803 WEST MAUNA KEA AQUIFER SECTOR AREA

803.1 SECTOR AREA PROFILE

803.1.1 General

The West Mauna Kea Aquifer Sector Area (ASEA) includes the Waimea Aquifer System Area (ASYA) [80301]. Its boundaries extend from the saddle area between Mauna Kea and Mauna Loa to Waimea and along the western shores at Kawaihae to Puako, capturing most of the South Kohala district and the western portion of the Hamakua district.

Average annual rainfall ranges from 9 inches along the coast to nearly 50 inches, however most of the sector receives less than 30 inches, making this sector area one of the driest on the island. The sustainable yield is 24 mgd.

803.1.2 Economy and Population

803.1.2.1 Economy

Tourism has become the leading economic industry in South Kohala. One of South Kohala's three luxury resorts, the Mauna Kea Resort, which includes two hotels and ten exclusive residential neighborhoods, lies within the West Mauna Kea ASEA.

Agriculture also continues to be a major economic contributor. Cattle ranching utilizes most of the agricultural land area, with pastures running from high mountain slopes to sea level. Parker Ranch, one of the nation's largest ranches, spreads approximately 175,000 acres of land. In addition to producing United States Department of Agriculture (USDA) choice beef from between 30,000 and 35,000 cattle annually, Parker Ranch's businesses include visitor activities, commercial leasing and real estate holdings.

As indicated in the General Plan, "Waimea is one of the most productive areas for vegetable crops on the Big Island" and "the agricultural industry…has the potential for further expansion."

The Canada-France-Hawaii Telescope Corporation, which has a telescope atop Mauna Kea, has a base facility south of Waimea in the West Mauna Kea ASEA with a staff of 51 and an annual operating budget of $6.2 million. Astronomical facilities within the 11,228-acre Mauna Kea Science Reserve are located within the West Mauna Kea ASEA. With 13 observatories and 12 of the world's state-of-the-art telescopes, Mauna Kea is considered the world's premier site for ground-based astronomical observatories. Astronomy generates over $619 million in capital investments and approximately 270 permanent jobs.

803.1.2.2 Population

Nearly all of the population contributing to the water demand of the sector area is within the South Kohala District. The growth in tourism has followed the dramatic increase in the population of South Kohala over the past 30 years; and as a result, South Kohala enjoyed the lowest unemployment rate and the highest median income in 1997.

Table 803-1: Historical Population

1980	1990	2000	1980-90 % Change	1990-2000 % Change
2,084	4,134	5,939	98.4	43.7

Data Source: 2000 U.S. Census
Data redistributed and evaluated for West Mauna Kea Aquifer Sector Area

Table 803-2: Population Projection

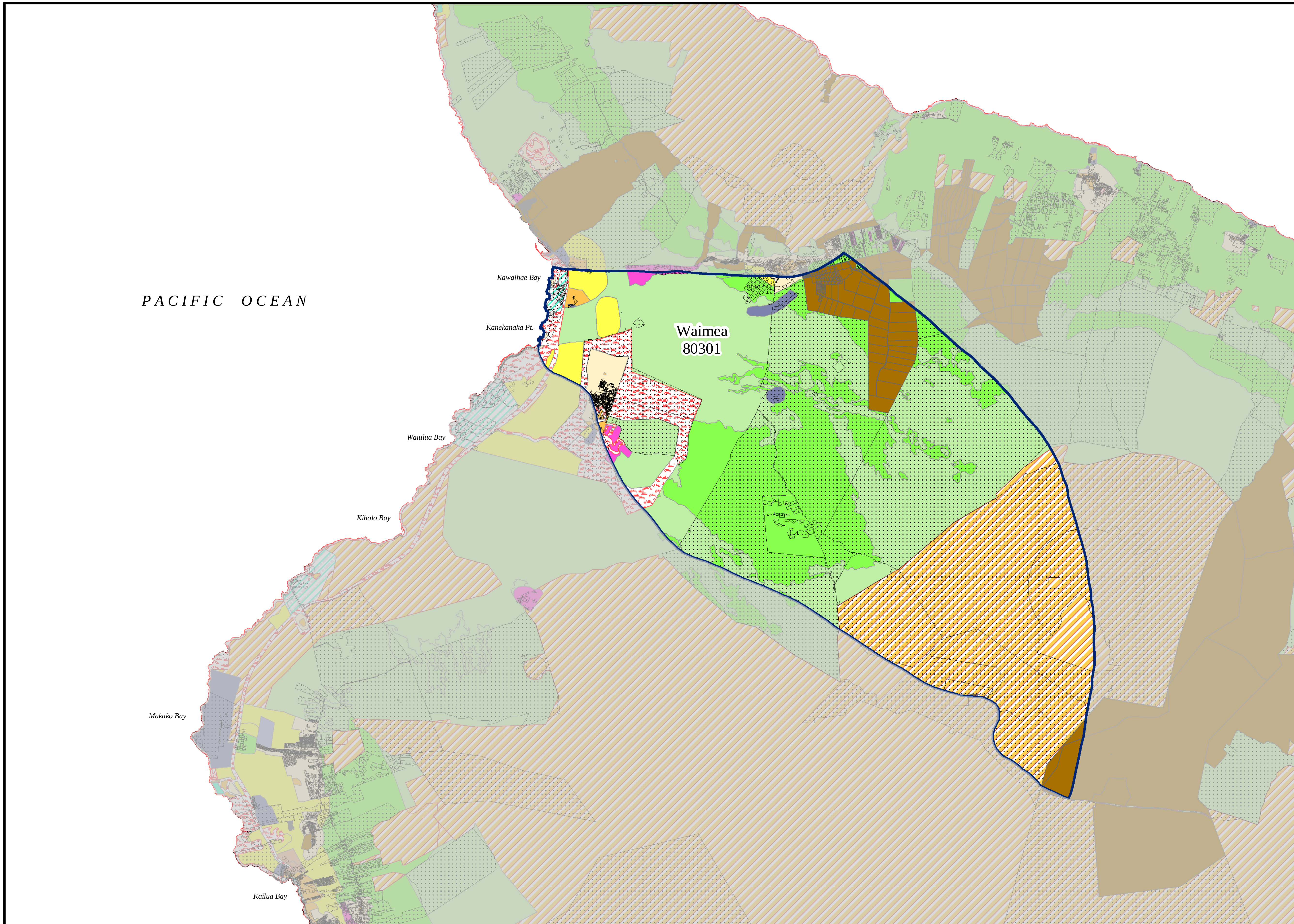
Growth Rate	2000	2005	2010	2015	2020	2000-10 % Change	2010-20 % Change
A – Low	5,939	7,060	8,153	9,392	10,831	37.3	32.8
B – Medium	5,939	7,082	8,224	9,531	11,048	38.5	34.3
C – High	5,939	7,378	8,740	10,279	12,042	47.2	37.8

Data Source: County General Plan, February 2005
Data redistributed and evaluated for West Mauna Kea Aquifer Sector Area

803.1.3 Land Use

803.1.3.1 Hawaii County General Plan

The Hawaii County General Plan Land Use Pattern Allocation Guide Map for the West Mauna Kea ASEA is shown on **Figure 803-1**. The estimated land use allocation acreage for each LUPAG designation within the sector area is listed in **Table 803-3**.



