Options

DEMAND (all units in mgd)	2000	2010	2015	2020	2025	2030
BWS System	**20.339**	**20.102**	**20.082**	**19.907**	**19.812**	**20.337**
Potable Demand (ground water)	18.008	18.034	18.016	17.854	17.767	18.250
Non-Potable Demand (ground water)	1.831	1.568	1.567	1.553	1.545	1.587
Potable Export to E. Honolulu (ground water)	0.500	0.500	0.500	0.500	0.500	0.500
State Systems	**0.657**	**0.657**	**0.657**	**0.657**	**0.855**	**1.051**
Potable Demand (ground water)	0.052	0.063	0.063	0.063	0.063	0.063
Non-Potable Demand (ground & surface water)	0.605	0.594	0.594	0.594	0.792	0.988
Federal Systems	**0.550**	**0.550**	**0.550**	**0.550**	**0.550**	**0.550**
Potable Demand (no potable systems)	0.000	0.000	0.000	0.000	0.000	0.000
Non-Potabke Demand (recycled water)	0.550	0.550	0.550	0.550	0.550	0.550
Private Systems	**8.448**	**18.311**	**19.917**	**20.678**	**21.158**	**21.633**
Potable Demand (no potable systems)	0.000	0.000	0.000	0.000	0.000	0.000
Non-Potable Demand (ground & surface water)	8.448	18.311	19.917	20.678	21.158	21.633
TOTAL DEMAND	**29.994**	**39.619**	**41.206**	**41.792**	**42.375**	**43.571**
SUPPLY (all units in mgd)	**2000**	**2010**	**2015**	**2020**	**2025**	**2030**
BWS System	**25.433**	**23.798**	**23.902**	**24.005**	**24.108**	**24.212**
BWS Permitted Use (ground water)[1]	16.595	16.595	16.595	16.595	16.595	16.595
KL Import (Long-Term SY Goal)	8.838	7.000	6.900	6.800	6.700	6.600
BWS Conservation[2]	TBD	0.203	0.407	0.610	0.813	1.017
Balance = Supply - Demand	**5.094**	**3.697**	**3.819**	**4.098**	**4.297**	**3.875**
State Sources	**0.551**	**0.572**	**1.253**	**1.274**	**1.995**	**2.253**
Ground Water[3]	0.075	0.075	0.135	0.135	0.135	0.372
Surface Water[4]	0.476	0.476	1.076	1.076	1.076	1.076
Recycled Water[6]	0.000	0.000	0.000	0.000	0.700	0.700
Water Conservation[7]	0.000	0.021	0.042	0.063	0.084	0.105
Balance = Supply - Demand	**-0.106**	**-0.085**	**0.596**	**0.617**	**1.140**	**1.202**
Federal Systems	**0.550**	**0.550**	**0.550**	**0.550**	**0.550**	**0.550**
Recycled Water	0.550	0.550	0.550	0.550	0.550	0.550
Balance = Supply - Demand	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Private Systems	**8.035**	**21.059**	**23.080**	**24.256**	**25.151**	**26.040**
Ground Water - Permitted Use	0.861	0.861	0.861	0.861	0.861	0.861
Ground Water - Future permit(s) required	0.000	4.059	4.685	5.446	5.927	6.401
Surface Water - Existing use	7.174	7.174	7.174	7.174	7.174	7.174
Surface Water-Future IFS amendments req for kalo[8]	0.000	8.551	9.530	9.530	9.530	9.530
Water Conservation[9]	0.000	0.415	0.829	1.244	1.659	2.074
Balance = Supply - Demand	**-0.413**	**2.748**	**3.163**	**3.578**	**3.993**	**4.407**
TOTAL SUPPLY	**34.806**	**45.979**	**48.785**	**50.085**	**51.804**	**53.055**
Balance = Supply - Demand	**4.812**	**6.360**	**7.579**	**8.293**	**9.429**	**9.484**

Table 5.4 Footnotes

[1] BWS PU includes pending permit requests for Waiheʻe Tunnel (4.5 mgd) and Inclined Wells (0.5 mgd), and Waimānalo III well (0.3 mgd)
[2] BWS conservation goal = 5% of 2030 demand by the year 2030
[3] From June 2010 Island Water Use Permit Index (non-saltwater caprock). Withdrawals (0.87 mgd) currently exceed SY (0.75 mgd). Expect that the recommendation that PU for WVWS be increased to 0.135 mgd will occur by 2015.
[4] Due to water loss, only 0.4 mgd flows into the WIS reservoir; planned repairs by 2015 are expected to increase supply by 1.0 mgd. State Hospital diverts Keaʻahala Stream for their *loʻi* – recorded demand is from BWS survey (2009).
[5] State conservation goal = 10% of 2030 demand by the year 2030.
[6] Future IFS amendment = increase in surface water demand over existing use (2000)
[7] Ag conservation goal = 10% of 2030 private diversified agriculture and kalo demand by the year 2030.
[8] Future IFS amendment = increase in surface water demand
[9] Agricultural conservation goal = 10% of 2030 private diversified agriculture and kalo demand (using 100,000 gad) by 2030.

Figure 5. 3 Koʻolau Poko Projected Water Supply and Demand – High-Growth Scenario

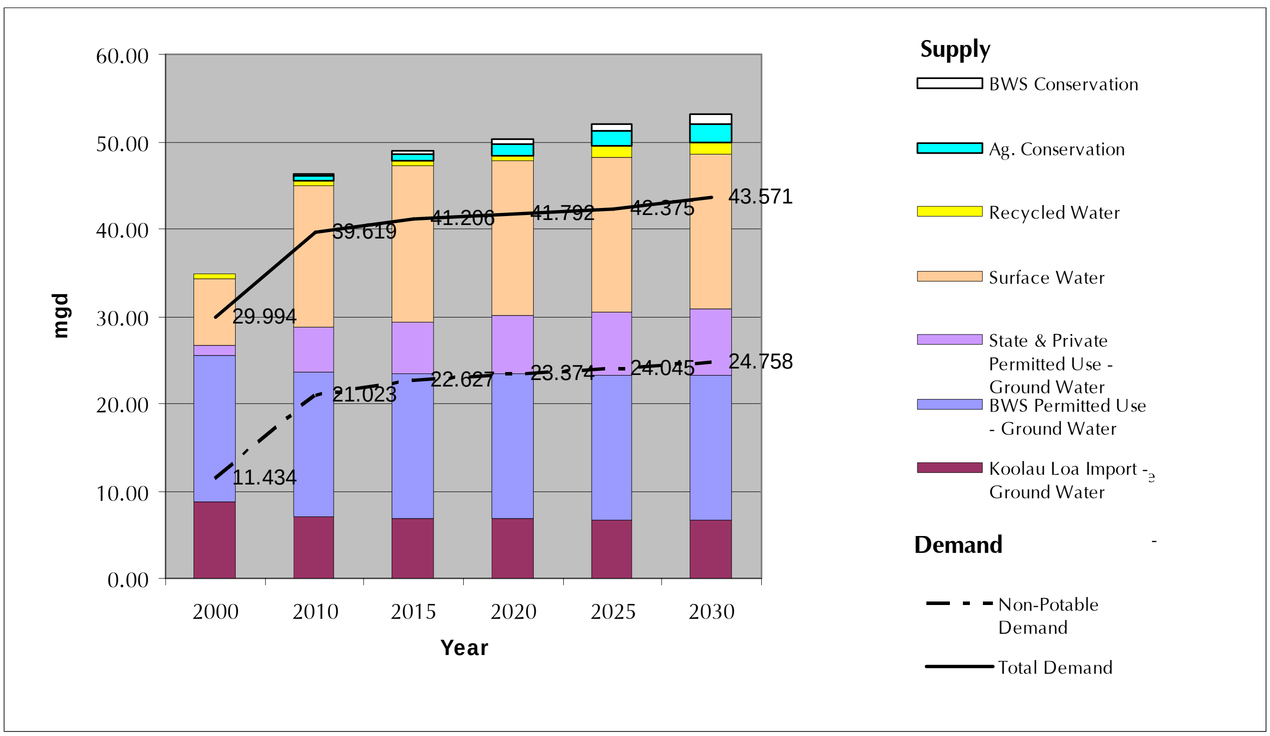


Table 5. 5 Summary of Water Supply Options
For the Selected Demand Scenario: "Low Growth"

WATER SUPPLY OPTIONS		Capital Cost ($/Gal)	Current Use, CY2000 (mgd)	Potential 2030 Use (mgd)	Development Feasibility	Feasibility Notes
GROUND WATER RESOURCES						
	BWS wells in Ko'olau Loa District	$6 – 10+	8.838 (CY 2000)	Possible 2.2 mgd Decrease	High	Additional ground water available within sustainable yields at relatively low cost. New wells in KL could also be developed.
	~~Additional~~ Wells in Ko'olau Poko and Waimānalo ASYAs (BWS/State/City/Private)	$6 – 10+	17.768 [1]	21.132 [2]	Moderate	Additional ground water available within sustainable yields but dike influences and possible stream impacts will increase development costs.
SURFACE WATER RESOURCES						
	Stream and spring diversions	n/a	7.650 [1]	9.932 [3]	Low	Use existing diversions efficiently before proposing new diversions. Appurtenant rights and permit issues present significant challenges.
ALTERNATIVE WATER RESOURCES						
	Waimānalo WWTP Recycled Water	$5 -12	0.00	0.70	Moderate	Costs of additional treatment capacity and distribution system are high.
	MCBH WWTP Recycled Water	$5 -12	0.55	0.55	Moderate	Costs of additional treatment capacity and distribution system are high.
CONSERVATION						
	Conservation and Drought Mitigation Strategies for BWS System	Avoid $6 – 10+ Millions Capital Cost	Saving approximately 1.0	Save approximately additional 1.0	High	Highly feasible
	Conservation and Drought Mitigation Strategies for various agricultural water systems (Waimanalo Irrigation & other smaller private systems)	Costs are site/project specific – including costs for lining or piping irrigation ditches	Unknown	Save approximately 1.1	High	Highly feasible

[1]BWS, State, & Private ground water use (CY 2000)
[2]Projected ground water demand based on Low Growth Scenario (City's "Policy")
[3]Projected surface water demand based on Low Growth Scenario (City's "Policy")

5.2.1 Water Demand/Supply Tables: Some Explanatory Notes

A detailed explanation of the data sources, assumptions, and calculations for the Water Demand Projections is provided in Chapter 3 of this Plan: "WATER USE AND PROJECTED DEMAND." More details for water demand and water supply numbers are provided in Appendix E. Some of the key assumptions and conclusions of the demand/supply analysis are summarized below.

- **There are 3 Water Demand Scenarios**: "Low-Growth," "Mid-Growth," and "High-Growth." These three Water Demand Scenarios were developed in accordance with the CWRM "Framework" for developing County Water Use and Development Plans.

- **BWS System – Potable Demand**: was calculated by multiplying projected population numbers by a constant "per capita demand" number of 175 gallons per person per day (gpd). This "per capita demand" number includes all types of demand for BWS water: domestic, commercial, industrial, institutional, parks, some small farms, and other miscellaneous uses. The per capita demand number of 175 gpd is a Koʻolau Poko-specific number that was calculated for the district's Year 2000 population and BWS records for Year 2000 metered consumption.

- **BWS System – Potable Demand/Low-Growth Scenario**: The demand numbers for the years 2010, 2015, 2020, 2025 and 2030 were calculated by multiplying the projected population for those years, per DPP population projections, by the per capita demand factor of 175 gpd. Note that DPP does NOT develop "Low-Mid-High" population projections. The DPP projections reflect the City's growth policies for each district, which for Koʻolau Poko call for a "stable" population.

- **BWS System – Potable Demand/Mid- and High-Growth Scenarios**: The demand numbers for the High-Growth Scenario were calculated by referring to the General Plan of the City and County of Honolulu, which sets forth policies for each district's "share" of the island's population. The most recently amended General Plan shows Koʻolau Poko with a maximum of 11.6% of the population of Oʻahu. This percentage was used to generate the demand numbers for the High-Growth Scenario. The numbers for the Mid-Growth Scenario were then calculated as mid way between the "High-Growth" and the "Low-Growth" Scenarios.

- **BWS System - Supply:** Total available BWS supply for meeting future demand is calculated using BWS existing permitted use for Koʻolau Poko, plus the pending permit requests for Waiheʻe Tunnel (4.5 mgd), Waiheʻe Inclined Well (0.500 mgd), and Waimānalo Well III (0.3 mgd).

- **State and Federal Systems** – the Demand and Supply numbers for State and Federal water systems are specific to particular land uses and sources, as detailed in the Demand/Supply Tables. The DOA Waimānalo Irrigation System may receive additional water from Waimānalo Well I (0.25 mgd) and from tentatively planned Waimānalo WWTP improvements for 0.7 mgd "R-1" recycled water.

- **Private Systems – For the Low-Growth Scenario**, future demand for irrigation water for Diversified Agriculture and for *kalo* was calculated based on an estimate of 1% per year increase in diversified agriculture and *kalo* lands, and the acreages were then converted to water demand numbers. Note that wetland *kalo* water demand may range from: 100,000 gallons per acre per day (gad) to 300,000 gad. This range of water use for *kalo* reflects the findings of USGS research as well as the experience of Koʻolau Poko *kalo* farmers. The *kalo* water demand numbers here are based on what was determined to be a reasonable per acre estimate of water demand (100,000 gad).

- **Private Systems – Mid- and High-Growth Scenarios** – Diversified Ag and *kalo* demand numbers were calculated for the High-Growth Scenario first, and then the Mid-Growth numbers were set at the mid-point of the Low-Growth and High-Growth Scenarios.

- **For Diversified Ag**, the **demand numbers were based on the still uncultivated good quality farm lands ("ALISH" lands) in Koʻolau Poko** that were identified using 2005 aerial photos and 2009 field verification. For the High-Growth Scenario, it was assumed that **all remaining uncultivated ALISH lands in Koʻolau Poko would be cultivated.** The **water demand numbers** for Diversified Ag were then calculated based on acreage X 3,400 gallons per acre per day (gad) for the drier areas of the District – Waimānalo and Kailua – and 2,500 gad for the wetter areas – Kāneʻohe and Kahaluʻu. Water supply for the expansion of Diversified Ag was assumed to come from ground water sources, both those already permitted and other sources that will require permits from CWRM.

- **For *kalo***, the High-Growth Scenario demand numbers were **constrained** by limitations in the District's stream water resources. It was assumed that existing and future *kalo* is/would be irrigated with stream water – as ground water extraction and transport for *kalo* irrigation would be too costly for *kalo* farmers to use. A somewhat complex set of calculations was performed to derive a number that would represent the maximum amount of Koʻolau Poko stream water that might be available for existing and future wetland *kalo* cultivation. That number was **46 cubic feet per second (cfs)** - which would be the equivalent of about **30 mgd** of combined flows of Koʻolau Poko streams. Given the *kalo* water demand factor of 100,000 gad, **30 mgd of stream flow could provide irrigation for about 300 acres of *kalo* in Koʻolau Poko.** However, as previously noted, these are highly theoretical numbers, as CWRM approvals of new stream diversions for *kalo* or other crops may be difficult to obtain.

Figures 5.4 and 5.5 illustrate "Ground Water Supply/Demand" and "Stream Water Supply/Demand" for the "Low"; "Mid"; and "High" Demand Scenarios, for the year 2030.

Figure 5. 4 Ground Water Supply/Demand

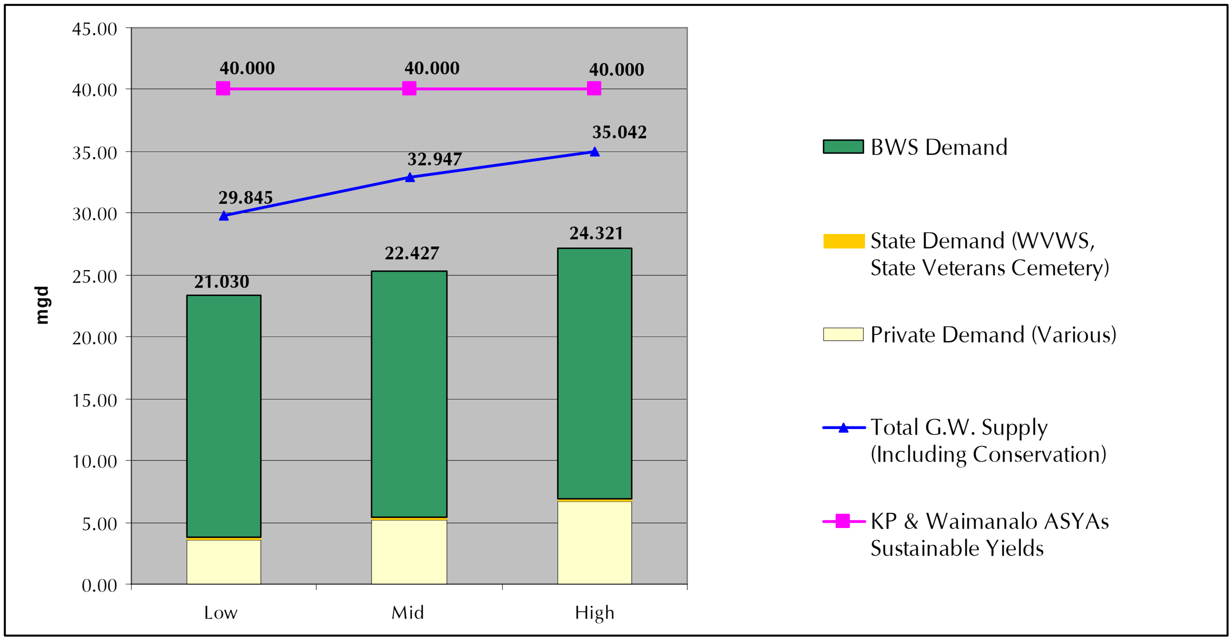
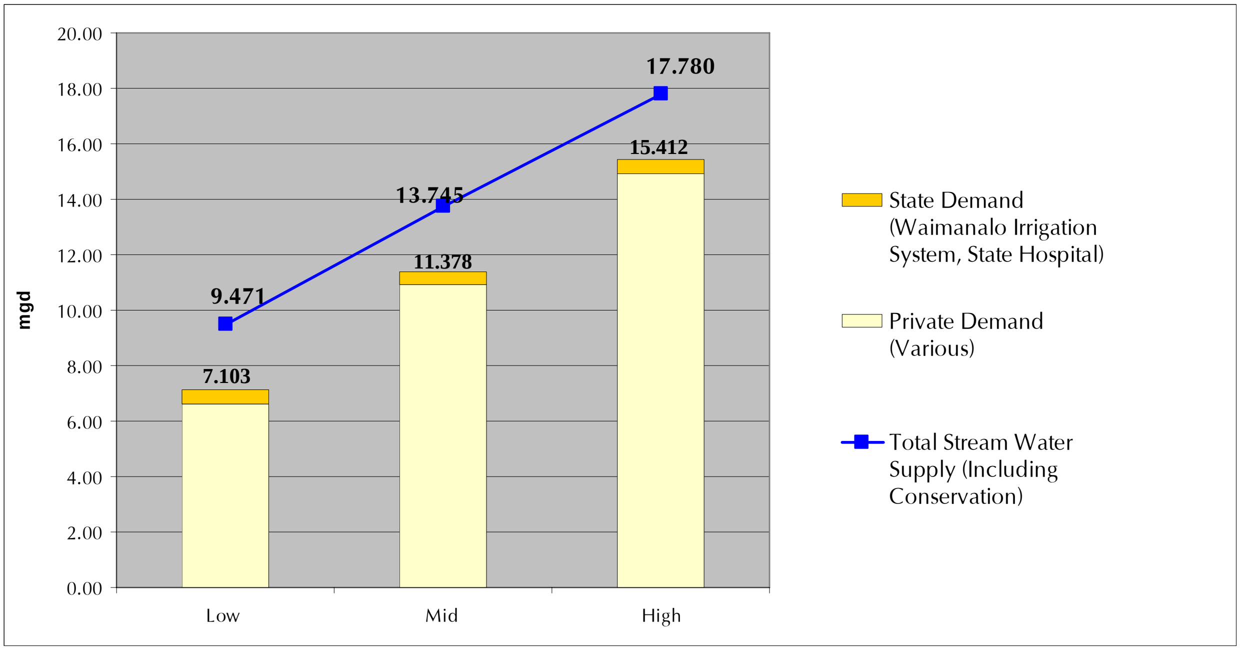


Figure 5. 5 Stream Water Supply/Demand



5.3 PHASING AND FUNDING OF "PROJECTS WITH CHAMPIONS"

5.3.1 Criteria Used to Establish Phasing

Projects were phased based upon the scope and complexity of each project as described by the project champion. Projects were categorized into one of two categories: short-term (1-5 years) and long-term (5+ years). Generally, projects with more "simple" scopes were designated short-term, while projects with "complex" scopes were designated long term projects.

Projects with short-term scopes embody all of the following characteristics:

- Projects that are not intended to be continuous on-going programs
- Projects that have already received funding for 75 percent to 100 percent of total project costs
- Projects that have already received or do not require major permits

Projects with long-term scopes do not embody one or more of the above characteristics.

5.3.2 Projects Phasing Table: Short-Term and Long-Term

The following table summarizes the phasing of the watershed management projects for Ko'olau Poko. The projects are listed in the same order as they were listed in Chapter 4. The table also summarizes the project's current status, short term actions, long-term actions (if applicable), and potential funding sources.

Table 5.6 Watershed Management Project Phasing

Project	Project Duration	Current Status	Short-Term Actions 1-5 Years	Long-Term Actions 5+ Years	Potential Funding Sources
(1) BWS Capital Program	Short-term	• Ha'ikū well renovation • Various water system and water line projects			BWS
(2) BWS Conservation Program	Long-term	• BWS is restructuring its conservation program plan with new programs, tools and staffing resources	• Implement high priority conservation measures	• Continue to expand high priority conservation programs throughout O'ahu	BWS
(3) BWS Pumpage Optimization	Long-term	• BWS has adopted pumpage optimization as a groundwater management and drought mitigation method	• Reduce production from large groundwater sources	• Continue pumpage optimization	BWS
(4) Ko'olaupoko *Ahupua'a* Boundary Marker Project	Short-term	• 16 preliminary sites have been identified as locations for *ahupua'a* markers • Design of *ahupua'a* boundary markers has been completed • Educational information for *ahupua'a* is being developed	• Complete construction of all 16 *ahupua'a* boundary markers • Create and conduct community awareness programs		Castle Foundation OHA
(5) Establish Measurable Instream Flow Standards	Long-Term	• BWS surface water diversion inventory was completed during the summer of 2010	• Conduct public fact gathering meetings in Ko'olau Poko on priority streams (Waihe'e and Maunawili Streams) • Obtain funding to conduct stream studies	• If funding is acquired, conduct in-stream and non-instream studies to develop IFS • Then establish measurable IFS for priority diverted streams: Waihe'e and Maunawili	CWRM

Project	Project Duration	Current Status	Short-Term Actions 1-5 Years	Long-Term Actions 5+ Years	Potential Funding Sources
(6) Hawaiʻi Ocean Resources Management Plan and Global Climate Change Adaptation Framework	Long-Term	• ORMP working group meets monthly	• Establish a climate change "adaptation team" to coordinate planning activities • Develop a long-term vision that identifies island values and needs • Identify planning areas and opportunities relevant to climate change	• Identify and scope potential climate change impacts to major sectors • Conduct climate change risk and vulnerability assessments • Develop plan(s) to mitigate climate change impacts • Implement climate change mitigation plans	CZM
(7) Hawaiʻi Coral Reef Assessment and Monitoring Program	Long-Term	• On-going programs: Kahaluʻu Project; UH UMEB Internship Program	• Coral reef field studies in Kāneʻohe Bay	• Continue on-going programs	HIMB
(8) MCBH Integrated Natural Resources Management Plan	Long-Term	• MCBH INRMP was updated in 2006. • Recommended management actions in the plan are being implemented	• Continue implementation of the INRMP • Update INRMP	• Continue implementation of the INRMP • Update INRMP	MCBH
(9) Implement Requirements of the TMDL Studies for Koʻolau Poko Streams	Long-Term	• Four streams have an approved TMDL • Kaʻelepulu Stream is undergoing TMDL development	• Complete Kaʻelepulu Stream TMDL • Complete Kamoʻoaliʻi Stream TMDL • Review and approve monitoring plans for streams with TMDLs	• Review and approve monitoring plans for streams with TMDLs • Implement TMDL recommendations	DOH
(10) Expansion of the Waimānalo Forest Reserve	Short-Term	• DOFAW and Land Division are negotiating terms of lands to be transferred into forest reserve	• Land Division transferred land to DOFAW		DLNR
(11) Waimānalo Irrigation System Improvements & Conservation	Long-Term	• DOA received $6 million in CIP funding for project and is soliciting bids for design and construction.	• Complete Waimānalo Repairs and Upgrades	• Plan, fund, design and implement comprehensive modernization of the Waimānalo Irrigation System	DOA

Project	Project Duration	Current Status	Short-Term Actions 1-5 Years	Long-Term Actions 5+ Years	Potential Funding Sources
(12) Aloha ʻĀina Programs	Long-Term	• 20 loʻi have been opened at its Pikoakea Farm • Developed "farm to cafeteria" program for Oʻahu families • On-going educational programs	• Fund and hire an *Ahupuaʻa* Education Coordinator at Pikoakea • Open additional loʻi	• Develop a *halau* for educational and cultural programs • On-site improvements and infrastructure improvements • Develop a native seed banking program	DOH OHA Private foundations
(13) Waiheʻe Ahupuaʻa Initiative (WAI)	Long Term	• WAI partners have been working on the Waiheʻe Stream fish passage project and conducting periodic volunteer "work trips" in Waiheʻe.	• Vegetative Cover Mapping • Waiheʻe Ahupuaʻa Strategic Plan • Water Resources Information Room • Complete Waiheʻe Stream fish passage project • Demonstration Rain Catchments System at KEY Project	• Waiheʻe Access Improvements • Riparian Zone Learning Center • Kahaluʻu Regional Park Stream Pathways	BWS DPR USFWS HTA Private foundations
(14) Hakipuʻu Learning Center	Long-Term	• HLC is continuing education programs at its "Moʻomona" outdoor laboratory sites	• Fund and develop new physical facilities • Develop partnerships with DAR and NOAA for Kāneʻohe Bay fish catch data program	• Partner with Polynesian Voyaging Society and DPR to develop a voyaging educational center	WCC DAR NOAA DOE HIMB OHA Private foundations
(15) Heʻeia Stream Restoration Project	Short-Term	• Volunteer workdays have been conducted to remove non-native vegetation, install erosion control, and plant native plants	• Complete Heʻeia Stream bank restoration		DOH EPA
(16) Papahana Kuaola	Long-term	• Programs in progress: ʻIliʻilikauhale; Lelekamanu; Hanaloa; Kupualau	• Update its strategic plan and site plan • Clear additional acreages of invasive species and replant with native species • Construct a *kahua* for *hula* practices	• Continue existing and new programs • Hanaloa program becomes economically self-sufficient	Hawaiʻi Community Foundation OHA

Project	Project Duration	Current Status	Short-Term Actions 1-5 Years	Long-Term Actions 5+ Years	Potential Funding Sources
(17) Māhuahua ʻAi o Hoi (Heʻeia Wetland Restoration)	Long-Term	• Non-profit organization Kākoʻo ʻŌiwi signed a 38-year lease with HCDA. • One acre wetland *kalo* demonstration *loʻi* has been developed • Completed Strategic Plan	• Complete a resource management master plan • Create and foster partnerships • Develop and implement protocols for property access • Start educational programs • Obtain Federal, State, City and County permits • Expand demonstration projects • Construct on-site caretaker facility and on-site office and equipment storage facility	• Design and develop a Hawaiian cultural complex and related program activities • Design and develop a *poi* mill, agricultural processing center, and commercial kitchen • On-going land and natural resource management program to restore additional acreages of wetland • Continue and expand educational programs	CZM USACE NOAA OHA HCDA National Science Foundation Castle Foundation Hawaiʻi Community Foundation
(18) Management and Stewardship of Heʻeia Fishpond	Long-Term	• Programs in progress: Physical maintenance (*Kū Hou Kuapā*) of the fishpond; Community-based economic development program is (*ʻĀina Momona*); Education programs and research activities (*Kaʻai Kamahaʻo*); Heʻeia *Ahupuaʻa* Internship	• Continue on-going actions	• Continue on-going actions	Castle-Foundation Hawaiʻi Community Foundation Kamehameha Schools
(19) Hydro-Modification Device Installation in Kahuhipa Street Storm Drain	Short-Term	• Project partners are reviewing final designs	• Complete installation of hydro-modification device		FHWA ENV

Project	Project Duration	Current Status	Short-Term Actions 1-5 Years	Long-Term Actions 5+ Years	Potential Funding Sources
(20) Halawa Luluku Interpretive Development	Long-Term	• Phase 1 (plan phase) almost completed • Phase 2 (Design and development) will begin shortly	• Complete Phase 1 • Complete Phase 2 • Start Phase 3 (Implementation)	• Complete Phase 3	FHWA
(21) Management and Stewardship of Waikalua Loko Fishpond	Long-Term	• Periodic community work days are being conducted • Fishpond utilized as field classroom and training area for teachers in cultural-based curricula	• Waikalua Loko Fishpond Preservation Society acquire ownership of fishpond and dog park • Continue on-going actions	• Continue on-going work days and educational programs at fishpond	HUD
(22) Kokokahi Cultural Learning Center	Long-Term	• Awaiting WLFPS to acquire Waikalua Loko Fishpond site;	• WLFPS acquire ownership of fishpond and dog park • Plan and design Cultural Learning Center • Start implementing Cultural Learning Center plan and design concepts	• Implement Cultural Learning Center plan and design concepts	HUD
(23) Marine Corps Base Hawai'i Water Conservation Program	Long-Term	• Conduct leak detection study • Promote water conservation awareness	• Leak repairs to MCBH water systems • 400 replacement homes outfitted with water efficient fixtures	• Upgrade MCBH WWTP to R-1 effluent quality	MCBH
(24) Management and Stewardship of Kawainui Marsh	Long-Term	• Wetland bird habitat restoration (various sites) • Community workdays (various sites) • Educational and interpretive programs (various sites)	• Complete wetland bird habitat restoration projects • Update Kawainui Marsh Master Plan • Continue workdays, educational, and interpretive programs	• Construct cultural education center • Construct visitor center • Restore sections of marsh for food production	NRCS USACE USFWS DOFAW Castle Foundation
(25) Hāmākua Marsh	Long-Term	• Community workdays • Hāmākua Marsh website developed	• Restore fresh water flow from Kawainui Marsh	• Continue community workdays	DOFAW

Project	Project Duration	Current Status	Short-Term Actions 1-5 Years	Long-Term Actions 5+ Years	Potential Funding Sources
(26) Purchase of Puʻu o Ehu Hillside	Short-Term	• Awaiting State funds to be released	• Finalize purchase agreement with current land owner • Plan and implement appropriate management measures for Puʻu o Ehu	• Implement Management Measures	DOFAW Hawaiʻi-Legacy-Lands-Funds Federal Recovery Lands Acquisition Program
(27) Kailua Beach Management Plan	Long-Term	• Draft management plan being finalized	• Finalize beach management plan	• Implement plan	UH Sea Grant OCCL
(28) Management and Stewardship of Kaʻelepulu Watershed	Long-Term	• Removal of mangrove from pond and wetlands • 2006 water quality report completed • Kaʻelepulu TMDL in progress • Wetland management activities in progress	• Improve street sweeping	• Install a BMP at the end of the lined channel of Kaʻelepulu Stream • Reroute Akumu Street storm drain to empty into hardened portion of Kaʻelepulu Stream • Continue Management Activities	ELRA NRCS ENV
(29) Kaʻelepulu Stream Storm Water Capture	Short-Term	• Project is currently being designed and scheduled for construction Fall 2010	• Complete construction of storm water capture		HTA
(30) Waimānalo Watershed Project	Short-Term	• 46 Waimānalo farms are developing soil conservation plans	• Implement conservation plans		NRCS
(31) Waimānalo WARMF Study	Short-Term	• Waimānalo WARMF model is being finalized	• Results of Waimānalo WARMF model will be presented at AWRA Tropical Hydrology Conference		Systech Water Resources Inc.
(32) God's Country Waimānalo	Long-Term	• Ongoing programs: E Mahiʻai No Ke Ola Pono; Aquaponics in Action;	• Construct 25 additional domestic aquaponic gardens • Obtain funding for He Moku, He Waʻa, He Waʻa, He Moku Program	• Continue current programs	OHA DHHL Hawaiʻi Community Foundation

Project	Project Duration	Current Status	Short-Term Actions 1-5 Years	Long-Term Actions 5+ Years	Potential Funding Sources
(33) Bellows AFS INRMP	Long-Term	• Restoring lower reaches of wetland area • Assist with organization of a Waimānalo Makahiki • Working with Hui Mālāma I Ke Kai on native plant garden	• Continue current programs • Remove mangrove from wetland • Update INRMP	• Continue current programs • Restore additional acreages of wetland habitat • Continuous updates of INRMP	DoD
(34) Waimānalo WWTP Recycle Water Reuse	Long-Term	• DLNR to transfer ownership of plant to ENV	• Complete R-1 planning study compliance	• Implement recommendations of planning study	ENV USACE

5.4 WATERSHED MANAGEMENT – CRITICAL WATERSHEDS AND CATALYST PROJECTS

5.4.1 Criteria Used to Select Critical Watersheds and Catalyst Projects

As part of the KPWMP process, the planning team decided to select one "critical watershed" for each of the four Koʻolau Poko Neighborhood Board areas – Kahaluʻu, Kāneʻohe, Kailua, and Waimānalo. In line with the five major objectives of the Oʻahu Water Management Plan, "critical watershed" was defined as a watershed that: (1) provides various opportunities to promote sustainable watersheds, or (2) protection or enhancement of water quality and quantity is needed, or (3) provides many opportunities to protect Native Hawaiian rights and traditional customary practices or (4) presents special opportunities for organizing and implementing important watershed management actions or (5) provides significant ground water or surface water supplies to meet current and future demand.

The selection of a "critical watershed" is not meant to diminish the importance of other watersheds in the Koʻolau Poko district. Rather, the selection of these "critical watersheds" provides an opportunity to develop implementation strategies at a more detailed level. Detailed strategies for other watersheds in the district can be developed as part of the KPWMP in future updates.

For each of the "critical watersheds," the following material is presented:

- Brief Watershed Profile
- Water Resources Management Issues
- Important Projects and Programs
- Action Agenda for a Catalyst Project: What, Who, Where, How, When

The "Catalyst Project" is a high priority project within the watershed that, when implemented, will provide energy, connectivity, information, and inspiration for other projects and programs within the particular critical watershed – that is, the project can be a catalyst for positive action and change.

5.4.2 Kahaluʻu NB Area: Waiheʻe Watershed

The Waiheʻe Watershed was selected as a critical watershed because:

- The watershed is the largest single source of BWS drinking water in Koʻolau Poko (approximately 5 mgd),
- The protection of water quantity and quality is critical here because of the important water uses within the watershed
- There are 15 acres of existing *kalo* cultivation and about 20 potential acres for new *kalo* cultivation,

- Presents special opportunities for organizing and implementing important watershed management actions through the existing Waiheʻe Ahupuaʻa Initiative partnership.

5.4.2.1 *Brief Watershed Profile*

The boundaries of the traditional *ahupuaʻa* of Waiheʻe correspond more or less with the Waiheʻe "watershed boundaries", as can be defined on contemporary USGS topographic maps.

The Waiheʻe Watershed is located along the northern coastline of Kāneʻohe Bay. It is bounded to the south by the Kahaluʻu watershed and to the north by the Kaʻalaea watershed. Waiheʻe literally means "squid liquid" in reference to the slime that flowed over the land from a legendary giant squid that was slain in the area. The watershed has an area of 1,300 acres.

The watershed extends *mauka* to *makai* for 5 miles. The inland flats of Waiheʻe are contiguous with the flats of the neighboring watershed. The contiguous flats of Kahaluʻu, Waiheʻe, and Kaʻalaea created one of the largest landscapes of wetland *kalo* cultivation in Koʻolau Poko, prior to western contact.[1] Today, although reduced in area, wetland *kalo* cultivation still remains an important feature of the landscape of the Waiheʻe watershed.

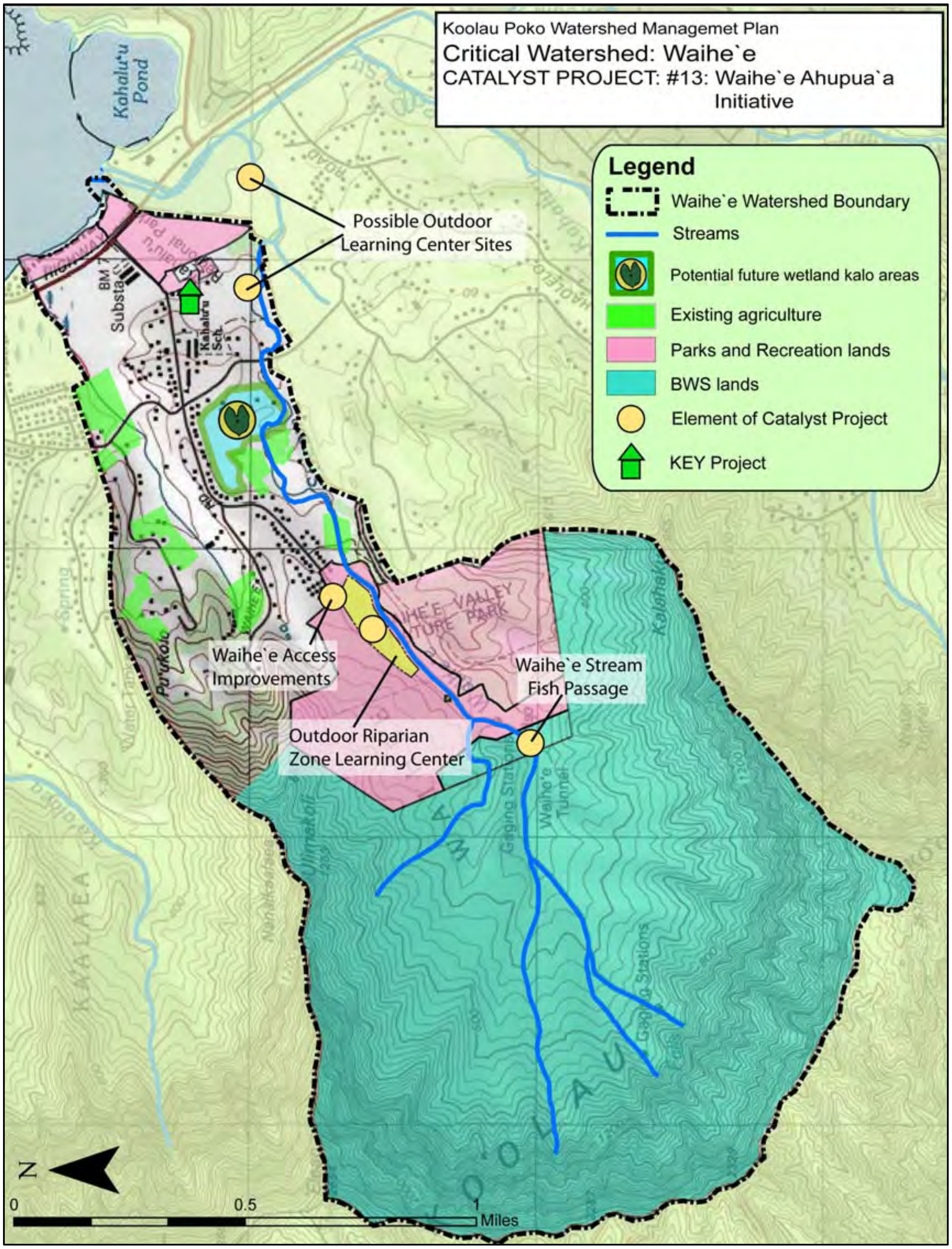
Since the 1950s, the Waiheʻe watershed has been a significant source of drinking water for the entire district of Koʻolau Poko, with the development of the Waiheʻe Tunnel and inclined well. In 2005, the Waiheʻe Tunnel supplied about 4.306 mgd, which was about one third of BWS drinking water in Koʻolau Poko in that year.

The Waiheʻe Stream is the primary source of water for approximately 15 acres of *kalo* currently being cultivated in the watershed. The stream has a length of 2.9 miles and it has a recorded median flow of 3.4 mgd.

5.4.2.2 *Water Resources Management Issues and Opportunities*

The diversion of water by the Waiheʻe Tunnel for municipal water uses has decreased the amount of stream flow for Waiheʻe Stream, and as a result affected the *kalo* farmers that depend upon a sufficient amount of consistent stream flow into their *loʻi* to successfully cultivate their *kalo*. Insufficient amounts of stream flow may lead to warmer water temperatures in the *loʻi*, which often leads to "*kalo* rot." Stream diversions by area farmers and water losses from open, unlined *auwai* also reduce stream flows and add to increases in water temperature.

Figure 5. 6 Critical Watershed: Waihe'e



A long time Waihe‘e farmer stated that many of the springs in Waihe‘e have dried up since the Waihe‘e Tunnel began to transport water out of the watershed and subdivisions and roads disrupted the flow of water throughout the valley. The loss of stream flow has not only affected *kalo* farmers; the reduced amount of flow in Waihe‘e Stream has affected the stream habitat as well as the near shore estuaries, as native species such as the *o‘opu* depend upon adequate amounts of stream flow for their survival.

BWS regularly monitors the flow of the Waihe‘e Stream. The 1970’s court order ensures a minimum stream flow of 2.7 mgd at the USGS stream gage – recognizing the importance of water for riparian and appurtenant water rights be maintained. BWS varies the operation of the Waihe‘e Tunnel and inclined wells to ensure stream flow does not fall below 2.7 mgd. This operation protects stream users and water rights and sustains enough ground water storage to mitigate drought impacts. To further water resource management in Waihe‘e, BWS and KEY project have entered into a watershed partnership called the Waihe‘e *Ahupua‘a* Initiative (WAI). Through the WAI, KEY and BWS have begun to participate, plan, and implement several natural resource management and educational activities in the watershed.

Access into the *mauka* areas of the watershed is sometimes complicated as both the BWS and DPR own land in the *mauka* area. DPR owns the gate that allows access to the upper watershed area, including access to BWS Waihe‘e lands. In addition, hundreds of users enter the *mauka* areas of Waihe‘e on a monthly basis. Waihe‘e access issues such as liability need to be resolved by the two agencies and other *mauka* users.

Water resource management issues and opportunities for the Waihe‘e watershed include:

- Improving access into the *mauka* areas of the watershed while mitigating adverse impacts to the ecosystem caused by the presence of additional visitors;
- Restoration of Waihe‘e Stream’s natural ecological functions;
- Conservation of urban and agricultural water uses
- Opportunities for the development of educational programs, interpretive resources, and additional research, analysis, and studies to support the long-term health of the Waihe‘e watershed.
- Measurement and reporting of stream diversions
- The preservation and expansion of *kalo* farming

5.4.2.3 *Important Projects and Programs*

Chapter 4 of the KPWMP includes a description of the Waihe'e *Ahupua'a* Initiative (Project #12) and two of the current on-going and future planned activities that WAI partners would like to pursue. These two activities, and a brief summary of their current status, are:

- **Waihe'e Stream Fish Passage Project.** The project has received funding from several sources including USFWS and the HTA. DAR has been in the process of conducting a survey of aquatic species in Waihe'e Stream to be used as baseline data to assess the effectiveness of the fish passage project. The survey is expected to be completed in 2010. The fish passage project is currently in the design phase.

- **Periodic Volunteer "Work Trips".** KEY Project has coordinated several community volunteer "work trips" in the *mauka* areas of Waihe'e. These work trips occur on a quarterly basis.

The WAI Project description in Chapter 4 also included a description of desired future projects and activities that the WAI partnership would like to pursue. These projects and activities are not currently being pursued as these ideas are still at a very early stage. These future projects and activities are listed below:

- Vegetative Cover Mapping
- Waihe'e *Ahupua'a* Strategic Plan
- Water Resources Information Room
- Waihe'e Access Improvements
- Riparian Zone Learning Center – and a demonstration *lo'i* as a part of the center
- KEY Project Rain Catchment Demonstration Project
- On-going Monitoring of USGS Waihe'e Stream Gage

5.4.2.4 *Action Agenda for Catalyst Project*

The "catalyst project" for the Waihe'e watershed is the development of a **"Waihe'e *Ahupua'a* Initiative Strategic Plan."** This project was selected because:

- The development of a Strategic Plan was a primary objective in the WAI MOU.

- The Strategic Plan would be an essential tool to help ensure that future WAI activities are coordinated amongst its various partners; it will provide clarity and guidance for subsequent detailed planning, design, and implementation actions.

- The Strategic Plan can be used as a marketing tool to obtain funding and grants to finance future WAI projects

- The Strategic Plan would identify other resources or partnerships that the WAI may need to accomplish WAI goals and implement future projects

The ACTION PLAN for the "Waihe'e *Ahupua'a* Initiative Strategic Plan" can be summarized as follows:

- **WHAT needs to be done?** Determine whether or not current WAI partners have the capacity to develop a Strategic Plan document. Factors that should be taken into consideration when making this determination include: meeting facilitation experience, ability to remain objective during the process, and time and energy needed to develop the document. If the WAI partners decide they do not have the capacity to develop a Strategic Plan at the current time, then the partners should begin to solicit professional services for the development of the Strategic Plan. WAI partners will also need to identify and obtain source(s) of funding to develop the plan.

- **WHO needs to take action?** BWS and KEY are the founding members of the WAI and should take the lead in developing the Strategic Plan or in soliciting professional services for the development of the Strategic Plan by developing a preliminary scope of work and request for proposal for professional services. The other WAI partners can provide input on the selection process as it proceeds. Hui o Ko'olau Poko recently joined the WAI partnership.

- **WHERE will planning and implementation take place?** The focus area for the WAI Strategic Plan will be the Waihe'e watershed with particular focus on the *mauka* areas of the watershed since most of the future WAI projects mentioned above will be located in the *mauka* area of the watershed.

- **HOW will the planning and implementation work be carried out?** A basic Strategic Plan scope and work process includes the following elements:
  - Development of a watershed profile to identify major opportunities and constraints
  - Development of rough draft elements of the Strategic Plan based on the watershed profile, input and consultation with WAI partners including: VISION, MISSION, VALUES, GOALS, PRIORITY ACTIONS, IMPLEMENTATION TIMELINE
  - Conduct working meetings to develop the rough draft into a DRAFT STRATEGIC PLAN
  - Conduct stakeholder meetings to review the DRAFT STRATEGIC PLAN
  - Revise and finalize the Strategic Plan

WAI partners will be responsible for the implementation of the Strategic Plan.

- **WHEN will the work take place?** Planning work can begin as soon as the WAI partnership decides to develop its own Strategic Plan or as soon as they have selected an outside professional to develop the plan. Actual time needed to develop the Strategic Plan should be three to sic months.

- **What will be the COST of the planning and implementation?** The cost to do a Strategic Plan by an outside professional may be in the range of $20,000 to $30,000, depending upon the scope of work and type of product that the WAI partnership desires.

- **Where will PROJECT FUNDING come from?** Funding for a Waiheʻe Strategic Plan could come from a number of sources, including local foundations like the Hawaiʻi Community Foundation.

5.4.3 Kāneʻohe NB Area: Heʻeia Watershed

The Heʻeia watershed was selected as a critical watershed because:

- The Heʻeia watershed is an important source of BWS potable water, providing about 2 mgd
- There are four ongoing projects that provide opportunities to promote sustainable watersheds. These projects also provide various opportunities to protect Native Hawaiian rights and traditional customary practices
- These projects present special opportunities for organizing and implementing important watershed management actions among the various community groups that are currently involved with natural and cultural resource management in Heʻeia
- The protection of water quality and quantity is critical here because of the important water uses within the watershed.

5.4.3.1 *Heʻeia Watershed Profile*

The boundaries of the traditional *ahupuaʻa* of HEʻEIA correspond more or less with the Heʻeia "watershed boundaries," as can be defined on contemporary USGS topographic maps.

The Heʻeia watershed is located in the central part of the Koʻolau Poko District. It is bounded to the north by the Kahaluʻu watershed and to the south by the Kāneʻohe watershed. The Hālawa and Moanalua *ahupuaʻa* lie on the leeward side of the Koʻolau Mountains from Heʻeia.

This relatively small watershed is characterized by steep, mountainous *mauka* terrain, a sloping upper valley, and somewhat steep to sloping lands in its middle and lower sections. He'eia has an average width of about 1.25 miles and an average depth of about 2.9 miles, and is thus about 3.65 square miles, or about 2,300 acres in size.

This watershed has two perennial streams: He'eia Stream and Ioleka'a Stream. He'eia Stream originates as Ha'ikū Stream near the ridgeline of the Ko`olau Mountains, and flows down through Ha'ikū Valley for a distance of about 2 miles until it is joined by Ioleka'a Stream, about 800 feet *mauka* of Kahekili Highway. From that point, the combined streams flow under the Highway, through residential subdivisions, and then through the He'eia Wetlands to the mangrove swamp that borders the northwestern end of He'eia Fishpond, a total distance of about 2.65 miles. According to available USGS data, Ha'ikū Stream has a median flow of 1.6 cfs and Ioleka'a Stream has a median flow of 0.50 cfs.

The He'eia watershed was traditionally an important food producing place, with its 88-acre He'eia Fishpond and some 200 acres of *lo'i kalo* in the He'eia Wetlands. The fishpond and the *lo'i* provided food for a substantial population of native Hawaiians in the Kāne'ohe area. The importance of this watershed is indicated by the remains of a number of important *heiau*, including the Leleahina *heiau*, located at the foot of the *pali* in Ioleka'a Valley.

In more recent times, Ha'ikū Valley and He'eia Stream have been impacted by the chemical application of herbicides as well as by the construction and operation of the U.S. Coast Guard's "Omega Station," which was used during World War II as a low frequency radio station capable of sending transmissions as far as Japan, and the construction of the H-3 Highway through the steep *mauka* lands of the watershed. The Ha'ikū rubbish dump may be degrading ground water and stream water quality. Residential development in the middle and lower areas of the watershed, with related impervious surfaces, increased and contaminated runoff, and concrete channelization of sections of the stream, has also contributed to the degradation of the stream, the fishpond, and the nearshore waters of Kāne'ohe Bay.

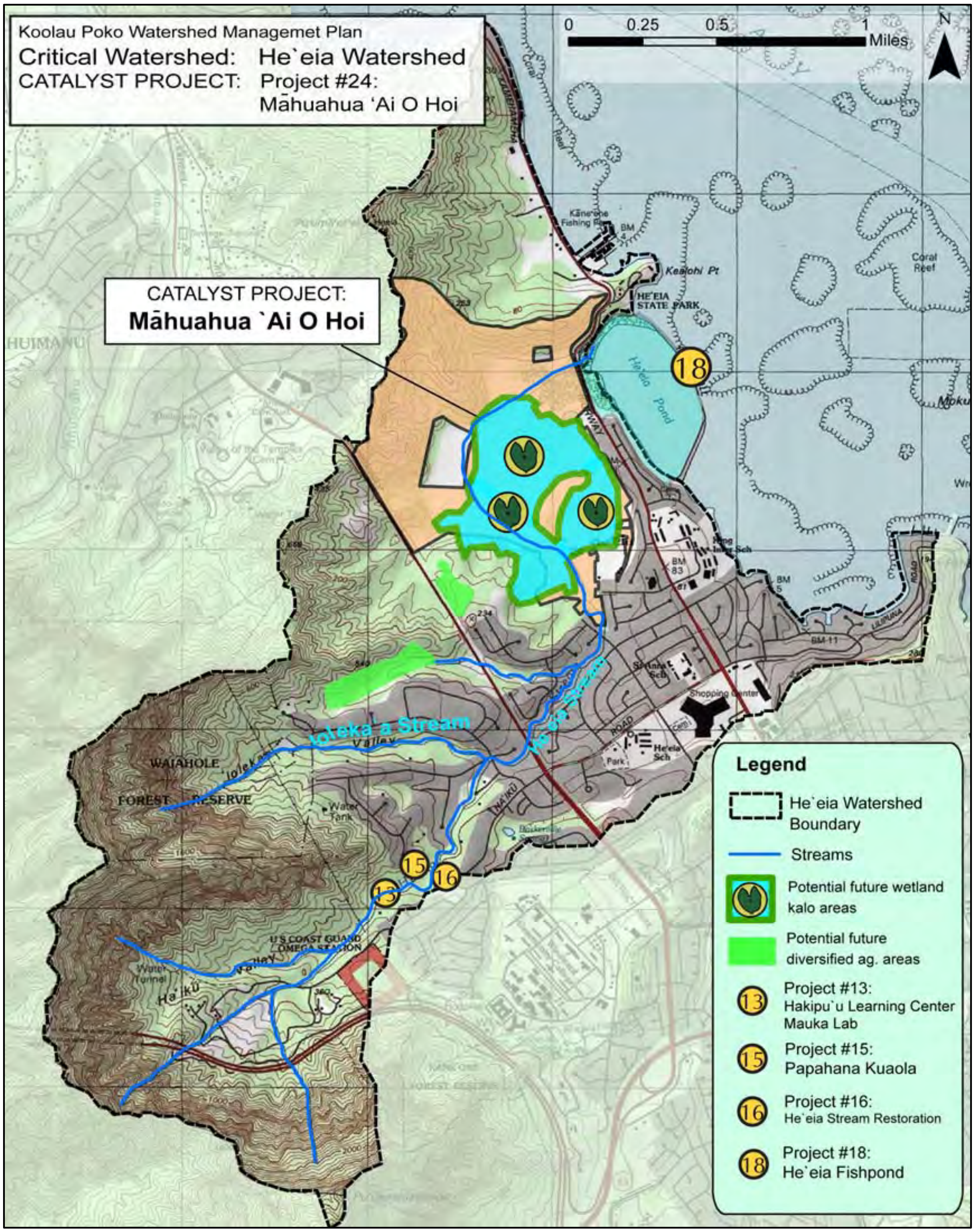
5.4.3.2 *Water Resources Management Issues and Opportunities*

About 400+ acres of the 2,300-acre watershed, roughly 20%, has been urbanized. There are at present no known plans or proposals for further urban or suburban development. About 50 percent of the undeveloped land is designated "CONSERVATION" under the State's land use classification system, and about 60 percent of the undeveloped land is owned by the State. Thus, although urban development has adversely impacted the He'eia watershed, there are still significant opportunities to conserve and restore some of its valuable land and water resources.

Water resources management issues and opportunities for the He‘eia watershed may thus be summarized as follows:

- Conservation of urban and agricultural water would benefit the watershed;
- Restoration of He‘eia Stream and improvement of stream water quality;
- Restoration and expanded fish production at He‘eia Fishpond;
- Measurement and reporting of stream diversions
- Ecosystem restoration and restoration of *lo‘i kalo* and other traditional farming activities and crops at He‘eia Wetlands and its adjacent upland areas;
- Conversion of the Omega Station to a Native Hawaiian cultural/educational center;
- Overall research, analysis, modeling, and ecosystem restoration plans and actions for the entire He‘eia watershed, in order to support the long term health and productivity of the Wetlands, the Fishpond, and the nearshore waters of Kāne‘ohe Bay.

Figure 5. 7 Critical Watershed: He'eia



5.4.3.3 *Important Projects and Programs*

Chapter 4 of the KPWMP includes descriptions of four "Projects with Champions" within the He'eia *ahupua'a*. These projects, and a brief summary of their current status, are:

- **He'eia Stream Bank Restoration Program** (Project #15) – Volunteer workdays have been conducted beginning in 2010 to remove non-native vegetation, install erosion control devices, and plant native plants. This program needs to continue for at least another year until these stream banks have been substantially restored.

- **Papahana Kuaola** (Project #16) – Community education programs that are fully integrated with traditional Hawaiian knowledge are ongoing in the *mauka* areas of the watershed. Papahana Kuaola has cleared acres of invasive species and replanted these areas with native vegetation as well as opened up several *lo'i kalo*, and is in the process of building an outdoor *hula* performance area.

