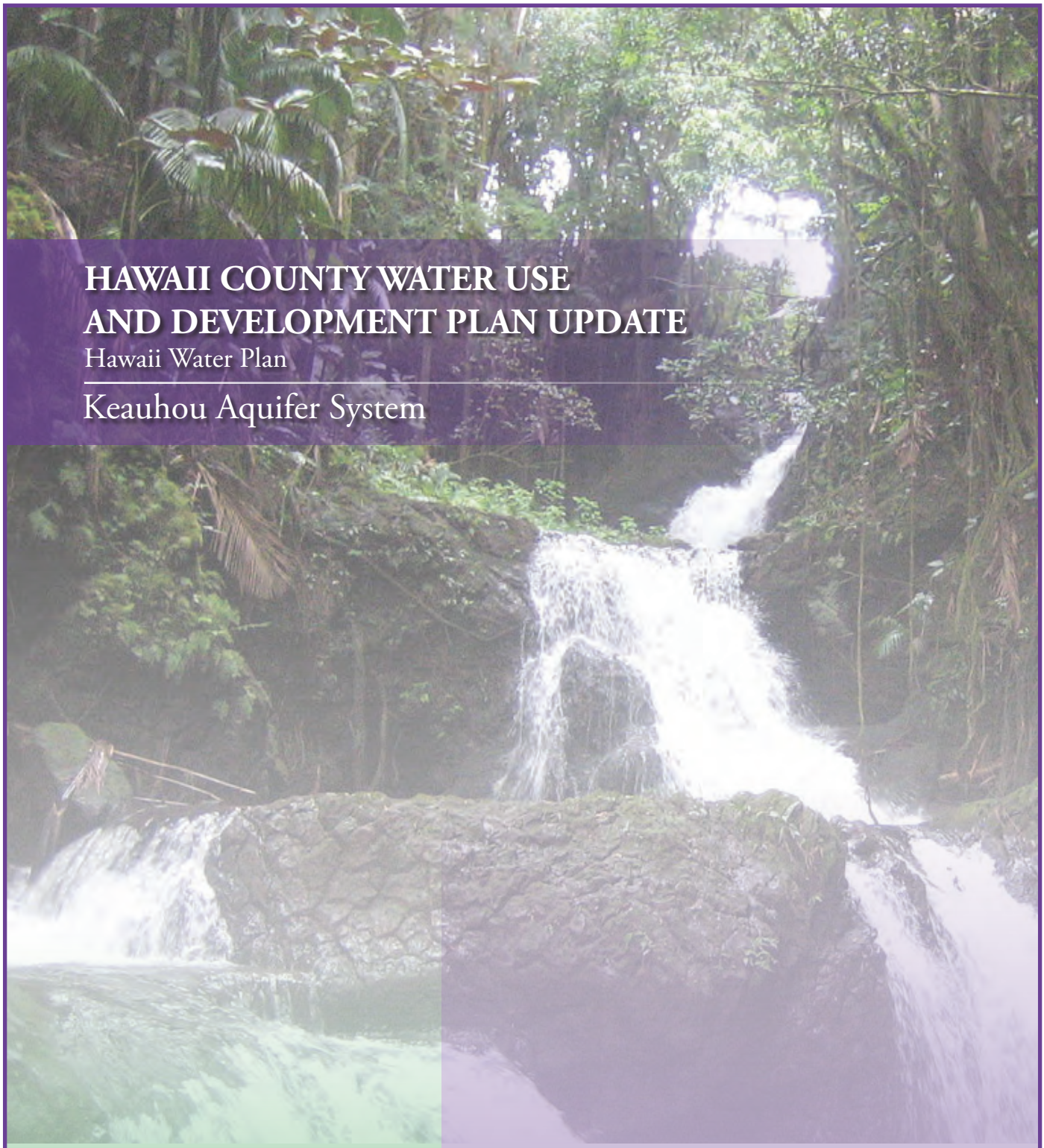

HAWAII COUNTY WATER USE AND DEVELOPMENT PLAN UPDATE

Hawaii Water Plan

Keauhou Aquifer System

Funded by the:

Department of Water Supply

For the:

County of Hawaii

FUKUNAGA & ASSOCIATES, INC.
Consulting Engineers
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Honolulu, Hawaii 96814 · (808) 944-1821

March 2017

Final Report

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

LIST OF ABBREVIATIONS

ASEA	Aquifer Sector Area
ASYA	Aquifer System Area
AWUDP	Agricultural Water Use and Development Plan
CDP	Community Development Plan
CIP	Capital Improvement Program
CWRM	State of Hawai‘i, Department of Land & Natural Resources, Commission on Water Resource Management
CWRM	State of Hawai‘i, Department of Land & Natural Resources, Commission on Water Resource Management
DBEDT	State of Hawai‘i, Department of Business, Economic Development and Tourism
DEM	County of Hawai‘i, Department of Environmental Management
DHHL	State of Hawai‘i, Department of Hawaiian Home Lands
DLNR	State of Hawai‘i, Department of Land & Natural Resources
DOFAW	State of Hawai‘i, Department of Land & Natural Resources, Division of Forestry and Wildlife
DOT	State of Hawai‘i, Department of Transportation
EA	Environmental Assessment
EIS	Environmental Impact Statement
ERU	Equivalent Residential Unit
GC	General Commercial
GIS	Geographic Information System
GP	General Plan
GPD	Gallons per Day
HAR	Hawai‘i Administrative Rules
HDWS	County of Hawai‘i, Department of Water Supply
HELCO	Hawai‘i Electric Light Company
HHFDC	State of Hawai‘i, Hawai‘i Housing Finance & Development Corporation
HWUDP	County of Hawai‘i Water Use and Development Plan
IAL	Important Agricultural Land
KS	Kamehameha Schools
MAV	Moving Average
MG	Million Gallon
MGD	Million Gallons per Day
MSL	Mean Sea Level
NELHA	Natural Energy Laboratory of Hawai‘i Authority

NHO	Native Hawaiian Organization
NPS	National Park Service
OEQC	State of Hawai‘i, Department of Health, Office of Environmental Quality Control
OHA	Office of Hawaiian Affairs
OHCD	County of Hawai‘i, Office of Housing and Community Development
OTEC	Ocean Thermal Energy Conversion
QLT	Queen Lili‘uokalani Trust
SDWB	State of Hawai‘i, Department of Health, Safe Drinking Water Branch
SDWP	Stream Diversion Works Permit
SLUD	State Land Use Designation
SWPP	State Water Projects Plan
SY	Sustainable Yield
T&C	Traditional and Customary Native Hawaiian Rights
TMA	Three Mountain Alliance
TMK	Tax Map Key
TND	Traditional Neighborhood Development
TOD	Transit Oriented Development
UHERO	Economic Research Organization at the University of Hawai‘i
UPC	Uniform Plumbing Code
WCPIPA	Well Construction and Pump Installation Permit Application
WMP	Water Master Plan
WRPP	Water Resources Protection Plan
WWRF	Wastewater Reclamation Facility
WWTP	Wastewater Treatment Plant

CHAPTER 1 INTRODUCTION

The primary objective of the Water Use and Development Plan (WUDP) is to set forth the allocation of water to land use. As required by the Hawai‘i Administrative Rules (HAR) Title 13, Chapter 170, Hawai‘i Water Plan, each of the four counties is responsible to prepare a WUDP to include, but not be limited to the following:

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

The County of Hawai‘i adopted by ordinance the Water Use and Development Plan Update dated August 2010 (2010 HWUDP), and the Commission on Water Resource Management (CWRM) granted approval in December 2011. The 2010 HWUDP update implemented a broad, uniform approach island-wide to conservatively evaluate the County’s land use policies set forth in the County General Plan and Zoning Code. The General Plan is the long-range conceptual land use plan for the island of Hawai‘i; whereas the Zoning Code is the legal instrument that regulates land development, and implements the General Plan policies. The intent of the 2010 HWUDP was to guide the County in prioritization and focus of future assessment efforts.

The 2010 HWUDP identified two aquifer sectors to be considered for further evaluation and detailed assessment. Prioritization of the aquifer areas identified resulted in the selection of the West Mauna Kea Aquifer Sector Area (ASEA) [803]/Waimea Aquifer System Area (ASYA) [80301] and the Hualālai ASEA [809]/Keauhou ASYA [80901] for update. Per decision of the CWRM, the update consisted of two phases. The first phase (Phase 1) refined the water demand scenarios and projections; and the second phase (Phase 2) involved the development of source development strategies and scenarios. The CWRM further requested that the HWUDP for the Keauhou ASYA include the following elements:

- Address how proposed source development strategies to meet projected demands may impact cultural uses and rights or other public trust purposes (T&C)
- Identify appropriate mitigation measures for potential impacts or alternative strategies

This document combines the elements of Phase 1 and Phase 2 of the Hawai‘i Water Use and Development Plan Update – Keauhou Aquifer System Area into a single plan. The HWUDP for the Waimea Aquifer System Area will be prepared separately.

CHAPTER 2 TECHNICAL APPROACH

The approach used in the update of the County of Hawai‘i Water Use & Development Plan (HWUDP) for the Keauhou Aquifer System Area (ASYA) was documented in the Project Description, as required by the Framework. The Project Description, which also addressed the Waimea ASYA, was presented to and conditionally approved by the Commission on Water Resource Management (CWRM) on February 18, 2015, and the final Project Description was submitted to the CWRM on March 4, 2015. The Project Description is presented in Appendix A.

2.1 WATER RESOURCES PLANNING METHODOLOGY

The HWUDP update considers an integrated approach to land use planning and water resource development and is a continually evolving process. This HWUDP update provides an estimate of anticipated future water demands, and refinements to water demand scenarios and projections based on County land use/zoning policies using realistic water use unit rates from actual metered data for undeveloped parcels and actual water use for developed parcels. 5-year incremental water needs for the next 20 years based on population and growth rate projections are also projected.

2.1.1 Existing Sources and Water Uses

Water resources that are currently utilized on the island of Hawai‘i include the following four categories:

- Ground water
- Surface water or stream diversions
- Rainwater catchment
- Recycled water

The CWRM has established water use categories based on water system purveyance and primary use of the system for the purposes of water use permitting and reporting. Existing water use will be described for each of the four water resource categories, and existing water demands will be presented in terms of each of the six CWRM water use categories as indicated in Table 2-1.

Table 2-1: CWRM Water Use Categories

Well Operator	Category	Sub-Category
Individual Operator	**Agriculture**	• Aquatic plants and animals • Crop irrigation and processing • Livestock water, pasture irrigation, and processing • Ornamental and nursery plants • Taro • Other agricultural applications
	Domestic Residential Domestic, includes potable and non-potable water needs	• Single- and multi-family households, including non-commercial gardening
	Non-residential Domestic, includes potable (and non-potable) water needs	• Commercial businesses • Office buildings • Hospitals • Churches • Hotels • Schools
	Industrial	• Fire protection • Mining, dust control • Geothermal, thermoelectric cooling, power development, hydroelectric power • Other industrial applications
	Irrigation	• Golf course • Hotel • Landscape and water features • Parks • Schools • Habitat maintenance
Agency Operator	**Military**	• All military use
	Municipal	• State • County • Private

2.1.1.1 Ground Water Pumpage

The CWRM maintains a ground water well database of all installed wells in the State and requires all well owners to report monthly pumpage data. Although there are several wells with an installed pump for which the CWRM has not received pumpage data, CWRM has confirmed that all well owners who are currently using ground water are reporting. Therefore, this database is the best available information to determine current ground water use. Data from August 2012 through July 2014 was assessed based on the 12-month moving average (12-MAV) of monthly reported pumpage within the aquifer system, as required by CWRM to address seasonal fluctuations. The highest of these 12-MAV calculations, from August 2012 through July 2013, was taken to

represent existing ground water use. Ground water pumpage represents the existing water use component incorporated into water demand scenarios described in Section 2.1.

2.1.1.2 Municipal Water Meter Records

Available meter records for individual accounts were obtained from the County Department of Water Supply (HDWS). These records were analyzed from a period between July 2013 and June 2014 to further subcategorize the HDWS municipal water use by the CWRM water use categories, and also to evaluate and develop water use unit rates described in the following section. Water use associated with meter records should not be compared to the ground water pumpage because the latter is calculated by determining the high 12-MAV and may be based on a different timeframe.

2.1.1.3 Water Use Unit Rates

Water use unit rates used in the 2010 HWUDP are listed in Table 2-2, and were largely based on the Water System Standards (WSS), which are planning level rates typically used for design of water system infrastructure, including pumping, storage and distribution facilities. These rates are conservative and were established to design infrastructure for service reliability during peak demand conditions. Long-term water resources planning should be based on actual water use data for a more realistic evaluation of anticipated water demand. This involved significant effort, incorporating detailed assessment methods and would typically be reserved for sensitive areas that required higher levels of precision.