Hawaii County

Department of Water Supply

DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

Job No. 2003-818

LEGEND:

- Developed Properties
- Hawaiian Home Lands

Land Use Pattern Allocation Guide

- Extensive Agriculture
- Important Agricultural Land
- Orchard
- High Density Urban
- Medium Density Urban
- Low Density Urban
- Industrial
- Urban Expansion
- Resort
- Resort Node
- Rural
- Conservation
- Open
- University Use
- Pond
- Break Water

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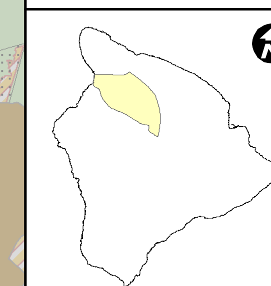
Miles



INDEX MAP - Island of Hawaii

FIGURE 803-1

AQUIFER SECTOR
W. MAUNA KEA - 803
Aquifer System
Waimea - 80301

2005 Revised General Plan Land Use Pattern Allocation Guide

FUKUNAGA & ASSOCIATES, INC.
Consulting Engineers
1388 Kapiolani Boulevard, 2nd Flr, Honolulu, Hawaii 96814

Table 803-3: LUPAG Map Estimated Land Use Allocation Acreage – West Mauna Kea Aquifer Sector Area

LAND USE PATTERN	ACREAGE	% of TOTAL
High Density Urban	0	0
Medium Density Urban	567	0.3
Low Density Urban	2,516	1.3
Industrial	915	0.5
Important Agricultural Land	47,663	24.8
Extensive Agriculture	73,087	38.1
Orchard	0	0
Rural	927	0.5
Resort/Resort Node	554	0.3
Open	8,283	4.3
Conservation	54,057	28.2
Urban Expansion	3,407	1.8
University Use	0	0
TOTAL	191,976	100.0

The water utility courses of action for South Kohala in the Hawaii County General Plan are as follows:

(a) *Seek alternative sources of water for the Lalamilo system.*
(b) *Improve and replace inadequate distribution mains and steel tanks.*
(c) *Continue to seek additional groundwater sources for the Waimea System.*

803.1.3.2 Hawaii County Zoning

Hawaii County Zoning for the West Mauna Kea ASEA is shown on **Figure 803-2**. The estimated land use allocation acreage for each zoning class within the sector area is listed in **Table 803-4**.

Table 803-4: County Zoning Estimated Class Allocation Acreage – West Mauna Kea Aquifer Sector Area

ZONING CLASS	ACREAGE	% of TOTAL
Single Family Residential	2,391	1.3
Multi-Family Residential (including duplex)	332	0.2
Residential-Commercial Mixed Use	0	0
Resort	82	0.0
Commercial	123	0.1
Industrial	39	0.0
Industrial-Commercial Mixed	0	0
Family Agriculture	0	0
Residential Agriculture	648	0.3
Agriculture	125,786	65.5
Open	7,738	4.0
Project District	0	0
Forest Reserve	53,826	28.0
(road)	1,003	0.5
TOTAL	191,969	100.0

803.2 EXISTING WATER RESOURCES

803.2.1 Ground Water

The West Mauna Kea ASEA has a sustainable yield of 24 mgd. According to the CWRM database, there are 30 production wells in the sector area, including 15 municipal, 11 irrigation, 2 industrial, 2 other. There are also 7 wells drilled and categorized as “unused.” Refer to **Appendix B** for this database. **Figure 803-3** shows the well locations.

803.2.2 Surface Water

The Waikoloa Stream south of Waimea is classified in the HSA as perennial but intermittent at lower elevations.

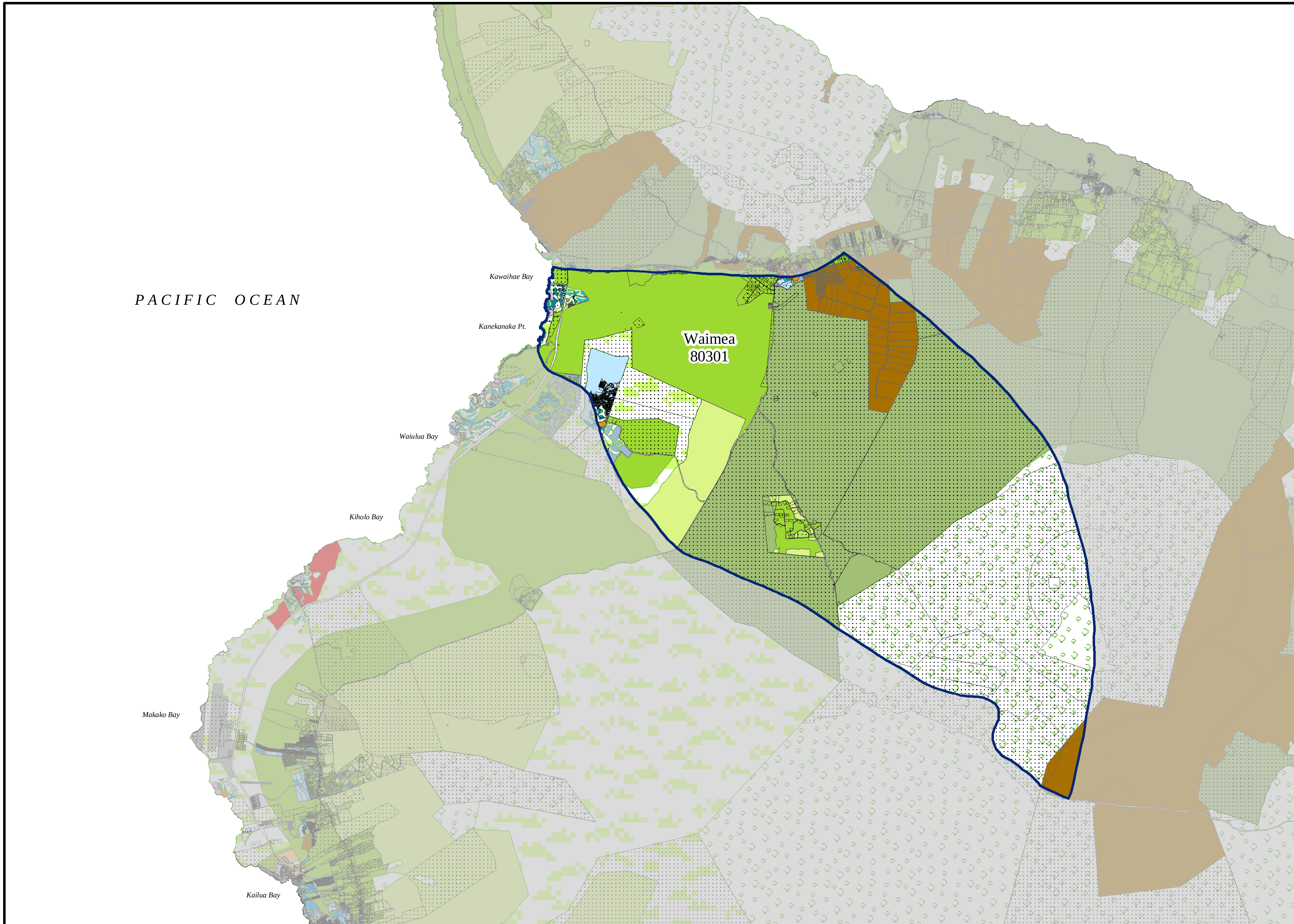
There are 7 declared stream diversions in the CRWM database listed in **Table 803-5** and shown on **Figure 803-4**; however, flow data is not available for the stream diversions.

Hawaii County

Department of Water Supply

DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

Job No. 2003-818



LEGEND:

Hawaiian Home Lands	
Developed Parcels	

Zoning Designations:

A-1a+	Agricultural - 1 thru 10 acres
A-20a	Agricultural - 20 acres
A-35a	Agricultural - 35 acres
A-40a	Agricultural - 40 acres
A-80a	Agricultural - 80 acres
A-200+	Agricultural - 200 thru 255 acres
A-500a	Agricultural - 500 acres
A-600a	Agricultural - 600 acres
A-800a	Agricultural - 800 acres
A-900a	Agricultural - 900 acres
APD	Agricultural Project Districts
CDH	Downtown Hilo Commercial District
CG	Commercial, General
CN	Commercial, Neighborhood
CV	Commercial, Village
FA	Family Agricultural
FR	Forest Reserse
MCX	Industrial - Commercial
MG	Industrial, General
ML	Industrial, Limited
O	Open
PD	Project Districts
RA	Residentail and Agricultural
RCX	Residential - Commercial Mixed Use
RD	Residential Double-Family
RM-7.5+	Res. Multi-Family - 7500-8000 sf
RM-14.5+	Res. Multi-Family - 14,500-20,000 sf
RS-7.5+	Res. Single Family - 7500-10,000 sf
RS-15+	Res. Single Family - 15,000-20,000 sf
V	Hotel/Resort

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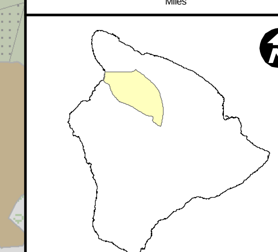

INDEX MAP - Island of Hawaii

FIGURE 803-2

AQUIFER SECTOR
W. MAUNA KEA - 803

Aquifer System

Waimea - 80301

County Zoning

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Figure 803-3: Well and Tunnel Location

