
Chapter 20303

Makaweli Aquifer System Area

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20303 MAKAWELI AQUIFER SYSTEM AREA

20303-1 SYSTEM AREA PROFILE

20303-1.1 General

The Makaweli [20303] Aquifer System Area (ASYA) is roughly bound on the west and north side along the ridge above the Mokuone Stream and up to the peak of Mount Wai'ale'ale, along the south and east along the ridge above the Kō'ula River to Port Allen, and the Pacific Ocean on the southwest from Port Allen to Waimea Town.

Rural residential areas are located along the makai shore side of the ASYA in proximity to Kaumuali'i Highway. A large portion of lands in this ASYA are currently in use as pasture lands and for cultivation of seed crops.

Average annual rainfall ranges from 35 inches per year along the coast to 300 inches in the mountains. The sustainable yield is 26 mgd.

20303-1.2 Economy and Population

20303-1.2.1 Economy

Land within the Makaweli ASYA is mainly used for agricultural activities – pastures and cultivation of seed crops. Small commercial areas, including Port Allen airstrip, and salt ponds are located along the shore area in proximity to Port Allen and Kaumuali'i Highway.

20303-1.2.2 Population

The population contributing to the demand within the Makaweli ASYA is primarily concentrated in rural subdivisions located along Kaumuali'i Highway. Historical population data for the Makaweli ASYA is summarized in **Table 20303-1**. Population projections through the year 2035 are summarized in **Table 20303-2a**. As summarized in **Table 20303-2b**, it is estimated that the area will experience growth rates between 2 to 7 percent per decade.

Table 20303-1: Historical Population – Makaweli ASYA

	Year		
	1990	2000	2010
Population	1,900	2,159	2,916
Percent Change		13.7	35.0

Data Source: Socioeconomic Analysis and Forecasts (2014) Technical Report.
Data redistributed and evaluated for Makaweli ASYA.

Table 20303-2a: Population Projection – Makaweli ASYA

Growth Rate	Population by Year								
	2015	2016	2017	2018	2019	2020	2025	2030	2035
A – Low	2,961	2,968	2,976	2,984	2,992	3,000	3,043	3,092	3,146
B – Med.	2,983	2,998	3,014	3,031	3,047	3,064	3,155	3,256	3,368
C – High	2,986	3,003	3,021	3,038	3,057	3,075	3,174	3,284	3,407

Data Source: Socioeconomic Analysis and Forecasts (2014) Technical Report. Data redistributed and evaluated for Makaweli ASYA.

Table 20303-2b: Population Projection – Percent Change – Makaweli ASYA

Growth Rate	2015-2025 % Change	2025-2035 % Change
A – Low	2.8	3.4
B – Medium	5.8	6.8
C – High	6.3	7.3

20303-1.3 Land Use

20303-1.3.1 2000 Kaua‘i General Plan

The 2000 Kaua‘i County General Plan Land Use Designation Map for the Makaweli ASYA is shown on **Figure 20303-1**. The estimated land use allocation acreage for each land use designation within the system area is listed in **Table 20303-3**.

Table 20303-3: General Plan Estimated Land Use Allocation Acreage – Makaweli ASYA

General Plan Land Use Designation	Acreage	Percent of Total
Agricultural	9,243	21.2
Military	0	0.0
Open	33,685	77.2
Park	23	0.1
Residential Community	147	0.3
Resort	171	0.4
Transportation	0	0.0
Urban Center	0	0.0
DHHL	343	0.8
TOTAL	43,612	100.0

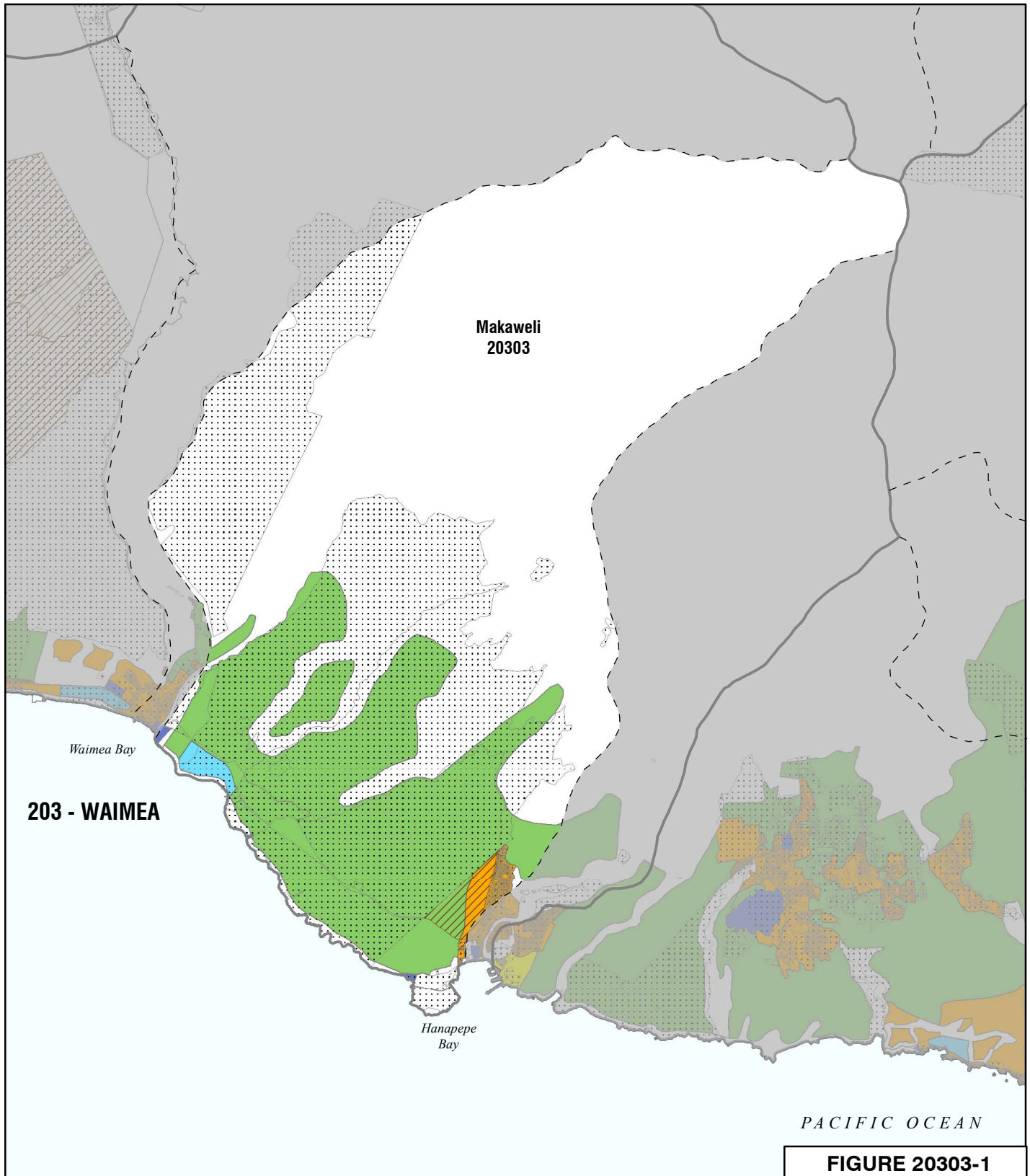
20303-1.3.2 Kaua‘i Zoning

Kaua‘i County Zoning Map for the Makaweli ASYA is shown on **Figure 20303-2**. The estimated land use allocation acreage for each zoning district within the system area is listed in **Table 20303-4**.

Table 20303-4: County Zoning Estimated District Allocation Acreage – Makaweli ASYA

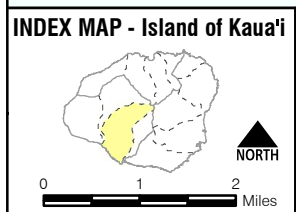
Zoning District	Acreage	Percent of Total
Agriculture	17,463	39.4
Commercial – General	0	0.0
Commercial - Neighborhood	0	0.0
Conservation	17,524	39.6
Industrial – General	0	0.0
Industrial - Limited	0	0.0
Open	8,656	19.6
Residential	96	0.2
Resort	134	0.3
Project Development	0	0.0
Special Planning Area	0	0.0
Special Treatment	11	0.0
No Zoning	33	0.1
DHHL	353	0.8
TOTAL	44,270	100.0

The number of dwelling units allowed in residential and resort districts varies by the type of residential or resort district. The average number of dwelling units allowed in residential districts in the Makaweli ASYA is 5.74 dwelling units per acre. The average number of dwelling units allowed in resort districts in the Makaweli ASYA is 1.00 dwelling units per acre.



