808 KILAUEA AQUIFER SECTOR AREA

808.1 SECTOR AREA PROFILE

808.1.1 General

The Kilauea Aquifer Sector Area (ASEA) includes the Pahoa [80801], Kalapana [80802], Hilina [80803], and Keaiwa [80804] Aquifer System Areas (ASYA). It captures most of the Puna District and the southeastern portion of the Kau District, and extends along most of the island's southeastern coastline as far south as Kuhua Bay outside Punaluu. The sector area includes most of the Kilauea Crater and Hawaii Volcanoes National Park.

Average annual rainfall in coastal areas ranges from less than 40 inches along the dryer, southern coastline to 118 inches along the windward or eastern coastline. Average annual rainfall at the summit of Kilauea is as low as 20 inches, and in the Mountain View area is almost 200 inches. The Pahoa ASYA has by far the highest SY of the four system areas at 435 mgd, followed by the Kalapana ASYA at 157 mgd, the Keaiwa ASYA at 17 mgd, and the Hilina ASYA at 9 mgd. The total sustainable yield of the Kilauea ASEA is 618 mgd.

808.1.2 Economy and Population

808.1.2.1 Economy

Agriculture is the primary economic function in the Puna District. Papayas in the Kapoho area, flowers in the Pahoa and Kapoho areas, and bananas are the principal products. Truck farming in the Volcano area is also significant. The majority of the State's papayas and bananas are grown in Puna.

There are some tourist attractions in the sector area, including Hawaii Volcanoes National Park; however, these have had little impact on the economy, evident by the limited number of tourist accommodations and roadside stands.

The Puna Geothermal Venture (PGV) plant located outside of Kapoho generates 30-MW of electricity using three geothermal wells. Plans are already under way to expand the facility to double its output. Currently, PGV employs 30 people. The geothermal industry is promising, as waste geothermal heat may be used for a variety of different functions, which may attract other business to the sector area.

808.1.2.2 Population

Nearly all of the population contributing to the demands from the Kilauea ASEA is within the Puna District. The rate of growth of Puna's population has slowed, but still ranks as the island's highest. The growth can be attributed to the affordability of residences outside of Hilo and the job opportunities in Hilo. Puna's status as a "bedroom community" for Hilo is evident from much slower growth in employment, and the worsening traffic on its roads leading into Hilo.

Table 808-1: Historical Population

1980	1990	2000	1980-90 % Change	1990-2000 % Change
9,385	16,587	25,007	76.7	50.8

Data Source: 2000 U.S. Census
Data redistributed and evaluated for Kilauea Aquifer Sector Area

Table 808-2: Population Projection

Growth Rate	2000	2005	2010	2015	2020	2000-10 % Change	2010-20 % Change
A – Low	25,007	28,916	33,688	39,158	45,561	34.7	35.2
B – Medium	25,007	29,009	33,986	39,736	46,471	35.9	36.7
C – High	25,007	30,218	36,116	42,858	50,656	44.4	40.3

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

808.1.3 Land Use

808.1.3.1 Hawaii County General Plan

The Hawaii County General Plan Land Use Pattern Allocation Guide Map (LUPAG) for the Kilauea ASEA is shown on **Figure 808-1**. The estimated land use allocation acreage for each LUPAG designation within the sector area is listed in **Table 808-3**.

Table 808-3: LUPAG Map Estimated Land Use Allocation Acreage – Kilauea Aquifer Sector Area

LAND USE PATTERN	ACREAGE	% of TOTAL
High Density Urban	0	0
Medium Density Urban	410	0.1
Low Density Urban	6,218	1.8
Industrial	42	0.0
Important Agricultural Land	26,719	7.5
Extensive Agriculture	93,911	26.2
Orchard	0	0
Rural	27,211	7.6
Resort/Resort Node	4	0.0
Open	2,587	0.7
Conservation	199,697	55.8
Urban Expansion	1,072	0.3
University Use	0	0
TOTAL	357,871	100.0

Kaloli Pt.

Cape Kumukahi

Pahoa
80801

Kalapana
80802

Hilina
80803

Keaiwa
80804

Apua Pt.

Naliikakani Pt.

PACIFIC OCEAN

Kuhua Bay

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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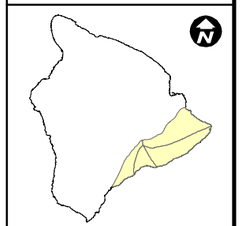

INDEX MAP - Island of Hawaii

FIGURE 808-1

AQUIFER SECTOR
KILAUEA - 808

Aquifer Systems
Pahoa - 80801
Kalapana - 80802
Hilina - 80803
Keaiwa - 80804

2005 Revised General Plan Land Use Pattern Allocation Guide

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Consulting Engineers
1388 Kapiolani Boulevard, Honolulu, Hawaii 96814

The water utility courses of action for Puna in the Hawaii County General Plan relevant to the Kilauea ASEA are as follows:

- ***(a)*** *Continue to improve inadequate water system facilities.*
- ***(b)*** *Water source investigation and exploration should be continued in order to provide service for anticipated needs.*
- ***(c)*** *Investigate additional groundwater sources in the Olaa area.*
- ***(d)*** *Investigate alternative means to finance the extension to subdivisions that rely on catchment.*

808.1.3.2 Hawaii County Zoning

Hawaii County Zoning for the Kilauea ASEA is shown on **Figure 808-2**. The estimated land use allocation acreage for each zoning class within the sector area is listed in **Table 808-4**.

Table 808-4: County Zoning Estimated Class Allocation Acreage – Kilauea Aquifer Sector Area

ZONING CLASS	ACREAGE	% of TOTAL
Single Family Residential	2,041	0.6
Multi-Family Residential (including duplex)	4	0.0
Residential-Commercial Mixed Use	0	0
Resort	1	0.0
Commercial	40	0.0
Industrial	0	0
Industrial-Commercial Mixed	9	0.0
Family Agriculture	8	0.0
Residential Agriculture	137	0.0
Agriculture	179,106	50.1
Open	139,914	39.1
Project District	0	0
Forest Reserve	31,857	8.9
(road)	4,571	1.3
TOTAL	357,688	100.0

808.2 AVAILABLE WATER RESOURCES

808.2.1 Ground Water

Kilauea ASEA has a sustainable yield of 618 mgd. According to the CWRM database, there are 45 production wells in the sector, including 8 municipal, 8 irrigation, 19 domestic, and 10 other.