MAP CURRENTLY NOT AVAILABLE ON-LINE

Figure 803-4: Streams & Diversions

MAP CURRENTLY NOT AVAILABLE ON-LINE

Table 803-5: Stream Diversions – West Mauna Kea Aquifer Sector Area

FILE REFERENCE	TMK	STREAM NAME	
STATE PARK HAW	4-4-015:001	Hopukani Spring (East)	Spring diversion, pipe from Hopukani Spring #1. See also new entry for declarant.
STATE PARK HAW	4-4-015:001	Hopukani Spring (West)	Spring diversion, pipe from Hopukani Spring #2. See also new entry for declarant.
STATE PARK HAW	4-4-016:003	Waihu Spring	Spring diversion, pipe from Waihu Spring (new entry).
STATE PARK HAW	4-4-016:003	Liloe Spring	Spring diversion, pipe from Liloe Spring (new entry).
WALLACH K	6-2-009:004	Keanuiomano	Stream diversion, pump from Keanuiomano Stream. Use when stream is running.
BALDWIN E	6-2-009:018	Keanuiomano	Stream diversion, 2 pipes from Keanuiomano Stream. Two pipes at one location.
PARKER RANCH	6-6-001:038	Resevoir	Stream diversion, Lihue Intake from reserve overflow.

803.2.3 Reclaimed Wastewater

There are 2 wastewater reclamation facilities (WWRF) in the sector area. **Table 803-6** lists the WWRF, reclaimed water classification, facility treatment capacity, current reuse amount, and current application.

Table 803-6: Wastewater Reclamation Facilities – West Mauna Kea Aquifer Sector Area

Wastewater Reclamation Facility	Reclaimed Water Classification	WWRF Capacity (MGD)	Current Reuse Amount (MGD)	Irrigation Application
South Kohala Wastewater Corp.	R-2	0.6	0.27	Mauna Kea Golf Course – golf course irrigation
Waimea Wastewater Company WRF	R-3	0.1	0.045	Parker Ranch – pasture irrigation

803.3 EXISTING WATER USE

803.3.1 General

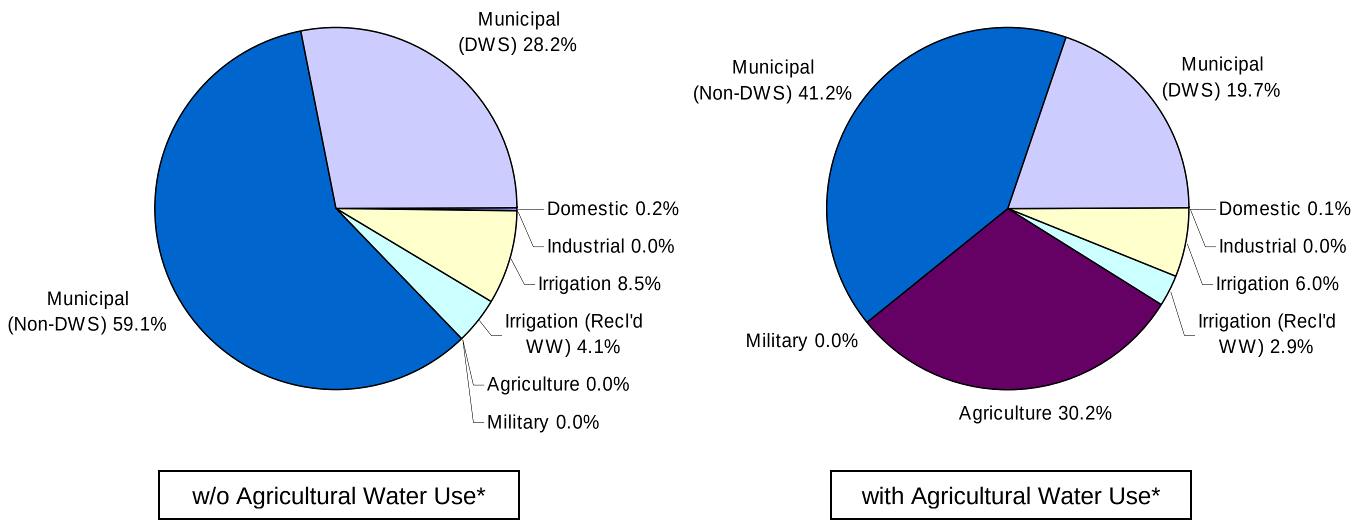
The total estimated average water use within the West Mauna Kea ASEA from 2004 to 2005 (DWS meter data and CWRM pumpage data from November 2004 through October 2005, available GIS data, estimates from the *2003 SWPP*, and estimated reclaimed wastewater usage) is listed in **Table 803-7**. The Waikoloa private water system operated by the West Hawaii Water Company supplied the largest quantity of the total estimated water use within the sector area. **Table 803-7** and **Figure 803-5** summarize water use in accordance with CWRM categories and indicate separately the quantities supplied excluding agricultural demands, and the quantities supplied including worst case agricultural demands (described in Chapter 2) by the DWS system, non-DWS systems, and reclaimed wastewater.

Table 803-7: Existing Water Use by Categories – West Mauna Kea Aquifer Sector Area

CWRM Water Use Category	Water Use (MGD)	Percent of Total without Ag*	Percent of Total with Ag*
Domestic	0.01	0.2	0.1
Industrial	0.00	0.0	0.0
Irrigation	0.66	8.5	6.0
Reclaimed WW	0.32	4.1	2.9
Agriculture	3.34	0.0	30.2
Military	0.00	0.0	0.0
Municipal			
DWS System	2.17	28.2	19.7
Private Public WS	4.56	59.1	41.2
Total without Ag*	7.71	100.0	
Total with Ag*	11.05		100.0

* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 803-5: Existing Water Use by Categories – West Mauna Kea Aquifer Sector Area



* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 803-6 generally shows the service area for the various water systems and indicates the extent of the DWS water system.

803.3.2 Domestic Use

Domestic use or water use by individual households is nominal, and is assumed to be supplied by private individual rainwater catchment systems.

803.3.3 Industrial Use

There are two drilled wells classified as “Industrial” in the CWRM database, owned by Mauna Kea Beach Hotel; however, neither have reported pumpage.

803.3.4 Irrigation Use

Irrigation is based on pumpage reported for private wells categorized by CWRM as irrigation wells and reclaimed water use as indicated earlier in **Table 803-7**. **Table 803-8** lists the average private irrigation well pumpage reported to the CWRM or listed in the *2003 SWPP*.

Table 803-8: Private Irrigation Well Pumpage

Private Irrigation	Irrigation Well Pumpage (mgd)
Mauna Lani Resort	0.62
Mauna Kea Properties	Not Reported
Arlin Trust	0.01
Hapuna State Recreation Area	0.028*
TOTAL	0.66

*Source: 2003 SWPP, Volume 2, Island of Hawaii

Records indicate that the Mauna Kea Beach Resort has brackish water wells for golf course irrigation, however none reported pumpage. The Mauna Lani Resort owns three irrigation wells in the West Mauna Kea ASEA.

The Hapuna State Recreation Area is located south of Kawaihae and is managed by the DLNR, State Parks division. Potable water demand is supplied by the DWS Waimea Water System. Nonpotable water is pumped from a single well with a safe source capacity of 0.33 mgd and stored in a reservoir which feeds the irrigation system. Safe source capacity is described in the *2003 SWPP* as two-thirds of the installed pump capacity,

803.3.5 Agricultural Use

Parker Ranch has a vast water system to service its numerous pasture lots, which consists of 175 miles of pipeline, 9 reservoirs, 145 water tanks, 40 ground tanks, 3 water dams and 650 water troughs. The Ranch also purchases water from the DWS where such supply is available. Since the sources for the Ranch livestock are stream diversions, yearly consumption varies depending on the weather and its related rainfall. The Ranch has a prepared master plan for residential, commercial, and other related uses. It is called the *Parker Ranch 20/20 Plan*.