The Single Family Residential unit rate used in the 2010 HWUDP was based on historical HDWS consumption data from specific developments (not the overall single family residential accounts). The Single Family Residential unit rate is a key component of water system planning for HDWS. For example, water commitments and water development agreements are expressed in terms of Equivalent Residential Units (ERU), which represents the planned water demand of 400 GPD from a customer with a 5/8" meter. Analysis of the HDWS meter records between July 2013 and June 2014 for accounts categorized as Single Family Residential with a 5/8" meter indicated an average unit rate of 430 GPD. This is marginally higher than the 400 GPD planning unit rate, and may include large-lot subdivisions which, if developed today, would require a larger meter. Therefore, use of the planning unit rate of 400 GPD for future residential demands is reasonable.

The Commercial, Industrial and Resort rates used in the 2010 HWUDP based on the WSS may not capture the variability in permitted land use associated with each of the zoning districts. For example, the Zoning Code lists over 50 different permitted uses within General Commercial (GC) districts, including schools, laundries, and residential dwellings, all of which would have markedly different water requirements. The average use unit rate would therefore depend on the distribution of these permitted uses within a particular GC district.

Anticipated water demand associated with zoning areas assumed that the existing character of each zoning district would be similar for future development. A single unit rate was developed for each of the three general zoning districts with wide ranges in permitted uses, specifically Commercial, Industrial, Resort, by determining the average existing areal consumption unit rates based on

HDWS meter records from July 2013 through June 2014 of all existing parcels connected to the HDWS system within each general zoning district.

The 2010 HWUDP utilized a unit rate of 3,400 gallons per acre per day for Agricultural areas, which was developed by the 2004 Agricultural Water Use and Development Plan (AWUDP), and considered General Plan Important Agricultural Land (IAL) areas to be the basis for agricultural irrigation. Public input suggested that the need for irrigation water was not predicated on the classification of agricultural lands, and that users would grow what is feasible according to the climate. Based on available information, most existing agricultural water use in the Keauhou ASYA relies on ambient rainfall and may be supplemented by HDWS. The Agricultural water unit rate was determined by determining the average existing areal consumption unit rate based on HDWS meter records from July 2013 through June 2014 of all existing parcels with accounts classified as Agricultural and located within lands classified by the General Plan as Important Agricultural Lands (IAL). IAL is described further in Section 2.1.3.3.

Table 2-2: Water Use Unit Rates

Land Use Category	Average Daily Demand (ADD)		
		2015 HWUDP – Keauhou	
	2010 HWUDP	Anticipated Demands	Zoning
Residential	1,000 gal/unit[1]	***400*** gal/unit	***400*** gal/unit
Commercial	3,000 gal/acre	3,000 gal/acre	***940*** gal/acre
Industrial	4,000 gal/acre	4,000 gal/acre	***780*** gal/acre
Resort	400 gal/unit or 17,000 gal/acre[2]	***400*** gal/unit	***2,965*** gal/acre
Agriculture	3,400 gal/acre[3]	N/A	***210 gal/acre***

[1]For North Kona and South Kohala districts
[2]Resort ADD of 17,000 gal/acre based on ADD for Maui
[3]Agriculture ADD based on AWUDP

2.1.1.4 Other Water Resources

Existing use of other water resources was determined where possible; however, these quantities were not used to project future demands. The CWRM stream diversion database was examined for potential declared diversion location and quantities. Recycled water data was determined from documents published by the Department of Health, Wastewater Branch. Recycled water is primarily used for irrigation of golf courses and landscaping and is a valuable potential resource to meet future non-potable demands in West Hawai‘i. There are little or no records or data on rainwater catchment systems. Therefore, information reflected in this report is based on deductions. If a developed parcel (building value of greater than $20,000) is not served by or near the service area of HDWS or other water system of record, then a catchment system is assumed.

2.1.2 Anticipated Water Demands

The calculation of anticipated water demands was based on a combination of existing water use, projected future water use with varying degrees of entitlement, and projected future water use associated with anticipated land use at varying stages of the approvals process. The latter was

based on an estimate of parcels proposed for development according to the Kona Community Development Plan (CDP). The components of the calculated water demands may or may not be associated with an identifiable development and are not associated with a specified timeframe. A flow chart depicting the methodology used to determine anticipated water demands is presented in Figure 2-2.

2.1.2.1 Water Demand for Existing Developed Parcels (Pumpage)

Existing developed parcels are considered to be those with current water service from a municipal water system. The water use associated with existing developed parcels is the existing ground water use discussed in Section 2.1.1.1, and includes private irrigation wells and other wells within the existing service area that supplement the municipal water system for non-potable uses.

2.1.2.2 Water Entitlements

"Water entitlements" for the purpose of the HWUDP are considered to be parcels or entities that have received an allocation of water or a promise of allocation of water upon fulfillment of certain conditions from HDWS and are categorized as follows:

- Installed service laterals to vacant lots – unimproved parcels that are not currently using water, but where a service lateral exists and a facilities charge has already been paid to HDWS. Water demand was calculated by multiplying the Residential unit rate by the number of parcels.
- Developer agreements – parcels that are tied to an agreement between a developer and HDWS, whereby the developer installs a well and/or other necessary infrastructure to be dedicated to HDWS in exchange for a set allocation of water.
- Water commitments – parcels where the owner has received commitments for water service (in terms of 5/8" water meters) from HDWS. Note that the credits may be applied to different parcels subject to HDWS approval. Water demand was calculated by multiplying the residential unit rate by the number of water credits.
- Approved open building permits – parcels not included in the above three entitlement categories with an existing approved building permit with the County Building Department. Water demand was calculated by multiplying the Residential unit rate by the number of parcels.

2.1.2.3 Community Development Plans

Community development plans (CDP) contain varying degrees of detail which, on their own, may or may not be adequate to generate water demands. In accordance with the General Plan (GP) Section 15.1, community development plans were developed by the County of Hawai'i Planning Department "to translate the broad GP statements to specific actions as they apply to specific geographical areas." The CDPs are long-term plans with a planning horizon to year 2020 consistent with the GP and were adopted by ordinance, giving them force of law.

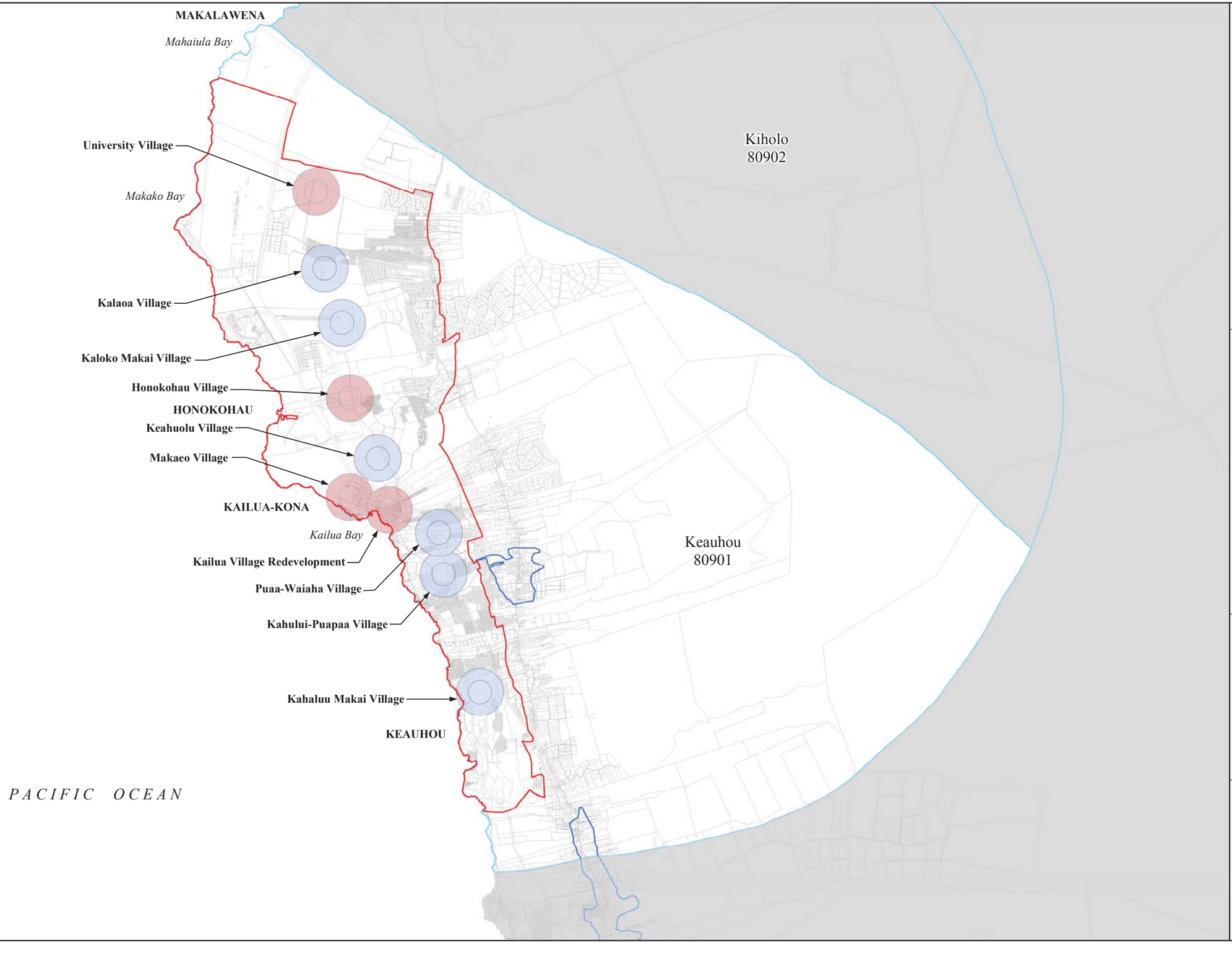
2.1.2.3.1 Kona Community Development Plan

The Kona CDP was adopted by ordinance in September 2008. This document alone does not provide enough detail to calculate water needs for the development vision. The Kona CDP encompasses the judicial districts of North and South Kona, and delineates Urban and Rural areas where future growth should be directed. The Urban Area identified encompasses the area spanning from Kona International Airport to Keauhou, makai of Māmalahoa Highway. The Rural TODs identified include the community of Holualoa, and the area encompassing the communities of Honalo, Kainaliu, Kealakekua, and Captain Cook. The latter area is not within the Keauhou ASYA and was not evaluated further. The CDP indicates that most of the future growth should be directed to 10 compact villages within the Urban Area identified as transit oriented development (TOD) zones, and that outside of the Urban Area, the character of the rural areas should prevail, meaning that future growth should be limited and directed to the rural communities in a way that revitalizes and enhances their existing rural lifestyle and culture. Outside of these Rural TODs, protection of the existing agricultural land is a priority. The Urban Area TODs are listed below, and are shown in Figure 2-1:

- University Village
- Kalaoa Village
- Kaloko Makai Village
- Honokōhau Village
- Keahuolū Village
- Makaeʻo Village
- Kailua Village Redevelopment
- Puaʻa-Waiʻaha Village
- Kahului-Puapuaʻa Village
- Kahaluʻu Makai Village

2.1.2.3.2 Kona CDP Financing Plan

The objective of the *Kona CDP Financing Plan for Public Facilities and Backbone Infrastructure*, dated January 2011 (Financing Plan) was to evaluate the ability of new development proposed in the Kona CDP to fund required public facilities and backbone infrastructure when they are needed. The report indicates that it is "simply a test of overall financial feasibility; the assumptions and results presented in this report are estimates, and actual results may vary." In order to accomplish the objective, the Financing Plan provides an estimate of the number of dwelling units and commercial/industrial area associated with the Kona CDP based on the best available information and various assumptions. Because the Kona CDP alone did not have sufficient detail to calculate associated water demands, the Financing Plan was used. The build-out projection provided in the Financing Plan has three components:



Hawaii County
Department of Water Supply

DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

Job No. 2014-0802

LEGEND:

- Kona Urban Area
- Rural Town TODs
- TMK

TOD Type

- Neighborhood
- Regional Center

1 0.5 0 1
Miles

INDEX MAP - Island of Hawaii

FIGURE 2-1

AQUIFER SECTOR HUALALAI - 809

Aquifer Systems
Keauhou - 80901

Kona CDP
Land Use Map

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1. Existing development baseline – an estimate of the number of vacant lots, based on an existing building value of $20,000 or less, scattered within existing subdivisions and proposed developments which could be developed
2. Proposed projects inventory – developers were consulted to estimate the phasing and magnitude of potential development
3. Build-out scenario – simulation of the build-out of proposed projects with priority given to future projects in the vicinity of the Urban Area TODs identified in the Kona CDP. The vast majority of the development proposed by the build-out projection is within the Urban Area, and Rural TODs were not considered.