There are also 19 wells drilled and categorized as "unused". Refer to **Appendix B** for this database. **Figure 808-3** shows the well locations.

808.2.2 Surface Water

There are no perennial streams in the sector area. There is 1 declared stream diversion in CRWM database listed in **Table 808-5** and shown on **Figure 808-4**.

Table 808-5: Stream Diversions – Kilauea Aquifer Sector Area

FILE REFERENCE	TMK	STREAM NAME	
MALU AINA FARM	1-7-002:002	Unnamed/ Unmapped	Stream diversion, waterway from Malu Aina Stream. See also two new entries for declarant.

808.2.3 Reclaimed Wastewater

There are no wastewater reclamation facilities within the Kilauea ASEA.

808.3 EXISTING WATER USE

808.3.1 General

The total estimated average water use within the Kilauea ASEA from November 2004 through October 2005 based on DWS meter data, available GIS data, DOH records, and CWRM pumpage data is listed in **Table 808-6**. **Table 808-6** and **Figure 808-5** summarize water use in accordance with CWRM categories and indicate the quantities supplied excluding agricultural demands, and the quantities supplied including worst case agricultural demands (as described in Chapter 2) by the DWS system, non-DWS systems.

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 Reserve
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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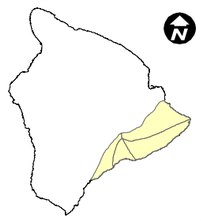

INDEX MAP - Island of Hawaii

FIGURE 808-2

AQUIFER SECTOR
KILAUEA - 808

Aquifer Systems
Pahoa - 80801
Kalapana - 80802
Hilina - 80803
Keaiwa - 80804

County Zoning

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Consulting Engineers
1388 Kapiolani Boulevard, Honolulu, Hawaii 96814

Figure 808-3: Well and Tunnel Location

MAP CURRENTLY NOT AVAILABLE ON-LINE

Figure 808-4: Streams & Diversions

MAP CURRENTLY NOT AVAILABLE ON-LINE

Table 808-6: Existing Water Use by Categories – Kilauea Aquifer Sector Area

CWRM Water Use Category	Water Use (MGD)	Percent of Total without Ag*	Percent of Total with Ag*
Domestic	2.69	61.6	40.9
Industrial	0.00	0.0	0.0
Irrigation	0.00	0.0	0.0
Reclaimed WW	0.00	0.0	0.0
Agriculture	2.22	0.0	33.7
Military	0.00	0.0	0.0
Municipal			
DWS System	0.70	16.0	10.6
Private Public WS	0.98	22.4	14.8
Total without Ag*	4.37	100.0	
Total with Ag*	6.58		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 808-5: Existing Water Use by Categories – Kilauea Aquifer Sector Area

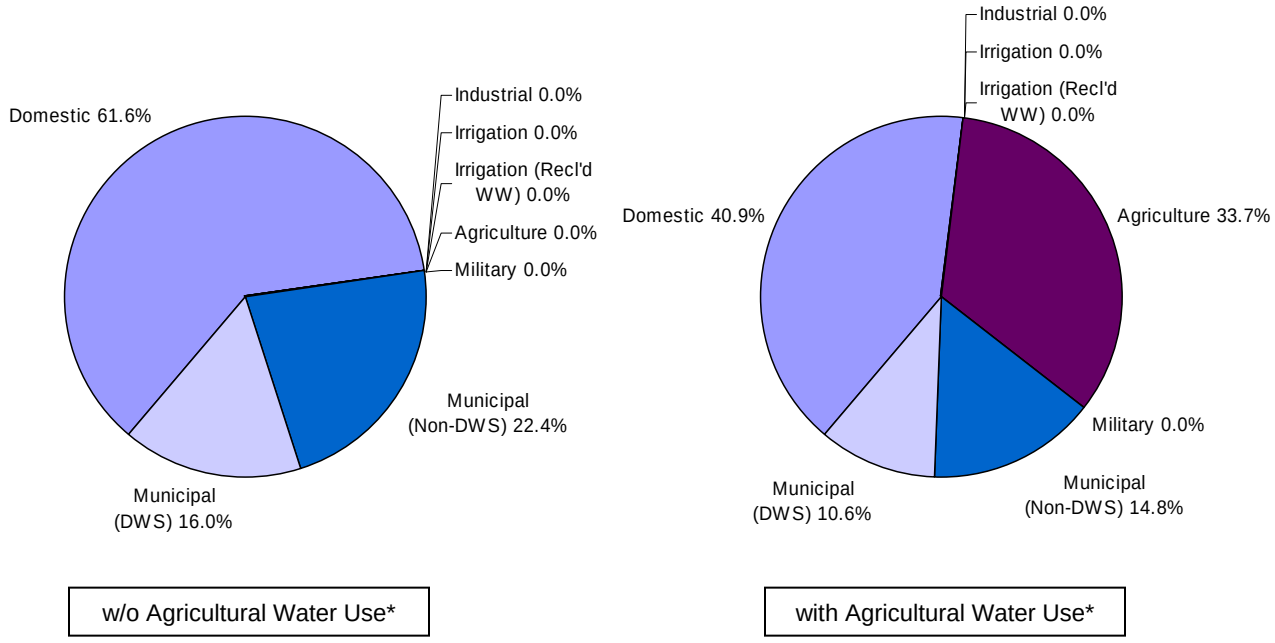

Figure 808-6 generally shows the service area for the various water systems and indicates the extent of the DWS water system.