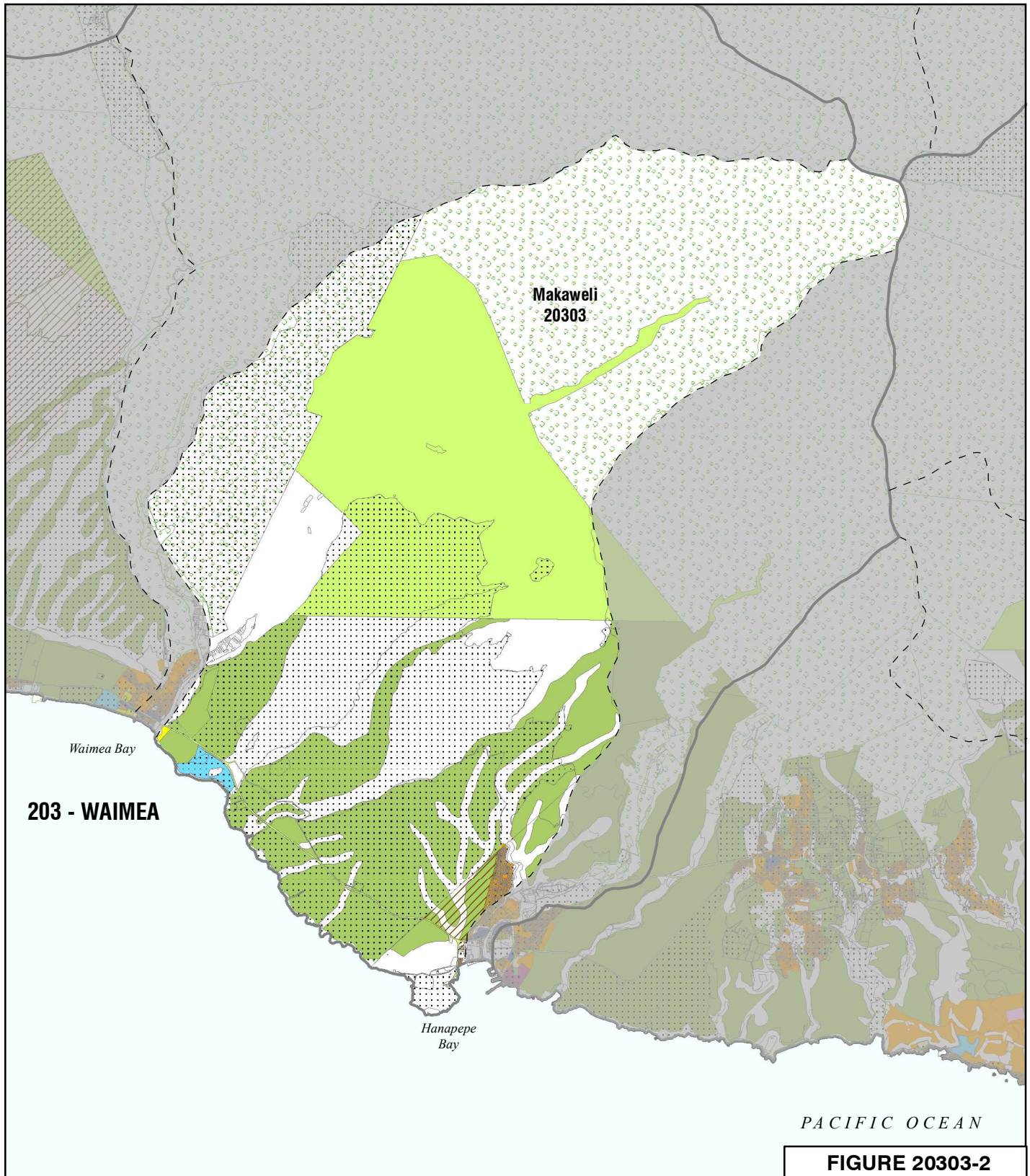
PACIFIC OCEAN

FIGURE 20303-1



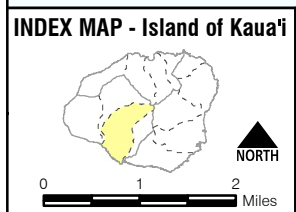
LEGEND:		
— Aquifer Sector Areas	Land Use Allocation Guide	
- - - Aquifer System Areas	Green Agricultural	Orange Residential Community
Diagonal lines Hawaiian Home Lands	White Open	Light Blue Resort
Stippled Developed Properties	Blue Park	Pink Transportation
	Purple Military	Yellow Urban Center

**GENERAL PLAN
LAND USE MAP**
 Aquifer Sector: WAIMEA - 203
 Aquifer System:
 MAKAWELI - 20303



PACIFIC OCEAN

FIGURE 20303-2



LEGEND:		
— Aquifer Sector Areas	Zoning Designations:	Industrial - Limited
- - - Aquifer System Areas	Agriculture	No Zoning
▨ Hawaiian Home Lands	Commercial - General	Open
⋯ Developed Properties	Commercial - Neighborhood	Residential
	Conservation	Resort
	Industrial - General	Special District

COUNTY ZONING
 Aquifer Sector: WAIMEA - 203
 Aquifer System:
 MAKAWELI - 20303

20303-2 EXISTING WATER RESOURCES

20303-2.1 Ground Water

The Makaweli ASYA has a sustainable yield of 26 mgd. According to the 2014 CWRM database, there are 4 production wells, 1 agriculture, 1 domestic, and 2 municipal wells. There are also 2 wells drilled and categorized as “unused.” Refer to **Appendix A** for this database. **Figure 20303-3** shows the well locations.

20303-2.2 Surface Water

There are 4 streams classified as perennial in the Makaweli ASYA, of which 3 are considered continuous and 1 is considered intermittent. Mahinauli Stream, Waipao Stream, and Waimea Stream are classified as continuous streams, and A‘akukui Stream is classified as an intermittent stream. The USGS has 5 active surface water gauges in the system area. The gauges are located on Waialae Stream, Waimea River, Makaweli River, and Kawaikōi Stream, which were previously listed in **Table 1-19**.

In accordance with the Code, the CWRM must establish and administer instream flow standards (IFS) on a stream-by-stream basis as necessary to protect public interests. IFS is defined as “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.” Considerably more research and study need to be completed to accumulate the data and perspective necessary to conduct a thorough and meaningful assessment of IFS. Until permanent IFS are established, interim IFS have been adopted. The interim IFS are defined as the amount of water flowing in each stream at the time the administrative rules governing them were adopted in 1988 and 1989. In order to assess surface water sustainability, this KWUDP assumes that no additional diversions will be allowed from any stream without amendment of the interim IFS.

There are 19 declared stream diversions in the CWRM database shown on **Figure 20303-4**, which accounts for 7 percent of the 292 declared stream diversions on the island. The declared stream diversions are listed in **Appendix B**. The total declared flow for the Makaweli ASYA is 18.13 mgd. In addition, some existing irrigation systems have the capability to transfer surface water to adjacent ASYAs. 5.06 mgd of declared flow from diversions in the Hanapēpē ASYA appear to be associated with irrigation lines that have service area in the Makaweli ASYA.

The Olokele Ditch Irrigation System was formerly owned by the Hawaiian Sugar Company to irrigate sugarcane fields. It is still active and is now operated and maintained by Gay and Robinson to irrigate their fields.