- **He'eia Wetlands Restoration Project (*Māhuahua 'Ai O Hoi*)** (Project #17) – In March of 2010, the non-profit, community-based organization Kāko'o 'Ōiwi received a 38-year lease from the land owner, the State's Hawai'i Community Development Authority (HCDA). Kāko'o 'Ōiwi is now proceeding with initial planning for the restoration of these once productive lands. Planning and permitting for the eventual restoration of *Hoi* will take 3 to 5 years to complete. Thereafter, the restoration of these lands will be a great challenge for the next several generations.

- **Management and Stewardship of He'eia Fishpond** (Project #18) – A number of important programs have been established and are ongoing, including: physical maintenance of the fish pond, community-based economic development, educational and research activities, and an internship program. Major restoration work of the fish pond walls still remains to be done, and future partnering with the *Māhuahua 'Ai O Hoi* project will be critical for the eventual improvement of fish pond water quality and productivity.

The eventual conversion of the Omega Station to a Native Hawaiian cultural/educational center is not presented as a "project with champion," as plans for this potential project are still at an early stage. Potentially, the Ko'olau Poko Hawaiian Civic Club (KPHCC) may become the champion for this project.

5.4.3.4 *Catalyst Project Action Plan*

The "catalyst project" for the He'eia *ahupua'a* is the restoration project for the He'eia Wetlands: ***Māhuahua 'Ai O Hoi – "Regrowing the Fruit of Hoi (He'eia Wetland)."*** This project was selected because:

- It will potentially have a major impact in terms of food production/local food security, ecosystem restoration, cultural education, community benefit, and jobs;

- This large scale restoration project is vitally connected to future restoration efforts both *mauka* and *makai*: to watershed and stream restoration programs throughout the He'eia *ahupua'a*, as well as to the future health and productivity of the He'eia Fishpond and the nearshore waters of Kāne'ohe Bay.

- Kāko'o Ō'iwi, the non-profit organization that is managing this restoration effort, has been successful in obtaining LAND CONTROL through a long-term lease with the land owner, HCDA. There are many non-profit organizations that propose to implement important resource restoration projects and programs, both in the Ko'olau Poko District and elsewhere, but very few of these non-profits have been able to obtain the critical element of land control.

The ACTION PLAN for *Māhuahua 'Ai O Hoi* can be summarized as follows:

- **WHAT needs to be done:** Develop a Master Plan and Environmental Assessment for the *Hoi* project. Obtain the various Federal, State, and City permits and approvals that will be needed to implement the restoration program. Organize and implement the restoration work in phases, over the next 10 to 20 years. Evaluate the ecological, cultural, social, and economic impacts and benefits of the *Hoi* project on an-going basis.

- **WHO needs to take action:** Kāko'o 'Ōiwi is the "champion" for the *Hoi* project. Many other partners and supporters are and will be involved in the planning and implementation of the project. Early indications are that significant financial and technical support may come from the National Oceanic and Atmospheric Administration (NOAA), the U.S. Army Corps of Engineers (USACE), the Office of Hawaiian Affairs (OHA), the University of Hawai'i, and the Castle Foundation.

- **WHERE will planning and implementation take place?** The focus area for the project is the He'eia Wetlands and the adjacent upland areas that are part of the HCDA-owned lands. In addition, land and water restoration efforts may extend to other adjacent and nearby lands, including lands owned by Kamehameha Schools.

- **HOW will the planning and implementation work be carried out?** Planning will be accomplished by a team of professionals that will include environmental planners, ecologists, terrestrial biologists, marine biologists, botanists, soils scientists, archaeologists, cultural practitioners, sociologists, hydrologists, limnologists, economists, civil engineers, and others. Implementation projects and programs will be organized and managed by Kākoʻo ʻŌiwi and other entities, including the University of Hawaiʻi and the Koʻolau Poko Hawaiian Civic Club.

- **WHEN will the work take place?** Initial planning work began in 2009. The Master Plan will be developed during the 2010-2011 timeframe, and the Environmental Assessment work is scheduled for 2011-2012. Work on the permits and approvals has also begun, and all of the major permits and approvals should be in place by 2013-2014.

- **What will be the COST of the planning and implementation?** Firm cost estimates have not yet been developed. The cost for the Master Plan, Environmental Assessment, and major permits and approvals may be in the range of $500,000 to $1,000,000. The phased restoration of productive *loʻi kalo* and other traditional food crops will require many thousands of hours of labor by both volunteers and paid workers. The cost of labor, materials, equipment, management, and overhead will likely be more than $1,000,000 per year.

- **Where will PROJECT FUNDING come from?** Initial project organization, staffing, and planning costs were funded by NOAA through a Hawaiʻi Coastal Zone Management (CZM) Program contract with the HCDA. Additional funding is expected from several Federal sources, including NOAA and USACE, from OHA, and from the Castle Foundation. Once several acres of *kalo* and organic crops are in active cultivation, some of the funds needed for salaries and operating expenses will be generated through the sale of food products. The long-term economic goal is to establish economically self-sufficient use of these historically productive lands.

5.4.4 Kailua NB Area: Kawainui Watershed

The Kawainui Watershed was chosen as a “critical watershed” for the Kailua NB area for the following reasons:

- Presents special opportunities for organizing and implementing important watershed management actions through the existing partnerships amongst the various community organizations involved with Kawainui Marsh and Maunawili Valley as well as existing partnerships between community organizations and government agencies

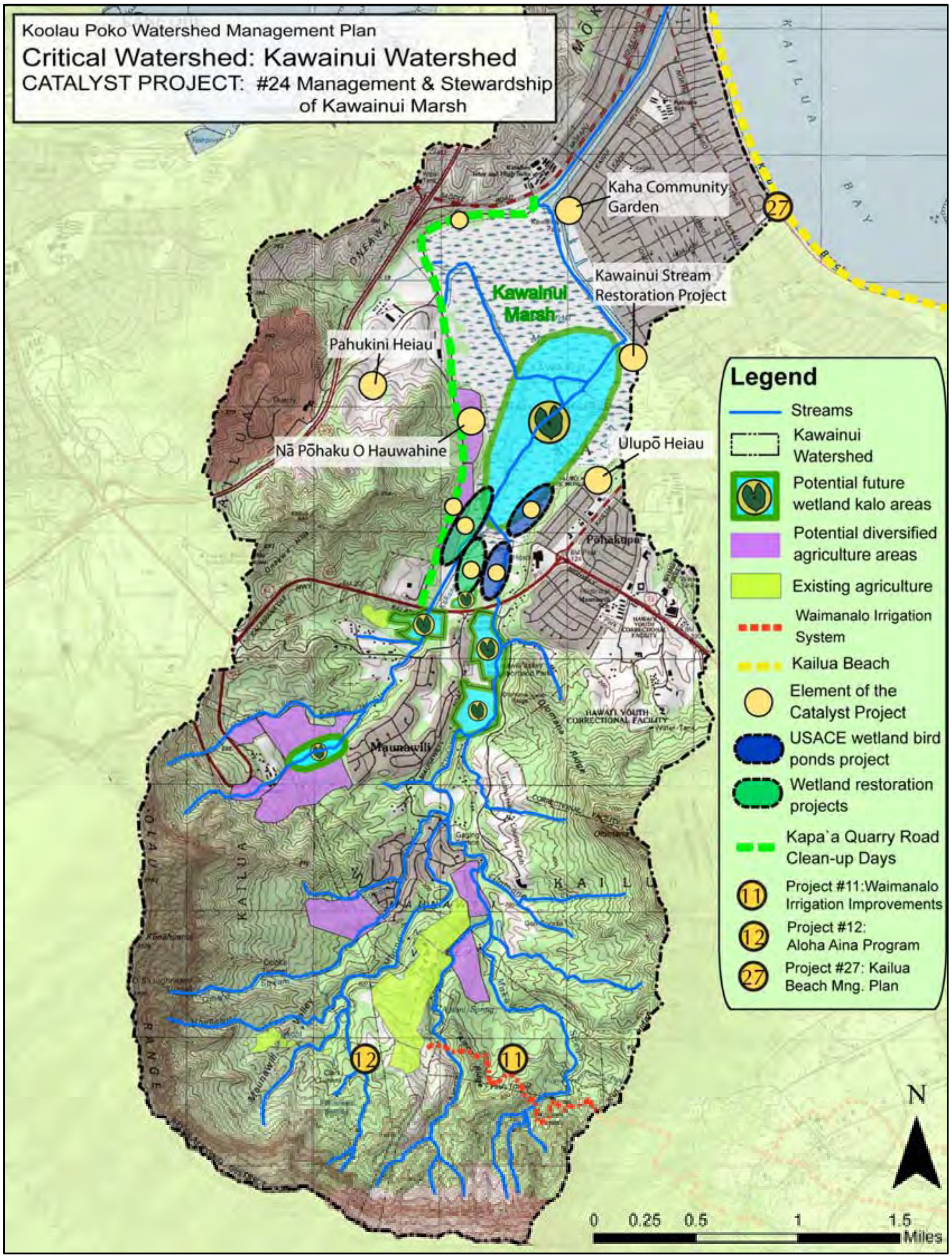
- Provides many opportunities to protect Native Hawaiian rights and traditional customary practices through the numerous cultural resources that exist within Kawainui Marsh and Maunawili Valley
- Provides many opportunities for promoting sustainable watersheds through the various ongoing eco-habitat restoration projects as well as future potential food producing endeavors
- The watershed is a significant source of water for agriculture in Kailua as well as Waimānalo
- Enhancement of water quality and quantity in this watershed is critical not only for the health of this watershed, but improvement of water quantity and quality may also benefit the Kaʻelepulu watershed if flow is restored from Kawainui to Kaʻelepulu.

5.4.4.1 *Brief Watershed Profile*

The Kawainui watershed covers some 9,400 acres, about 21% of the district's 43,598 acres, and contains the Maunawili stream system – including its tributary streams Kahana Iki, Palapū, ʻŌmao, ʻAinoni, Makawao, and Olomana – and some of the urban/suburban settlements of Kailua including Pōhākapu, Maunawili, and Coconut Grove. The watershed is bounded to the northwest by Kāneʻohe watershed, to the southeast by the Kaʻelepulu watershed, and to the northeast by the Pacific Ocean. The Nuʻuanu, Mānoa, and Pālolo watersheds lie on the leeward side of the Koʻolau Mountains from the Kawainui watershed.

The Kawainui watershed was the major portion of the Kaʻelepulu watershed until the mid-1960's, when the Oneawa Canal was constructed, draining to the north end of Kailua Bay, and the levee was constructed, cutting off Kawainui Stream from its headwaters. This watershed is characterized by steep, mountainous *mauka* terrain, a sloping upper valley, a moderately sloping, narrow mid-valley area and the low lying level lands of Kawainui Marsh. The Kawainui watershed has an average width of about 2.2 miles and an average depth of about 6.7 miles, and is thus about 14.7square miles in area. Prior to the urbanization of Windward Oʻahu, waters from the Kawainui marsh flowed into the Kaʻelepulu watershed via the Kawainui Stream. Today the Kaʻelepulu watershed receives no flow from the Kawainui watershed and is often stagnant which exacerbates the water quality of Kaʻelepulu by limiting exchange between the ocean and the Kaʻelepulu system.

Figure 5. 8 Critical Watershed: Kawainui



The watershed has one major stream system: Maunawili Stream and its six named branch streams. The system includes many seeps and springs, including several major springs noted on the USGS maps: Kapakahi Spring, Pikoakea Spring, and ʻAinoni Spring. Maunawili Valley is the largest stream watershed area in Koʻolau Poko, covering some 9,408 acres. The stream has a median flow of 7.9 cfs, or about 5.1 mgd (USGS). The Kawainui watershed lands are about 19.5% covered with impervious surfaces.

The substreams of Maunawili originate high in the Koʻolau Mountains and flow in a generally northerly direction until five of the six branches – all except for Kahana Iki – join together in the vicinity of the existing USGS stream gage to form the main stem of Maunawili Stream. The stream then flows along the foot of Olomana Ridge, under Kalanianaʻole Highway, and is joined by Kahana Iki Stream just as the two streams flow into Kawainui Marsh.

The only major diversions of Maunawili Stream water are owned and operated by the State Department of Agriculture. The diversions are located high up in the watershed, where the flows of several sub-streams are diverted into a system of tunnels, pipes, and ditches that transports the water to farm lands in Waimānalo. This DOA diversion system takes about 1.48 mgd from the Maunawili Stream system. Currently only about 0.4 mgd of the 1.48 mgd diverted water is available to Waimānalo farmers because of numerous leaks in this 100 year-old irrigation system. DOA is currently planning improvements to the system that will be implemented with $6 million of appropriated funds.

This watershed was once a major food producing area, with many wetland taro terraces and the great fishpond of Kawainui, which in the old days was famous for mullet and oʻopu. These lands supported a sizeable native Hawaiian population. Here were also many *heiau,* both large and small, and *wahi pana*, including Mount Olomana, which was named for a great warrior who was *"twelve yards or six fathoms in height, if measured from the head to the feet." (Fornander)*

The existing development pattern within the Kawainui watershed is characterized by urban development in the *makai* area of the watershed that occupies most of the acreage except for Kawainui Marsh and very steep lands, and mostly undeveloped forest lands and some agricultural lands in Maunawili Valley, with some lower density suburban and rural development.

5.4.4.2 *Water Resources Management Opportunities and Issues*

About 19.5% of this 9,400 acre watershed has been urbanized. There are at present no official plans or proposals for further urban or suburban development, although residents are concerned about the possibility of the development of high priced "gentlemen estates" in Maunawili Valley. About 75 percent of the undeveloped land within the watershed is designated "CONSERVATION" under the State's land use classification system. Thus, although urban development has impacted the *makai* area of this watershed, there are still significant opportunities to conserve and restore some of its valuable land and water resources.

Water resources management issues and opportunities for the Kawainui Watershed include the following:

- A beach management program for Kailua Beach;
- Restoration of Kawainui Marsh for habitat for native birds and fishes, as well as restoration of portions of the marsh for *lo'i kalo* and other traditional agricultural practices and products;
- Potential for restoring flow from Kawainui Watershed to the Ka'elepulu Watershed
- Restoration of *lo'i kalo* and other traditional farming practices and products in Maunawili Valley;
- Repairs to the Maunawili-Waimānalo Ditch System to reduce water losses, to provide more water to Waimānalo farmers, and also potentially restore unused fresh water flows to Kawainui Marsh.
- Measurement and reporting of stream diversions

5.4.4.3 *Important Projects and Programs*

Chapter 4 of the KPWMP includes descriptions of five "watershed management" projects that are specific to the Kawainui Watershed. These projects are:

- Expansion of the Waimānalo Forest Reserve (Project #10)
- Aloha 'Āina Projects and Programs (Project #12)
- Waimānalo Irrigation System Improvements and Conservation (Project #11)
- Management and Stewardship of Kawainui Marsh (Project #24)

5.4.4.4 *Action Agenda for Catalyst Project*

The "catalyst project" for the Kawainui Watershed is the **Management and Stewardship of Kawainui Marsh.** This project was chosen because of the historical/cultural importance of Kawainui Marsh and the many opportunities for ecosystem restoration and environmental and cultural education that the marsh presents – for the people of Koʻolau Poko and for the people of Hawaiʻi.

As summarized in the description of "Project #23: Management and Stewardship of Kawainui Marsh," there are at present a number of public and non-profit organizations that are implementing projects for wetland and habitat restoration at the marsh. The various stakeholders have also formed an umbrella group, Hoʻolaulima Ia Kawai Nui, that has been coordinating the various projects and programs for the marsh.

The ACTION PLAN for the Management and Stewardship of Kawainui Marsh can be summarized as follows:

- **WHAT needs to be done:** Hoʻolaulima Ia Kawainui should continue their monthly meetings to inform and coordinate with other organizations involved with Kawainui Marsh. These future activities include coordinating separate individual projects such as DOFAW wetland habitat restoration projects or joint coordinated activities such as the annual Ramsar World Wetland Day. In addition, DOFAW plans to update its 1994 Kawainui Marsh Master Plan in 2011.

- **WHO needs to take action:** Member organizations of Hoʻolaulima Ia Kawainui and other like minded organizations or individuals, including USACE and DOFAW, that would like to contribute to the goals of "Project #23: Management and Stewardship of Kawainui Marsh."

- **WHERE will planning and implementation take place:** The focus areas of near term management and stewardship of Kawainui Marsh include the project areas of DOFAW wetland habitat restoration as well as prominent cultural sites of Kawainui Marsh including Na Pohaku O Hauwahine, Ulupo Heiau, and Pahukini Heiau. Kaha Garden and the Kapaʻa Quarry Road are also possible sites for future community workdays.

- **HOW will the planning and implementation work be carried out:** Planning and implementation of Kawainui Marsh management and stewardship activities will be accomplished through coordinated efforts of Hoʻolaulima Ia Kawainui members with assistance from elected officials, community leaders, community volunteers and professional consultants, when necessary. Periodic reporting of implementation progress should be made at public meetings or gatherings such as neighborhood board meetings, community meetings convened by elected officials, or annual Ramsar World Wetland days.

- **WHEN will the work take place:** Planning and implementation work is already underway.

- **What will be the COST of the planning and implementation:** The three DOFAW wetland restoration projects total cost is not yet known. The cost of various Kawainui Marsh workdays is minimal. The cost of the Kawainui Marsh Master Plan update will be $400,000.

- **Where will PROJECT FUNDING come from:** Wetland restoration projects have received funding from DOFAW and its government agency partners including USACE, NRCS, and USFWS. Other marsh management activities have received funding from private entities such as the Castle Foundation and Ameron Hawaiʻi.

5.4.5 Waimānalo NB Area: Waimānalo and Kahawai Watersheds

Unlike the other neighborhood board areas in the district, the plan will focus on two critical watersheds (Waimānalo Watershed and Kahawai Watershed) in the Waimānalo Neighborhood Board area because one of the most critical watershed issues in the area is the shortage of agriculture water for Waimānalo farms. Significant amounts of agricultural land are located in both the Waimānalo and Kahawai watersheds. The Waimānalo Irrigation System spans both watersheds and provides water to most of the farms in Waimānalo. There are no farms in the Makapuʻu watershed area. There are also important issues here relating to stream water quality and water quality of Waimānalo Bay.

5.4.5.1 *Brief Watershed Profile*

The Waimānalo Neighborhood Board Area contains three watersheds: Waimānalo, Kahawai, and Makapu'u watersheds. The Waimānalo and Kahawai watersheds cover some 6,200 acres, about 15% of the district's 43,598 acres, and contain the Waimānalo stream system, the suburban/rural settlements of Waimānalo and Waimānalo Beach, ~~and~~ Waimānalo Homesteads, and the 900-acre "Bellows Air Force Station." Waimānalo is bounded to the west and northwest by the Kailua *ahupua'a,* to the east by Pacific Ocean, and to the south by the ridgeline of the Ko'olau Mountains. The district of East Honolulu lies on the leeward side of the Ko'olau Mountains from Waimānalo. Waimānalo is characterized by steep, mountainous *mauka* terrain, a broad, gently sloping upper valley, and the level, sandy and marshy lands of Bellows Air Force Station.

Waimānalo has one major stream system: Waimānalo Stream and its one tributary: Kahawai Stream. The stream is 3.4 miles long and has a median flow of 1.163 mgd (USGS). This small median flow reflects the relatively drier climate of Waimānalo as compared to other Ko'olau Poko *ahupua'a*, and also its relatively smaller area of steep, rain generating terrain. The Waimānalo Stream watershed lands are about 9.2% covered with impervious surfaces.

Waimānalo is one of the original Native Hawaiian settlement areas of windward O'ahu. From the late 19th through the middle of the 20th century, the 3,000-acre Waimānalo Sugar Plantation was the dominant land use and employer in this area.

5.4.5.2 *Water Resources Management Opportunities and Issues*

Less than 10% of this still rural neighborhood board area has been urbanized. At present, the only plans for further suburban development are plans of the Department of Hawaiian Home Lands to continue their development of homestead lands for native Hawaiians. To date, DHHL has developed about 500 homestead lots and homes in Waimānalo. An additional 300 homestead lots and homes are planned. At an estimated potable water demand of 500 gallons per unit per day, these additional 300 homes will require about 0.15 mgd of BWS water.

About 60 percent of the undeveloped land within Waimānalo is designated "AGRICULTURE" and about 30 percent is "CONSERVATION" under the State's land use classification system. Thus, although suburban development has had some impact on the *makai* area of this *ahupua'a,* there are still significant opportunities to conserve and restore some of its valuable land and water resources.

Water resources management issues and opportunities for Waimānalo include the following:

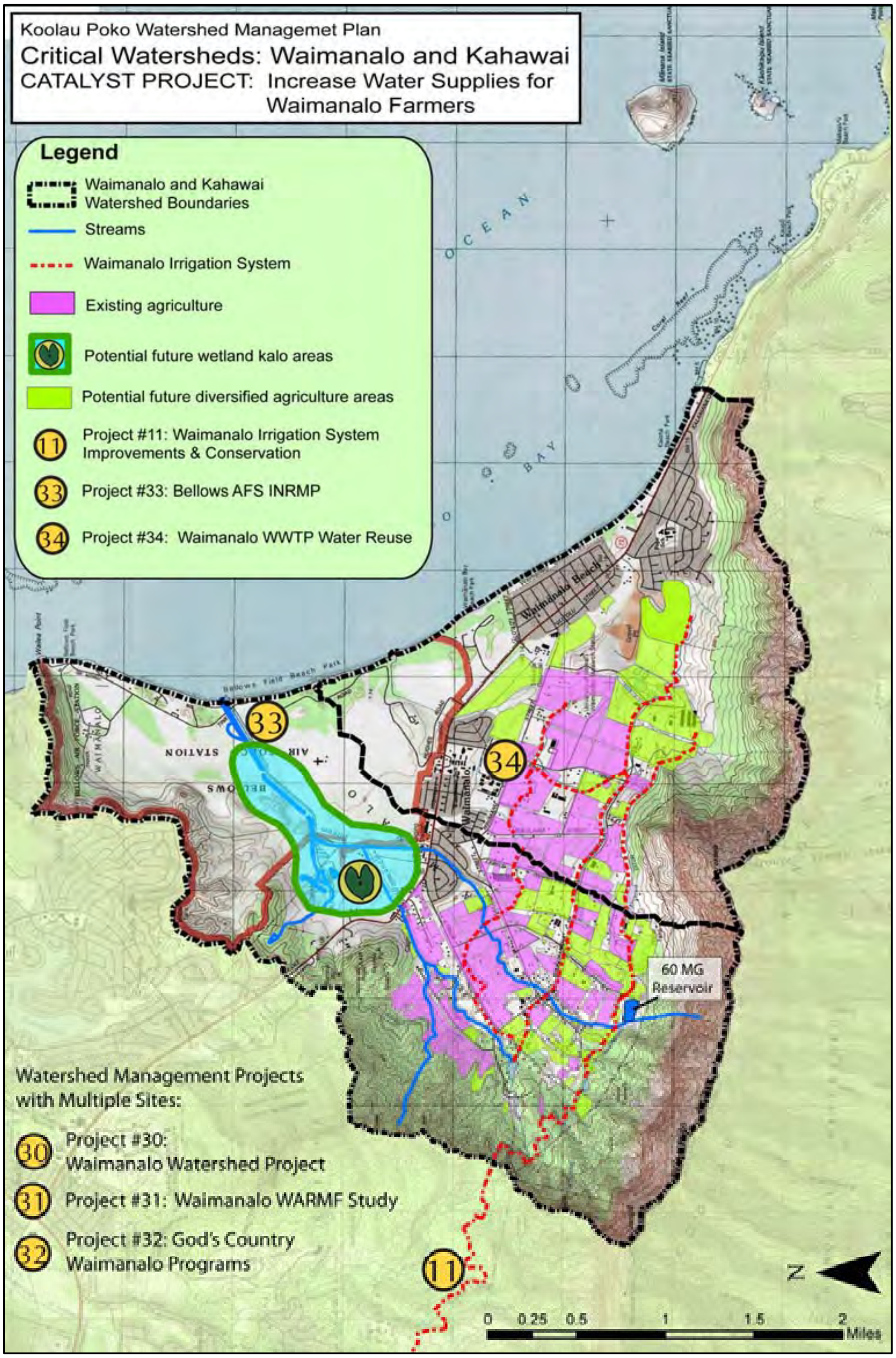
- Preservation of Waimānalo farm lands, and possible expansion of agricultural activities;
- Pollution abatement and water quality improvement for Waimānalo Stream and the waters of Waimānalo Bay;
- Providing increased, affordable, and dependable nonpotable water supplies for Waimānalo farmers, including repairs to the Maunawili-Waimānalo Ditch System to reduce water losses, to provide more water to Waimānalo farmers, and also potentially to provide more fresh water flows to Kawainui Marsh.
- Measurement and reporting of stream diversions

5.4.5.3 *Important Projects and Programs*

Chapter 4 of the KPWMP includes descriptions of six "watershed management" projects that are specific to the Waimānalo *ahupua'a.* These projects are:

- Waimānalo Irrigation System Improvements and Conservation (Project #11)
- Waimānalo Watershed Project (Project #30)
- Waimānalo Watershed Analysis Risk Management Framework (WARMF) Study (Project #31)
- God's Country Waimānalo Programs (Project #32)
- Bellows AFS Watershed Projects (Project #33)
- Waimānalo Waste Water Treatment Plant Recycle Water Non-Potable Irrigation Feasibility Study (Project # 34)

Figure 5. 9 Critical Watershed: Waimānalo



5.4.5.4 *Action Agenda for Catalyst Project*

The "catalyst project" for Waimānalo is **"Increase Water Supplies for Waimānalo Farmers."** "Increase Water Supplies" was chosen as the catalyst project because:

- Waimānalo farms have great importance for the overall agricultural economy and food security of O'ahu;
- Waimānalo farmers are already suffering from water shortages due to the poor condition of the Waimānalo Ditch system and also due to the severe drought conditions of 2010;

As noted earlier, Waimānalo farmers presently cultivate approximately 730 acres of land for various diversified agriculture products, including vegetables, fruits, flowers, and nursery plants. At an average water demand of 3,400 gallons per acre per day for diversified agriculture in this drier area of the region, current agricultural water needs are about 2.482 mgd. If diversified agriculture activities expand in the future, there will be a demand for still more water.

Currently, a limited amount of irrigation water for Waimānalo farms comes from the Maunawili diversion and the Waimanalo Irrigation System. This 100-year old system diverts about 1.48 mgd from Maunawili Stream in the Kailua ahupua'a, but, because of many leaks in the system, only about 0.4 mgd is currently available to Waimānalo farms. The Department of Agriculture has allocated $6 million to implement high priority repairs of the ditch.

About 0.65 mgd of BWS potable water is also being used by area farmers to supplement the limited ditch water, and about 0.25 mgd of non-potable water from Waimanalo Well I can also be used. The current total available agricultural water supply for Waimanalo farmers is thus about 1.3 mgd – which indicates a shortage of about 1.182 mgd.

As noted earlier in other sections of this plan, additional sources of irrigation water could include:

- Implementation of the Waimānalo Ditch repairs project, which should result in a significant reduction in water lost to leaks, and a corresponding increase in water available to Waimānalo farmers;
- Waimānalo Wastewater Treatment Plant, for which the City has plans to eventually install equipment to produce up to about 0.7 mgd of "R-1" quality recycled water;

- Some of the as yet untapped sustainable yield of the Waimānalo Aquifer System Area, which is approximately 10 mgd. This aquifer could possibly be tapped by wells and connected directly to the Waimānalo irrigation system which has a large 60 mg reservoir. Note, however, that any new wells should be located so as to have minimal effect on streamflows or fresh water springs. Also, costs for constructing and operating wells for irrigation water may be prohibitively high.

- Implementation of BMPs by farmers to reduce irrigation needs and conserve precious water resources.

The ACTION PLAN for increasing water supplies for Waimānalo Farmers could involve the following elements:

- **WHAT needs to be done?** Provide irrigation water from various sources, including repairs to the Maunawili Ditch, existing and future non-potable water wells, recycled water, and water conservation measures.

- **WHO needs to take action?** The key public agencies that will need to collaborate for this project are the Federal Natural Resource Conservation Service, the Windward O'ahu Soil and Water Conservation District, the State Department of Agriculture, the State Commission on Water Resource Management and the City Department of Environmental Management. Waimānalo farmers and other stakeholders will also need to be involved.

- **WHERE will the project be located?** Various elements of the project will be located at the Waimānalo Waste Water Treatment Plant, ground water well sites within the Kailua and Waimānalo *ahupua'a*, and the Waimānalo Ditch system.

- **HOW will the planning and implementation work be carried out?** As with any complex, multi-dimensional project, there will need to be a project manager/coordinator who will design and coordinate the process for project planning and implementation. The project manager for this project could be a senior staff person from NRCS or from DOA.

- **WHEN will the work take place?** Initial inter-agency meetings on this project were begun in mid-2010. A detailed plan of action could be developed in 2011.

- **What will be the COST of the planning and implementation?** Cost estimates for this project have not yet been developed. Planning costs will include: agency staff time to develop a detailed action plan and to collaborate with stakeholders; agency and consultant costs for the planning and permitting of various project elements, including repairs to the Waimānalo Ditch system, design of a recycled water facility for the Waimānalo WWTP, and location and design of new water wells and associated reservoirs and transmission lines.

- **Where will PROJECT FUNDING come from?** Project funding will probably come from a combination of State and Federal sources, including appropriations for DOA and grants from Federal agencies like the USDA, NRCS, USACE, or the Federal Bureau of Reclamation.

5.5 IMPLEMENTATION AND FUNDING: SOURCES AND STRATEGIES

5.5.1 Implementing Entities – Public and Private Sectors

The implementation of the many elements of the KPWMP will depend on the future availability of resources – expertise, manpower, organization, and funding – from both the public and private sectors.

A number of public agencies and private non-profit organizations have been named in this plan as possible implementers of specific projects and programs. These agencies and organizations include the following:

Public Agencies

- Department of Housing and Urban Development (HUD)
- Environmental Protection Agency (EPA)
- Federal Highway Administration (FHWA)
- Federal Recovery Lands Acquisition Program
- Marine Corps Base Hawai'i (MCBH)
- National Oceanic and Atmospheric Agency (NOAA)
- Natural Resource Conservation Service (NRCS)
- National Science Foundation (NSF)
- U.S. Army Corps of Engineers (USACE)
- U.S. Fish and Wildlife Service (USFWS)
- Commission on Water Resource Management (CWRM)
- Department of Agriculture (DOA)
- Department of Health (DOH)
- Department of Land and Natural Resources (DLNR)
- Division of Forestry and Wildlife (DOFAW)
- Hawai'i Coastal Zone Management (CZM) Program

- Hawai'i Legacy Lands Fund
- Hawai'i Tourism Authority (HTA)
- Office of Conservation and Coastal Lands (OCCL)
- Office of Hawaiian Affairs (OHA)
- UH Sea Grant Program
- Department of Environmental Management (ENV)
- Department of Parks and Recreation (DPR)
- Honolulu Board of Water Supply (BWS)

Private Non-Profit Organizations

- Castle Foundation
- Enchanted Lake Residents Association
- Hakipu'u Learning Center
- Hawai'i Community Foundation
- Kāko'o 'Ōiwi
- Kamehameha Schools
- Paepae O He'eia
- Waihe'e Ahupua'a Initiative Partners
- Pacific American Foundation

Many of the above-listed public agencies have one or more funding programs that could provide funds for water supply and/or watershed management projects. Private non-profit entities like the Castle Foundation and the Hawai'i Community Foundation are also possible significant sources of funds for environmental improvement projects.

5.5.2 Dedicated Funding Source(s) for Watershed Management Projects

The KPWMP provides policies, objectives, project descriptions and general strategies that collectively serve to guide future water resources management in the District.

City and State agencies are not solely responsible for implementing the KPWMP. CIP appropriations, Federal and private foundation grants, and the work of volunteers and non-profit organizations will all be needed to implement important elements of the Plan.

There has been some discussion over the years among advocates of good watershed management on the need for a "dedicated funding source" for important watershed projects – i.e., a funding source that would provide a fairly regular and significant revenue stream year after year.

An example of this concept is a bill that was proposed to the Twentieth State Legislature in 2000: House Bill No. 2835 – "A Bill for an Act Relating to Watershed Protection." Key excerpts from that Bill are as follows:

> *"The legislature finds that Hawaii's forests function as critical watersheds and are the primary source of fresh water for the islands."*
>
> *"The purpose of this chapter is to establish a dedicated source of funds to protect, preserve, and enhance important watershed areas as essential and sustainable sources of fresh water."*
>
> *"There is established within the state treasury a watershed protection trust fund to be administered by the commission on water resource management to implement the purposes of this part."*
>
> *"The purpose of the trust fund is to fund public and private watershed management projects and activities benefiting water quality, water quantity, and general watershed values within designated watershed management areas."*
>
> *"There shall be levied, assessed, and collected a watershed protection tax on the domestic use of water from municipal water systems at the rate of 5 cents per one thousand gallons of water used. The tax shall be collected by the county water agency as part of its regular billing to its customers."*

A number of issues and concerns were raised during public hearings on HB 2835, including the concern that other major water users that managed their own water sources – including the U.S. Army, the U.S. Navy, and some large agricultural corporations – would not be required to contribute to the "watershed protection trust fund." This Bill did not become law.

There has also been some public discussion on tapping other sources for watershed management action projects, including possibly using a percentage of the annual proceeds from the state's real estate conveyance tax. Others have proposed using a percentage of the Transient Accommodations Tax or the establishment of "Drainage Districts" that would be funded through special real property tax assessments. "Impact Fees" that would be paid by large federal, state, or private water systems have also been suggested. The fundamental issue for these funding concepts is: "who benefits and who pays?"

BWS, DPP, DLNR and CWRM could collaborate to develop a watershed projects funding Bill for consideration by the State Legislature – perhaps when the O'ahu Water Management Plan has been completed. A new Bill could address some of the unresolved issues, including contributions to the "watershed protection trust fund" by significant public and private water users who are managing their own water sources.

It should be noted that HB2835 focused on the importance of good management of Hawai'i watersheds because of their value in providing fresh water supplies. The Bill did not explicitly recognize other watershed values, including their value as storied places, scenic mountain landscapes, natural habitat for native animals, sources of medicinal and cultural plants, outdoor recreation, streams and wetlands, fish ponds and healthy nearshore waters. A future Bill might include recognition of these other important watershed values. The proposed strategies and projects within this plan are the result of a comprehensive watershed analysis and stakeholder consultation process. The projects may involve various governmental agencies and non-governmental organizations. The implementation and funding of these projects are not the sole responsibility of the Board of Water Supply, City and County of Honolulu, or State of Hawai'i. This Plan is intended to guide agencies and organizations in implementing the most important initiatives for Ko'olau Poko watersheds and water resources; however, implementation will depend on budgetary priorities, the availability of grants, and partnering efforts over the long term.

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APPENDIX A

O'AHU WATERSHED MANAGEMENT PLAN FRAMEWORK

Oahu Water Management Plan Framework And Scope of Work for Wai`anae, Ko`olauloa and Ko`olaupoko Watershed Management Plans

Submitted to the State Commission on Water Resource Management in Compliance with the Statewide Framework for Updating the Hawaii Water Plan, Oahu County Water Use and Development Plan.

Attachment to BWS Transmittal Letter to CWRM, Dated February 20, 2004.

Table of Contents:

OWMP Framework Summary

The OWMP consists of policies and strategies, which guide the activities of the City and County of Honolulu and advises the State Commission on Water Resource Management (CWRM) in the areas of planning, management, water development and use and allocation of Oahu's natural water resources. The OWMP framework proposes regional plans entitled "watershed management plans" and shall be consistent with the following:

1. State Water Resource Protection Plan, State Water Quality Plan, State Water Projects Plan, State Agricultural Water Use and Development Plan and Department of Hawaiian Home Lands water plans as listed in Chapter 174C-31, Hawaii Water Plan, State Water Code.
2. The Statewide Framework for Updating the Hawaii Water Plan (Statewide Framework)
3. The General Plan for the City and County of Honolulu. The General Plan is a comprehensive statement of objectives and policies, which sets forth the long range aspirations of Oahu's residents and the strategies of actions to achieve them. It is the focal point of a comprehensive planning process that addresses physical, social, economic and environmental concerns affecting Oahu. This planning process serves as the coordinative means by which the City provides for the future growth of the metropolitan area of Honolulu. http://dev.honoluludpp.org/Planning/GeneralPlan.aspx
4. 8 Development Plan (DP) and Sustainable Community Plan (SCP) land use planning regions of Oahu. Each community oriented land use plan is intended to help guide public policy, investment, and decision making over the next 20 years. Each plan responds to specific conditions and community values of each region. Ewa and Primary Urban Center are "development plan" areas where growth and supporting facilities will be directed and be the policy guide for development decisions and actions needed to support that growth. The remaining 6 land use areas are "sustainable communities" plans, which are envisioned as relatively stable regions in which public programs will focus on supporting existing populations. The following table lists the 8 land use planning reports with links.

Oahu's Land Use Planning Regions	**Web Page Links to the Plans**
Waianae	http://dev.honoluludpp.org/Planning/DevelopmentSustainableCommunitiesPlans/WaianaePlan.aspx
Ko`olauloa	http://dev.honoluludpp.org/Planning/DevelopmentSustainableCommunitiesPlans/KoolauloaPlan.aspx
Ko`olaupoko	http://dev.honoluludpp.org/Planning/DevelopmentSustainableCommunitiesPlans/KoolaupokoPlan.aspx
North Shore	http://dev.honoluludpp.org/Planning/DevelopmentSustainableCommunitiesPlans/NorthShorePlan.aspx
Ewa	http://dev.honoluludpp.org/Planning/DevelopmentSustainableCommunitiesPlans/EwaPlan.aspx

Oahu's Land Use Planning Regions	Web Page Links to the Plans (Continued)
Central Oahu	http://dev.honoluludpp.org/Planning/DevelopmentSustainableCommunitiesPlans/CentralOahuPlan.aspx
East Honolulu	http://dev.honoluludpp.org/Planning/DevelopmentSustainableCommunitiesPlans/EastHonoluluPlan.aspx
Primary Urban Center	http://dev.honoluludpp.org/Planning/DevelopmentSustainableCommunitiesPlans/PrimaryUrbanCenter.aspx

5. City and County of Honolulu Ordinance 90-62, Water Management establishing the Oahu Water Management Plan establishing water management policies and strategies "for water use and development within each development plan area."
6. Annual Report to the Twenty-First Legislature 2001 Regular Session on Act 152, SLH 2000, Relating to Watershed Protection. The annual report set forth the development of a watershed master plan, including identifying protected watersheds areas, enhancement projects and an implementation plan.
7. Supreme Court Decision on Waiahole Ditch Contested Case applying the Public Trust Doctrine and the Precautionary Principle to water resource management.
8. BWS Sustainability Vision and Mission of "Water for Life" to enhance the quality of life of our community by providing world-class water services. Protecting the environment and supporting Oahu's economy while involving the community achieve BWS goals of sustainable water supplies for future generations. BWS accomplishes these goals with our watershed protection and water conservation partnership programs and diversifying our water supplies, both natural and alternative technologies, such as recycled water, seawater desalination and ocean resource development.

Background:

The Commission in 1990 formally adopted the initial Hawaii Water Plan, prepared by various state and county agencies. Further updates in 1992 were deferred pending additional refinement of plan components. In 1994, the City and County of Honolulu began their initial revision to the Oahu Water Management Plan. The draft OWMP update was completed in January 1998 and is the most current reference document. However, it was not submitted for adoption because Oahu's water situation was in a state of flux, with major changes in the agriculture industry, including the closing of the Oahu Sugar Company and the Waialua Sugar Company.

In 1999, the Honolulu Board of Water Supply (BWS) initiated the integrated resource planning process to update the Oahu Water Management Plan, Oahu's County Water Use and Development Plan. The integrated islandwide water planning effort was met with significant opposition, which surfaced in our public participation process. After almost two years of effort, we did not move beyond the public participation process and so before we started the water planning stage, we decided to stop and re-evaluate our approach. We summarize the main lessons learned as follows:

1. It is important to have equal focus on resource protection, conservation and restoration as on water use and development. There needs to be a reassurance that our natural resources are protected and our water supplies are sustainable before planning on water use and development can successfully occur.
2. It is important to elevate the community's knowledge about water related issues so the interested community can actively participate in a community-based planning process. It is equally important that the planning document is written so that it is easily understood.
3. The islandwide integrated approach elevated community concerns on growth limits and regional water transport. The integrated approach is more complex on Oahu because approximately ¾'s of Oahu's water systems are interconnected. The communities needed assurance that there were sufficient water resources within their watersheds before islandwide regional water needs were discussed.

In February 2000, CWRM adopted a framework for updating the Hawaii Water Plan to provide focus and additional guidance to each agency responsible for updating specific plan components. CWRM recognized the complexities in addressing water resource planning and views the plans as "living documents which over several plan iterations will result in a truly comprehensive water plan" (Statewide Framework page 1-2)

In August 2000,the Hawaii Supreme Court's decision on the Waiahole Ditch Contested Case, and the remand hearings, provided additional guidance for water resources planning, like the precautionary principle. In addition, three public trust uses of water were identified; domestic use, instream use and water for traditional and cultural practices. Commercial and agricultural water uses are in a lower category.

In 2001, BWS broadened its mission to "Water for Life", which strives for sustainability of all water supplies and to enhance the quality of life of our community by providing world-class water services.

The 2000 Act 152 Watershed Protection required the development of a watershed protection master plan that identified priority watersheds and protection projects for implementation. Act 152 renewed BWS investment in watershed protection recognizing the importance of watersheds for the sustainability of our groundwater supplies and streams. To date, about $1 million has been invested by BWS into Oahu's watersheds and aquifers. Noteworthy watershed protection projects are as follows:

- Ka`ala Bog Fencing to prevent feral animals from destroying the Mt. Ka`ala native habitat.
- Grant to the Oahu Invasive Species Committee to control invasive plant species within the Ko`olau watersheds
- Ala Wai Mauka Restoration Project for the Ko`olau Mountain Watershed Partnership
- BWS and Kamehameha Schools funded a USGS study to assess the hydrological and biological features and also funded the Punalu`u Agricultural Lands and Irrigation System Assessment to help set the in-stream flow standard for Punalu`u Stream.
- Waihe`e Valley Make a Difference Day invasive species removal
- Malama O Manoa "Kuleana Project" to change the residential practices of the Manoa Ahupua`a to increase awareness of water conservation and polluted runoff control.
- Watershed protection studies in Ala Wai, West Honolulu and Central Oahu.
- Ka`ala Farms and Mohala I Ka Wai educational awareness program
- Makaha Valley Restoration project
- Wai`anae and Ko`olauloa Watershed Management Plans

From 2001 to the present, several mountain and urban watershed partnerships have been established among BWS, agencies, organizations and community groups. Together, these partnerships have identified watershed protection projects and plans have been developed and funded. The following partnerships have been developed:

- Ko`olau Mountain Watershed Partnership
- Mohala I Ka Wai in Wai`anae
- Punalu`u Watershed Partnership
- Waihe`e Ahupua`a Initiative
- Ahupua`a Restoration Council of He`eia
- Malama O Manoa
- Wai`anae Kai Watershed Partnership
- University of Hawaii Manoa / BWS Water Conservation Partnership
- Hawaiian Electric Co. / BWS Energy and Water Conservation Partnership

Watershed Planning Approach:

The OWMP Framework proposes individual planning documents referred to as regional watershed management plans, which collectively will be the Oahu Water Management Plan. The regional watershed management plans will address the water needs, both present and future, for the 8 land use districts on Oahu. Rather than an islandwide approach brought down to each watershed, the watershed planning approach will start from the basic planning unit, each watershed or "ahupua`a" and expand it to the region or "moku". It is important that this watershed management plan allow equal focus on resource protection, conservation and restoration as well as on water use and development. The watershed approach is supported by the following references:

- The planning regions will be consistent with and support each of the 8 DP/SCP land use planning regions established in the General Plan. The State Water Code, Chapter 174C-31(b)(2), requires that "Each water use and development plan shall be consistent with the respective county land use plans and policies, including general plan and zoning".
- The Statewide Framework for Updating the Hawaii Water Plan, Page 3-26, Need for Flexibility, recognizes the need for appropriate flexibility in the county plans due to institutional and /or funding constraints, to encourage innovation as well as to accommodate unique and county-specific concerns.
- The Statewide Framework Page 3-19 also requires the preparation of "**regional plans** for water development including recommended and alternative plans, costs, adequacy of plans and relationship to water resource protection and quality plan." (Emphasis added).

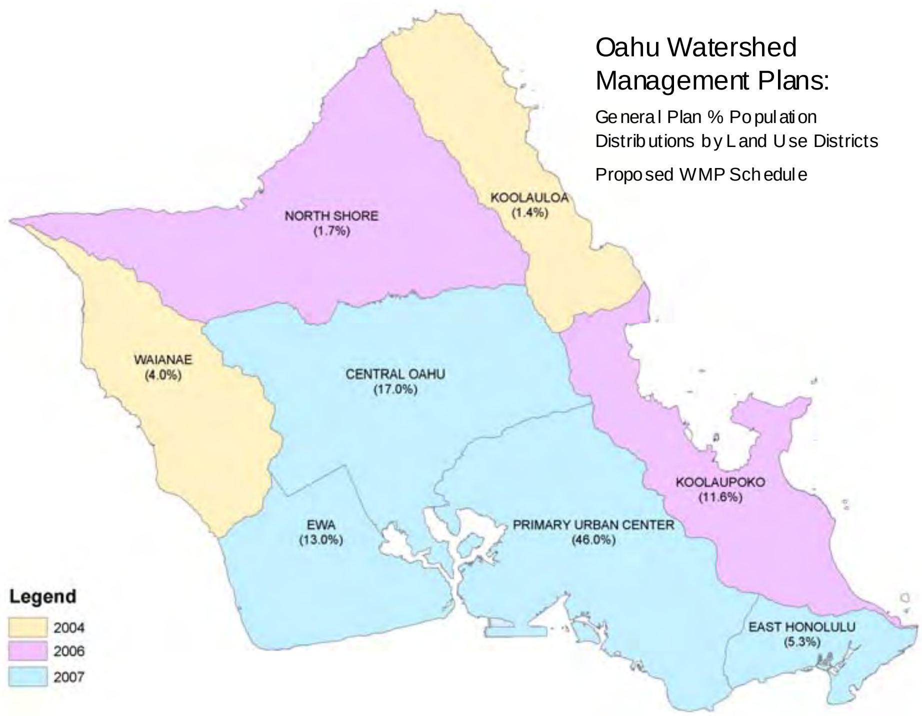
The watershed management plans will have the following key themes:

- Community-Based: In addition to public meetings, there will be many small group meetings with the community to educate, understand and apply the community's thinking and values about water resources. A wide-range of community meetings will be conducted including regional organizations such as Mohala I Ka Wai, Malama Ohana and the Neighborhood Boards, to local councils and associations, down to key individual meetings. The BWS watershed partnerships will be asked to provide representation for the community and key stakeholder groups.
- Environmentally Holistic: The watershed approach from mountains to the coral reefs recognizes the inter-dependence of water and land. The watershed management planning approach will not only address water use and development in the urban and agricultural zoned lands, but also describe protection strategies and enhancement projects for the forest reserves, conservation districts, streams and near-shore waters.
- Action-Oriented: The plan will describe specific watershed protection projects as well as natural and alternative water supply facilities that can be implemented by federal, state and city agencies and programs. The projects will be presented in a budgetary level format with information specific enough to support grant funding requests or an agency's capital improvement program.
- Alignment with State and County Water and Land Use Policies as stated above.
- Reflects Ahupua`a Management Principles: The watershed management plans will incorporate Ahupua`a principles in the plans. The community's help will be needed to identify their thinking and values about water. Living with Ahupua`a values and protocols is

very important to culturally intact communities, like Wai`anae and Ko`olauloa. Ahupua`a principles are not major factors in all districts, such as the urban metropolitan districts, however, these principles can still be used to guide water resource planning.

Proposed Schedule of Funding and Plan Approval:

The Oahu graphic below, shows the 8 land use areas on Oahu and the proposed funding schedule for the watershed management plans.



The following table lists the proposed funding schedules and anticipated target dates for submittal to CWRM for plan approval. The approval dates are based on an 18-month planning time frame and are only estimates and therefore subject to change.

Watershed Planning Areas	**BWS Funding Schedule Fiscal Year**	**Target Dates for Submittal to CWRM for Plan Approval**
Wai`anae, Ko`olauloa	FY 2004	1st Qtr FY 2006
North Shore, Ko`olaupoko	FY 2006	2nd Qtr FY 2007
South Oahu: (Ewa, Central Oahu, Primary Urban Center, East Honolulu)	FY 2007	2nd Qtr FY 2008

* BWS Fiscal Year is July 1 to June 30.

The four-year funding schedule is proposed due to the following reasons:

1. The Statewide Framework recognizes that implementation of the requirements and recommendations will need to be phased over the next several years and possibly over successive iterations of the updating process for the Hawaii Water Plan. (Statewide Framework Implementation Plan, Page 4-1)
2. BWS budgetary and staffing constraints.
3. As this watershed approach is new and unique, we are proposing an 18-month planning process to develop a baseline format and obtain the necessary approvals.
4. Wai`anae, Ko`olauloa, North Shore and Ko`olaupoko are designated as low growth, sustainable communities in the General Plan. The water demand projections for these areas show only marginal water demand increases through the planning horizon, currently 2025.
5. BWS is participating in active watershed partnerships in the Wai`anae and Ko`olauloa areas among others and these partnerships could assist in the public participation process.
6. South Oahu will be funded after the 4 rural districts for the following reasons:
   - To allow time for progress on the Section IV Framework Implementation Plan; Phase I Framework Adoption and Initial Updates to Hawaii Water Plan components, Phase II Development and Funding of New Framework Initiatives and Phase III Component Integration Phase of the Statewide Framework.
   - To allow time to complete the on-going products of the CWRM led Pearl Harbor Monitoring Group as part of the Milestone Framework for the Revised Pearl Harbor Sustainable Yields. Since 1998, BWS has funded over $4 million for the construction of deep monitor wells throughout Oahu and have committed staffing resources for the monitoring of these wells on a quarterly basis. These wells will be essential in the groundwater monitoring and modeling efforts currently underway to increase our understanding of the groundwater supply in the Pearl Harbor and Honolulu aquifers.
   - To allow time to complete the Board of Water Supply's 3-dimensional groundwater model of the Honolulu aquifers.
   - To allow time to incorporate state projects water demands and agricultural water needs. We understand that the State Water Projects Plan was recently completed and the State Agricultural Water Use and Development plan is now underway.
   - The watershed management plans for South Oahu will be funded in the same fiscal year and may be combined into a single plan to more easily address the integration of water resources.

   In calendar year 2000, South Oahu consumed about 78% of the islandwide municipal source pumpage of 154.6 mgd. We anticipate that the South Oahu watershed management plan(s) will fully utilize the IRP decision tools as described in the Statewide Framework for Updating the Hawaii Water Plan. The scope of work contemplated for the South Oahu regional watershed plan(s) will provide for compiling and developing water demand projections for domestic, commercial, industrial, agricultural, and nonpotable uses of municipal, state, federal and private water systems. It will also include assessment of environmental factors as part of the project objectives and evaluation criteria to be developed for the purpose of evaluating resource options and water management strategies.

Commitment for Agency Coordination:

As each watershed management plan moves forward and in addition to the public participation process, we anticipate several staff meetings with CWRM, City Department of Planning & Permitting and BWS to update our planning progress and obtain feedback and guidance. At key milestones, as coordinated with CWRM staff, we will present updates to the CWRM, tentatively mid-way through the planning process, after the public review draft is available, during plan approval and as otherwise requested by the CWRM. A schedule will be developed.

Each watershed management plan will be submitted for approval as separate documents, closely supporting each respective DP/SCP land use plan. At the completion of the first iteration of all planning regions, there will be a consolidating process to provide an islandwide perspective and to resolve any remaining inter-regional issues.

Proposed Scope of Work, Major Project Elements:

As each planning region is funded, their scopes of work will be submitted to the CWRM for review and approval. The proposed scopes of work for the Wai`anae and Ko`olauloa sustainable community plan areas are being submitted for CWRM review and approval (see attached). The draft scopes and planning approach were discussed with some of the community leaders and organizations in Wai`anae and Ko`olaupoko, and their feedback incorporated. The major project elements for the FY 2004 watershed management plans for Wai`anae and Ko`olauloa are:

1. Project Organization
2. Preliminary Watershed Analysis
3. Preliminary Stakeholders Consultations
4. Preliminary Watershed Management Strategies
5. 5-year Watershed Action Plan
6. Water Use and Development Plan
7. Draft Report
8. Final Report
9. Watershed Management Plan Approval

Summary of Current Water Distribution:

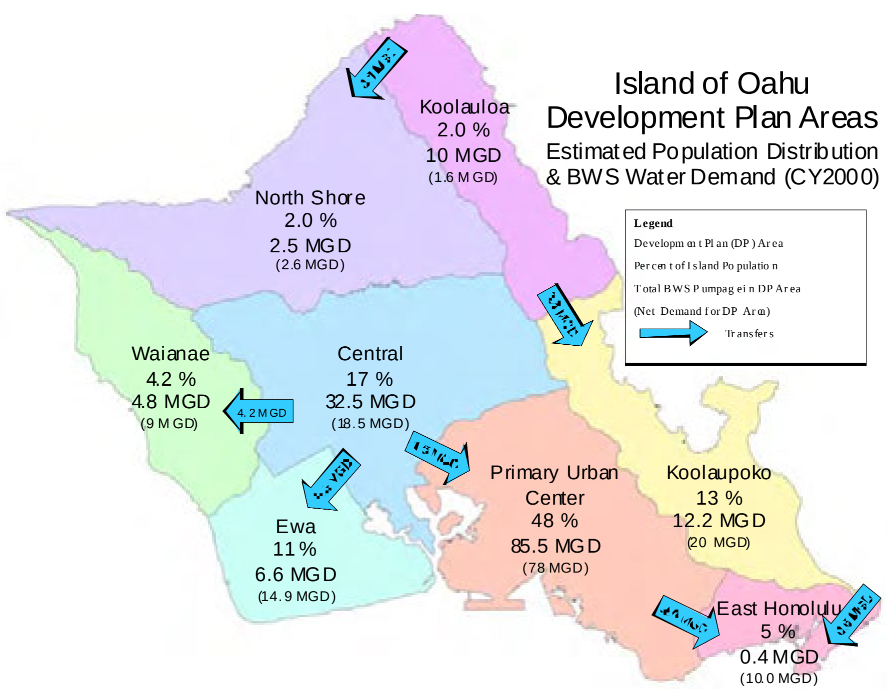
As part of the process of initiating the update of the OWMP and consistent with the guidelines set forth in the Statewide Framework for Updating the Hawaii Water Plan, we have compiled information on existing and projected water demands and sources of supply for the municipal system. BWS has evaluated the adequacy of the supply to meet the potable and nonpotable needs through ground water and recycled water sources. Water demand will be met with existing and funded source projects beyond the estimated 5-year planning period during the completion of all of the regional watershed management plans for Oahu.

The sustainable communities of Wai`anae, North Shore, Ko`olauloa and Ko`olaupoko have essentially the same water demand throughout the planning period. The existing sources and infrastructure in these areas are adequate to provide potable water service through the planning horizon and therefore, additional integration of water supplies between these regions will be limited.

In South Oahu, the water supplies, both natural and alternative, will be fully integrated and described in a future scope of work that once funded in FY 2007, will be submitted to CWRM for their review and approval. The following summarizes the main land use and water planning highlights in South Oahu.