808.3.2 Domestic Use

Domestic use or water use by individual households is assumed to be supplied by private individual rainwater catchment systems or private wells. Based on available GIS data, there are 6,668 such parcels which would serve an estimated 18,000 people or nearly two-thirds of the

sector area population. The estimated demand from rainwater catchment usage of 2.7 mgd is by far the most of all sector areas on the island. None of the 19 wells in the CWRM database classified as "Domestic" have reported pumpage.

808.3.3 Industrial Use

There are no wells classified as "Industrial" in the CWRM database.

Puna Geothermal Venture has two wells classified as "Other" and one well classified as "Observation," which are used as monitoring wells to conduct chemical analyses on the groundwater twice a year. PGV also has three production wells which extract geothermal fluid and three injection wells which return the used fluid. Because the temperature of the fluid is greater than 150 degrees Fahrenheit, the wells are regulated by the Land Division, Engineering Branch of the DLNR.

808.3.4 Irrigation Use

There is one golf course in the sector area. The Volcano Golf & Country Club is situated along Hawaii Belt Road opposite Hawaii Volcanoes National Park. There is no irrigation system; rainfall in the area is sufficient to maintain the course.

There are no known irrigation uses dedicated other landscaping activities.

808.3.5 Agricultural Use

Although agricultural activity is significant in the sector area, abundant ambient rainfall is sufficient for most of the agricultural products, such as papayas and bananas. According to DWS records, a significant portion of the water consumed in the Kapoho and Kalapana Water Systems is by accounts classified as "Agricultural;" however, altogether this amounts to less than 0.1 mgd.

808.3.6 Military Use

The Kilauea Military Camp is located within the Kilauea ASEA. The camp is a resort facility for active and retired military personnel and their families, including 90-1, 2 and 3 bedroom cottages and apartments, and several amenities including restaurants, stores, sports and games. The camp has 100 full-time employees. DOH records indicate that water is supplied via catchment; however, details of the system and consumption are not known.

808.3.7 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.

Kaloli Pt.

Hawaiian Beaches

Hawaiian Shores

Cape Kumukahi

Pahoa

Pahoa
80801

Kapoho

Kalapana

Kalapana
80802

Hilina
80803

Keaiwa
80804

Apua Pt.

Naliikakani Pt.

PACIFIC OCEAN

Punaluu

Kuhua Bay

Hawaii County

Department of Water Supply

DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

Job No. 2003-818

LEGEND:

- DWS Water System Service Area
- Possible Catchment Area (Building Value > $10000)
- Private Water System Service Area
- Aquifer Systems
- DWS Water System

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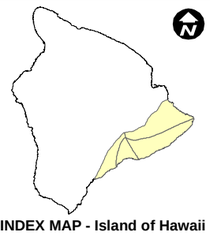

INDEX MAP - Island of Hawaii

FIGURE 808-6

AQUIFER SECTOR
KILAUEA - 808

Aquifer Systems

Pahoa - 80801
Kalapana - 80802
Hilina - 80803
Keaiwa - 80804

Water System and Service Area

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808.3.7.1 County Water Systems

The DWS has 3 water systems in the Kilauea ASEA.

The Olaa-Mt. View Water System described in Chapter 804 services areas in the Kilauea ASEA south of Hawaii Belt Road and along Keeau-Pahoa Road to Kaloli Drive. The water system is connected along Keeau-Pahoa Drive to the Pahoa Water System, allowing water to flow in either direction.

The Pahoa Water System obtains its water from two wells at Keonepoko Nui and two wells at the Pahoa well field. Both sources have good quality water with chloride content between 4 and 27 ppm. The water system services six operational zones in the Pahoa area using one booster pump station and four storage tanks.

The Kapoho Water System formerly depended on an infiltration gallery type of well, and now relies entirely on the Pahoa Water System for its supply. A single tank provides storage for the water system.

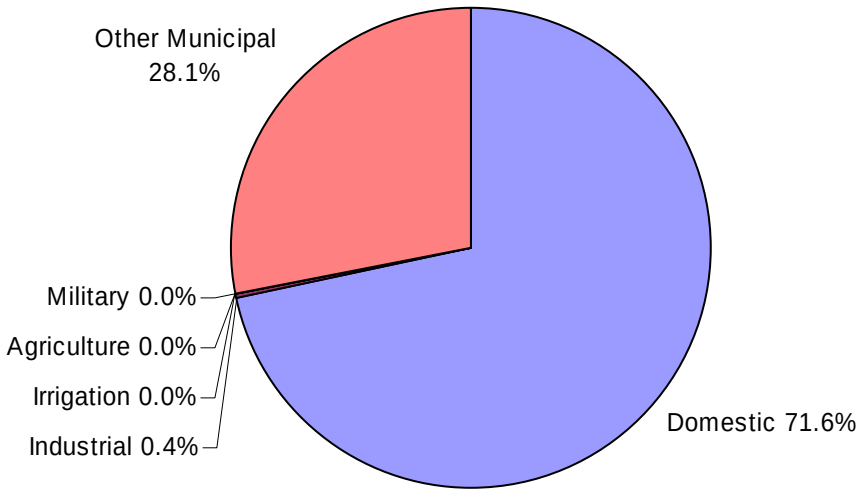
The Kalapana Water System obtains its water supply from two wells located at the southwesterly edge of Keauohana Forest Reserve near the Pahoa-Kalapana Highway. The water has a relatively high chloride content of between 107 and 124 ppm. The water system's service area runs from the forest reserve along the highway to Kaimu area and along the coastal road to Queens Bath area. However, the lava flow has buried long segments of the highway and watermains and destroyed many residences in the area. Presently, two operational zones are serviced using two storage tanks. There are no booster pump stations in the water system.