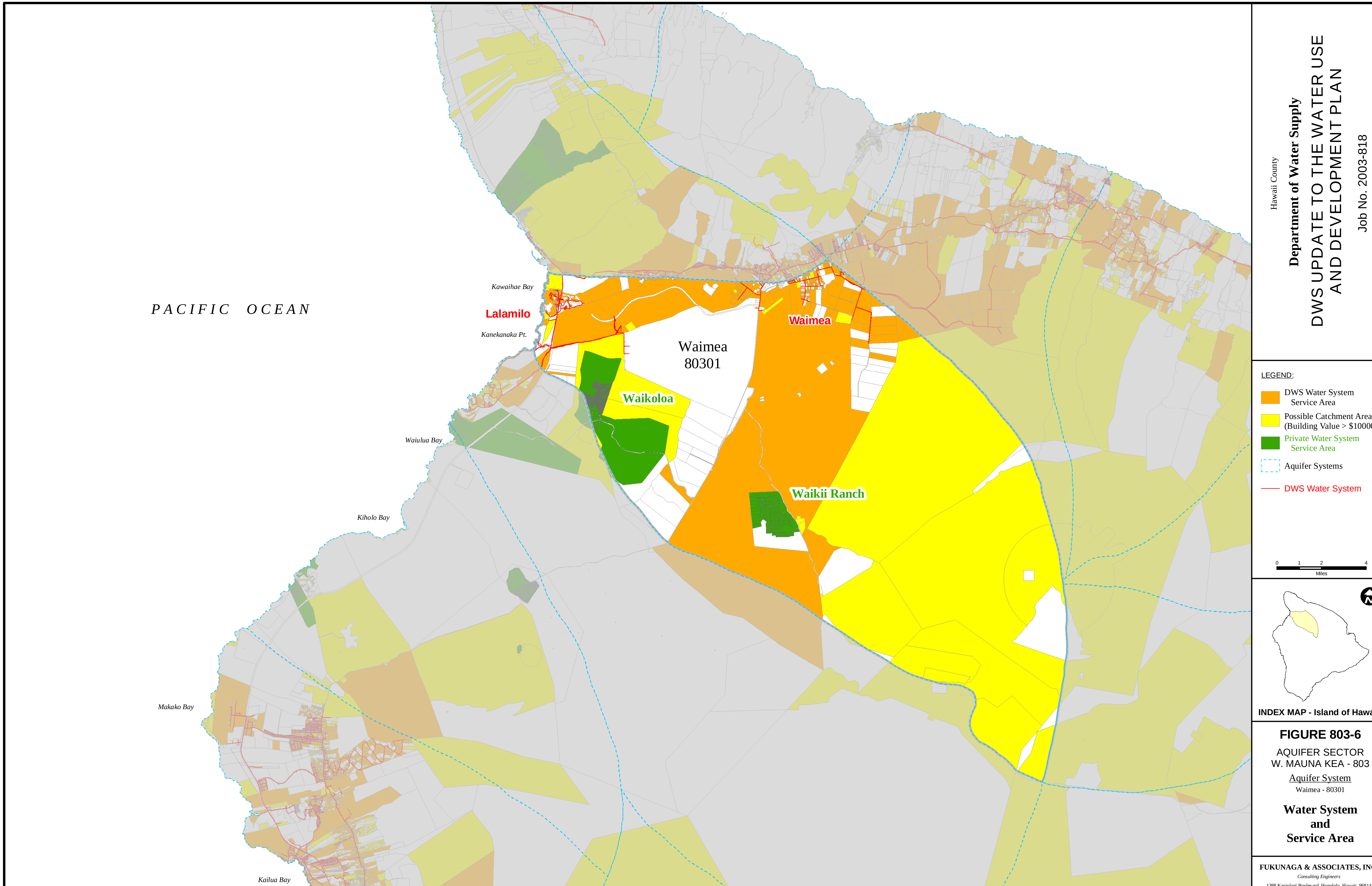
The farm lots in Lalamilo and Puukapu utilize the Waimea Irrigation System. The pressurized distribution system consists of pipelines varying between 8 and 18 inches in diameter. According to the AWUDP, in 2003 the system drew 0.908 mgd from 117 metered accounts. The source water for the system is stream diversions from the Kohala Mountain watersheds, which lie within the Kohala ASEA (801).

803.3.6 Military Use

There is no military use in the West Mauna Kea ASEA.

803.3.7 Municipal Use

Municipal use can be subcategorized into the other water use categories, namely Domestic, Industrial, Irrigation, Agriculture, and Military, if detailed information is available.



Hawaii County
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FIGURE 803-6
AQUIFER SECTOR
W. MAUNA KEA - 803
Aquifer System
Waimea - 80301

Water System and Service Area

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1388 Kapiolani Boulevard, Honolulu, Hawaii 96814

803.3.7.1 County Water Systems

The DWS has two major water systems that service the sector area. The Waimea Water System (WS) covers the mauka areas and the Lalamilo WS services the coastal areas. Refer to **Figure 803-6**.

The Waimea WS described in Chapter 801 spans three aquifer sector areas, serving areas within the West Mauna Kea ASEA south of Mamalahoa Highway, including the residential lots at Puukapu-Nienie and Kamuela Airport.

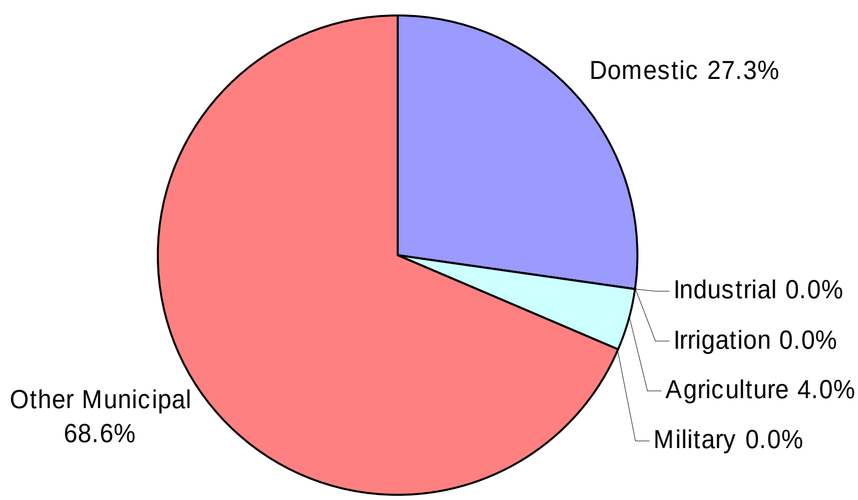
The Lalamilo WS was originally designed to service the small village of Kawaihae. A 2-inch pipeline transported water from the Waimea WS down to Kawaihae, generally following Kawaihae Road. In the 1950's, the State developed the Puako subdivision and a deep draft harbor at Kawaihae. This necessitated replacement of the existing small lines and extension of the system to Puako. The small pipeline from Waimea to Kawaihae was replaced with a 6-inch pipeline and additional storage tanks were erected. In the 1960's, the Rockefeller development at Mauna Kea Beach opened a new era for this region. To develop sufficient supply, high level exploratory deep wells were attempted along Kawaihae Road. This resulted in marginal quality water with high chloride content. The high chloride content and temperature reflected the geothermal anomaly which occurs in this area. However, these wells supplemented the limited supply from Waimea. Water from the wells was blended with the fresh mountain water to supply the emerging developments. Based on the success of the adjacent Waikoloa deep wells, the State drilled an exploratory well on the State lands of Lalamilo at an elevation of approximately 1,200 feet in 1977. The well produced water of good quality with a chloride content of 78 ppm. Subsequently, additional wells were drilled with financing by the Mauna Lani Resort developer which allowed Mauna Lani and Mauna Kea resorts to expand their facilities. The Kawaihae Village area around the harbor has also expanded, and is served by the Lalamilo WS. The two Parker Wells replaced the two Kawaihae Wells in the late 1990's. The system presently services the area from Kawaihae to Mauna Lani in five operational zones, through two booster pump stations and nine storage tanks.

DWS water use is subcategorized in **Table 803-9** to the extent possible based on available meter data and is depicted in **Figure 803-7**. "Other Municipal" includes facilities such as schools, and various commercial, government, medical and nonprofit entities which have mixed water use and cannot be specifically allocated to the other categories.