- The City's General Plan directs the majority of the growth to South Oahu.
- Based on the City's growth forecast evaluating population, visitors, housing and employment factors, we forecast an increase in potable water demand for Oahu averaging about 1.1 million gallons per day per year, most of which will occur in South Oahu. In 5 years the BWS system demand is expected to increase by about 5.5 mgd, from 156 mgd in 2003 to 161.5 in 2008. New sources in the Waipahu-Waiawa Water Management Area, as identified in the City DP and SCP land use plans, will be able to provide adequate water supply.
- In addition, in that time period, recycled water facilities in Ewa and Central Oahu will be expanded to continue to off-set additional groundwater development.
    - In 2000, BWS acquired and now operates the 12 mgd Honouliuli Water Recycling Facility supplying irrigation and industrial process water for Ewa.
    - BWS has also funded the design of a delivery system to utilize approximately 3.0 mgd of Wahiawa recycled water in Central Oahu.
- The Kalaeloa seawater desalination plant is currently under design and will bring an additional 5.0 mgd of potable water supply to the second city of Kapolei.

For your information, a summary of Oahu's estimated population distribution based on the 2000 census, BWS potable water demand in calendar year 2000 and water distribution is provided among the 8 land use regions. The is essentially the base case of existing water demand and distribution in the BWS system, which will referenced in the watershed management plans.



APPENDIX B

PLANS, POLICIES, GUIDELINES, AND CONTROLS

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B PLANS, POLICIES, GUIDELINES, AND CONTROLS

B.1 OVERVIEW

The development of the Honolulu Board of Water Supply’s Watershed Management Plans (WMPs) is guided by various Federal, State, and County statutes, ordinances, plans, and controls with specific policies regarding the use and management of water. The critical water policies have been outlined in this section to ensure compliance with and adherence to the broader context under which this plan falls. The framework for developing the WMPs is provided by:

- State Water Code
- Statewide Framework for Updating the Hawai‘i Water Plan
- O‘ahu Water Management Plan Framework
- Act 44: An Act to Provide for the Encouragement and Protection of Agriculture, Horticulture, and Forestry
- Act 152: Relating to Watershed Protection, 2000 and the Annual Report to the Twenty-First Legislature 2001 Regular Session on Act 152.

Additionally, the O'ahu Watershed Management Plan strives for consistency with:

- Federal Clean Water Act and Safe Drinking Water Act
- All of the Hawai'i Water Plan components
- Department of Hawaiian Home Lands (DHHL) water plans as listed in the Hawai'i Revised Statutes (HRS) Chapter 174C-31
- Hawai'i State Plan
- General Plan for City and County of Honolulu
- County Development Plan/Sustainable Communities Plans
- City and County of Honolulu Ordinance Chapter 30: Water Management
- Supreme Court Decision on Waiāhole Ditch Contested Case applying the Public Trust Doctrine and Precautionary Principle
- BWS Sustainability Vision and Mission of "Water for Life."

This section is not meant to be a summary of these guidance documents, but a characterization of the major policy objectives that form the framework for the development of the WWMP. For more detailed information, the reader is directed to the original documents.

B.2 FEDERAL PLANS AND CONTROLS

Federal policy documents generally refer to the quality of recreational and drinking waters in order to protect the health and safety of users.

B.2.1 CLEAN WATER ACT (CWA) OF 1977, AMENDED 1987

The Clean Water Act (CWA) is the common name for the 1977 legislative amendment to the Federal Water Pollution Control Act Amendments of 1972. The objective of the CWA is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters" so they can support "the protection and propagation of fish, shellfish, and wildlife and…recreation in and on the water."[1] It provides the basic structure for regulating pollutant discharges to waters of the United States and sets water quality standards for all contaminants in surface waters. The CWA employs a variety of regulatory and non-regulatory tools to significantly reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff.

The CWA requires states to prepare and submit a 303(d) List of Impaired Waters every two years. This list includes waterbodies not expected to meet state water quality standards, even after application of technology-based effluent limitations to the U.S. Environmental Protection Agency (EPA). States are required to determine the level of impairment for that waterbody based on all existing and readily available surface water quality data and related information.[2]

B.2.2 SAFE DRINKING WATER ACT (SDWA) OF 1974, AMENDED 1996

Enacted in 1974, the purpose of the Safe Drinking Water Act (SDWA) is to protect public health by regulating the nation's public drinking water supply. Amended in 1996, the SDWA recognized the provisions of source water protection, operator training, funding for water system improvements, and public information as critical components to safe drinking water. The following are important programs as authorized by the SDWA:

- National standards for drinking water. Determined by EPA, these standards ensure consistent national water quality by setting enforceable maximum contaminant levels, which are the maximum permissible levels of a particular drinking water contaminant in a public water system.
- State source water assessment program. The Hawai'i Source Water Assessment Program (SWAP) is the first step in the development of a comprehensive drinking water source protection program. The SWAP requires delineation of the area around a drinking water source within which contaminants might filter through to that supply source. The SWAP requires an inventory of activities that might lead to the release of microbiological or chemical contaminants in the area. The Hawai'i SWAP report is currently under agency review.

B.3 STATE OF HAWAI'I PLANS AND CONTROLS

State water policy goals generally seek to protect, conserve, and manage the resource in such a way as to maintain its quality and availability for future generations.

B.3.1 CONSTITUTION OF THE STATE OF HAWAI'I

Article XI, Section 1 (Conservation, Control and Development of Resources) of the State Constitution mandates the State and its political subdivisions to conserve and protect its natural resources, including water. The State is to promote development and utilization of water in a manner that conserves and sustains the resource. As with all public resources, water is held in trust by the State for the benefit of the people.[3]

Article XI, Section 7 (Water Resources) expresses the State's obligation to "protect, control and regulate the use of Hawaii's water resources for the benefit of its people." It also mandates the establishment of a water resources agency that "shall set overall water conservation, quality and use policies; define beneficial and reasonable uses; protect ground and surface water resources, watersheds and natural stream environments; establish criteria for water use priorities while assuring appurtenant rights and existing correlative and riparian uses and establish procedures for regulating all uses of Hawaii's water resources."[4]

B.3.2 HAWAIʻI STATE PLAN

It is the goal of the State, under the Hawaiʻi State Planning Act (HRS, Chapter 226), to achieve: a) a strong and viable economy; b) a desired physical environment; and c) physical, social, and economic well-being for its people. The objectives and policies of the State Plan that are pertinent to the development of the Watershed Management Plans are discussed below:

B.3.2.1 Physical Environment: Land-Based, Shoreline, and Marine Resources

It is the objective of the State to make prudent use of Hawaii's land-based, shoreline, and marine resources and to protect unique and fragile environmental resources. It is the policy of the State to consider multiple uses in watersheds, provided such uses do not detrimentally affect water quality and recharge functions.[5]

B.3.2.2 Physical Environment: Land, Air, and Water Quality

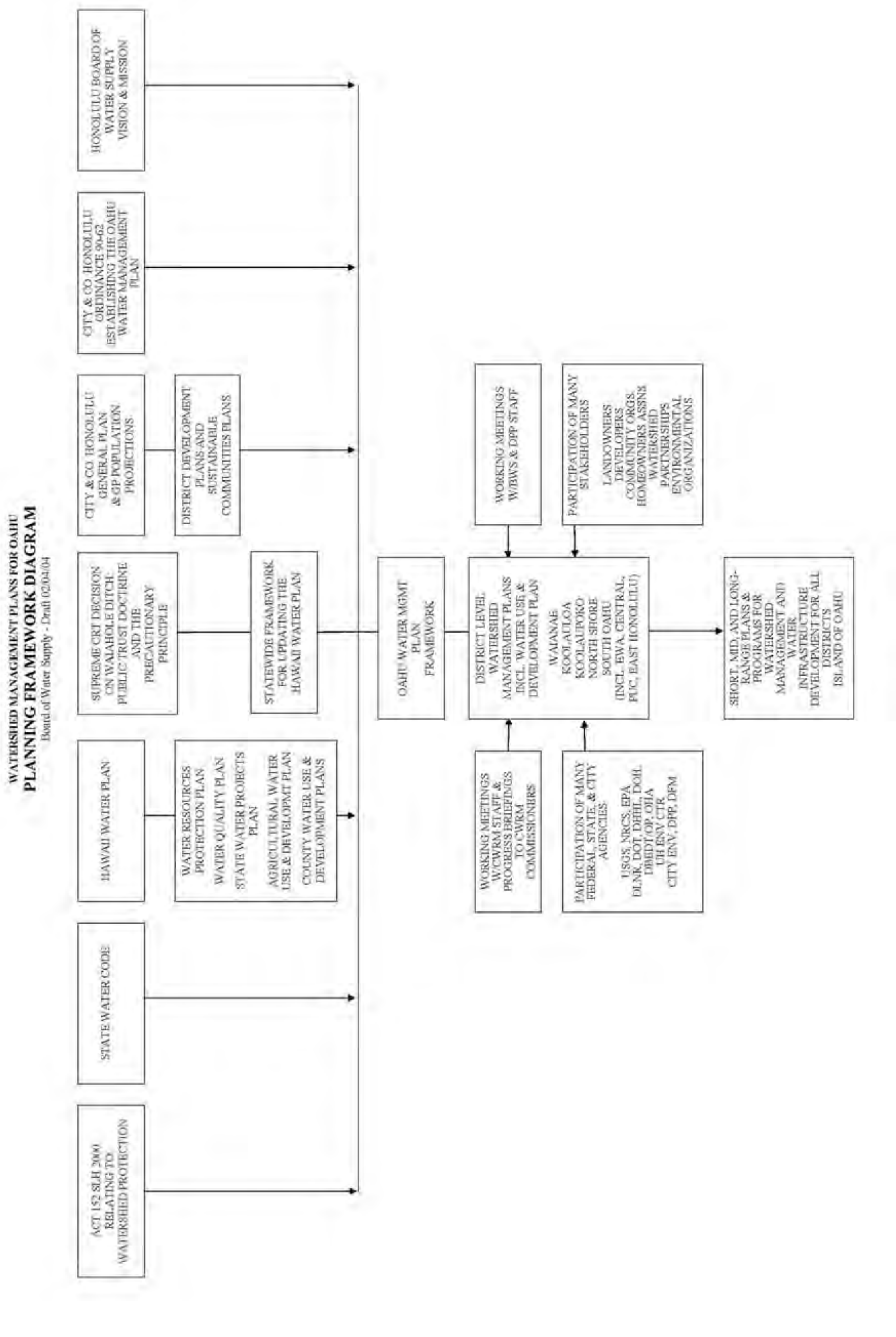
It is the objective of the State to maintain and pursue an improved quality of land, air, and water resources and to promote greater public awareness of Hawaii's environmental resources. In support of this, it is the policy of the State to:

- Promote the proper management of Hawaii's land and water resources
- Promote effective measures to achieve desired quality in Hawaii's surface, ground, and coastal waters
- Foster recognition of the importance and value of land, air, and water resources to Hawaii's people, their culture, and visitors.[6]

B.3.2.3 Facility Systems: Water

It is the objective of the State to adequately accommodate domestic, agricultural, commercial, industrial, recreational, and other needs within resource capacities. It is the policy of the State to:

- Coordinate the development of land use activities with existing and potential water supply.
- Support research and development of alternative methods to meet future water requirements well in advance of anticipated needs.
- Reclaim and encourage the productive use of runoff water and water discharges.
- Assist in improving the quality, efficiency, service, and storage capabilities of water systems for domestic and agricultural use.
- Support water supply services to areas experiencing critical water problems.
- Promote water conservation programs or practices in government, private industry, and the general public to help ensure adequate water to meet long-term needs.[7]


WATERSHED MANAGEMENT PLANS FOR OAHU
PLANNING FRAMEWORK DIAGRAM
Board of Water Supply - Draft 02/04/04
ACT 152 SLH 2000 RELATING TO WATERSHED PROTECTION
STATE WATER CODE
HAWAII WATER PLAN
WATER RESOURCES PROTECTION PLAN
WATER QUALITY PLAN
STATE WATER PROJECTS PLAN
AGRICULTURAL WATER USE & DEVELOPMT PLAN
COUNTY WATER USE & DEVELOPMENT PLANS
SUPREME CRT DECISION ON WAIAHOLE DITCH: PUBLIC TRUST DOCTRINE AND THE PRECAUTIONARY PRINCIPLE
STATEWIDE FRAMEWORK FOR UPDATING THE HAWAII WATER PLAN
CITY & CO. HONOLULU GENERAL PLAN & GP POPULATION PROJECTIONS
DISTRICT DEVELOPMENT PLANS AND SUSTAINABLE COMMUNITIES PLANS
CITY & CO. HONOLULU ORDINANCE 90-62 ESTABLISHING THE OAHU WATER MANAGEMENT PLAN
HONOLULU BOARD OF WATER SUPPLY VISION & MISSION
OAHU WATER MGMT PLAN FRAMEWORK
DISTRICT LEVEL WATERSHED MANAGEMENT PLANS INCL. WATER USE & DEVELOPMENT PLAN
WAIANAE KOOLAULOA KOOLAUPOKO NORTH SHORE SOUTH OAHU (INCL. EWA, CENTRAL, PUC, EAST HONOLULU)
WORKING MEETINGS W/BWS & DPP STAFF
PARTICIPATION OF MANY STAKEHOLDERS
LANDOWNERS DEVELOPERS COMMUNITY ORGS. HOMEOWNERS ASSNS WATERSHED PARTNERSHIPS ENVIRONMENTAL ORGANIZATIONS
WORKING MEETINGS W/CWRM STAFF & PROGRESS BRIEFINGS TO CWRM COMMISSIONERS
PARTICIPATION OF MANY FEDERAL, STATE, & CITY AGENCIES:
USGS, NRCS, EPA, DLNR, DOT, DHHL, DOH, DBEDT/OP, OHA, UH ENV CTR, CITY ENV, DPP, DFM
SHORT, MID, AND LONG-RANGE PLANS & PROGRAMS FOR WATERSHED MANAGEMENT AND WATER INFRASTRUCTURE DEVELOPMENT FOR ALL DISTRICTS ISLAND OF OAHU

B.3.3 STATE WATER CODE

The State Water Code (Code) was enacted in 1987 as HRS Chapter 174C by the State Legislature to protect and manage Hawaii's surface and ground water resources. The Code recognizes five general policies regarding water:

- Waters of the State are held for the benefit of the citizens of the State, who have a right to have the waters protected for their use.
- The Hawai'i Water Plan is the guide for developing and implementing a program of comprehensive water resources planning to address the problems of supply and conservation of water.
- The Code shall be liberally interpreted to obtain maximum beneficial use of the waters of the State for purposes such as domestic, aquaculture, irrigation and other agricultural, power development, and commercial and industrial uses. However, adequate provision shall be made for the protection of traditional and customary Hawaiian rights, the protection and procreation of fish and wildlife, the maintenance of proper ecological balance and scenic beauty, and the preservation and enhancement of water of the State for municipal uses, public recreation, public water supply, agriculture, and navigation.
- The Code "shall be liberally interpreted to protect and improve the quality of waters of the State….The people of Hawaii have an absolute interest in the prevention, abatement, and control of both new and existing water pollution and in the maintenance of high standards of water quality."
- The State Water Code shall be liberally interpreted and applied to conform to the intentions and plans of the counties in terms of land use planning.[8]

The Commission on Water Resource Management (Commission) was created within the State Department of Land and Natural Resources to administer the State Water Code. The Commission is responsible for the protection and management of water resources through appropriate measures such as setting policies, defining uses, establishing priorities while assuring rights and uses, and establishing regulatory procedures. The Commission has jurisdiction over land-based surface water and ground water resources, but not coastal waters. The protection and management of these water resources is carried out through resource assessments, planning, and regulation. Generally, the Commission is responsible for addressing water quantity issues, while water quality issues are under the purview of the State Department of Health.[9] The complete text of the State Water Code may be viewed at: http://www.state.hi.us/dlnr/cwrm/regulations/Code174C.pdf.

B.3.4 HAWAIʻI WATER PLAN

The State Water Code also mandates the development of the Hawaiʻi Water Plan (HWP), whose process is to be guided by the Commission. The HWP objectives include: (1) obtaining maximum reasonable beneficial use of water; (2) proper conservation and development of the waters of the State; (3) control of the waters of the State for such public purposes as navigation, drainage, sanitation, and flood control; (4) attainment of adequate water quality as expressed in the water resource protection and water quality plans; and (5) implementation of the Code's water resource policies.

The Hawaiʻi Water Plan originally consisted of four parts: the Water Resource Protection Plan (WRPP), the Water Use and Development Plans (WUDP) for each county, the State Water Projects Plan (SWPP), and the Water Quality Plan (WQP). An Agricultural Water Use and Development Plan (AWUDP) was added through Act 101 by the 1998 State Legislature.

As of June 2009, the status of the HWP components was as reflected in the following table:

HAWAI'I WATER PLAN COMPONENTS	OFFICIAL DOCUMENT	STATUS
Water Quality Plan (WQP)	June 1990	Update in progress
State Water Projects Plan (SWPP)	February 2003	O'ahu update in progress
Water Resource Protection Plan (WRPP)	June 2008	Update completed
Agricultural Water Use and Development Plan (AWUDP)	December 2004	Update in progress
Hawai'i WUDP	August 2010	Update completed
Kaua'i WUDP	1990	Update in progress
Maui/Lāna'i/Moloka'i WUDP	1990	Update in progress
O'ahu WUDP • Ko'olau Loa • Wai'anae • Ko'olau Poko • North Shore • 'Ewa • Central O'ahu • East Honolulu • Primary Urban Center	1990 August 2009 August 2009	 Update completed Update completed Update completed Update in progress Update in progress Awaiting funding Awaiting funding Awaiting funding

Specific requirements that the Code established for the county WUDPs include discussion of the status of water and related land development, future land uses and related water needs, and regional plans for water developments.[10] The WUDPs must also be consistent with the WRPP, WQP, county land use plans and policies (including General Plans and Zoning), and State land use classification and policies.[11]

B.3.5 STATEWIDE FRAMEWORK FOR UPDATING THE HAWAIʻI WATER PLAN

The Code calls for coordination between the Commission and other State and County agencies to formulate an integrated and coordinated program to develop and update the Hawaiʻi Water Plan (HWP). To effectively implement these requirements, the Commission established a Statewide Framework in February 2000 to incorporate the techniques of Integrated Resources Planning.

The Statewide Framework established that the intent of the County WUDP was to ensure that future water needs of the County are met and to provide guidance to the Commission for decision-making on water uses and water reservation requests. Evaluation of the current HWP components, including the County WUDPs, noted several areas of improvement and planning complexities that need to be addressed. Implications of the Statewide Framework to the WUDPs are as follows:[12]

- Establish a focus that promotes the welfare of the resource, unrestricted by jurisdictional responsibility.
- Avoid unrealistic simplification of complex water availability and allocation scenarios.
- Address competing uses within the overall planning context.
- Address a range of future water demand projection scenarios, taking into account impact to the physical, environmental or other socioeconomic costs of the strategies, and plan for uncertainties.
- Integrated planning is needed to address competition for available resources.
- Greater sophistication is necessary in planning for future water resource development, especially for the uncertain agriculture, military, urban land development, and tourism industries.
- Public involvement and education is a necessary component of the plan process.
- Closer monitoring and implementation of management strategies to protect the aquifer from over-withdrawal are necessary.
- Management strategies should consider the full range of development options, including balancing various source developments with non-structural options and articulate decision-making criteria.
- Recognize and plan for water requirements for all legally protected water rights.

The Statewide Framework recommended plan elements that should be included in the WUDP updates. These elements are:[13]

- Submission of a County-Specific WUDP Project Description
- Coordination with the Commission
- Stakeholder and Public Involvement
- County Public Participation Process
- Objectives and Criteria
- Consistency with the WRPP
- Current and Future Demand Forecast
- Water System Profiles
- Resource and Facility Options
- Strategies Development and Evaluation
- Flexible Sequence of Supply, Infrastructure, Storage, and Conservation Program Additions Needed
- Uncertainties
- Final Strategy Selection
- Modeling Tools
- Implementation Plan
- Underlying Assumptions
- Flexibility
- County-Specific Project Descriptions
- Priorities and Objectives
- County IRP Scope
- WUDP Schedule

B.3.6 STATE WATERSHED PROTECTION AND MANAGEMENT PROGRAM, ACT 44 (1903) AND ACT 152 (2000)

During the expansion of the sugar and cattle industries in the late 1800s in Hawai‘i, it was recognized that in order to ensure a steady supply of abundant water, legislation was needed to promote stronger conservation measures for Hawaii’s forests. On April 25, 1903, Act 44, An Act to Provide for the Encouragement and Protection of Agriculture, Horticulture and Forestry, was passed by the Territorial Legislature, thereby creating Hawaii’s forest reserve system and the basis for public-private partnerships to protect these resources.

Since the enactment of Act 44, "public and private investment in watershed protection and management has increasingly diminished and, once again, our forested watersheds are steadily degrading."[14] Act 152, Relating to Watershed Protection, passed in 2000, recognized that "Hawaii's forests function as critical watersheds and are the primary source of fresh water for the islands…have evolved into efficient ecosystems that capture and store appreciably more water than any other natural milieu…[and] are vital recharge areas for Hawaii's underground aquifers and a dependable source of clean water for its streams."[15] It therefore called for the development of a Watershed Protection Master Plan to provide for the protection, preservation, and enhancement of important watershed areas.

The Annual Report to the Twenty-First Legislature 2001 Regular Session on Act 152 was prepared by the watershed protection board created by Act 152. This annual report contains some policies that are specific to particular areas. Therefore, each Watershed Management Plan should refer back to this report to identify any policy or reference that specifically applies to the appropriate Development Plan or Sustainable Communities Plan area. Key points of the 2001 Annual Report that pertain specifically to Ko'olau Poko include:

- A recommendation that forested watersheds that are important for recharge should be a priority as they affect the water sources for agricultural, industrial, and domestic use.[16]
- The Ko'olau forests are a primary water resource for the island of O'ahu with an estimated sustained yield of over 133 billion gallons of water each year and are a habitat for several thousand native species and natural communities.[17]
- The Ko'olau Mountains Watershed Partnership, consisting of major landowners within the watershed and associated non-landowner interests, is a valuable asset in the holistic, sustainable management of the watershed.[18]

B.4 WATER RIGHTS IN HAWAI'I

Water rights and uses in Hawai'i are governed by the State Water Code[19] and the common law. The Water Code preserved appurtenant rights but not correlative and riparian rights in designated water management areas. Thus, when a ground water management area is designated, existing correlative uses within that area can be issued water use permits under the existing use provisions of the Water Code, but unexercised correlative rights are extinguished. Similarly, when a surface water management area is designated, existing riparian uses within that area are eligible for water use permits as existing uses, but unexercised riparian rights are extinguished. Furthermore, the Hawaii Supreme Court has ruled that when there is an undisputed direct interrelationship between the surface and ground waters, designation of a ground water management area subjects both ground and surface water diversions from the designated area to the statutory permit requirement.[20] Presumably, permits would also be required for ground and surface water diversions when the interrelationship occurs in a surface water management area.

While water use permits are required only in designated water management areas and the common law on water rights and uses continue to apply in non-designated areas, other provisions of the Water Code apply throughout the state. Thus, for example, well construction and pump installation permits are required for any new or modified ground water use and stream diversion and stream alteration permits are required for any new or modified surface water diversions. If the proposed stream diversion will affect the existing instream flow standard, a successful petition to amend the interim instream flow standard is also required.

B.4.1 CORRELATIVE RIGHTS

Under the common law, owners of land overlying a ground water source have the right to use that water on the overlying land as long as the use is reasonable and does not injure the rights of other overlying landholders.[21] When the amount of water is insufficient for all, each is limited to a reasonable share of the ground water. Overlying landowners who have not exercised their correlative rights cannot prevent other landowners from using the water on the theory that they are using more than their reasonable share. They must suffer actual, not potential, harm. Only when landowners try to exercise their correlative rights and the remaining water is insufficient to meet their needs, can they take action to require existing users to reduce their uses.

B.4.2 RIPARIAN RIGHTS

Riparian rights are rights of land adjoining natural watercourses and are the surface water equivalent of correlative rights to ground waters; i.e., the use has to be on the riparian lands, the use has to be reasonable, and the exercise of those rights cannot actually harm the reasonable use of those waters by other riparian landowners. The Court had originally stated that the right was to the natural flow of the stream without substantial diminution and in the shape and size given it by nature,[22] but later concluded that the right should evolve in accordance with changing needs and circumstances. Thus, in order to maintain an action against a diversion which diminishes the quantity or flow of a natural watercourse, riparian owners must demonstrate actual harm to their own reasonable use of those waters.[23]

B.4.3 APPURTENANT RIGHTS

Appurtenant water rights are rights to the use of surface water utilized by (non-riparian) parcels of land at the time of their original conversion into fee simple lands; i.e., when land allotted by the Mahele was confirmed to awardees by the Land Commission and/or when the Royal Patent was issued based on such award, the conveyance of the parcel of land carried with it the appurtenant right to water.[24] The amount of water under an appurtenant right is the amount that was being used at the time of the Land Commission award and is established by cultivation methods that approximate the methods utilized at the time of the Mahele; for example, growing wetland taro.[25] Once established, future uses are not limited to the cultivation of traditional products approximating those utilized at the time of the Mahele,[26] as long as those uses are reasonable, and if in a water management area, meets the Water Code's test of reasonable and beneficial use ("the use of water in such a quantity as is necessary for economic and efficient utilization, for a purpose, and in a manner which is both reasonable and consistent with the State and county land use plans and the public interest"). As mentioned earlier, appurtenant rights are preserved under the Water Code, so even in designated water management areas, an unexercised appurtenant right is not extinguished and must be issued a water use permit when applied for, as long as the water use permit requirements are met.

B.4.4 EXTINGUISHING RIPARIAN OR APPURTENANT RIGHTS

Unlike appurtenant rights, which are based in the common law, the Court has interpreted riparian rights as originating in an 1850 statute.[27] This has led to a curious inconsistency in that, while unexercised appurtenant rights are preserved and unexercised riparian rights are extinguished in designated water management areas, actions by private individuals can extinguish appurtenant but not riparian rights. Both appurtenant and riparian rights cannot be severed from the lands they are attached to, and such rights pass with the title to the land whether or not the rights are expressly mentioned in the deed. If the transferor of the land attempts to reserve the riparian right in the deed, the reservation is not valid and the right nevertheless belongs to the transferee as the new owner of the land. The law with regards to appurtenant rights is not clear. The Court in Reppun held that where a landowner attempted to reserve an appurtenant right while selling the underlying land, the reservation is not valid and the attempt to reserve extinguishes the appurtenant right. In doing so, the Court reasoned that there is nothing to prevent a transferor from effectively providing that the benefit of the appurtenant right not be passed to the transferee.[28] This difference is due to the Court's interpretation that riparian rights had been created by the 1850 statute, so any attempt by the grantor to reserve riparian water rights in the deed when riparian lands are sold is invalid. Presumably, the inconsistency could be cured by legislation providing a statutory basis for appurtenant rights. In fact, the Court in the Waiāhole Ditch Contested Case cited to the Water Code's recognition of appurtenant rights and legislative comment to the effect that "Appurtenant rights may not be lost."[29] However, the Court did not explicitly discuss its prior Reppun decision, so it is unclear whether its Waiāhole decision overruled Reppun.

B.4.5 APPROPRIATED USES

Appropriated uses are uses of surface or ground waters on non-riparian or non-overlying lands. In the case of ground water, "(p)arties transporting water to distant lands are deemed mere 'appropriators,' subordinate in right to overlying landowners …(T)he correlative rights rule grants overlying landowners a right only to such water as necessary for reasonable use. Until overlying landowners develop an actual need to use ground water, non-overlying parties may use any available 'surplus' (citations omitted)."[30] For surface waters, "the effect of permitting riparian owners to enjoin diversions beneficial to others in the absence of a demonstration of actual harm may occasionally lead to wasteful or even absurd results…The continuing use of the waters of the stream by the wrongful diversion should be contingent upon a demonstration that such use will not harm the established rights of others."[31] Thus, appropriated uses are not based on water rights but are allowed as long as they are reasonable and do not actually impinge on correlative and riparian rights. Note that appurtenant uses would be a type of appropriated uses if they were not based on appurtenant rights, and that in fact, the history of appurtenant uses in the Kingdom of Hawai'i has led to their establishment as water rights superior to riparian rights. Also note that when a water management area is designated, appropriated uses become superior to unexercised water rights, because appropriated uses become existing uses and are eligible for water use permits, while unexercised correlative and riparian rights are extinguished.

B.4.6 OBSOLETE RIGHTS: PRESCRIPTIVE AND KONOHIKI RIGHTS

Until 1973, surface waters were treated as private property and could be owned. Prescriptive water rights were the water equivalent of "adverse possession" in land ownership, where open and hostile occupation of another's private property for a specified number of years entitled the occupier to take legal ownership, because it raised the legal presumption of a grant. Prescriptive rights to water were exercisable only against the ownership of other private parties and not against the government. Thus, under prescriptive rights, appropriated uses could ripen into a prescriptive right superior to riparian rights. (Some early Court cases viewed appurtenant rights as a type of prescriptive right.) In 1973, the Court voided private ownership of water resources and prescriptive rights because of public ownership of all surface waters.[32] As for ground water, two early cases (1884[33] and 1896[34]) reflected the then prevailing law on surface waters that water could be private property, but those cases also concluded that prescriptive rights cannot be exercised against subterranean waters that have no known or defined course; i.e., you could not adversely possess what you could not see. In 1929, the Court adopted the correlative rights rule,[35] in which the overlying landowners could not use the water as they pleased, because it was a shared resource.

Until 1973, "*konohiki* lands," or lands whose title had passed from persons documented as *konohiki*, owned the "normal daily surplus water" in excess of waters reserved by appurtenant and prescriptive rights. (Despite a number of earlier cases, in 1930 the Court had concluded that riparian rights had never been the law in Hawai'i.[36] The 1973 Court, instead of overturning that decision, found a statutory basis for riparian rights in the 1850 statute.) In 1973, in addition to voiding any private property interest in water, the Court ruled that there can be no "normal daily surplus water," because the recognition of riparian rights entitled owners of riparian lands to have the flow of the watercourse in the shape and state given it by nature.[37]

B.4.7 NATIVE HAWAIIAN WATER RIGHTS

The Water Code contains the following provisions on Native Hawaiian water rights (section 174C-101):

- Provisions of this chapter shall not be construed to amend or modify rights or entitlements to water as provided for by the Hawaiian Homes Commission Act, 1920, as amended, and by chapters 167 and 168, relating to the Molokai irrigation system. Decisions of the commission on water resource management relating to the planning for regulation, management, and conservation of water resources in the State shall, to the extent applicable and consistent with other legal requirements and authority, incorporate and protect adequate reserves of water for current and foreseeable development and use of Hawaiian home lands as set forth in section 221 of the Hawaiian Homes Commission Act.
- No provision of this chapter shall diminish or extinguish trust revenues derived from existing water licenses unless compensation is made.
- Traditional and customary rights of ahupuaʻa tenants who are descendants of native Hawaiians who inhabited the Hawaiian Islands prior to 1778 shall not be abridged or denied by this chapter. Such traditional and customary rights shall include, but not be limited to, the cultivation or propagation of taro on one's own kuleana and the gathering of hīhīwai, ʻōpae, ʻoʻopu, limu, thatch, ti leaf, aho cord, and medicinal plants for subsistence, cultural, and religious purposes.
- The appurtenant water rights of kuleana and taro lands, along with those traditional and customary rights assured by this section, shall not be diminished or extinguished by a failure to apply for or to receive a permit under this chapter. (The exercise of an appurtenant water right is still subject to the water use permit requirements of the Water Code, but there is no deadline to exercise that right without losing it, as is the case for correlative and riparian rights, which must have been exercised before designation of a water management area.

B.5 THE PUBLIC TRUST DOCTRINE AND THE PRECAUTIONARY PRINCIPLE

The Waiāhole Ditch Contested Case drew upon principles from the Public Trust Doctrine and Precautionary Principle in one of the landmark decisions in Hawaiʻi water law.

B.5.1 THE PUBLIC TRUST DOCTRINE

In its review of the Waiāhole Ditch Contested Case, the Hawaiʻi Supreme Court held that: 1) title to the water resources is held in trust by the state for the benefit of its people; 2) article XI, sections 1 and 7 of the Hawaiʻi Constitution adopted the public trust doctrine as a fundamental principle of constitutional law in Hawaiʻi; 3) the legislature incorporated public trust principles into the Water Code; and 4) nevertheless the Water Code did not supplant the protections of the public trust doctrine, which the Court would continue to use to inform the Court's interpretation of the Water Code, define its outer limits, and justify its existence.[38]

The Court has identified four trust purposes, three in the Waiāhole Ditch Contested Case, and a fourth in its 2004 decision, *In the Matter of the Contested Case Hearing on Water Use, Well Construction, and Pump Installation Permit Applications, Filed by Wai'ola o Moloka'i, Inc. and Moloka'i Ranch, Limited:*

- Maintenance of waters in their natural state;
- Domestic water use of the general public, particularly drinking water;
- The exercise of Native Hawaiian and traditional and customary rights, including appurtenant rights;[1] and
- Reservations of water for Hawaiian home lands.

The Court also identified the following principles for the water resources trust:[2]

- The state has both the authority and duty to preserve the rights of present and future generations in the waters of the state;
- This authority empowers the state to revisit prior diversions and allocations, even those made with due consideration of their effect on the public trust;
- The state also bears the affirmative duty to take the public trust into account in the planning and allocation of water resources and to protect public trust uses whenever feasible;
- Competing public and private water uses must be weighed on a case-by-case basis, and any balancing between public and private purposes begin with a presumption in favor of public use, access, and enjoyment;

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[1] Although the Court has not ruled specifically on the issue, the exercise of an appurtenant right presumably would have to be done in a traditional and customary manner if it is to be considered a public trust purpose. Otherwise, commercial uses of appurtenant rights would be a protected public trust use. Note, however, that unexercised appurtenant rights cannot be extinguished, and this also applies to commercial uses of appurtenant rights as long as that use is reasonable and beneficial.

[2] While these principles are directed at surface water resources, they apply equally to ground water resources.

- There is a higher level of scrutiny for private commercial uses, with the burden ultimately lying with those seeking or approving such uses to justify them in light of the purposes protected by the trust; and
- Reason and necessity dictate that the public trust may have to accommodate uses inconsistent with the mandate of protection, to the unavoidable impairment of public instream uses and values; offstream use is not precluded but requires that all uses, offstream or instream, public or private, promote the best economic and social interests of the people of the state.

B.5.2 THE PRECAUTIONARY PRINCIPLE

When scientific evidence is preliminary and not conclusive regarding the management of the water resources trust, it is prudent to adopt "precautionary principles." The Court's interpretation as explained in the Waiāhole Ditch Contested Case is as follows:

- As with any general principle, its meaning must vary according to the situation and can only develop over time. At a minimum, the absence of firm scientific proof should not tie the commission's hands in adopting reasonable measures designed to further the public interest.
- The precautionary principle simply restates the commission's duties under the Constitution and the Code. The lack of full scientific certainty does not extinguish the presumption in favor of public trust purposes or vitiates the commission's affirmative duty to protect such purposes wherever feasible. Nor does its present inability to fulfill the instream use protection framework render the statute's directives any less mandatory. In requiring the commission to establish instream flow standards at an early planning stage, the Water Code contemplates the designation of the standards based not only on scientifically proven facts, but also on future predictions, generalized assumptions, and policy judgments. Neither the Constitution nor the Water Code constrains the commission to wait for full scientific certainty in fulfilling its duty toward the public interest in minimum instream flows.

The Court's linking of the Public Trust Doctrine to the Precautionary Principle offers significant guidance to the Watershed Management Plans. The tenets of the Precautionary Principle state that:

- There is a duty to take anticipatory action to prevent harm to public resources;
- There is an obligation to examine the full range of alternatives before starting a new activity and in using new technologies, processes, and chemicals; and
- Decisions should be open, informed and democratic and include affected parties.

In this regard, “precautionary actions” may include:

- Anticipatory and preventive actions;
- Actions that increase rather than decrease options;
- Actions that can be monitored and reversed;
- Actions that increase resilience, health, and the integrity of the whole system; and
- Actions that enhance diversity.

The Public Trust Doctrine establishes a general duty to take precautionary actions and thus shifts the burden of proof to non-trust purposes and requires preventive action in the face of uncertainty.

B.6 CITY AND COUNTY OF HONOLULU PLANS AND CONTROLS

City and County of Honolulu water policies generally relate to water in regard to development goals, sustainability, and as a system that cannot be separated between its natural and human uses.

B.6.1 GENERAL PLAN (GP)

The General Plan is required by City Charter as a statement of (1) the long-range social, economic, environmental, and design objectives for the general welfare and prosperity of the people of Oʻahu and (2) the broad policies which facilitate the attainment of the objectives of the plan.[39] The 1992 GP, as amended, discusses eleven public policy areas that provide the framework from which the City and County of Honolulu derives public policies that address all aspects of health, safety, and welfare within its jurisdiction including: population, economic activity, the natural environment, housing, transportation and utilities, energy, physical development and urban design, public safety, health and education, culture and recreation, and government operations and fiscal management. The GP contains policies that are specific to particular areas. Therefore, each Watershed Management Plan should refer back to the original document to identify any policy or reference that specifically applies to the appropriate Development Plan or Sustainable Communities Plan area. The County WUDP, and specifically the Koʻolau Poko Watershed Management Plan, needs to consider:

<u>Population</u>

Control population growth to the extent possible to avoid social, economic, and environmental disruptions, plan for future population growth, and establish a pattern of population distribution that will allow the people of Oʻahu to live and work in harmony. The specific policy toward these objectives is to direct growth according to population policies set forth in the GP by providing land development capacity and needed infrastructure to distribute 11.6 percent of the island-wide population to the Koʻolau Poko region by 2025.[40]

Economic Activity

Provide, encourage, and promote economic opportunities and maintain the viability of agriculture. Maintain agricultural land along the Windward, North Shore, and Waiʻanae coasts for truck farming, flower growing, aquaculture, livestock production, and other types of diversified agriculture.[41]

Natural Environment

Provide, preserve, and enhance our natural environment by restoration, mitigation, and increasing public awareness and appreciation of our island resources. Policies to achieve these objectives include:

- Seek the restoration of environmentally damaged areas and natural resources.
- Retain the Island's streams as scenic, aquatic, and recreation resources.
- Design surface drainage and flood-control systems in a manner which will help preserve their natural settings.
- Protect the natural environment from damaging levels of air, water, and noise pollution.
- Protect plants, birds, and other animals that are unique to the State of Hawaiʻi and the Island of Oʻahu.
- Increase public awareness and appreciation of Oahu's land, air, and water resources.
- Protect the island's well-known resources: its mountains and craters; forests and watersheds areas; marshes, rivers, and streams; shoreline, fishponds, and bays; and reefs and offshore islands.
- Provide opportunities for recreational and educational use and physical contact with Oahu's natural environment.[42]

Housing

Provide a choice of living environments which are adequately served by public utilities. Encourage residential development in areas where existing roads, utilities, and other community facilities are not being used to capacity and discourage development where the aforementioned cannot be provided at a reasonable cost.[43]

Transportation and Utilities

Develop and maintain an adequate water supply for the needs of residents, visitors, agriculture, and industry. Encourage the development of new technology that will reduce the cost of providing water and support the recycling of wastewater. Encourage a lowering of per-capita consumption of water. Maintain existing utility systems to avoid major breakdowns, provide improvements to reduce substandard conditions, plan for the timely and orderly expansion of utility systems, and increase efficiency by encouraging a mixture of uses with peak demand periods at different times of the day.[44]

Physical Development and Urban Design

Coordinate the construction of public facilities with location and timing of development. Policies that support this objective include:

- Plan for the construction of new public facilities and utilities in the various parts of the Island according to the following order of priority: first, in the primary urban center; second, in the secondary urban center at Kapolei; and third, in the urban-fringe and rural areas.
- Coordinate the location and timing of new development with the availability of adequate water supply, sewage treatment, and drainage.[45]

Health and Education

Coordinate county health codes and other regulations with State and Federal health codes to facilitate the enforcement of water pollution controls.[46]

Government Operations and Fiscal Management

Ensure that government attitudes, actions, and services are sensitive to community needs and concerns.[47]

B.6.2 DEVELOPMENT PLANS AND SUSTAINABLE COMMUNITIES PLANS

The County Development Plans (DP) and Sustainable Communities Plans (SCP) for the eight land use districts established in the General Plan were developed to guide public policy, investment, and decision-making for a planning horizon of 20 years. Each DP or SCP contains guidance that is specific to the district it addresses. Therefore, each Watershed Management Plan should refer back to the appropriate DP or SCP to identify any policy or reference that specifically applies to the area being studied.

The Koʻolau Poko SCP recognizes this district as relatively stable, with a vision to protect the community's natural, scenic, cultural, historic, and agricultural resources. The following are land use policies and guidelines from the Koʻolau Poko SCP that have implications for the Koʻolau Poko Watershed Management Plan:

- Historic and Cultural Resources
  - Emphasize physical references to Koʻolaupoko's history and cultural roots.
  - Preserve significant historic features.
- Agricultural Uses
  - Encourage small-lot agricultural uses and prevent conversion of agricultural lands to non-agricultural uses.
  - Provide supporting infrastructure, services, and facilities to foster and sustain agricultural operations.
  - Implement policies and incentives to promote active, long-term agricultural uses.
- Residential Uses
  - Maintain the predominantly low-rise, low-density, single family character of the region.
  - Reduce average density guidelines to 2-8 units per acre in urban fringe areas and 0.2-4 units per acre in rural areas.
- Water Systems Development:
  - Integrate management of all potable and non-potable water sources, including groundwater, stream water, storm water and effluent, following State and City legislative mandates.
  - Adopt and implement water conservation practices in the design of new developments and the modification of existing uses, including landscaped areas and as a major element in integrated water resource planning.

- Wastewater Treatment
  - Connect all wastewater produced within the Urban Community and Rural Community boundary areas to municipal or military sewer service systems.
  - Where feasible, use water recycling as a water conservation measure.
- Drainage System
  - Promote drainage system design, which emphasizes control and minimization of polluted run-off and the retention of storm water on-site and in wetlands.
  - View storm water as a potential source of water for recharge of the aquifer that should be retained for absorption rather than quickly moved to coastal waters.
  - Select natural and man-made vegetated drainageways and retention basins as the preferred solution to drainage problems wherever they can promote water recharge, help control non-point source pollution, and provide passive recreation benefits.
  - Keep drainageways clear of debris to avoid flooding problems.
- Natural Resources
  - Adapt the concept of "ahupua'a" in land uses and natural resource management.
  - Protect watersheds, natural resources, and water supplies
  - Preserve park lands, wilderness and beach reserves and conserve natural ecosystems of endemic plants, fish, and wildlife forestry.
  - Protect coastal lands, marine waters, fishponds, and tide pools.
- Mountain Forested Lands
  - Protect watersheds by retaining existing acreage in the State Conservation District or within the area defined by the Preservation boundary or designated Preservation.

B.6.3 REVISED ORDINANCES OF HONOLULU, CHAPTER 30: WATER MANAGEMENT

The O'ahu Water Management Plan (OWMP) was enacted by Ordinance No. 90-62 in 1990, and codified as Chapter 30, articles 1, 2, and 3, Revised Ordinances of Honolulu, The OWMP provides a long-range 20-year plan for the preservation, restoration, and balanced management of ground water, surface water, and related watershed resources for O'ahu.

The State Water Code (HRS Chapter 174C) mandates the preparation and adoption of a water use and development plan by each county as part of the Hawai'i Water Plan. In adopting the plan, the City and County of Honolulu recognizes that water is a limited resource, the development and use of which must be carefully planned. The Water Use and Development Plan for the City and County of Honolulu, which is called the OWMP, is intended to fulfill the requirements set forth by the State Water Code.

The OWMP consists of overall policies and strategies and regional watershed management plans, which guide the activities of the City and County of Honolulu and advises the State Commission on Water Resource Management in the areas of planning, management, water development and use, and allocation of Oʻahu's limited water resources. In areas where a regional watershed plan has not been adopted, Articles 1, 2, and 3 of Chapter 30 and the Technical Reference Document for the OWMP, dated March 1990, shall serve as the water use and development plan.

The intent of the Ordinance is to ensure (1) optimum utilization of the existing water supply in order to minimize the need for the development of additional potable ground water resources, (2) preservation of the aquifers for the benefit of future generations, in perpetuity, by proper management of Oahu's ground water sources, (3) timely development of additional potable ground water sources and alternative sources to provide for additional consumer demand, and (4) that growth in consumer demand will be compatible with available water supply.[48] The following policies recognize the vital role water plays in supporting land use activities and apply to all County agencies in their powers, duties, and functions and include the following:

- Facilities for the provision of water shall be based on the General Plan population projections and the land use policies contained in the DPs/SCPs and depicted on the DP and SCP Land Use Maps.
- System flexibility shall be maintained to facilitate the provision of an adequate supply of water consistent with planned land uses. The municipal water system shall be developed and operated substantially as an integrated island-wide water system.
- Close coordination shall be maintained between Federal, State, and County agencies involved in the provision or management of water to ensure optimal distribution of the available water supply.
- The quality and integrity of the water supply shall be maintained by providing for the monitoring and protection of the water supply in accordance with the requirements of the State Water Code.
- The development and use of non-potable water sources shall be maximized in a manner consistent with the protection of the ground water quality.
- Water conservation shall be strongly encouraged.
- Alternative water sources shall be developed wherever feasible to ensure an adequate supply of water for planned uses on Oʻahu.[49]

B.6.4 OʻAHU WATER MANAGEMENT PLAN (OWMP) FRAMEWORK

The Honolulu Board of Water Supply (BWS) prepared and submitted to the Commission the OWMP Framework and Scope of Work for the eight regional watershed management plans for each of Oʻahu's land use districts to comply with the Statewide Framework for Updating the Hawaiʻi Water Plan. The Commission approved the OWMP Framework in 2003. The OWMP

Framework of eight regional watershed management plans provides equal focus on resource protection, conservation, and restoration, as well as water use and development.

The watershed management plans are community-based, environmentally holistic, action-oriented, in alignment with State and County water and land use principles, and based on *ahupuaʻa* management principles.

B.6.5 HONOLULU BOARD OF WATER SUPPLY (BWS) MISSION

The BWS' mission is "Water for Life, providing safe, dependable water supply now and into the future," which expanded the BWS' focus from water systems and services to meeting the needs of the community, economy, and environment. In fulfilling its mission, BWS provides safe and dependable water supply in the context of sustainability of all water resources and the environment.

B.7 PUBLIC/PRIVATE PARTNERSHIPS

The value of public/private partnerships has been increasingly recognized as an important tool in natural resource protection, restoration, and conservation. Various partnerships have been formed in each of the County's Development Plan/Sustainable Communities Plan areas. The following is a discussion of the goals of existing and potential partnerships in Koʻolau Poko.

B.7.1 KOʻOLAU MOUNTAINS WATERSHED PARTNERSHIP

The Koʻolau Mountains Watershed Partnership was created in 1999 to cooperatively protect and manage the Koʻolau watershed, which consists of the most intact native forests on Oʻahu and provides the majority of the island's water supply. Voluntary membership is comprised primarily of agencies and major landowners or lessees, defined as those who own or lease 100 acres or more. The partners include the Honolulu Board of Water Supply, Bishop Museum, Kamehameha Schools, Queen Emma Foundation, U.S. Army, the State of Hawaiʻi Agribusiness Development Corporation, Department of Hawaiian Home Lands, Department of Land and Natural Resources, and the Pacific Cooperative Studies Unit of the University of Hawaiʻi. Of the 111,047 acres within the partnership boundary, 100,484 acres are under the jurisdiction of partner entities. The KMWP is actively implementing their management plan, developed in 2002.

The goals of the partnership are:

- To develop funding capacity to support *mauka* watershed initiatives,
- To increase public and political support and form new island-based *mauka* watershed partnerships, and
- To develop and implement individual projects having mutual interests, such as invasive species control, fencing, forestry management, and mapping.

B.7.2 WAIHE'E WATERSHED PARTNERSHIP

BWS, signed an MOU with the Kualoa-He'eia Ecumenical Youth Project (KEY) on "Make a Difference Day" in 2003 to protect, restore, and manage the Waihe'e Ahupua'a, which provides one-fourth of Windward O'ahu's drinking water and supplies surface water to active *kalo* and diversified agricultural lands. The goals of the partnership are to:

- Preserve, protect, restore, enhance, and interpret the unique natural and cultural inheritance of Waihe'e for future generations;
- Protect endangered tropical forests, wetlands, riparian, coastal, estuarine, and marine habitat through promotion of environmental policies and practices that address biological sustainability and human well-being; and
- Develop natural resource stewardship models that respect native Hawaiian rights and those of an island community while helping to re-establish a corresponding acceptance of civic responsibilities attached to these rights.

The Watershed Management Plans will use the framework set forth in these documents and policies to develop plans that are consistent with Federal, State, and County plans and policies, cognizant of community values and visions, and useful to agencies, organizations, and individuals seeking to protect, conserve, and enhance water resources on O'ahu.

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[5] State of Hawai'i, Hawai'i Revised Statutes Chapter 226, Hawai'i State Planning Act, §226-11

[6] Ibid, §226-13.

[7] Ibid, §226-16.

[8] State of Hawai'i, Hawai'i Revised Statutes Chapter 174C, State Water Code, 1992, §174C-2.

[9] Ibid, §174C-5.

[10] Ibid, §174C-31.

[11] Ibid.

[12] State of Hawai'i Commission on Water Resource Management, *Statewide Framework for Updating the Hawaii Water Plan*, 2000, pp. 2-1 to 2-3.

[13] Ibid, pp. 3-19 to 3-27.

[14] State of Hawai'i, *Act 152 SLH 200 (HB 2835, HD2, SD2, CD1): Relating to Watershed Protection*, 2000, p. A1-1.

[15] Ibid.

[16] State of Hawai'i Department of Land and Natural Resources, *Annual Report to the Twenty-First Legislature 2001 Regular Session on Act 152 SLH 2000 (HB 2835, HD2, SD2, CD1): Relating to Watershed Protection*, October 2001, pp. 61-62.

[17] Ibid, pp. 43-45.

[18] Ibid, p. 44.

[19] HRS 174C, §§ 174C-1 to 174C-101.

[20] *In re Water Use Permit Applications*, 94 Haw. 97, at 173; 9 P3d 409, at 485 (2000).

[21] *City Mill Co. v Hon. S. & W. Com.*, 30 Haw. 912 (1929).

[22] *McBryde v Robinson*, 54 Haw. 174, at 198; 504 P.2d 1330, at 1344 (1973); *aff'd on rehearing*, 55 Haw. 260; 517 P.2d 26 (1973); *appeal dismissed for want of jurisdiction and cert. denied*, 417 U.S. 962 (1974).

[23] *Reppun v Board of Water Supply*, 65 Haw. 531, at 553; 656 P.2d 57, at 72 (1982).

[24] 54 Haw. 174, at 188; 504 .2d 1330, at 1339.

[25] 65 Haw. 531, at 554; 656 P.2d 57, at 72.

[26] *Peck v Bailey*, 8 Haw. 658, at 665 (1867).

[27] 54 Haw. 174; 504 P.2d 1330.

[28] 65 Haw. 531, at 552; 656 P.2d 57, at 71 (1982).

[29] 94 Haw. 97 at 179, 9 P.3d 409 at 491 (2000).

[30] 94 Haw. 97, at 178; 9 P3d 409, at 490 (2000).

[31] 65 Haw. 531, at 553-554; 656 P.2d 57, at 72 (1982).

[32] 54 Haw. 174; 504 P.2d 1330 (1973).

[33] *Davis v Afong*, 5 Haw. 216 (1884).

[34] *Wong Leong v Irwin*, 10 Haw. 265 (1896).

[35] *City Mill Co. v Hon. S. & W. Com.*, 30 Haw. 912 (1929).

[36] *Territory v Gay*, 31 Haw. 376 (1930); *aff'd* 52 F.2d 356 (9th Cir. 1931); *cert. denied* 284 U.S. 677 (1931).

[37] 54 Haw. 174, at 198; 504 P.2d 1330, at 1344 (1973).

[38] 94 Haw. 97, at 130-133; 9 P3d 409, at 443-445.

[39] City and County of Honolulu, *General Plan*, 1992, as amended, Preamble.

[40] Ibid, Title I: Population.

[41] Ibid, Title II: Economic Activitiy.

[42] Ibid, Title III: Natural Environment.

[43] Ibid, Title IV: Housing.

[44] Ibid, Title V: Transportation and Utilities.

[45] Ibid, Title VII: Physical Development and Urban Design.

[46] Ibid, Title IX: Health and Education.

[47] Ibid, Title XI: Government Operations and Fiscal Management.

[48] City and County of Honolulu, *Revised Ordinances of Honolulu, Chapter 30: Water Management*, 1990, as amended by Ordinance 90-62, §30-2.1.

[49] Ibid, §30-2.2.

APPENDIX C

O‘AHU WATER USE PERMIT INDEX

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C O‘AHU WATER USE PERMIT INDEX

The State Commission on Water Resource Management maintains a database of permitted uses of water. Both fresh water and brackish water wells are listed in the following table that documents the well owner, well name, well number, volume permitted for withdrawal by the water use permit, and use of the water. The wells are further categorized by aquifer system area.

The permitted ground water uses are documented in the following table.