20303-2.3 Water Conservation

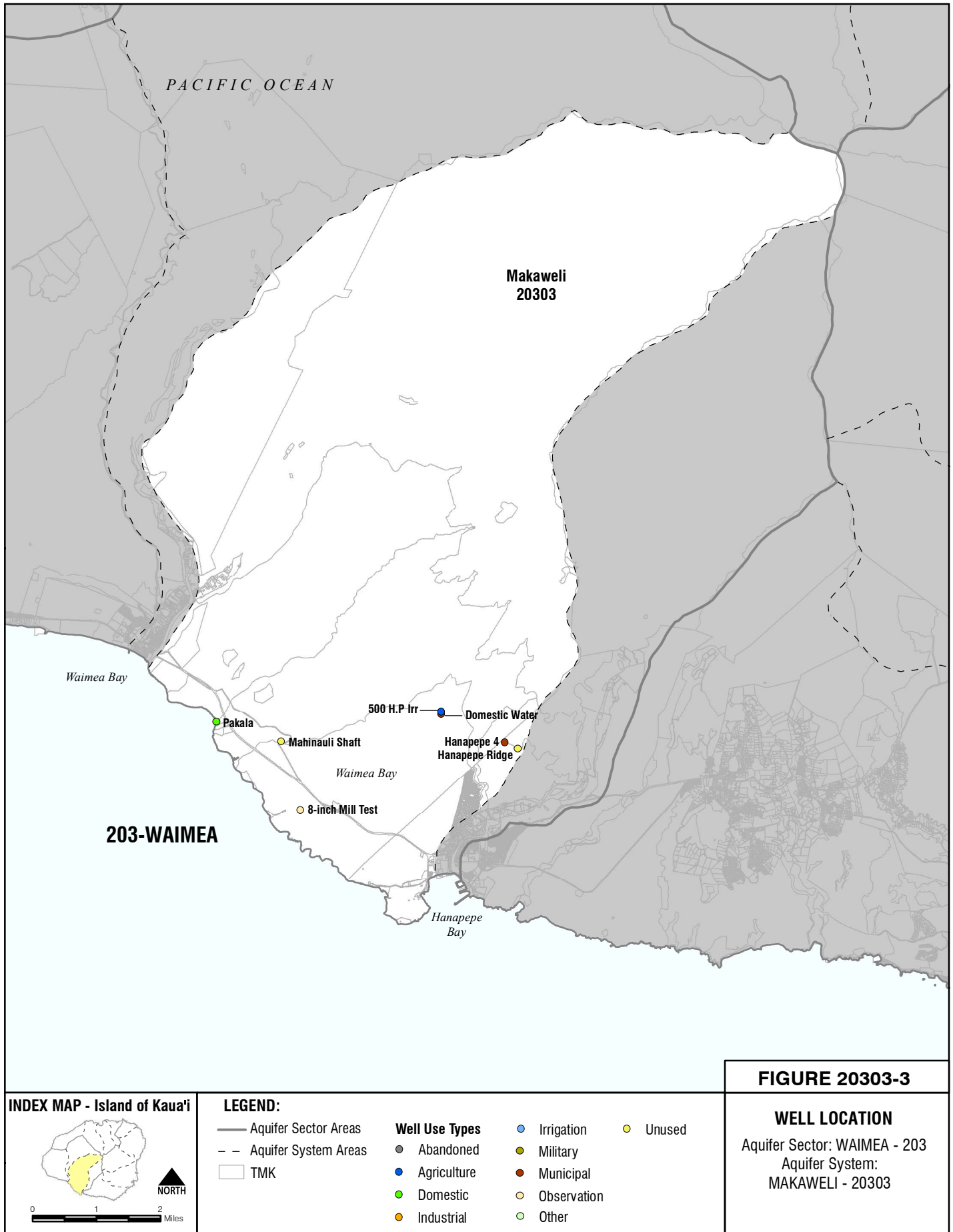
Water conservation increases the amount of water available and helps to ensure the long-term viability of water resources. Water conservation measures for this ASYA are described in **Section 1.5.7** of this report. There are no ASYA specific special conservation measures in place at this time.

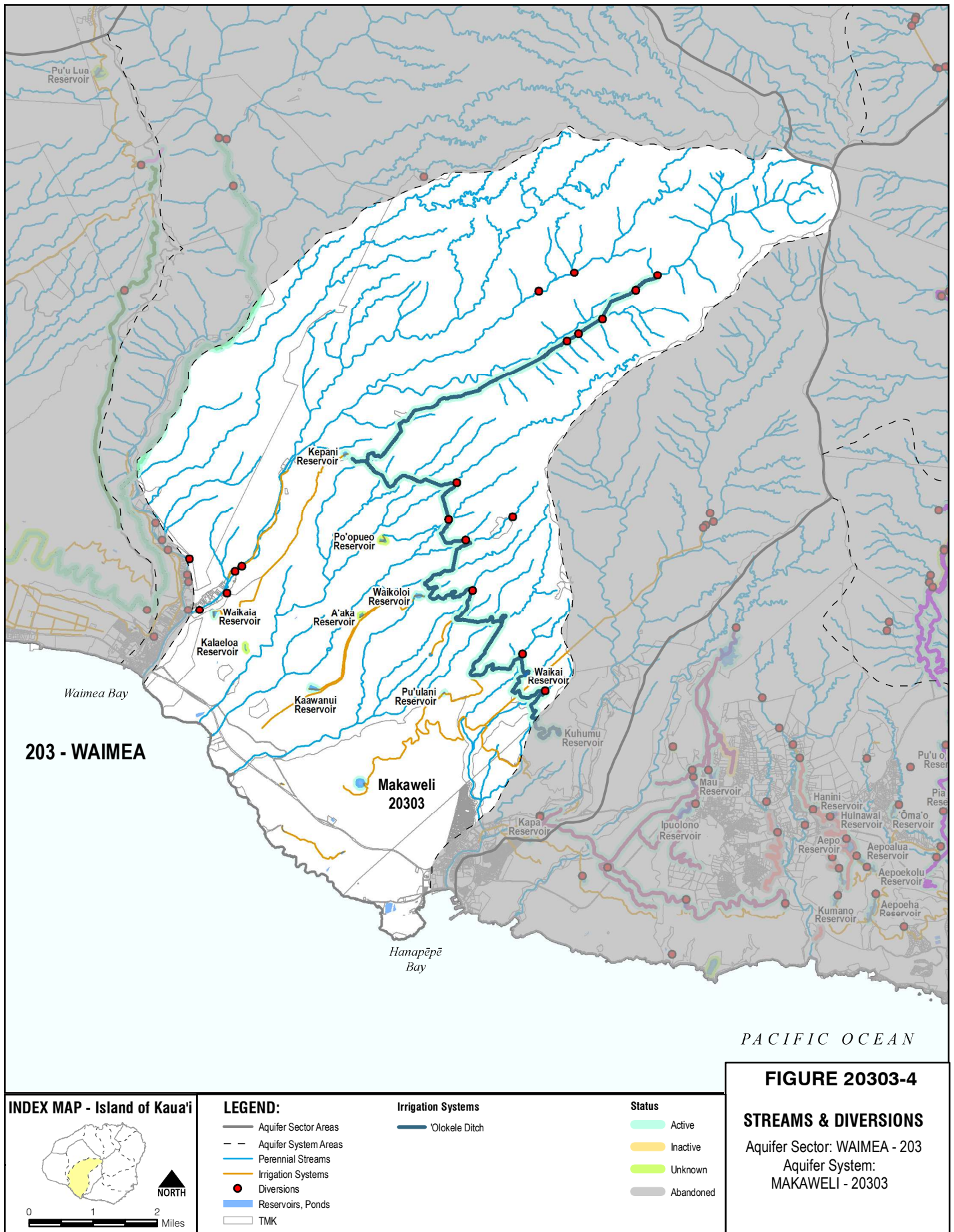
20303-2.4 Rainwater Catchment

Rainwater catchment is a viable resource for areas that are not served by ground water or surface water. **Figure 20303-5** shows the possible catchment areas, or parcels with a building value greater than \$20,000 and assumed to be developed but without a ground water or surface water source.

20303-2.5 Recycled Water

There are no wastewater reclamation facilities in the Makaweli ASYA.