Table 803-9: DWS Existing Water Use by Categories – West Mauna Kea Aquifer Sector Area

CWRM Water Use Category	DWS Purveyed Water Use (MGD)	Percent of Total
Domestic	0.59	27.3
Industrial	0.00	0.0
Irrigation	0.00	0.0
Agriculture	0.09	4.0
Military	0.00	0.0
Other Municipal	1.49	68.6
Total	2.17	100.0

Figure 803-7: DWS Existing Water Use by Categories – West Mauna Kea Aquifer Sector Area



803.3.7.2 State Water Systems

The DLNR, Division of State Parks owns the Mauna Kea State Park water system located on the southwestern side of Mauna Kea on Saddle Road. In exchange for water use by the Pohakuloa Training Area (PTA), the water system sources and transmission lines are maintained by the U.S. Army. The PTA is located in the Northwest Mauna Loa ASEA (807). Sources of water for the system are from five springs, namely Upper Hopukani Spring, Hopukani Spring, Waihu Spring, Lilole Spring and an unnamed spring. The spring water is gravity fed through two above ground

2-inch galvanized pipelines into three 420,000 gallon steel storage reservoirs, then filtered and disinfected with sodium hypochlorite prior to distribution. There are 13 service connections which include the Mauna Kea State Park, the PTA and service to approximately 25 people. The estimated park demand is 0.015 mgd.

803.3.7.3 Federal Water Systems

There are no Federal water systems in the West Mauna Kea ASEA.

803.3.7.4 Private Public Water Systems

There are two private public water systems within the West Mauna Kea ASEA regulated by the Department of Health, which supply a significant percentage of the total estimated water use within the sector. **Table 803-10** lists the average pumpage each system reported to the CWRM, and is assumed to be the system water use.

Table 803-10: Private Public Water System Water Use – West Mauna Kea Aquifer Sector Area

Private Public Water System	Water Use (mgd)
Waikoloa	4.50
Waikii Ranch	0.04

The Waikoloa Resort lands were purchased in 1968 from Parker Ranch by Boise Cascade. The lands are split between the West Mauna Kea ASEA and the Northwest Mauna Loa ASEA (807), with the higher elevation lands above the beach resort used for residential development within the former and the oceanfront lands used for resort hotel development within the latter. Five wells located within the West Mauna Kea ASEA provide potable water for all of the developments. DOH records indicate that the system serves a population of 9,960 through 1,629 service connections.

The Waikii Ranch is a 2,995-acre ranch lot subdivision at elevations 3,800 feet to 4,800 feet on the west slopes of Mauna Kea along the Saddle Road. The potable water source is two deep wells at ground elevations in excess of 4,300 feet with a total pump capacity of 288,000 gallons per day. The water system also includes two booster pump stations and three concrete reservoirs and approximately 8 miles of 6-inch ductile iron watermain.

803.3.8 Water Use by Resource

803.3.8.1 Ground Water

Table 803-11 summarizes the current production, potential production (16 and 24-hour operation), sustainable yield (SY), and percentage of SY for the various productions calculated. Current production is represented by the highest 12-month moving average (MAV) or the highest annual average yield calculated from the actual pumpage data. Potential well production is based on installed pump capacities, and calculated for both 16 hours of operation a day and 24 hours of operation a day. Data is based on pumpage data reported to CWRM.

Table 803-11: Sustainable Yield – West Mauna Kea Aquifer Sector Area

Sys Code	System Area	High 12-Month MAV (MGD)	Potential 16 -Hour Production (MGD)	Potential 24-Hour Production (MGD)	SY (MGD)	High 12-Month MAV SY (%)	Potential 16-Hour Production SY (%)	Potential 24-Hour Production SY (%)
		9.13	**17.56**	**26.34**	**24**	**38.04**	**73.17**	**109.75**
80301	Waimea	9.13	17.56	26.34	24	38.04	73.17	109.75

Based on available information from the CWRM database, the current groundwater use is over a third of the sustainable yield. If the installed pumps operate 16-hours a day, close to three-quarters would be used, and if the installed pumps operate continuously, the sustainable yield would be exceeded.

803.3.8.2 Surface Water

Parker Ranch has one declared stream diversion in the West Mauna Kea ASEA; however, consumption is not known.

According to the SWPP, the estimated source capacity from the five springs serving the Mauna Kea State Park water system is 0.00125 mgd, which is not adequate to meet the existing consumption of the Park and the PTA.

803.3.8.3 Rainwater Catchment

Water consumption calculated for developed parcels that are not supplied by groundwater or surface water is assumed to be supplied by rainwater catchment. The water use categorized as Domestic Use previously in **Table 803-7** is assumed to be supplied by individual catchment systems.

803.3.8.4 Reclaimed Wastewater

Reclaimed wastewater from the two wastewater treatment plants within the West Mauna Kea ASEA is used for golf course and pasture lot irrigation. Refer to **Table 803-6**, presented earlier.

803.4 FUTURE WATER NEEDS

803.4.1 General

Table 803-12 summarizes the LUPAG, Zoning and 5-year incremental water demand projection scenarios for the total aquifer sector area and the individual aquifer system area. The sustainable yield (SY) is presented to draw comparisons.

Table 803-12: Summary of Demand Projections

Without Agricultural Demand*	SY (mgd)	LUPAG (mgd)	Zoning (mgd)	Growth Rate B Demand Projections (mgd)				
				2005	2010	2015	2020	2025
Total W. Mauna Kea ASEA	24	52.1	13.8	7.7	9.0	10.4	12.0	13.9
80301 – Waimea ASYA	24	52.1	13.8	7.7	9.0	10.4	12.0	13.9
With Agricultural Demand*	**SY (mgd)**	**LUPAG (mgd)**	**Zoning (mgd)**	**Growth Rate B Demand Projections (mgd)**				
				2005	**2010**	**2015**	**2020**	**2025**
Total W. Mauna Kea ASEA	24	186.7	150.6	11.0	12.8	14.9	17.2	20.0
80301 – Waimea ASYA	24	186.7	150.6	11.0	12.8	14.9	17.2	20.0

* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

There is only one aquifer system area within the West Mauna Kea ASEA; therefore, demands presented by aquifer sector area and by aquifer system area are one in the same.

803.4.2 Full Build-Out Water Demand Projections

The full build-out water demand projections based on the General Plan and County Zoning for the West Mauna Kea ASEA are listed in **Tables 803-13** and **803-14**, and reflect refinement as discussed below. Each land use class is associated with the most appropriate CWRM water use category.

Table 803-13: Hawaii County General Plan Full Build-Out Water Demand Projection – West Mauna Kea Aquifer Sector Area

LUPAG Class	CWRM Category	Water Demand (mgd)
Urban	Domestic/Irrigation/Municipal	22.1
Urban Expansion	Domestic/Irrigation/Municipal	15.4
Resort	Irrigation/Municipal	9.4
Industrial	Industrial	3.7
Agriculture	Agriculture	134.6
University	Irrigation/Municipal	0.0
Rural	Irrigation/Municipal	0.9
DHHL	Irrigation/Municipal	0.6
TOTAL w/o Ag*		52.1
TOTAL w/ Ag*		186.7

* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 803-14: County Zoning Full Build-Out Water Demand Projection – West Mauna Kea Aquifer Sector Area

Zoning Class	CWRM Category	Water Demand (mgd)
Residential	Domestic/Irrigation/Municipal	11.5
Resort	Irrigation/Municipal	1.1
Commercial	Municipal	0.4
Industrial	Industrial	0.2
Agriculture	Agriculture	136.8
DHHL	Irrigation/Municipal	0.6
TOTAL w/o Ag*		13.8
TOTAL w/ Ag*		150.6

* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

803.4.2.1 Refine Land Use Based Projection

803.4.2.1.1 State Water Projects Plan

The total projected demand to the year 2020 for 19 State Water Projects within the West Mauna Kea ASEA is 15.66 mgd, 0.31 mgd using potable, 15.30 mgd using nonpotable, and 0.06 nonpotable using potable sources. The total demand exceeds the projected 2020 water demand for the sector area; however, it is anticipated that the nonpotable demands will be supplied by nonpotable sources. Furthermore, it is anticipated that the next phase of the *AWUDP* will examine projections and sources in greater detail. The projects which will generate the most significant demands, with the exception of DHHL projects, which are covered separately, are listed in **Table 803-15**.