DWS water use is subcategorized in **Table 808-7** to the extent possible based on available meter data and is depicted in **Figure 808-7**. "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 808-7: DWS Existing Water Use by Categories – Kilauea Aquifer Sector Area

CWRM Water Use Category	DWS Purveyed Water Use (MGD)	Percent of Total
Domestic	0.43	71.6
Industrial	0.00	0.4
Irrigation	0.00	0.0
Agriculture	0.00	0.0
Military	0.00	0.0
Other Municipal	0.17	28.1
Total	0.61	100.0

Figure 808-7: DWS Existing Water Use by Categories – Kilauea Aquifer Sector Area



808.3.7.2 State Water Systems

There are no State water systems in the Kilauea ASEA regulated by the DOH.

808.3.7.3 Federal Water Systems

There are two federal water systems in the Kilauea ASEA regulated by the DOH.

The Kilauea Military Camp water system described in Section 808.3.6 is operated by the U.S. Military Joint Forces.

The Hawaii Volcanoes National Park water system is operated by the Department of the Interior. DOH records indicate that a catchment supplies water to the system, which serves several buildings, including the Kilauea Visitor Center, the restrooms at Thurston Lava Tube, Volcano House restaurant and hotel, USGS Volcano Observatory, Namakani Paio Compound, park offices and workshops, and park staff residences. The average demand is 0.027 mgd.

808.3.7.4 Private Public Water Systems

There are two private public water systems in the Kilauea ASEA regulated by the DOH.

The Hawaiian Beaches Water System includes a 100,000 gallon steel tank serving approximately 3,388 people through 1,059 service connections to residential lots. The average pumpage from one well is 0.82 mgd. The Hawaiian Shores subdivision is comprised primarily of residential lots, with lots dedicated to parks, recreation center and water yard. The water system includes one well and storage tank serving approximately 400 service connections. The average pumpage from one well is 0.13 mgd. The two systems are connected by a valve that may be opened in an emergency situation.

808.3.8 Water Use by Resource

808.3.8.1 Ground Water

Table 808-8 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 808-8: Sustainable Yield – Kilauea 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 (%)
		1.53	**5.53**	**8.29**	**618**	**0.25**	**0.89**	**1.34**
80801	Pahoa	1.47	3.53	5.30	435	0.34	0.81	1.22
80802	Kalapana	0.06	1.99	2.99	157	0.04	1.27	1.90
80803	Hilina	0.00	0.00	0.00	9	0.00	0.00	0.00
80804	Keaiwa	0.00	0.00	0.00	17	0.00	0.00	0.00

808.3.8.2 Surface Water

There are no known surface water uses in the sector area.

808.3.8.3 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 previously categorized as Domestic Use in **Table 808-7** is assumed to be supplied by individual catchment systems.

808.3.8.4 Reclaimed Wastewater

There are no wastewater reclamation facilities within the Kilauea ASEA.

808.4 FUTURE WATER NEEDS

808.4.1 General

Table 808-9 summarizes the LUPAG, Zoning and 5-year incremental water demand projection scenarios for the total aquifer sector area and the individual aquifer system areas. The sustainable yield (SY) is presented to draw comparisons.

Table 808-9: 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 Kilauea ASEA	618	36.5	4.6	4.4	5.1	6.0	7.0	8.2
80801 – Pahoa ASYA	435	33.3	3.8	3.8	4.4	5.2	6.1	7.1
80802 – Kalapana ASYA	157	3.1	0.8	0.6	0.7	0.8	0.9	1.1
80803 – Hilina ASYA	9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
80804 – Keaiwa ASYA	17	0.1	0.0	0.0	0.0	0.0	0.0	0.0
With Agricultural Demand*	**SY (mgd)**	**LUPAG (mgd)**	**Zoning (mgd)**	**Growth Rate B Demand Projections (mgd)**				
				2005	**2010**	**2015**	**2020**	**2025**
Total Kilauea ASEA	618	127.3	94.5	6.6	7.7	9.0	10.4	12.2
80801 – Pahoa ASYA	435	67.6	37.6	4.6	5.4	6.3	7.4	8.6
80802 – Kalapana ASYA	157	53.1	50.4	1.8	2.1	2.5	2.9	3.4
80803 – Hilina ASYA	9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
80804 – Keaiwa ASYA	17	6.6	6.5	0.2	0.2	0.2	0.2	0.2

* 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.

For all aquifer system areas, full build-out and 2025 projection water demands excluding agricultural demands are a small fraction the SY. Therefore, analysis of the three demand scenarios does not need to be broken down by aquifer system areas and thus will be presented for the aquifer sector area only.

808.4.2 Full Build-Out Water Demand Projections

The full build-out water demand projections based on the General Plan and County Zoning for the Kilauea ASEA are listed in **Tables 808-10** and **808-11**, and reflect refinement as discussed below. Each land use class is associated with the most appropriate CWRM water use category.

Table 808-10: Hawaii County General Plan Full Build-Out Water Demand Projection – Kilauea Aquifer Sector Area

LUPAG Class	CWRM Category	Water Demand (mgd)
Urban	Domestic/Irrigation/Municipal	20.7
Urban Expansion	Domestic/Irrigation/Municipal	3.3
Resort	Irrigation/Municipal	0.2
Industrial	Industrial	0.2
Agriculture	Agriculture	90.8
University	Irrigation/Municipal	0
Rural	Irrigation/Municipal	10.9
DHHL	Irrigation/Municipal	1.4
TOTAL w/o Ag*		36.5
TOTAL w/ Ag*		127.3

* 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 808-11: County Zoning Full Build-Out Water Demand Projection – Kilauea Aquifer Sector Area

Zoning Class	CWRM Category	Water Demand (mgd)
Residential	Domestic/Irrigation/Municipal	3.1
Resort	Irrigation/Municipal	0.0
Commercial	Municipal	0.1
Industrial	Industrial	0.0
Agriculture	Agriculture	89.9
DHHL	Irrigation/Municipal	1.4
TOTAL w/o Ag*		4.6
TOTAL w/ Ag*		94.5

* 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.