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Oahu Water Use Permit Index (Fresh water and Brackish water)

Dated: September 2, 2010

Well Owner	Well Name	Well No.	WUP 2007	Use Description
Aina Nui Corporation	EP 10	2006-01 to 11	0.957	Urban Nonpotable Use
Del Monte Fresh Produce	Kunia	2703-01	1.075	Agriculture, irrigation for 2,595 acres pineapple; contaminant removal
Grace Pacific Corp.	Lower Makakilo	2104-01	0.044	Industrial washing and dust control
Grace Pacific, Inc.	Lower Makakilo	2104-01	0.124	Industrial washing and dust control
Honolulu BWS	Barbers Point Nonpotable	2006-14, 15	1.000	Municipal Nonpotable Irrigation Ko Olina Resort
Honolulu BWS	Ewa Desalt Plant	1905-04	0.500	Supply brackish desalination plant
Honolulu BWS	Honouliuli 5	2303-05, 06	2.240	Municipal Use
Honolulu BWS	Honouliuli I	2303-01 to 04	4.480	Municipal Use
Honolulu BWS	Makakilo	2004-04	1.500	Municipal Use
Ko Olina Co.	W. Beach Estates	2006-13	0.700	Golf course irrigation
State DLNR DOWALD	Ewa Desalt Plant	1905-04	0.500	Supply brackish desalination plant
U.S. Navy	Barbers Point Shaft	2103-03	2.337	Military and State use at Kalaeloa
		Ewa-Kunia Total	**16**	
		Assigned	**15.457**	
		Available	**0.543**	

Well Owner	Well Name	Well No.	WUP	Use Description
Honolulu BWS	Kahana Wells	3353-01, 02	0.600	Municipal Use
Kahana Valley State Park	Kahana Artesian	3352-01	0.008	Kahana Valley Park system serving 16 residences
Kualoa Ranch, Inc.	Saito	3251-03	0.200	Irrigation of 50 acres of pasture
Kualoa Ranch, Inc.	Tomasu	3251-01	0.288	Irrigation for 46 acres of pasture & 4 acres of aquaculture
Kualoa Ranch, Inc.	Yamamoto	3351-04	0.005	Irrigate one acre of papaya
		Kahana Total	**15**	
		Assigned	**1.101**	
		Available	**13.899**	

Well Owner	Well Name	Well No.	WUP	Use Description
Bishop Estate	Kamehameha A & B	2051-01, 02	0.229	Domestic use for Kamehameha Schools
Honolulu BWS	Kalihi Station	1952-06 to 08, 16 to 19, 22	6.948	Municipal Use
Honolulu BWS	Kapalama	2052-13, 14	1.500	Municipal Use
Oahu Country Club	OCC Irrigation	2050-01	0.060	Irrigation for 187-acre golf course
Palama Setlmt	Palama Setlmt	1952-15	0.024	
		Kalihi Total	**9**	
		Total	**8.761**	
		Available	**0.239**	

Well Owner	Well Name	Well No.	WUP	Use Description
Honolulu BWS	Kapolei Irr 1 & Irr 2	1905-08, 10	0.302	City of Kapolei back-up irrigation for R-1 recycled water system
Kapolei People's, Inc.	Kapolei Golf Course A	2003-01, 02, 05	1.000	Kapolei Golf Course irrigation supply
State HCDCH	Kapolei Irr C-1, D	2003-07, 04	0.494	Kapolei Village landscape irrigation
State HCDCH	East Kapolei	2003-08	0.237	Kapolei Village landscape irrigation
		Kapolei Total		
		Total	***2.033***	*Managed by chloride limit of 1,000 mg/l*

Well Owner	Well Name	Well No.	WUP	Use Description
Attractions Hawaii	Waimea Falls 1	3803-01	0.100	800 acres of botanical gardens, nursery, landscape
Attractions Hawaii	Waimea Falls 2	3803-03	0.200	
Henry, Frank A.	Henry F.	4002-06	0.005	Use for 4 acres of pasture land
Honolulu BWS	Waialee I	4101-07	0.339	Municipal use
Honolulu BWS	Waialee II	4101-08	0.411	Municipal Use
Nakamura, Takemitsu	Nakamura T.	4002-09	0.001	Irrigation of 2 acres of banana and citrus
Paniolo Ranch	Meadow Gold Sh	3704-01	0.430	Livestock and irrigation of pasture land
Sean Ginella	Kawela Mauka	4100-06	0.102	
UH Dept. of Animal Science	Waialee	4101-10	0.026	Dairy & piggery wash water
		Kawailoa Total	**29**	
		Total	**1.614**	
		Available	**27.386**	

Well Owner	Well Name	Well No.	WUP	Use Description
Campbell Estate	Sugar Mill Pump	4057-11	0.028	Domestic & Irrigation of 40 acres of various crops
Diversified Ag Promotions LLC	Kahuku Air Base	4158-12, 13	0.300	Aquaculture, Agriculture, Pasture, Residential
E.L.C. Foundation	Hauula	3755-03	0.019	Nursery (2 acres) and landscape
Hanohano Enterprises, Inc.	Hanohano	3553-01	0.432	Aquaculture over 70 acres & domestic for 250 units
Hawaii Reserves Inc.	Egg Farm	3956-05	0.001	Supply chicken and egg farm needs
Hawaii Reserves Inc.	Kawananakoa	4056-01	0.576	Domestic & Irrigation for 135 acres of ranchland & cattle
Hawaii Reserves Inc.	Laie Maloo	3755-04	0.039	Agriculture
Hawaii Reserves Inc.	Malaekahana (KP7)	3956-01	0.062	Domestic service to 33 homes, Malaekahana Park and ranch
Hawaii Reserves Inc.	Prawn Farm	3856-07	0.171	Agricultural irrigation over 60 acres

Oahu Water Use Permit Index (Fresh water and Brackish water)

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Hawaii Reserves Inc.	Pump 12-A	4057-10	1.200	Aquaculture for 25 acres prawns
Hawaii Reserves Inc.	Quarry Well D	3856-04	0.036	Irrigation for 51 acres bananas, papayas, grass
Hawaii Reserves Inc.	Truck Farm	3755-06	0.142	Irrigate 51 acres of grass
Hawaii Reserves Inc.	Welfare Farm	3855-04	0.091	Irrigate 39 acres bananas, papayas, grass
Holt, Lemon	LW Holt	3654-02	0.002	Irrigation of 1 acre of coconut trees
Honolulu BWS	Hauula Well	3655-01	0.250	Municipal use
Honolulu BWS	Kahuku Wells	4057-15, 16	0.600	Municipal use
Honolulu BWS	Kaluanui Wells	3554-04 to 06	1.093	Municipal use
Honolulu BWS	Maakua Well	3655-02	0.667	Municipal use
Honolulu BWS	Punaluu I Well	3553-02	0.360	Municipal Use
Honolulu BWS	Punaluu II Wells	3553-03, 04, 06 to 08; 3554-03	4.618	Municipal Use
Honolulu BWS	Punaluu III Wells	3453-06, 07	1.327	Municipal Use
Kaio, Jacob I. Sr.	Kaio Artesian	3956-07	0.017	Irrigate 3 acres of taro, on choi, other
Kapaka Farm	Kapaka Farm 1	3554-01	0.038	30 acres diversified fruits & vegetables
Kapaka Farm	Kapaka Farm 3	3654-03	0.190	
Laie Water Co., Inc.	Campus Well	3855-06, 07	1.375	Municipal for 607 residential, BYUH, Commercial, Laie School
Ming Dynasty Fish Co.	Amor RCA Brackish	4258-04	0.010	Aquaculture
Nihipali, George N.	Nihipali	3855-12	0.009	Supply 1 home, irrigate 3.5 acre banana
Polynesian Cultural Center	PCC Lagoon Well	3855-09	0.568	Supply lagoon's aquatic life, provide circulation
Serenity Park LLC	Pump 12	4057-07	0.300	Irrigation of ag parcel
Serenity Park LLC	Pump 3	3957-01	1.244	Agriculture irrigation & domestic; truck farm (40 ac.) & taro (20 ac.)
State DOA	Pump 1	4057-01	0.307	Domestic & Irrigation of 215 acres of various crops
U.S. Fish and Wildlife Service	Kii Wildlife Refuge 1 to 4	4157-05, 06, 07, 13	1.000	Habitat maintenance
U.S. Fish and Wildlife Service	Pump 15	4157-04	1.517	Wetlands, agriculture
		Koolauloa Total	**36**	
		Total	**18.589**	Remaining WUP's for salt water use
		Available	**17.411**	

Well Owner	Well Name	Well No.	WUP	Use Description
Astori International Ltd.	RL Montgomery	2751-08	0.036	Supply 2 homes, livestock, 12 acres fruits, vegetables
Chang, Dudley W.A.	Kahaluu	2750-09	0.002	Irrigation of 6 acres for heliconias & ginger
Hawaii State Hospital	HI State Hosp/416	2448-01	0.088	Domestic consumption; nursery irrigation 2,280 sq. ft.
Honolulu BWS	Haiku Tunnel	2450-01	1.340	Municipal Use
Honolulu BWS	Haiku Well	2450-02	0.457	Municipal Use
Honolulu BWS	Iolekaa Well	2549-01	0.153	Municipal Use
Honolulu BWS	Kahaluu Tunnel	2651-01	2.128	Municipal Use
Honolulu BWS	Kahaluu Well	2651-03	0.927	Municipal Use
Honolulu BWS	Kuou Well II	2348-05	0.010	Municipal Use
Honolulu BWS	Kuou Well III	2348-06	0.196	Municipal Use
Honolulu BWS	Kuou Wells I	2348-02, 03	2.969	Municipal Use
Honolulu BWS	Luluku Tunnel	2349-01	0.713	Municipal Use
Honolulu BWS	Luluku Well	2349-02	1.050	Municipal Use
Koolau Golf Partners LLC.	Minami 1 & 2	2347-02, 03	0.150	100 Acres golf course, landscape, fire protection
State HFDC	Waiahole A and B	2853-04, 05	0.075	Serve 110 homes, 305 acres of bananas, papayas, etc.
Valley of the Temples	Heeia	2550-01	0.018	Irrigate 65 acres grass,Temple fish ponds, domestic
		Koolaupoko Total	**30**	
		Total	**10.312**	
		Available	**19.688**	

Well Owner	Well Name	Well No.	WUP	Use Description
Chevron USA, Inc.	P-2095	1807-01	1.500	Industrial: Refinery
Chevron USA, Inc.	P-5219	1807-03	0.100	Industrial: Refinery
Chevron USA, Inc.	P-6109	1806-20	2.000	Industrial: Refinery
Covanta Energy Corp.	H-Power	1806-10	3.340	Industrial: Power Plant
Kalaeloa Partners, L.P.	Kalaeloa 1-9	1805-04 to 12	3.168	Industrial: Refinery
State DLNR DOWALD	Ewa Caprock	1905-05	0.500	Supply brackish desalination plant
VIP Sanitation, Inc.	VIP Sanitation	1805-16	0.003	Irrigation, flush & clean portable toilets & trucks
		Malakole Total		
		Total	***10.611***	*Managed by chloride limit of 1,000 mg/l.* *Remaining WUP's for salt water use.*
		Available		

Well Owner	Well Name	Well No.	WUP	Use Description
Damon Estate	Damon Estate	2153-02	0.021	Irrigate taro and fish pond, misc. uses
Hon Int CC	Honolulu Int CC	2154-01	0.346	Irrigate golf course
Honolulu BWS	Kalihi Shaft	2052-08	9.500	Municipal Use
Honolulu BWS	Moanalua Wells	2153-10 to 12	3.790	Municipal Use
U.S. Army	Fort Shafter	2053-11	1.035	
U.S. Army	Tripler	2153-07, 08	0.609	
U.S. Navy	Halawa Red Hill	2254-01	4.659	Navy usage
		Moanalua Total	**16**	
		Total	**19.960**	
		Available	**-3.960**	

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Dated: September 2, 2010

Well Owner	Well Name	Well No.	WUP	Use Description
D.O.T. AIRPORTS	Dillingham AFB	3412-02	0.055	Supply airfield, Camp Erdman, and some residents
Dillingham Ranch Aina LLC	Mokuleia Hmstds	3310-01	1.250	Agriculture and domestic
Dillingham Ranch Aina LLC	Mokuleia Hmstds	3310-02	0.850	Irrigation and domestic use
Dillingham Ranch Aina LLC	Mokuleia Hmstds	3410-01	0.500	Domestic, irrigation of polo field, pasture
Dillingham Ranch Aina LLC	Mokuleia Hmstds	3410-03	1.500	Domestic & irrigation for Mokuleia Homesteads
Hawaii Fish Co.	Hawaii Fish Co. #1	3412-04	0.576	Fish hatchery & farm
Kaala Ranch	Mokuleia	3309-02	0.127	Cattle water, pasture & nursery irrigation
Mark Hamamoto	Hamamoto - 2006	3306-16	0.013	Domestic, 6-acre agriculture and domestic
Mokuleia Assoc.	Mokuleia Assoc.	3409-16	0.000	Well sealment planned
Mokuleia Hmstd	Mokuleia Hmstds	3410-05	0.000	Stock watering
Stanhope Farms	Stanhope Farms	3308-02	0.056	Agriculture, Irrigation, domestic
U.S. Air Force	USAF Kaena Pt.	3314-03	0.018	Military use
Waialua Sugar [02]	Pump 11	3409-13	0.530	Irrigate 133 acres of sugar, 75 gpm domestic
Waialua Sugar [02]	Pump 5	3411-04, 06 to 11, 13	2.550	Irrigate 315 acres of sugar cane
		Mokuleia Total	**8**	
		Total	**8.025**	
		Available	**-0.025**	

Well Owner	Well Name	Well No.	WUP	Use Description
Honolulu BWS	Beretania Station	1851-12, 13, 31, 33 to 35, 67, 74, 75	7.000	Municipal Use
Honolulu BWS	Manoa II	1948-01	0.700	Municipal Use
Honolulu BWS	Wilder Wells	1849-13 to 16	7.000	Municipal Use
Kawaiahao Church	Kawaiahao Church	1851-73	0.030	Domestic consumption & irrigation
MTL, INC.	MTL, Inc.	1851-20	0.000	Well sealed
Oahu Country Club	Irrigation Test	2050-01	0.000	Irrigation of OCC Golf Course
Pacific Club	Pacific Club	1851-07	0.040	Domestic and irrigation for private club
Punahou School	Punahou School	1849-10	0.158	Drinking, pool, irrigation
Queens Hospital	Queens Hospital	1851-54	0.237	Municipal use, air conditioning cooling, lawn
		Nuuanu Total	**14**	
		Total	**15.165**	
		Available	**-1.165**	

Well Owner	Well Name	Well No.	WUP	Use Description
Honolulu BWS	Kaimuki Station	1748-03 to 10	4.000	Municipal Use
Honolulu BWS	Palolo Wells	1847-01, 02	1.310	Municipal Use
Kokusai Kogyo Co., Ltd.	Kokusai, K.	1749-19	0.336	Supplies water to hotel, incl. drinking water
		Palolo Total	**5**	
		Total	**5.646**	
		Available	**-0.646**	

Well Owner	Well Name	Well No.	WUP	Use Description
Aoao Suncrest/Shores/Lombard/Avalon	Gentry Area 24	2001-10	0.022	Irrigation of 7.37 acres landscaped area and roadway
Arbors Association	Arbors	2001-07	0.063	Irrigation for Arbors & Golf Villa 1, Area 3
C&C Dept. of Parks & Rec.	Geiger Park	2001-03	0.030	Irrigation of 10-acre Geiger Park
C&C DWWM	Honouliuli STP 1 and 2	1902-03, 04	0.500	WWTP in plant process water, emergency backup
Coral Creek Golf, Inc.	Coral Creek No. 10	2001-14	0.892	Backup golf course irrigation
Coral Creek Golf, Inc.	Coral Creek No. 2	2002-17	0.498	Water feature, backup golf course irrigation
Coral Creek Golf, Inc.	Coral Creek No. 4	2001-13	0.800	Water feature
Ewa by Gentry Comm. Assoc.	Soda Creek III	2001-05	0.195	13.23 acres of park lawn & Roadway landscaping
Gentry Development Co.	Fort Weaver Apt.	2001-09	0.023	Irrigation of 7.8 acres of landscape and roadways
Gentry Development Co.	Sunrise Apt.	2001-04	0.040	Irrigation for 13 acres of lawn and road landscape
Gentry Development Corp.	Ewa Gentry	2001-02	0.080	Irrigation for 20 acres of Gentry Entry Park
Gentry Homes, Ltd.	Gentry Area 13	1901-05	0.037	Irrigation (common area & roadway)
Gentry Homes, Ltd.	Gentry Area 35 Well No.1	1900-24	0.255	Irrigation (common area & roadway)
Gentry Homes, Ltd.	Gentry Area 45	1901-08	0.066	Irrigation (common area & roadway)
Gentry Homes, Ltd.	Keaunui Area 30	2001-12	0.225	Irrigation (golf course, common area, park, roads)
Haseko (Ewa), Inc.	Ocean Pointe 4	1901-06	1.337	Dust control; golf course, roadway irrigation. Supplements R-1
Hawaii Prince Golf Club	EP 22, Well 1 to 5	1900-02, 17-20	1.201	Golf Course Irrigation including lake evaporation
Palm Court Association	Palm Court 3	2002-12	0.040	Irrigation for 22 acres of Palm Court 2&3, Area 1C
Palm Villa I Association	Palm Villa 1	2001-06	0.080	Irrigation for 15 acres fo Palm Villas 1, Area 1A
Palm Villa II Association	Palm Villa 2	2001-08	0.048	Irrigate 16 acres of Palm Villa 2, Area 4
U.S. DOC/NOAA/NWS	Pacific Tsunami	1900-23	0.023	Irrigation (30 acres turf)
U.S. Fish & Wildlife	Honouliuli Unit	2101-14	0.216	Maintenance of 37 acre habitat for endangered water birds
U.S. Navy	EP 23	2001-01	5.890	Agriculture irrigation of Navy Blast Zone
YHB EWA LLC	Puuloa Dug Wells A and B	1959-08, 1900-21, 22	0.700	Irrigate golf course
		Puuloa Total		
		Total	***13.261***	*Managed by chloride limit of 1,000 mg/l*
		Available		

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Dated: September 2, 2010

Well Owner	Well Name	Well No.	WUP	Use Description
Del Monte Fresh Produce	Del Monte Well 3 and 4	2803-05, 07	3.960	Irrigate for 2480 acres pineapple; 150 residential @ Kunia Village
Galbraith Estate	Del Monte #5	3103-01	2.000	Pineapple agriculture
Honolulu BWS	Wahiawa Wells I	2901-08, 09, 11	3.270	Municipal Use
Honolulu BWS	Wahiawa Wells II	2902-01, 02	1.000	Municipal Use
Kelena Farms LLC	WSCo. Pump 25	3203-01	1.442	Agriculture
Sandwich Isles Communications	SIC-01	2801-03	0.100	154.25 net acres for various irrigation, landscape irrigation
U.S. Army	Schofield Battery	2901-10	0.000	Supply Schofield Base
U.S. Army	Schofield Shaft	2901-02, 03, 04	5.648	Supply Schofield Base
U.S. Navy Public Works	Wahiawa Deep	3100-02	0.208	Potable supply for NCTAMS
Waialua Sugar	Pump 24	3102-02	2.580	Irrigate 526 acres of sugar cane
Waialua Sugar	Pump 26	3203-02	1.720	Irrigate 506 acres sugar, 1803 acres pineapple
		Wahiawa Total	**23**	
		Total	**21.928**	
		Available	**1.072**	

Well Owner	Well Name	Well No.	WUP	Use Description
Agribusiness Dev. Corp.	Waiahole Ditch	2853-01	2.000	System losses
Bishop Estate	Waiahole Ditch	2657-05	0.170	Agricultural use for 150 acres
Dole/Castle & Cooke	Waiahole Ditch	2853-01	2.130	Irrigation for 1,459 acres
Edmund C. Olson Trust No. 2	Waiahole Ditch	2657-05	0.024	Diversified Agriculture
Grace Pacific	Waiahole Ditch	2657-05	0.750	
HiI Agricultural Research Ctr.	Waiahole Ditch	2657-05	0.260	Diversified Agriculture
Mililani Golf Club	Waiahole Ditch	2657-05	0.250	Golf course use for 165 acres
Mililani Memorial Park	Waiahole Ditch	2657-05	0.140	Cemetery use for 67 acres
Monsanto Company	Waiahole Ditch	2657-05	2.636	Seed Corn
Nihonkai	Waiahole Ditch	2657-05	0.480	Agricultural use for 190 acres
Pioneer Hi-Bred Intl., Inc.	Waiahole Ditch	2657-05	0.470	Seed Corn
Robinson Kunia Lands LLC	Waiahole Ditch	2657-05	2.390	Agricultural use for 1,854 acres
State DLNR	Waiahole Ditch	2657-05	0.150	Waiawa Correctional Facility domestic and irrigation (210 ac)
Syngenta Hawaii LLC	Waiahole Ditch	2657-05	0.590	Seed Corn
		Waiahole Ditch Total	**15**	
		Total	**12.440**	
		Available	**2.560**	

Well Owner	Well Name	Well No.	WUP	Use Description
Bishop Estate	Waialae Nui Ridge	1746-04	0.000	Municipal use within BWS System
Honolulu BWS	Kuliouou Well	1843-01	0.300	Municipal Use
Honolulu BWS	Waialae Iki Well	1746-02	0.190	Municipal Use
Honolulu BWS	Wailupe Well	1745-01	0.300	Municipal Use
		Waialae-East Total	**2**	
		Total	**0.790**	
		Available	**1.210**	

Well Owner	Well Name	Well No.	WUP	Use Description
Bishop Estate	Waialae C C	1646-01	0.460	Irrigation fo the Waialae Golf Course
Honolulu BWS	Aina Koa II	1746-01	0.480	Municipal Use
Honolulu BWS	Aina Koa II (Waialae Ridge)	1746-04	0.997	Municipal Use
Honolulu BWS	Waialae Nui	1747-03	0.700	Municipal Use
Honolulu BWS	Waialae West	1747-05	0.160	Municipal Use
		Waialae-West Total	**4**	
		Total	**2.797**	
		Available	**1.203**	

Well Owner	Well Name	Well No.	WUP	Use Description
A.J. Lopez sone, Inc.	Lopez No. 1	3406-16	0.072	Irrigation of 13 acres truck farm crops
BG Farm	BG Farm	3506-10	0.003	Irrigation supply for 1 acre banana, papaya
Gora, Dan	Gora	3406-08	0.144	Irrigation, aquaculture, on 7 acres
Honolulu BWS	Haleiwa	3405-03, 04	1.000	Municipal Use
Honolulu BWS	Waialua	3405-01, 02	1.730	Municipal Use
Kawamata, S.	Kawamata, S.	3406-03	0.100	Irrigate banana and watercress crops
Kunihiro, S.	Kunihiro, S.	3406-06; 3407-02	0.200	Irrigate lotus crop
Michael Jewett & Megan Ward	Pump 9	3406-02	0.160	Diversified agriculture
NHAC	Lopez	3407-02	0.200	Domestic; irrigate 4.5 acres various crops; aquaculture
Poamoho Venture, L.P.	Poamoho A	3205-02	0.600	Irrigation for 150 acres of diversified agriculture
Waialua Sugar	Pump 3	3505-01 to 20	1.552	Irrigate 362 acres of sugarcane, 75 gpm domestic
Waialua Sugar	Pump 7	3407-11, 12	2.930	Irrigate 440 acres of sugar cane, 125 gpm domestic
Waialua Sugar [02]	Pump 1	3407-04 to 06, 14, 15	2.330	Irrigate 367 acres of sugarcane
Waialua Sugar [02]	Pump 17	3404-01	8.630	Irrigate 990 acres of sugar cane, 300 gpm domestic
Waialua Sugar [02]	Pump 2	3307-01 to 06, 08 to 10	4.370	Irrigate 409 acres of sugar cane, some domestic
Waialua Sugar [02]	Pump 2A	3307-07	3.586	Irrigate 429 acres of sugar cane, 600 gpm domestic

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Waialua Sugar [02]	Pump 2A	3307-11 to 14	0.864	
Waialua Sugar [02]	Pump 7	3407-18, 19	0.180	
Waialua Sugar [02]	Pump 8	3506-03, 04	1.660	Irrigate 136 acres of sugar cane, domestic
		Waialua Total	**25**	
		Total	**30.311**	
		Available	**-5.311**	

Well Owner	Well Name	Well No.	WUP	Use Description
Honolulu BWS	Aiea Gulch Wells	2355-03, 05	0.980	Municipal Use
Honolulu BWS	Aiea Wells	2355-06, 07	1.300	Municipal Use
Honolulu BWS	Halawa Shaft	2354-01	11.320	Municipal Use
Honolulu BWS	Halawa Wells	2255-37 to 39	1.080	Municipal Use
Honolulu BWS	Kaahumanu I #1 and #2	2357-23, 24	1.110	Municipal Use
Honolulu BWS	Kaamilo	2356-58, 59	1.200	Municipal Use
Honolulu BWS	Kalauao Wells	2355-09 to 14	11.750	Municipal Use
Honolulu BWS	Kaonohi I	2356-55, 56	1.350	Municipal Use
Honolulu BWS	Newtown	2456-01 to 03	1.500	Municipal Use
Honolulu BWS	Punanani	2457-05, 06, 09 to 12	11.970	Municipal Use
Honolulu BWS	Waiau	2457-13 to 15	1.890	Municipal Use
Honolulu BWS	Waimalu Wells	2356-49, 50	0.080	Municipal Use
Honolulu BWS	HECO Waiau Wells	2357-11, 12	0.000	Municipal Use
Lau Taro Farm	Kalauao	2356-70	0.100	Supply farm and a fish pond
Minami Farm	Minami Farm	2455-02	0.158	Agriculture (piggery)
Pearl Country Club	Pearl Country Club	2356-54	0.330	Golf course irrigation (189 net acres)
State of Hawaii	Waimano Trng Sch	2557-01, 02	0.136	Supply for swimming pool, laundry plant
U.S. Navy	Aiea Halawa Shft	2255-32	0.697	Navy usage
		Waimalu Total	**45**	
		Total	**46.951**	
		Available	**-1.951**	

Well Owner	Well Name	Well No.	WUP	Use Description
Honolulu BWS	Waimanalo Tunnel I-IV	2044-03, 04, 2045-03,05	0.700	Municipal Use
Honolulu BWS	Waimanalo Well II	1943-01	0.452	Municipal Use
Honolulu BWS	Waimanalo Well III	1942-01	0.200	Municipal Use
Royal Hawaiian CC	Royal Hawaiian 6, 1, 2, 4	2045-06, 2145-01, 02, 04	0.155	Irrigation for 176.4 acres fo RHCC Golf Course
State DHHL	Reservation		0.124	Reservation via 11/17/93 rule 13-171-63 via CWRM
		Waimanalo Total	**10**	
		Total	**1.631**	
		Available	**8.369**	

Well Owner	Well Name	Well No.	WUP	Use Description
Abe, Tadahiro	Honouliuli	2202-02	0.009	Irrigation supply for 1.5 acre roses
C&C Des., Golf Course Div.	EP 2	2201-03, 04, 07	0.000	Backup Irrigation
D.R. Horton - Schuler Homes, LLC	EP 18 Battery	2102-02, 04 to 15; 2202-03 to 14	7.969	Diversified Ag
Gary Takiguchi	Honouliuli	2201-02	0.019	Domestic and irrigation (4.8 acres) for six (6) houses
Gentry Hawaii, Ltd. [06]	Waiawa 575-ft 1, 765-ft 2	2658-05, 03	0.000	Municipal use for Waiawa by Gentry, Phase I
Gentry Hawaii, Ltd. [06]	Waiawa 575-ft 2, 765-ft 1	2659-04	0.000	Municipal use for Waiawa by Gentry, Phase I
Harris Rug CL	Harris Rug	2201-14	0.003	Industrial use for laundering or cleaning rugs
Hawaii Country Club	Haw Country Club	2603-01	0.400	Irrigation for Hawaii Country Club
Honolulu BWS	Ewa Shaft (EP 15,16)	2202-21	7.661	Municipal Use
Honolulu BWS	Hoaeae Wells 1-6	2301-34 to 39	6.610	Municipal Use
Honolulu BWS	Kunia I	2302-01 to 04	5.000	Municipal Use
Honolulu BWS	Kunia II	2402-01 to 03, 05	2.710	Municipal Use
Honolulu BWS	Kunia III	2401-04 to 06	3.350	Municipal Use
Honolulu BWS	Manana	2458-05	0.100	Municipal Use
Honolulu BWS	Mililani I	2800-01 to 04	2.980	Municipal Use
Honolulu BWS	Mililani II	2859-01 to 02	1.900	Municipal Use
Honolulu BWS	Mililani III	2600-03, 04	1.250	Municipal Use
Honolulu BWS	Mililani IV	2858-01 to 04	2.022	Municipal Use
Honolulu BWS	Pearl City I	2458-03, 04	0.700	Municipal Use
Honolulu BWS	Pearl City II	2457-01 to 03	1.800	Municipal Use
Honolulu BWS	Pearl City III	2557-03	0.500	Municipal Use
Honolulu BWS	Pearl City Shaft	2458-01	1.220	Municipal Use
Honolulu BWS	Waipahu I	2400-01 to 04	6.000	Municipal Use
Honolulu BWS	Waipahu II	2400-05, 06, 08, 14	2.100	Municipal Use
Honolulu BWS	Waipahu III	2400-09 to 13	3.029	Municipal Use
Honolulu BWS	Waipahu IV	2301-44 to 47	3.000	Municipal Use
Honolulu BWS	Waipio Hts.	2459-19, 20	0.630	Municipal Use
Honolulu BWS	Waipio Hts. I	2459-23, 24	0.680	Municipal Use
Honolulu BWS	Waipio Hts. II	2500-01, 02	1.000	Municipal Use
Honolulu BWS	Waipio Hts. III	2659-02, 03	0.850	Municipal Use
Kahua Meat Co., Ltd.	Kahua Meat Co.	2101-01	0.110	Supply for slaughter house
Kenneth Simon	Pearl City	2358-35, 44	0.040	Diversified agriculture
Kenneth Simon	Pearl City	2358-36	0.004	Domestic use for eight (8) residences

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Kipapa Acres Assoc.of Owners	Kipapa Acres	2600-02	0.100	Supply residences, agricultural businesses, farm
Mark H. Ortiz	Ortiz	2202-01	0.003	Domestic supply for six (6) residences
Michael Watanabe	Watanabe, A.	2300-11	0.680	Irrigate watercress, onchoy, and taro farm
Michael Watanabe	Watanabe, A.	2300-20	0.400	Irrigate watercress, onchoy, and taro farm
Nazarene Church	Pearl City	2358-49	0.003	Supply Pastor's residence, church
Pearl City Community Church	Pearl City Comm Ch.	2359-10	0.005	Domestic for 10 residential units
Robinson Kunia Land, LLC	Robinson No. 1	2602-03	0.100	Agricultural food processing
Royal Kunia CC	Royal Kunia CC	2401-07	0.600	Irrigate 151 acre Royal Kunia CC Golf Course
State DHHL	Reservation		1.358	Reservation via 11/17/93 rule 13-171-63 via CWRM
TABA FARM, INC	Taba Farm	2358-21, 22, 26, 29	0.864	Agriculture
Tadao Abe	Honouliuli	2201-02	0.002	Domestic
U.S. Fish & Wildlife	PHNWR No. 1	2359-19	0.180	Habitat maintenance
U.S. Navy	Waiawa Shaft	2558-10	14.977	Navy usage
Waiawa Development, LLC	Gentry Waiawa 1	2658-07	0.524	Irrigation of 181-acre golf course
Waiawa Development, LLC	Gentry Waiawa 2	2658-08	0.458	Irrigation of 149-acre golf course
Waikele Golf, LLC	WP 1	2301-01 to 10	0.950	Waikele Golf Course irrigation
Yoshimura, D.	Waipahu	2459-21	0.006	Irrigate farm
		Waipahu-Waiawa Total	**104**	
		Total	**84.856**	
		Available	**19.144**	

APPENDIX D

OVERVIEW OF O‘AHU HYDROGEOLOGY

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D OVERVIEW OF O'AHU HYDROGEOLOGY

1.1 SETTING

The island of O'ahu is approximately 600 square miles in size.[1] With less than ten percent of the land area of the State of Hawai'i, O'ahu's importance is not based upon its size, but upon its relationship to the economic and political activity of the state. As the center of business and government, O'ahu is the State's economic mainstay, supporting tourism, military, agriculture, manufacturing, and research and development. Although the City and County of Honolulu and Kaua'i are the smallest counties of the four counties in geographical size, the City and County of Honolulu alone has nearly three-fourths of the State's population with an estimated resident population of 876,000 in 2000.[2]

1.2 CLIMATE

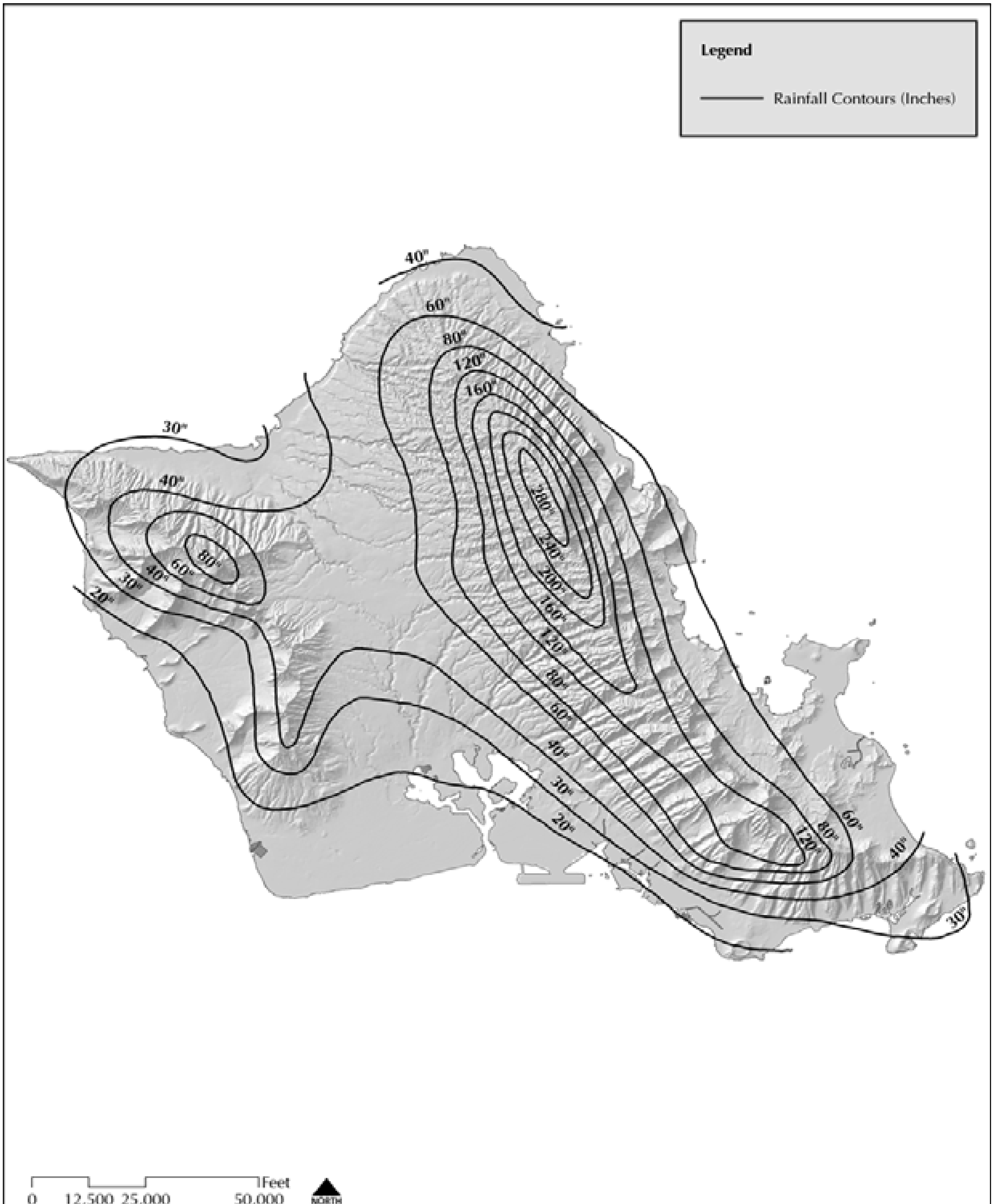
O'ahu's climate is mild throughout the year due to the island's location on the northern fringe of the tropics within the belt of cooling northeasterly trade winds. The two seasons in Hawai'i are the warmer and drier period from May to October and the cooler, cloudier, wet weather from October to April. The coldest month, January, averages 72 degrees Fahrenheit and the warmest, August, 78.5 degrees Fahrenheit. Maximum temperatures rarely exceed 90 degrees Fahrenheit, and minimum temperatures hover around 50 degrees Fahrenheit. The average temperature in the lowlands is 75 degrees Fahrenheit, decreasing 4 degrees Fahrenheit with each 1,000 feet increase in elevation. Humidity of the area is generally within the 60 to 80 percent range.[3]

The contrast between O'ahu's lush green mountains and the arid lowland plains reflects extremely wide rainfall variations. Annual average rainfall on O'ahu ranges from less than 20 inches on the leeward coast to almost 300 inches near the central crest of the Ko'olau Range (Figure D.1). Such a marked difference over a distance of less than 15 miles has a significant effect upon water resources.

The sea surrounding O'ahu receives no more than 30 inches of rain each year, far too little to sustain vigorous plant growth in the tropics. However, because the rugged, steep Ko'olau Mountains intercept prevailing trade winds, the moisture carried by these winds is lifted, cooled, and thereby condensed into rain. Rainfall is heaviest high in the mountains and decreases in the leeward direction. The Wai'anae Range is a less effective rainmaker since it lies to the lee of the Ko'olau Range.

Another significant contributor to precipitation is fogdrip. Fogdrip is cloud vapor that clings to vegetation and then drips to the ground. This generally occurs between 2,000 and 6,000 feet above sea level.[4]

Figure D.1 O‘ahu Annual Average Rainfall



Source: Rainfall Atlas of Hawai‘i Report R76,
State of Hawai‘i Department of Land and Natural Resources, 1986.

Trade winds prevail throughout the year, but are least continuous from October through April, Hawaiʻi's winter season. During these months, tropical storms occasionally bring heavy rains, which account for practically all the rainfall on the leeward plains. Flooding is more likely during the wet winter weather, and during the dry period, stream flow decreases and the supply of irrigation waters dependent on this source can be an issue.[5]

Climate Change and Rising Sea Levels

Climate variability affects the availability and quality of ground water and surface waters. The following summarizes the key points on climate change identified in the 2006 American Water Works Association (AWWA) Publication *Climate Change and Water Resources: A Primer for Municipal Water Providers.*[6]

- Global average temperatures have increased approximately 0.6 degrees Celsius over the past century and warming is expected to accelerate over the next century. The arctic areas have warmed more rapidly than other areas increasing glacial melt.
- Air pollution has changed the composition of the atmosphere.
- Global warming will change atmospheric and oceanic circulation and the hydrologic cycle leading to altered patterns of precipitation and runoff.
- Global average precipitation and evaporation will increase with warming because a warmer atmosphere can hold more moisture. However, this does not mean that it will get wetter everywhere and in all seasons. Some say average precipitation will tend to be less frequent but more intense. This implies unanticipated extremes, such as unprecedented droughts and floods.
- Climate variability affects the availability and quality of water resources. Long-term climatic trends could trigger vegetation changes that would alter a watershed's water balance. Changes in the quantity of water percolating to ground water will result in changes to aquifer levels, in base flows entering streams and in seepage losses from streams to ground water.
- While artic areas are warming and glaciers are melting more rapidly, current climate models suggest that arctic and equatorial regions may have a tendency to become wetter and that subtropical regions may experience drying. Hawaiʻi is within the tropical region defined as those areas between the Tropics of Cancer and Capricorn.

- Rising sea levels will introduce new stresses on physical and ecological systems, including aquifers, streams, forests and riparian zones as well as coastal and freshwater aquatic systems. Rising sea levels impact coastal environments in the following ways:
  - Lowland inundation and wetland displacement
  - Altered tidal range in rivers and bays
  - Changes in stream sedimentation patterns
  - Severe storm surge flooding
  - Saltwater intrusion into estuaries and freshwater aquifers
  - Increased wind and rainfall damage in regions prone to hurricanes

Sea level on O'ahu has risen 10 inches over the last century and is expected to rise another 3 feet during this century[7]. The rise is due in large part to the effects of climate change and in small part to O'ahu's slow but steady sinking into the ocean. Greenhouse gases, such as carbon dioxide and methane in the atmosphere hold global heat, melt ice at the polar caps, and coupled with thermal expansion of the oceans, causes sea levels to rise. Carbon dioxide also contributes to ocean acidification.

Aquifers are susceptible where caprock above msl is thin, such as in Pearl Harbor. Brackish caprock sources will be impacted first. Due to density differences, the basal freshwater levels will rise accordingly above rising seawater and the aquifers will tend to migrate inland. Deep wells may be impacted as the brackish transition zone rises to a new equilibrium head, and wells may have to be partially backfilled. Climate change indicators will have to be monitored closely and mitigative measures initiated incrementally to minimize costs and detrimental impacts.

1.3 WATER CYCLE

A continuous cycle of water can be easily traced on small oceanic islands like Hawai'i. As noted most **precipitation or rainfall** begins as moist trade wind air that rises up the mountain side, cools and condenses and falls as rain or fog drip. However, in the winter months (November to April) extra-tropical storms approach from the north, covering the entire island during times when low pressure occurs in the northern Pacific. Sub-tropical "Kona" storms are important for recharging the drier leeward area of O'ahu.

The water cycle is illustrated in Figure D.2. The three main elements of the water cycle are precipitation, runoff and evapotranspiration and can be summarized by the equation

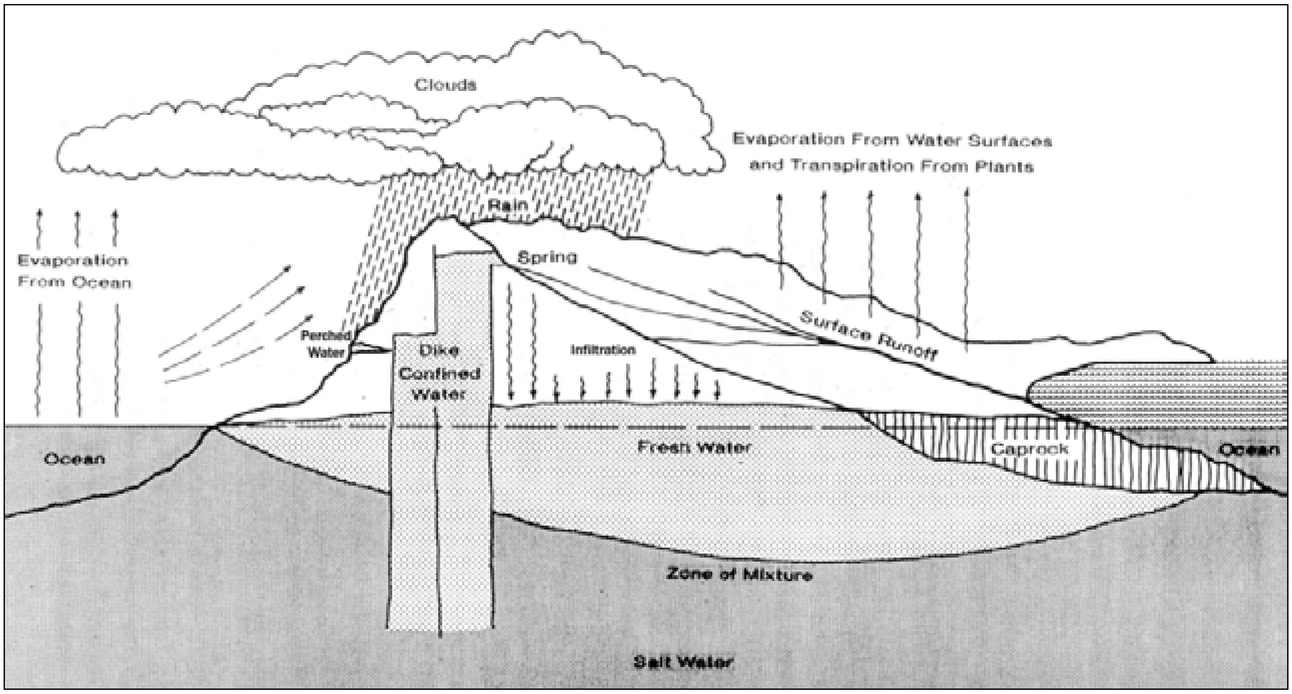
$$R=P-RO-ET$$

where R = recharge, P=precipitation, RO = runoff and ET = evapotranspiration.

Rainfall varies greatly around the island and is measured by a limited network of rain gages. The rainfall data is then extrapolated to represent actual rainfall distribution. Trade wind rainfall in particular can be very localized. Rainfall distribution is based on averages and there are significant variations from wet and dry years. Maintaining existing rain gages are essential and more are needed, especially in critical aquifer systems.

When precipitation occurs faster than it can infiltrate the ground, it becomes **runoff**. Runoff flows over land surfaces into streams and drainage systems and eventually into the ocean. Ground water may supply stream base flows. *Runoff* is measured by stream gages but additional water flows in streams as underflow beneath and around the streams perched upon alluvium and is not measured in stream gages. Storm water flowing overland, through intermittent stream channels and storm drains are difficult to accurately estimate and account for in water budgets.

Figure D.2 Hydrologic Cycle



(O'ahu Water Management Plan, 1990)

Evapotranspiration is the loss of water from the soil by evaporation and by plant uptake of water as it lives and grows. Evaporation is the change of liquid water to a vapor. As the water heats, vaporization occurs. Warm moist air rises up into the atmosphere and becomes the vapor involved in condensation. There are also evaporation losses from water bodies above the ground and from water that lands on plants and other exposed surfaces. Evapotranspiration is based on pan evaporation data and an assumed vegetative transpiration quantity. Global warming will increase evaporation. Transpiration data is limited to few plant species, yet the vegetative cover is varied and changing over time with different land uses and changing ecosystems, which requires more study.

Percolation or infiltration occurs when precipitation sinks into the ground and becomes ground water. Some factors that affect the rate of infiltration are ground slope, vegetative thickness and soil permeability. Permeability is the measure of how easily a fluid flows through soil and rock. The more permeable, the more quickly precipitation seeps into the ground.

Recharge is water infiltrating into the aquifer. Recharge is not directly measured and is the calculated remainder of rainfall minus runoff and evapotranspiration, in a water budget.

Leakage is the seaward flow of ground water to nearshore waters in the form of springs, seeps and underflow. Leakage is not easily quantifiable and varies in aquifers due to the amount of caprock or lack of sedimentary caprock. There are also freshwater losses to the aquifer transition zone or zone of mixture between freshwater and seawater.

Human activities can alter the components of the water cycle. For example, global warming and forest degradation can change evapotranspiration rates; agricultural and urban development can affect runoff patterns.

1.4 GEOLOGY

The islands of the Hawaiian Archipelago are emerged volcanoes on a great submarine ridge that extends northwesterly and southeasterly for 1,600 miles in the central Pacific Ocean. The creation of the Hawaiian Islands chain is thought to result from a fixed "hot spot" and moving plate tectonics.[8] The ridge and resulting islands are created with the movement of the Pacific plate northwest across the hot spot. The ridge, rising from ocean depths of 20,000 feet, was formed from immense quantities of lava, flow upon flow, spewing forth.

The sequential formation of the archipelago is indicated by the occurrence of submerged older islands in the northwest portion of the chain and by the youngest island at its southeast end, where volcanic activity continues. Eight of the islands are of sufficient elevation to intercept trade wind moisture and large enough to permit settlement.

Comparatively rapid weathering and erosion of their volcanic rock structure has reduced the size and altered the form of the islands. O'ahu is comprised of the remnants of two elongate shield volcanoes, the Ko'olau and Wai'anae volcanic ranges, joined by a broad convex plateau.

The giant Nu'uanu debris avalanche took out much of the seaward flank of the Ko'olau volcano. The eroded Ko'olau volcanic shield, stretching nearly straight northwest southeast for 37 miles from Kahuku to Makapu'u, is O'ahu's principal mountain range. The older Wai'anae volcano, an arcing mountain range 20 miles long from Ka'ena Point to the 'Ewa Plains, makes up the western bulwark of the island.

The peaks of the Koʻolau Range average about 2,500 feet in elevation. The highest point, Kōnāhuanui, overlooking Nuʻuanu and Mānoa Valleys in Honolulu, rises to 3,150 feet. The Waiʻanae Range peaks are somewhat higher, averaging nearly 3,000 feet. The highest point on the island is Mount Kaʻala in the Waiʻanae Range, at 4,025 feet elevation.

The Waiʻanae shield volcano emerged first and was partially eroded before the Koʻolau volcano emerged to the east, sending lava flows westward to overlap against the Waiʻanae flank. The shield building lavas of the Waiʻanae and Koʻolau volcanoes are known as the Waiʻanae Volcanics and Koʻolau Volcanics, respectively.

During later periods, erosional and depositional platforms of marine and terrestrial sediments interbedded with lava flows were created around Oʻahu. This was very important in determining Oʻahu's water resources. These formations formed what is called the caprock and impounds the freshwater lens of ground water from flowing into the ocean. Under the caprock the freshwater lens thickens and is under pressure, a characteristic referred to as artesian, if the piezometric surface of the aquifer is higher than the land surface elevation.

1.5 HYDROGEOLOGY

Oʻahu's geology, climate and the water cycle all influence the storage and movement of ground water. The most important feature of the volcanic formations making up the aquifers is that they were emitted on land and not as submarine flows. Under their subaerial environment, degassing and physical emplacement of the lava allowed the physical feature important to permeability to develop. The volcanic rock and their residual soils have a very great capacity to absorb and percolate water, and consequently, the amount of rainfall that recharges the ground water is greater than the amount of rainfall that runs over the surface to the sea. This infiltration and confinement in areas confined by the caprock creates the large ground water bodies on which Oʻahu depends for its water supply. It should be noted that while infilitration into the ground water is great, much water is released into the atmosphere through evapotranspiration.

1.5.1 GROUND WATER

There are several types of general ground water bodies on Oʻahu. The most important and most extensive is the "basal freshwater lens" that floats on seawater under much of the southern and northern portions of the island. Less widespread, but of singular importance in some areas, is ground water restrained between impermeable nearly vertical rock structures called "dikes" in the rugged core of the mountains. Dikes form from chilled magma in the fissures that feed lava flows. The third type, of minor significance on Oʻahu, is ground water held up, or "perched," on horizontal impermeable beds such as volcanic ash (Figure D.2). And, finally there is caprock water, water within the caprock, which is typically brackish water and is perched over the basal water.

1.5.1.1 Basal Water

The immense basal water bodies, which are artesian where they underlie the coastal plain, exist because of the difference in density between freshwater and seawater. Freshwater floats on the heavier seawater, both of which permeate the subsurface rock. This relationship is known as the Ghyben-Herzberg principle. The density ratio between freshwater and salt water is such that, theoretically, for each foot that the freshwater lens stands above sea level (i.e. for each foot of "head"), the lens extends 40 feet below sea level to a midpoint where salinity is half seawater. A zone of mixture ("transition zone") grades upward to freshwater and downward to seawater. For example, if the freshwater head was found to be 20 feet above sea level, it can be reasonably estimated that the depth to the midpoint of the transition zone would be approximately 800 feet below sea level (Figure D.2).

On O'ahu, the Leeward basal aquifers are much larger than the Windward basal aquifers. On the Windward side of the island, the dike complex makes this a much smaller or truncated lens (Figure D.2).

Basal waters can be either confined or unconfined. Since confined aquifers underlie the coastal plains, O'ahu's aquifers are mostly unconfined. Unconfined aquifers are where the upper surface of the saturated aquifer is not bounded. Confined aquifers are bounded by impermeable or poorly permeable formations.

In some coastal areas there is a relatively impermeable sediment sequence commonly called "caprock." This caprock barrier tends to restrict the seaward flow of freshwater and causes the thickness of the freshwater lens to be greater than if the caprock were absent. Depending upon the effectiveness of the caprock, the resulting lens could range from local thickening of a relatively thin lens of a hundred feet to over 1800 feet. The amount of water stored in basal lens is significant. Water can be and is withdrawn from the basal aquifer for various uses but mainly for the island's municipal water supply.

Where fresh and salt water merge, a brackish zone of the mixture forms. The movement of this transition zone, both horizontally inland from the seacoast and vertically upward, presents a constant potential danger of saline contamination to the freshwater portion of the system.

Utilization of brackish water sources for municipal supplies requires reduction of chlorides by blending and/or demineralization. Water containing more than 250 ppm of chloride ion is considered undesirable for drinking.[9] Although BWS prefers to distribute water containing less than 160 ppm, it will consider a higher level of salinity where appropriate to enhance opportunities for blending fresh and brackish water (Figure D.3).

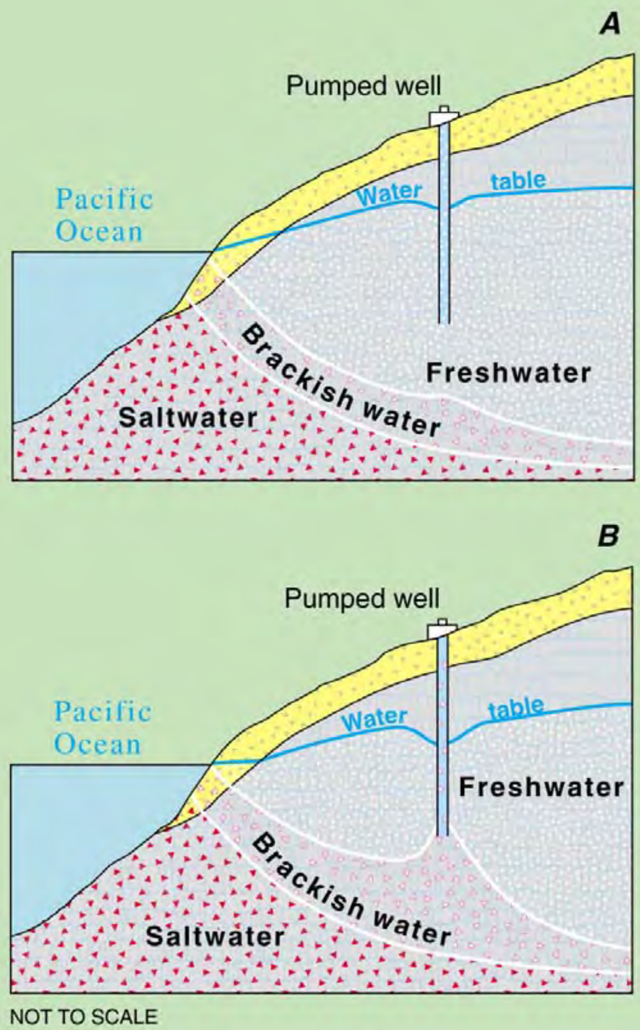
1.5.1.2 Dike Water

Water impounded behind impermeable dikes in the mountains is called “dike water,” or “high-level water.” Dikes are formed when molten magma intrudes and solidifies in conduits within the volcano’s rift zone. These conduits may feed eruptions on the surface or may stay beneath the surface. Typically, they consist of nearly vertical slabs of dense, massive rock, generally a few feet thick, that can extend for considerable distances and cut across existing older lava flows. High level water impounded in permeable lavas occurring between dikes in the interior portions of O‘ahu is of excellent quality and is generally hydrologically distinct from the basal water found in dike-free areas.

The dike water is not subject to saline contamination because of the high head of the water trapped between the dikes, distance from the sea, and the low permeability of the dikes which inhibits the lateral flow of seawater. However, water leaking through the dikes or overflowing, supplies the basal lens. The Waiāhole Tunnel complex relies on dike water.

Dike-impounded water may discharge at the ground surface where stream erosion has breached dike compartments. Once breached to the water table, the percentage of overall contribution to total stream flow depends on the head of the stored water, how deep the stream has cut into the high level reservoir, the permeability of the lavas between dikes, the size of the compartments as well as connections to other compartments, and the amount of recharge into the compartment that is breached.

Figure D.3 Salt Water Intrusion



*Saltwater intrusion is a potential problem near the coast. (**A**) Diagram of a well completed in a volcanic-rock aquifer in which withdrawal is small. Only limited saltwater intrusion has taken place. (**B**) Diagram of the same well under conditions of large ground-water withdrawal. Pumping has lowered the water table and caused the freshwater lens to thin. Brackish water has reached the well.*

Source: USGS Ground water in Hawai‘i

In the northern portion of the Waiʻanae region and on the windward side of the Koʻolau Range, dikes are exposed at or near sea level. Due to proximity to the ocean and lower head, freshwater within the dikes is in balance with underlying salt water and is classified as dike basal water. Dike basal water is found in windward Oʻahu.

1.5.1.3 Perched Water

Oʻahu has only minor perched water, but in a few small areas it has met minor supply demands. This type of water is "perched" on top of layers of impermeable material such as dense volcanic rock, weathered and solidified ash, or clay-bearing sediments. Discharge of perched water sometimes occurs as springs where the water table has been breached by erosion. Perched water supplies can be developed by tunnels or by constructing masonry chambers around spring orifices to collect flow and to prevent surface contamination. This type of water is of excellent mineral quality, and like most dike water, is free from seawater encroachment.

Another type of perched water is alluvial water, which is in limited quantities. Alluvial water is found in the more recent alluvial layers and remains perched because of older compacted alluvial layers below. Sometimes small wells can be productive in this area but generally the alluvium provides small amounts of water for Oʻahu.

1.5.1.4 Caprock Water

The limestone in the caprock generally contains ground water. Caprock water is mostly brackish to saline. It is recharged from sparse local rainfall, return irrigation water and leakage of basal water bodies. Caprock water occurs around the island with the sizeable ʻEwa Caprock having the most appreciable amount of brackish water that is pumped and utilized. Caprock withdrawals are not counted against basal sustainable yields.