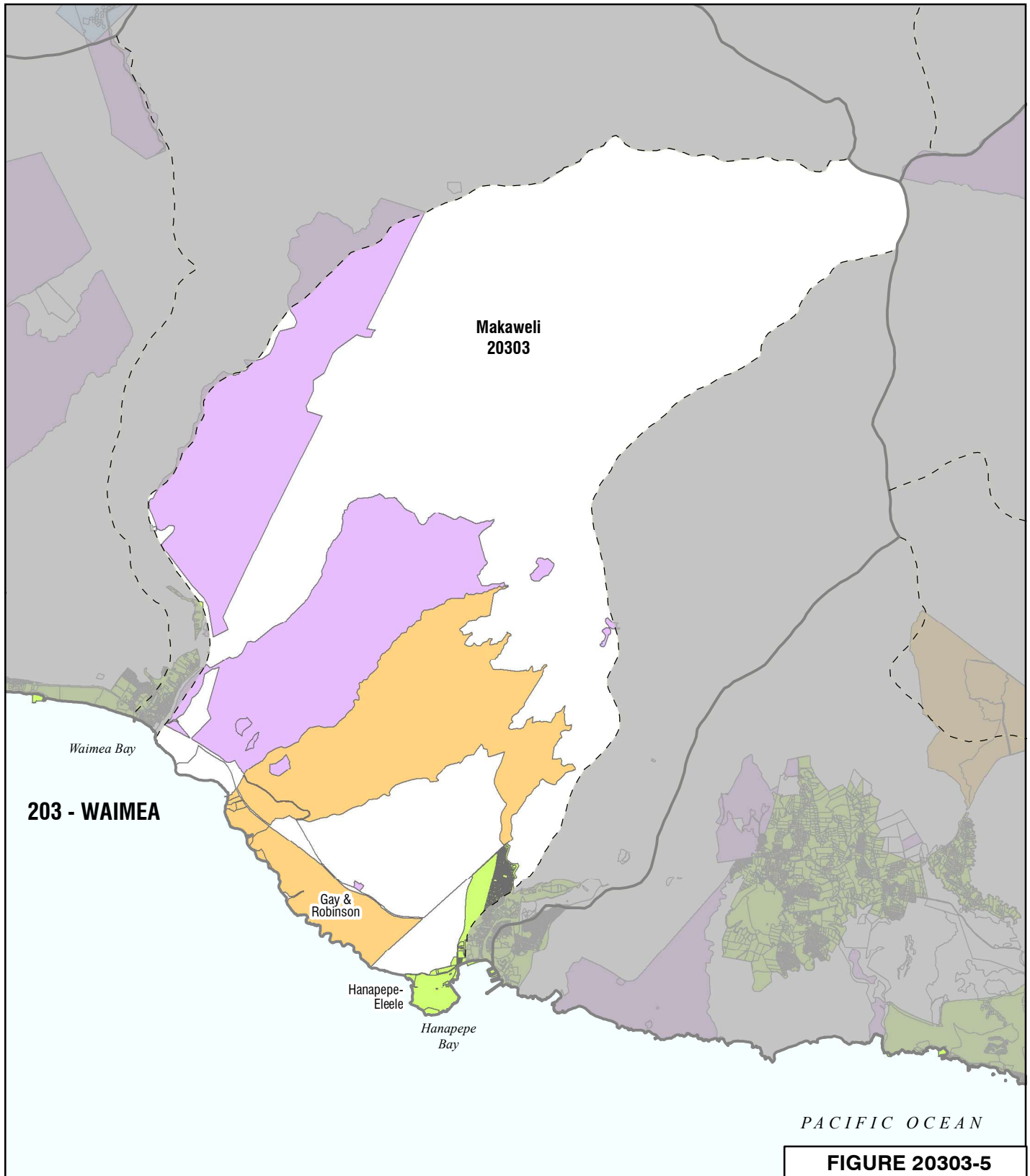
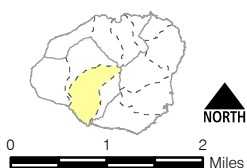


FIGURE 20303-5

WATER SYSTEM & SERVICE AREA

Aquifer Sector: WAIMEA - 203
 Aquifer System:
 MAKAWELI - 20303

INDEX MAP - Island of Kaua'i



LEGEND:

- Aquifer Sector Areas
- - Aquifer System Areas
- DOW Service Area
- Private Water System
- State Water System
- Federal Water System
- Possible Catchment Area (Building Value > \$20,000)

20303-3 EXISTING WATER USE

20303-3.1 General

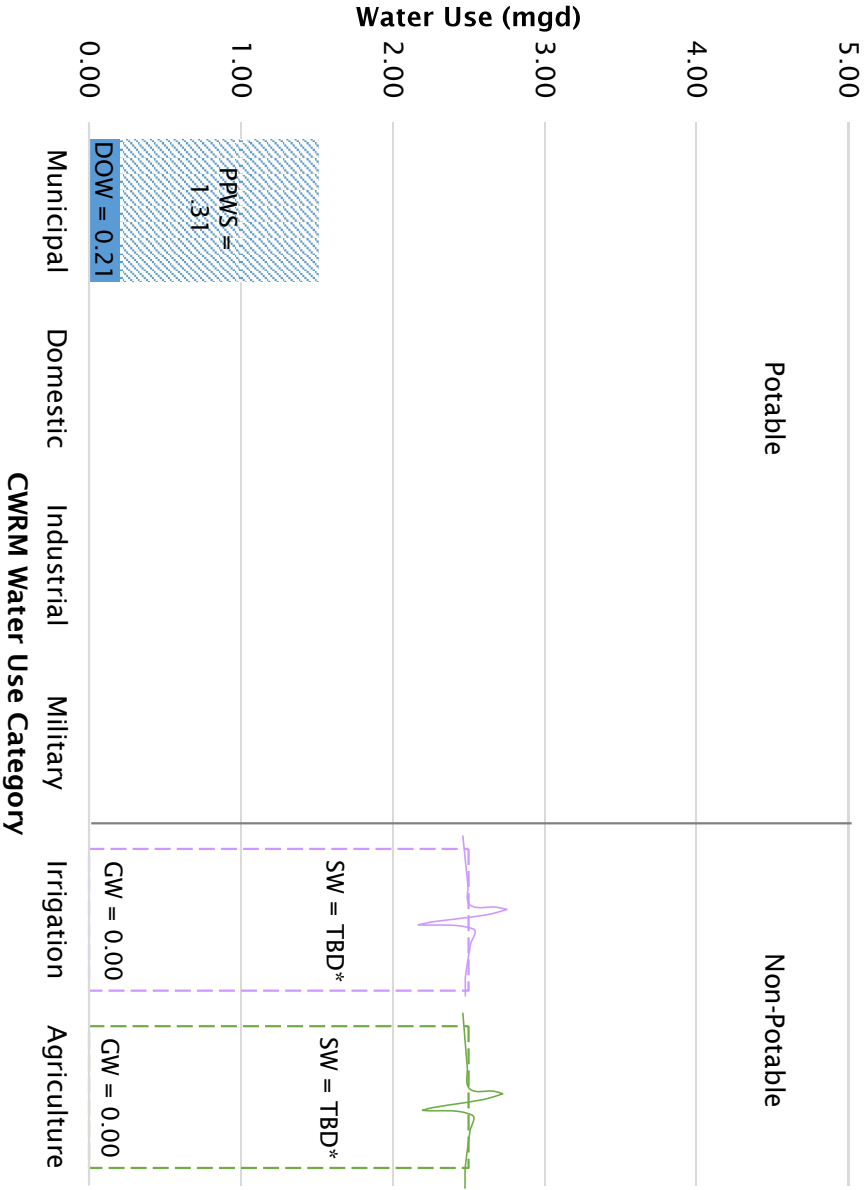
The following section presents the total estimated average water use within the Makaweli ASYA. The total estimated average water use was based on data from CWRM (well pumpage) and DOH (Sanitary Surveys for Public Water Systems and estimated recycled water usage) for the year 2014. **Table 20303-5** and **Figure 20303-6** summarize the water use in accordance with CWRM categories.

Table 20303-5: Existing Water Use by Category – Makaweli ASYA

CWRM Category	Ground Water (mgd)	Other Sources (mgd)	Total (mgd)	Percent of Total
Domestic	0.00	TBD ¹	0.00	0.0
Industrial			0.00	0.0
Irrigation			0.00	0.0
Agriculture	0.00		0.00	0.0
Military			0.00	0.0
Municipal				
DOW System	0.21		0.21	13.8
Private-Public WS	1.31		1.31	86.2
TOTAL	1.52		1.52	100.0

¹ Surface Water – TBD from AWUDP

Figure 20303-6: Existing Water Use by Category – Makaweli ASYA



*Values to be determined by other components of the Hawai'i Water Plan

20303-3.2 Domestic Use

There is one well classified as “Domestic” in the 2014 CWRM database owned by Richland Mortgage Corporation; however, it has not reported pumpage.

20303-3.3 Industrial Use

There are no wells classified as “Industrial” in the Makaweli ASYA.

The Kaumakani-Makaweli Hydropower and Olokele Hydro Expansion power plant are located on Olokele ditch. The Kaumakani-Makaweli Hydropower plant was built in the 1920s to supply power to the Hawaiian Sugar Company’s plantation. The Olokele Hydro Expansion power plant was built in 2019. Both plants are owned, operated, and maintained by Gay and Robinson and can produce up to 7.3 MW of power that is sold to the Kaua’i Island Utility Cooperative (KIUC). Water is diverted from Olokele Ditch.