808.4.2.1 Refine Land Use Based Projection

808.4.2.1.1 State Water Projects Plan

The total projected demand to the year 2020 for 23 State Water Projects within the Kilauea ASEA is 1.71 mgd, using 0.23 mgd potable, 1.47 mgd nonpotable, and 0.01 nonpotable using potable sources. These demands account for up to 25 percent of the projected total demand for the sector area. The projects that will generate the most significant demands, with the exception of DHHL projects, which are covered separately, are listed in **Table 808-12**.

Table 808-12: Future State Water Projects to Generate Significant Demands

Project Name	Primary Use	State Department	2020 Demand (mgd)
Hawaiian Paradise Park Elementary School	Potable	DOE	0.06
Keeau High School 2nd Increment	Potable	DOE	0.048

808.4.2.1.2 State Department of Hawaiian Home Lands

The Makuu Tract consists of two pre-1994 sections with a total area of 2,000 acres; including Makuu 1 north of Pahoa Village below the highway, and Makuu-2 above the highway, and the Makai section along the coast south of Hawaiian Paradise Park Subdivison. DHHL has proposed demands only for the mauka sections. The total average demand for the existing farm lots, and the proposed agricultural, residential and commercial lots is 1.38 mgd. Water would be supplied by the DWS Pahoa Water System, which pumped 0.55 mgd of its 4 wells' 1.91 mgd pump capacity in 2005.

Keonepoko is a small tract a short distance south of Makuu-1. No demands have been proposed by DHHL.

808.4.2.1.3 Agricultural Water Use and Development Plan

There is no information available in the AWUDP specific to activity within the Kilauea ASEA to further refine projections.

808.4.3 Water Use Unit Rates

Water use unit rates are based on the *Water System Standards* as discussed in Chapter 1.

808.4.4 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 Kilauea ASEA. The projected low, medium, and high growth rates are listed in **Table 808-13**, and are graphed in **Figure 808-8**. Potable and nonpotable water demands are also differentiated.

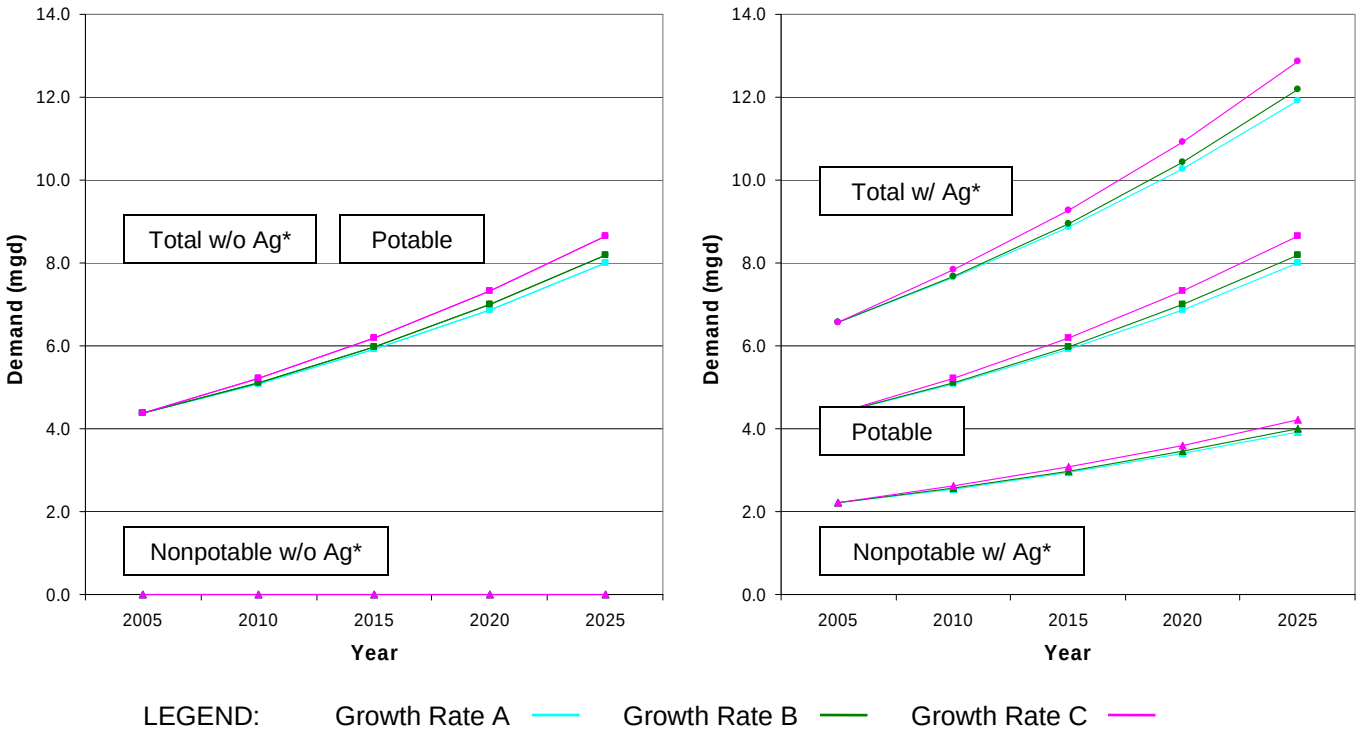
Figure 808-9 illustrates the magnitude of the sustainable yield, both LUPAG and Zoning full build-out water use, and water use projection through the year 2025 focusing on Medium Growth Rate B. **Figure 808-10** shows the breakdown of water demand projections by CWRM categories through the year 2025. **Table 808-14** summarizes these figures.