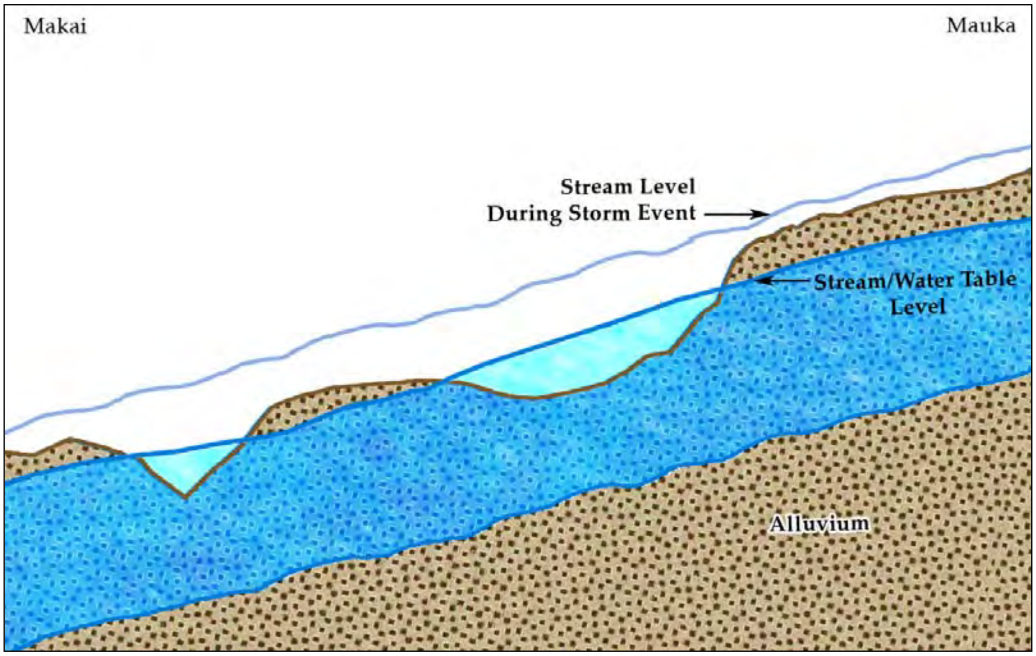
1.5.1.5 Brackish Water

Water occurring in the caprock, the basal water transition zone, and some basal springs comprises a large resource that is presently unused for municipal supplies due to excessive chlorides (salt) content. Chlorides range from just above recommended drinking water limits to that nearly of seawater.

1.5.1.6 Salt Water

Salt water exists in basal and caprock formations underlying the fresh and brackish aquifers. Salt water can be extracted with wells and used for aquaculture and to assist in building cooling systems. Salt water replaces the use of potable water for cooling towers in chilled water air conditioning systems.

Figure D.4 Intermittent Streams During Wet and Dry Periods



1.5.2 SURFACE WATER

Streamflow from Oʻahu's perennial and intermittent streams is significant to agricultural pursuits and environmental and cultural values, especially on the windward side. Although the island is deeply incised by many stream valleys, the amount of perennial streamflow reaching the sea is comparatively low. Storm flows may be very heavy, but because of their short duration stream recharge may be slight.

On the leeward side of the island, streams are perennial in their headwaters because of high rainfall but intermittent in their lower reaches due to diversions, riparian vegetation, and porous ground conditions. Outflow of basal ground water as springs, especially in the Pearl Harbor area, maintains perennial streamflow near the shoreline. Figure D.4 shows how areas with porous ground can make streams appear and disappear from the surface, but may be still be flowing beneath the surface.

Perennial streams by definition flow all year round. On Oʻahu, they occur within the Koʻolau Mountain watersheds. These streams are sustained by high rainfall and leakage from high-level dike compartments. In addition, low permeability of the dike complex and small easily saturated compartments mean insignificant infiltration losses.

1.5.3 THE RELATIONSHIP BETWEEN GROUND AND SURFACE WATER

The aquifer systems in Windward O'ahu consist of basal aquifers, high level dike aquifers and dike basal aquifers, which are a combination of the first two. Three of the windward aquifer system areas – Waimānalo, Ko'olau Poko and Kahana – are generally considered to have a direct relationship between surface and ground water conditions. In Ko'olau Loa, the upper elevations of these dike areas intersect with streams. At lower elevations, surface water may be hydraulically separated from the basal and dike basal aquifers by layers of thick sediments.[10] Case by case test pumping is needed to verify localized site conditions.

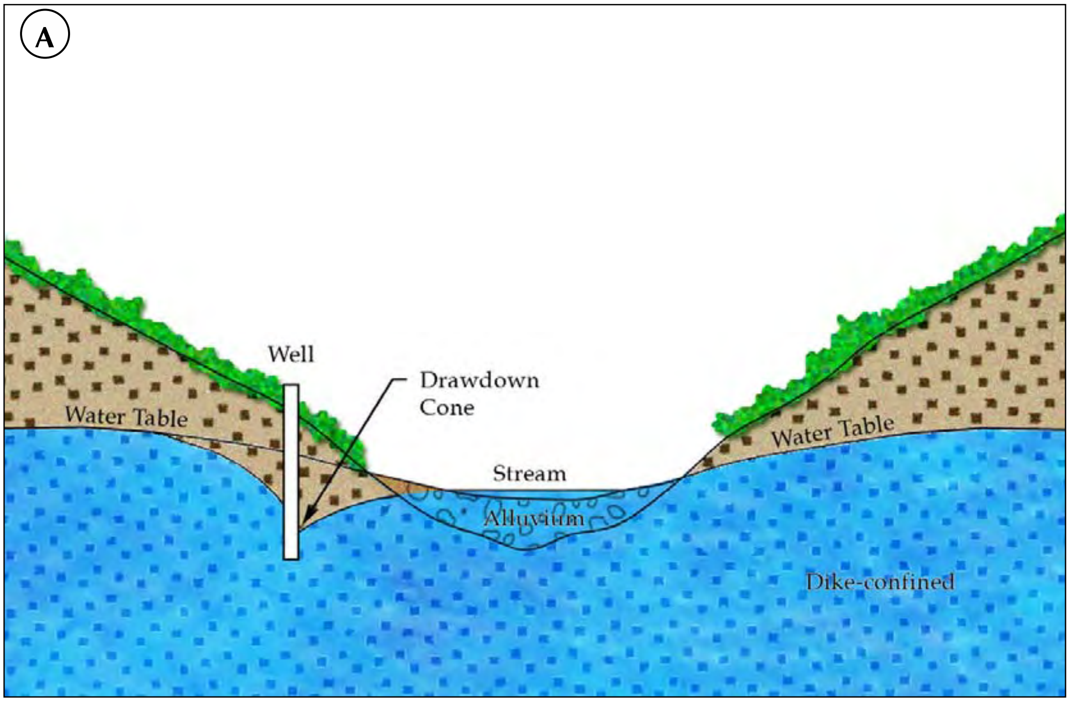
The interactions between ground and surface water depend upon the location within a valley. Figure D.5 shows two locations in a windward valley. Location A is high in the back of the valley and Location B is in the lower reaches of the valley.

At Location A, there is a relationship between ground and surface water as illustrated in Figure D.6, (Location A). This is a gaining stream reach, where the dike water supplies water to the stream, and therefore ground water withdrawals affect streamflow. Also, where tunnels tap dikes for water supply, streams can be affected because dike water levels have been lowered.

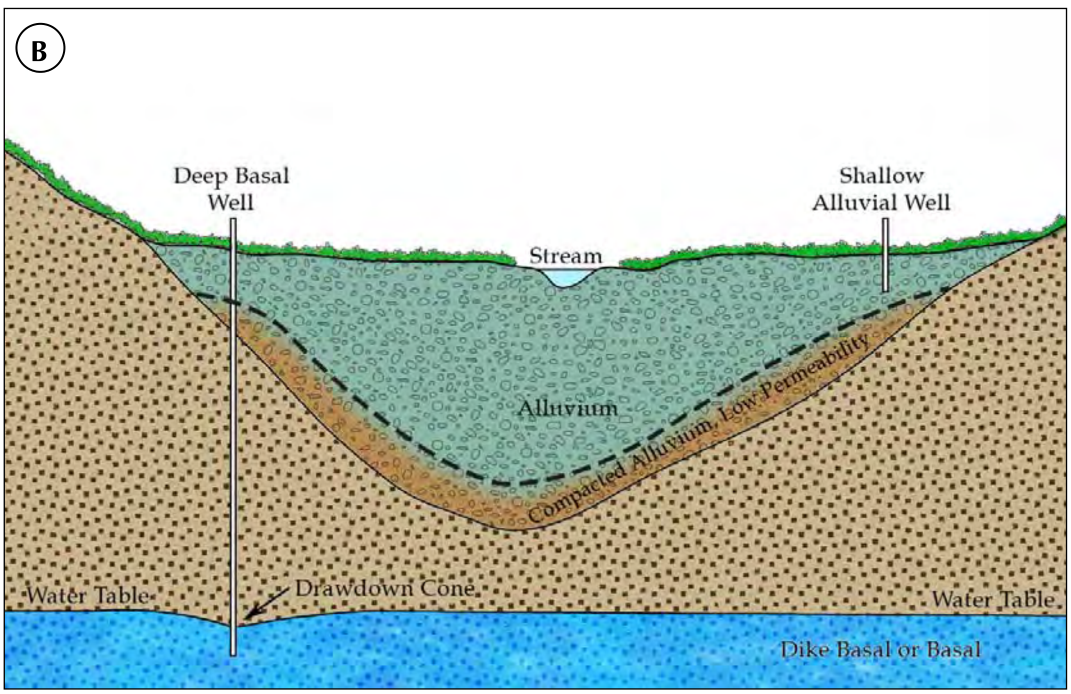
At Location B (Figure D.6), the stream water and ground water are not hydraulically connected. This is a losing stream reach where streamflow is not directly supplied by the basal ground water which occurs far below it. While shallow alluvial wells at this location may affect streamflow, basal well withdrawals of ground water will not. This is the case for the mouth of the valley in Windward O'ahu and for most locations in Leeward O'ahu (Figure D.7). The ground water and surface water relationship in the Ko'olau Poko Aquifer System Area will vary between different streams based on long-term well production experience and therefore, significant effects of ground water withdrawal on surface water should be evaluated on a case-by-case basis.

Figure D.5 Typical Windward Valley with Upper (A) and Lower (B) Elevation Stream Locations

Figure D.6 Well/Ground Water Relationship

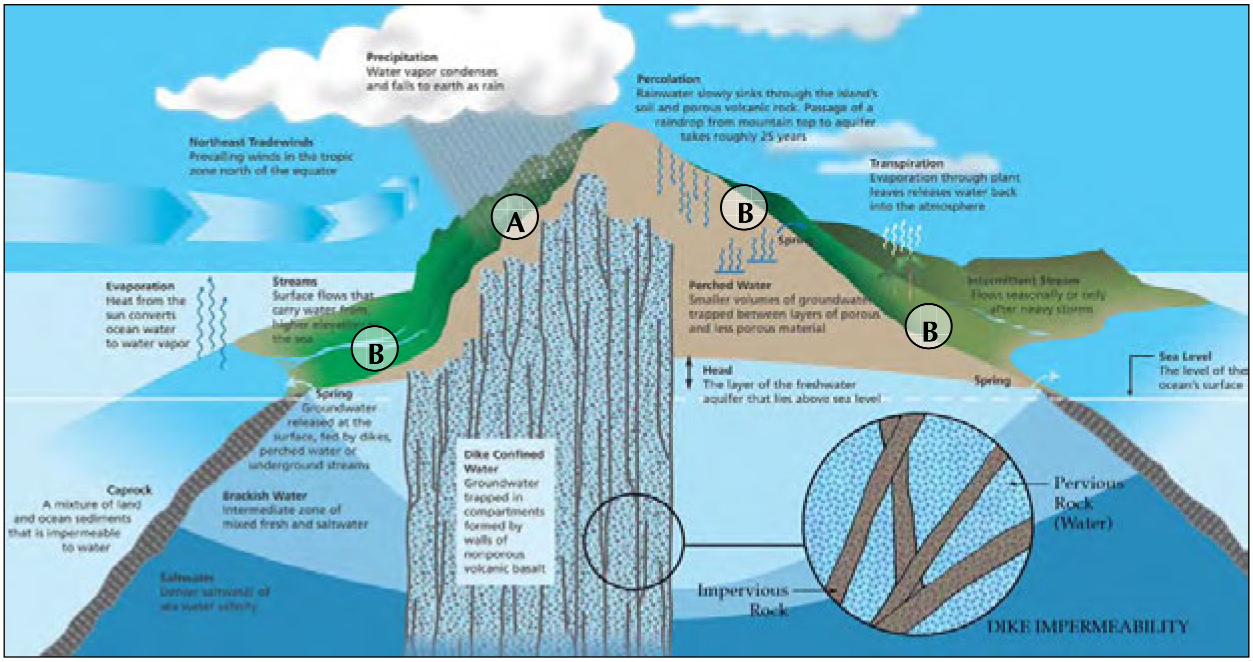


Well Affecting Stream Flow



Basal Well **Not** Affecting Stream Flow
Alluvial Well Potentially Affecting Stream Flow

Figure D.7 Island Cross Section with Stream Type and Elevation Locations

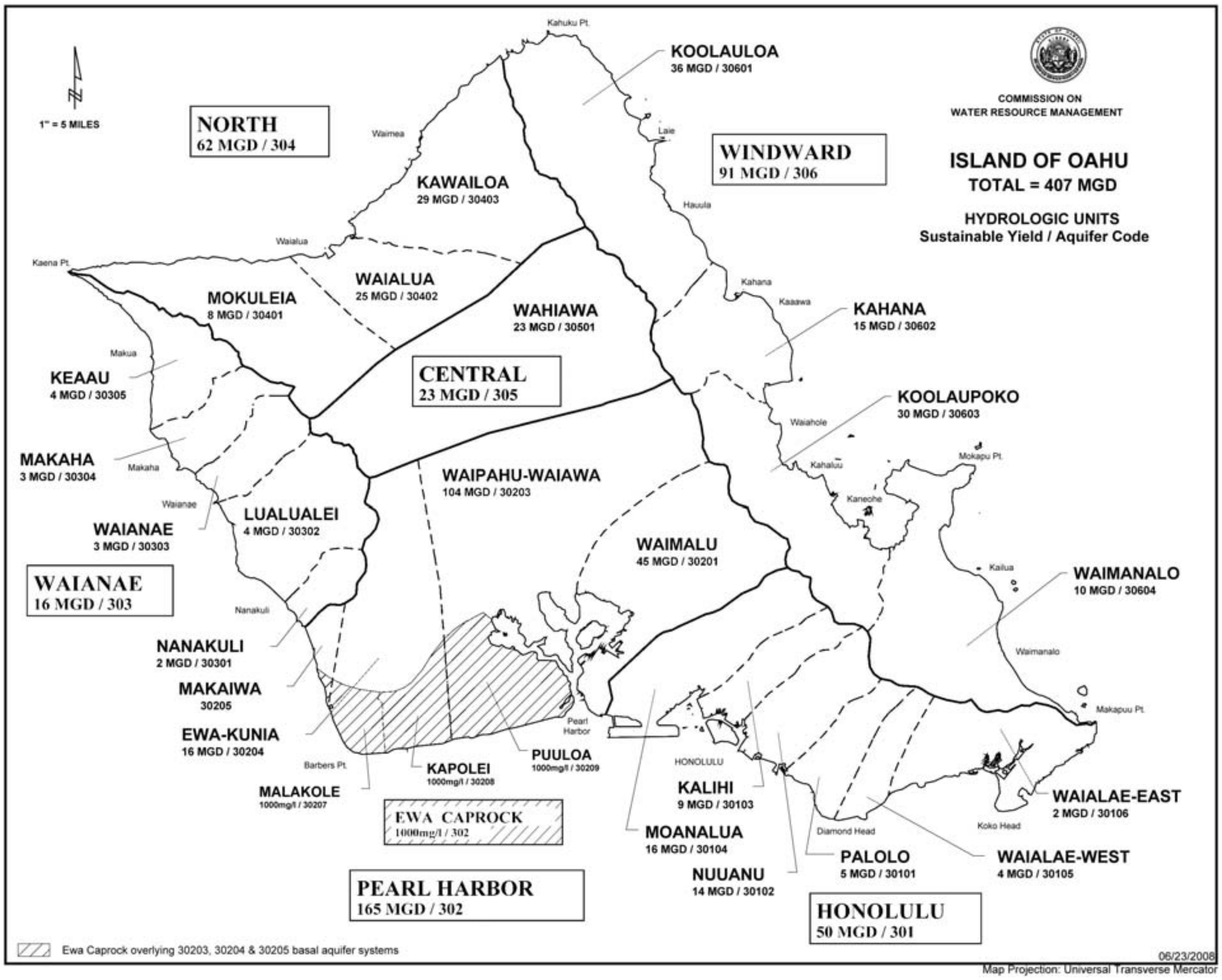


1.6 SUSTAINABLE YIELD

Sustainable yields for all aquifer system areas have been adopted as part of the State Water Code's Water Resources Protection Plan (WRPP) and are used for resource management and protection. Sustainable yield is defined by the Hawai'i Administrative Rules as *the maximum rate at which water may be withdrawn from a water source without impairing the utility or quality of the water source as determined by the commission.*[11] The island is divided up into Aquifer Sector and System Areas which are management tools that do not imply non-communication or separate independent aquifer bodies. Aquifer Sector Areas generally define large geological boundaries such as rift zones, unconformities or differences in water levels. Aquifer Sector Areas reflect broad hydrogeological similarities and are generally bounded geologic structures, which incorporate topographic divides, such as Honolulu and Pearl Harbor aquifer sectors. Aquifer System Areas such as Waipahu-Waiawa and Waimalu are more specifically defined by ground water hydraulic continuity.

Figure D.8 shows the sustainable yields for the island of O'ahu for each Aquifer System Area. The sustainable yield numbers determined by CWRM are the maximum levels of withdrawal permissable for each Aquifer System Area. *Note: withdrawals affecting streams require amendments to the interim instream flow standards.*

Figure D.8 Aquifer Sector and Aquifer System Area



The WRPP recommends that a periodic review of sustainable yields and pertinent hydrologic data and water quality parameters be done at least every five years (p. I-4). CWRM has periodically reviewed and modified sustainable yields for certain aquifer system areas based upon new information (1991 ‘Ewa-Kunia, 1993 Wahiawā and Pearl Harbor, 1997 ‘Ewa Caprock, and 2000 Waipahu-Waiawa and ‘Ewa-Kunia).

The sustainable yields have been calculated with the water budget method using the widely accepted Robust Analytical Model (RAM). In August 2003 the CWRM updated the sustainable yields throughout the State using a modified RAM model calibrated to deep monitor well data where applicable. New 3-dimensional numerical ground water models calibrated with deep monitor well data may refine future estimates, but are costly and are only recommended as pumpage and permitted uses approach the adopted sustainable yield.

1.6.1 RECOVERABILITY OF SUSTAINABLE YIELD

Recoverability is the ability to feasibly extract ground water through wells or tunnels, up to the adopted sustainable yield. The recoverable amount of water is usually less than (or equal to) the CWRM sustainable yield estimate and is used to plan for uncertainty. Various factors affect the full recoverability of the adopted sustainable yield:

1. ***Well spacing and pump size optimization:*** In general, a higher level of recoverability can be achieved with many smaller wells spaced evenly throughout the aquifer system area, than fewer larger wells concentrated in a few locations. When pumping ground water, wells have an upconing effect where the saline water is drawn up toward the well (Figure D.3). Even in areas where well pumpage is within the sustainable yield, this may occur because of factors such as total station pumpage and the vertical permeability of the rock. The upconing may progress to a point where salt water begins to come up into wells instead of freshwater. This localized upconing effect can be more pronounced when wells are clustered as show in Figure D.9. To avoid the upconing of saline water, wells can be more evenly distributed over the aquifer area as shown in Figure D.9.

2. ***Surface and ground water interactions:*** Full recoverability is affected if a portion of the sustainable yield impacts surface water. Kahana and Ko'olau Loa have dike formations (dike complex and marginal dike zones) near the crest and basal aquifers near the coast. Surface and ground water interactions are more likely in dike formations. Ground water development in the basal formations usually does not have an effect on stream flows. Stream impacts from ground water development are evaluated on a case-by-case basis. Interim instream flow standards as well as appurtenant rights, riparian rights, and existing instream uses directly affect the availability of the portion of ground water interacting with surface water and require the approval of the CWRM.

3. ***Separate hydro-geological formations:*** The adopted sustainable yields provide a gross estimate for the entire aquifer system area assuming a single homogeneous geologic formation, and do not specifically account for the yields of each of the separate hydro-geological formations within the aquifer system, such as dike, basal, alluvial or caprock formations. CWRM does not count caprock withdrawals against sustainable yields, but does count alluvial withdrawals. In the sustainable yield calculations, residual rainfall is assumed to recharge the basal aquifer formed by alluvium and other geologic formations. Perched aquifers divert recharge from the underlying basal aquifer with the result that sustainable yields are lower from some areas. The hydraulic interaction between these

geologic formations is not fully understood, estimated or readily measurable and affect recoverability.

4. ***Extended Drought:*** Extended drought impacts all water resources and affects recoverability. O'ahu experienced an extended, multi-year drought from 1998-2003 where rainfall averaged between 60% and 80% of normal levels and several source yields eventually dropped below permitted use. Dike sources declined first due to smaller storage volume compared to basal sources. These six straight years of drought were unprecedented in over 100 years of rainfall record. Sustainable yield and permitted use are based on averages, and BWS basal ground water sources can usually sustain permitted use levels through 3-4 years of drought depending on severity and max day demand.

5. ***Municipal Infrastructure Cost:*** The cost of infrastructure continues to rise and can affect recoverability in the following ways:

   a. ***Cost*** considerations limit the number of wells and length of connecting pipelines. Exploratory wells in dike and alluvial formations are risky due to potentially low yields and potential affects to IIFS.
   b. ***Land constraints*** such as steep terrain or urbanization can make potential well development infeasible due to high costs.
   c. In general, the higher the uncertainty from the factors noted above, the higher the **financial risk** and the less likely full recoverability will be achieved. However, water may be feasibly extracted through small on-site wells for private water systems.

1.6.2 WAIĀHOLE MANAGEMENT AREA

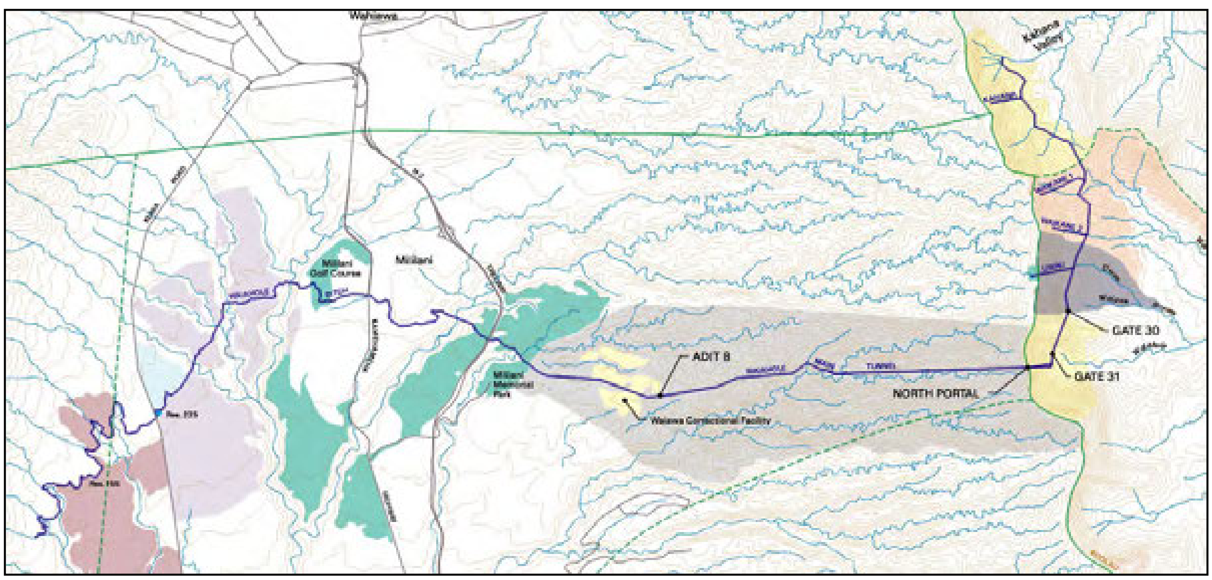
The approximately 25-mile long ditch stretching from Kahana Valley to Kunia was constructed to transport water from windward streams and springs to irrigate sugar cane fields on the drier leeward side (Figure D.10). Initial construction on the Waiāhole Ditch and Tunnel System (Waiāhole Ditch) took place between February 1913 and December 1915. During construction, large amounts of dike-impounded ground water were encountered at the high elevations (between approximately 700 to 800 feet elevation) at which the transmission tunnels were being bored, and subsequent extensions of the tunnel system during 1925 to 1933 and again in 1964, have resulted in a system that currently collects mostly dike-impounded ground water. Development of these dike-impounded waters that previously fed Waiāhole (and its tributary Waianu), Waikāne and Kahana Streams through springs and seeps resulted in diminished flows in these streams.

The State CWRM has determined that the Waiāhole Ditch develops an average of 27 mgd, consisting of 23.3 mgd measured at the North Portal, which is directly underneath the crest of the Koʻolau Mountains, and an additional 3.7 mgd is developed on the leeward side measured at Adit 8, where the Waiāhole Ditch surfaces in Waiawa.

The development tunnels of the Waiāhole Ditch system include the Kahana Tunnel (1.1 mgd after bulkheading), Waikāne #1 Tunnel (4.2 mgd), Waikāne #2 Tunnel (1.1 mgd), Uwau Tunnel (13.5 mgd) and the Main Bore from the North Portal to Adit 8 (3.7 mgd). The remaining flows are captured in the ditch between Kahana and the North Portal averaging 3.4 mgd for a total of approximately 27 mgd.

As of 2006, CWRM has authorized a total of 15 mgd available for non-instream uses through water use permits, of which a total of 12.57 mgd has been allocated for leeward uses. 12 mgd of water was added to the Kahana, Waikāne, Waianu and Waiāhole Streams.[12]

Figure D.10 Waiāhole Ditch System

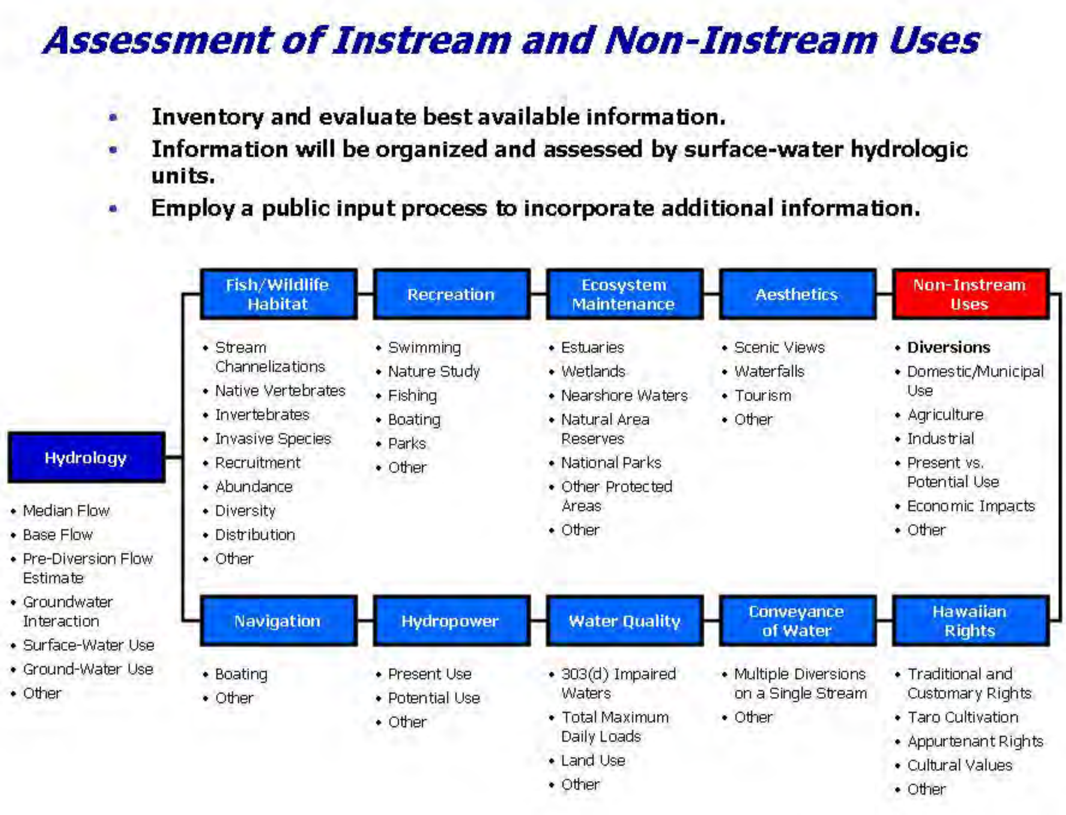


Source: CWRM

1.7 INSTREAM FLOW STANDARDS

Instream flow standards (IFS) are similar to sustainable yields for ground water, in that their establishment provides a management system that protects the resource and cultural uses while allowing for possible non-instream water use. The State Water Code defines instream flow standards as *"the quantity or flow of water or depth of water which is required to be present at a specific location in a stream system at certain specified times of the year to protect fishery, wildlife, recreational, aesthetic, scenic, and other beneficial instream uses."*[13] The instream flow standards need to consider the best available information in assessing the range of present or potential instream and non-instream uses. The Hawaiʻi Administrative Rules lists instream and non-instream uses to be considered (Figure D.11). The figure shows the complexity involved in assessing instream and non-instream water uses and there are 87 surface water hydrologic units on Oʻahu. The CWRM is working to develop a methodology for amending instream flow standards.

Figure D.11 Information to Consider in Setting Measurable Interim Instream Flow Standards



Source: CWRM Presentation to Water Commission, June 2006

The current instream flow standards for O'ahu streams are called interim IFS and are based on the "amount of water flowing in each stream on the effective date of the standard without further amounts of water being diverted off-stream through new or expanded diversions". The effective dates are December 10, 1988 for Leeward O'ahu and May 4, 1992 for Windward O'ahu.[14] In the Waiāhole Contested Case Hearing, the CWRM recognized that "retaining the status quo (through the adoption of the previous interim standards) helped to prevent any future harm to streams while the scientific basis for determining appropriate measurable instream flow standards is developed and an overall stream protection program put into place."[15] The stream flows and diversions were not quantified in the standard, however users of surface water and ground water were required to register their uses with CWRM.

In an effort to approximate current water usage, and in accordance with the State Water Code and Chapter 13-168-31, HAR, the CWRM initiated the Registration of Stream Diversion Works and Declarations of Water Use (Registration) process in 1989. This process required the owner or operator of any stream diversion works to register with the CWRM. In September 1992, the Commission released a final report summarizing the findings of the Registration process for both ground and surface water. These reports are referred to as the Declaration of Water Use, Volume I (Declarations Summarized by File Reference) and Volume II (Location Data Sorted by Tax Map Key). The Declarations of Water Use provide a qualitative description of water use, but also includes a number of declarations comprised of claims for water rights, proposed future uses of water, and instream uses.[16]

Table D.1 Amended O'ahu Interim Instream Flow Standards

Stream	1960s Streamflow	Amended Interim Instream Flow Standard	Percent Increase
Waiāhole	3.9 mgd	8.7 mgd	124%
Waianu	0.5 mgd	3.5 mgd	600%
Waikāne	1.4 mgd	3.5 mgd	150%
Kahana	11.2 mgd	13.3 mgd	19%

The CWRM amended the interim instream flow standards for four windward streams - Waiāhole, Waianu, Waikāne and Kahana have been established via the *Findings of Fact, Conclusions of Law, and Decision and Order on Second Remand in the matter of water use permit applications, petitions for interim instream flow standard amendments, and petitions for water reservations for the Waiāhole Ditch Combined Contested Case Hearing (CCH-OA95-1) on July 13, 2006*. (Table D.1).

The 1989 Registration process provided a baseline of current surface water diversions at that time. However, any new diversions constructed or existing diversions altered after the effective dates of the standards are subject to the Commission's regulatory permitting requirements. In essence, surface water diversions that were registered as part of the CWRM's Registration process and currently remain in use can continue to be utilized. Any person wishing to construct a new stream diversion or alter an existing diversion structure is required to obtain a Stream Diversion Works Permit from CWRM. As a result, construction or alteration of structures constitutes an alteration to the stream channel. Therefore, a Stream Channel Alteration Permit is also required (Chapter 13-169-50, HAR). In addition, any change to the instream flow that may result from the constructed or altered diversion requires a Petition to Amend the Interim Instream Flow Standard (Chapter 13-169-40, HAR). Owners of stream diversion works wishing to abandon or remove their diversion structures are also required to obtain a permit from CWRM (Chapter 13-168-35, HAR).

ENDNOTES

[1] Atlas of Hawai'i, 1983

[2] US Census, 2000

[3] O'ahu Water Management Plan Technical Reference Document, March 1990

[4] Groundwater in Hawai'i. USGS, FS 126-00

[5] State of Hawai'i Agricultural Water Use and Development Plan, December 2003

[6] Climate Change and Water Resources: A Primer for Municipal Water Providers by Kathleen Miller and David Yates National Center for Atmospheric Research, American Waterworks Assoc. Research Foundation Publication

[7] Rising Sea Levels, Sunny Lewis, Hawai'i Public Radio, July 19, 2006

[8] Atlas of Hawai'i, Third Edition, 1998

[9] Groundwater in Hawai'i. USGS, FS 126-00

[10] Report on the Hydrologic Investigation of Groundwater and Surface Water Conditions in the Windward O'ahu Water Management Area, 1990

[11] Water Resources Protection Plan, CWRM, June 1990.

[12] Waiāhole Ditch Contested Case

[13] State Water Code Section 174-C 3

[14] HAR Section 13-169-49 and 49.1

[15] Waiāhole Ditch Contested Case

[16] Declarations of Water Use, September 1992, State Commission on Water Resource Management

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APPENDIX E

WATER FORECASTING

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E WATER FORECASTING

INTRODUCTION

This appendix provides technical details on assumptions and methods used to estimate water demand and water supply for Koʻolau Poko. In order to adequately plan for Koʻolau Poko's future water needs, District water demand was projected through the year 2030. These projections not only suggest how much water might be needed over the next 20 years, they also indicate when the demand might require infrastructure improvements.

The Statewide Framework for Updating the Hawaiʻi Water Plan (Statewide Framework) requires that the County Water Use and Development Plans (WUDP) "…also include forecasts of water requirements of federal, and private sector purveyors." Therefore, water demand was not only forecast for the Honolulu Board of Water Supply (BWS) system, but for State, Federal, and private uses as well. However, BWS system demands were called out to assist in BWS water system planning.

Existing use was based on available data for each of the sources, which varied. In some cases, water use was not available, and was therefore estimated based on what the water is used for (e.g., diversified agriculture), parcel size (e.g., acres), and typical water demand factors for that use (e.g., 2,400 gallons per acre per day). BWS existing use is taken from metered consumption records for calendar year 2000, as it was the last available year that could be correlated with U.S. Census figures.

The Statewide Framework recommends including "a range of forecasts of the amount of water required over the planning horizon…Among the scenarios are the base case scenario, a high-growth scenario and a low-growth scenario." For all three future water use scenarios in Koʻolau Poko, future population growth in the district is projected to be minimal. This assumption is based upon the City and County of Honolulu's (City's) Population Projections, published in September 2009, which were made in conformance with the *Koʻolau Poko Sustainable Communities Plan* (KPSCP) that outlines the City's land use and growth policies for the district. Projections were made in five year increments through the year 2030 and reflect the policies set forth in the KPSCP.

TABLE E- 1 KO'OLAU POKO DISTRICT POPULATION PROJECTIONS

Scenario	2000	2005	2010	2015	2020	2025	2030
Low-Growth[1]	117,999	117,004	114,209	115,631	116,118	114,975	113,243
% of O'ahu population	13.5%	12.8%	12.0%	11.6%	11.2%	10.7%	10.1%
Mid-Growth[2]	117,999	117,004	115,580	116,028	116,010	115,176	115,641
% of O'ahu population	13.5%	13.0%	12.7%	12.3%	12.0%	11.6%	11.4%
High-Growth[3]	117,999	117,475	116,950	116,426	115,902	115,377	118,039
% of O'ahu population	13.5%	13.1%	12.8%	12.4%	12.0%	11.6%	11.6%

1 Source: Department of Planning and Permitting *City and County of Honolulu Socioeconomic Projections*, September 2009.
2 Mid-Growth Scenario: Calculated to be mid-way between the General Plan (2006) goal that Ko'olau Poko accounts for 11.6% of O'ahu's population by the year 2025 (and continues to account for 11.6% of O'ahu's population in 2030) and DPP's *City and County of Honolulu Socioeconomic Projections* (2009).
3 High-Growth Scenario: Calculated to meet the General Plan (2006) goal that Ko'olau Poko accounts for 11.6% of O'ahu's population by the year 2025, and continues to account for 11.6% of O'ahu's population in 2030.

Additionally, minimal growth is expected in Ko'olau Poko because nearly all of the land currently zoned for urban use has been built out, making future large residential or commercial developments in Ko'olau Poko unlikely. There are approximately 10,500 acres of land in the Ko'olau Poko district that are designated by *both* the State and County for urban uses. Of those, approximately 45 acres have not been developed.

Because population growth and urban development are expected to be minimal within the time horizon of this plan*, agricultural activity is assumed to be the main variable for future water use.* While there is little land available for urban development, there is a substantial amount of land in Ko'olau Poko that could be put into agricultural production in the future. Recent movements toward food sustainability, food security, and self-sufficiency due to the constant rise of energy and shipping costs to and from Hawai'i over the last few of decades, also supports a potential increase in agricultural production in the foreseeable future.

E.1 LOW GROWTH SCENARIO

The low-growth scenario is an estimate of water demand based on the policies set forth in the KPSCP. The SCP emphasizes minimal growth for Koʻolau Poko and preservation of open space and agricultural lands.

E.1.1 Low Growth Scenario: Honolulu Board of Water Supply (BWS) System

The BWS system serves both potable (residential, commercial, industrial, resort, government facilities, schools, military facilities, religious, and temporary) and non-potable (agricultural, golf course, parks, and other irrigation) demands with potable water. Potable water demands were calculated using a *per capita* approach, which applies a water use factor to the population served and assumes that the *per capita*, i.e. per person, demand remains constant throughout the planning horizon.

The population served by BWS systems was calculated by adding the visitors present in Koʻolau Poko and subtracting the residents absent and the population served by State water systems (Table E-2). There are no potable water needs served by federal or private water systems in Koʻolau Poko.

BWS-Served Population	=	Total Population	+	Visitors Present	–	Residents Absent	–	Population Served by State Water Systems

TABLE E- 2 KO‘OLAU POKO BWS-SERVED POPULATION PROJECTION FOR THE LOW-GROWTH SCENARIO

	2005	2010	2015	2020	2025	2030
RESIDENT POPULATION[1]						
Ko‘olau Poko	117,004	114,209	115,631	116,118	114,975	113,243
O‘ahu	899,695	911,841	941,847	969,467	994,632	1,017,576
Ko‘olau Poko % of O‘ahu	13.0%	12.5%	12.3%	12.0%	11.6%	11.1%
RESIDENTS ABSENT[2]						
Ko‘olau Poko	4,785	4,817	4,933	5,013	5,028	5,023
O‘ahu	36,795	38,455	40,184	41,853	43,495	45,136
VISITOR UNITS[3]						
Ko‘olau Poko	60	68	62	60	62	70
O‘ahu	34,622	38,592	44,559	45,234	45,231	47,798
Ko‘olau Poko % of O‘ahu	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%
VISITORS PRESENT[4]						
Ko‘olau Poko	154	172	148	151	167	191
O‘ahu	88,832	97,394	106,722	114,101	121,987	130,414
Ko‘olau Poko % of O‘ahu	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%
DE FACTO POPULATION[5]						
Ko‘olau Poko	112,373	109,564	110,846	111,256	110,114	108,411
O‘ahu	964,950	1,011,600	1,062,100	1,109,500	1,156,550	1,202,600
Ko‘olau Poko % of O‘ahu	11.7%	10.8%	10.4%	10.0%	9.5%	9.0%
POPULATION SERVED BY STATE WATER SYSTEMS[6]						
Ko‘olau Poko	300	365	365	365	365	365
BWS-SERVED POPULATION[7]						
Ko‘olau Poko	112,007	109,384	111,138	111,104	109,169	108,773

1 Population numbers are from City DPP population projections (September 2009) and are based on policies articulated in the Ko‘olau Poko SCP.
2 Total residents absent for Honolulu County from State DBEDT, which provides a “residents absent” figure for Honolulu County as a whole. The number of residents absent from Ko‘olau Poko is therefore based on Ko‘olau Poko's proportion of Honolulu County’s population.
3 Visitor units are from City DPP projections (September 2009).
4 Total visitors present for Honolulu County if from State DBEDT, which provides a “total visitors” figure for Honolulu County as a whole. The number of visitors present in Ko‘olau Poko is proportional to Ko‘olau Poko's percentage of Honolulu County visitor units.
5 De Facto Population = Resident Population – Residents Absent + Visitors Present.
6 The State Waiāhole Valley Water System serves approximately 300 people (SWPP, 2003). DHHL was expected to add 22 residential lots by 2010. The average household size in Kahalu‘u in the year 2005 was 2.970 persons per household. Multiplying 22 residential lots by 2.970 persons per household, it was calculated that approximately 65 additional people would be served by the State WVWS as a result of the DHHL development.
7 BWS-Served Population = De Facto Population – State-served Population

The ***per capita* water demand factor** was calculated by dividing the BWS Ko'olau Poko water demand in the year 2000 by the BWS-served population for that same year (Table E-3). The *per capita* water use coefficient was then applied to DPP's projected service area population for the low-, mid-, and high-growth scenarios to estimate future BWS water demands in five-year increments through the year 2030.

TABLE E- 3 BWS KO'OLAU POKO PER CAPITA WATER DEMAND CALCULATION

BWS-Served Population[1] (2000)	BWS Ko'olau Poko Area Demand[2] (mgd)	BWS Per Capita Demand[3] (gpcd)
113,345	19.84	175

1 BWS-Served Population = (DeFacto Population) - (Population on State Water Systems)
2 Based on Board of Water Supply Average Daily Metered Consumption. Includes residential, agriculture, commercial, industrial, resort, golf course, Federal government, State government, City Government, parks and other irrigation, schools, military, religious institutions, and temporary uses. A water loss factor of 1.106 mgd was applied to the metered consumption data to get the total water demand needed at the source (BWS demand = metered consumption X 1.106)
3 Per Capita Demand = $\frac{\text{(2000 BWS Water Demand for Ko'olau Poko)}}{\text{(2000 BWS-Served Population)}}$ X 1,000,000 gallons

BWS water demand calculated using the per capita method accounts for both potable and non-potable uses. Therefore, **potable water demand** was calculated as a percentage of total BWS water demand. An analysis of water demand by use categories found that approximately 92% of total water demand is used for potable purposes in Ko'olau Poko (Table E-4). It was assumed that 91% of water demand in Ko'olau Poko would continue to be used for potable uses through the year 2030.

TABLE E- 4 BWS KO'OLAU POKO POTABLE AND NON-POTABLE WATER DEMAND FOR CALENDAR YEAR 2000[1]

BWS Potable Water Demand[2]		BWS Non-Potable Water Demand[3]		Total BWS Water Demand
mgd	% of Total Demand	mgd	% of Total Demand	mgd
18.007	91%	1.833	9%	19.840

1 CY 2000 data were used as the base year, because they could be matched with U.C. Census data. The percentages of potable vs. non-potable water demand for CY 2009 were found to be similar.
2 BWS metered consumption data was multiplied by a factor of 1.1 to account for water loss through leaks in the BWS system. BWS potable uses included residential, commercial, industrial, resort, government facilities, schools, military, religious institutions, and temporary facilities.
3 BWS Non-potable uses included agricultural, golf course irrigation, and parks and other irrigation.

BWS **non-potable water demand**, calculated as 9% of total BWS water demand, was further broken down between agricultural demand and other irrigation (golf course, parks, etc.).

BWS also exports 0.5 mgd to East Honolulu. The current volume of water exported is primarily to keep the water line active in the event that water transfers do become necessary in the future. BWS has no plans to increase or decrease the **export of water** to East Honolulu at this time.

E.1.2 Low-Growth Scenario: State Water Systems

The State of Hawaiʻi operates four water systems in Koʻolau Poko: Waiāhole Valley Water System (WVWS), Waimānalo Irrigation System (WIS), a stream diversion at the Hawaiʻi State Hospital, and ground water wells for the Hawaiʻi State Veteran's Cemetery. WVWS serves both potable and non-potable needs and is the only State system that provides potable water in Koʻolau Poko. Approximately 300 people (SWPP, 2003) are served by WVWS. An assessment of the WVWS estimated that residential demand was about 0.052 mgd (Bills Engineering, 2007). A planned DHHL development, Waiāhole Scattered Lots, was expected to add 22 residential lots by 2010 requiring an additional 0.011 mgd of water (SWPP, 2003) for a total **potable water demand** of 0.063 mgd through the year 2030.

The 2003 State Water Projects Plan estimated that WVWS provided a total of 0.139 mgd. When the estimated water demand for potable use (0.052 mgd) is subtracted from this total, 0.087 mgd is available for agricultural uses. Based on the 2003 SWPP, agricultural demand was assumed to remain constant. Additional **non-potable diversified agriculture demand** is served by the Waimānalo Irrigation System. A 2003 record of flow at the WIS intake measured 1.48 mgd, but the 2003 State Agricultural Water Use and Development Plan found that only 0.4 mgd is used. This demand of 0.4 mgd was expected to remain constant through the planning horizon.

There is one *loʻi kalo* in Koʻolau Poko served by a stream diversion registered to a State agency. Estimated kalo demand for the 0.76-acre loʻi is 0.076 mgd. The State *loʻi* is not expected to expand, therefore demand remained constant throughout the planning horizon.

Ground water wells provide approximately 0.042 mgd to the Hawaiʻi State Veteran's Cemetery for **landscape irrigation**. No increase in demand was projected through 2030.

E.1.3 Low-Growth Scenario: Federal Water Systems

The Federal government owns and operates only one water system in Koʻolau Poko: the recycled water facility at the Marine Corps Base Hawaiʻi Air Station at Kāneʻohe Bay. **Kāneʻohe Klipper Golf Course** currently uses approximately 0.550 mgd and has no plans for expansion.

E.1.4 Low-Growth Scenario: Private Water Systems

Private water demands are for non-potable agricultural and landscape irrigation uses. Current **diversified agriculture** water demands were calculated from an estimate of both surface water and ground water use based on available records. In some cases, water use for 2000 was not available, so the most recent water use records were used. It should be noted that water use records are incomplete and in some cases, no water use data were available for surface water sources. Water use was then estimated based on acres served and type of use (i.e. diversified agriculture or *kalo*).

For the Low-Growth Scenario, the total increase in acres of diversified agriculture for Koʻolau Poko was equal to a one percent increase in agricultural acreage every year through the year 2030 (Table E-5). The acres of diversified agriculture was then multiplied by a per acre water use factor to determine the projected future water demand.

Diversified agriculture water demand was calculated separately for each neighborhood board area due to the differences in rainfall and agricultural production throughout the district. Two water use factors were calculated to reflect the relatively wet conditions in Kahaluʻu and Kāneʻohe and the relatively dry conditions in Kailua and Waimānalo (Table E-6). Both estimates of per acre water demand are conservative. The wet area estimate of 2,500 gad was on the high end of the demand range in previous studies and the dry area estimate of 3,400 gad was derived from a study done in an area that generally receives less rainfall than Kailua and Waimānalo.

TABLE E- 5 INCREASE IN ACRES OF DIVERSIFIED AGRICULTURE IN KOʻOLAU POKO (LOW-GROWTH SCENARIO)

ACRES[1]	2000[2]	2010	2015	2020	2025	2030
Kahaluʻu	320	336	352	368	384	400
Kāneʻohe	82	86	90	94	98	103
Kailua	92	97	101	106	110	115
Waimānalo	1,100	1,155	1,210	1,265	1,320	1,375
KOʻOLAU POKO	**1,594**	**1,674**	**1,753**	**1,833**	**1,913**	**1,992**

1 A one percent increase in the number of acres of diversified agriculture in the base year was calculated for each neighborhood board area. This one percent was added to each year through the year 2030.

2 Existing (2000) acres of diversified agriculture was determined through analysis of aerial photos taken in 2005 and by a 2009 field verification of a sample of cultivated areas identified in the photo analysis. It was assumed that the number of acres in 2005 was the same as in the base year of 2000.

TABLE E- 6 WET VS. DRY AREA WATER USE FACTORS FOR DIVERSIFIED AGRICULTURE

	Water Use Factor (gad)
WET AREAS[1] **Kahaluʻu and Kāneʻohe**	2,500
DRY AREAS[2] **Kailua and Waimānalo**	3,400

1 Wet area water demand factor is from the *Punaluʻu Agricultural Water System Assessment* (R.M Towill Corporation, 2007). Rainfall for Kahaluʻu and Kāneʻohe fell within the average rainfall range for Punaluʻu. Irrigation demand for orchard (banana) crops in June (month with the highest demand) ranged between 1,493 gad and 4,083 gad. The average demand is 2,788 gad. However, irrigation was only needed for five months out of the year. When irrigation demands were averaged over the entire year, water demand was 1,578 gad. Therefore, the water demand estimate of 2,500 gad was considered conservative.

2 Dry area water demand factor is from the Agricultural Water Use and Development Plan (2004), which was calculated using observations from the Lalamilo Field Station. Average rainfall in Lalamilo is lower than in Kailua or Waimānalo, making the water use factor conservative.

Water demand for diversified agriculture was calculated by multiplying the projected agricultural acreage for each five-year increment by the appropriate water demand factor.

wet area water demand = current demand + (additional acres X 2,500 gad)

or

dry area water demand = current demand + (additional acres X 3,400 gad)

Total Koʻolau Poko diversified agriculture water demand was derived by adding the water demand from each of the neighborhood board areas.

TABLE E- 7 WATER DEMAND FOR DIVERSIFIED AGRICULTURE IN KO‘OLAU POKO UNDER THE LOW-GROWTH SCENARIO

	2000	2010	2015	2020	2025	2030
KAHALU‘U						
Acres of diversified agriculture	320	336	352	368	384	400
Water demand (mgd)[1]	0.379	0.419	0.459	0.499	0.539	0.579
KĀNE‘OHE						
Acres of diversified agriculture	82	86	90	94	98	103
Water demand (mgd)[2]	0.005	0.006	0.025	0.006	0.006	0.006
KAILUA						
Acres of diversified agriculture	92	97	101	106	110	115
Water demand (mgd)[3]	0.009	0.024	0.040	0.056	0.071	0.087
WAIMĀNALO						
Acres of diversified agriculture[4]	1,100	1,155	1,210	1,265	1,320	1,375
Water demand (mgd)[5]	3.740	3.694	3.728	3.755	4.488	4.675
KO‘OLAU POKO TOTAL						
Water demand (mgd)	**4.133**	**4.144**	**4.253**	**4.316**	**5.105**	**5.347**

1 Total water demand for each neighborhood board area is calculated by adding the water required to irrigate the increase in diversified agriculture acreage over the base year (2000) to the base year demand. Therefore, the 2030 water demand for Kahalu‘u is calculated as: (base year water demand) + (80 additional acres of agriculture X 2,500 gad) = 0.2 mgd + 0.379 mgd = 0.579 mgd. Water use factor of 2,500 gad was used because Kahalu‘u is a wet area.

2 There is no diversified water demand in Kāne‘ohe through 2020 because the entire acreage is banana patch with no known wells or stream diversions servicing it. It is therefore assumed that the banana is entirely rain-irrigated. Additional demand in 2025 and 2030 is attributed to additional acreage of diversified agriculture that would need irrigation. Water use factor of 2,500 gad was used because Kāne‘ohe is a wet area.

3 There is no diversified water demand in Kailua through 2015 because the entire acreage is banana patch with no known wells or stream diversions servicing it. It is therefore assumed that the banana is entirely rain-irrigated. Additional demand from 2020 through 2030 is attributed to additional acreage of diversified agriculture that would need irrigation. Water use factor of 3,400 gad was used because Kailua is a dry area.

4 The large increase in acres of diversified agriculture in Waimānalo is a factor of the methodology applied. Private agricultural acreage is calculated by subtracting the BWS and State-served acres of diversified agriculture from the total acres of diversified agriculture. The BWS-served acreage of diversified agriculture was estimated by dividing the projected agricultural demand by the water use factor (3,400 gad in Waimānalo). Because BWS agricultural water demand was based (indirectly) on population served, it decreased in the initial years, therefore requiring private agriculture to absorb the entire increase in diversified agricultural acreage.

5 Water use factor of 3,400 gad was used because Waimānalo is a dry area.

Water demand for **wetland *kalo* farming** was calculated separately because it requires substantially more water than diversified agriculture. *Loʻi kalo* are served by surface and spring water, and all but one in Koʻolau Poko are served by private sources. The *loʻi* at the Hawaiʻi State Hospital is described above in Section E.1.2.

Previous studies on the amount of water needed to support healthy *kalo* fields document a wide range of inflow volumes.[1] These studies, as well as discussions with several *kalo* farmers, indicate that a general range of 100,000 to 300,000 gad of inflow is needed. Some of the factors that affect *loʻi kalo* water demand include:

- Temperature of the water in the stream at the point of diversion
- Time of year (season)
- Acres of *kalo* in each particular stage of growth: fallow, recently planted, growing, and ready to harvest
- Location and size of other diversions upstream of a particular user

Of these factors, water temperature is one of the most critical. Water temperature is itself affected by several factors, including the volume of water in the stream, the length of the stream, the location along the stream, and riparian vegetation cover.

TABLE E- 8 WATER DEMAND FACTORS USED IN CALCULATING *LOʻI KALO* WATER DEMAND

	Water Demand Factor in gallons per acre per day (gad)	Source
Low Estimate	100,000	Available *kalo* water use studies: State Office of Planning (1995) Preliminary Assessment of Potential Water Demand for Economic and Instream Uses in the Waiāhole-Kualoa Region. Recognized a range of 100,000 – 300,000 gad, and used a flow-through water rate requirement of 172,000 gad.
High Estimate	300,000	USGS (2007) *Report on Water Use in Wetland* Kalo *Cultivation in Hawaiʻi*. Average inflow for 17 windward sites was 270,000 gad Consultation with windward Oʻahu *kalo* farmers typically results in estimates ranging between 100,000 and 300,000 gad

[1] Available *kalo* water use studies include the USGS 2007 "Report on Water Use in Wetland *Kalo* Cultivation in Hawaiʻi"; Office of Planning 1995 "Preliminary Assessment of Potential Water Demand for Economic and Instream Uses in the Waiāhole-Kualoa Region," the "Agricultural Water Use and Development Plan" produced by the State DOA, Penn, D.C. 1997 dissertation on "Water and Energy Flows in Hawaii Taro Pondfields," Watson, L. J. 1964 "Observations made with respect to irrigation and growth of taro at certain patches at Waiāhole and Kahaluu, and Miles, K. 1931 "Report on study of water requirements of taro in Hanapēpē Valley, cooperative study by the Territory of Hawaiʻi and McBryde Sugar Company: ʻEleʻele, Hawaiʻi.

The Ko'olau Poko Watershed Management Plan recognizes the range of 100,000 gad to 300,000 gad is needed for *kalo* cultivation. However, for simplicity, it used 100,000 gad as the water demand factor for to use for planning purposes in estimating future water demands for Ko'olau Poko. While a flow of 300,000 gad is ideal for ensuring healthy *kalo*, several factors, including appropriate water management, could reduce the needed water flow to 100,000 gad.

Kalo water demand factors were then multiplied by the projected increase in acres of *lo'i* to get water demand for the given year.

wetland *kalo* water demand = acres of *lo'i kalo* X 100,000 gad

Expansion of *lo'i kalo* was based on various assumptions for a low-, mid-, and high-growth scenarios. The low-demand scenario projected that the number of acres of *lo'i kalo* would increase by 1% every year over the base year.

The acreage of privately-served *lo'i* was derived by subtracting state-served acreage from the total acreage of *lo'i kalo* projected for any given year. Since the state has no plans to expand its *lo'i*, all changes in taro acreage were assumed to be served by private sources.

TABLE E- 9 INCREASE IN ACRES OF *LOʻI KALO* IN KOʻOLAU POKO (LOW-GROWTH SCENARIO)

Acres of *loʻi kalo*	2000	2010	2015	2020	2025	2030
Kahaluʻu	47.11	49.47	51.82	54.18	56.53	59.89
Kāneʻohe[1]	0.96	1.01	1.06	1.10	1.15	1.20
Kailua	0.08	0.08	0.08	0.09	0.09	0.09
Waimānalo[2]	0	0	0	0	0	0
KOʻOLAU POKO TOTAL						
Acres of *loʻi kalo* served by private systems	**48.82**	**51.26**	**53.70**	**56.14**	**58.58**	**61.03**

1 Acres of *loʻi kalo* served by private sources = (total acres of *loʻi*) – (state-served acres of *loʻi*). The Hawaiʻi State Hospital *loʻi* is located in Kāneʻohe and is therefore only subtracted out of the acreage in the Kāneʻohe neighborhood board area. State-served acres = 0.76 acres.