The Financing Plan represents the best available data in line with the County vision of future development.

The development proposed by the build-out projection was identified to the extent possible using Geographic Information System (GIS) software and available County Real Property Tax records. An estimate of the number of potential development units not accounted for in other components of anticipated water demands was determined.

The Kona CDP does not provide specific details for how the Holualoa Rural Area should be developed, but states that "rural towns are encouraged to be redeveloped as TODs/TNDs" (TNDs or Traditional Neighborhood Developments are similar to TODs but may be located off of the trunk or secondary transit route at a location approved by a rezoning action). CDP Attachment B – Village Design Guidelines provides standards of development for TODs and TNDs, including guidelines on density calculations. While these guidelines lead to a range of residential densities, the calculated number of units for redevelopment of the Holualoa area at the most conservative end of the range would be nearly 2,000 units, which does not seem to align with the CDP's vision of preserving the rural character. A more realistic approach assumed that the parcels accounted for in the other components of anticipated water demands would not be redeveloped. A unit count for the remaining undeveloped infill areas was determined using the most conservative end of the range of the guidelines on density calculations.

Water use unit rates revised as described in Section 2.1.1.3 were applied to these potential development estimates to project water demand associated with the Kona CDP.

2.1.3 Hawai'i County Zoning Water Demands

Hawai'i County Code Chapter 25, the Zoning Code, is the County's legal instrument that regulates land development, and implements the General Plan policies; therefore, zoning must be consistent with the GP. County Zoning is the basis for a potential build-out scenario for water demand, to determine if there are adequate water resources to sustain the development of land use already zoned. The 2010 HWUDP zoning water demands considered build-out to the maximum allowable unit densities for residential and resort zoning districts, and commercial and industrial districts based on land area and multiplied by the appropriate Water System Standards water use unit rates.

Several refinements were applied to this methodology to produce a more realistic calculation. A flow chart depicting the methodology used to determine the zoning water demand is presented in Figure 2-3 at the end of this Chapter.

2.1.3.1 Water Demand for Existing Developed Parcels (Pumpage)

While the 2010 HWUDP zoning scenario represented a potential water demand associated with the legally allowable build-out of various zoning districts, it is unlikely that all existing areas would be developed in this manner. It is more realistic to assume that the demands associated with most existing developed parcels would remain status quo and would not be redeveloped to maximum potential densities. For parcels connected to the HDWS system, although the accounts and corresponding water usage are associated with specific TMKs, it is possible that some parcels are not fully developed. To more accurately estimate the existing area served by the HDWS system, all parcels larger than 50 acres were examined further to ascertain how much, if any, of each parcel's area was likely developed. Using satellite imagery and comparison of parcel area to meter consumption records, over 17,000 additional acres of parcels greater than 50 acres were estimated to be undeveloped. The demands are presented in Section 3.4.3.

As described in Section 2.1.1.1, the high 12-MAV reported pumpage for all wells in the ASYA was considered to be the existing water use associated with the developed area. Inclusion of the existing water use in the zoning water demand assumes that existing developed parcels would retain their current zoning designation.

2.1.3.2 Updated Zoning of Undeveloped Parcels

The Planning Department provided the latest GIS zoning layer. The undeveloped parcels were identified using GIS software and the updated existing developed area layer was removed from the total zoning area. This data was sorted to quantify the undeveloped area for each of the four general zoning districts. The revised water use unit rates listed in Section 2.1.1.3 were applied to the undeveloped area to determine the projected water demand associated with the undeveloped parcels.

2.1.3.3 Agricultural Water Use Demands

Agricultural demands for the zoning water demand were calculated based on the General Plan Important Agricultural Land (IAL) area within lands zoned for agriculture districts multiplied by the unit rate developed from existing agricultural use, described in Section 2.1.1.3. A large portion of the IAL within the Keauhou ASYA is utilized for Kona coffee farming, which generally relies on ambient rainfall; however, a small amount of irrigation water may be used for processing. The relatively low consumption unit rate of 210 GPD/acre appears to support this assumption. The agricultural water demands conservatively assumes that all undeveloped agricultural parcels will be irrigated at the existing rate; therefore, agricultural water demands presented in this update represent worst case scenario for lack of better information and on an interim basis, until addressed by the AWUDP. Furthermore, future agricultural water demands should consider non-potable water source options.

2.1.4 Additional Information Used to Refine Land Use Based Water Demands

The information used to refine both the anticipated water demand and zoning water demand include State Water Projects and Department of Hawaiian Home Lands (DHHL) demands, and information on other developments.

2.1.4.1 State Water Projects Plan Updates and DHHL Demands

At the time of this report, the State Water Projects Plan (SWPP) was being updated by the State of Hawai‘i, Department of Land & Natural Resources (DLNR), Engineering Division. A partial update of the SWPP, in the Final stage, covered projects for the Department of Hawaiian Home Lands (DHHL). DLNR was also preparing a separate SWPP for the West Hawai‘i region, focusing on projected State agency demands proposed in the area.

On November 24, 2014, DHHL submitted a letter to CWRM formally requesting a water reservation of 3.398 MGD in the Keauhou ASYA. The purpose of the request was to adequately serve DHHL's foreseeable development based on unit counts and area estimates from the 2006 DHHL Villages of La‘i‘Ōpua Water Master Plan. The reservation request considered an ultimate demand scenario and accounted for demands from completed development phases with existing water service and demands from development phases with water commitments. The reservation request was considered a better estimate of projected DHHL demands than the demands presented in the DHHL SWPP because, like the land based water demands, it was not associated with a specified timeframe, whereas the DHHL SWPP demands were projected over a 20-year timeframe to 2031. The reservation request was used as the basis for future DHHL demands in the Keauhou ASYA and was included in the demands with consideration of DHHL water entitlements.

Based on evaluation of available environmental documents from the Department of Health Office of Environmental Quality Control (OEQC) and preliminary discussions with State agencies, the agencies with projects requiring water are the University of Hawai‘i, the Department of Business, Economic Development and Tourism (DBEDT), Natural Energy Laboratory of Hawai‘i Authority (NELHA), the Department of Transportation (DOT), and the Judiciary:

- University of Hawai‘i Center, West Hawai‘i – had 15 water credits or 6,000 GPD via a water developer agreement with Pālamanui. The Final Environmental Impact Statement (EIS) indicated a maximum enrollment of 1,500 students in 2023, and an estimated water demand of 60,000 GPD. The EIS indicated that potable water was not anticipated to be used for landscape irrigation.
- NELHA West Hawai‘i Explorations Academy – relocation of the existing campus with facilities to allow an expansion from 195 to 300 students. According to the Final Environmental Assessment (EA), the school would place an emphasis on xerophytic landscaping, and at full build-out, the school's average water demand including irrigation would be 6,650 GPD. The current demand is 3,500 GPD.
- NELHA OTEC Research, Development and Demonstration Facility – potable water would be required for a new administration building. The Draft EA indicated that the potable water requirement would be 100 GPD.

- NELHA Monk Seal Rehabilitation Facility – the facility would include two buildings for use as office, laboratory, clinic, and fish kitchen. The 2011 Final EA did not include water demand projections.
- Kona Judiciary Complex – the planned facility would be a consolidated replacement of several existing facilities along the Kona coast. At the time of this report, the project was in design and specific details were not available, but the 2011 Draft EIS estimated the average daily demand based on the maximum anticipated 220-employee and 280-visitor capita at full build-out of 6,640 GPD.
- DOT Airfield, Terminal and Facility Improvements at the Keahole-Kona Airport – water service would need to be extended to new facilities located in areas where there are no previously existing structures; however, the Final EA indicated that the airport is currently operating below its current water allocation and it is anticipated that the current water allotment would be sufficient to serve the proposed improvements.

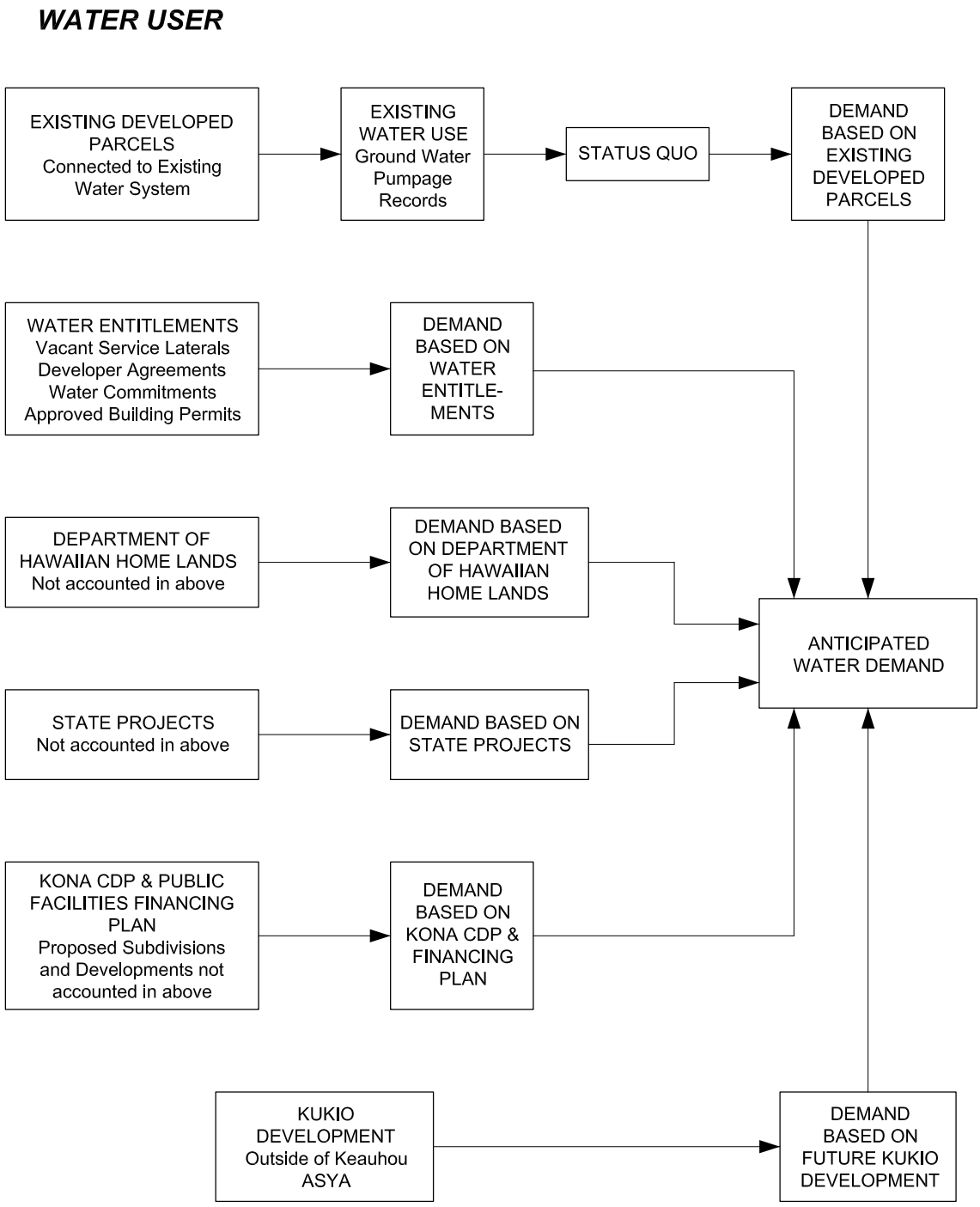
2.1.4.2 Other Development Plans

The Kukio development includes the Kukio Golf and Beach Club, the Makalei Golf Course and luxury real estate in Kukio and Maniniowali. The development is served by five wells, three of which are located in the Keauhou ASYA. See Section 3.3.7.4 for more information on the water system. Development plans indicate that 103 additional lots will be developed. Although the development is located in the Kiholo ASYA, part of the ground water serving this future development will originate in the Keauhou ASYA.

2.1.5 5-Year Incremental Water Demand Projections

Existing population and ground water use were calculated as the basis of the water demand projections to the year 2035. Population and growth rate projections were applied in 5-year increments for the next 20 years; and have high-growth, medium-growth (base case) and low-growth (the most conservative) scenarios. The high 12-MAV of existing ground water pumpage described in Section 2.1.1.1 was considered to be existing water use and was projected forward. The demands are further differentiated into potable and non-potable demands in Chapter 3.