Table 808-13: Water Demand Projection – Kilauea 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	4.4	5.1	5.9	6.9	8.0	6.6	7.6	8.9	10.3	11.9
Potable	4.4	5.1	5.9	6.9	8.0	4.4	5.1	5.9	6.9	8.0
Nonpotable	0.0	0.0	0.0	0.0	0.0	2.2	2.6	2.9	3.4	3.9
GROWTH RATE B	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	4.4	5.1	6.0	7.0	8.2	6.6	7.7	9.0	10.4	12.2
Potable	4.4	5.1	6.0	7.0	8.2	4.4	5.1	6.0	7.0	8.2
Nonpotable	0.0	0.0	0.0	0.0	0.0	2.2	2.6	3.0	3.4	4.0
GROWTH RATE C	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	4.4	5.2	6.2	7.3	8.6	6.6	7.8	9.3	10.9	12.9
Potable	4.4	5.2	6.2	7.3	8.6	4.4	5.2	6.2	7.3	8.6
Nonpotable	0.0	0.0	0.0	0.0	0.0	2.2	2.6	3.1	3.6	4.2

* 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 808-8: Water Demand Projection Summary – Kilauea Aquifer Sector Area



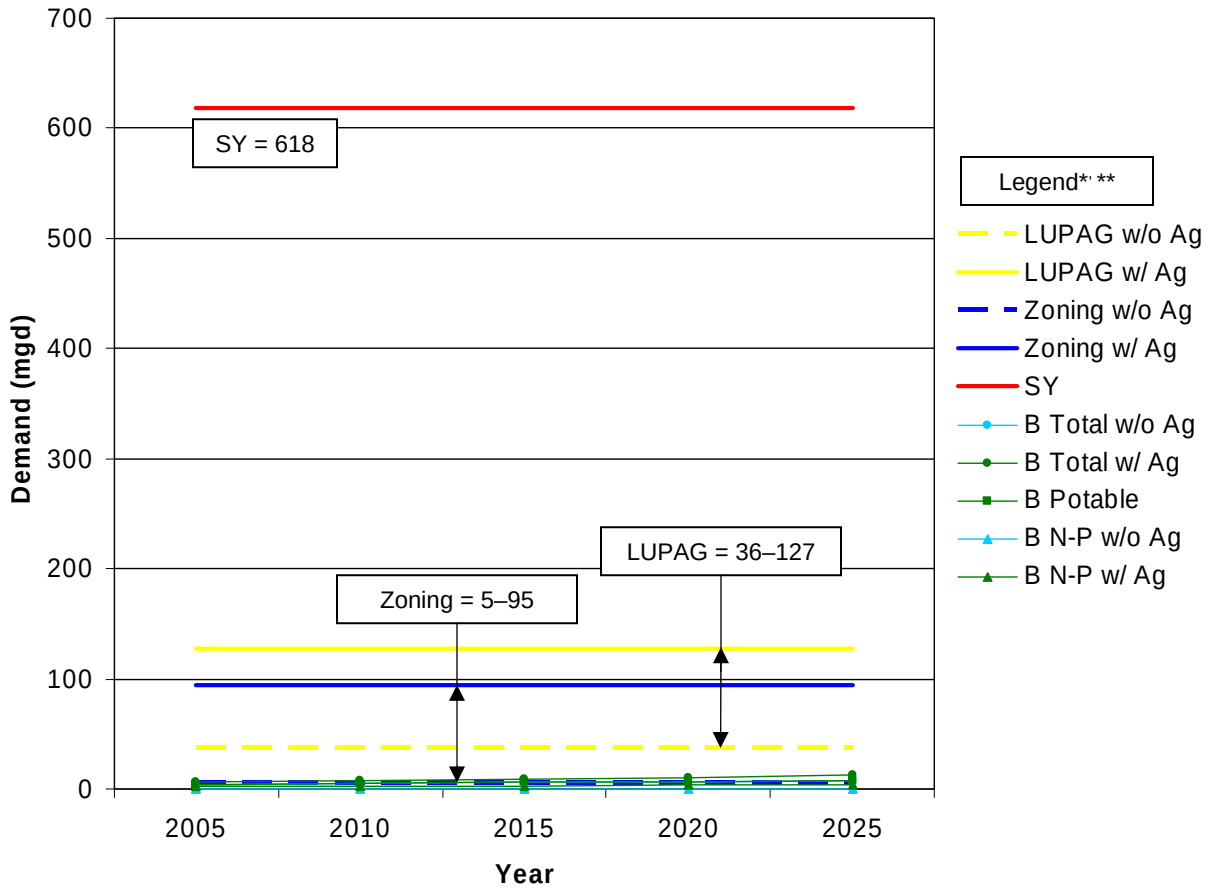
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 808-14: Medium Growth Rate B Water Demand Projection by Category – Kilauea Aquifer Sector Area

Water Use Category	2005 (mgd)	2010 (mgd)	2015 (mgd)	2020 (mgd)	2025 (mgd)
Total without Ag*	4.4	5.1	6.0	7.0	8.2
Total with Ag*	6.6	7.7	9.0	10.4	12.2
Domestic	2.7	3.1	3.7	4.3	5.0
Industrial	0.0	0.0	0.0	0.0	0.0
Irrigation	0.0	0.0	0.0	0.0	0.0
Agriculture	2.2	2.6	3.0	3.4	4.0
Military	0.0	0.0	0.0	0.0	0.0
Municipal	1.7	2.0	2.3	2.7	3.1
Potable	4.4	5.1	6.0	7.0	8.2
Nonpotable w/o Ag*	0.0	0.0	0.0	0.0	0.0
Nonpotable w/ Ag*	2.2	2.6	3.0	3.4	4.0
DWS	0.7	0.8	1.0	1.1	1.3