Table 803-15: Future State Water Projects to Generate Significant Demands

Project Name	Primary Use	State Department	2020 Demand (mgd)
Future Subdivision in Honokaa	Nonpotable	DOA	7.00
Future Subdivision in Paauilo	Nonpotable	DOA	1.25
Waimea/Paauilo Watershed Project	Nonpotable	DOA	4.00

803.4.2.1.2 State Department of Hawaiian Home Lands

The three Puukapu Sections are existing pre-1994 DHHL tracts totaling about 12,000 acres. Puukapu 1 is comprised of three parcels totaling 392 acres, and generally located in the southeast section of Waimea. Some pasture lots have already been awarded. Together the existing and potential pastoral developments have a potable water need of 0.13 mgd and an irrigation water need of 0.48 mgd. Potable water supply would be from the DWS Waimea Water System. Irrigation water supply would be from the Waimea Irrigation System.

803.4.2.1.3 Agricultural Water Use and Development Plan

The AWUDP estimates the 20-year service area of the Waimea Irrigation System between 712 and 880 acres, which, using an estimated 3,400 gpd/acre, translates to a water demand of 2.42 to 2.99 mgd. As discussed, this report presents a range of agricultural nonpotable water use in the demand projections. It is anticipated that the next phase of the *AWUDP* will examine the sources and demand requirements in greater detail.

803.4.3 Water Use Unit Rates

Water use unit rates are based on the *Water System Standards* as discussed in Chapter 1, and single family residential (Low Density Urban category of the General Plan and RS-7.5 and greater or Single-Family Residential categories of one lot per at least 7,500 square foot of County Zoning) consumption is 2.5 units per lot based on historical consumption data.

803.4.4 5-Year Incremental Water Demand Projection to the Year 2025

The following section presents 5-year incremental water demand projections to the year 2025 for the West Mauna Kea ASEA. The projected low, medium, and high growth rates are listed in **Table 803-16**, and are graphed in **Figure 803-8**. Potable and nonpotable water demands are also differentiated.

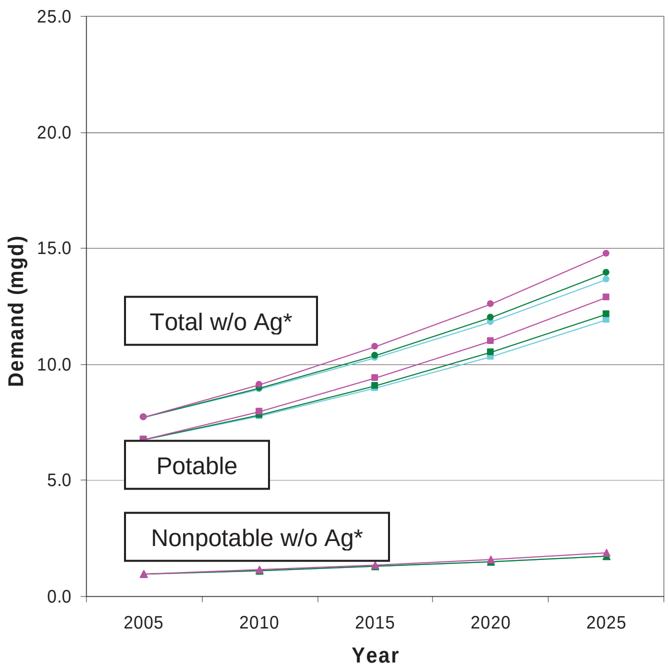
Focusing on Medium Growth Rate B, **Figure 803-9** illustrates the magnitude of the sustainable yield, both LUPAG and Zoning full build-out water use, and water use projection through the year 2025. **Figure 803-10** shows the breakdown of water demand projections by CWRM categories through the year 2025. **Table 803-17** summarizes these figures.

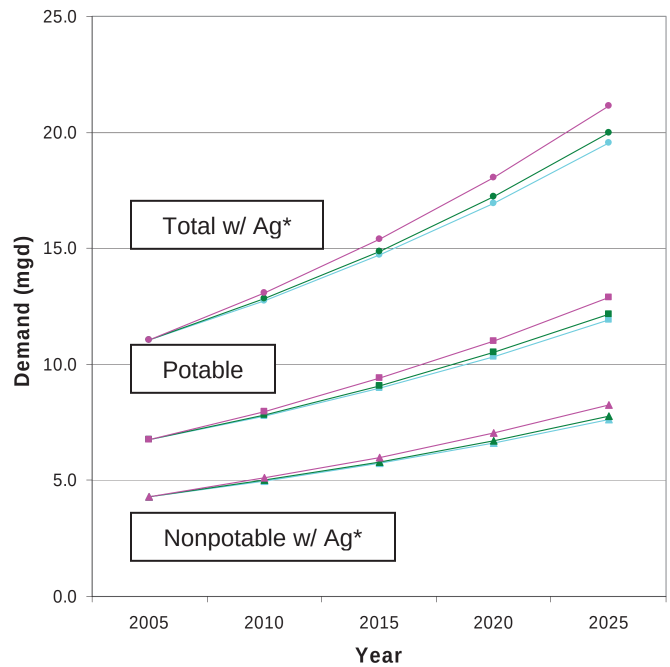
Table 803-16: Water Demand Projection – West Mauna Kea Aquifer Sector Area

	Without Agricultural Demands* (mgd)					With Agricultural Demands* (mgd)				
GROWTH RATE A	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	7.7	8.9	10.3	11.8	13.6	11.0	12.8	14.7	16.9	19.5
Potable	6.7	7.8	9.0	10.3	11.9	6.7	7.8	9.0	10.3	11.9
Nonpotable	1.0	1.1	1.3	1.5	1.7	4.3	5.0	5.7	6.6	7.6
GROWTH RATE B	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	7.7	9.0	10.4	12.0	13.9	11.0	12.8	14.9	17.2	20.0
Potable	6.7	7.8	9.1	10.5	12.2	6.7	7.8	9.1	10.5	12.2
Nonpotable	1.0	1.1	1.3	1.5	1.8	4.3	5.0	5.8	6.7	7.8
GROWTH RATE C	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	7.7	9.1	10.7	12.6	14.7	11.0	13.1	15.4	18.0	21.1
Potable	6.7	8.0	9.4	11.0	12.9	6.7	8.0	9.4	11.0	12.9
Nonpotable	1.0	1.2	1.4	1.6	1.9	4.3	5.1	6.0	7.0	8.2

* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 803-8: Water Demand Projection Summary – West Mauna Kea Aquifer Sector Area





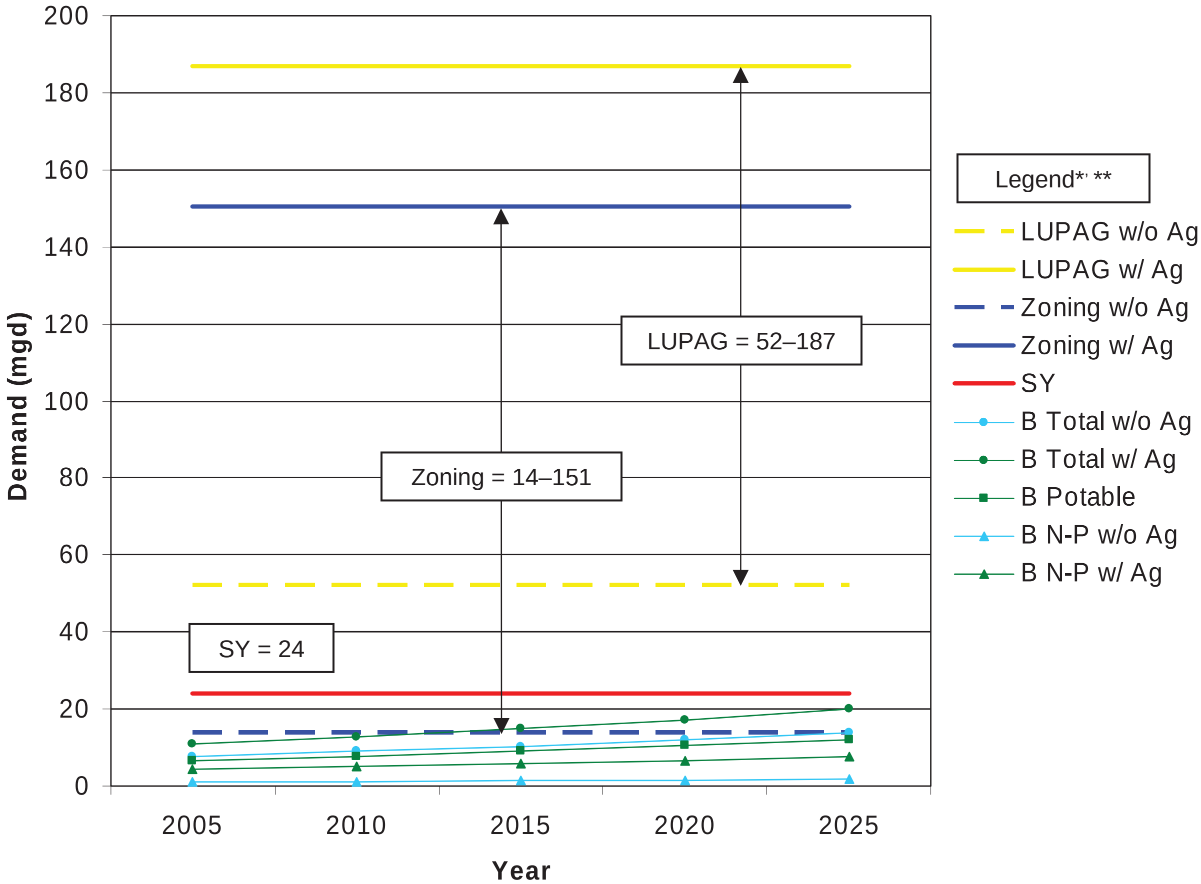
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 803-17: Medium Growth Rate B Water Demand Projection by Category – West Mauna Kea Aquifer Sector Area