20303-3.4 Irrigation Use

Irrigation use has been divided into ground water, recycled water, and surface water.

20303-3.4.1 Ground Water

There are no wells classified as “Irrigation” in the Makaweli ASYA.

20303-3.4.2 Recycled Water

There is no recycled water use in the Makaweli ASYA.

20303-3.4.3 Surface Water

Information on surface water use for irrigation is to be determined by the AWUDP. However, typically, due to the location of parks and other landscaped areas within communities, it is assumed that it is unlikely for landscaping to be irrigated with surface water.

20303-3.5 Agricultural Use

Agricultural use has been divided into ground water, recycled water, and surface water.

20303-3.5.1 Ground Water

There is 1 well classified as AGRCP – Crops and Processing Agriculture owned by Gay and Robinson, Inc. It serves the Gay & Robinson Water System (PWS 417) and is discussed in **Section 20303-3.7**.

20303-3.5.2 Recycled Water

There is no recycled water use in the Makaweli ASYA.

20303-3.5.3 Surface Water

Information on surface water use for agriculture is to be determined by the AWUDP.

20,888 acres of Important Agricultural Lands (IAL), owned by Robinson Family Partners, are located in the Makaweli ASYA. Approximately 18,700 acres of IAL is used for cattle ranching and is leased to Gay & Robinson, who operates the ranch under the tradename Makaweli Ranch. The remaining 2,188 acres of IAL is used for seed production and is leased to Agrigenetics Inc. and DuPont Pioneer. Both the Kō‘ula Ditch System and the Olokele Ditch System serve the IAL. The existing surface water use is unknown.

20303-3.6 Military Use

There is no military water use in the Makaweli ASYA.

20303-3.7 Municipal Use

There is 1 well in the CWRM database classified as “Municipal” (MUNCO – Municipal County) and 1 well classified as MUNPR – Municipal Private. Municipal can be subcategorized into the other water use categories: Domestic, Industrial, Agricultural, Military, and Municipal.

20303-3.7.1 County Water Systems

Hanapēpē-‘Ele‘ele Water System

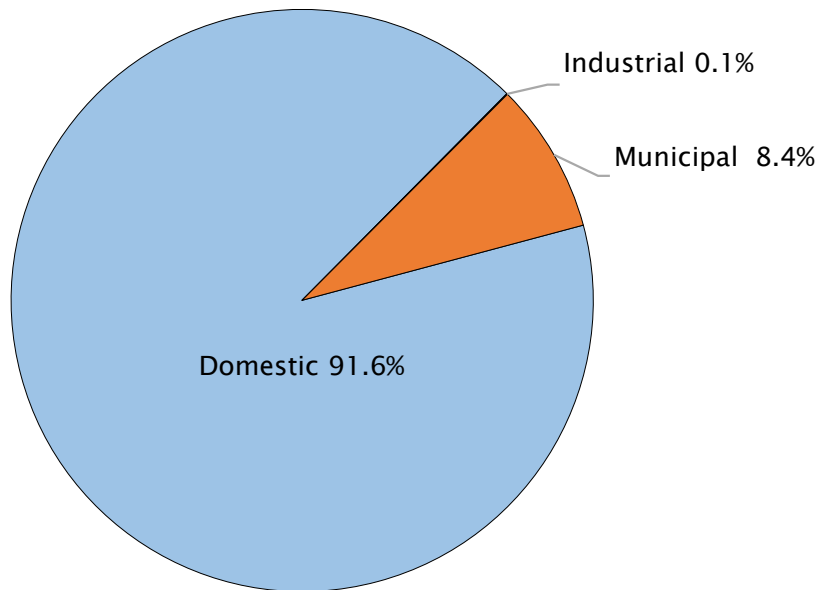
The DOW has one major water system that serves the Makaweli ASYA. The Hanapēpē-‘Ele‘ele water system is DOH Public Water System (PWS) No. 404 and services areas in the Makaweli, Hanapēpē, and Kōloa ASYA. Majority of the water system serves the Hanapēpē ASYA and therefore will be discussed in **Section 20304**.

DOW Water Use by Category

DOW water use is subcategorized in **Table 20303-6** to the extent possible based on available meter data and is depicted in **Figure 20303-7**.

Table 20303-6: DOW Existing Water Use by Category – Makaweli ASYA

CWRM Water Use Category	DOW Metered Water Use (MGD)	Percent of Total
Agricultural	0.0000	0.0
Domestic	0.1440	91.6
Industrial	0.0001	0.1
Military	0.0000	0.0
Municipal	0.0130	8.3
Total	0.1581	100.0

Figure 20303-7: DOW Existing Water Use by Category – Makaweli ASYA

20303-3.7.2 State Water Systems

There are no State water systems in the Makaweli ASYA regulated by the DOH.

20303-3.7.3 Federal Water Systems

There are no Federal water systems in the Makaweli ASYA regulated by the DOH.

20303-3.7.4 Private-Public Water Systems

The Gay & Robinson Water System (PWS 417) is the only private-public water system in the Makaweli ASYA regulated by the DOH. The water system is owned by Gay & Robinson, Inc. and provides water to customers living in plantation housing in Pākala, Kaumakani Village, and Camp-6. Prior to 2009, the water system also provided water to the sugar mill. Water for the system is provided by a well and a shaft, with reported pumpage of 1.31 mgd. The well and shaft also provide water for the plantation's irrigation system by pumping water through the pump-to-waste line uphill to an irrigation ditch. An air gap between the pump-to-waste discharge and the irrigation system separates the potable water system from the irrigation system.

20303-3.7.5 Per Capita Use

The per capita existing water use consumption based on domestic DOW metered water use and private-public water system use is presented in **Table 20303-7**. The per capita use in the Makaweli ASYA is approximately 178.2% lower than the overall County of Kaua'i per capita use largely due to the high PPWS use. However, it is noted that the Gay & Robinson water system is used for both domestic and irrigation purposes.

Table 20303-7: Per Capita Use – Makaweli ASYA

	DOW Metered Water Use – Domestic (mgd)	Private-Public Water System (mgd)	90% of 2015 Population	Per Capita Use (gpd)
Makaweli ASYA	0.144	0	2,685	540
County of Kauaʻi	9.360	2.951	63,462	194

20303-3.8 Existing Water Use by Resource

20303-3.8.1 Ground Water

Table 20303-8 summarizes the current production, sustainable yield (SY), and percentage of SY for the current production. Current production is represented by the 2014 average yield calculated from the actual pumping data.

Table 20303-8: Pumpage – Makaweli ASYA

Pumpage (mgd)	SY (mgd)	Pumpage Portion of SY
1.52	26	5.8%

Based on available information from the CWRM database, the current ground water use is 5.8 percent of the sustainable yield.

20303-3.8.2 Surface Water

Information on surface water use for agriculture is to be determined by the AWUDP. However, some limited information is available in the AWUDP dated 2003 (revised 2004) and in IAL designation documents.

The Olokele Ditch Irrigation System and Koʻula Ditch System provides water to 20,888 acres of IAL for cattle ranching (Makaweli Ranch) and seed production owned by Robinson Family Partners. Existing surface water use is unknown.

20303-3.8.3 Water Conservation

Water conservation, including water loss management, may reduce water use. See **Section 20303-2.3** for discussion of existing conservation efforts.

20303-3.8.4 Rainwater Catchment

Developed parcels that are not supplied by ground water or surface water are assumed to be supplied by rainwater catchment.

20303-3.8.5 Recycled Water

There is no recycled water use in the Makaweli ASYA.

20303-4 FUTURE WATER USE

20303-4.1 Full Build-Out Water Demand Projections

The full build-out water demand projections based on the General Plan and County Zoning for the Makaweli ASYA is listed in **Tables 20303-9** and **20303-10**, respectively. Each land use class is associated with the most appropriate CWRM water use category.