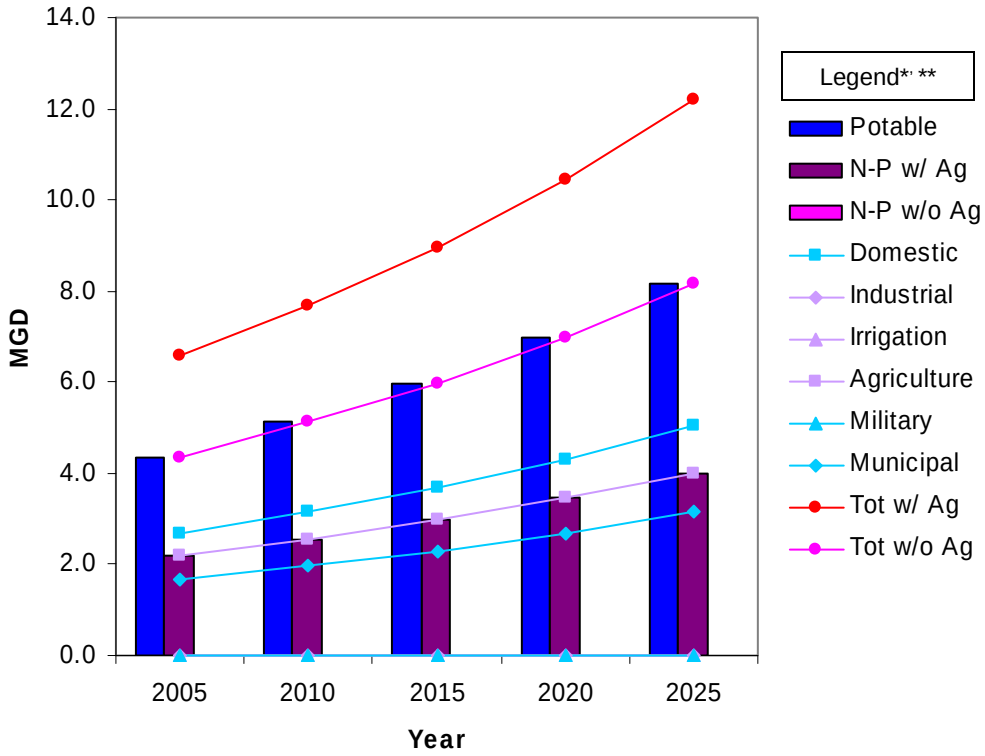
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 808-9: Medium Growth Rate B Water Demand Projections and Full Build-Out – Kilauea 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 808-10: Medium Growth Rate B Water Demand Projection by Category – Kilauea Aquifer Sector Area

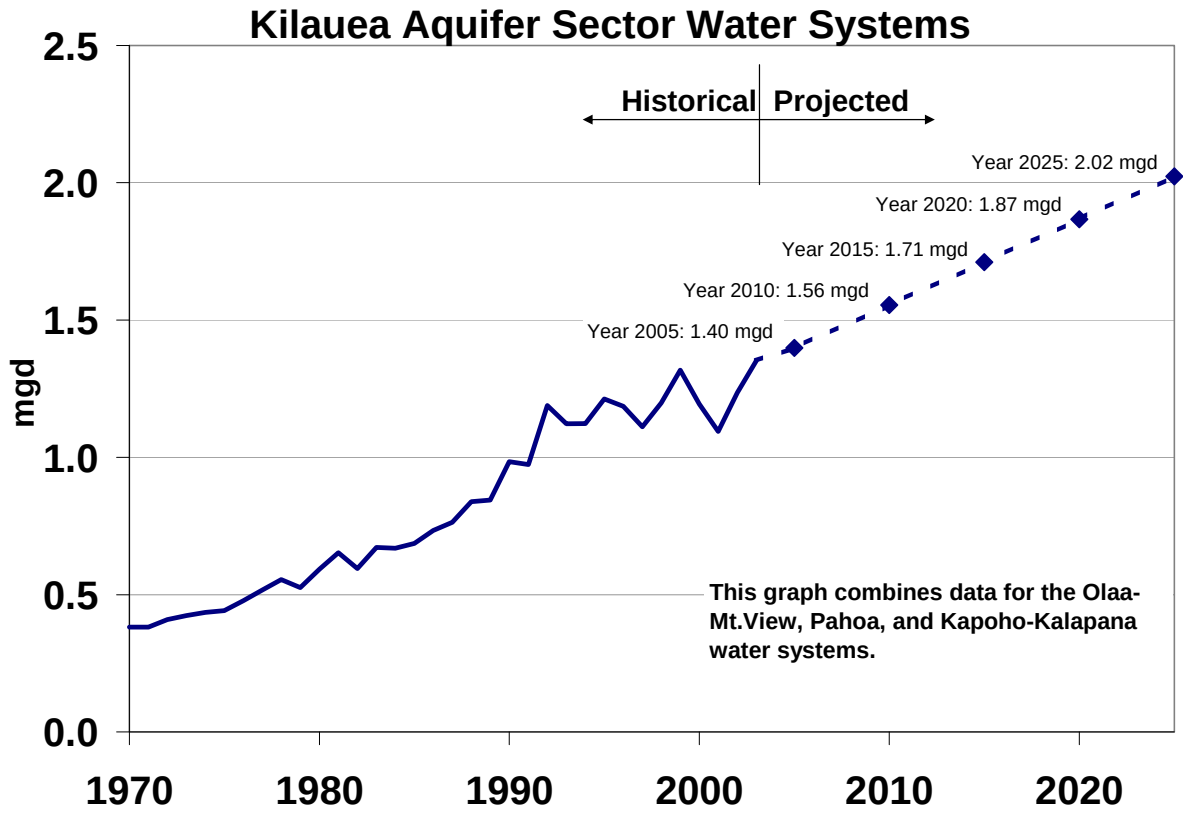


* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.
** "N-P" represents the nonpotable component of the demand.

808.4.5 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 808-11**.

Figure 808-11: DWS Water Demand Projection – Kilauea Aquifer Sector Area



Historical data provided by RW Beck, Inc.

Projections based on historical DWS water consumption data cannot be compared to projections based on population growth rate, because most of the Olaa-Mt.View Water System is within the Northeast Mauna Loa ASEA. However, the projected rate of growth of the future population is considerably higher than the rate of increase based on historical consumption.