Water Use Category	2005 (mgd)	2010 (mgd)	2015 (mgd)	2020 (mgd)	2025 (mgd)
Total without Ag*	7.7	9.0	10.4	12.0	13.9
Total with Ag*	11.0	12.8	14.9	17.2	20.0
Domestic	0.0	0.0	0.0	0.0	0.0
Industrial	0.0	0.0	0.0	0.0	0.0
Irrigation	1.0	1.1	1.3	1.5	1.8
Agriculture	3.3	3.9	4.5	5.2	6.0
Military	0.0	0.0	0.0	0.0	0.0
Municipal	6.7	7.8	9.1	10.5	12.2
Potable	6.7	7.8	9.1	10.5	12.2
Nonpotable w/o Ag*	1.0	1.1	1.3	1.5	1.8
Nonpotable w/ Ag*	4.3	5.0	5.8	6.7	7.8
DWS	2.2	2.5	2.9	3.4	3.9

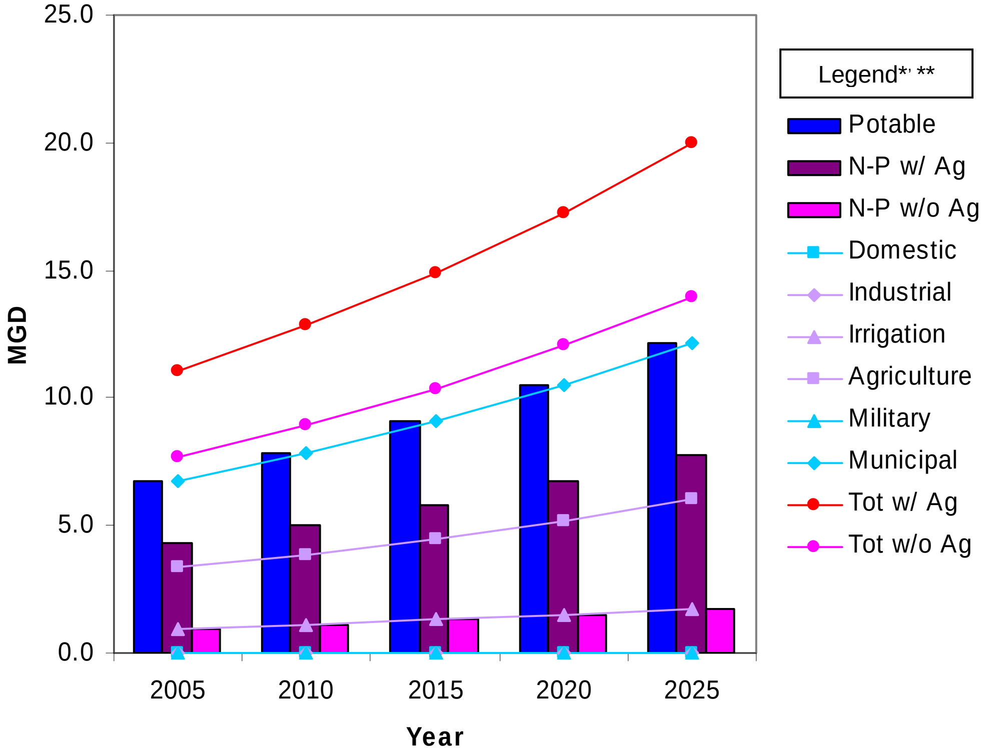
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 803-9: Medium Growth Rate B Water Demand Projections and Full Build-Out – West Mauna Kea Aquifer Sector Area



* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.
** The LUPAG and Zoning scenarios represent demand from full build-out to the maximum density allowed and are not associated with a timeline. The B scenario represents the 5-year incremental demand based on Growth Rate B population projections, with “Potable” representing the potable component, “N-P” representing the nonpotable component and “Total” representing the sum of the two.

Figure 803-10: Medium Growth Rate B Water Demand Projection by Category – West Mauna Kea Aquifer Sector Area

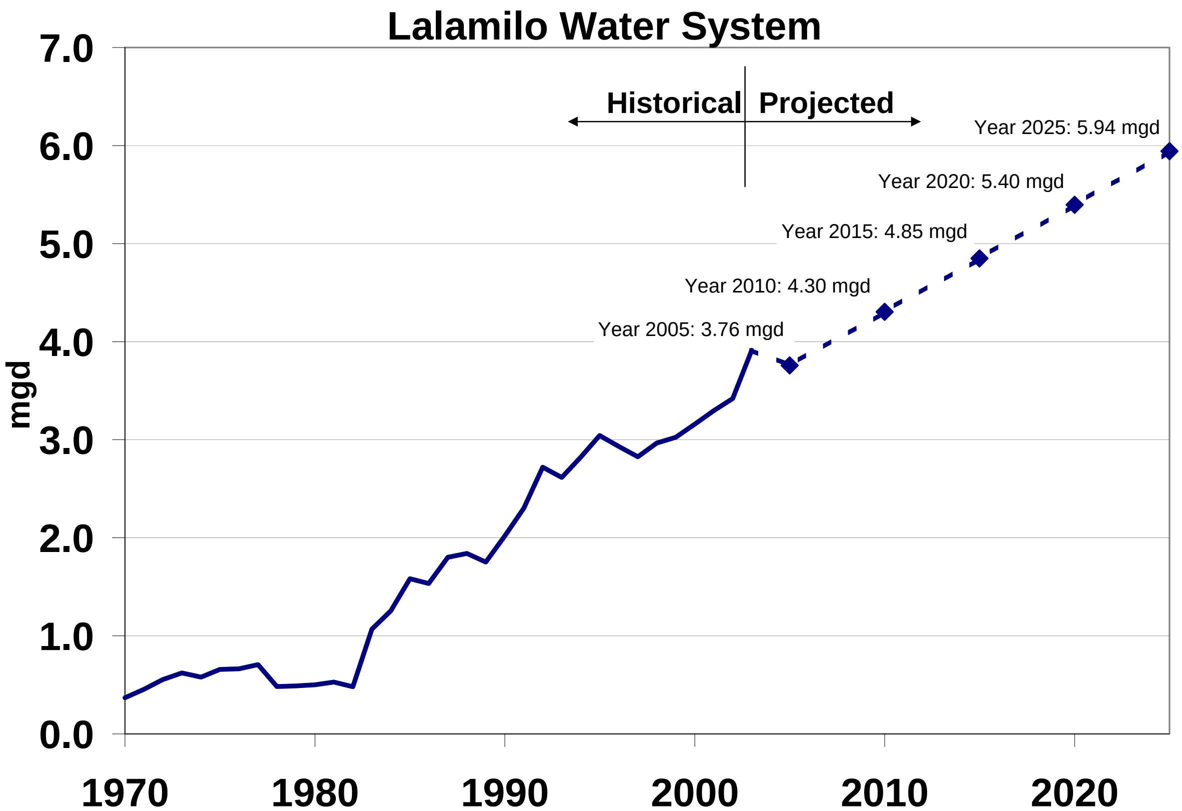


* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.
** "N-P" represents the nonpotable component of the demand.