Table 20303-9: General Plan Full Build-Out Water Demand Projection – Makaweli ASYA

GP Category	CWRM Category	Water Demand (MGD)
Agriculture	Agriculture/Domestic	0.37
Open	Domestic	0.05
Military	Military	0
Park	Irrigation	0.09
Residential	Domestic/Municipal	0.42
Resort	Domestic/Irrigation/Municipal	0.12
Transportation	Municipal	0
Urban Center	Domestic/Industrial/Municipal	0
DHHL	Domestic	0.40
TOTAL		1.45

Table 20303-10: Zoning Full Build-Out Water Demand Projection – Makaweli ASYA

Zoning Class	CWRM Category	Water Demand (MGD)
Agriculture	Agriculture/Domestic	0.37
Commercial	Municipal	0
Industrial	Industrial/Municipal	0
Open	Domestic	0.05
Residential	Domestic/Municipal	0.27
Resort	Domestic/Irrigation/Municipal	0.09
DHHL	Domestic	0.40
TOTAL		1.18

20303-4.1.1 Refined Land Use Based Water Projection

State Water Projects Plan

Table 20303-11 lists future State water projects reported in the 2021 SWPP update. The total projected demand to the year 2034 for the four State water projects within the Makaweli ASYA is 0.982 mgd using potable, 0.292 mgd using non-potable, and 0.245 mgd non-potable using potable sources.

Table 20303-11: Future State Water Projects – Makaweli ASYA

Project Name	State of Hawai'i Department	Primary Use	Water Development Strategy	2034 Demand (mgd)
Hanepēpē	DHHL	Potable	NEWSWS	0.4045
Hanepēpē (Non-Potable)	DHHL	Non-potable	NONE-AMBIENT MOISTURE	0.2924
Hanepēpē (Non-Potable using Potable)	DHHL	Non-potable using Potable	NEWSWS	0.2448
DLNR West Kaua'i Field Operations Facility	DLNR	Potable	REMAIN	0.0400
TOTAL REMAIN				0.0400
TOTAL MAKAWELI ASYA SWPP 2034 DEMAND				0.9817

As mentioned in **Section 2.2.2.5.1**, State water projects with the water development strategy of REMAIN are located within the service areas of County water systems which need to be coordinated with the respective County water departments. One of the four State projects within the Makaweli ASYA was assigned the REMAIN water development strategy and results in a total 2034 demand of 0.0400 mgd. This accounts for 0.15 percent of the 26 mgd sustainable yield for the Makaweli ASYA. See the following paragraph for more information on the DHHL projects within the Makaweli ASYA.

State Department of Hawaiian Home Lands

The Hanapēpē Tract is the DHHL tract located within the Makaweli ASYA. The State Water Projects Plan – DHHL Update (SWPP), dated May 2017, discusses the projected water demands for DHHL and the proposed water development strategies to meet these water demands. The DHHL demands have also been incorporated into the SWPP Update, dated May 2021. See **Table 20303-11** for a breakdown of the demands. The projected potable water demands for the Hanapēpē tract is 0.405 mgd. The 2017 SWPP suggests that this demand be met by a new State water system in the Makaweli ASYA.

The 2017 SWPP also discussed non-potable demands. It projects that non-potable demand for the Hanapēpē Tract will be 0.537 mgd, and that the need can be met by ambient moisture.

Agricultural Water Use and Development Plan

The AWUDP dated 2003 (revised 2004) was limited in scope. More recent, comprehensive information on agricultural lands is available in the County of Kaua'i Important Agricultural Lands Study.

In 2019, a public review draft of the AWUDP was released and it is anticipated that the next phase of the AWUDP will provide agricultural water demand projections in greater detail and will supersede information in the KWUDP when it becomes available.

County of Kaua'i Important Agricultural Lands Study

7,620 acres of agricultural lands within the Makaweli ASYA received a score of 28 or better in the County of Kaua'i Important Agricultural Lands (IAL) Study. Lands that receive a score of 28 or better were determined to have met all eight IAL criteria to some degree. Only a subset of lands with a score of 28 or better is expected to be designated as IALs. A total of 20,888 acres of agricultural lands have been designated as IAL in the Makaweli ASYA thus far. **Table 20303-12** compares these lands that received a score of 28 or better to the declared surface water use from diversions and to the diversified water use rate of 3,400 gallons per acre per day (gpad) estimated in the 2004 AWUDP.

Table 20303-12: Irrigation of Agricultural Lands

(1) Declared Surface Water Use from Diversions (mgd)	23.19
(2) Agricultural Lands with a Score $\geq$ 28 (Acres)	7,620
- How many acres can be sustained by (1) at a water rate of 3,400 gpad? (Acres)	6,821
- What percent of (2) can be sustained with a water rate of 3,400 gpad?	90
- If all of (2) were to be irrigated, what is the water unit rate? (gpad)	3,043

20303-4.1.2 Water Use Unit Rates

Water use unit rates are based on the *Water System Standards* (WSS), as discussed in Chapter 2.

The General Plan provides only broad density guidelines for residential and resort designations. For these designations, under the assumption that most residents would like their communities, including the development density, to remain similar in the future, the average number of dwelling units as allowed by zoning was used as the density (i.e., 5.74 dwelling units per acre for residential designation and 1.00 dwelling units per acre for resort designation).

20303-4.2 Water Demand Projections to the Year 2035

The following section presents water demand projections to the year 2035 for the Makaweli ASYA. The projected low, medium, and high growth rates are listed in **Table 20303-13** and are graphed in **Figure 20303-8**. Potable (domestic, industrial, municipal, and military water uses) and non-potable (irrigation) water demands are also differentiated.

Table 20303-13: Water Demand Projection – Makaweli ASYA

Water Use Category	Water Demand by Year (mgd)								
	2015	2016	2017	2018	2019	2020	2025	2030	2035
GROWTH RATE C (HIGH)									
TOTAL	1.52	1.52	1.53	1.54	1.55	1.56	1.61	1.66	1.72
Potable	1.52	1.52	1.53	1.54	1.55	1.56	1.61	1.66	1.72
Non-Potable	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GROWTH RATE B (MEDIUM)									
TOTAL	1.52	1.52	1.53	1.54	1.54	1.55	1.60	1.65	1.71
Potable	1.52	1.52	1.53	1.54	1.54	1.55	1.60	1.65	1.71
Non-Potable	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GROWTH RATE A (LOW)									
TOTAL	1.52	1.52	1.52	1.52	1.53	1.53	1.55	1.58	1.61
Potable	1.52	1.52	1.52	1.52	1.53	1.53	1.55	1.58	1.61
Non-Potable	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Figure 20303-8: Water Demand Projection Summary – Makaweli ASYA

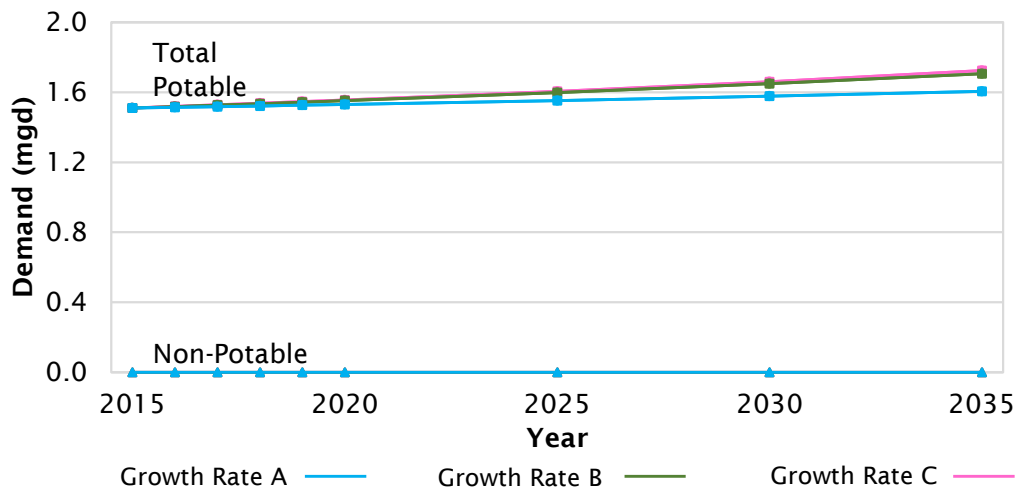
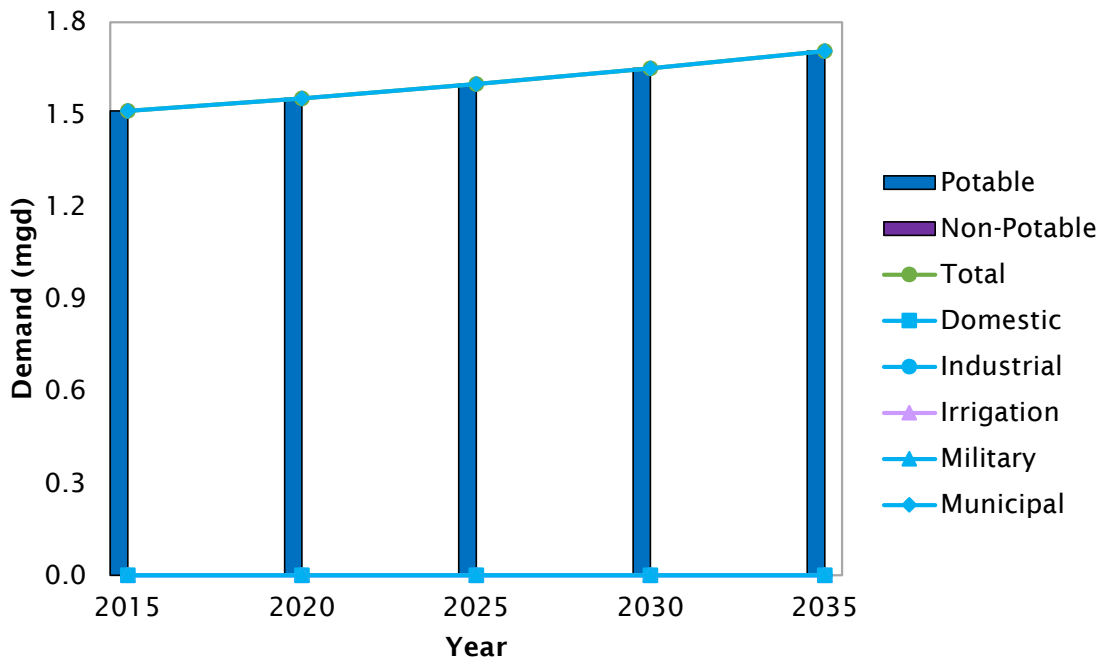