2 Although there is a projected increase in agricultural jobs in Waimānalo, no *loʻi* were anticipated because no plans for wetland taro cultivation were identified through discussion with the community.

TABLE E- 10 WATER DEMAND FOR *LOʻI KALO* SERVED BY PRIVATE WATER SYSTEMS IN KOʻOLAU POKO (LOW-GROWTH SCENARIO)

	2005	2010	2015	2020	2025	2030
Acres of *loʻi kalo* served by private water systems	48.82	51.26	53.70	56.14	58.58	61.03
Water demand factor (gad)	100,000	100,000	100,000	100,000	100,000	100,000
Water demand (mgd)[1]	4.864	5.108	5.352	5.596	5.840	6.085

1 *Loʻi kalo* water demand was calculated by multiplying the projected acres of *loʻi kalo* by the water demand factor of 100,000 gad.

There is one **aquaculture** operation in Ko'olau Poko, and it is fed by a private water source. No records for water use were available, so a per acre water use demand factor of 145,000 gad, from the State's *Agricultural Water Use and Development Plan* (2004) was used to estimate demand.

Aquaculture water demand = acres X 145,000 gad

TABLE E- 11 WATER DEMAND FOR AQUACULTURE SERVED BY PRIVATE WATER SYSTEMS IN KO'OLAU POKO (LOW-GROWTH SCENARIO)

	2005	2010	2015	2020	2025	2030
Acres of aquaculture served[1]	4.14	4.14	4.14	4.14	4.14	4.14
Water demand factor (gad)	145,000	145,000	145,000	145,000	145,000	145,000
Water demand (mgd)	0.600	0.600	0.600	0.600	0.600	0.600

1 Acres of aquaculture in Ko'olau Poko were determined by analysis of 2005 aerial photos available from the Office of Planning.

Private water sources serve Ko'olau Golf Club, Luana Hills Golf Course, and Valley of the Temples Cemetery. **Landscape irrigation** water demand was expected to remain constant through the planning horizon, because none of these properties has any plans for expansion or major improvement in the near future.

TABLE E- 12 KO'OLAU POKO WATER DEMAND, LOW-GROWTH SCENARIO

LOW-GROWTH SCENARIO	Base Year	Projected				
DEMAND (all units in mgd)	**2000**	**2010**	**2015**	**2020**	**2025**	**2030**
BWS System	**20.339**	**19.665**	**19.972**	**19.966**	**19.767**	**19.535**
Potable Demand (ground water)	18.008	17.632	17.914	17.909	17.726	17.512
Non-Potable Demand (div. ag + landscape irr) served by potable water (ground water)	1.831	1.533	1.558	1.557	1.541	1.523
Potable export to E. Honolulu (ground water)	0.500	0.500	0.500	0.500	0.500	0.500
State Systems	**0.657**	**0.657**	**0.657**	**0.657**	**1.854**	**2.035**
Potable demand: WVWS (ground water)	0.052	0.063	0.063	0.063	0.063	0.063
Non-Potable Demand: WVWS(ground water)	0.087	0.076	0.076	0.076	0.076	0.076
Diversified Ag Demand: WIS (surface water)	0.400	0.400	0.400	0.400	0.400	0.400
Diversified Ag Demand: DOA & ENV	0.000	0.000	0.000	0.000	1.197	1.378
Kalo Demand: State Hospital (surface water)	0.076	0.076	0.076	0.076	0.076	0.076
Golf Course	0.000	0.000	0.000	0.000	0.000	0.000
Landscape Irr: HI State Veteran's Cem (ground water)	0.042	0.042	0.042	0.042	0.042	0.042
Federal Systems	**0.550**	**0.550**	**0.550**	**0.550**	**0.550**	**0.550**
Golf Course: Klipper (recycled water)	0.550	0.550	0.550	0.550	0.550	0.550
Landscape irrigation	0.000	0.000	0.000	0.000	0.000	0.000
Private Systems	**8.448**	**8.952**	**9.271**	**9.584**	**9.903**	**10.226**
Diversified Ag Demand (ground & surface water)	2.746	3.006	3.081	3.151	3.226	3.304
Kalo Demand (surface water)	4.806	5.050	5.294	5.538	5.782	6.027
Aquaculture (surface water)	0.600	0.600	0.600	0.600	0.600	0.600
Golf Courses: Ko'olau & Luana Hills	0.290	0.290	0.290	0.290	0.290	0.290
Landscape Irr: Valley of the Temples (ground water)	0.005	0.005	0.005	0.005	0.005	0.005
TOTAL DEMAND	**29.994**	**29.824**	**30.450**	**30.757**	**32.074**	**32.346**

E.2 HIGH-GROWTH SCENARIO

The high-growth scenario is based on the City's General Plan (2006) goal that Ko'olau Poko will account for 11.6% of O'ahu's population by the year 2025 (Table E-1). The increase in population was then distributed evenly amongst the five-year increments leading up to 2025. Ko'olau Poko's percentage of the total O'ahu-wide population was kept at 11.6% for the year 2030.

E.2.1 High-Growth Scenario: Honolulu Board of Water Supply System

Demand for the BWS system under the high-growth scenario was calculated using the *per capita* method described above. Potable and non-potable water demand was calculated using the same methodology as was described under the low-growth scenario: non-potable water demand accounts for 9% of total BWS water demand. As in the low-growth and mid-growth scenarios, the amount of **water exported** to East Honolulu remains constant at 0.5 mgd.

BWS non-potable demand for **diversified agriculture and landscape irrigation** was calculated using the same methodology as was used under the low-demand scenario, where 9% of the total BWS water demand calculated using the *per capita* method was attributed to non-potable uses.

TABLE E- 13 KO'OLAU POKO BWS-SERVED POPULATION PROJECTION FOR THE HIGH-GROWTH SCENARIO

	2005	2010	2015	2020	2025	2030
RESIDENT POPULATION						
Ko'olau Poko	117,475	116,950	116,426	115,902	115,377	118,039
O'ahu	899,695	911,841	941,847	969,467	994,632	1,017,576
Ko'olau Poko % of O'ahu	13.1%	12.8%	12.4%	12.0%	11.6%	11.6%
RESIDENTS ABSENT						
Ko'olau Poko	4,804	4,932	4,967	5,004	5,045	5,236
O'ahu	36,795	38,455	40,184	41,853	43,495	45,136
VISITOR UNITS						
Ko'olau Poko	60	68	62	60	62	70
O'ahu	34,622	38,592	44,559	45,234	45,231	47,798
Ko'olau Poko % of O'ahu	0.17%	0.18%	0.14%	0.13%	0.14%	0.15%
VISITORS PRESENT						
Ko'olau Poko	154	172	148	151	167	191
O'ahu	88,832	97,394	106,722	114,101	121,987	130,414
Ko'olau Poko % of O'ahu	0.17%	0.18%	0.14%	0.13%	0.14%	0.15%
DE FACTO POPULATION						
Ko'olau Poko	112,825	112,190	111,607	111,049	110,499	112,994
O'ahu	964,950	1,011,600	1,062,100	1,109,500	1,156,550	1,202,600
Ko'olau Poko % of O'ahu	11.69%	11.09%	10.51%	10.01%	9.55%	9.40%
State-Served Population						
Ko'olau Poko	300	365	365	365	365	365
BWS-SERVED POPULATION						
Ko'olau Poko	112,525	111,825	111,242	110,684	110,134	112,629

1 Population numbers for the high-demand scenario are based on the assumption that Ko'olau Poko will account for 11.6% of O'ahu's population by the year 2025 and maintain that percentage through 2030.
2 Total residents absent for Honolulu County from DBEDT. Ko'olau Poko's percentage of Honolulu County population equals percentage of those residents absent from Honolulu County.
3 Total visitors present for Honolulu County from DBEDT. Ko'olau Poko percentage of Honolulu County visitor units equals percentage of those visitors present in Honolulu County.
4 De Facto Population = Resident Population – Resident Absent + Visitors Present.

E.2.2 High-Growth Scenario: State Water Systems

Potable demand from the State Waiāhole Valley Water System was expected to remain the same as under the low-growth scenario. Additionally, demand for non-potable water for diversified agriculture from the WVWS and Waimānalo Irrigation System, for *kalo* at the State Hospital, and for landscape irrigation at the Hawai'i Veteran's Cemetery was expected to remain the same as under the low-growth scenario.

E.2.3 High-Growth Scenario: Federal Water Systems

Demand for landscape irrigation at the Klipper Golf Course remained constant under each of the three growth scenarios.

E.2.4 High-Growth Scenario: Private Water Systems

Private water systems serve diversified agriculture, wetland *kalo*, and landscape irrigation demands. To determine the water demand for diversified agriculture, an analysis of Agricultural Lands of Importance to the State of Hawai'i (ALISH) was conducted to identify the acres of land in Ko'olau Poko with an ALISH designation of "Prime," "Unique," or "Other." Currently cultivated and/or developed land was subtracted from the lands with ALISH designation, to determine the acres of land that could potentially be put into agricultural production in the future. The high-growth scenario assumed that all of the potentially developable ALISH agricultural land would be in production by the year 2030. The increase in agricultural acreage was then distributed evenly amongst each five year increment between 2005 and 2030 (Table E-13).

TABLE E- 14 UNDEVELOPED ALISH LANDS IN KO‘OLAU POKO

	ALISH-Designated Land in Ko‘olau Poko (acres)		Acres of Land that could potentially be put into Diversified Agriculture		
	Designated (acres)[1]	Excluded from Future Cultivation (acres)[2]	High-Growth Scenario[3]	Acres potentially served by BWS or State Water Systems	Acres to be served by Private Water Systems
Kahalu‘u	3,232	2,709.0	523.0	6.20	516.81
Kāne‘ohe	1,248	1,159.0	89.0	4.82	84.19
Kailua	2,021	1,765.4	255.6	2.47	253.13
Waimānalo	2,167	1,875.0	292.0	-40.30	332.30[4]
TOTAL	**8,688**	**7,508.4**	**1,159.6**	**-26.81**	**1,186.43**

1 ALISH lands were identified using GIS data obtained from the State Department of Business, Economic Development and Tourism (DBEDT): “Agricultural Lands of Importance to the State of Hawaii,” based on data from the State Department of Agriculture, November 1977.

2 ALISH lands that can not be cultivated in the future included those that are either already developed, currently in cultivation, or are either zoned as City Preservation or are designated as State and Use Conservation. The acres of ALISH lands currently in cultivation was estimated through analysis of air photos obtained from DBEDT and taken in 2005. A sample of the cultivated lands was ground-checked in 2009.

3 For the high-growth scenario, the acres of land that could potentially be put into cultivation (acres of currently uncultivated and undeveloped ALISH-designated lands) was determined to be the total acres of ALISH-designated lands in Ko‘olau Poko minus those lands that are either already in cultivation or are currently developed.

4 The acres of diversified agriculture served in Waimānalo is greater than the total estimated acres that could be put into cultivation because the acres of diversified agriculture served by BWS systems decreased and was replaced by agriculture served by private systems.

There are approximately 1,159.6 acres of uncultivated ALISH lands in Ko‘olau Poko that could potentially be put into production under the high-growth scenario. The number of acres of diversified agriculture that would be served by BWS water systems is expected to decrease. Therefore, private water systems are expected to serve both an increase in diversified agricultural acreage, as well as a greater portion of the existing diversified agriculture served by BWS. This increase in acres of diversified agriculture would be added to the acres currently under cultivation to determine total future water demand for diversified agriculture.

TABLE E- 15 WATER DEMAND FOR DIVERSIFIED AGRICULTURE SERVED BY PRIVATE WATER SYSTEMS IN KOʻOLAU POKO UNDER THE HIGH-GROWTH SCENARIO

	2005	2010	2015	2020	2025	2030
KAHALUʻU						
Acres of diversified agriculture	50.2	130.0	233.2	336.8	441.5	543.9
Water demand[1]	0.125	0.325	0.583	0.842	1.104	1.360
KĀNEʻOHE						
Acres of diversified agriculture	76.00	76.00	76.00	128.8	146.6	164.4
Water demand[2]	0.000	0.000	0.000	0.132	0.177	0.221
KAILUA						
Acres of diversified agriculture	82.0	133.3	184.5	235.6	286.8	337.8
Water demand[3]	0.000	0.174	0.348	0.522	0.696	0.870
WAIMĀNALO						
Acres of diversified agriculture	790.3	898.3	1,005.1	1,005.1	1,005.1	1,005.1
Water demand[4]	2.687	3.054	3.233	3.417	3.417	3.417
KOʻOLAU POKO TOTAL						
Water demand	**2.812**	**3.553**	**4.174**	**4.913**	**5.394**	**5.868**

1 Total water demand for each neighborhood board area is calculated by adding the water required to irrigate the increase in diversified agriculture acreage over the base year (2005) to the base year demand. Therefore, the 2030 water demand for Kahaluʻu is calculated as: (base year water demand) + (493.7 additional acres of agriculture X 2,500 gad) = 0.125 mgd + 1.234 mgd = 1.360 mgd. Water use factor of 2,500 gad was used because Kahaluʻu is a wet area.

2 There is no diversified water demand in Kāneʻohe through 2020 because the entire acreage is banana patch with no known wells or stream diversions servicing it. It is therefore assumed that the banana is entirely rain-irrigated. Additional demand in 2025 and 2030 is attributed to additional acreage of diversified agriculture that would need irrigation. Water use factor of 2,500 gad was used because Kāneʻohe is a wet area.

3 There is no diversified water demand in Kailua in 2005 because the entire acreage is banana patch with no known wells or stream diversions servicing it. It is therefore assumed that the banana is entirely rain-irrigated. Water use factor of 3,400 gad was used because Kailua is a dry area.

4 Water use factor of 3,400 gad was used because Waimānalo is a dry area.

Lo'i kalo expansion in the high-growth scenario was based on a GIS-modeling study conducted by The Nature Conservancy (TNC) in 2009 on opportunities and constraints for intensive wetland *kalo* and sweet potato cultivation in Hawai'i before western contact. The study incorporated several physical parameters including water source, elevation, slope, riparian corridors, and soils, and identified 5,004 acres of land that would be suitable for wetland *kalo* cultivation in Ko'olau Poko. Most of these lands are already developed or are in cultivation, leaving approximately 1,070 acres potentially available for future *kalo* cultivation. The 1,070 acres include approximately 250 acres in the He'eia Wetlands and 600 acres in Kawainui Marsh. This land would be added to the existing acres under cultivation to determine total future water demand for wetland *kalo*.

TABLE E- 16 POTENTIAL LANDS AVAILABLE FOR ADDITIONAL WETLAND TARO CULTIVATION IN KO'OLAU POKO UNDER THE HIGH-GROWTH SCENARIO

	Acres of Land "Suitable" for Wetland Taro Cultivation[1]	Excluded from Future Cultivation[2] (acres)	Acres of Land Potentially Available for Additional Wetland Taro Cultivation
Kahalu'u	1,505	1,366	139
Kāne'ohe	1,355	1,086	269
Kailua	1,037	383	654
Waimānalo	1,107	1,099	8
TOTAL	**5,004**	**3,934**	**1,070**

1 Lands suitable for wetland taro cultivation were identified from a GIS-modeling study conducted by The Nature Conservancy in 2009. The study identified lands with characteristics suitable for wetland *kalo* cultivation prior to western contact.

2 Land excluded from future *kalo* cultivation included areas that are already developed, in cultivation, or are designated as City or State parks. Currently cultivated and developed lands were identified through analysis of aerial photos dated 2005 from DBEDT. Photo analysis was ground checked with site visits to a sample of the sites in 2009.

The high-growth scenario assumed that all of the currently undeveloped lands identified as being previously cultivated for wetland *kalo* would be returned to *kalo* cultivation by the year 2030. However, it was determined that there may not be enough surface water flow in the streams to support 100% of the acreage. Therefore, the increase in wetland *kalo* acreage and water demand **was restricted by available stream flow**, where appropriate.

Available stream flow was determined to be 50% of the base stream flow. Base stream flow was determined to be the Q70, or the volume of daily mean stream flow present 70 percent of the time. There were seven streams for which there was not enough stream gage data to be able to calculate the base stream flow. The base stream flows for these streams were estimated using watershed size and base flows for adjacent streams (see Table E-17).

TABLE E- 17 CALCULATIONS FOR ESTIMATING BASE STREAM FLOW FOR STREAMS WITH INSUFFICIENT DATA

Ungaged Stream		Adjacent Stream				Ungaged Stream
Name	Watershed Size	Name	Watershed Size	USGS-Calculated Base Flow (cfs)[1]	USGS-Calculated Base Flow (mgd)	Estimated Base Flow based on Watershed Size
Waiāhole	2,526	Waikāne (Waikāne)	1,695	3.0	1.9	2.9
Kaalaea	1,126	Waikāne (Waikāne)	1,695	3.0	1.9	1.3
Haiamoa	409	Waiheʻe (Waiheʻe)	1,543	4.7	3.0	0.8
ʻĀhuimanu	1,449	Kahaluʻu (Kahaluʻu)	1,285	1.4	0.9	1.0
Keaʻahala	743	Kamooalii (Kaneohe)	3,641	7.9	5.1	1.0
Kāwā	1.336	Kamooalii (Kaneohe)	3.641	7.9	5.1	1.9
Kaʻelepulu	3,466	Maunawili (Kawai Nui)	9,404	5.6	3.6	1.3

1 Data calculated by USGS for CWRM.

Known stream diversion volumes were subtracted from the available stream flow calculation. Flow for diversions without gaging records were estimated based on type of crop (diversified agriculture or wetland *kalo*) and acres served. Those streams that were not gaged or already had at least 50% of their base stream flows already diverted were excluded from the calculation to determine potentially available stream flow.

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TABLE E- 18 KO'OLAU POKO STREAM FLOW AND SURFACE WATER DEMAND

			Existing Agricultural Acreage (2005)			Estimated Agricultural Water Use (2005) in gad								
Watershed	**Stream**	**Base Stream Flow (mgd)[1]**	**Div. Ag**	**Kalo**	**Aqua-culture**	**Div. Ag[2]**	**Kalo - 100,000 gad**	**Aqua-culture**	**Div. Ag.+Kalo (100,000 gad)+Aquaculture**	**Half of Base Stream Flow (mgd)**	**Estimated Amount of Stream Water Available for Additional Agricultural Use (mgd)[3]**	**Land that Could Potentially be Converted to Kalo (acres)[4]**	**Additional Kalo Acres that could be served by available stream flow[5] (Using water demand factor of 100,000 gad)**	**Estimated Additional Kalo (acres)[6] (Using water demand factor of 100,000 gad)**
Kahalu'u Neighborhood Board Area														
Kualoa	No stream	N/A	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	no stream	0.0
Hakipu'u	Hakipu'u	0.41	39.2	7.0	0.0	0.10	0.70	0.00	0.80	0.21	0.00	20.00	Not enough water	0.0
Waikāne	Waikāne	1.94	33.6	0.0	0.0	0.08	0.00	0.00	0.08	0.97	0.89	35.00	8.9	8.9
Waiāhole	Waiāhole*	2.89	69.0	10.0	0.0	0.17	1.00	0.00	1.17	1.44	0.27	22.00	2.7	2.7
Ka'alaea	Ka'alaea*	1.29	68.8	14.2	4.1	0.17	1.42	0.60	2.19	0.64	0.00	4.50	Not enough water	0.0
Haiamoa	Haiamoa*	0.81	37.6	0.0	0.0	0.09	0.00	0.00	0.09	0.40	0.31	25.00	3.1	3.1
Waihe'e	Waihe'e	3.04	48.0	15.9	0.0	0.12	1.59	0.00	1.71	1.52	0.00	29.00	Not enough water	0.0
Kahalu'u	Kahalu'u	0.90	23.5	0.0	0.0	0.06	0.00	0.00	0.06	0.45	0.39	3.50	3.9	3.5
'Āhuimanu	'Āhuimanu*	2.22	0.3	0.0	0.0	0.00	0.00	0.00	0.00	1.11	1.11	0.00	11.1	0.0
TOTAL		**13.49**	**320.0**	**47.1**	**4.1**	**0.80**	**4.71**	**0.60**	**6.11**	**6.75**	**2.97**	**139.00**	**29.7**	**18.2**
Kaneohe Neighborhood Board Area														
Heeia[7]	He'eia ('Ioleka'a + Ha'ikū)	1.16	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.58	0.58	258.0	200.0	150.0
Kea'ahala	Kea'ahala*	1.04	0.0	0.8	0.0	0.76	0.08	0.00	0.84	0.52	0.00	0.0	0.0	0.0
Kaneohe	Kamo'oali'i	5.11	76.0	0.2	0.0	0.20	0.02	0.00	0.22	2.55	2.33	11.0	23.3	11.0
Kāwā	Kāwā*	1.87	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.94	0.94	0.0	9.4	0.0
TOTAL		**9.18**	**76.0**	**1.0**	**0.0**	**0.96**	**0.10**	**0.00**	**1.06**	**4.59**	**3.85**	**269.0**	**232.7**	**161.0**
Kailua Neighborhood Board Area														
Pu'u Hawaiiloa	No stream	N/A	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.0	no stream	0.0
Kawainui	Maunawili	3.62	92.0	0.8	0.0	0.01	0.08	0.00	0.08	1.81	1.73	654.0	17.3	17.3
Ka'elepulu	Ka'elepulu*	1.33	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.67	0.67	0.0	6.7	0.0
TOTAL		**4.95**	**92.0**	**0.8**	**0.0**	**0.01**	**0.08**	**0.00**	**0.08**	**2.48**	**2.39**	**654.0**	**23.9**	**17.3**
Waimānalo Neighborhood Board Area														
Waimanalo	Waimanalo	0.65		0.0	0.0	0.00	0.00	0.00	0.00	0.32	0.32	8.0	3.2	3.2
	Waimanalo Irr. System[8]	0.40	1,100.0	0.0	0.0	0.40	0.00	0.00	0.40	0.20	0.00	0.0	Not enough water	0.0
Kahawai	No stream	N/A		0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.0	no stream	0.0
Makapu'u	No stream	N/A	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.0	no stream	0.0
TOTAL		**1.05**	**1,100.0**	**0.0**	**0.0**	**0.40**	**0.00**	**0.00**	**0.40**	**0.52**	**0.32**	**8.0**	**3.2**	**3.2**
DISTRICT TOTAL		**28.68**	**1,588.0**	**48.8**	**4.1**	**2.17**	**4.88**	**0.60**	**7.65**	**14.34**	**9.53**	**1,070.0**	**289.5**	**199.7**

Notes for Table E-18 Ko'olau Poko Stream Flow and Surface Water Demand

1 Base Stream Flow is approximated at the 70th percentile of daily mean stream flow (Q70).

2 Additional diversified agriculture is assumed to be served by ground water sources. Therefore, there is no change in the acreage of diversified agriculture from current. Diversified agriculture water demand for Kahalu'u and Kāne'ohe calculated using 2,500 gad; water demand for Kailua and Waimanalo calculated using 3,400 gad

3 Hakipu'u, Kaneohe, Maunawili, and Waimanalo Streams have gages downstream of the diversions so estimated amount of stream water available for additional agriculture is half of base stream flow (existing use does not need to be subtracted). Estimated agriculture water use in 2005 assumes 100,000 gad water demand for *kalo*. Where diversion amount already exceeds stream flow, estimated amount of stream water available for additional agriculture use equaled zero.

4 "Land that Could Potentially be Converted to Kalo" was derived from the TNC study of historic *kalo* lands. Lands that are currently developed or in the State Conservation District were subtracted out.

5 Additional *kalo* acreage = Additional *kalo* acreage that could potentially be served with the "Estimated Amount of Stream Water Available for Additional Agricultural Use." This does not take into account available land.

6 Acres that could be converted to *kalo*, considering "Land that Could Potentially be Converted to Kalo" and "Stream Water Available for Additional Agricultural Use" as limiting factors.

7 He'eia Watershed has known ground water inputs and can therefore support more taro than would be indicated using the methodology in this table. The He'eia wetlands (Hoi) were known to have approximately 200 acres of *kalo* and rice, as documented in a 1928 aerial photo. Additionally, the stream gages are high in the watershed, and do not account for gaining flows downstream. Flow in one of at least three known 'auwai was measured at 2.2 mgd at the diversion, and 7.1 mgd (May 2010), approximately 3,000 feet downstream. The estimated additional *kalo* acres (150 acres) are based on the number of acres that the ongoing *kalo* project is hoping to restore. This acreage is still less than the acres of *kalo* that were known to have previously been under production (200 acres).

8 Agricultural Water Use and Development Plan (2004) indicates that average WIS water use is 0.4 mgd

* Streams are ungaged. Base flow was estimated assuming that it was proportional to the watershed size and base flow of adjacent streams within the same neighborhood board area.

TABLE E- 19 WATER DEMAND FOR *LO'I KALO* SERVED BY PRIVATE WATER SYSTEMS IN KO'OLAU POKO (HIGH-DEMAND SCENARIO)[1]

	2005[2]	2010	2015[3]	2020	2025	2030
Kahalu'u	4.711	7.491	7.681	7.681	7.681	7.681
Kāne'ohe	0.002	3.223	3.852	3.852	3.852	3.852
Kailua	0.075	2.465	2.465	2.465	2.465	2.465
Waimānalo	0.000	0.160	0.320	0.320	0.320	0.320
KO'OLAU POKO	**4.788**	**13.339**	**14.318**	**14.318**	**14.318**	**14.318**

1 Water demand was calculated using the demand factor of 100,000 gad.

2 Water demand for 2005 was calculated from estimates of existing acreage and a water demand factor of 100,000 gad.

3 Water demand for future wetland *kalo* is constrained by stream flow available for diversion (Table E.18). Total available water = currently diverted flow + flow available for additional cultivation. In the High-Demand Scenario, all of the streams met their limit of maximum available stream flow by 2015.

Demand for **landscape irrigation** at the Ko'olau Golf Club, Luana Hills Golf Course, and Valley of the Temples Cemetery remained constant under each of the three growth scenarios.

TABLE E- 20 KO'OLAU POKO WATER DEMAND, HIGH-GROWTH SCENARIO

HIGH-GROWTH SCENARIO	Base Year	Projected				
DEMAND (all units in mgd)	**2000**	**2010**	**2015**	**2020**	**2025**	**2030**
BWS System	**20.339**	**20.102**	**20.082**	**19.907**	**19.812**	**20.337**
Potable Demand (ground water)	18.008	18.034	18.016	17.854	17.767	18.250
Non-Potable Demand, served by potable water (ground water)	1.831	1.568	1.567	1.553	1.545	1.587
Potable export to E. Honolulu (ground water)	0.500	0.500	0.500	0.500	0.500	0.500
State Systems	**0.657**	**0.657**	**0.657**	**0.657**	**0.855**	**1.051**
Potable demand: WVWS (ground water)	0.052	0.063	0.063	0.063	0.063	0.063
Non-Potable Demand: WVWS(ground water)	0.087	0.076	0.076	0.076	0.076	0.076
Diversified Ag Demand: WIS (surface water)	0.400	0.400	0.400	0.400	0.400	0.400
Diversified Ag Demand: DOA & ENV	0.000	0.000	0.000	0.000	0.198	0.394
Kalo Demand: State Hospital (surface water)	0.076	0.076	0.076	0.076	0.076	0.076
Golf Course	0.000	0.000	0.000	0.000	0.000	0.000
Landscape Irr: HI State Veteran's Cem (ground water)	0.042	0.042	0.042	0.042	0.042	0.042
Federal Systems	**0.550**	**0.550**	**0.550**	**0.550**	**0.550**	**0.550**
Golf Course: Klipper (recycled water)	0.550	0.550	0.550	0.550	0.550	0.550
Landscape irrigation	0.000	0.000	0.000	0.000	0.000	0.000
Private Systems	**8.448**	**18.311**	**19.917**	**20.678**	**21.158**	**21.633**
Diversified Ag Demand (ground & surface water)	2.746	4.059	4.685	5.446	5.927	6.401
Kalo Demand (surface water)	4.806	13.357	14.336	14.336	14.336	14.336
Aquaculture (surface water)	0.600	0.600	0.600	0.600	0.600	0.600
Golf Courses: Ko'olau & Luana Hills	0.290	0.290	0.290	0.290	0.290	0.290
Landscape Irr: Valley of the Temples (ground water)	0.005	0.005	0.005	0.005	0.005	0.005
TOTAL DEMAND	**29.994**	**39.619**	**41.206**	**41.792**	**42.375**	**43.571**

E.3 MID-GROWTH SCENARIO

The Mid-Growth population scenario was calculated to be half-way between the population projections for the low- and high-growth scenarios (Table E.1). Acreage for diversified agriculture was estimated by assuming that growth in acreages would be half that used in the High-Growth Scenario. Water demand for wetland *kalo* was estimated to be half of the water demand under the High-Growth Scenario.

E.3.1 Mid-Growth Scenario: Honolulu Board of Water Supply System

Demand for the BWS system under the Mid-Growth Scenario was calculated using the *per capita* method described above. Potable and non-potable water demand was calculated using the same methodology as was described under the low-growth scenario: non-potable water demand accounts for 9% of total BWS water demand. As in the low-growth and high-growth scenarios, the amount of water exported to East Honolulu remained constant at 0.5 mgd.

BWS non-potable demand for **diversified agriculture and landscape irrigation** was calculated using the same methodology as was used under the low-demand scenario, where 9% of the total BWS water demand calculated using the *per capita* method was attributed to non-potable uses.

TABLE E- 21 KO‘OLAU POKO BWS-SERVED POPULATION PROJECTION FOR THE MID-GROWTH SCENARIO

	2005	2010	2015	2020	2025	2030
RESIDENT POPULATION						
Ko‘olau Poko[1]	117,004	115,580	16,028	116,010	115,176	115,641
O‘ahu	899,695	911,841	941,847	969,467	994,632	1,017,576
Ko‘olau Poko % of O‘ahu	13.0%	12.7%	12.3%	12.0%	11.6%	11.4%
RESIDENTS ABSENT[2]						
Ko‘olau Poko	4,785	4,874	4,950	5,008	5,037	5,129
O‘ahu	36,795	38,455	40,184	41,853	43,495	45,136
VISITOR UNITS						
Ko‘olau Poko	60	68	62	60	62	70
O‘ahu	34,622	38,592	44,559	45,234	45,231	47,798
Ko‘olau Poko % of O‘ahu	0.17%	0.18%	0.14%	0.13%	0.14%	0.15%
VISITORS PRESENT[3]						
Ko‘olau Poko	154	172	148	151	167	191
O‘ahu	88,832	97,394	106,722	114,101	121,987	130,414
Ko‘olau Poko % Increase						
DE FACTO POPULATION[4]						
Ko‘olau Poko	112,373	110,877	111,227	111,153	110,307	110,702
O‘ahu	964,950	1,011,600	1,062,100	1,109,500	1,156,550	1,202,600
Ko‘olau Poko % of O‘ahu	11.65%	10.96%	10.47%	10.02%	9.54%	9.21%
State-Served Population						
Ko‘olau Poko	300	365	365	365	365	365
BWS-SERVED POPULATION						
Ko‘olau Poko	112,073	110,512	110,862	110,788	109,942	110,337

1 Population numbers in the mid-growth scenario are half the increase in population under the high-growth scenario.
2 Total residents absent for Honolulu County from DBEDT. Ko‘olau Loa's percentage of the Honolulu County population equals percentage of those Ko‘olau Loa residents absent from Honolulu County.
3 Total visitors present for Honolulu County from DBEDT. Ko‘olau Loa 's percentage of Honolulu County visitor units equals percentage of those visitors present in Honolulu County.
4 De Facto Population = Resident Population – Resident Absent + Visitors Present.

E.3.2 Mid-Growth Scenario: State Water Systems

Potable demand from the State Waiāhole Valley Water System was expected to remain the same as under the low-growth and high-growth scenarios. Additionally, demand for non-potable water for diversified agriculture from the WVWS and Waimānalo Irrigation System, for *kalo* at the State Hospital, and for landscape irrigation at the Hawai'i Veteran's Cemetery was expected to remain the same as under both the low-growth and high-growth scenarios.

E.3.3 Mid-Growth Scenario: Federal Water Systems

Demand for landscape irrigation at the Klipper Golf Course remained constant under each of the three growth scenarios.

E.3.4 Mid-Growth Scenario: Private Water Systems

Private system water demand under the Mid-Growth Scenario assumed that half of the expansion expected under the high-growth scenario would occur for diversified agriculture. Water demand for wetland *kalo* was estimated to be half of the water demand under the High-Growth Scenario. Demand for **landscape irrigation** at the Ko'olau Golf Club, Luana Hills Golf Course, and Valley of the Temples Cemetery remained constant under each of the three growth scenarios.

TABLE E- 22 UNDEVELOPED ALISH LANDS IN KO'OLAU POKO

	ALISH-Designated Land in Ko'olau Poko (acres)		Acres of Land that could potentially be put into Diversified Agriculture		
	Designated (acres)[1]	Excluded from Future Cultivation (acres)[2]	Mid-Growth Scenario[3]	Acres potentially served by BWS or State Water Systems	Acres to be served by Private Water Systems
Kahalu'u	3,232	2,709.0	261.5	3.04	258.46
Kāne'ohe	1,248	1,159.0	44.5	4.68	39.88
Kailua	2,021	1,765.4	127.8	4.68	39.82
Waimānalo	2,167	1,875.0	146.0	2.37	125.43
TOTAL	**8,688**	**7,508.4**	**579.8**	**14.77**	**463.59**

1 ALISH lands were identified using GIS data obtained from the State Department of Business, Economic Development and Tourism (DBEDT): "Agricultural Lands of Importance to the State of Hawaii," based on data from the State Department of Agriculture, November 1977.

2 ALISH lands that can not be cultivated in the future included those that are either already developed, currently in cultivation, or are either zoned as City Preservation or are designated as State and Use Conservation. The acres of ALISH lands currently in cultivation was estimated through analysis of air photos obtained from DBEDT and taken in 2005. A sample was ground-checked in 2009.

3 For the Mid-Growth Scenario, the acres of land that could potentially be put into cultivation (acres of currently uncultivated and undeveloped ALISH-designated lands) was determined to be half of the total acres that were identified under the high-growth scenario.

There are 579.8 acres of uncultivated ALISH lands in Ko'olau Poko that could be put into diversified agriculture under the Mid-Growth Scenario.

TABLE E-23 WATER DEMAND FOR DIVERSIFIED AGRICULTURE SERVED BY PRIVATE WATER SYSTEMS IN KO'OLAU POKO UNDER THE MID-GROWTH SCENARIO

	2005	2010	2015	2020	2025	2030
KAHALU'U						
Acres of diversified agriculture	50.2	78.9	129.0	179.8	232.5	284.5
Water demand[1]	0.044	0.116	0.241	0.368	0.500	0.630
KĀNE'OHE						
Acres of diversified agriculture	76.0	76.0	76.0	102.1	111.0	119.9
Water demand[2]	0.000	0.000	0.000	0.065	0.088	0.110
KAILUA						
Acres of diversified agriculture	82.0	107.7	133.3	158.9	184.5	210.0
Water demand[3]	0.000	0.087	0.175	0.262	0.349	0.435
WAIMĀNALO						
Acres of diversified agriculture	790.3	870.8	917.3	917.3	917.3	917.3
Water demand[4]	2.687	2.961	3.037	3.119	3.119	3.119
KO'OLAU POKO TOTAL						
Water demand	**2.731**	**3.164**	**3.453**	**3.814**	**4.056**	**4.294**

1 Total water demand for each neighborhood board area is calculated by adding the water required to irrigate the increase in diversified agriculture acreage over the base year (2005) to the base year demand. Therefore, the 2030 water demand for Kahalu'u is calculated as: (base year water demand) + (234.3 additional acres of agriculture X 2,500 gad) = 0.044 mgd + 0.630 mgd = 0.670 mgd. Water use factor of 2,500 gad was used because Kahalu'u is a wet area.

2 There is no diversified water demand in Kāne'ohe until 2020 because the entire acreage is banana patch with no known wells or stream diversions servicing it. It is therefore assumed that the banana is entirely rain-irrigated. Additional demand from 2020 through 2030 is attributed to additional acreage of diversified agriculture that would need irrigation. Water use factor of 2,500 gad was used because Kāne'ohe is a wet area.

3 There is no diversified water demand in Kailua in 2005 because the entire acreage is banana patch with no known wells or stream diversions servicing it. It is therefore assumed that the banana is entirely rain-irrigated. Additional demand is attributed to additional acreage of diversified agriculture that would need irrigation. Water use factor of 3,400 gad was used because Kailua is a dry area.

4 Water use factor of 3,400 gad was used because Waimānalo is a dry area.

Water demand for *lo'i kalo* in the Mid-Growth Scenario was projected to be half the water demand under the High-Growth Scenario (Table E-23).

TABLE E- 23 WATER DEMAND FOR *LO'I KALO* SERVED BY PRIVATE WATER SYSTEMS IN KO'OLAU POKO (MID-GROWTH SCENARIO)[1]

	2005[2]	2010[3]	2015	2020	2025	2030
Kahalu'u	4.711	5.126	5.541	5.955	6.370	6.785
Kāne'ohe	0.078	5.126	5.541	5.955	6.370	6.785
Kailua	0.075	0.316	0.557	0.798	0.039	1.279
Waimānalo	0.000	0.032	0.064	0.096	0.128	0.160
KO'OLAU POKO	**4.788**	**5.883**	**6.979**	**8.074**	**9.170**	**10.265**

1 Water demand was calculated using the demand factor of 100,000 gad.
2 Water demand for 2005 was calculated from estimates of existing acreage and a water demand factor of 100,000 gad.
3 Water demand for future wetland *kalo* is not constrained by stream flow available for diversion (Table E.18).

TABLE E- 24 KO'OLAU POKO WATER DEMAND, MID-GROWTH SCENARIO

MID-GROWTH SCENARIO	Base Year	Projected				
DEMAND (all units in mgd)	**2000**	**2010**	**2015**	**2020**	**2025**	**2030**
BWS System	**20.339**	**19.872**	**20.016**	**19.925**	**19.778**	**19.936**
Potable Demand (ground water)	18.008	17.822	17.955	17.871	17.736	17.881
Non-Potable Demand, served by potable water (ground water)	1.831	1.550	1.561	1.554	1.542	1.555
Potable export to E. Honolulu (ground water)	0.500	0.500	0.500	0.500	0.500	0.500
State Systems	**0.657**	**0.657**	**0.657**	**0.657**	**0.756**	**0.954**
Potable demand: WVWS (ground water)	0.052	0.063	0.063	0.063	0.063	0.063
Non-Potable Demand: WVWS(ground water)	0.087	0.076	0.076	0.076	0.076	0.076
Diversified Ag Demand: WIS (surface water)	0.400	0.400	0.400	0.400	0.400	0.400
Diversified Ag Demand: DOA & ENV	0.000	0.000	0.000	0.000	0.099	0.297
Kalo Demand: State Hospital (surface water)	0.076	0.076	0.076	0.076	0.076	0.076
Golf Course	0.000	0.000	0.000	0.000	0.000	0.000
Landscape Irr: HI State Veteran's Cem (ground water)	0.042	0.042	0.042	0.042	0.042	0.042
Federal Systems	**0.550**	**0.550**	**0.550**	**0.550**	**0.550**	**0.550**
Golf Course: Klipper (recycled water)	0.550	0.550	0.550	0.550	0.550	0.550
Landscape irrigation	0.000	0.000	0.000	0.000	0.000	0.000
Private Systems	**8.448**	**10.546**	**11.952**	**13.427**	**14.767**	**16.105**
Diversified Ag Demand (ground & surface water)	2.746	3.745	4.053	4.429	4.669	4.909
Kalo Demand (surface water)	4.806	5.905	7.004	8.103	9.202	10.301
Aquaculture (surface water)	0.600	0.600	0.600	0.600	0.600	0.600
Golf Courses: Ko'olau & Luana Hills	0.290	0.290	0.290	0.290	0.290	0.290
Landscape Irr: Valley of the Temples (ground water)	0.005	0.005	0.005	0.005	0.005	0.005
TOTAL DEMAND	**29.994**	**31.625**	**33.175**	**34.559**	**35.851**	**37.546**

APPENDIX F

BWS KO‘OLAU POKO STREAM DIVERSION SURVEY

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F BWS KO‘OLAU POKO STREAM DIVERSION SURVEY

The BWS Hydrology-Geology Section conducted the Ko‘olaupoko Stream Diversion Survey between October 2008 and July 2011 to document the significant amount of surface water use in this district. The survey was conducted in coordination with the Commission on Water Resource Management's Stream Protection and Management Branch.

A total of 133 stream diversions were surveyed between Ka‘a‘awa and Waimānalo. The Waiāhole Ditch system intakes 1 through 19 in the Kahana hydrologic unit were also included. While these intakes are not within the Ko‘olaupoko area, they are integral to the Waiāhole Ditch System. Ka‘a‘awa Valley diversions, as listed in the Department of Land and Natural Resources inventory, were also included although that hydrologic unit is not within the Ko‘olaupoko ahupua‘a.

Discharge measurements were taken utilizing various hydrologic methods. In several reaches, streams, and tributaries, it was not possible to take measurements because of unsuitable site conditions. While considerable staff time was dedicated to this important effort, stream reconnaissance was only pursued in reaches of streams that were likely to have diversions. The existing CWRM inventory of stream diversions was used as a baseline for conducting these surveys. The reporting format, field sheets, stream measurement forms and photo documentation are consistent with recent CWRM sponsored stream surveys conducted on Maui.

The surveyed stream diversions are documented in the following table.

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Koʻolaupoko Stream Diversion Survey, 2008 to 2011 (HBWS)

Diversion Name	Surface Hydrologic Units	TMK	Diversion	[a]Status	Stream	[b]Stream (mgd)	Diversion (mgd)	[b]Acreage	Crop
Fuller W&C	3035	4-1-010:048	---	I	Waimanalo	---	0.00	5.00	---
Fuller W&C	3035	4-1-010:048	---	I	Waimanalo	---	0.00		---
Lee (Green DW)	3035	4-1-025:042	pump	I	Waimanalo	---	0.00	1.00	---
Hashimoto Orchids	3035	4-1-018:015	pump	I	Waimanalo	---	0.00	1.00	diversified ag.
Hongs FF	3035	4-1-025:046	---	I	Waimanalo	---	0.00	2.00	other uses
Kamei ES	3035	4-1-013:003	---	I	Waimanalo	---	0.00	2.00	---
Lum AK	3035	4-1-025:040	gravity	I	Tributary to Waimanalo	---	0.00		kalo
Yamashita WM	3035	4-1-018:013	pump	I	Waimanalo	---	0.00	e0.86	diversified ag.
Yamashita Y	3035	4-1-018:014	pump	I	Waimanalo	---	0.00	e0.71	diversified ag.
Makalii Valley Farmers	3033	4-2-006:001	pump	I	Tributary to Maunawili	---	0.00	46.00	---
Maunawili Farmers Association	3033	4-2-008:001	gravity	I	Tributary to Maunawili	---	0.00	51.00	diversified ag.
St. Stephens Diocesan spring box 1	3033	4-2-010:001	gravity	A	Tributary to Kahanaiki				
St. Stephens Diocesan spring box 2	3033	4-2-010:001	gravity	A	Tributary to Kahanaiki	---	0.009	---	potable supply
St. Stephens Diocesan spring box 3	3033	4-2-010:001	gravity	A	Tributary to Kahanaiki				
Maunawili Ditch System Source 1	3033	4-2-010:001	gravity	A	Tributary to Maunawili	0.92	0.92		diversified ag.
Maunawili Ditch System Source 3	3033	4-2-010:001	gravity	A	Maunawili	0.29	0.29		diversified ag.
Maunawili Ditch System Source 10	3033	4-2-010:001	gravity	A	Ainoni	0.15	0.14	[c]750	diversified ag.
Maunawili Ditch System Source 16	3033	4-2-010:001	gravity	A	Tributary to Makawao	---	0.22		diversified ag.
Maunawili Ditch System Source 17	3033	4-2-010:001	gravity	I	Makawao	0.15	0.00		diversified ag.
Lew A	3033	4-2-012:001	pump	I	Kahanaiki	---	0.00	3.00	diversified ag.
Tanaka M	3033	4-2-011:002	pump	I	Kahanaiki	---	0.00		---
Atlas	3031	4-5-030:037	pump	I	Kawa	---	0.00	---	other uses
State Hospital	3030	4-5-023:002	gravity	A	Kapunahala	0.23	0.17	0.76	kalo
Yanagida	3030	4-5-025:005	---	U	Unnamed spring	---	---	---	---
Crocker	3030	4-5-025:025	---	U	Unnamed spring	---	---	---	---
Salas	3030	4-5-041:016	gravity	A	Luluku	0.78	0.14	e0.16	kalo
Strive	3030	4-5-041:017	gravity	A	Luluku	0.78	0.08	e5.00	diversified ag.
Burgher	3029	4-5-012:011	pump	I	Keaahala	---	0.00	---	other uses
Heeia Fishpond Wai 1	3028	4-6-005:001	gravity	A	Heeia	---	---	88.00	aquaculture
Heeia Fishpond Wai 2	3028	4-6-005:001	gravity	A	Heeia	---	---	88.00	aquaculture
Heeia Fishpond Wai 3	3028	4-6-005:001	gravity	I	Heeia	---	0.00	88.00	aquaculture
Hakipuu Learning Center	3028	4-6-014:001	gravity	A	Haiku	0.42	0.05	e0.39	kalo
Hui kū Maoli Ola	3028	4-6-014:002	gravity	A	Haiku	0.08	---	e0.46	kalo
Wing Wo Tai auwai	3028	4-6-016:001	gravity	A	Heeia	---	---	e0.04	kalo
Lee auwai	3028	4-6-016:002	gravity	A	Heeia	---	---	---	kalo
S Asato	3027	4-7-005:002	pump	A	Tributary to Waihee	0.31	---	e7.00	diversified ag.
Silverstein (McCord)	3027	4-7-005:009	gravity	A	Tributary to Waihee	0.45	0.23	e0.34	kalo
Field	3027	4-7-005:013	pump	A	Unnamed spring	e0.10	---	e0.02	diversified ag.
Akima	3027	4-7-005:017	pump	A	Waihee (auwai 3)	0.31	---	---	other uses
Chen	3027	4-7-005:070	pump	I	Tributary to Waihee	---	0.00	4.00	---
Silva	3027	4-7-005:073	pump	A	Tributary to Waihee	0.38	---	1.75	diversified ag.
Spencer	3027	4-7-005:074	pump	A	Tributary to Waihee	0.38	---	1.75	diversified ag.
Y Higa	3027	4-7-005:075	pump	A	Tributary to Waihee	0.29	---	e1.80	diversified ag.
Wainwright	3027	4-7-005:079	pump	A	Tributary to Waihee	0.24	---	e0.92	diversified ag.

[a] Status: A (active), I (inactive), U (unknown).
[b] Stream/Acreage: (e) estimation.
[c] Randy Teruya, State DOA (personal communication).

Koʻolaupoko Stream Diversion Survey, 2008 to 2011 (HBWS)

Diversion Name	Surface Hydrologic Units	TMK	Diversion	[a]Status	Stream	[b]Stream (mgd)	Diversion (mgd)	[b]Acreage	Crop
Alvarado	3027	4-7-005:090	gravity	A	Waihee (auwai 3)	0.31	0.003	e0.04	other uses
B Young	3027	4-7-012:003	pump	A	Waihee	2.97	---	e0.25	diversified ag.
Anderson	3027	4-7-029:010	gravity	I	Kahaluu	---	0.00	---	---
C&C Hio Basin	3027	4-7-029:034	gravity	A	Kahaluu	3.62	3.62	---	---
C&C Hio Basin	3027	4-7-029:002			Kahaluu			e2.00	kalo, div. ag.
C&C Hio Basin	3027	4-7-029:003			Kahaluu				kalo, div. ag.
C&C Hio Basin	3027	4-7-029:004			Kahaluu			e3.00	kalo, div. ag.
C&C Hio Basin	3027	4-7-029:005			Kahaluu	3.62	3.62	e2.50	kalo, div. ag.
C&C Hio Basin	3027	4-7-029:017			Kahaluu			0.70	diversified ag.
C&C Hio Basin	3027	4-7-029:018			Kahaluu			1.00	diversified ag.
C&C Hio Basin	3027	4-7-029:033			Kahaluu			e5.00	diversified ag.
Hasegawa	3027	4-7-037:020	pump	I	Kahaluu	---	0.00	---	other uses
S Higa	3027	4-7-039:017	pump	I	Kahaluu	---	0.00	3.00	diversified ag.
Lesperance	3027	4-7-046:027	pump	I	Tributary to Kahaluu	---	0.00	e0.34	diversified ag.
Bowman	3027	4-7-046:028	pump	I	Tributary to Kahaluu	---	0.00	---	---
DT Chang	3027	4-7-049:002	gravity	A	Unnamed spring	e0.01	---	e0.01	kalo
Au	3027	4-7-049:003	gravity	I	Unnamed spring	0.01	0.00	---	diversified ag.
Waihee auwai 1	3027	4-7-006:010	gravity	A	Waihee	3.29	0.21	4.00	---
Waihee auwai 1	3027	4-7-006:004				3.29	0.21	1.00	kalo
Waihee auwai 1	3027	4-7-006:013						e4.00	kalo
Waihee auwai 2	3027	4-7-006:010	gravity	A	Waihee	3.08	0.19		
Waihee auwai 2	3027	4-7-064:001				3.08	0.21	0.50	diversified ag.
Waihee auwai 3	3027	4-7-064:014	gravity	A	Waihee	2.93	1.09	---	kalo
Waihee auwai 3	3027	4-7-005:017				---	0.31	---	diversified ag.
Waihee auwai 3	3027	4-7-005:090						e0.04	other uses
Waihee auwai 3	3027	4-7-006:002						e0.14	kalo
Waihee auwai 3	3027	4-7-006:003				2.93	0.78	e1.50	kalo, div. ag.
Waihee auwai 3	3027	4-7-006:013						e0.30	kalo, div. ag.
Waihee auwai 3	3027	4-7-026:002				---	0.31	e2.00	kalo
Waihee auwai 3	3027	4-7-026:005						e2.00	kalo
Waihee auwai 3	3027	4-7-026:024				---	0.31	e1.00	kalo
Waihee auwai 3	3027	4-7-027:006						e2.30	kalo
Waihee auwai 4	3027	4-7-012:021	gravity	A	Waihee	2.97	0.69	2.00	kalo
Waihee auwai 4	3027	4-7-026:004				2.97	0.69	e1.00	kalo
Waihee auwai 4	3027	4-7-026:024						e6.00	kalo
W. Chang	3026	4-7-033:010	pump	I	---	---	0.00	---	---
S Yogi	3026	4-7-033:016	pump	I	Unnamed spring	---	0.00	---	diversified ag.
R Yogi	3026	4-7-033:017	pump	I	Unnamed spring	---	0.00	1.00	diversified ag.
Saiki	3026	4-7-033:026	pump	I	Unnamed spring	---	0.00	---	diversified ag.
Serikaku	3026	4-7-047:015	pump	I	Unnamed spring	e0.02	0.00	0.67	diversified ag.
K Chang	3026	4-7-047:016	pump	A	Unnamed spring	e0.02	---	---	other uses
Higuchi	3026	4-7-047:020	gravity	I	Unnamed spring	---	0.00	---	diversified ag.

[a] Status: A (active), I (inactive), U (unknown).
[b] Stream/Acreage: (e) estimation

Koʻolaupoko Stream Diversion Survey, 2008 to 2011 (HBWS)

[d]Diversion Name	Surface Hydrologic Units	TMK	Diversion	[a]Status	Stream	Stream (mgd)	Diversion (mgd)	[b]Acreage	Crop
H Asato	3026	4-7-047:042	pump	A	Unnamed spring	---	---	0.01	diversified ag.
Fong	3025	4-7-007:010	gravity	I	Kaalaea	---	0.00	---	---
Magoon	3025	4-7-015:013	gravity	I	Kaalaea	1.48	0.00	---	---
Murakami (lower pump)	3025	4-7-015:014	pump	A	Kaalaea	1.48	---	e10.00	diversified ag.
Murakami (upper pump)	3025	4-7-015:014	pump	A	Kaalaea	1.48	---		
Wong's Taro Leaf Farm-auwai	3025	4-7-015:009	gravity	A	Kaalaea	1.48	0.52	e6.00	aquaculture
Wong's Taro Leaf Farm-pump 1	3025	4-7-015:009	pump	A	Kaalaea				kalo
Wong's Taro Leaf Farm-pump 2	3025	4-7-015:009	pump	A	Kaalaea				kalo
Wong's Taro Leaf Farm	3025	4-7-015:010							kalo
Wong's Taro Leaf Farm	3025	4-7-015:020				1.48	0.52	e6.00	kalo
Wong's Taro Leaf Farm	3025	4-7-014:026							kalo
Wong's Taro Leaf Farm	3025	4-7-014:006							kalo
Wong's Taro Leaf Farm	3025	4-7-014:013							kalo
Wong's Taro Leaf Farm	3025	4-7-016:007							kalo
Dan Bishop	3024	4-8-011:001	gravity	A	Waiahole	8.12	1.49	e3.49	kalo
Dan Bishop	3024	4-8-011:008			Waiahole		---	e0.21	kalo
Dan Bishop	3024	4-8-011:009			Waiahole		---	e0.12	kalo
Ota	3024	4-8-011:002	---	U	Waiahole	---	---	3.78	---
Lau	3024	4-8-012:001	---	U	Waiahole	---	---	51.55	---
Lam Ho	3024	4-8-012:002	---	I	Waiahole	---	0.00	3.80	---
Emelia L. H. Kailio	3024	4-8-012:003	---	I	Waiahole	---	0.00	1.34	---
McCandless	3024	4-8-013:013	gravity	A	Waianu	---	0.62	e32.05	kalo/diversified ag.
McCandless	3024	4-8-012:010			Waianu			e7.00	diversified ag.
McCandless	3024	4-8-012:022			Waianu			e6.00	diversified ag.
McCandless	3024	4-8-012:023			Waianu			e8.00	diversified ag.
McCandless	3024	4-8-012:027			Waianu			e0.75	diversified ag.
McCandless	3024	4-8-012:030			Waianu			e1.20	diversified ag.
McCandless	3024	4-8-012:034			Waianu			e1.50	kalo
McCandless	3024	4-8-012:035			Waianu			e5.90	diversified ag.
McCandless	3024	4-8-012:036			Waianu			e1.00	kalo/diversified ag.
McCandless	3024	4-8-012:043			Waianu			e0.70	diversified ag.
Chris Wilkinson	3024	4-8-012:014	gravity	A	Waianu	3.99	2.54	e0.36	other uses
Reppun-upper auwai	3024	4-8-012:021	gravity	A	Waianu	5.65	0.54	e1.50	kalo
Reppun-lower auwai	3024	4-8-012:021	gravity	A	Waianu	5.11	0.40	e0.75	kalo
Nguyen (Minakami)	3022	4-8-004:005	---	U	Waikane	---	---	2.74	---
Roman Catholic Church	3022	4-8-005:001	---	I	Waikane	---	0.00	3.97	---
Roberts	3022	4-8-006:009	---	U	Waikeekee	---	---	3.10	---
Waiahole Ditch System Intake 20	3022	4-8-014:005	gravity	A	Tributary to Waikane	---	---	[e]5644.00	diversified ag./other uses
Waiahole Ditch System Intake 21 (Kahana gage)	3022	4-8-014:005	gravity	A	Tributary to Waikane	---	---	[e]5644.00	diversified ag./other uses
Waiahole Ditch System Intake 22 (Development tunnel 1)	3022	4-8-014:005	gravity	A	Tributary to Waikane	---	---	[e]5644.00	diversified ag./other uses

[a] Status: A (active), I (inactive), U (unknown).
[b] Acreage: (e) estimation.
[d] Waiahole Ditch System intakes 1 through 19 are in Kahana.
[e] CWRM 2006, Waiahole Findings of Fact, Conclusions of Law; and Decision and Order. Table 2 and Table 3.