808.5 RESOURCE AND FACILITY RECOMMENDATIONS

808.5.1 Water Source Adequacy

808.5.1.1 Full Build-Out

Full development to the maximum density of the County General Plan and Zoning land use within the Kilauea Aquifer Sector Area (ASEA)can be sustained by conventional water resources if agricultural demands are not included. Water demands associated with the LUPAG scenario amount to approximately 5 percent of the sustainable yield (SY) of the sector area, and the existing zoning requires less than 1 percent of the SY. If worst case agricultural demands are included, the LUPAG and Zoning full build-out water demand scenarios would require 21 and 15 percent of the SY, respectively.

808.5.1.2 Twenty-Year Projection

Existing and 20-year projected water demands are insignificant compared to the SY of the sector area. Existing water demands are approximately 1 percent of the SY, and 2025 projected demands range between 1 and 2 percent of the SY.

808.5.2 Source Development Requirements

808.5.2.1 Supply-Side Management

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

808.5.2.1.1 Conventional Water Resource Measures

808.5.2.1.1.1 Ground Water

Because of the continuing activity of Kilauea, and the youth of the geology, the groundwater relationships are complex. Basal water exists along the coast of the Kalapana Aquifer System Area (ASYA) and extends several miles inland. This is evidenced by the development of existing potable water wells. Geothermal fluids also exist, and interestingly, are being developed a few miles from existing potable water wells. Large volumes of high-level water exist in the rift zone of Kilauea, but is likely accessible only in the Pahoa ASYA. Exploratory wells in the Glenwood area of the adjacent Southeast Mauna Loa ASEA (805) have tapped high level water at over 1,000 feet, however, high level potable water wells have yet to be put in service. Based on chloride content of existing wells, development of basal groundwater sources should continue at least a few miles inland of the coast. Undoubtedly, based on the measured head in the existing wells, a large volume of basal water exists.

As indicated in the *1999 Central Puna Water Master Plan*, it may be more economical to develop high level water instead of basal water. In systems serving multiple pressure zones, high

level water would be pumped at a higher elevation and thus may be transmitted downhill by gravity and a series of pressure reducing valves, whereas basal water would require initial pumping and a series of booster pumps.

808.5.2.1.1.2 Surface Water

Surface water is nearly non-existent in the Kilauea ASEA; there are no perennial streams and only one registered stream diversion. Surface water sources are not considered a viable water resource.

808.5.2.1.1.3 Water Transfer

Some degree of water transfer is already taking place. The service area of the DWS Olaa-Mt. View Water System, sources for which are in the Northeast Mauna Loa ASEA (804), extends into the Kilauea ASEA. The water transfer is not a concern as the DWS demands in the water system are insignificant compared to the large sustainable yield of both aquifer sector areas. Potable sources may be developed in either sector area and transferred to the other sector areas without impacting the aquifer.

808.5.2.1.2 Alternative Water Resource Enhancement Measures

808.5.2.1.2.1 Rainwater Catchment Systems

The Kilauea ASEA is unique in that most of the residents within the sector area rely on rainwater catchment systems as their sole potable water source. Most significantly, units within the 89-square foot area in Central Puna comprised of 12 subdivisions, with the exception of the immediate vicinity of Keeau-Pahoa Road, all utilize individual catchment systems. Except for the uninhabited Hilina and Keaiwa ASYAs, the sector area receives sufficient ambient rainfall to support catchment systems.

Larger scale rainwater catchment systems are also an option to supply nonpotable needs if necessary. Many agricultural crops and irrigation needs can be satisfied by the ambient rainfall.

808.5.2.1.2.2 Wastewater Reclamation

Wastewater reclamation facilities are not considered a viable option at this time due to the small service population of the municipal wastewater systems in the sector area. However, the potential population of the Central Puna area, with an estimated 30,000 lots, could justify a wastewater reclamation facility. Additionally, availability of reclaimed wastewater could help supplement the significant contingent of 1-acre lots in the area that engage in live-grow operations.

808.5.2.1.2.3 Desalination

The potential for desalination plants exist where brackish water is present from the coastline to a few miles inland. In general, these areas typically are not served by a municipal water system, have small service populations, and significant growth is not anticipated. In these areas, it is probably more cost-effective to extend the municipal water system rather than construct desalination facilities.

808.5.2.2 Demand-Side Management

808.5.2.2.1 Development Density Control

Full build-out demands associated with LUPAG maximum density are nearly eight times greater than that of Zoning. The discrepancy results from vast areas classified as Rural in the LUPAG, compared to Agricultural in Zoning. Many of these lots will likely be used for family agricultural operations or residential dwellings. Additional sources eventually will be required; however, these demands are sustainable by conventional resources. Development density of the Rural designation was assumed to be 1 unit per acre, which is considerably lower than the island average Urban and Residential land use unit density rates; therefore, development density control is not considered necessary.

808.5.2.2.2 Water Conservation

The average water consumption per connection to the DWS water system in the Kilauea ASEA is 550 gpd, which is higher than the island average, but the average consumption of DWS accounts classified as "Residential" is less than 400 gpd per connection. The average potable water consumption per capita from all sources is 150 gpd, which is acceptable.

The DWS Pahoa and Kalapana Water Systems have a significant percentage of water not accounted for, with the Kalapana Water System having between 30 and 50 percent of the water produced unaccounted. Although source production is still adequate to meet the projected demands, and the amount of water lost is insignificant compared to the SY of the sector area, it would be prudent for DWS to examine the economic impact of the water losses.

Demand and supply side conservation measures should continue to be stressed, but strict enforcement is not critical at this point.

808.5.3 Recommended Alternatives

Consistent with the utility goals for the Puna District stated in the General Plan, alternative means to finance the extension of water systems to subdivision that rely on catchment should be considered. A feasibility study to investigate both the need and desire for a municipal water system, either by extension of the existing system, or new system altogether, would be prudent. The key consideration is that a municipal system should not be imposed on residents if it is not desired.

Groundwater sources in Olaa also should be investigated. A cost-benefit analysis would determine whether to seek high level or basal potable water sources. Currently, DWS has planned a new production well in the center of Mountain View. An observation well in the vicinity indicates that high-level water over 1,000 feet in elevation should be expected.