It was assumed that population growth, and thus water use, from projects described in the SWPP, the AWUDP and from DHHL projects are already accounted for by the population projections; therefore, information from these documents was not used to further refine the 5-year incremental water demand projections. A flow chart depicting the methodology used to determine the 5-year incremental projected demands is presented in Figure 2-4.



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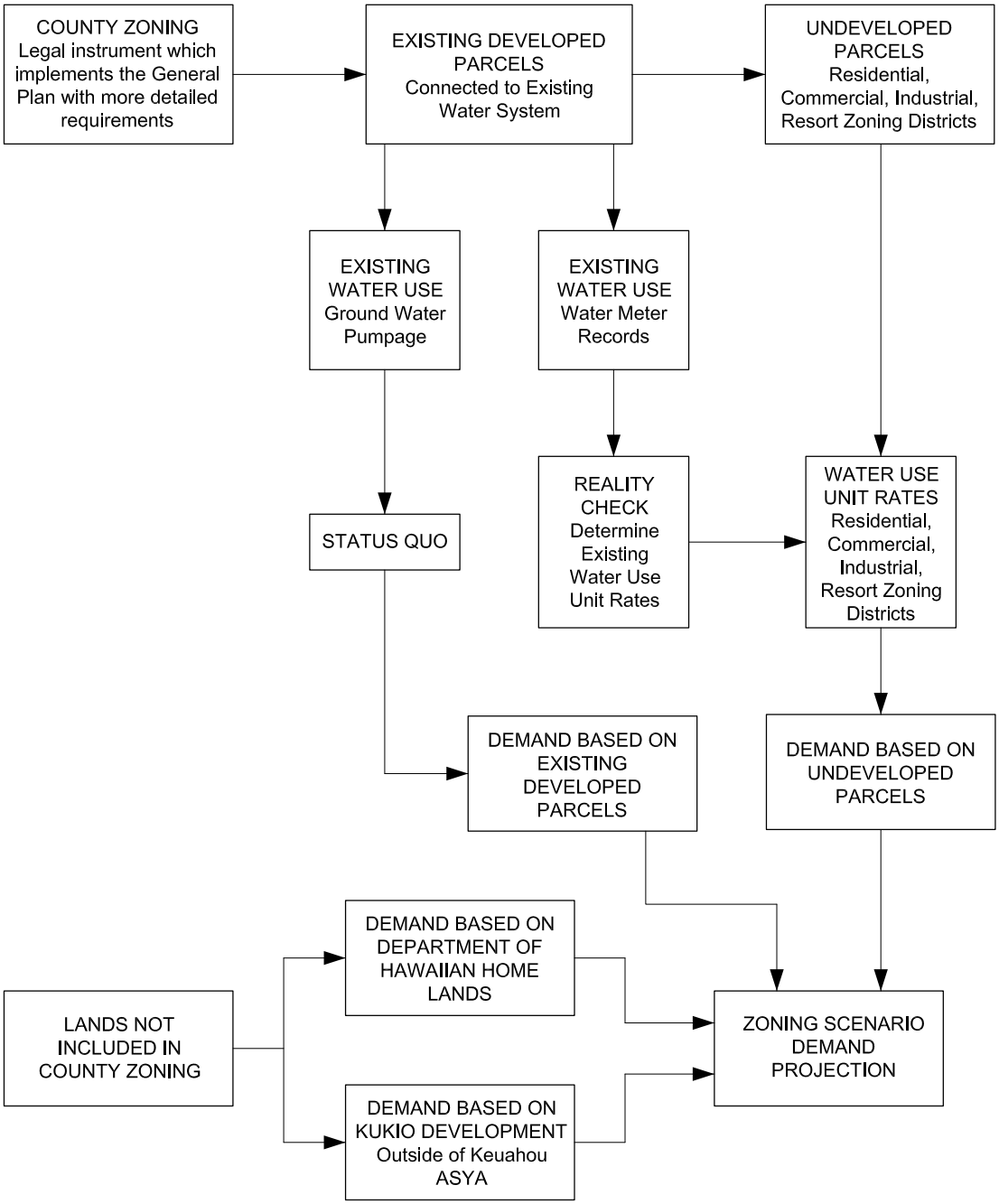
Water Use & Development Plan Update
Keauhou & Waimea Aquifer Systems

FIGURE 2-2: ANTICIPATED WATER DEMAND EVALUATION METHODOLOGY



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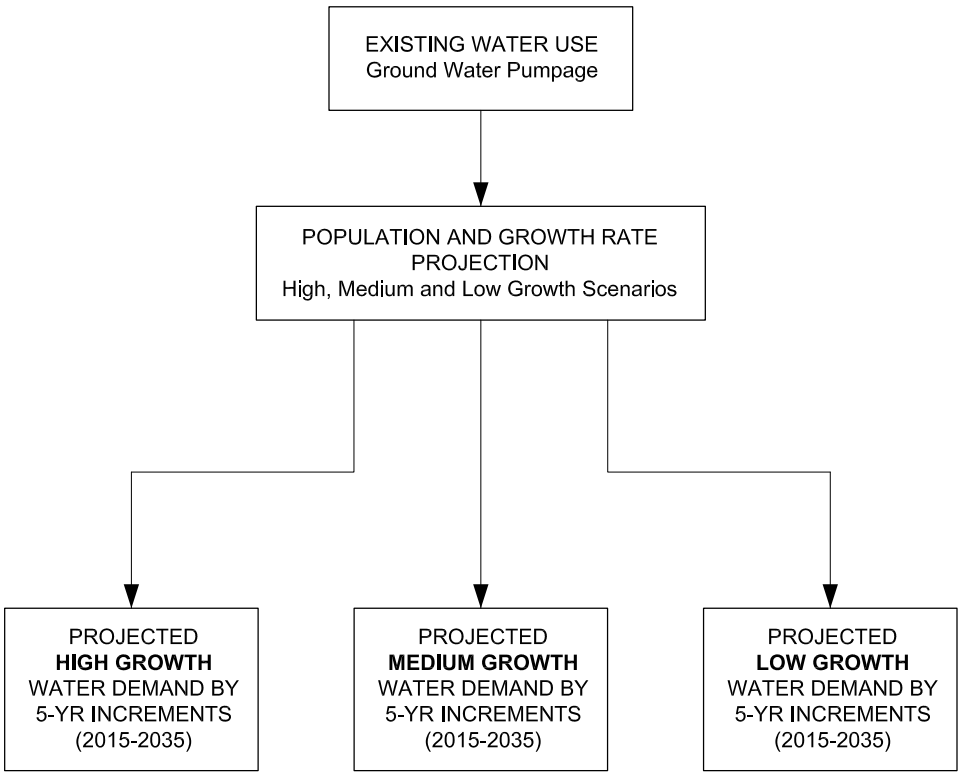
Keauhou & Waimea Aquifer Systems

FIGURE 2-3: COUNTY ZONING WATER DEMAND EVALUATION METHODOLOGY



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County of Hawaii
Water Use & Development Plan Update
Keauhou & Waimea Aquifer Systems

FIGURE 2-4: 5-YEAR INCREMENTAL WATER DEMAND PROJECTION METHODOLOGY

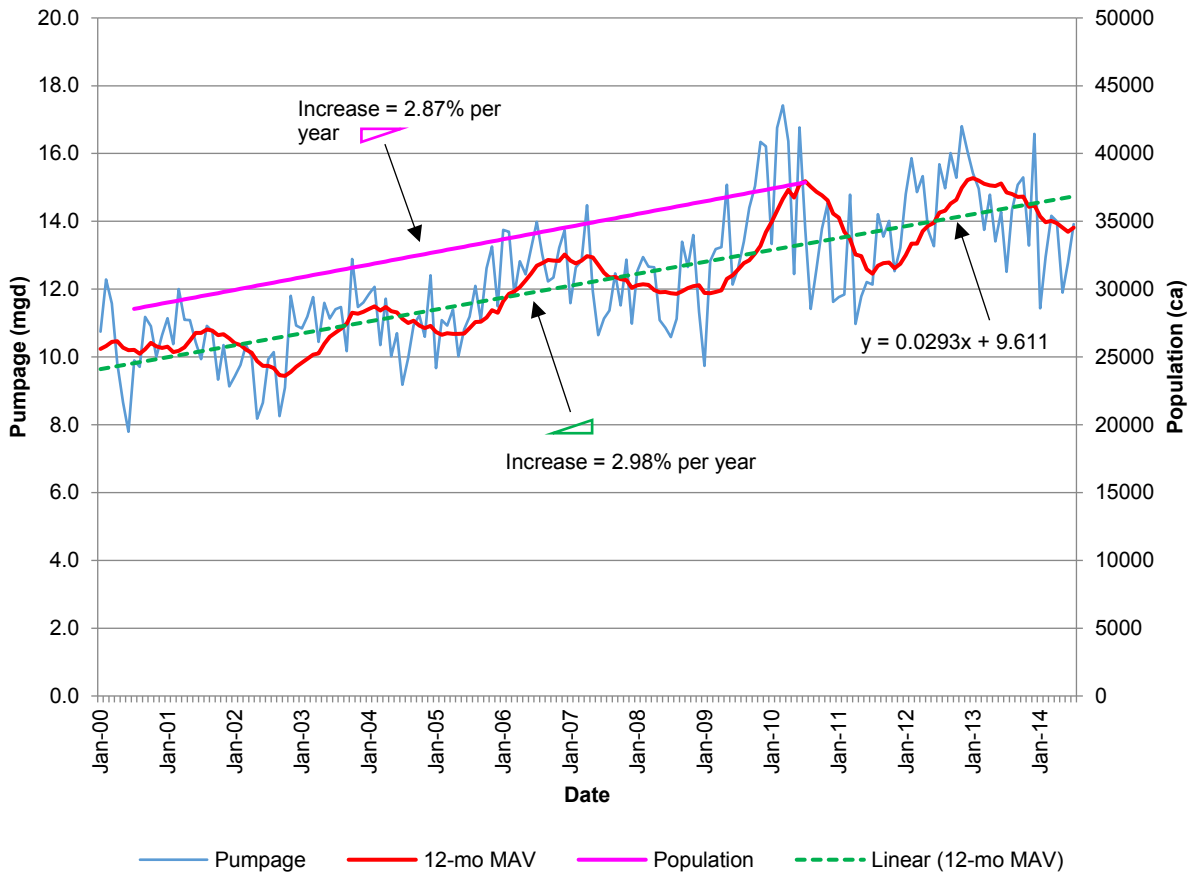
2.1.5.1 Population and Growth Rate Projections

The population projections to the year 2020 are from the Economic Assessment, PKF Hawai‘i, January 2000, and were also the basis of the 2005 General Plan. The growth rates were derived from this data. At the time of this report, the State Department of Business, Economic Development and Tourism (DBEDT) and the Hawai‘i County Planning Department did not have more recent population projections specific to judicial districts. The Planning Department is anticipating initiating the update to the GP, which is expected to include population projections by judicial district, in 2015. The 2005 GP represents the best available data; therefore, population projections for each 5-year increment from 2015 to 2035 utilized the growth rate projected between 2015 and 2020 in the GP.

2.1.5.2 Historical Ground Water Use and Population

As a reality check, the annual rate of historical population growth and the annual rate of increase in ground water pumpage were calculated and compared. Census estimates are only available every 10 years, so the average population growth rate was interpolated between 2000 and 2010. A linear regression analysis was performed on the 12-MAV pumpage data between 2000 and 2014. The results of the analysis indicated an average population growth rate for North Kona of 2.87 percent per year, and an average rate of increase in pumpage within the Keauhou ASYA of 2.98 percent per year. Therefore, because past trends show that increase in ground water usage closely follows population growth, it is reasonable to utilize the rate of increase in future population projections as the basis to project future ground water use. The results of the analysis are graphed in Figure 2-5.

Figure 2-5: Historical Ground Water Pumpage and Population Growth Rates



CHAPTER 3 WATER DEMAND SCENARIOS AND PROJECTIONS

3.1 KEAUHOU AQUIFER SYSTEM AREA PROFILE

3.1.1 General

The Hualālai Aquifer Sector Area includes the entire Hualālai shield volcano and is surrounded by Mauna Loa. The sector area is divided into the Keauhou [80901] and Kiholo [80902] Aquifer System Areas (ASYA) along Hualālai's main northwest-southeast rift zone.