Koʻolaupoko Stream Diversion Survey, 2008 to 2011 (HBWS)

[d]Diversion Name	Surface Hydrologic Units	TMK	Diversion	[a]Status	Stream	Stream (mgd)	Diversion (mgd)	[b]Acreage	Crop
Waiahole Ditch System Intake 23 (release point)	3022	4-8-014:005	gravity	I	Tributary to Waikane	---	0.00	[e]5644.00	diversified ag./other uses
Waiahole Ditch System Intake 24	3022	4-8-014:005	gravity	A	Tributary to Waikane	---	---	[e]5644.00	diversified ag./other uses
Waiahole Ditch System Intake 25	3022	4-8-014:005	gravity	A	Waikeekee	---	---	[e]5644.00	diversified ag./other uses
Waiahole Ditch System Intake 26	3022	4-8-014:003	gravity	A	Tributary to Uwau	---	---	[e]5644.00	diversified ag./other uses
Waiahole Ditch System Intake 27	3022	4-8-014:003	gravity	A	Uwau	---	0.01	[e]5644.00	diversified ag./other uses
Waiahole Ditch System Intake 28	3022	4-8-013:014	gravity	A	Tributary to Waianu	---	---	[e]5644.00	diversified ag./other uses
Waiahole Ditch System Intake 29	3022	4-8-013:014	gravity	A	Tributary to Waianu	---	---	[e]5644.00	diversified ag./other uses
Waiahole Ditch System Intake 30 (release point to Waianu Stream)	3022	4-8-013:013	gravity	A	Tributary to Waianu	---	---	[e]5644.00	diversified ag./other uses
Waiahole Ditch System Intake 31 (release point to Waiahole Stream)	3022	4-8-013:001	gravity	A	Waiahole	---	---	[e]5644.00	diversified ag./other uses
Waiahole Ditch System Intake 32	3022	4-8-013:001	gravity	A	Waiahole	---	---	[e]5644.00	diversified ag./other uses
Waiahole Ditch System Intake 33	3022	4-8-013:001	gravity	A	Tributary to Waiahole	---	---	[e]5644.00	diversified ag./other uses
Waiahole Ditch System Intake 34	3022	4-8-013:001	gravity	A	Tributary to Halona	---	---	[e]5644.00	diversified ag./other uses
Waiahole Ditch System Intake 35	3022	4-8-013:001	gravity	A	Tributary to Halona	---	---	[e]5644.00	diversified ag./other uses
Waiahole Ditch System Intake 36	3022	4-8-013:001	gravity	A	Tributary to Halona	---	---	[e]5644.00	diversified ag./other uses
Waiahole Ditch System Intake 37	3022	4-8-013:001	gravity	A	Tributary to Halona	---	---	[e]5644.00	diversified ag./other uses
Waiahole Stream pumphouse	3022	4-8-013:001	gravity	I	Tributary to Waiahole	---	0.00	---	---
Waiahole baseyard	3022	4-8-013:001	gravity	A	Tributary to Waiahole	---	---	---	other uses
JUDD MS (Pahalona Spring)	3021	4-9-001:002	gravity	I	Pahalona Spring	---	0.00	2.40	---
K Johnson (Kealohiwai Spring)	3021	4-9-001:006	gravity	A	Kealohiwai Spring	---	---	---	kalo/other uses
K Johnson (Kealohiwai Spring)	3021	4-9-001:007				---	---	---	other uses
K Johnson (Kealohiwai Spring)	3021	4-9-001:014				---	---	e1.40	kalo
North Tributary to Hakipuu Stream	3021	4-9-002:001	gravity	I	Unnamed spring	0.08	0.00	---	---
Hakipuu Spring	3021	4-9-006:001	gravity	A	Hakipuu spring	0.12	0.06	e6.00	diversified ag./other uses
Hakipuu Lo'i	3021	4-9-006:001	gravity	A	Hakipuu spring	---	0.05	0.62	kalo
Sebastian JT	3021	4-9-002:005	gravity	I	Hakipuu	---	0.00	0.20	---
Kualoa Ranch ponds (UH4)	3021	4-9-001:014	pump	A	Hakipuu Stream	0.70	---	e4.00	aquaculture
Buntin (Gregory J)	3019	5-1-009:011	---	I	Unnamed spring	---	0.00	0.23	---
Buntin (Gregory J)	3019	5-1-009:025	---	I	Unnamed spring	---	0.00	0.32	---
Hoolulu Prawns	3019	5-1-009:001	pump	I	Kaaawa	0.69	0.00	e0.32	aquaculture
Kualoa Ranch Inc.	3019	5-1-007:001	---	U	Unnamed spring	---	---	---	---
Tomasu Farm	3019	5-1-001:001	---	I	Kaaawa	0.69	0.00	---	---

[a] Status: A (active), I (inactive), U (unknown).
[b] Acreage: (e) estimation.
[d] Waiahole Ditch System intakes 1 through 19 are in Kahana.
[e] CWRM 2006, Waiahole Findings of Fact, Conclusions of Law; and Decision and Order. Table 2 and Table 3.

APPENDIX G

NEIGHBORHOOD BOARD MINUTES

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G NEIGHBORHOOD BOARD MINUTES

The Public Review Draft of the Koʻolau Poko Watershed Management Plan was released in November 2010. Two public meetings were held in January 2011 to present a summary of the Plan to the community. One meeting was held in Waimānalo and the other in Kahaluʻu. The BWS then met with the four Neighborhood Boards in Koʻolau Poko: Kahaluʻu, Kāneʻohe, Kailua, and Waimānalo to present the Plan and answer any questions the Board might have.

In the second half of 2011, BWS requested a vote of support for the Koʻolau Poko WMP from each of the Neighborhood Boards. All four of the Neighborhood Boards voted to support the plan. This appendix includes the minutes from the meetings during which support was obtained.

Neighborhood Board #29	Kahaluʻu October 12, 2011
Neighborhood Board #30	Kāneʻohe November 17, 2011
Neighborhood Board #31	Kailua November 3, 2011
Neighborhood Board #32	Waimānalo October 10, 2011

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KAHALU`U NEIGHBORHOOD BOARD NO. 29
(Heeia Kea, Ahuimanu, Kahalu`u, Waihee, Kaalaea, Waiahole, Waikane, Hakipuu, Kualoa

HONOLULU HALE, ROOM 406 • 530 SOUTH KING STREET • HONOLULU, HAWAII, 96813
(808) 768-3710 • FAX (808) 768-3711 • E-MAIL nco@honolulu.gov • INTERNET: http://www1.honolulu.gov/nco

"LET US NOT EVER HAVE AN UNHAPPY MINORITY; RATHER, LET US BUILD A COMMUNITY CONSENSUS."

DRAFT REGULAR MEETING MINUTES
WEDNESDAY, OCTOBER 12, 2011
KEY PROJECT

CALL TO ORDER: Chair David Henkin called the meeting to order at 7:05 p.m. **with a quorum of 10 members present.** Note – this 15-member Board requires eight (8) members to establish a quorum and to take official Board action.

Members Present – Gregory Geboski, Lee Gomes (arrived 7:12 p.m.), David Henkin, Rocky Kaluhiwa, Ken LeVasseur, Clifford Loo, Amy Luersen, Art Machado, Yvonne Nelson, Brian Nuss, and Flora Obayashi.

Members Absent – Matt Longfellow and Lucy Salas.

Guests – Major Allan Crouch, Sgt. Daniel Woodall, and Jeffrey Patrick (USMC), Karen and Peter Field, Lt. Dave Eber (Honolulu Police Department), Acting Capt. Steve Jenness, Jim Niermann (R.M. Towill Corp); Curtis Matsuda, Bruce Shimokawa, Marshall Ando, and James Fu (State Department of Transportation); April Coloretti (SSFM), Clifford Wong, Anthony S. Naito, Fran Tully, Tim Krantz, Richard Vermeesch, John Reppun, Barry Usagawa (Board of Water Supply), Director Wayne Yoshioka (City Department of Transportation Services), Chad Taniguchi (Hawaii Bicycling League, Terry George (HKL Castle Foundation), Paul Zweng, Senator Clayton Hee, Representative Jessica Wooley, Mike Sakata (City Council Chair Ernie Martin's Office staff), Gloria J.P. Gaines (Neighborhood Commission Office staff).

INFORMATIONAL SESSION:

Honolulu Fire Department (HFD) – Acting Capt. Steve Jenness reported the following:

- Statistics for September 2011 – Included 1 structure, 1 wildland, and 2 rubbish fires. There were 40 medical emergencies, 2 search/rescue, and 4 miscellaneous calls for service. A major incident involved three fire companies. No unusual incidents reported.
- Fire Prevention Week (FPW) – FPW is October 9th to 15th and the National Fire Protection Association selected "Protect Your Family From Fire" as its theme, focusing on keeping you, your family, and the community safe from fire. In October 2011, children attending elementary schools statewide will receive a Fire Fighter's Safety Guide (FFSG) from their teachers. HFD encourage parents to review the FFSG with their child, practice their fire escape plan, test their smoke alarms, and consider the safety tips in the guide.

Honolulu Police Department (HPD) – Lt. Dave Eber reported the following:

- Statistics for September 2011 – Included 5 assaults, 10 auto/motorcycle thefts, 4 burglaries, 1 drugs/narcotics offense, 1 graffiti offense, 11 thefts, and 9 unauthorized entries to a motor vehicle.

Questions, comments, and concerns followed:

1. No Parking Signs – Member Kaluhiwa raised a concern about the need for no parking signs along Kamehameha Highway by He`eia Kea Harbor. She has witnessed six or more cars parking every night and has called 911 with no result. She was informed that it is against the law to live in a vehicle and that, if there is a parking violation, HPD can issue a citation if the car is on City or State land; if the land is private, it is the landowner's issue. Lt. Eber stated that if residents are not satisfied with the results of their 911 complaint that they should ask for the officer's supervisor.

At 7:12 p.m., Member Gomes arrives; **eleven (11) members present.**

2. Thefts – Lt. Eber clarified if property was not stolen from a car, residence, or business it will be reported as a theft.

FILLING OF VACANCIES: There were no nominations or volunteers at this time.

ANNOUNCEMENTS: Chair Henkin reminded residents of the speaker policy as noted on the agenda and announced the following:

- Next Meeting – The Kahalu'u Neighborhood Board No. 29 will meet Wednesday, November 9, 2011 at 7:00 p.m. at KEY Project, 47-200 Waihe'e Road.
- O'ahu General Plan Update: Public comment period is extended until Wednesday, November 30, 2011. Written comments can be submitted via email at gp2035@hhf.com. Key planning issues and background reports are posted at http://honoluludpp.org/planning/OahuGenPlan.asp.
- Kualoa Regional Park – An Archaeological inventory survey begins Monday, October 3, 2011 for a proposed reconstruction of the wastewater systems project. The survey is being done in consultation with the O'ahu Island Burial Council.
- Code for America Grant – Honolulu was among 22 cities selected to receive the Code for America Grant. Submit ideas for web applications to make city government more open, participatory and efficient by going on-line at http://citycamphnl.govfresh.com/ or call 768-9999 to leave a recorded message. The deadline is Friday, November 23, 2011.

RESIDENTS'/COMMUNITY CONCERNS:

Kahekili Highway Community Charette – April Coleretti provided members with a flyer inviting residents to a Kahekili Highway Community Charette 2-Part meeting. Residents will have the opportunity to discussion possible alternatives and vision for Kahekili Highway. Part 1 will be held on Wednesday, November 2, 2011 at Windward Community College Hale Akoakoa Campus Center from 5:00 p.m. to 9:00 p.m. For questions, contact Mr. Darell Young of the State Department of Transportation at 808-587-1835. Part 2 will be held on Tuesday, November 8, 2011 at the same location and time. All comments will be posted on the website following the two-part meetings. Ms. Coleretti explained how the surveys were distributed among the residents from Kahalu`u to Ka`a`awa.

Rebuilders Addictions Ministry (RAM) Program Update – A resident requested an update on RAM's proposed move to a Mapele Road location. Terry George of the Harold Castle Foundation announced that the foundation is providing funding for a project manager to help RAM select a new site with zoning and other attributes that satisfy both RAM and community concerns. RAM will be on next month's agenda.

Dredging Concerns – A resident is concerned that if the City dredges the Kahalu'u Lagoon it will cause erosion of his property that sits along Waihe'e Stream.

INFORMATIONAL SESSION:

Board of Water Supply (BWS) – Barry Usagawa reported the following:

- Main Break – There were two main breaks for the month of September:
  - On Saturday, September 24, 2011 at 47-482 Aialii Street an eight-inch pipe that was installed in 1973.
  - On Monday, September 26, 2011 at 47-288 Kamehameha Highway a six-inch pipe installed in 1978.
- Potable Pumpage – O'ahu potable pumpage for the week ending Saturday, October 2011 was 145 million gallons per day.
- Wildfire Prevention and Watershed Protection – In the event of a wildfire, BWS works closely with the HFD to provide efficient and reliable water service to save lives and property. Wildfires devastate O'ahu's natural resources and the watershed's ability to collect rainwater and replenish ground water supplies. BWS and HFD encourage residents to support wildfire prevention and watershed protection activities in their communities. Practicing water conservation will also assist in watershed protection by reducing the need to use ground water essential for healthy watershed forests and stream ecosystems.

Questions, comments, and concerns followed:

1. Rate Increases – The BWS Board of Directors has not yet made a decision on the proposed rate increases.
2. Pipe Under Kalahaku Stream Bridge – Water is eroding under a BWS main that is under the Kalahaku Stream bridge on Mapele Road; debris coming down the stream might take out the pipe. Mr. Usagawa will inform BWS field crews to investigate this concern.

Marine Corps Base Hawai`i (MCBH) – Sgt. Daniel Woodall reported the following:

- Hours of Operation – Mondays through Thursdays from 7:00 a.m. to midnight; Fridays from 7:00 a.m. to 10:00 p.m.; and Saturdays from 8:00 a.m. to 5:00 p.m. Closed Sundays and holidays.
- October/November 2011 Events – October 7th to 9th – Marines hosting Boy Scout Camporee; October 3rd to18th – Combined Federal Campaign at MCB Hawaii; October 13th – CPRW-2 Change of Command (Capt. Cutter to Capt. Ramsden); October 20th – HMH-463 Change of Command (Lt. Col. Gadd to Lt. Col. Davis); October 21st – retiree Appreciation Luncheon (by invitation) and Enhanced Military Operations in Urbanized Terrain (MOUT) training facility opens in Bellows, Waimanalo; October 24th to 28th – Malama Ka `Aina (Respect the Land) base-wide clean up; November 8th, 9th or 10th – MCB Hawaii to host Marine Corps Birthday Pageant at Kainalu Elementary School, Kailua
- Deployments – Deployed units include 1st Battalion, 3rd Marine Regiment; 1st Battalion, 12th Marine Regiment; and Heavy Helicopter Squadron 363. Third Battalion, 3rd Marine Regiment is completing its training in preparation for deployment this month.
- Announcements –
  - Several commanding generals are planning to visit MCB Hawaii in October 2011, to include the commanders of 3rd Marine Division, 3rd Marine Logistics Group, 1st Marine Air Wing, and the new Marine Corps Installations Pacific
  - Osprey/H-1 Draft Environmental Impact Study is expected to be published Monday, November 14, 2011 and public meetings planned for the first week of December on O'ahu.
- Community Notes and Reminders –
  - A "Friends of K-Bay" pass is required to access the Klipper Golf Course or K-Bay Lanes without a Federal Department of Defense identification
  - Kane'ohe Bay Air Show is planned for September 29-30, 2012 and will include the U.S. Navy's Blue Angels.
  - Next summer will also include the return of RIMPAC
  - For more information about career opportunities at MCB Hawaii, please visit the MCCS site, www.mccshawaii.com or call 254-7632.
  - For noise complaints call the PAO at 257-8832 as soon as possible with the date and time of the incident. If you leave a message please consider leaving your name and phone number for a reply.

Kane`ohe Bay Regional Council (KBRC) – There was a discussion about efforts to form a steering committee by the KBRC's November 9 meeting. It has been difficult since individuals representing neighborhood boards cannot serve as officers. It is up to the Governor to appoint people to the KBRC.

TREASURER'S REPORT: Treasurer Machado reported the Board received an allocation of $1,281 for fiscal year 2012; compared to last year's allocation of $850.43.

REPORTS BY PUBLIC OFFICIALS:

Mayor Peter Carlisle's Representative – A representative or report was not available.

City Council Chair Ernie Martin – Mike Sakata provided members with a report and highlighted the following:

- Stream Remediation – Stream remediation is everyone's responsibility. Council Chair Martin's report explained the laws and responsibilities governing streams and waterways that are private owned. For information regarding stream maintenance, call 768-7890 or visit www.honolulu.gov/cleanstream.htm.
- Bill 54 – Bill 54 establishes a procedure for the removal and disposal or personal property that remains on public property for 24 hours.

- Bill 55 – Bill 55 relates to enforcing noise control and restricts the use of machines that produce sound that is audible more than 150 feet from the source.

Questions, comments, and concerns followed:

1. Mango Tree – Member Machado requested assistance with the trimming of a mango tree at 47-210 Kamehameha Highway. The branches overhang the road, making it difficult to see cars coming around the road ahead.
2. La`ie Inn Special Management Area (SMA) Permit – The Council granted an SMA permit for the La`ie Inn, which now must go through the permitting process. An environmental assessment was submitted.
3. Collapsed Wall on Kamehameha Highway – Litigation between the owner and contractor is delaying repair of the wall on Kamehameha Hwy near Lulani Street that collapsed at the end of December 2010.
4. Guard Rail– The guard rail on Kamehameha Highway near He'eia Kea Harbor is bent and dangerous.
5. He`eia Kea – Member Kaluhiwa raised a concern about people removing large rocks from under the shoulder of the road on the beach side of Kamehameha Highway and replacing fill with debris.
6. Dredging of Pond – A dredging study from Kahalu'u to Waialua will be completed by the end of this year and Council Chair Martin's office staff will follow up when the study is completed. Resident Clifford Wong shared his concern for his property when dredging the Kahalu'u Pond. The water rushes down and erodes his property.

Representative Jessica Wooley – Representative Wooley stated the legislative session will open mid-January 2012 and was available for questions.

1. Ahupua`a Markers – Representative Wooley will follow up with the State Department of Transportation on the delay in installing ahupua`a boundary markers.
2. RAM Project – The issue is using agricultural land for uses other than agriculture. Representative Wooley supports the RAM Project but it needs to find an appropriate site.
3. Kawamoto Property – Representative Wooley reported success in using Act 76 to get Genshiro Kawamoto to pay to trim hazardous trees and remove boulders that threatened his neighbors. The success resulted from collaboration between the residents, the State Civil Defense (SCD), and Representative Wooley. There are still neighbors with concerns that need to be addressed; the SCD will be monitoring this situation. A discussion followed regarding the resignation of Vice Director Mr. Ed Texeira from SCD.
4. Disaster Preparedness – A Disaster Preparedness meeting will be held Saturday, November 5, 2011 at KEY Project from 9:00 a.m. to noon. It is open to the public.

Senator Clayton Hee – Senator Clayton Hee reported that, after redistricting, his Senate district will extend from 'Ahuimanu to Mokule'ia. The entire area is country, which should be together. Hee urged the Board to take a position in opposition of the Ho`opili and Koa Ridge projects to save land zoned for agriculture.

PRESENTATIONS ON COMMUNITY PROJECTS:

2011 Honolulu Century Ride – Department of Transportation Services (DTS) Director Wayne Yoshioka reported that his staff felt the 2011 Honolulu Century Ride (HCR) had gone well. Chad Taniguchi of the Hawaii Bicycling League stated that there was an improvement to last year's ride and provided members with a fold out map that was given to all bike riders of the 2011 Honolulu Century Ride.

- Map – The map included the route outbound/inbound, aid stations and their events, and photo stops. The ten safety tips were also listed and addressed the Board's and residents' concerns, including that bikers should not take photos/video while moving and should ride single file at all times, make eye contact with drivers, and stop and let the car go if a car has been waiting in a driveway.
- Friendship Riders – There were 45 friendship riders who wore yellow bibs and promoted good bicycling behavior throughout the event. These riders also assisted with fixing 31 bicycle tires and tried their best to keep everyone riding single file.

Questions, comments, and concerns followed:

1. KEY Project – John Reppun stated this was the first time KEY was used as an aid station for the HCR. He worked with Mr. Taniguchi to showcase the talents of Kahalu`u which included a hula halau. Mr.

Reppun will follow up with the Hawaii Bicycling League to provide a bike riding workshop for the kids in the community. He also looks forward to working with Mr. Taniguchi next year. The Hawaii Bicycling League is looking for a community service project through the KEY Project.

2. Enforcement – Member LeVasseur stated that he had heard that the Hawaii Bicycling League had urged HPD to give tickets to bike riders who violate the law. Mr. Taniguchi confirmed that the Hawaii Bicycling League had met with HPD and believes that cyclists need to be responsible and should be ticketed if they violate the rules of the road.
3. Responsiveness to Community Concerns – Members Machado and Nuss commended the Hawaii Bicycling League for a job well done in responding to community concerns.

Trimming Milo Trees and Illegal Camping along Kamehameha Highway in He`eia – Member Kaluhiwa stated that people who are parking and camping along the makai side Kamehameha Highway in He`eia are cutting milo trees with electric chainsaws to sell the wood for carving. The branches and other debris are used to fill in the shoulder of the road where they are also removing rocks to build fish ponds. She is also concerned about manhole covers that were removed. All concerns mentioned pose a danger to the community. She contacted HPD and the Department of Land and Natural Resources (DLNR), but each agency said it did not have jurisdiction. Photos were circulated.

Questions, comments, and concerns followed:

1. Member LeVasseur stated the sliver of land on the makai side of Kamehameha Highway is the owned by DLNR, while the right of way is the City's. Council Chair Martin's staff will investigate this matter.
2. John Reppun reported that someone in Punalu'u is accepting the manhole covers as scrap metal.

Final Draft of Ko`olaupoko Watershed Management Plan (KPWMP) – Planner Bruce Tsuchida of Townscape, Inc. explained that the KPWMP is sponsored by BWS and the City's Department of Planning and Permitting, is required by the State Water Code, and has been in the works for three years. It is a 20-year plan looking at all water resources from Makapu`u Point to Kualoa Point. He also noted that the Kahalu`u Board formed a Permitted Interaction Group with the planners to review and comment on the draft KPWMP in January 2011; and again commented in April 2011. The KPWMP will be submitted to the City Council for adoption as an ordinance and then presented to the State Water Commission. Mr. Tsuchida has met with all the other Neighborhood Boards of Ko`olaupoko to seek their endorsement of the KPWMP and requested the same of the Kahalu`u Board.

Questions, comments, and concerns followed:

1. Water for Taro Farmers – Member Luersen explained the Board's comments on how to calculate how much water is needed to grow kalo; the original draft of the KPWMP had 300,000 gallons per acre per day (GAD), and the revised draft uses a range from 100,000 to 300,000 GAD, based on a U.S. Geological Survey study from 2006 or 2007. Mr. Wong, a taro farmer, expressed concerns about getting warm water, which harm kalo. Mr. Tsuchida reminded that residents will have an opportunity to comment at City Council's public hearing. A hard copy of the plan will be provided to Mr. Wong.

At 8:50 p.m. Lee Gomes left the meeting; **ten (10) members remain.**

2. Public Review of Draft Plan – Terry George of the Castle Foundation expressed concerns about members of the public having difficulty accessing hard copies of the draft plan and offered to see if the foundation could fund printing some copies.
3. Board's Comments Reviewed – Member Luersen reported that the draft responded to most of the Board's past concerns, except for the need to revise Table 2.1 to delete Waianu as a separate watershed.
4. General Plan – Member Kaluhiwa stated that Board's comments should also be mentioned in the City's General Plan.

Luersen moved and Kaluhiwa seconded that the Kahalu`u Neighborhood Board No. 29 supports the final draft of the Ko'olaupoko Watershed Management Plan in concept. THE MOTION WAS ADOPTED, 10-0-0 (**AYES:** Geboski, Henkin, Kaluhiwa, LeVasseur, Loo, Luersen, Machado, Nelson, Nuss, and Obayashi; **NAYS:** None; **ABSTENTIONS:** None).

Harold K.L. Castle Foundation (HKLCF) Grants – Executive Director Terry George stated that HKLCF was established in 1962 and has awarded more than $150 million in grants, with $5.8 million in grants this year. The

HKLCF is the owner of Kane'ohe Ranch and collects income from its properties in Aikahi and Kailua. The HKLCF's mission is to strengthen the vibrancy of windward communities from Kahuku to Waimanalo, help every child receive a good education, and protect the health of nearshore fisheries. In recent years, the HKLCF has given grants to KEY Project for strategic planning, to the Nature Conservancy to help get alien algae out of Kane'ohe Bay, to install ahupua'a markers, and to restore the Hoi wetlands. The HKLCF is open for ideas from the community for grant projects. Information about Windward Youth Leadership grants is on the HKLCF website; the grants provide up to $5,000 for service projects.

Questions, comments, and concerns followed:

1. Funding for RAM – The foundation had awarded RAM a $125,000 grant to move to Mapele Road, subject to the Neighborhood Board's approval. Since the Board did not approve the move at its last meeting, the HKLCF decided to cover the cost of a project manager to look at other sites for the RAM program. Member Machado added that RAM will need the Board's support when a new site is located.
2. Castle Complex Redesign – The foundation is supporting a community-based process to redesign the Castle Complex to reduce the dropout rate.
3. Upward Bound – Member Nuss thanked the HKLCF for supporting the Upward Bound program, which provides mentors starting freshman year at James B. Castle High School to get local kids excited about going to college. Mr. George said that the foundation gave seed money to get the program started.
4. Types of Grants – The purpose of the grant is to provide children and youth of Windward O'ahu with a sense of hope, belonging, and service. The foundation also funds advocacy, especially for watershed management and marine protection. The grants are for start-ups and some continuing grants, but not for proven programs. The HKLCF generally does matching grants of half or less; it rarely funds 100 percent of a project. It supports programs, but does not make grants to individuals.
5. Ready-Set-Grow – Member Obayashi mentioned Windward Community College has a Ready-Set-Grow program. Mr. George noted that the HKLCF did not previously fund that program, but may fund its expansion to help Windward Community College improve the numbers on students completing their AA degree.
6. Capital Improvement Projects – Chair Henkin mentioned the Board's high priority capital improvement projects (CIPs), which the foundation should consider for funding: A) Bringing privately owned roads up to standard so they could be dedicated to the City for an emergency bypass when Kamehameha Highway is blocked. Member LeVasseur will brief Mr. George about this project. B) Improving pedestrian and bicycle circulation in the community to promote health, mind, and body and reduce traffic.
7. Shared-Use Path – The State Department of Transportation (DOT) has money in its CIP budget to build a shared-use path along Kahekili Highway between the Hygienic Store and Temple Valley, but does not consider it a priority. Chair Henkin will brief Mr. George on this project.

Waikane Stream Bridge Replacement Project – Jim Niermann provided Board members with an information sheet and map of the State DOT Highways Division Waikane Stream Bridge replacement project. The current bridge was built in 1928 and is only 27 feet wide. The new bridge will be 40 feet wide (12 -foot lanes and eight-foot shoulders) and will include pedestrian access, guardrails, utility relocation, bridge abutment, and stream bank protection. The proposed design will bring the bridge up to current standards, but will not alleviate flooding, which is a broader issue. The project will require staging areas and the construction of a detour road and bridge to convey highway traffic during the construction. The decision to align the detour on either the mauka or makai side of the highway will be based on public input and the evaluation of environmental effects. Placing the detour on the makai side would encroach on existing uses (e.g., a fruit stand) and would require temporary relocation of those uses on adjacent properties during the construction. Placing the detour on the mauka side may adversely affect cultural and riparian resources. The draft environmental assessment for the project, including a cultural impact study, will be published in January 2012 at the earliest, with the first public meeting in December 2011 or January 2012.

Questions, comments, and concerns followed:

1. Flooding – Member Luersen stated that it's a shame to redo the bridge and not address the flooding. Mr. Niermann said the bridge replacement is not to address the flooding, which is more of a regional issue due to the large upstream drainage basin and the lack of a defined channel. DOT would need to construct a viaduct to pass the water during flooding events, especially given the tidal influence. Chair Henkin noted that sea level rise is not going to go away, so DOT might as well address the flooding issue sooner than later.

2. Timing – It will take 18 months from the start of construction to replace the bridge. Currently, the schedule is for 2016.

At 10:00 p.m., Neighborhood Assistant Gloria J.P. Gaines left the meeting. The remainder of the meeting was recorded by Chair Henkin.

Comments On The General Plan Update – Member Luersen noted that the public comment period had been extended to November 30, with community meetings in January 2012. The draft update includes agriculture under "Economic Activity," rather than call it out separately. In addition, there is no specific area focused on sustainability (e.g., food security and sea level rise).

Luersen moved and Machado seconded that the Kahalu`u Neighborhood Board No. 29 feels that the update of the General Plan should include a specific section addressing agriculture and a specific section addressing sustainability; and that agricultural policies should promote sustainable agriculture to increase potential for locally grown food, leading to increased food security, and to increase economic opportunities with living wage employment. Moreover, the Kahalu'u Neighborhood Board No. 29 looks forward to the opportunity to provide comments on the draft updates and requests ample opportunity for community review and comment. THE MOTION WAS ADOPTED, 10-0-0 (**AYES:** Geboski, Henkin, Kaluhiwa, LeVasseur, Loo, Luersen, Machado, Nelson, Nuss, and Obayashi; **NAYS:** None; **ABSTENTIONS:** None)

AGENDA ITEMS FOR FUTURE BOARD MEETINGS: The consensus of the Board was to take up the following matters at the November 9, 2011 meeting, subject to confirmation that presentations are ready: 1) Proposed move of the RAM program from 47-528 Kamehameha Hwy and 2) Complete Streets.

APPROVAL OF SEPTEMBER 14, 2011 REGULAR MEETING MINUTES: **Machado moved and Kaluhiwa seconded that the Kahaluʻu Neighborhood Board No. 29 APPROVED the September 14, 2011 regular meeting minutes as corrected. THE MOTION WAS ADOPTED, 10-0-0** (**AYES:** Geboski, Henkin, Kaluhiwa, LeVasseur, Loo, Luersen, Machado, Nelson, Nuss and Obayashi; **NAYS:** None; **ABSTENTIONS:** None). The corrections are as follows:

- Page 7, in the discussion of alternate sites for RAM (Item 11), insert "her understanding that" before "the $125,000 Castle Foundation grant."
- Page 7, the vote on the motion to table should be "7-4-1," not "7-5-1."
- Page 8, the vote on "[t]he motion offered by Luersen" should be "4-9-0," not "4-8-0."
- Page 8, in the first sentence of the discussion of "Project Goals" for the Ohulehule Forest Conservancy (OFC), delete "he" and insert "OFC."
- Page 9, in the motion under the Planning Committee report, insert "extension of the public comment period so there is" before "ample opportunity."

COMMITTEE REPORTS:

Water and Environment – There were no updates to report.

Transportation and Safety – Member LeVasseur reported that, in response to the Board's concerns, DOT evaluated the portion of Kamehameha Hwy near Johnson Road and discovered that signs had been removed. DOT then put up a 35 mph speed limit sign and a sign indicating a T-intersection before the rise in the road as one travels in the Kahuku direction. DOT is working on installing flashing lights in the crosswalk as an add-on to this project. Member Nuss stated that pedestrians need to be able to push a button to trigger the flashing lights when the pedestrians want to cross the highway.

Parks and Recreation – There were no updates to report.

Planning – There were no updates to report.

Preservation of Hawaiian Heritage – There were no updates to report.

Military/Civilian Affairs Liaison – There were no updates to report.

Legislation and School – There were no updates to report.

ADJOURNMENT: The meeting adjourned at 10:25 p.m.

Submitted By: Gloria J.P. Gaines, Neighborhood Assistant

Reviewed By: David Henkin, Chair

KANEOHE NEIGHBORHOOD BOARD NO. 30

c/o NEIGHBORHOOD COMMISSION • 530 SOUTH KING STREET ROOM 406 • HONOLULU, HAWAII, 96813
TEL: (808) 768-3710 • FAX: (808) 768-3711 • INTERNET: www1.honolulu.gov/nco

DRAFT REGULAR MEETING MINUTES
THURSDAY, NOVEMBER 17, 2011
BENJAMIN PARKER SCHOOL CAFETORIUM
45-259 WAIKALUA ROAD

CALL TO ORDER: Chair Roy Yanagihara called the meeting to order at 7:10 p.m. with **a quorum of 11 members present**. Note - This 17-member Board requires nine (9) members to establish quorum and take official Board action.

Members Present - John Flanigan, Marie Gavigan, Kekoa Kaluhiwa, Chad Kaukani, Carol Makainai, Tina Mueller, Maurice “Mo” Radke, Bill Sager, Daniel Siangco, Patty Yamashiro-Hironaka, and Roy Yanagihara.

Members Absent - Felipe San Nicolas and Larry Zdvoracek.

Board Vacancies - There are four (4) vacancies in Subdistricts 2, 3, 7, and 9 (one seat each).

Guests - Sgt. Danny Woodall (Marine Corps Base Hawai'i); Sam Moku (Mayor Peter Carlisle's Representative, Director, Department of Community Services); Councilmember Ikaika Anderson and J.D. Aweau (Councilmember Ikaika Anderson's Office staff); (Honolulu Police Department, District 4, Kaneohe); (Honolulu Fire Department); Barry Usagawa (Board of Water Supply); Doug Dykstra (Windward Community College, Chancellor), Chris Aguinaldo (Hawai'i Pacific University), Claudine M. Tomasa (Kailua Neighborhood Board No. 31, Secretary), Clemens Jung (Kailua Neighborhood Board No. 31, Disaster Preparedness Subcommittee), Kimo Chun (Amateur Radio Operator - Delta Committee); Bruce Tsuchi and Sherri Hiraoka (Townscape, Inc.); Mark Yamashiro (Boy Scouts), Ben Baniaga; Mahealani Cypher and Rocky Kaluhiwa (Ko'olau Foundation); Sachiko Takahashi, Cheryl Peltier, Jerry Kaluhiwa (Ko'olau Poko), Dennis Kajiura, Alice Hewett, Maryanne Takahashi, and K. Russell Ho (Neighborhood Commission Office staff).

FILLING OF BOARD VACANCIES: Four Seats in Subdistricts 2, 3, 7 and 9 (one seat each) - As there were no volunteers, this item was deferred to the next meeting.

APPROVAL OF THE AUGUST 18, 2011 REGULAR MEETING MINUTES: **As there were no objections, the Kaneohe Neighborhood Board No. 30 APPROVED the August 18, 2011 regular meeting minutes, as circulated by UNANIMOUS CONSENT, 11-0-0** (**AYE**: Flanigan, Gavigan, Kaluhiwa, Kaukani, Makainai, Mueller, Radke, Sager, Siangco, Yamashiro-Hironaka, and Yanagihara)**.**

APPROVAL OF THE SEPTEMBER 15, 2011 REGULAR MEETING MINUTES: **Siangco moved; Yamashiro-Hironaka seconded that the Kaneohe Neighborhood Board No. 30 APPROVE the September 15, 2011 regular meeting minutes as corrected. The motion was ADOPTED by UNANIMOUS CONSENT, 11-0-0** (**AYE**: Flanigan, Gavigan, Kaluhiwa, Kaukani, Makainai, Mueller, Radke, Sager, Siangco, Yamashiro-Hironaka, and Yanagihara)**.**

- Page 1, under Guests, and after Marine Corps Base Hawai'i (MCBH), it should read, "Maj. Alan Crouch."
- Page 2, it should read, "Gavigan arrived at 7:15 p.m. The meeting was officially called to order; **a quorum of 9 members present**."
- Page 2, under FILLING OF BOARD VACANCIES, it should read, "There were no persons present interested in filling the vacancies."
- Page 2, under APPROVAL OF TUESDAY, SEPTEMBER 6, 2011 AGENDA PLANNING AND COMMITTEES' MEETING MINUTES, it should read, "**Flanigan moved Yamashiro-Hironaka seconded that the Kaneohe Neighborhood Board No. 30 APPROVE the September 6, 2011 Agenda Planning and Committees' Meeting minutes as circulated. The motion was ADOPTED by UNANIMOUS CONSENT, 9-0-0 (AYE:** Flanigan, Gavin, Kaluhiwa, Makainai, Mueller, San Nicolas, Yamashiro-Hironaka, Sager and Yanagihara)**.**"

- Page 2, under Mayor Peter Carlisle's Representative, it should read, "Request for Yellow Blinking Lights at the Mid-Block Crosswalk on Paia Road - The DTS would like clarification on the location of the mid-block crosswalk. The request was for an evaluation of how this pedestrian cross walk can be made safer. One of the suggestions was to install blinking LED lights that can be activated by any pedestrian wanting to cross Kamehameha Hwy. Sager transmitted suggestions for traffic calming he had received from a private traffic engineer to Councilman Anderson."
- Page 3, under Trucking of Raw Sewage from Sand Island to Other Wastewater Treatment Facilities, it should read, "The sludge has not been trucked to either Kailua or Waianae."
- Page 4, under Hawaii Pacific University (HPU), it should read, "Questions, comments, and concerns: Crosswalks - Concern was raised regarding crosswalks across Pali Highway to the Hawaii Loa Campus. The blinking yellow lights installed at the Kamehameha Highway are a safety improvement. The Pali Highway crossing is controlled by a traffic light and is not a concern."
- Page 4, under Koolaupoko Watershed Management Plan (KPWMP) Summary, it should read, "Purpose of the Management Plan - KPWMP is a long-range 20-year plan to the year 2030, for the preservation, restoration, and balanced management of ground water, surface water, and related watershed resources in the Ko'olau Poko District on the island of O'ahu."
- Page 4, under Presentation on Proposal for Several Halfway Houses in Kaneohe, it should read, "Chair Yanagihara further stated that Neighborhood Boards are no longer permitted to make recommendations in support or in opposition to the drug or alcohol rehabilitation group homes located in residential neighborhoods as a result of a change in state law several years ago."
- Page 5, it should read, "3. Residents - Solbach indicated that there are currently at least 12 people residing at each of the halfway houses he operates."
- Page 5, it should read, "9. Comment - It was noted that the rules have changed and donations are being ask for through the Tradition House Foundation. It was asked who would be in charge of the care of the sex offenders and mentally disabled people; and noted that the house manager was one of the recovering addicts at that time."
- Page 5, it should read, "12. Comments - (A) It was suggested that the resident manager of the house go door-to-door, introducing his/her self to the neighbors. (B) Concern was raised that there are new occupants every three months, which is unfair to the neighbors and shows a lack of respect. (C) Concern was raised regarding the honesty of the foundation and homeowner, because this is the first time the resident has heard about the halfway houses, which have been operating for the last four years. (D) The issues, being caused in the neighborhoods, are outrageous."
- Page 5, it should read, "Koolau View Drive Comments - (A) At one time 16 people resided in the home. (B) Occupants were witnessed at least three times jumping over a neighbor's fence and peeking into another home while a lady was changing her clothes. When confronted the perpetrator ran to the halfway house. The neighbor was asked to disregard a police report on the incident. Other "Peeping Tom" incidents were relayed. (D) It was reiterated that the house manager does not have a copy of the filed police report. (E) Recently, when neighbors witnessed two occupants smoking marijuana, they were reported to the manager and drug paraphernalia was left in front of the residence. (E) Break-ins of other two elderly residents were reported, as well as neighbors being robbed while moving in.
- Page 6, it should read, "17. Increase in Occupants - When asked if the houses can accommodate 16 people each and if the bathroom facilities were adequate, Solbach answered that each house has at least three (3) bedrooms and two (2) bathrooms each. Solbach did not indicate any plans to enlarge any of the houses he operates.

APPROVAL OF THE OCTOBER 20, 2011 REGULAR MEETING MINUTES: This item was deferred to the next meeting.

APPROVAL OF TUESDAY, NOVEMBER 1, 2011 AGENDA PLANNING AND COMMITTEES' MEETING MINUTES: **Siangco moved; Yamashiro-Hironaka seconded that the Kaneohe Neighborhood Board No. 30 APPROVE the November 1, 2011 Agenda Planning and Committees' meeting minutes. The motion was ADOPTED by UNANIMOUS CONSENT, 11-0-0** (**AYE**: Flanigan, Gavigan, Kaluhiwa, Kaukani, Makainai, Mueller, Radke, Sager, Siangco, Yamashiro-Hironaka, and Yanagihara)**.**

PUBLIC SAFETY AND MILITARY REPORTS

Honolulu Fire Department (HFD) - HFD reported the following:

- October Statistics - There were 5 fires, 89 medical emergencies/rescues, 9 hazardous conditions, 12 service calls, 50 good intent calls, and 5 false alarms.
- Fire Safety Tip - For many people, the holiday season means festive decorations, extensive food preparations, and family get-togethers. Enjoy family celebrations during the holiday season with the following helpful tips:
  - Consider a fire-resistant, artificial Christmas tree. If a real tree is purchased, choose one as fresh as possible, and keep it hydrated and away from heat sources. Use noncombustible materials for decorations. Choose only Underwriter's Laboratory-approved electrical decorations and follow the manufacturer's instructions for installation and usage. Do not overload extension cords.
  - Family gatherings often include extensive food preparation. If you must leave the stove, even for a few minutes, turn it off. Unattended cooking is the number one cause of home fires. Have a metal lid ready to cover grease fires in pans. Never wear long, loose-sleeved clothing while cooking. Turn the handles on pots and pans inward to prevent accidents. Keep children away from cooking areas.
  - If hosting overnight guests, share the home escape route and designated meeting place outside the home with them.

Honolulu Police Department (HPD) - HPD reported the following for District 4, Sector 3:

- October Statistics - There were 7 assaults, 13 auto/motorcycle thefts, 36 burglaries, 3 drugs/narcotics cases, 1 graffiti, 0 robberies, 50 thefts, and 15 unauthorized entry into a motor vehicle (UEMV) or thefts from autos.

Comments followed:

1. Residents were concerned about the number of recent burglaries and the need for Neighborhood Security Watch Teams.
2. It was reported that fights at Castle High School were after school and not "gang-related." The fights on You-tube were not at the same location. HPD is aware of the situation.
3. There were three drug busts/cases referred to the Federal Drug Enforcement Agency (DEA).

Board of Water Supply (BWS) - Barry Usagawa distributed the following report and was available to hear community concerns:

- Main Break Report: There were three water main breaks in the Kaneohe area during the month of October:
  - On October 9th, a 16-inch water main installed in 1951 broke at the intersection of Paleka Road and Kamehameha Highway.
  - On October 11th, a 6-inch water main installed in 1944 broke at 45-147 Waikalua.
  - On October 13th, a 6-inch water main broke at 45-512 Keaahala Road.
- Safety and Security at BWS Properties and Facilities
  - BWS has been proactive in its efforts to protect the safety of O'ahu's water supply from the increasing problem of theft and vandalism of public property. However, having the community as a partner to help the BWS keep an eye on its various properties, especially the remote ones, is something that is very important.
  - The BWS would like to remind everyone that should residents see any suspicious activity occurring at BWS facilities, please call the Honolulu Police Department first at 9-1-1. Law enforcement officials can respond quickly and work with the BWS in an investigation. If, after contacting the police, the community would like to give the BWS a follow up call, please dial the BWS's Security Office at 748-5911. BWS truly appreciates the assistance with helping to keep Oahu's water supply facilities safe.

Marine Corps Base Hawai`i (MCBH) - Sgt. Danny Woodall reported the following:

- MCAS Kaneohe Bay Hours of Operation: Monday - Thursday 7:00 a.m. - midnight; Friday, 7:00 a.m. - 10:00 p.m.; Saturday, 8:00 a.m. - 5:00 p.m. Closed Sundays and holidays. Exceptions: Saturday, November 12, 10:00 a.m. - 8:00 p.m. and Sunday, November 13, 9:00 a.m. - midnight. Pu'uloa Range Training Facility: Mon - Sunday, 7:00 a.m. - 5:00 p.m. Exceptions: None.
- News and Events:
  - November 10 - The 236th Birthday Pageant of the U.S. Marine Corps was held at Kainalu Elementary School in Kailua.
  - November 17 - MCB Hawaii Change of Command Ceremony. Col. Brian Annichiarico assumed command of MCBH
  - November 19 - 14th Annual Turkey Trot 10K Run on base, open to the public.

  - December 3 - Marines supporting the Kaneohe Christmas Parade with Color Guard and Band.
- Deployments: Deployed units include 3rd Battalion, 3rd Marine Regiment; Heavy Helicopter Squadron 363. 1st Battalion, 3rd Marine Regiment and 1st Battalion, 12th Marine Regiment are expected to return from Afghanistan this week.
- Announcements:
  - Osprey/H-I Draft Environmental Impact Statement (EIS) published in the Public Register; public meetings in the 2nd week of December. The Kaneohe public meeting is scheduled for December 8, at the Castle High School cafeteria. For more information, visit - http://www.mcbh.usmc.mil/mv22h1eis/.
  - For information regarding the 2011 Toys for Tots Hawaii collection effort, please call Chief Lorenzo Branch at the 4th Force Reconnaissance Company/Anti-Terrorism Battalion at 257-7148 or via cell at 348-4532.
- Community Notes & Reminders:
  - A "Friends of K-Bay" pass is required to access the Klipper Golf Course or K-Bay Lanes w/o Department of Defense (DoD) ID.
  - For more information about career opportunities at MCB Hawaii, please visit the MCCS site, www.mccshawaii.com, or call 254-7632.
  - Kaneohe Bay Air Show planned for September 29-30, 2012, and will include the U.S. Navy's Blue Angels.
  - For noise complaints or other concerns please call the Public Affairs Officer (PAO) at 257-8838 as soon as possible with the date and time of the incident. If you leave a message, please consider leaving your name and phone number for a reply.

TREASURER'S REPORT: No report was available.

PUBLIC INPUT AND RESIDENTS' CONCERNS: There were none.

ELECTED OFFICIALS' REPORTS

Councilmember Ikaika Anderson - Councilmember Anderson reported the following:
- Bill 47, Regulation of Non-commercial (Campaign) Signs - It was deferred to the December 7th meeting. It proposes 75 sq. ft. (three signs of 3 feet X 5 feet each) for residential and 150 sq. ft. for agricultural properties. A two-thirds vote (six votes) of the Council is needed to pass.
- Asia-Pacific Economic Cooperation (APEC) - The City over-budgeted for Asia-Pacific Economic Cooperation (APEC) by about $10 million.
- No Further Council Committee Meetings - There will be no further Council Committee meetings.
- 3 Talks - The next one will be on December 13, 2011, from 6:30 p.m. to 8:00 p.m. at the Kaneohe Community & Senior Center.
- Honolulu Reapportionment - District 3 would extend from Makapu'u to Waimanalo to Ahuimanu on the final map.
- E Komo Mai Bar Meeting - It was canceled, as the E Koko Mai people were advised not to attend by their attorneys.

Comments followed:
Chair Yanagihara asked Councilmember Anderson to arrange for a representative from the Honolulu Liquor Commission to attend the Board's next meeting.

Mayor Peter Carlisle's Representative - Sam Moku reported the following:
- Tradition House Foundation - Jody Solbach has not submitted a Conditional Use Permit (CUP) application yet. Department of Planning and Permitting (DPP) responded that it is unable to provide a response until it receives the address(es) or TMK(s), so it can monitor if and when Jody Solbach submits a Conditional Use Permit (CUP) application. (The September 15, 2011 meeting minutes were approved with corrections tonight.)
- Pahia Street Crosswalk -The Department of Transportation Services (DTS) previously conducted an evaluation, which included site observations and a review of the area's traffic history, and found that the marked crosswalk, pedestrian warning signs, and the recently installed pedestrian crossing pavement markings are appropriately installed and visible. We are actively looking for ways to improve safety. Currently, DTS is conducting a pilot project to evaluate the latest traffic control devices, such as the in-

pavement warning lights and overhead flashing lights to improve pedestrian safety at non-signalized crosswalks. DTS will be making evaluations on the effectiveness of these devices and using the data gathered to determine if and when it might be appropriate to utilize them at other locations throughout the island.

Comments followed:

1. Crosswalk in Front of Hawai'i Pacific University (HPU) on Kamehameha Highway - The flashing lights were installed. It was a long time coming.
2. Weeds Again - Mayor's Representative Moku offered to contact the State Department of Transportation (HDOT) again.
3. Savings of the APEC Budget - It was suggested that the $10 million savings could go to the Kaneohe Capital Improvement Projects (CIP).
4. Paving on Lilipuna Road - It was reported that the paving of the north side of Lilipuna Road by the Safeway near Pohaikea Point was uneven and was hazardous. Mayor's Representative Moku would visit the site after the meeting.

Governor Neil Abercrombie’s Representative - No representative was present and no report was available.

U.S. Representative Mazie Hirono - No representative was present and no report was available.

State Senator Jill Tokuda - No representative was present and no report was available.

State Senator Clayton Hee - No representative was present and no report was available.

State Representative Ken Ito - No representative was present and no report was available.

State Representative Pono Chong - No representative was present and no report was available.

COMMUNITY GROUPS AND ORGANIZATIONS

Hope Chapel - No representative was present and no report was available.

Hawai'i Pacific University (HPU) - Chris Aguinaldo reported the following:

- ‘Ride to Remember’ David Tyner this Sunday - HPU graduate student John David Tyner, who died in a multi-vehicle accident March 31, will be honored at a special “Ride to Remember” Nov. 20. It takes riders all over Oahu. The motorcycle ride in memory of the retired Navy Command Master Chief will benefit the David Tyner Memorial Scholarship for Diplomacy and Military Studies at HPU. The event is sponsored by the Naval Information Operations Command (NIOC) Hawaii Chief Petty Officers Association and HPU.
- Crosswalk Light Activated - Residents, pedestrians, students, faculty and staff, and community members now have a functioning crosswalk light on Kamehameha Highway. Thanks to the community for its support and mahalo to State Senator Jill Tokuda, who called the HDOT to follow up on the status of the project, which impacts public safety.
- Oceanic Institute Showcased Shrimp Tech Yesterday
  - OT, an affiliate of HPU, has pioneering technology that can gradually revolutionize the shrimp industry.
  - Shrimp can be grown effectively and at a larger size, with Hawai'i-developed technology. It took 10 years of research and development.
  - A demo was held yesterday, November 16, and was covered on KHON and KITV news stations.
- HPU Students, Faculty And Staff At APEC
  - Malaysian HPU students dined with Malaysia’s Prime Minister on Sunday night. Malaysia Honorary Consul former Hawaii Governor John Waihee was there.
  - Also, several students assisted the Peruvian delegation, including Christopher Ota from Aiea, who drove delegates to their APEC meetings.
  - Dr. Carlos Juarez, Chairman of HPU’s Department of Social Sciences, is Honorary Consul of Peru, and served as the translator for the Peruvian President and met several heads of state, including U.S. President Barack Obama, at the APEC Leaders Dinner.
- HPU Paul And Vi Loo Theatre Season Continues To December 4

- “The House of Blue Leaves” is in performance November 10 to December 4. Set in Sunnyside, Queens, on that 1965 day when Pope Paul VI visited New York, John Guare's early, breakthrough play features mockingly observed nuns, a lethal (but farcical) political bombing, a G.I. earmarked for Vietnam and, as a protagonist, a zoo keeper who dreams in vain of making it big in Hollywood as a songwriter. As if that weren’t enough countercultural loopiness, the zoo keeper, Artie Shaughnessy, has a wife named Bananas, who really is bananas and destined for the institution that provides the play’s title.

- HPU Gallery Exhibit Starts November 20 -
  - Kailua i ke oho o ka Malanai (Kailua in the wisps of the Malanai breeze), an exhibition featuring contemporary photographs (silver gelatin prints not digital images) of Mark Hamasaki and Kapulani Landgraf, collaboratively known as Piliāmo’o. The photographs document the significant cultural, geographical, historical places within Kailua. In an ancient epic of the goddess Pele and her family, “Kailua i ke oho o ka Malanai” is chanted by Hi’iaka, the youngest sister of Pele, while traveling through Kailua. The Malanai is known as a gentle breeze, contributing to “Kailua in the calm.” It runs November 20, 2011 to January 13, 2012.
- Reminder: HPU Graduation Ceremony, December 20
  - Ceremony is scheduled at the Neal Blaisdell Arena and Exhibition Hall on Tuesday, December 20, 2011 at 6:00 p.m.
  - Mandatory dress rehearsal is at 3:30 p.m. at the Neal Blaisdell Exhibition Hall. Come dressed in cap and gown.
  - Graduate line-up is at 5:30 p.m. and the ceremony begins promptly at 6:00 p.m. Doors open to guests at 5:30 p.m.
  - See http://www.hpu.edu/Graduation/index.html

Windward Community College (WCC) - No representative was present and no report was available.

UNFINISHED BUSINESS:

Emergency Preparedness Report

Amateur Radio Emergency Service - Clemens Jung, an amateur radio operator, presented a proposal to install amateur radio repeater antennas that would service Windward O'ahu from Makapu'u to Kahuku. The Pu'u Papaa site is at Kaneohe Ranch and there would be no cost to the public. The repeater would be placed in an existing white box on an existing pole. The site is safe, as radiation beyond 21.9 feet is considered safe by Federal standards. A Category IV hurricane could cut off the Windward-side communications and the Red Cross needs to contact 911.

Comments followed:

There were concerns over radio frequency radiation. The 75-foot high poles are 1,500 feet from the nearest neighbor. As mentioned earlier, radiation beyond 21.9 feet is considered safe by Federal standards. Jung wants to present this proposal to the Kailua Neighborhood Board No. 31 in January or February 2012. Amateur radio operators are licensed by the Federal government. Citizen Band (CB) radio does not have the range as amateur radio.

Flanigan moved; and Radke seconded that the Kaneohe Neighborhood Board No. 30 supports the installation of amateur radio repeater antennas at the Pu'u Papaa Ridge site by volunteer amateur radio operators for the purpose of providing communications support in emergencies or disasters. The Kaneohe Neighborhood Board No. 30 ADOPTED the resolution, 9-1-1 (**AYE**: Flanigan, Gavigan, Kaluhiwa, Makainai, Mueller, Radke, Sager, Siangco, and Yamashiro-Hironaka; **NAY**: Kaukani; **ABSTAIN**: Yanagihara)**.**

Resolution of the Kaneohe Neighborhood Board re installation of Repeater Antenna Atop Pu’u Papaa

WHEREAS, the Kaneohe Neighborhood Board No. 30 is concerned with planning and preparing our community in case of emergency and/or disaster; and

WHEREAS, establishing a reliable communications system is a vital part of emergency preparedness; and

WHEREAS, the existing communications systems could be impaired and would be inadequate to ensure communications in the event of a major emergency event; and

WHEREAS, Kaneohe and other Windward districts may be cut off from county, state, federal or military assistance for an extended period of time after an emergency event; and

WHEREAS, in times of crisis and natural disasters, amateur radio has proven to be an alternative means of emergency communications should conventional wired and wireless systems fail or become impaired; and

WHEREAS, our Board has recently been informed that a repeater antenna is needed to ensure more reliable amateur radio communications between Windward Oahu communities, the City & County of Honolulu Department of Emergency Management and the State Civil Defense; and

WHEREAS, it has been proposed that an amateur radio repeater will be installed and maintained by volunteer amateur radio operators at no cost to the government; and

WHEREAS, a presentation has been made to the Kaneohe Neighborhood Board No. 30 by volunteer amateur radio operators; and

WHEREAS, the Kaneohe Neighborhood Board No. 30 has considered the visual impact, radiological concerns and biological hazards that the installation of a radio repeater antenna on Pu’u Papaa would create and determined that the impact would be minimal or negligible and that the potential benefit of the site considerable should an emergency arise;

NOW, THEREFORE, BE IT RESOLVED, that the Kaneohe Neighborhood Board No. 30 supports the installation of amateur radio repeater antennas at the Pu'u Papaa Ridge site by volunteer amateur radio operators for the purpose of providing communications support in emergencies or disasters; and

BE IT FURTHER RESOLVED that copies of this resolution be sent to the Mayor of the City & County of Honolulu, all City Council members and to Kaneohe Ranch, who is the owner of the site located on the Pu'u Papaa Ridge.