Figure 20303-9 shows the breakdown of water demand projections for a medium growth rate by CWRM categories through the year 2035. Table 20303-14 summarizes this figure.

Figure 20303-9: Medium Growth Rate B Water Demand Projection by Category – Makaweli ASYA**Table 20303-14: Medium Growth Rate B Water Demand Projection by Category – Makaweli ASYA**

Water Use Category	Water Use by Year (mgd)								
	2015	2016	2017	2018	2019	2020	2025	2030	2035
Total	1.52	1.52	1.53	1.54	1.54	1.55	1.60	1.65	1.71
Potable	1.52	1.52	1.53	1.54	1.54	1.55	1.60	1.65	1.71
Non-Potable	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Domestic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Industrial	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Irrigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Military	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Municipal	1.52	1.52	1.53	1.54	1.54	1.55	1.60	1.65	1.71
DOW	0.21	0.21	0.21	0.21	0.21	0.21	0.22	0.22	0.23

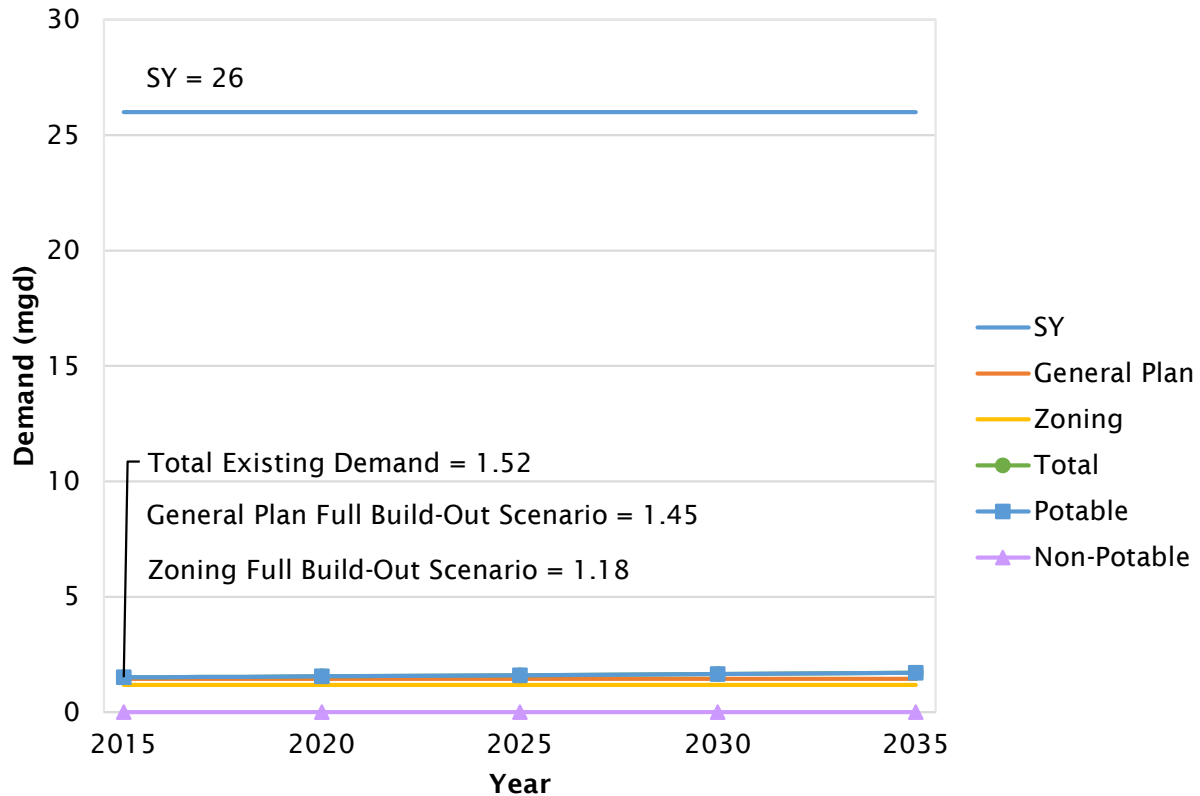
20303-4.3 Summary

Figure 20303-10 illustrates the magnitude of the sustainable yield, both General Plan and Zoning full build-out water use projections, and water use projection through the year 2035 focusing on Medium Growth Rate B. **Table 20303-15** summarizes the General Plan, Zoning, and 20-year water demand projection scenarios for the Makaweli ASYA. The sustainable yield is presented to draw comparisons. All demands are in mgd.

Table 20303-15: Summary of Demand Projections

SY (mgd)	FBO (mgd)		Medium Growth Rate Demand by Year (mgd)								
	GP	Zoning	2015	2016	2017	2018	2019	2020	2025	2030	2035
26	1.45	1.18	1.52	1.52	1.53	1.54	1.54	1.55	1.60	1.65	1.71

Figure 20303-10: Medium Growth Rate B Water Demand Projections and Full Build-Out - Makaweli ASYA



Note: Total existing demand includes municipal, domestic, industrial, military, and irrigation water uses. It does not include agriculture water use. For future agricultural water use analysis, please see Section 20303-4.1.1 County of Kaua'i Important Agricultural Lands Study.

20303-5 RESOURCE AND FACILITY RECOMMENDATIONS

20303-5.1 Water Source Adequacy

20303-5.1.1 Full Build-Out

Development to the highest extent allowed by the General Plan and County Zoning within the Makaweli ASYA is sustainable, with General Plan and County Zoning full build-out water demands requiring 6 and 5 percent of the 26 mgd sustainable yield, respectively.

20303-5.1.2 Twenty-Year Projection

The 2035 water demand projection for the Makaweli ASYA is sustainable and is only 6 percent of the 26 mgd sustainable yield.

20303-5.2 Source Development Requirements

20303-5.2.1 Supply-Side Management

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

Conventional Water Resource Measures

Ground Water

The Makaweli ASYA contains basal and perched ground water. All reported pumpage is from the perched zone.

The 2035 water demand projection for the Makaweli ASYA is only 6 percent of the 26 mgd sustainable yield. This indicates that theoretically, more water could be pumped from the aquifer without impairing the utility or quality of the water resource if wells are optimally placed and the proper due diligence with regard to traditional and customary rights and impacts has been completed. However, it is noted that sustainable yield does not consider the feasibility of developing the ground water resources, and that the safe yield of an individual production well may be limited by localized ground water behavior near the well as a result of pumpage. Water supply reliability and quality, feasibility, environmental and cultural impacts, and water rights shall be considered as projects and programs develop. More detailed and site-specific evaluation of these impacts shall be required and accomplished through the environmental review process (HRS Chapter 343) for source development projects and programs utilizing public funding, and CWRM could consider requiring compliance with the environmental review process for private source development projects and programs also. **Section 1.5.3.1** provides additional information regarding the protection of traditional and customary rights.