Average rainfall in the Keauhou ASYA ranges from less than 20 inches along the northwest coast to about 125 inches in the Kahaluʻu Forest Reserve, and according to the 2008 Water Resources Protection Plan, has a sustainable yield of 38 MGD.

3.1.2 Economy and Population

3.1.2.1 Economy

North Kona continues to be a major visitor industry area with direct national and international flights to the Keahole-Kona International Airport, and contains a large percentage of the number of hotel rooms on the island.

Part of the Kona coffee belt lies within the Keauhou ASYA. The coffee belt has the ideal climate without the need for irrigation for this crop. The demand and value of Kona coffee continues to grow and has steadily increased, and the crop generates over $30 million annually.

North Kona supports many other industries, including timber, fishing, quarrying, manufacturing, service, wholesale and retail activities. According to the County General Plan, Kona is considered the center for government, commercial and industrial activities for West Hawaiʻi. Additionally, Kona is also home to "big-box" retailers such as Costco, K-Mart, Walmart and international sporting events such as the IronMan Triathlon, the Hawaiian International Billfish Tournament, and the Senior PGA Tournament of Champions at the Hualālai Resort.

The Natural Energy Laboratory of Hawaiʻi Authority (NELHA) is an ocean science and technology park located at Keahole Point. According to the Economic Research Organization at the University of Hawaiʻi (UHERO), in 2013, the NELHA facility hosted 37 tenants, and together with these tenants, provided a total State economic impact of approximately $123 million a year and 617 jobs through their $99 million in expenditures.

3.1.2.2 Population

Over 95% of the North Kona district population lies within the Keauhou ASYA. The population growth rate in the area has decreased since the rapid growth of 1970's and 80's.

Table 3-1: Historical Population – Keauhou ASYA

1980	1990	2000	2010	1980-90 % Change	1990-2000 % Change	2000-2010 % Change
13,304	21,565	27,622	36,653	62.1	28.1	32.7

Data source: 2000 and 2010 U.S. Census
Data redistributed and evaluated for the Keauhou ASYA

The population projection for the system area, in five-year increments for low, medium and high growth cases, show slower growth than in the past. According to the GP, growth in North Kona will be closely associated with the growth of the visitor and agricultural industries.

Table 3-2: Population Projection – Keauhou ASYA

Growth Rate	2000	2005	2010	2015	2020	2000-10 % Change	2010-20 % Change
A – Low	27,622	29,390	32,638	36,165	40,110	18.2	22.9
B – Medium	27,622	29,484	32,926	36,698	40,911	19.2	24.2
C – High	27,622	30,714	34,990	39,581	44,595	26.7	27.4

Data source: Hawai'i County General Plan, February 2005
Data redistributed and evaluated for the Keauhou ASYA

3.1.3 Land Use

3.1.3.1 Anticipated Water Demands

The land use area associated with anticipated water demands is shown on Figure 3-1.

3.1.3.2 Hawai'i County Zoning Water Demand

The land use area associated with the Hawai'i County Zoning build-out scenario is shown on Figure 3-2. The existing developed parcels currently connected to the County Department of Water Supply (HDWS) North Kona Water System are also shown. The estimated land use allocation acreage of undeveloped area for each zoning district is listed in Table 3-3.

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Department of Water Supply

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Job No. 2014-0802

LEGEND:

- Hawaiian Home Lands
- Kona CDP Subdivisions
- Kona CDP Vacant Lots
- Existing Water Service
- Water Commitments
- Developer Agreements
- Vacant Laterals
- Open Building Permits
- TMK

1 0.5 0 1
Miles

INDEX MAP - Island of Hawaii

FIGURE 3-1

AQUIFER SECTOR HUALALAI - 809

Aquifer Systems
Keauhou - 80901

Anticpated Water Demands Map

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Makalawena

Mahaiula Bay

Makako Bay

Honokohau

Kiholo
80902

Keauhou
80901

Kailua Bay

Kailua-Kona

Keauhou

PACIFIC OCEAN

Hawaii County
Department of Water Supply

DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

Job No. 2014-0802

LEGEND:

- Hawaiian Home Lands
- Existing Water Service

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
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

1 0.5 0 1
Miles

INDEX MAP - Island of Hawaii

FIGURE 3-2

AQUIFER SECTOR HUALALAI - 809

Aquifer Systems
Keauhou - 80901

County Zoning Build-out Map

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Table 3-3: County Zoning Undeveloped District Allocation Acreage – Keauhou ASYA

ZONING DISTRICT	ACREAGE	% of TOTAL
Single Family Residential	910	1.03
Multi-Family Residential (including duplex)	532	0.60
Residential-Commercial Mixed Use	0	0.00
Resort	193	0.22
Commercial	406	0.46
Industrial	889	1.00
Industrial-Commercial Mixed	277	0.31
Family Agriculture	132	0.15
Residential Agriculture	237	0.27
Agriculture	54,518	61.67
Open	20,180	22.83
Project District	0	0.00
Forest Reserve	7,980	9.03
(road)	2,148	2.43
TOTAL	88,401	100.00

3.2 EXISTING WATER RESOURCES

3.2.1 Ground Water

The Keauhou ASYA currently has a sustainable yield of 38 MGD. According to the CWRM database, there are 47 production wells in the system area, including 16 municipal, 12 irrigation, 1 industrial, 5 agricultural, and 13 wells drilled, but categorized as "unused". Figure 3-3 shows the well locations. The industrial well is owned by Hawaiian Electric Light Company, Inc. (HELCO) and pumps brackish water for cooling, and several of the wells categorized as "other" are used for aquaculture or resort water features.

High-level groundwater was encountered in the early 1990's within the Keauhou ASYA, which is reflected in the WRPP sustainable yield; however, the extent to which it could be developed was not known. Exploratory drilling at elevations above 1,600 feet mean sea level (MSL) encountered water elevations ranging from 25± feet MSL to 241± feet MSL. Notably, 10 of the municipal wells and 11 of the irrigation wells were drilled since 1990, as this new resource was rapidly developed. Growth in the area and the associated increase in demand for water supplies led to competition among large landowners/developers for the new sources of water supply and well sites. The CWRM became concerned with proper planning, well placement and associated problems of well interference, and with the help and partnership of the private sector, undertook the task to collect and analyze data, and continues to monitor groundwater in West Hawai'i.

3.2.2 Surface Water

Wai‘aha Stream is the only perennial stream in the area, due to the high permeability of the basaltic lava flows from Mauna Loa and Hualālai volcanoes. In the wettest part of the rain belt, a few small springs may occur, such as Wai‘aha Springs; however, the small and intermittent springs can sustain only small needs. There are 8 declared stream diversions in the CWRM database listed in Table 3-4 and shown on Figure 3-4; however, flow data is not available.

Table 3-4: Stream Diversions – Keauhou ASYA

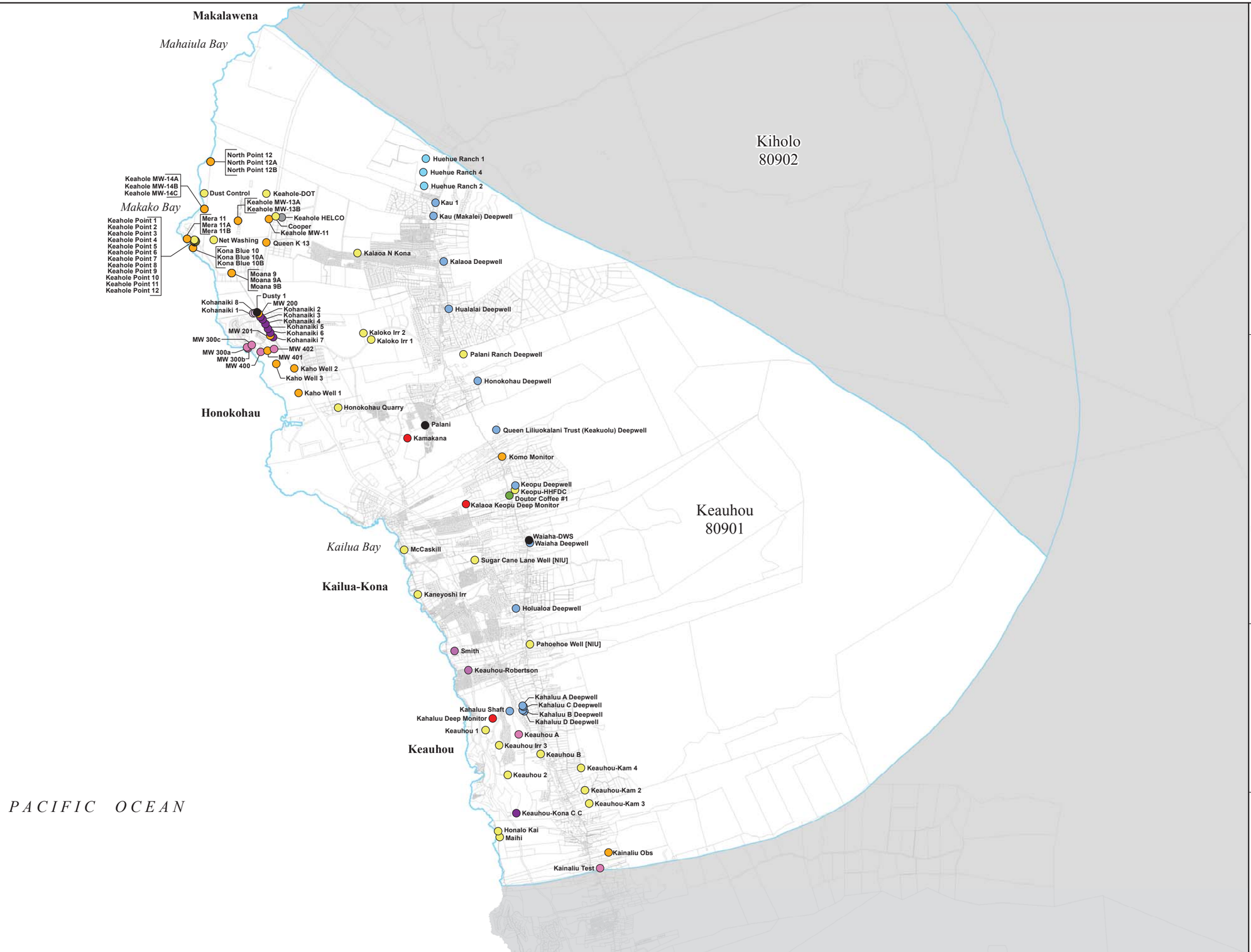
FILE REFERENCE	TMK	STREAM NAME	DESCRIPTION
PALANI RANCH	7-4-001:003	Unnamed	Stream diversion, Pipe #1 from tributary of Wai‘aha Stream and rights claim.
GOMES J	7-5-014:002	Wai‘aha	Stream diversion, pipe in concrete from Wai‘aha Stream.
PALANI RANCH	7-6-001:002	Unnamed	Stream diversion, Pipe #2 from tributary of Wai‘aha stream and rights claim.
PALANI RANCH	7-6-001:002	Tributary to Wai‘aha	Stream diversion, pipe from Wai‘aha Tributary and rights claim (new entry).
TWIGG-SMITH C	7-7-005:002	Unnamed/ Unmapped	Stream diversion, mauka dam on Unnamed stream and rights claim. See new entries for 2 other dams.
TWIGG-SMITH C	7-7-005:002	Unnamed/ Unmapped	Stream diversion, makai dam on Unnamed (new entry).
TWIGG-SMITH C	7-7-005:002	Unnamed/ Unmapped	Stream diversion, old Hawaiian dam on Unnamed (new entry).
WALL RANCH	7-9-008:010	Unnamed/ Unmapped	Stream diversion, pipe from Kawanui Stream.

3.2.3 Rainwater Catchment

The first potable water wells in the Keauhou ASYA were drilled in 1959 and were placed in service in 1967. Prior to these sources, potable water was supplied primarily from individual rainwater catchment systems. Rainwater catchment remains a viable resource for the area.

3.2.4 Recycled Water

There are four active wastewater reclamation facilities (WWRF) in the study area. Table 3-5 lists the WWRF, recycled water classification, facility treatment capacity, current reuse amount, and current application. The County Kealakehe WWRF formerly supplied the privately-owned Swing Zone Golf Facility in Kona; however, Swing Zone at one point obtained brackish water at a lower cost but has since closed. The County Wastewater Division has plans to upgrade the WWRF to produce R-1 quality effluent and has acquired a State Revolving Fund (SRF) loan to fund the project, and planning is underway.