The Kaneohe Neighborhood Board No. 30 adopted this resolution by a majority vote, 9-1-1, at its meeting on November 17, 2011.

Submitted by:
Roy Yanagihara, Chair

Ko'olau Poko Watershed Management Plan (KWMP) Presentation - The Ko'olau Poko Watershed Management Plan (KWMP) highlights were presented. It has 500 pages and is required by the State Water Code. This was the third of four Neighborhood Board presentations. Highlights included that future projections include a 4% decline in population, but industrial and agricultural water use may increase. There is a need for more farmers. Historical data may not be reliable for future variables, like global climate changes or sea level rising. Board of Water Supply (BWS) has plans for increases in water sources and droughts.

Flanigan moved; and Sager seconded that the Kaneohe Neighborhood Board No. 30, while recognizing the difficulty of including the effects of global climatic change in the projections included in the report, the Board desires to express its support for the plan, noting the reservations express herein. The motion was ADOPTED by UNANIMOUS CONSENT, 11-0-0 (**AYE**: Flanigan, Gavigan, Kaluhiwa, Kaukani, Makainai, Mueller, Radke, Sager, Siangco, Yamashiro-Hironaka, and Yanagihara)**.**

Resolution on the Ko'olau Poko Watershed Management Plan

WHEREAS, the Ko'olau Poko Watershed Management Plan (KWMP) has an excellent analysis of present and needed projects within the planning area; and

WHEREAS, the Ko'olau Poko Watershed Management Plan (KWMP) has been drafted that presents an analysis of present and projected water usage needs for the study area which includes Kaneohe;

WHEREAS, the KWMP has a planning time frame of 20 years; and

WHEREAS, historic sustainable water supply cannot be relied on for the future due to the probable impacts of climate change; and

WHEREAS, the Ko'olau Poko Watershed is especially vulnerable to drought because our dike system does not retain water for extended periods of time; and

WHEREAS, there are no programs addressing the maintenance of quality watersheds and the inevitable impacts of invasive species on future water supplies; and

WHEREAS, the impacts of climate change will invalidate the water availability assumptions of this plan; and

WHEREAS, the impacts of climate change on future water supplies have been identified in a document prepared by the Ocean Resources Management Plan Working Group with the assistance of the University of Hawaii, Center for Island Climate Adaptation and Policy; and

WHEREAS, none of the following probable climate change impacts of water supply have been addressed in the Ko'olau Poko Watershed Management Plan:

- Sea level rise impacts water quality and quantity
- Water quality degradation from the intrusion of salt water into fresh and brackish water aquifers and stream estuaries as sea level rises
- As coastal communities retreat from the coast, development pressures will increase in agricultural and conservation zoned lands. Increased urbanization may reduce prime recharge areas (> 50” annual rainfall) affecting water supply.
- Sea level rise immerses more metallic pipeline infrastructure in seawater increasing corrosion, main breakers and replacement costs.
- Climate change reduces aquifer recharge and available water supply
- More frequent and severe drought
- Changes in rainfall patterns, such as thermal inversion effects - Higher evaporation due to higher global temperatures reduces recharge
- Increased runoff if forest health declines
- Climate change increases water demand
- Higher evapo-transpiration rates in landscaping due to warmer temperatures
- Higher evapo-transpiration rates in landscaping due to warmer temperatures
- Population growth and migration from inundated Pacific islands
- Increased capital costs and water rates to develop alternative water supply
- Expansion of recycled water treatment and systems for irrigation and brackish water supplies
- Expansion of brackish and seawater desalination to supplement natural potable water supplies
- Brine concentrate discharge in ocean outfalls threatens coastal zone and shallow waterway ecosystems unless mitigated, which increases cost.
- Increased capital costs to harden water delivery, communication and emergency response facilities from more severe and frequent hurricanes caused by climate change.

WHEREAS, the Board of Water Supply chose a planning time frame that may not see the most severe impacts of climate change and therefore, did not require the potential impacts of climate change to be considered by the planners; now

THEREFORE, BE IT RESOLVED, the Kaneohe Neighborhood Board No. 30 recognizes the detailed work and analysis contained in the report to document current water usage and projected needs in the future; and

BE IT FURTHER RESOLVED, that the Kaneohe Neighborhood Board No. 30, while recognizing the difficulty of including the effects of global climatic change in the projections included in the report, the Board desires to express its support for the plan, noting the reservations express herein; and

BE IT FURTHER RESOLVED, that this resolution be distributed to the Mayor of the City & County of Honolulu and to the Director of the Board of Water Supply.

The Kaneohe Neighborhood Board No. 30 adopted this resolution by a unanimous vote, 11-0-0, at its meeting on November 17, 2011.

Submitted by:
Roy Yanagihara, Chair

Resolution Voicing Concerns Over the Inter-island Power Cable and Wind Farm Project - Andrea Jepson was not present and no report was available.

NEW BUSINESS:

Hawaii Job Corp Outreach and Admission - T.S. Tuiteleleapaga presented information about the Hawai'i Job Corps. It offers job training and jobs for youth in Waimanalo. Jobs for the building trades are available as well as for the health occupations, culinary arts, automotive, landscaping, and facilities maintenance. It is all free and open to 18 to 24 year-olds, with priority to veterans and low-income individuals. This program is funded by the U.S. Department of Labor. There is a residential program for youth 16 to 18 years of age. Graduates have an 87% employment rate. Tuiteleleapaga invited the Board for a tour and he will arrange for the culinary arts students to cook the meal. A brochure was available.

Presentation on Haiku Valley Plan - Bruce Tsuchida presented the Haiku Valley Cultural Preserve Plan by the non-profit Ko'olau Foundation. The project is mauka of H-3 and not at the Coast Guard site. They have native plants, two heiau, gardens, and security.
Comments followed:

1. One of the entrances into the project is behind a residential area. It may need widening.
2. The State Department of Hawaiian Homes Lands (DHHL) owns a small parcel and it may not be worth it to put in infrastructure.
3. Five years ago, the Kaneohe Neighborhood Board No. 30 approved a cultural preserve after the Coast Guard leaves.
4. It was asked if the foundation could purchase a corner house for access.

COMMITTEE REPORTS

Legislative, State Legislature Committee, City & County Ordinance Committee, Public Health & Safety, Mental Health Committee, Public Safety Committee, Planning Committee, Transportation Committee, Environmental Committee, Windward Civilian/Military Committee, O'ahu Metropolitan Planning Organization (OMPO) Citizen Advisory Committee, Neighborhood Board Website Contact Committee, Publicity Committee, Haiku Stairs Special Task Force, and Special Information Gathering Committee Bar and Cabaret Licenses - No reports.

Education Committee - Chair Maurice Radke reported that there will be a Castle High School re-design meeting.

Emergency Management Plan Committee - Chair William Sager announced that there will be a Windward Neighborhood Security Watch (NSW) meeting at Aikahi School to prevent crime in the Kalaheo/Aikahi areas.

ANNOUNCEMENTS:

- Next Agenda Planning & Committees' Meeting - The next Agenda Planning and Committees' Meeting will be held on Tuesday, December 6, 2011, Kaneohe Community and Senior Center, 7:00 p.m.
- Next Kaneohe Neighborhood Board No. 30 Regular Meeting - The next Kaneohe Neighborhood Board No. 30 regular meeting will take place at the Benjamin Parker School Cafetorium on Thursday, December 15, 2011 at 7:00 p.m. It will be a short meeting with refreshments to celebrate the holiday season. PLEASE MARK YOUR CALENDARS.

ADJOURNMENT: The meeting adjourned at 9:04 p.m.

Submitted by: K. Russell Ho, Neighborhood Assistant

Not reviewed by: Bill Sager, Secretary and Roy Yanagihara, Chair

KAILUA NEIGHBORHOOD BOARD NO. 31

HONOLULU HALE, ROOM 406 • 530 SOUTH KING STREET • HONOLULU, HAWAI`I 96813 U.S.A.
TEL: (808) 768-3710 • FAX: (808) 768-3711 • EMAIL: nco@honolulu.gov • INTERNET http:///www1.honolulu.gov/nco

<u>DRAFT</u> REGULAR MEERTING MINUTES
THURSDAY, NOVEMBER 3, 2011
KAILUA RECREATION CENTER

<u>CALL TO ORDER</u>: Chair Chuck Prentiss called the meeting to order at 7:04 p.m. **with a quorum of 15 members present.** Note – This 19-member Board requires 10 members to establish quorum and to take official action.

<u>Members Present</u>: Joseph Aiona, Larry Bartley, Jon Chinen (left 8:30 p.m.), Pamela DaGrossa, Douglas Dudevoir, Derrick Fenske, Debbi Glanstein, Michael Hawes, William Hicks, Michael Hirao, Charles Prentiss, Ursula Retherford, Randy Rodriguez, Claudine Tomasa, Kelly Tomioka (arrived 8:35p.m.), and Donna Wong.

<u>Members Absent</u>: Michael Green, Knud Lingard, and Ronald Weinberg.

<u>Vacancy</u>: There are no vacancies at this time.

<u>Guests</u>: Derek Tamura, Art Machado (Pali Lanes), Bruce Tsuchida (Townscape, Inc.), Councilmember Ikaika Anderson, JD Aweau (Councilmember Anderson's Office staff), Senator Pohai Ryan, Representative Chris Lee, Laurel Leslie, Nani Nikcevich; Stan and Barbara Krasniewski; Lt. Dave Eber (Honolulu Police Department), Maria T. Go~~m~~rak (Homeless Animals); Battalion Chief Sacrates Bratakos and Acting Captain David Taratko (Honolulu Fire Department); Joe Gilman, Bob Twogood (Twogood Kayaks), Barry Usugawa (Board of Water Supply), Tinkle Malama (Videographer) and Gloria J. P. Gaines (Neighborhood Commission Office staff).;

<u>ANNOUNCEMENTS</u>: Member DaGrossa reminded residents that the Kailua Neighborhood Board No. 31 places a donation box at each meeting for used cell phones, non-perishable canned foods and paper products to distribute to appropriate services agencies and encouraged everyone to participate.

<u>PUBLIC SAFETY AGENCIES</u>:

<u>Honolulu Fire Department (HFD)</u> – Acting Captain David Taratko reported the following:

- <u>Statistics for October 2011</u> – Included 23 structure, 5 wildland, 3 rubbish, and 1 vehicle fire; 118 medical emergencies, 8 search and rescues and 11 miscellaneous calls for service. No Major or unusual incidents were reported.
- <u>Safety Tip for the Holidays</u> – Consider a fire-resistant, artificial Christmas tree. If a real tree is purchases, choose one as fresh as possible, keep hydrated, and away from heat sources. Use noncombustible materials for decorations. Choose only Underwriter's Laboratory-approved electrical decorations and follow the manufacturer's instructions for installation and usage. Do not overload extension cords.
- <u>Safety Tip when Cooking</u> – If you must leave the stove, turn it off. Unattended cooking is the number one cause of home fires. Have a metal lid ready to cover grease fires in pans. Never wear long, loose-sleeved clothing while cooking. Turn the handles on pots and pans inward to prevent accidents. Keep children away from cooking areas.

<u>Honolulu Fire Prevention Bureau (HFPB)</u> – Battalion Chief Socrates Bratakos clarified the fire flow and hydrant spacing requirements of the Honolulu Fire Department. Members were provided a copy.

- <u>BWS Fire Code Interpretation</u> – In a residential neighborhood on Oahu the fire hydrants must be capable of applying 1,000 gallons a minute for one hour and the average spacing must be 350 feet apart. This is a City Ordinance standard that the Board of Water Supply (BWS) uses as their guideline. Some areas of Oahu are not up to the standards described because of a transition in the 1970's to BWS took over the fire hydrants in some of the outlining areas of the City like Kaneohe and Kailua (during the 1970's). These standards apply to those residential areas on public roads and streets and are governed by BWS.
- <u>BWS</u> – BWS interprets the fire hydrant standards for a home renovation permit by taking half the distance or 175 feet. If the center of the driveway is more than 175 feet away from the fire hydrant that would be

too far. A recommendation by HFD was to either bring the fire hydrants closer or install fire sprinkler system in the home. BWS starting enforcing the fire flow and hydrant spacing requirements April 2011. Due to the number of complaints received BWS and HFD held a series of meetings. The question was if the house was 350 feet away from the hydrant would HFD be okay with that?

- HFD Interpretation – Although the 350 feet away fire hydrant requirement is City Ordinance standard, that would not impact the fire fighting operations, and therefore is "okay" with that. A memorandum of agreement was signed by Fire Chief Kenneth Silva and Acting Chief Engineer Dean Nakano. Thirty-five out of the 40 permit applications for home renovations were satisfied by the decision.
- Fire Code – On private property and down private lanes is the jurisdiction of the HFD and the Fire Code. According to the Fire Code, if the single dwelling private property if in excess of 150 feet from a fire hydrant, the Fire Code requires that another onsite water supply source is provided when required by the Fire Chief. Exceptions include installing a fire protection sprinkler system, use of tanks, reservoir with pumps, and any other requirements modified by the Fire Chief. Battalion Chief Bratakos added that you can be further away and sprinkler the house to provide adequate fire protection for your home as specified in the Fire Code. The Fire Codes are minimum standards for safety. Battalion Chief Bratakos presented a short fire fighting story to provide understanding of how HFD and BWS operate and why the fire hydrant standards apply.

Questions, comments, and concerns followed:

1. Enforcement – Member Bartley was concerned about what prompted the enforcements by BWS? Battalion Chief Bratakos stated the question is better answered by BWS and will not make implications of BWS.
2. Map of Kailua Neighborhood – Member Hicks presented the map of a Kailua neighborhood that showed a large number of homes were in excess of 175 feet from the nearest fire hydrant. Battalion Chief Bratakos clarified that those homes have adequate fire protection by HFD.

The following questions, comments, and concerns were addressed to BWS representative Mr. Kurt Tsue:

3. BWS Comment – Kurt Tsue stated pending permit applicants were all contacted and informed that their permits will be moving forward through BWS and through the permit process. BWS also extended their apologies for the inconvenience. Enforcement of the fire hydrant standards were not identified earlier and it was a situation identified by the manager that the standards were not being complied with as they should have made the call to put a hold on the permit applications.
4. Informing Public – Member Wong raised a concern about BWS including new policies informing the public ahead of time of similar situations that may arise in the future. Mr. Tsue stated a change in the standards would require public comment. This case was not a policy change, but a change in interpretation of the Fire Code.
5. BWS Monthly Billing – Member Retherford raised a concern about the BWS monthly billing when people already have the option to pay the water bill in installments. Also, people are short of money these days.
6. Building Permit Concern – A resident raised a concern that he applied for a similar building permit in 2009 and was required to install a new water meter and a sprinkler system and would like his situation reviewed. Mr. Tsue will work with resident with BWS service engineer.

Honolulu Police Department (HPD) – Lieutenant Dave Eber provided members with a report and highlighted the following:

- Statistics for October 2011 – Included 15 assaults, 15 auto/motorcycle thefts, 37 burglaries, 3 drugs/narcotics offense, 1 graffiti, 1 robbery, 46 thefts, and 53 unauthorized entries to a motor vehicle (UEMV). There were an increase in burglaries and UEMV. A fingerprint was identified and the arrest for burglary was made. The number of burglaries should decrease with the recent arrest.

Questions, comments, and concerns followed:

1. Comparison Report – Member Retherford would like to hear a statistics report of comparisons by percentages. Also questioned whether the Lanikai and beach park statistics includes the residential area of Lanikai.

2. Parking Problem in Lanikai – Member Bartley received illegal parking complaints from Lanikai residents especially during the weekends and request HPD monitor that area. Lt. Eber stated the officers on the Cushman carts issue illegal parking citations in business areas only.
3. Assaults in Maunawili and Olomana – Lt. Eber stated incidents occurred at Kailua High School, Hale Kipa homes, or juvenile facility may be the reason for the high number of assaults in the Maunawili and Olomana area.
4. Reporting Illegal Drug Activity – Member Hicks raised a concern about reporting drug activity at Kailua Beach Park. Lt. Eber stated officers refer all suspicious activity calls to HPD's Crime Reduction Unit.
5. Illegal Left Turn – Member Aiona requested HPD officers monitor the illegal left /right turns off of Kalanianaole Hwy between 6:00 a.m. and 7:15 a.m. at the intersection of the Hawaiian Electric Transfer Station and Maunawili Elementary School. He has noticed more cars taking the illegal turns during that time.

Marine Corps Base Hawaii (MCBH) – Sgt. Withington reported the following:

- Hours of Operation – Mondays through Thursdays from 7:00 a.m. to midnight; Fridays from 7:00 a.m. to 10:00 p.m.; and Saturdays from 8:00 a.m. to 5:00 p.m. Closed Sundays and holidays.
- November 2011 Events –
  - November 8th – Marine Corps Birthday Pageant at Kainalu Elementary School at 12:45 p.m.
  - November 9th – Marine Corps Birthday Pageant at Marine Corps Base Hawaii at 10:00 a.m.
  - November 19th – 14th Annual Turkey Trot 10k Run on base, open to the public
- Deployments – Deployed units include 1st Battalion, 3rd Marine Regiment; 1st Battalion, 12th Marine Regiment; and Heavy Helicopter Squadron 363. Third Battalion, 3rd Marine Regiment just deployed to Afghanistan earlier this week.
- Announcements –
  - The Marine Corps birthday is November 10th. Many units will have elaborate ceremonies to celebrate this event in early November.
  - Osprey/H-1 Draft Environmental Impact Study expected to be published mid-November and public meetings planned for the first week of December on Oahu.
  - For more information about career opportunities at MCB Hawaii, please visit the MCCS site, www.mccshawaii.com or call 254-7632.
  - The first four CH-53E helicopters to replace the CH-53Ds arrived September 2011.
  - For noise complaints call the PAO at 257-8832/8838 as soon as possible with the date and time of the incident. If you leave a message please consider leaving your name and phone number for a reply.
  - Kaneohe Bay air Show planned for September 29-30, 2012, and will include the U.S. Navy's Blue Angels.

RESIDENT AND COMMUNITY CONCERNS:

Proposed Speed Skating Route – Derrick Tamura provided members with a handout proposing the First Annual International Speed Skating Federation Marathon route on Oahu for November 2012. The route will begin in Kailua, through the southern coast of Waimanalo on Kalanianaole Highway and finish at Kaka`ako Waterfront Park with ceremonies and festival. The race will be promoted nationally and internationally by the internationally recognized "Hawaiian Skaters" race team that currently holds five world records. Estimate 1,000 skaters with a gallery of 5,000. Permits required would be similar to the annual Honolulu Marathon. Staging would be near where the new Target Store on Hamakua Drive is located. Mr. Tamura will keep the Board apprised of the proposed Speed Skating Marathon.

Senate Bill 266 – Maria Gorak stated Senate Bill 266 related to cruelty to animals did not pass during the last legislative session and seek the Board's support at the 2012 legislative session. She also encouraged residents to write letters supporting Senate Bill 266.

Pali Lanes – Owner Art Machado provided members with a handout of Pali Lanes activities offered to the community. Twenty-two schools use the bowling facility at Pali Lanes. Most recent was Kailua Elementary School's 144 students that incorporated bowling into their curriculum. Mondays through Fridays special aide and handicapped accessible programs are available. Pali Lanes also accommodate events for non-profit organizations, like the Cancer Society.
Questions, comments, and concerns followed:

1. Appreciation – Member Aiona expressed his appreciation for keeping Pali Lanes open.
2. Recycling Center – The contract was terminated by Kaneohe Ranch who had concerns about the homeless at the recycling center.

ELECTED OFFICIALS:

Representative Pono Chong – A representative or report was not available.

Representative Cynthia Thielen – A report was submitted.

Representative Chris Lee – Representative Lee provided members with a report and highlighted the following:

- Traffic – Kailua Beach Park traffic includes cars stopping for beach park roadside parking, at Kalapawai Market intersection, and the increase of visitors to Kailua and Lanikai beaches. Representative Lee will discuss the Kailua Beach traffic concerns with the City and State officials.
- Tax Enforcement Division – To prohibit further proliferation of illegal commercial activity at Kailua Beach Park Representative Lee asked the State's Tax Enforcement Division inspectors to monitor the area. Fines for illegal operators who refuse to abide by the law can be as high as $2,000 per incident.
- Advertisements in Schools – The Board of Education (BOE) is supporting a plan allowing advertising in public schools to raise money. Advertisements would be limited to corporate logos and brief messages. Supporting Coke or Pepsi logos may contradict messages schools are trying to promote, like eating healthy foods. Other states found that advertising in schools can compromise education. Instead of resorting to bring private corporations into public schools, the BOE should see that our schools are properly funded by the State.
- Budget Cuts – Avoiding budget cuts and not raising taxes will be hard to do ~~come~~ at the next legislative session.

Questions, comments, and concerns followed:

- Crew Signs – Member Wong noticed the crew directional signs posted along the Kailua bound side of the highway coming down from the Pali Tunnel and raised a concern about the movie people filming during the night in the Maunawili community.
- Illegal Left Turn – Representative Lee will follow up on Member Aiona concern about the illegal left turn on Kalanianaole Highway at the HECO transfer station and Maunawili Elementary School intersection.
- Tax Credit – Member Hicks raised a concern about the photo voltaic solar panel tax credit and whether if the tax credit would stop would people be able to be "grandfathered-in" to get the tax credit? Rep. Lee stated photo voltaic industry has grown and he doesn't expect the tax credit to end. Chair Prentiss added that the tax department has a T.I.R. letter on their website addressing their position on the one or two system photo voltaic panel that started raising concerns about the tax credit.
- Appreciation – Member Retherford extended her appreciation for all that Representative Lee does and supported his position on corporate advertising in public schools.

Councilmember Ikaika Anderson – Councilmember Anderson provided members with a report and highlighted the following:

- Sprinkler/Fire Hydrant – Councilmember Anderson stated that with Council Chair Ernie Martin and Representative Thielen worked together with BWS and HFD towards the solution to the recent building modification requirement of sprinklers or fire hydrants may be required in certain instances. He also extended his appreciation for everyone's involvement in getting that approved.
- City Park Rules – Councilmember Anderson met with Department of Parks and Recreation Director Gary Cabato and is working on the revisions to the existing park rules with his staff before presenting for public input. Councilmember Anderson will continue to work with Director Cabato towards protecting residents access to all beach areas and limited commercial activities be permitted.
- Bill 47 – Bill 47, regulating non-commercial signs was deferred at Wednesday, November 2, 2011 City Council meeting. This is the third time this bill has been deferred. This bill would place a limitation on non-commercial signs including political signs and is currently being amended to a maximum total of square footage of signs.

- 3-Talks Meeting – The next 3-Talks meeting will be Tuesday, November 15, 2011 at Waimanalo Public Library.

Questions, comments, and concerns followed:

1. Rail Resolution – Member Wong raised a concern about the rail resolution introduced by Councilmember Tom Berg and why City Council felt necessary to dispense of it so rapidly. Member Wong stated in light of new information that City Council did not act on the public's best interest by not allowing the Councilmember Berg's resolution go further to public discussions on the merits of the resolution.
2. Landfill Site – Councilmember position on the landfill remains the same. That the Waimanalo Gulch land fill remains open until it reaches its capacity which is another 15-20 years.

Senator Pohai Ryan – Senator Ryan provided members with a report and highlighted the following:

- Ameron – Ameron informed Senator Ryan that there is no shortage of cement. Also, Ameron does not support a landfill at that site once Ameron is done with the quarry. It was the previous City Administration that was targeting Kapa`a Quarry for a landfill site.
- Geothermal Summit Broadcast – A three-hour airing of the Geothermal Summit held Saturday, October 15, 2011 at the Hawaii National Guard Training Center Auditorium in Waimanalo can be viewed on December 24th at 7:00 p.m. on Channel 54; December 26th at 8:00 a.m. on Channel 49; December 29th at 10:30 a.m. on Channel 52; and December 30th at 9:00 a.m. on Channel 54.
- Donation – Acknowledgement was expressed to Dog "the Bounty Hunter" Chapman and wife Beth Chapman for their generous $4,500 donation assisting the Hawaii Kai community for the restoration of beach access known as Hanapepe Brow.
- Marine Operations in Urban Terrain (MOUT) Training – On Friday, October 21, 2011Senator Ryan attended the MOUT training demonstration simulating the realistic deployment environment of a Middle East village in Bellows; including visuals, sounds, and smell. Role playing exercises conducted by American Afghani actors.
- Drug Sales Activity – Senator Ryan will follow up on the drug sales activity occurring at Kailua Beach Park.
- Crew Signs – The crew signs are directions for the film crew. Member Wong raised a concern that the community needs to know what the signs are for.

Mayor Peter Carlisle's Office – Alenka Remec reported the following:

1. Asian-Pacific Economic Cooperation (APEC) – Ms. Remec reminded residents of the APEC Conference next week on Oahu from Monday November 7 to Sunday, November 13, 2011. For information regarding City services during APEC visit the City website at Honolulu.gov and click on APEC City Service Information Page. There will be temporary road closure information and suggested routes to take. The primary area of impact will be at the Honolulu Convention Center and Ewa side of Waikiki. Residents should to plan the day accordingly with extra traveling time due to traffic. For security reasons, exact times of road closures are unknown. For more information visit the City's website at Honolulu.gov.
2. Tsunami Zone Signage – The Department of Emergency Management (DEM) is contracting a consultant to complete an evacuation study to provide a baseline. Once completed, DEM will meet with the community to implement the project. Funding may be provided by a Tsunami Grant via Hawaii State Civil Defense.
3. Kaelepulu Stream Berm – Kaelepulu was the first stream to be breached island wide since the U.S. Army Corps permit was issued. Department of Facilities Maintenance (DFM) is currently working on removing sand plugs for streams that have not been breached since 2010. DFM will monitor the stream and if needed will send a crew out to open the stream to minimize flooding under emergency conditions.
4. Concrete for Rail – Sand for concrete will also be coming in from Maui. As for the Ameron Kapaa site for a landfill, no site has been selected at this time, and the Mayor's Landfill Site Selection Committee continues to meet.
5. Keolu Drive and Akumu Street – According to the City's Department of Design and Construction, curb ramps already exist at all four corners of Keolu Drive and Akumu Street intersection and need clarification.
6. Code for America – The City was given a grant for programmers to update the City system. The Code for America program is a software development contract where people will be hired full time to develop ideas into applications that will benefit our city, such as developing an application for the City's bus route. The Code for America program will give the City the ability to expand services. Submit your ideas on how to

improve the City's system of getting more services to the community by visiting Citycamhnl.govfresh.com or call 768-9999 and leave a voice message.

Questions, comments, and concerns followed:

1. Playground Equipment Repaired – Member Fenske stated the playground apparatus is still taped off at the Kailua District Park and would like to know how soon playground equipment can be repaired; as this is a heavily used park.
2. Hawaii Five-O – Member Wong raised concerns about Hawaii Five-O filming activity in Maunawili with the use of bright lights during the night. For assistance, contact the City's Film Commission Office.

Senator Jill Tokuda – A representative or report was not available.

At 8:30 p.m., Member Chinen left the meeting; **14 members present.**

OLD BUSINESS:

Koolaupoko Watershed Management Plan, Townscape, Incorporated – **DaGrossa moved and Aiona seconded that the Kailua Neighborhood Board No. 31 support the Koolaupoko Watershed Management Plan with the exception of the listing of projects. The motion WAS ADOPTED, 14-0-0,** (**AYES:** Aiona, Bartley, DaGrossa, Dudevoir, Fenske, Glanstein, Hawes, Hicks, Hirao, Prentiss, Retherford, Rodriguez, Tomasa, and Wong; **NAYES:** None; **ABSTENTIONS:** None).

Board of Water Supply fire Protection Requirements – This item was previously reported under HFD report.

PARKS COMMITTEE MOTION: **The Kailua Neighborhood Board No. 31 requests the City and County to research, review, and implement more location-appropriate mandatory specifications for its construction projects, including the minimum useful life expectancy of structures.** Member Bartley stated the issue is the lousy construction of the comfort stations at Kailua Beach Park. The City should require that comfort stations be built to withstand the weather and salty air elements. City does not give specifications for comfort stations at beach parks. Therefore, Member Bartley recommended the City to do a type specification of a minimal life expectancy to all City structures. The Uniform Building Code addresses safety issues, not life expectancy. **The motion WAS ADOPTED, 14-0-0** (**AYES:** Aiona, Bartley, DaGrossa, Dudevoir, Fenske, Glanstein, Hawes, Hicks, Hirao, Prentiss, Retherford, Rodriguez, Tomasa, and Wong; **NAYES:** None; **ABSTENTIONS:** None).

At 8:35 p.m., Member Tomioka arrived; **15 members present.**

APPROVAL OF MINUTES: **There being no objections, the Kailua Neighborhood Board No. 31 approved the October 6, 2011 regular meeting minutes as corrected. The MOTION WAS ADOPTED, 14-0-1** (**AYES:** Aiona, Bartley, DaGrossa, Dudevoir, Fenske, Glanstein, Hawes, Hicks, Hirao, Prentiss, Retherford, Rodriguez, Tomasa, and Tomioka; **NAYS:** None; **ABSTENTIONS:** Wong). The corrections are as follows:

- Page 4, first paragraph, delete last sentence and replace with, **"Member Retherford pointed out that under the present bi-monthly billing system, customers are given the option of paying the bill in two installments. The proposed monthly bulling does not help customers to budget better, and would incur an additional $5.00 billing fee, which is not fair."**
- Page 4, under Enchanted Lake Association (ELA), last sentence, delete "levy" and replace with **"levee".**
- Page 5, under Senator Jill Tokuda, Questions, comments, and concerns, item 2, insert **"…in the cost…"**after the word, "increase" and before the word, "of "**.**
- Page 6, under Presentations, Drug Houses in the Community, How Can you Help, second sentence, the correct word should be, **"… intolerant…",** not "tolerant".
- Page 7, item 1, Civil Action, second sentence, delete "…to not allow…" and replace with **"…for not allowing…"**

COMMITTEE REPORTS:

Permitted Interaction Group, Kailua Beach Park – Chair Bartley stated he has not heard from DPR Director Gary Cabato in response to his ideas regarding the assignment of the concession to a single vendor.

Transportation and Public Works – Chair Prentiss stated he is also waiting to hear from the City Department of Transportation Services (DTS) regarding Kailua projects. There will be an update on the Kailua Transit Center by DTS consultant at the next Planning and Zoning meeting.

Public Health, Public Safety and Civil Defense Committee – Chair Tomasa reported on the subcommittee's efforts towards Kailua being recognized and certified as a "Storm Ready/Tsunami Ready Community" by the National Weather Service (NWS) and National Oceanic and Atmospheric Administration (NOAA):

- April to November 2011 – Outreach activities to educate the public about disaster preparedness to reduce the impact of a disaster upon the community. Visited and conducted information meetings with faith-based groups in Kailua, Waimanalo, Kaneohe, and Kahaluu. Also conducted site visits at both public and private schools in Kailua to assure each school has a functioning NOAA radio and an emergency plan.
- September, 2011 – Kailua's first annual Emergency Preparedness Fair.
- November, 2011 – The NWS and NOAA application with the Multi-Hazard Mitigation Plan for Kailua will be submitted November, 2011. Kaneohe MCBH will also submit their application.
- December, 2011 – A visit from NWS/NOAA Inspectors is expected.
- January, 2012 – Kailua and Kaneohe MCBH to be officially recognized by NWS/NOAA as a Storm Ready/Tsunami Ready Community. NWS/NOAA to provide official recognition signs to post at the entrance to Kailua and Kaneohe MCBH.
- Subcommittee Meeting – The next subcommittee meeting is Tuesday, November 22, 2011, 6:00 p.m. to 8:30 p.m. at the LeJardin Academy High School Building.

Government and Community Services – There were no updates to report.

Planning, Zoning and Environment – Chair Wong stated the final recommendations to the General Plan will be presented at the December 2011 Board meeting.

Parks and Recreation –The committee is reviewing the proposed resolutions regarding the commercial activities on public beaches. Also, there has been no further movement on Bill 5 (2010) prohibiting commercial activities at public beaches on Sundays which is held up in committee.

Civilian-Military Council – There were no updates to report.

Chair's Report – No Committee meetings scheduled for December, 2011. Committee reports for December Board meeting due to Chair by Sunday, November 20th. Also due on November 20th are committee agendas for January, 2012. The Board will recess in January, 2012.

ADJOURNMENT: The meeting adjourned 8:58 p.m.

Submitted By: Gloria J.P. Gaines, Neighborhood Assistant

Reviewed By: Chuck Prentiss, Chair

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WAIMANALO NEIGHBORHOOD BOARD NO. 32

HONOLULU HALE, ROOM 406 • 530 SOUTH KING STREET • WAIMANALO, HAWAI`I 96813 U.S.A.
TEL: (808)768-3710 • FAX (808)768-3711 • E-MAIL: nco@honolulu.gov• INTERNET: http://www1.honolulu.gov/nco

DRAFT REGULAR MEETING MINUTES
MONDAY, OCTOBER 10, 2011
WAIMANALO PUBLIC AND SCHOOL LIBRARY

CALL TO ORDER: Chair Wilson Kekoa Ho called the meeting to order at 7:30 p.m. with a quorum of **(eight) 8 members present.** Note – This 13-member Board requires seven (7) members to establish quorum and to take official Board action.

Members Present: Shannon Alivado, Rosina Ho, Wilson Kekoa Ho, Andrew Jamila, Jr., Ryan Kalama, Maynard Beany Koa, Bob Lastimosa, Marvelle Kuulei Laughlin, and Shelly Texeira-Vickery (appointed this meeting).

Members Absent: Nani Akeo.

Vacancies: There are four vacancies: Subdistrict 1, 2, 5, and 6.

Guests: Bruce Tsuchida (Townscape, Inc.), Representative Chris Lee, Renwick and June Toguchi Tassill, Blanche McMillan; Kris and Ken Lesperance; Craig Gorsuch and Nhut Dao (Bellows Air Force); Sgt. Kawamoto (Honolulu Police Department), Capt. Norbert K. Pokini (Honolulu Fire Department), Kawehi Kanui-Gill, Paul Marquez; John and Lorraine Hoapili; Lauree Nakata (Job Corps), City Managing Director Douglas Chin, Senator Pohai Ryan, City Councilmember Ikaika Anderson, Keoni and Cyndy Aylette (Mayor's Representative); Dave Amodo and Dayton Oshiro (Videographers), and Gloria J.P. Gaines (Neighborhood Commission Office staff).

Pule: Chair Ho welcomed everyone to the meeting and noted the meeting usually begins with an open prayer. Chair Ho also stated if prayer offends anyone that they should leave at this time. Member Laughlin offered pule.

FILLING OF VACANCIES:

Subdistrict 1 (Flamingo Street, Saddle City, Bellows, and Country Homes on Kailua side of Kumuhao Street) – There were no volunteers or nominations at this time.

Subdistrict 2 (Humuniki) – There were no volunteers or nominations at this time.

Subdistrict 5 (Waimanalo Village) – **Member Jamila nominated Shelly Texeira-Vickery for Subdistrict 5 vacancy. There being no other nominations, Shelly Texeira-Vickery was appointed to Subdistrict 5 by acclamation, 8-0-0 (AYES:** Alivado, R. Ho, W.K. Ho, Jamila, Kalama, Koa, Lastimosa, and Laughlin; **NAYS:** None; **ABSTENTIONS:** None). Ms. Texeira-Vickery provided a brief background of herself as the former resident manager of Waimanalo Village for 17 years. A short recess was called and the oath of office was administered by Neighborhood Assistant Gloria J.P. Gaines. The meeting resumed.

Subdistrict 6 (Beach Lots) – There were no volunteers or nominations at this time.

PUBLIC SAFETY INPUT:

Honolulu Fire Department (HFD) – Capt. Norbert K. Pokini reported the following:

- Statistics for September 2011 – Included 2 structure, 4 wildland, and 1rubbish fire; 40 medical emergencies, 1 search/rescue, and 12 miscellaneous call for service (7 activated alarms, 4 unauthorized burns, and 1 hazardous condition). No major or unusual incidents reported.
- Fire Prevention Week (FPW) – FPW is October 9th to 15th and the National Fire Protection Association selected "Protect Your Family From Fire" as its theme, focusing on keeping you, your family, and the community safe from fire. In October 2011, children attending elementary schools statewide will receive a Fire Fighter's Safety Guide (FFSG) from their teachers. HFD encourage parents to review the FFSG with their child, practice their fire escape plan, test their smoke alarms, and consider the safety tips in the guide.

Honolulu Police Department (HPD) – Sgt. Kawamoto reported on the following:

- Statistics for September 2011 – Included 5 assaults, 2 auto/motorcycle thefts, 6 burglaries, 3 drugs/narcotics, 18 thefts, and 21 unauthorized entries of a motor vehicle (UEMV).
- Bellows Incidents for September 2011 – Included 2 assaults, 1 burglary, 1 drugs/narcotics offense, 4 thefts, and 4 unauthorized entries of a motor vehicle (UEMV). The lost of property incident occurred during the week when Bellows is closed to the public. The remaining cases occurred when the base was open to the public on the public side of the base.
- UEMV – Majority of the UEMV incidents occurred in the Makapuu area to the tourist rental cars.

At this time Chair Ho recognized the City Managing Director Douglas Chin. There were no objections to hear from Managing Director Chin.

City Managing Director Chin – Managing Director Chin stated that he was challenged to visit all 33 Neighborhood Boards before the end of the year. The Waimanalo Neighborhood Board is the 25th Board he visited so far and expressed his gratitude for the opportunity of being there. He also expressed his appreciation to the members for serving on the Board. He also recognized and thanked Mayor's Representative Cyndy Aylette and Neighborhood Assistant for all the work they do.

Questions, comments, and concerns followed:

1. Rail Issue – The latest update to the financial plan should be available soon. Managing Director Chin attended the rail town hall meetings and heard from the leeward residents that the rail will bring jobs; it's a green alternative not requiring gas or fossil fuel, and understood that the rail will address the transportation needs as the population increases.
2. Burial Sites – Although it would be several years before the rail reaches down town, the rail project is testing for potential burial sites in the down town area to address these concerns earlier on the project. Managing Director assured that all burial sites found will be handled with respect and care.
3. Rail Route – Member R. Ho shared her experience with the rail system in Canada from the airport to Vancouver in 12 minutes which would have been an hour in traffic. Also that it would be a benefit for our visitors in Hawaii to be able to take the rail from the airport to Waikiki.
4. Kaneohe Bus 77 – Resident Tassill raised his concern for an additional Bus Route 77 to Kaneohe. The Administration is working with Mr. Tassill on his concern.

Mayor Peter Carlisle's Representative – Cyndy Aylette reported the following:

- Asian Pacific Economic Cooperation (APEC) Update – The APEC Conference will be from Monday, November 7, 2011 to Sunday, November 13, 2011. Plans on what roads will be shut down have not been released yet. The Board will be kept apprised as plans develop. Because there will be roads closed and detours motorists should allow additional travel time, use an alternate route, use public transportation when possible, monitor the daily traffic report on the radio or television, and check the City's traffic cams along your route.
- Code for America – The City was given a grant for programmers to update the City system. The Code for America program is a software development contract where people will be hired full time to develop ideas into applications that will benefit our city, such as developing an application for the City's bus route. The Code for America program will give the City the ability to expand. Submit your ideas on how to improve the City's system of getting more services to the community by visiting Citycamhnl.govfresh.com or call 768-9999 and leave a voice message.
- Lemonade Stand Contest – On Saturday, November 12, 2011 will be a contest for kids from grades K-12 called Lemonade Alley. The contest is for kids can submit their business proposition will be eligible to win $1,000.00. Flyers were made available to residents.
- Portable Signs – Portable signs are used to inform motorist of scheduled projects. In order to deploy a message board, a location must be determined such that it will not interfere with traffic or pedestrians causing more congestion, getting the message board to the location will take time since the vehicle towing the board will also have to drive in the traffic congestion, and someone must stay with the message board to change the message as traffic condition changes. The City Department of Transportation Services suggests motorist tune in to the radio to receive updated traffic information. Resident Tassill added he spoke to Governor Neil Abercrombie and that the State will bring all

emergency units together to discuss his portable sign concern for traffic incidents. He suggested that a portable sign at the bottom of the H-1 freeway Hawaii Kai bound pass Kahala Mall.

- Park Use Permit – Resident raised a concern about the park use permit at Waimanalo Beach Park. Also, was concerned about the park use permit section previously staffed by Renee Wallace.

City Councilmember Ikaika Anderson – Councilmember Anderson reported the following:

- Kaupo Beach Park – Extended his appreciation to Blanche McMillan for cleaning up Kaupo Beach Park or Baby Makapuu on Sunday, September 25, 2011.
- Nakini Street – Working together with the Department of Hawaiian Home Lands, DTS, Senator Ryan, and Representative on getting traffic calming devices on Nakini Street to combat motorists speeding. The community will be kept apprised of its development.
- Temporary Housing on Agriculture Land – The zoning committee chaired by Councilmember Anderson reviewed and tabled a resolution allowing for shipping containers used as temporary housing on agriculture land. Testimonies from the Waimanalo farmers opposed the measure. Councilmember Tom Berg is working on to ensure those housed will be required to perform actual agricultural work on a bonafied farm. Once amendments are completed, the Zoning Committee will hear the measure again. The Waimanalo farmers will also have an opportunity for testimony.
- Rail Volution – A Rail Volution Conference begins Sunday, October 16, 2011 In Washington, D.C. The Pacific Resources Partnership donated trips for the City to attend this conference. Councilmembers Anderson, Ann Kobayashi, and Romy Cachola will be attending along with other City Administrative staff.
- 3-Talk – The next 3-Talk will be Tuesday, October 11, 2011 at St. John Lutheran Church in Kailua at 6:30 p.m. The Waimanalo 3-Talk will be Tuesday, November 15, 2011 at Waimanalo Public Library at 6:30 p.m.

Questions, comments, and concerns followed:

1. Containers for Temporary Housing – Member R. Ho raised a concern of how many containers would be permitted on agricultural land. The maximum would be five containers per 1,500 square feet total. This is not housing for the homeless but work force housing for those working on agriculture land.
2. Sewer Concerns – Councilmember Berg researched the waste issue. City Council is waiting for Gary Hoosier of the State Office of Environmental Quality Control to brief the council members of the sewage issue. This is one of the reasons the measure was tabled. Member R. Ho stated this is more of a health issue. Also, before moving ahead on this measure that the community be informed to allow comments. Councilmember Anderson will present Councilmember Berg's amendments to the Board when received.
3. Waimanalo Agricultural Association (WAA) – The WAA is concerned with the preservation of agriculture land and shipping containers for temporary housing is not an agricultural use.
4. Aloun Farm – Member Jamila stated that there are shipping containers currently used as housing on Aloun Farm which is also owned by Councilmember Berg.

Board of Water Supply (BWS) – Danielle Ornellas reported the following:

- Main Break – There were no main breaks to report for September 2011.
- Wildfire Prevention – BWS works closely with HFD efforts to prevent wildfires by encouraging residents to do the same by supporting wildfire prevention and watershed protection activities in their communities. Practicing water conservation also assist in watershed protection by reducing the need to use ground water that is essential for healthy watershed forests and stream ecosystems.
- Water Rate Proposal – The BWS Board of Directors has not yet decided upon any rate adjustment for water services. BWS customers and the neighborhood boards will be notified when the Board of Directors makes a decision on the proposal. Fore more information on the proposed rate schedule, visit www.boardofwatersupply.com or call the BWS Communications Office at 748-5041.

Questions, comments, and concerns followed:

1. Water for Farmers – A resident raised a concern of how much water is used by the farm lots. Ms. Ornellas will check into this matter.

2. State Department of Agriculture System – Barry Usugawa stated the State DOA system is using .4 million gallons a day (mgd). About 1.4 mgd is diverted from the Maunawili Ditch and only .4 mgd reaches Waimanalo. There is a loss of a million mgd along the Maunawili Ditch. About six million dollars were allocated for the Maunawili Ditch repairs. The State DOA may have already started the repairs to the Maunawili Ditch System. Improvements to this system are described in the Koolaupoko Water Management Plan.
3. BWS System – Water consumptions can be retrieved by metered readings. Mr. Usugawa noted comparisons when the plantations were in operation until present. The difference of water used before and what is used now is either not being diverted into the stream or not being pumped from ground water wells.
4. Wasting Water – Member R. Ho observed a sprinkler on for 30 minutes wasting water at a Hawaii Kai townhouse complex. Contact BWS and they will contact the townhouse management. Whenever you see water being wasted by broken water pipe, a malfunctioning irrigation sprinkler, a faucet left running, or something similar contact our Water Waste Hotline at 748-5041.

ANNOUNCEMENTS:

Waimanalo Food Systems – A representative or report was not available.

Sustainable Agriculture Practices – A representative or report was not available.

COMMUNITY CONCERNS:

Kaupo Beach Park – Blanche McMillan introduced herself and Sissy Kamaka as Guardians of Kaupo, a non-profit community association and approved by the City's Department of Parks and Recreation in the park adoption of Kaupo Beach Park or Baby Makapuu as a beautification project. Also informed that the City will be installing a park closure gate in front of the Kaupo Beach Park driveway from 7:00 p.m. to 7:00 a.m. The purpose is for the health and security of the park. Ms. McMillan also expressed her appreciation to Senator Pohai Ryan, Representative Chris Lee, and Councilmember Ikaika Anderson for providing the lunch boxes for those volunteered on the September 25, 2011 Kaupo Park clean up. Also to Member Laughlin of the Waimanalo Hawaiian Civic Club for endorsement of the non-profit status.

Issues of Concern – A resident shared her list of concerns: Rail, water, camping, fishing, homeless, jobs, signage, and helicopters, and bicyclists riding through the homestead land. Chair Ho stated that every month those issues are addressed. Last month the Board addressed the concern of the bicyclists riding through Waimanalo.

BOARD BUSINESS:

Conference of Chairs – Members Laughlin and Koa attended the Neighborhood Commission's Conference of Chairs on Saturday, September 24, 2011

Waimanalo Park and Pavilion Signage – City's Camping Specialist Keoni Aylette seek board support for the Waimanalo Beach Park and pavilion closure signs. Residents near by witness the ongoing illegal drug activity and closing the park and pavilion is one way of deterring the activity. Drug paraphernalia is found at the park. HPD needs the park and pavilion closure signs posted before they can do anything.

Questions, comments, and concerns followed:

1. Park Closure – Member Laughlin stated she would like to know what will be accomplished with the park and pavilion closure signs. Also what were the results when other City parks posted closure signs? Most other City parks are closed and the crime rate at the park reduced significantly.
2. Camp Site – Mr. Aylette stated no camping is allowed Wednesdays and Thursdays at all state and city camp sites. This is to allow for cleaning the camping area and to rejuvenate. There was a concern as to where those campers would go for the two days if the pavilion is closed.
3. Gate – Member Jamila raised concerns about a gating the entrance to the parking lot and whether the bathrooms and pavilion will be closed also. Signs posting park and pavilion closure hours will be posted first. If there is no improvement to the crime, the next step will be to close the bathrooms. Last resort would be installing a gate at the entrance of the parking lot.
4. Chair Ho's Comment – The park and pavilion closure signs will give HPD the authority to enforce.

5. Kaiona Beach – A resident mentioned that with the Waimanalo Beach Park closed the illegal activity might move to Kaiona Beach.
6. Permit Event – Events require a permit for Waimanalo Beach Park running over 11:00 p.m.

Laughlin moved and Kalama seconded that the Waimanalo Neighborhood Board No. 32 support the posting of park and pavilion closure signage from 11:00 p.m. to 6:00 a.m. at Waimanalo Beach Park. A discussion followed.

7. Signage – Member Lastimosa stated he understood the priority for the signage is to deter illegal drug activity and that the Board should inform the residents of Waimanalo before posting park closure signs.
8. Illegal Drug Debris – Member R. Ho stated that she witnessed the illegal drug debris at the park grounds and along the beach and supported the park and pavilion closure signs.

The MOTION WAS ADOPTED, 7-0-2 (**AYES:** Alivado, R. Ho, W.K. Ho, Jamila, Kalama, Koa, and Laughlin; **NAYS:** None; **ABSTENTIONS:** Lastimosa and Texeira-Vickery).

Koolau Poko Watershed Management Plan – Chair Ho stated that this is a follow up to last month's presentation and each Board member received a copy of the Koolau Poko Watershed Management Plan. Mr. Bruce Tsuchida seeks the Board's endorsement of the Koolau Poko Watershed Management Plan and to answer questions. **Kalama moved and R. Ho seconded that the Waimanalo Neighborhood Board No. 32 approve the Koolau Poko Watershed Management Plan.** Member Jamila stated he reviewed the Koolau Poko Watershed Management Plan which addressed all issues thoroughly in managing our water system as well as educating everyone on how to preserve the water. **The MOTION WAS APPROVED, 8-0-1,** (**AYES:** Alivado, R. Ho, W.K. Ho, Jamila, Kalama, Koa, Lastimosa, and Laughlin; **NAYS:** None; **ABSTENTIONS:** Texeira-Vickery).

Sirens, Helicopters, Water and Power Poles – Kawehi Kanui-Gill announced that Kamehameha VI is living in Waimanalo and she is part of a group called Na Aha Maluhia and they are seeking to unite all Hawaiians of Kamehameha lineage. The Hawaiians are looking up to Kamehameha VI to create a plan towards their rights of the land to get them back on the Waimanalo farm lands. Those of Kamehameha lineage should call 650-863-3870.

Ms. Kanui-Gill also stated the State's public education, how lands not managed well by the State, that we need more jobs, and that she is here to fight for the people who cannot attend tonight's meeting. After discussing her issues further, she reminded residents to check their genealogy and if there are questions to call 650-863-3870.

Waimanalo Drug Houses –City Deputy Prosecuting Attorney (DPA) Mark Miyahira provided members with a handout on Drug Nuisance Abatement about what the community can do to close down "drug houses" through use of civil lawsuits and civil retraining orders.

- How Can You Help – Using tough love if illegal drug use is found in your family. Be tolerant to ice activity in your neighborhood, be vocal, and take action. Get involved by joining neighborhood security watch and report observed illegal drug activity to police. Sign anti-drug neighborhood petitions or letters that are sent to property owners where drug dealers reside.
- Drug Dealer – If you suspect someone is dealing drugs in your neighborhood, call the Honolulu Police Department Narcotics Vice Division at 529-3101 and ask to file a complaint. You may report suspicious drug activity online at www.honolulupd.org/nv/report.htm.
- Information – To help investigators with your complaint include exact address or description of location; suspects' names, height, weight, hair color, eye color, complexion, type of clothing worn, ethnic background; vehicle license plate numbers, color, two or four doors and type of drug being sold or used. Explain activity occurring, eg. Vehicles coming and going at all hours, loud parties all the time, people coming and going, etc. Give dates and times activities occur. Leave a contact number.
- Waimanalo Drug Houses – Member Jamila reminded DPA Miyahira of the two drug houses that are currently active.

For more information, contact DPA Miyahira at 768-7504 or e-mail at mmiyahira@honolulu.gov.

APPROVAL OF MINUTES: **Laughlin moved and Koa seconded that the Waimanalo Neighborhood Board No. 32 approve the September 12, 2011 regular meeting minutes as circulated. The MOTION WAS**

ADOPTED UNANIMOUSLY, 9-0-0 (**AYES:** Alivado, R. Ho, W.K. Ho, Jamila, Kalama, Koa, Lastimosa, Laughlin, and Texeira-Vickery; **NAYS:** None; **ABSTENTIONS:** None).

TREASURER'S REPORT: Deferred.

COMMUNITY REPORTS:

Blanche Pope Elementary School – A representative or report was not available.

Waimanalo Elementary School – A representative or report was not available.

Hawaii Job Corps – Laurie Nakota extended her appreciation to the community and elected officials for their letters of support of the Hawaii Job Corps. She also reminded of the 2-year program that is available to the Waimanalo community. There are seven career skill training programs. Tours are available every other Thursday. For tours call 545-4019.

Hawaii Health Initiative – A representative or report was not available.

Hui Malama O Ke Kai – A representative or report was not available.

Waimanalo Health Center – A representative or report was not available.

Bellows Air Force Station – Environmental, Cultural and Natural Resource Program Manager Craig Gorsuch reminded the Second Annual Waimanalo Makahiki Youth Tournament and Ceremonial Tradition event will take place Friday, Saturday, and Sunday, November 18 to 20, 2011 at Bellows Beach Park. A meeting is scheduled at the Waimanalo District Park 6:30 p.m. Member Kalama added that this event allows children to be knowledgeable of their culture and tradition through Kupuna story telling, games, food, and arts. This event is opened to keiki of all ages.

Marine Corps Base Hawaii – A representative or report was not available.

ELECTED OFFICIALS:

Senator Pohai Ryan – Senator Ryan provided member with a copy of her report and highlighted the following:

- Visit to Kahoolawe – Senator Ryan visited Kahoolawe was for budget purposes because funds are running out for the removal of munitions in the ground.
- Community Meeting – Senator Ryan's invited Pono Shim to give a presentation on "Aloha; the key to Hawaii's survival" on Tuesday, October 25, 2011 at Kailua Elementary School Cafeteria from 5:30 p.m. to 8:00 p.m.
- Job Training – Senator Ryan and Representative Chris Lee will be working with the State Department of Labor and Industrial Resources and Target store who has agreed provide job training skills for the new Kailua Target.
- Geothermal – The Geothermal Summit 2011 will be on Saturday, October 15, 2011 from 8:00 a.m. to 12:30 p.m. at the Hawaii National Guard Training Center Auditorium, Bellows, Waimanalo. Sign in begins at 7:30 a.m. There will be exhibits and presentations by leaders in this industry.
- Walk for Women – There will be a 3-mile walk honoring women we love and/or battling cancer on Sunday, October 30, 2011 at 7:30 a.m. Meet at Kawainui Neighborhood Park, also known as Kaha Park. For more information call 230-3654.
- Waimanalo Homestead Association (WHA) – WHA received matching funds for a new technical center. The WHA also received disaster kit funding for 86 units.
- Hawaiians in Prison – Senator Willy Espero is the Chair of the Senate Public Safety Committee and he is committed to bring the incarcerated Hawaiians back home from mainland prisons.

Questions, comments, and concerns followed:

1. Kahoolawe – Member R. Ho raised a concern as to whether why the military not funding the clean up of Kahoolawe. The $400 million from the military is running out and only a third of the island has been cleared. Member Kalama added organizations have donated funds, plants or material when visiting the

Kahoolawe. Senator Ryan supports a user impact fee on tourists to provide support of all natural resources.

Representative Chris Lee – Representative Lee reported the following:

- Kahoolawe – Representative Lee will work hard to save the marine population and indigenous species on Kahoolawe and all natural resources on Kahoolawe. The island is experiencing poaching of the natural resources and need to be protected. The commission is looking at confiscating vehicles (boats, helicopters, etc.) This will be addressed at the t legislature next year. Representative Lee will be accompanying a leadership group going to Kahoolawe and set up an aquaponic garden set up.
- Reporting Drug Use – The direct number for Drug Use and Abatement office is 586-1328. Laws were passed that limited the ability to procure the resources to create methamphetamine. Illegal drugs enter Hawaii through our ports, harbors, or airports and the State do not have the resources to monitor those ports.
- Cable Access – New federal regulation will provide a public access channel dedicated for the State Capitol. Representative Lee will provide more information as when this will start.
- Alternative Agriculture – With the Agriculture Leadership Group, Representative Lee went to New Mexico to see how they produce food, ship 97 percent out and ship 97 percent in. They are rebuilding their agriculture industry to serve the local population, growing their own food for their own communities and save money, rebuilding their economy and jobs at the same time.

ADJOUIRNMENT: The meeting adjourned at 9:47 p.m.

Submitted By: Gloria J.P. Gaines, Neighborhood Assistant

Reviewed By: Wilson Kekoa Ho, Chair

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