There are two public water systems in the Makaweli ASYA: the Gay & Robinson water system and DOW's Hanapēpē-ʻEleʻele water system.

The Gay & Robinson water system serves customers living in plantation housing in Pākala, Kaumakani Village, and Camp-6.

The DOW's Hanapēpē-ʻEleʻele water system serves Hanapēpē, Hanapēpē Heights, ʻEleʻele Nani, and Port Allen and services areas in the Makaweli ASYA and Hanapēpē ASYA. One of the system's water sources is in the Makaweli ASYA. The DOW's Water Plan 2020 did not identify any additional new ground water sources to meet its projected demands.

The 2017 SWPP proposed a new state water system in the Makaweli ASYA to meet the projected potable demands of DHHL's Hanapēpē tract.

Further development of ground water to meet future demands should be viable.

Surface Water

There are 19 declared diversions in the Makaweli ASYA. Until permanent instream flow standards are established, interim instream flow standards have been adopted. According to Section 13-169-46, Hawai'i Administrative Rules, "Interim Instream Flow Standard for all streams on Hawai'i, as adopted by the commission on water resource management on June 15, 1988, shall be that amount of water flowing in each stream on the effective date of this standard, and as that flow may naturally vary throughout the year and from year to year without further amounts of water being diverted off-stream through new or expanded diversions, and under the stream conditions existing on the effective date of the standard, except as may be modified [by the commission]." Therefore, for the purposes of assessing surface water availability, it is assumed that no additional diversions will be allowed without amendment of the interim IFS.

The existing declared diversions have the potential to meet additional demands. However, a challenge with developing surface water is transmission of these resources from source to location of need. Farmers generally grow what is feasible for the area; therefore, it is anticipated that agricultural water use will follow the availability of irrigation water. Increase in the availability of surface water would likely promote additional usage and could thereby minimize ground water being used for irrigation.

The Olokele Ditch Irrigation System is operated and maintained by Gay and Robinson. The Agricultural Water Use and Development Plan (AWUDP) should provide an inventory of large irrigation systems and provide information on their rehabilitation and maintenance needs. The AWUDP should also include a more detailed assessment of agricultural water demand projections that will supersede information in the KWUDP when it becomes available.

Water Transfer

Some existing irrigation systems have the capability to transfer surface water to adjacent ASYAs. The AWUDP should study irrigation system services areas and provide information on irrigation systems' water transfer.

Water can also be transferred between ASYAs through public water systems. The service area of DOW's Hanapēpē-ʻEleʻele water system falls in the Makaweli ASYA, Hanapēpē ASYA, and Kōloa

ASYA. Its wells are located in the Makaweli ASYA and Hanapēpē ASYA, and water must be transferred to ‘Ele‘ele via booster pump stations.

Water Conservation

The per capita use in the Makaweli ASYA is approximately 178.2% lower than the overall County of Kaua‘i per capita use largely due to the high PPWS use. However, it is noted that the Gay & Robinson water system is used for both domestic and irrigation purposes. There are no ASYA-specific conservation measures in place at this time; however, there are general water conservation programs that are described in **Section 1.5.7**. Water conservation, including water loss management, can increase the amount of water available and help to ensure the long-term viability of water resources.

In the DOW’s Water Plan 2020, instituting water conservation measures in the Hanapēpē-‘Ele‘ele water system service area was proposed to avoid a slight supply and storage deficit.

Alternative Water Resource Measures

Rainwater Catchment

Rainwater can be utilized as a water resource in several ways.

Rainwater can be harvested in rainwater catchment systems which can be utilized to supply domestic potable water needs. These systems are viable in areas that receive abundant rainfall and are a suitable source of potable water for individual domestic users in areas outside the limits of municipal water systems. Generally, these are remote areas and are not expected to expand significantly because most development is anticipated to be concentrated within existing urban areas. Therefore, use of rainwater catchment systems is not anticipated to increase significantly.

Rainwater can also be used to supplement or satisfy agricultural non-potable water needs through ambient rainfall.

See the Storm Water Reuse section below to see how rainwater as storm water runoff can be reclaimed and reused.

Storm Water Reuse

Rainfall can turn into storm water runoff. Storm water runoff from impervious surfaces in urban areas can be significant. This water could be captured, treated, and used as a source of non-potable water (e.g., irrigation), integrated with recycled water, or even as potable and/or non-potable ground water recharge. However, due to the lack of storm water reuse standards, the high initial infrastructure costs, and the treatment requirements, storm water reclamation and reuse on a small or large scale may not be feasible and requires further assessment as noted in the Water Resource Protection Plan. The U.S. Department of the Interior, Bureau of Reclamation published An Appraisal of Stormwater Reclamation and Reuse Opportunities in Hawai‘i (Storm Water Report) in 2008 but did not identify any storm water reclamation and reuse opportunities in the Makaweli ASYA.

Recycled Water

Recycled water is a valuable resource; an increase in its use may lower the dependence on potable sources. However, there are no wastewater reclamation facilities (WWRFs) in the Makaweli ASYA.

Desalination

Desalination of brackish ground water is a potential alternative; however, due to its high capital and operational costs, it likely would not be considered when other potable water sources are available.

20303-5.2.2 Demand-Side Management

Development Density Control

The full build-out demand for the Makaweli ASYA based on County Zoning is 1.18 mgd which is 5 percent of the sustainable yield. This indicates that there are adequate water resources to sustain the level of development that is allowed by law. In the Makaweli ASYA, the average number of dwelling units allowed by County Zoning is 5.74 dwelling units per acre in residential districts and 1.00 dwelling units per acre in resort districts.

The full build-out demand for the Makaweli ASYA based on the General Plan is 1.45 mgd which is 6 percent of sustainable yield. Therefore, development density control may not be necessary. However, the County Planning Department could consider development density control for areas where there is the flexibility to do so, such as areas that are not yet zoned as residential or resort, and promote sustainable development. Further, it is noted that the full build-out scenario is unlikely to occur since it assumes all land is developed to the maximum extent.

20303-5.3 Recommended Alternatives

To optimize appropriate use of water resources, the quality of the water source should be matched to the quality of water required. The highest quality of water shall be reserved for the most valuable end use. Potable water is considered the highest quality water, and the sustenance of life is the most valuable end use. Recycled water, brackish water, untreated surface water, and other lower quality water sources should be used for landscaping and agriculture when available, thereby reserving potable water for human consumption. If there is a practical alternative water source available, that alternative source should be used in lieu of ground water or surface water. With this in mind, the following recommendations are made for the Makaweli ASYA:

Alternative Water Resources

Use of alternative water sources can reduce demands on both ground and surface water resources and conserve water resources as a whole. However, aside from rainwater, there are no available alternative water sources in the area. Alternative water sources are unlikely to be developed when other water resources are readily available.

Conservation

Water resources are a finite resource that should be managed and used wisely. It should be conserved and not wasted. Implementation of conservation measures should continue to be encouraged.

Ground Water

Meeting future demands at a reasonable cost is a planning objective, and conventional sources, such as ground water, are typically the most cost-effective means for meeting projected water demands. Projected potable water needs are within the sustainable yield for this area. Therefore, ground water resources could continue to be used and developed to meet potable water needs now and into the future. However, as noted above, development of conventional water resource measures can have challenges, and water supply reliability and quality, feasibility, environmental and cultural impacts, and water rights shall be considered as projects and programs develop.

Development of ground water resources is the primary strategy to serve future potable demands in the Makaweli ASYA.

Surface Water

Surface water, where available, should be used to meet non-potable demands if alternative water resources are not available. To achieve this, it will be critical to maintain and improve existing irrigation systems. Making surface waters more readily available to meet non-potable water demands has the potential to minimize future dependence on the use of ground water. It is therefore recommended that the AWUDP provide information on the rehabilitation and maintenance needs of large irrigation systems.

Demand-Side Management

Full build-out demand based on the General Plan is 6 percent of sustainable yield. At this projection, implementation of development density control by the County Planning Department is not needed in this area. Although the projection is sustainable, the County Planning Department will need to consider potential impacts on available water resources when considering any future zoning modifications. Modifications that may result in increased development density within the area will increase demands on water resources.