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Job No. 2014-0802

LEGEND:

- ABNSLD - Sealed
- AGRAQ - Aquatic Plants and Animals
- AGRCP - Crops and Processing
- INDEL - Geothermal, Thermoelectric Cooling, Power Develop
- IRR - Irrigation (non-domestic, non-agriculture)
- IRRGC - Golf Course
- IRRLA - Landscape/Water Features
- MUNCO - County
- MUNPR - Private (but Public - DOH definition)
- OBS - Observation
- OBSDM - Deep (through transition zone)
- OBSWL - Water Level
- UNU - Unused
- TMK

1 0.5 0 1
Miles

INDEX MAP - Island of Hawaii

FIGURE 3-3

AQUIFER SECTOR HUALALAI - 809

Aquifer Systems
Keauhou - 80901

Well Location

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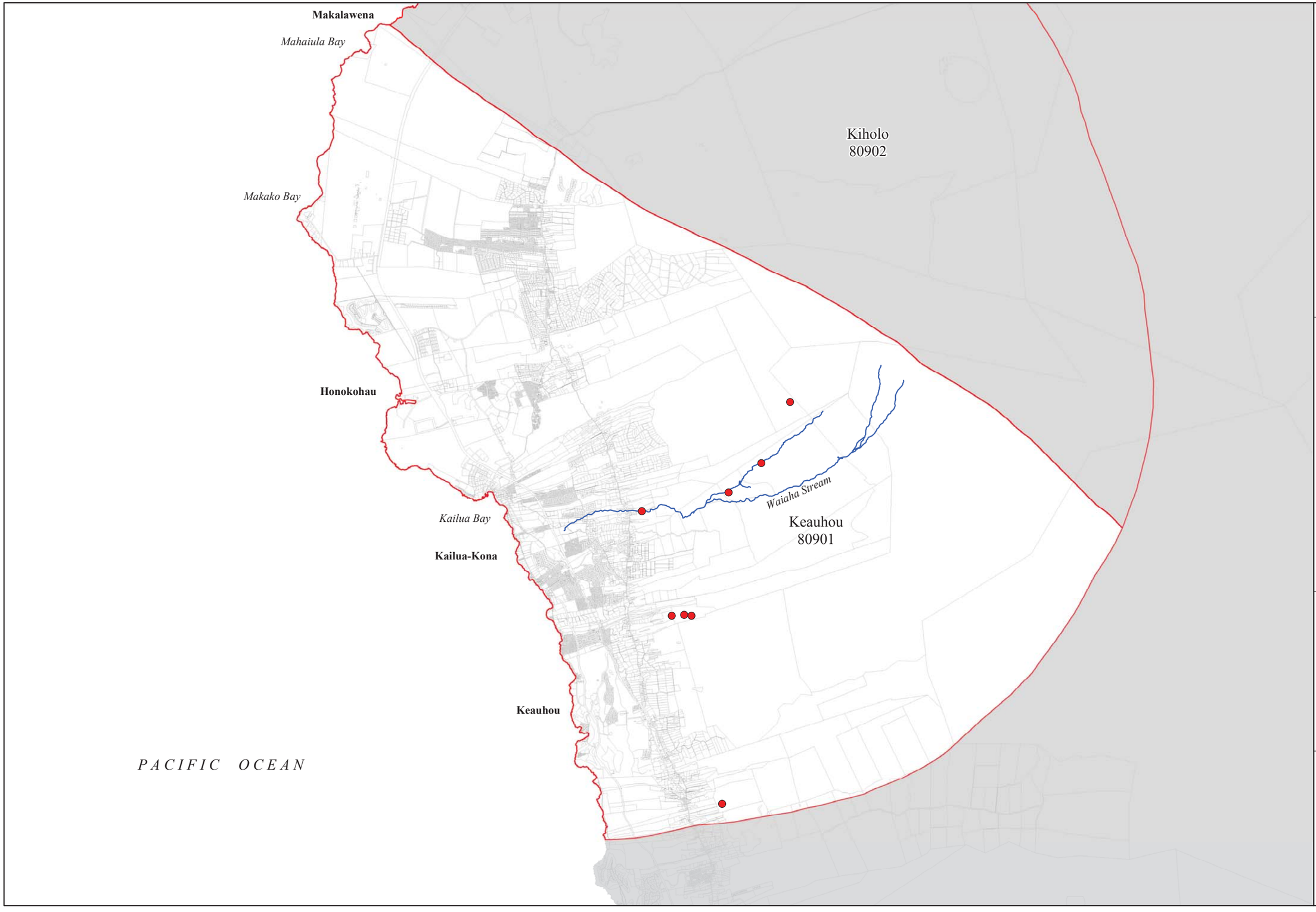

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DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

Job No. 2014-0802

LEGEND:

- Diversion
- Perennial Stream
- TMK

1 0.5 0 1
Miles

INDEX MAP - Island of Hawaii

FIGURE 3-4

AQUIFER SECTOR HUALALAI - 809

Aquifer Systems
Keauhou - 80901

Streams and Diversions

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Table 3-5: Wastewater Reclamation Facilities – Keauhou ASYA

Wastewater Reclamation Facility	Recycled Water Classification	Design Capacity (MGD)	Current Reuse Amount (MGD)	Irrigation Application
He'eia	R-2	1.80	0.34	Kona and Alii Country Club Golf Course
Keahole-Kona Airport	R-1	0.13	0.04	Landscape
Kaiser-Kona	R-3	0.01	0.01	N/A
Kohanaiki	R-1	0.07	0.00	Golf Course

3.3 EXISTING WATER USE

3.3.1 General

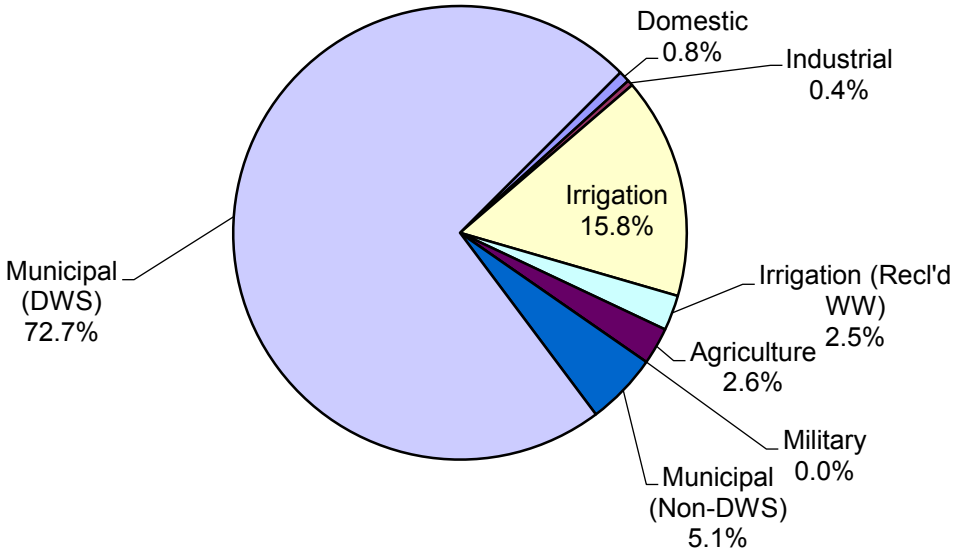
The following section presents the total estimated existing water use within the Keauhou ASYA. Total estimated water use was based on HDWS meter data from July 2013 to June 2014, CWRM pumpage data from August 2012 through July 2014, available GIS data and recycled water usage. The water use is presented and summarized for the Keauhou ASYA in Table 3-6 and Figure 3-5 in accordance with CWRM categories. The table and figure also indicate the quantities associated with the HDWS system, private public water system and recycled water.

Table 3-6: Existing Water Use by Categories – Keauhou ASYA

CWRM Water Use Category	Ground Water (MGD)	Other Sources (MGD)	Total (MGD)	Percentage of Total
Domestic	0	0.12[1]	0.12	0.81
Industrial	0.06		0.06	0.41
Irrigation	2.42	0.39[2]	2.81	18.29
Agriculture	0.41		0.41	2.64
Military	0		0	0
Municipal				
HDWS System	11.18		11.18	72.72
Private Public WS	0.79		0.79	5.13
Total	14.86	0.51	15.37	100.00

[1]*Catchment*
[2]*Recycled Water*

Figure 3-5: Existing Water Use by Categories – Keauhou ASYA



3.3.2 Domestic Use

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

3.3.3 Industrial Use

Industrial use is minimal. HELCO has one well in the Keauhou ASYA, which is used for cooling. Unlike at the HELCO Hilo plant, this water is not injected back into the ground. As indicated in Table 3-6, the industrial use is 0.06 MGD.

3.3.4 Irrigation Use

Irrigation makes up a significant portion of the water used in the Keauhou ASYA. Estimated irrigation use is based on pumpage reported for private wells categorized by CWRM as irrigation wells and recylced water use as indicated previously in Table 3-5. Table 3-7 lists the private irrigation well pumpage reported to CWRM.

Table 3-7: Private Irrigation Well Pumpage – Keauhou ASYA

Private Irrigation	Irrigation Well Pumpage (MGD)
Kona Country Club	0.95
Smith	0.00
Kohanaiki	1.47
TOTAL	2.42

3.3.5 Agricultural Use

Estimated agricultural water use within the Keauhou ASYA is relatively low considering the amount of agricultural activity within the area. A portion of the Kona coffee belt is within the system area; however, coffee cultivation relies primarily on ambient or available rainfall for production. Agricultural use in the amount of 1.43 MGD is supplied by HDWS. The Keahole agricultural park on the mauka side of Queen Kaʻahumanu Highway across from the airport is comprised of several significant users of water connected to the HDWS system.

Aquaculture is a notable industry with the Natural Energy Laboratory of Hawaiʻi Authority (NELHA) located within the Keauhou ASYA. This facility primarily uses deep cold seawater, but also uses a significant amount of potable water from the HDWS system. King Ocean Farm, Inc. is a commercial tenant of NELHA that produces superior quality macroalgae and other ocean products, according to the NELHA website. King Ocean Farm Inc. owns 11 brackish water wells. The pumpage from the four wells reporting to the CWRM is 0.41 MGD.

3.3.6 Military Use

There is no military use in the Keauhou ASYA.

3.3.7 Municipal Use

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

3.3.7.1 County Water Systems

The HDWS has one system in North Kona. It is the second largest system on the island. The existing use associated with meter records from July 2013 through June 2014 was previously listed in Table 3-6. The system is supplied entirely by ground water sources, including 12 wells and the Kahaluʻu inclined shaft.

The Kona Water System extends from the Keahole-Kona International Airport south to the South Kona boundary where interconnection with the South Kona Water System is made. The Kona districts were without any County water systems until funds were provided by the Legislature in 1951. The first increment of the North Kona Water System was completed in 1953. Surface water from Waiʻaha Stream was diverted into large storage tanks located in Waiʻaha above Māmalahoa

Highway, filtered, then piped down to Kailua by a small transmission line to large tanks above Kailua Village. This provided the impetus for the resort development which occurred in subsequent years. The first potable water wells were placed in service in 1967. Expansion of the system, mainly through legislative funds, continued for years. Most of the small pipelines initially installed have been replaced with larger mains. The system expanded to Keauhou, permitting the development of hotels along this coastline. Expansion to Kona International Airport opened up a new area for development, such as the Honokōhau Small Boat Harbor. The expansion program did not neglect the existing farming community in the mauka areas, as the system eventually was extended to service the North Kona District from Kalaoa Homesteads to the South Kona boundary, a distance of over 18 miles.

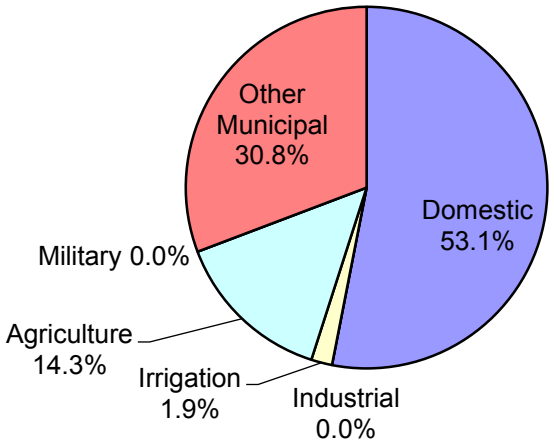
HDWS water use is subcategorized in Table 3-8 to the extent possible based on available meter data. This use is depicted in Figure 3-6. "Other Municipal" subcategory includes facilities such as schools, and various commercial, government, medical and nonprofit entities which have mixed water use and cannot be specifically allocated to the other CWRM categories.