803.4.5 DWS Historical Water Consumption Data Projections

DWS supplied water consumption was projected in 5-year increments to the year 2025 based on DWS historical water system consumption data from 1970 to 2003, as shown on **Figure 803-11**.

Figure 803-11: DWS Water Demand Projection – West Mauna Kea Aquifer Sector Area



Historical data and graph provided by RW Beck, Inc.

Over half of the Lalamilo Water System, and a small part of the Waimea Water System are within the West Mauna Kea ASEA, therefore, the former was included in the graph above; the latter was not. Projections based on historical DWS water consumption data and projections based on population growth rate cannot be compared as representation of the same area; however, the rate of increase based on population projections are significantly greater than the historical growth rate of the demand.

803.5 RESOURCE AND FACILITY RECOMMENDATIONS

803.5.1 Water Source Adequacy

803.5.1.1 Full Build-Out

Full build-out water demands associated with the maximum density of LUPAG land uses are not sustainable. If agricultural demands are not included, the LUPAG full build-out water demand requires over twice the sustainable yield (SY) of the West Mauna Kea Aquifer Sector Area (ASEA), and nearly eight times the SY if worst case agricultural demands are included. The existing zoning is legally developable, and requires nearly 60 percent of the existing sustainable yield if agricultural demands are not included, and over six times the SY if worst case agricultural demands are included.

803.5.1.2 Twenty-Year Projection

The 2025 water demand projection is nearly 60 percent of the SY not including agricultural demands, and over 80 percent of the SY if worst case agricultural demands are included. Existing water demands range between 32 and 46 percent of the SY of the sector area.

803.5.2 Source Development Requirements

803.5.2.1 Supply-Side Management

Supply-side management, including conventional water resource measures and alternative water resource enhancement measures, are evaluated to meet projected water demands.

803.5.2.1.1 Conventional Water Resource Measures

803.5.2.1.1.1 Ground Water

Measurements of the chloride content and height of the basal aquifer in the vicinity of the Lalamilo well field indicate that the quality and potential of this source is lower than the adjoining Waikoloa well field; however, the two Parker wells have shown good results. Kawaihae wells also have a high chloride content and indicate the presence of a geothermal anomaly. Nearby irrigation wells used by Mauna Kea Properties showed high chlorides. These may be reactivated if needed; however, production must be viewed with caution, because the high chloride content may be an indication that the potable basal aquifer is overdrawn.

Impact on the basal aquifer is of high concern because of the proximity of the wells to each other and the large volumes of withdrawal. Although pumpage is not reported to the CWRM, Mauna Kea Properties owns five wells classified as “Irrigation.” Mauna Lani Resort owns three wells classified as “Irrigation,” one of which reports pumpage. Overpumping of the lower level brackish water wells could possibly cause salt water intrusion into the freshwater lens and adversely affect the salinity of the nearby potable water wells. Additional nonpotable wells will need to be carefully placed and monitored.

Exploration should be continued to determine the extent and volume of high level water. The WRPP indicates that high level dike water occurs at great depth in the Hamakua formation towards the crest of Mauna Kea. The Waikii Ranch wells at elevation 4,350 feet above sea level, tap high level water at an elevation over 1,500 feet above sea level.

803.5.2.1.1.2 Surface Water

The Waikoloa Stream and associated tributaries generally run parallel to Kawaihae Road, flowing into the ocean on the north side of the Mauna Kea Resort. The proximity to development areas suggests it is a promising resource for both potable and nonpotable uses. The stream is intermittent at lower elevations. The USGS has several gauges on the stream and its tributaries. Additional stream flow studies would be required to evaluate the potential as a water resource.

803.5.2.1.1.3 Water Transfer

Water already is being transferred both out of and into the West Mauna Kea ASEA. All of the source wells for both the DWS Lalamilo Water System (WS) and the private Waikoloa System are located in the West Mauna Kea ASEA. Both systems supply developments in the Northwest Mauna Loa ASEA (807). Conversely, the well and stream sources supplying the DWS Waimea WS, part of which is in the West Mauna Kea ASEA, are in the Kohala ASEA (801). ASEA 801 has an abundance of both groundwater and surface water. The Waimea and Lalamilo WSs are interconnected by a valved connection. Development of sources in the ASEA 801 and subsequent transfer to the DWS Lalamilo WS within the West Mauna Kea ASEA could be easily accomplished.

803.5.2.1.2 Alternative Water Resource Enhancement Measures

803.5.2.1.2.1 Rainwater Catchment Systems

West Mauna Kea is one of the drier sector areas on the island. Although areas in Waimea near the northeastern boundary receive upward of 50 inches per year, most of the area in the sector receives less than 30 inches per year, which is not enough to sustain rainwater catchment systems.

803.5.2.1.2.2 Wastewater Reclamation

The two wastewater reclamation facilities currently produce 0.315 mgd and are expandable to 0.7 mgd. Effluent from the facility at Mauna Kea Resort is currently combined with brackish water to irrigate the golf course. Future irrigation uses are likely to follow increased development of the resort. Proximity to the facility may not be enough to promote usage, as the purveyor currently charges $0.35 per 1,000 gallons. Reclaimed wastewater from the Waimea

WRF used on Parker Ranch's pasture lots is expected to continue, however additional usage will depend on development in the immediate vicinity requiring nonpotable water.

803.5.2.1.2.3 Desalination

Desalination is a potential source of potable water from brackish wells in the lower lying areas. Chloride content of existing nonpotable wells is generally less than 500 ppm, which would be suitable for desalination. Typically, brackish water with chlorides less than 5,000 ppm is desirable for desalination. As described previously, brackish water should not be overdrawn, therefore the quantity of water available for desalination may be limited. Minimization of pumping costs would be desired to make this alternative feasible, thus restricting the service area to coastal regions such as Mauna Kea Resort and Kawaihae.

803.5.2.2 Demand-Side Management

803.5.2.2.1 Development Density Control

Full build-out of LUPAG demands nearly four times the amount of water than full build-out of Zoning, largely due to the greater proportion of Urban area in LUPAG. Additionally, Urban Expansion areas comprise over half of the Urban areas. Therefore, controlling the development densities of Urban Expansion areas, as well as re-assessing LUPAG Urban area densities could greatly reduce the full build-out water demand.

803.5.2.2.2 Water Conservation

The extremely high average water use unit rate per connection in the DWS water system of over 4,000 gpd can likely be attributed to the large water users in the Mauna Kea Resort. However, DWS accounts classified as "Residential" still consume over 1,000 gpd per connection. The estimated per capita potable water usage from all sources is over 900 gpd, which is also extremely high. This suggests that either a significant quantity of water is being used by the transient population or most people are using a considerable amount of water for non-domestic purposes, such as landscaping. Clearly, there is much room for conservation by resort and residential users. Requirements for efficient irrigation equipment and practices and usage restrictions during drier and warmer periods may be implemented. Several measures may be considered to reduce the residential unit rate consumption, including education, plumbing code regulation, and a rate structure deterring excessive water use. These measures may be more strictly enforced, justified by the climate and limited potable water sources.

Unaccounted water amounts to less than 10 percent of the source water produced in the Waimea WS, therefore supply-side conservation measures to reduce losses would not have a significant impact compared to the associated costs.

803.5.3 Recommended Alternatives

Development of potable basal groundwater should proceed with caution in the Lalamilo WS, and confirmation of its availability should precede expansion of the service area and/or demand in the system. Consistent with the Utility Courses of Action recommended in the General Plan, alternative sources of water for the Lalamilo WS should be sought. Studies should be initiated evaluating these potential alternative sources. Alternatives may include the following: development of sources in the Waimea area within the Kohala ASEA (801) and transfer of water via the Waimea WS, development of surface water sources from the Waikoloa Stream, and desalination of brackish water from low lying wells.

Demand-side water conservation programs should be implemented with the goal of reducing residential unit consumption rates closer to the island average.

The concept of utilizing the highest quality water for the highest end use should continue to be followed. Such is evident in the resort complexes where reclaimed wastewater and brackish water is already used for irrigation purposes. These sources should be expanded as additional irrigation requirements arise. The feasibility of a nonpotable water system within the resort should also be explored. A study of the potable water system within the resort would be prudent, with the objective of identifying potential areas where potable water consumption can be reduced and/or replaced.