Table 3-8: HDWS Existing Water Use by Categories – Keauhou ASYA

CWRM Water Use Category	HDWS Metered Water Use* (MGD)	Percent of Total
Domestic	5.30	53.07
Industrial	0	0
Irrigation	0.19	1.88
Agriculture	1.42	14.29
Military	0	0
Other Municipal	3.07	30.76
Total	9.98	100.00

**Metered water use should not be compared to pumpage because the latter is calculated by determining the high 12-MAV and may be based on a different timeframe*

Figure 3-6: HDWS Existing Water Use by Categories – Keauhou ASYA



3.3.7.2 State Water Systems

There are no State water systems in the Keauhou ASYA.

3.3.7.3 Federal Water Systems

There are no Federal water systems in the Keauhou ASYA.

3.3.7.4 Private Public Water Systems

Huehue Ranch owns five wells categorized as "Municipal" that are operated by the Kona Water Service Company. Three of the wells are located in the Keauhou ASYA, and the other two are located in the Kiholo ASYA. The water system is classified by the Department of Health, Safe Drinking Water Branch as Public Water System No. 165. The water system serves 166 residential lots in the Kukio development as well as the Makalei Golf Course and Kukio Golf and Beach Club. The water is disinfected, treated for corrosion control, and the lower part of the water system is also treated using reverse osmosis. The total pumpage from the three wells within the Keauhou ASYA is 0.79 MGD.

3.3.8 Water Use by Resource

3.3.8.1 Ground Water

Table 3-9 summarizes the current production, sustainable yield (SY), and percentage of SY for the production calculated. Current production is represented by the highest 12-month moving average (12-MAV) or the highest annual average yield calculated from the actual pumpage data reported to CWRM between August 2012 and July 2014.

Table 3-9: Pumpage and Sustainable Yield – Keauhou ASYA

High 12-MAV (MGD)	Sustainable Yield (MGD)	High 12-MAV Portion of Sustainable Yield
14.86	38	39.09%

3.3.8.2 Surface Water

There is no flow data available for surface water use within the Keauhou ASYA.

3.3.8.3 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 in Table 3-6 is assumed to be supplied by individual catchment systems. Only parcels mauka of Māmalahoa Highway were considered, as other areas would not receive adequate rainfall to support catchment systems.

3.3.8.4 Recycled Water

Four wastewater reclamation facilities within the Keauhou ASYA supply recycled water for irrigation use, as previously indicated in Table 3-6.

3.4 FUTURE WATER NEEDS

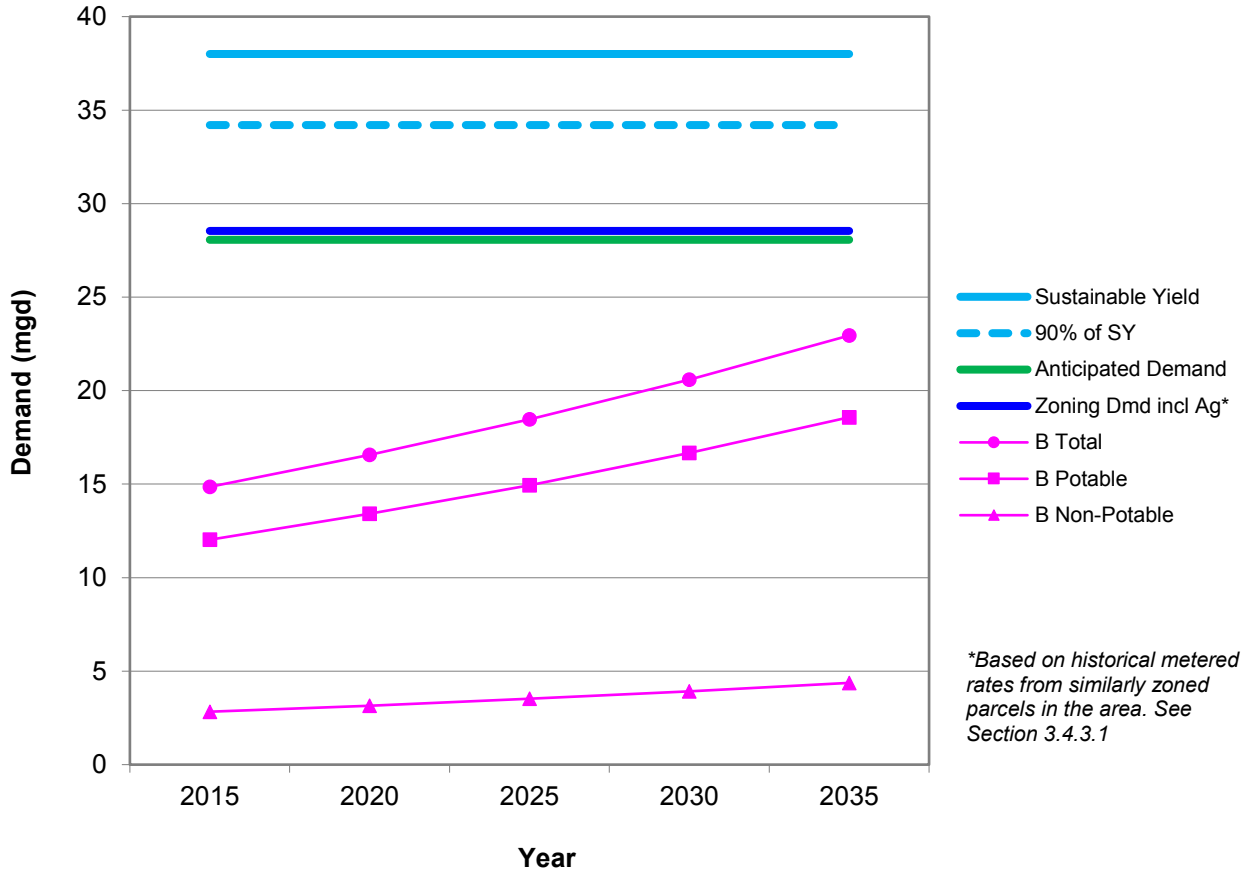
3.4.1 General

Table 3-10 summarizes the anticipated water demand (Antic.), Zoning, and 5-year incremental water demand for Growth Rate B (medium growth) projection scenarios for the Keauhou ASYA. The SY is presented for comparison. Figure 3-7 graphically illustrates this data.

Table 3-10: Summary of Water Demand Scenarios – Keauhou ASYA

Keauhou ASYA	SY	Anticipated	Zoning	Growth Rate B Demand Projections (Year)				
				2015	2020	2025	2030	2035
MGD	38	28.07	28.54	14.86	16.56	18.46	20.58	22.94
Portion of SY	100%	73.86%	75.10%	39.09%	43.58%	48.59%	54.16%	60.38%

Figure 3-7: Summary of Water Demand Scenarios – Keauhou ASYA



One of the criteria for designation of a ground water hydrologic unit is if ground water pumpage reaches 90% of the SY, which would be 34.2 MGD for the Keauhou ASYA. Both the anticipated and zoning water demand scenarios are well under 90% of the SY of the Keauhou ASYA. Analysis of the three water demand scenarios are presented in the following sections.

3.4.2 Anticipated Water Demands

The anticipated water demand for the Keauhou ASYA is summarized in Table 3-15, and reflects refinement as discussed below and as indicated in Section 2.1.1.3. Each land use classification is associated with the most appropriate CWRM water use category.

As described in Section 2.1.4.1, the DHHL component of the anticipated water demand was based on the November 24, 2014 reservation request in lieu of the State Water Projects Plan Update for DHHL.

Known State projects with projected demands that are not already accounted for by existing water use, water entitlements and DHHL are listed in Table 3-11. These demands will be updated with project data from the forthcoming SWPP.

Table 3-11: State Projects Component of Anticipated Water Demands

Project	State Department	Demand (MGD)
University of Hawai'i Center, West Hawai'i Long Range Development Plan	University of Hawai'i	0.054
West Hawai'i Explorations Academy	NELHA	0.003
OTEC Research, Development and Demonstration Facility	NELHA	<0.001
Kona Judiciary Complex	Judiciary	0.007
TOTAL		0.064

The Kona CDP component of the anticipated water demand considers the proposed subdivisions with appropriate State Land Use Designation (SLUD) approval, vacant lots within existing subdivisions, and potential infill of the Holualoa rural area which are not already accounted for by existing developed parcels, water entitlements and DHHL. The demand from proposed subdivisions with SLUD approval was based on the unit counts and gross land areas indicated in Table E-2 of the Financing Plan, and subtracting the units and areas already accounted for in other components of anticipated water demand or those that did not have SLUD approval. Table E-2 is shown in Figure 3-8. Water demands were calculated based on 400 GPD/unit for residential and resort units, and 3,500 GPD/acre for non-residential areas. The latter represents an average of the Water Systems Standards unit rate for Commercial (3,000 GPD/acre) and Industrial (4,000 GPD/acre) areas.

Table 3-12: Proposed Subdivisions with SLUD Approval Unit Count

Component	Residential/Resort (units)	Commercial/ Industrial Gross Area (acres)
Financing Plan Table E-2	11,672	170.8
Subtract:		
DHHL	649	0
Existing or Entitlements	7,424	9.5
Without SLUD	1,407	0
Remaining Units or Area	2,192	161.3

Table 3-13: Proposed Subdivisions with SLUD Approval Water Demand

Component	Units or Area	Average Daily Demand Unit Rate	Demand (MGD)
Residential/Resort	2,192 units	400 gal/unit	0.877
Commercial/Industrial	161.3 acres	3,500 gal/acre	0.565
TOTAL			1.441

Based on GIS, there were 262 vacant lots within existing subdivisions, and there were 767 potential infill units within Holualoa. The demands accounted for by the three Kona CDP components are listed in Table 3-14.

Figure 3-8: Kona CDP Financing Plan Table E-2

Table E-2
Kona Community Development Plan
Financing Plan
Detailed Land Use Breakdown of New Development Areas

ID	Subdivision Name	Units/Bldg SF: Single Family *Units*	Multi-Family *Units*	Non-Residential *Bldg SF*	Resort *Units*	Acres: Single Family	Multi-Family	Non-Residential	Resort	TOD Assignment [1]
1	Palamanui	-	144	228,219	-	-	15.0	4.1	-	1
2	Palamanui	135	-	-	-	28.2	-	-	-	1
3	Palamanui	45	-	-	-	14.0	-	-	-	1
4	Palamanui	35	-	-	-	11.1	-	-	-	1
5	Palamanui	43	-	-	-	13.5	-	-	-	1
6	Palamanui	16	-	-	-	3.4	-	-	-	1
7	Palamanui	-	-	317,160	-	-	-	18.2	-	1
8	Palamanui	35	-	-	-	10.9	-	-	-	1
9	Palamanui	232	-	-	-	72.6	-	-	-	1
10	Palamanui	165	-	-	-	51.7	-	-	-	1
11	Lokahi/Wainani	114	-	-	-	102.9	-	-	-	2
12	Seaside	-	213	336,984	-	-	22.1	6.0	-	2
17	Kona Palisades	50	-	-	-	218.1	-	-	-	2
22	Kaloko Makai	-	433	687,125	-	-	45.1	12.3	-	3
32	Honokohau TOD	-	352	558,126	-	-	36.7	10.0	-	4
33	Lanihau MP	150	-	-	-	31.3	-	-	-	4
34	Lanihau MP	346	-	-	-	72.1	-	-	-	4
35	Laiopua	223	-	-	-	69.6	-	-	-	4
37	Laiopua	156	-	-	-	48.8	-	-	-	4
38	Laiopua	68	-	-	-	21.1	-	-	-	4
39	Laiopua	168	-	-	-	52.4	-	-	-	4
40	Laiopua	72	-	-	-	22.4	-	-	-	4
41	Keahuolu	1,089	-	-	-	227.0	-	-	-	5
42	QLT MP	806	-	-	-	168.0	-	-	-	5
43	Kona Commons TOD	-	142	224,939	-	-	14.8	4.0	-	6
44	KV Core Area	-	97	153,414	-	-	40.3	11.0	-	7
45	Suffolk/Puaa	-	225	210,529	-	-	13.8	3.8	-	9
48	Laipala Makai	59	-	-	-	10.6	-	-	-	10
49	Laipala Mauka	27	155	1,474	-	7.2	17.3	-	-	10
52	Kahaluu TOD	-	116	183,268	-	-	12.0	3.3	-	10
53	Keauhou	1,094	-	-	-	227.9	-	-	-	10
46	Pualani+	212	-	-	-	66.2	-	-	-	11.1
47	Kona Vistas/Iolani	103	-	-	-	99.3	-	-	-	11.1
50	White Sands Mauka	11	-	-	-	34.4	-	-	-	11.1
51	White Sands Makai	-	95	-	-	-	9.4	-	-	11.1
31	West HI Business Pk	-	-	1,142,227	-	-	-	65.6	-	11.2
13	Makalei Estates	39	-	-	-	250.3	-	-	-	11.3
14	Kaloko Mauka	88	-	-	-	1,855.1	-	-	-	11.3
15	Kona Coastview	23	-	-	-	136.0	-	-	-	11.3
16	Kona Hills Estates	26	-	-	-	79.0	-	-	-	11.3
18	12Extg	32	-	-	-	29.3	-	-	-	11.3
19	13Extg	14	-	-	-	13.4	-	-	-	11.3
20	17Extg	43	-	-	-	45.9	-	-	-	11.3
21	Kula Nei	367	-	-	-	114.5	-	-	-	11.3
23	Kaloko Makai	1,407	-	-	-	293.2	-	-	-	11.3
24	Ooma [2]	-	-	49,145	200	-	-	1.2	303.4	11.3
25	Kohanaiki Shores	-	-	-	500	-	-	-	463.3	11.3
26	Kaloko Industrial III/IV	-	-	450,274	-	-	-	25.8	-	11.3
27	Kaloko Hts	-	192	305,216	-	-	20.0	5.5	-	11.3
28	Kaloko Hts	678	-	-	-	141.3	-	-	-	11.3
29	Kaloko Hts	587	-	-	-	183.4	-	-	-	11.3
30	327 Kona	52	-	-	-	258.6	-	-	-	11.3
	TOTAL [3]	**8,809**	**2,163**	**4,848,100**	**700**	**5,084.7**	**246.7**	**170.8**	**766.6**	

[1] Although not assigned to a TOD, projects assigned to TOD "11.1", "11.2", and "11.3" fall within the general geographic areas of Scenario 1, 2, or 3, respectively. See Table E-3.
[2] Having recently been denied LUC approval for 1,000 resort units and 200,000 square feet of non-residential, it is assumed that a smaller version of the project is ultimately approved and constructed.
[3] Assumes 90% of residential (non-resort) development capacity/plan is actually constructed.

Sources: PBR Hawaii; Goodwin Consulting Group, Inc. *1/14/2011*

Figure 3-9 illustrates the overlap of the Kona CDP and other components of anticipated water demand, with the red diagonal hatch representing the Kona CDP subdivisions.

Figure 3-9: Kona CDP Overlap

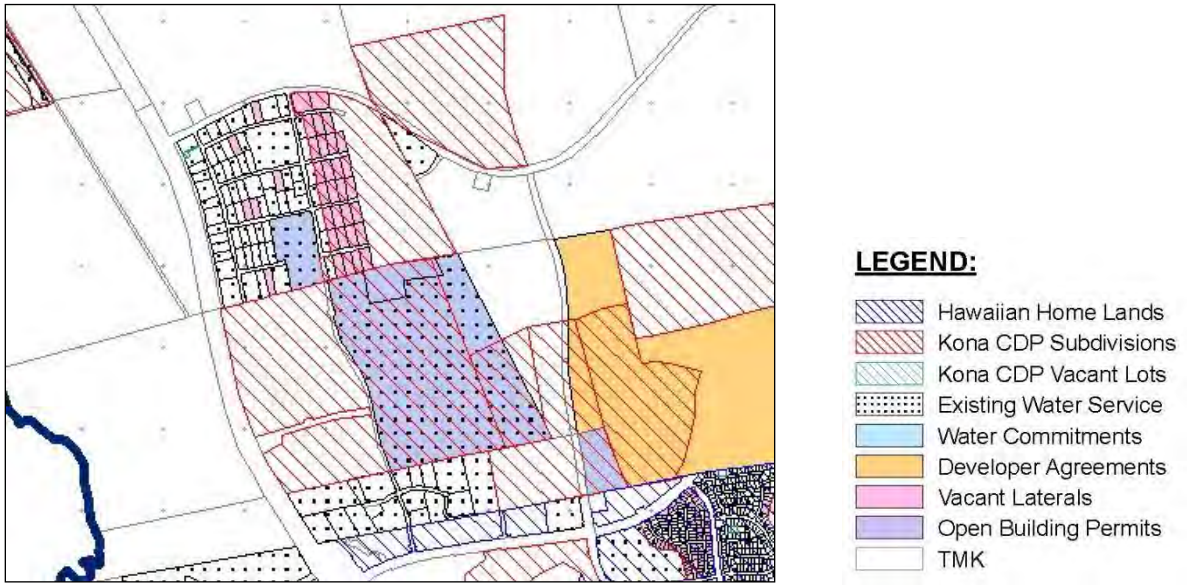


Table 3-14: Kona CDP Demand Components of Anticipated Water Demands

Kona CDP Component	Demand (MGD)
Proposed Subdivisions with SLUD Approval	1.441
Vacant Lots	0.105
Holualoa	0.307
TOTAL	1.853

Table 3-15: Anticipated Water Demands – Keauhou ASYA

Component	CWRM Category	Water Demand (MGD)
Existing Developed Parcels*	Domestic/Irrigation/Municipal	14.86
Water Entitlements:		
Vacant Service Laterals	Municipal	1.10
Developer Agreements	Municipal	3.39
Water Credit Commitments	Municipal	2.66
Approved Open Building Permits	Municipal	0.09
Other Developments (Kukio)	Irrigation/Municipal	0.66
DHHL	Irrigation/Municipal	3.40
State Projects	Irrigation/Municipal	0.06
Kona CDP	Municipal	1.85
TOTAL		28.07

**Highest 12-MAV pumpage between August 2012 and July 2014*

3.4.3 Hawai‘i County Zoning Water Demands

As described in Section 2.1.4.1, the DHHL component of the zoning build-out water demand was based on the November 24, 2014 reservation request in lieu of the State Water Projects Plan Update for DHHL.

The water demand based on the County Zoning for the Keauhou ASYA is listed in Table 3-16, and reflect refinement as discussed below and as indicated in Section 2.1.1.3. Each zoning district is associated with the most appropriate CWRM water use category.

Table 3-16: Hawai‘i County Zoning Water Demand – Keauhou ASYA

Zoning District/ Component	CWRM Category	Water Demand (mgd)
Existing Developed Parcels*	Domestic/Irrigation/Municipal	14.86
Residential	Domestic/Irrigation/Municipal	4.31
Resort	Irrigation/Municipal	0.57
Commercial	Municipal	0.38
Industrial	Industrial	0.91
Agricultural**	Agricultural	3.45
Kukio	Irrigation/Municipal	0.66
DHHL	Irrigation/Municipal	3.40
TOTAL		28.54

**Highest 12-MAV pumpage between August 2012 and July 2014*
***Based on historical metered rates from similarly zoned parcels in the area. See Section 3.4.3.1*

3.4.3.1 Agricultural Water Demands

The estimated maximum agricultural water demand based on irrigation of all Important Agricultural Land (IAL) area within the undeveloped agriculturally zoned areas and the revised unit rate of 210 GPD/acre based on historical unit rates of similarly zoned parcels in the area is 3.45 MGD. Most agricultural demands are not expected to be supplied by potable ground water sources and therefore should not count against the SY. Figure 3-11 shows the IAL and agriculturally zoned areas, the existing HDWS system and average annual rainfall isohyets.

3.4.4 5-Year Incremental Water Demand Projection

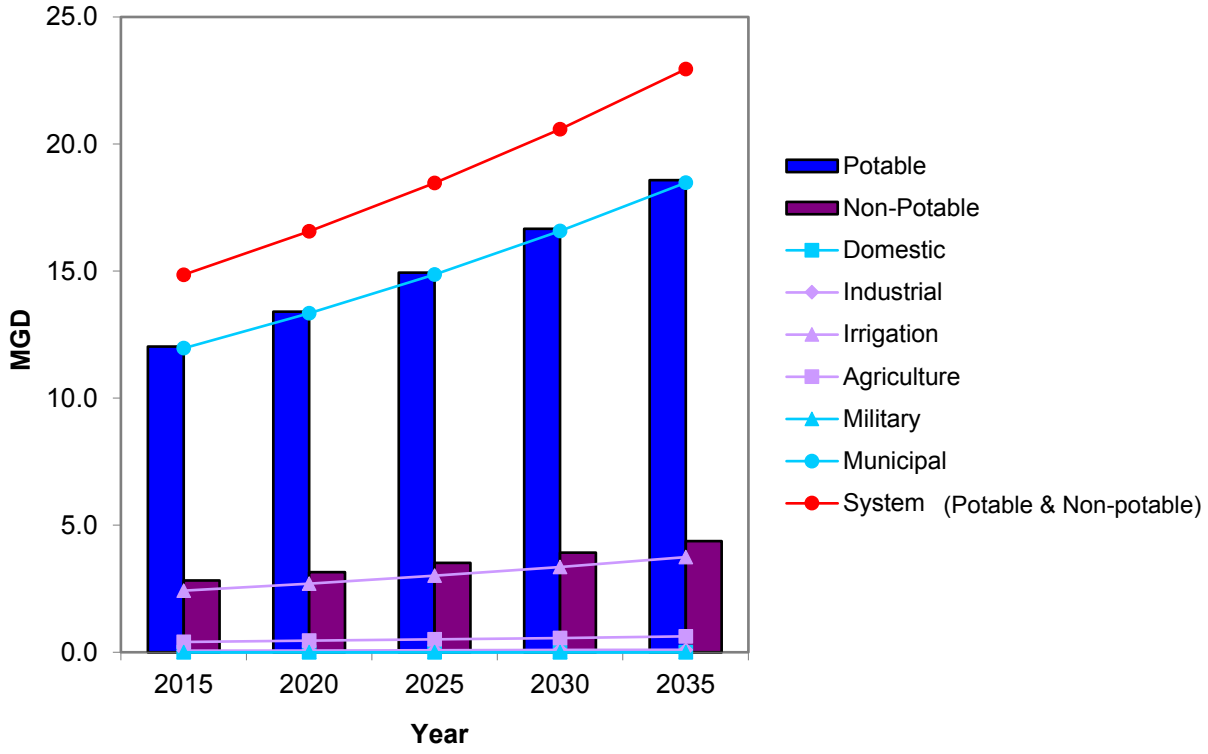
The following section presents 5-year incremental water demand projections to the year 2035 for the Keauhou ASYA. Figure 3-10 shows the breakdown of water demand projections by CWRM categories, potable (Domestic, Industrial, Military and Municipal) and non-potable (Irrigation and Agriculture), and HDWS through the year 2035, and Table 3-17 summarizes this figure.

The projected low, medium, and high growth rates are listed in Table 3-18 and are graphed in Figure 3-12. Potable and non-potable water demands are also differentiated.

Table 3-17: Growth Rate B Water Demand Projection by Category – Keauhou ASYA

Water Use Category	2015 (MGD)	2020 (MGD)	2025 (MGD)	2030 (MGD)	2035 (MGD)
Total	14.86	16.56	18.46	20.58	22.94
Domestic	0.00	0.00	0.00	0.00	0.00
Industrial	0.06	0.07	0.08	0.09	0.10
Irrigation	2.42	2.70	3.01	3.36	3.74
Agriculture	0.41	0.45	0.50	0.56	0.63
Military	0.00	0.00	0.00	0.00	0.00
Municipal	11.96	13.34	14.87	16.57	18.48
Potable	12.03	13.41	14.95	16.66	18.57
Non-potable	2.83	3.15	3.52	3.92	4.37
HDWS	11.18	12.46	13.89	15.48	17.26

Figure 3-10: Growth Rate B Water Demand Projection by Category – Keauhou ASYA



Makalawena

Mahaiula Bay

Makako Bay

Honokohau

Kiholo
80902

Keauhou
80901

Kailua Bay

Kailua-Kona

Keauhou

20"

30"

35"

40"

45"

70"

PACIFIC OCEAN

Hawaii County
Department of Water Supply

DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

Job No. 2014-0802

LEGEND:

- Annual Rainfall
- Hawaiian Home Lands
- Existing Water Service
- Important Agricultural Land

Agricultural Zoning:

A-1a+	1 thru 10 acres
A-20a	20 acres
A-35a	35 acres
A-40a	40 acres
A-80a	80 acres
A-200a+	200 thru 255 acres
A-500a	500 acres
A-600a	600 acres
A-900a	900 acres

TMK

1 0.5 0 1
Miles

INDEX MAP - Island of Hawaii

FIGURE 3-11

AQUIFER SECTOR HUALALAI - 809

Aquifer Systems
Keauhou - 80901

Undeveloped Agricultural Lands

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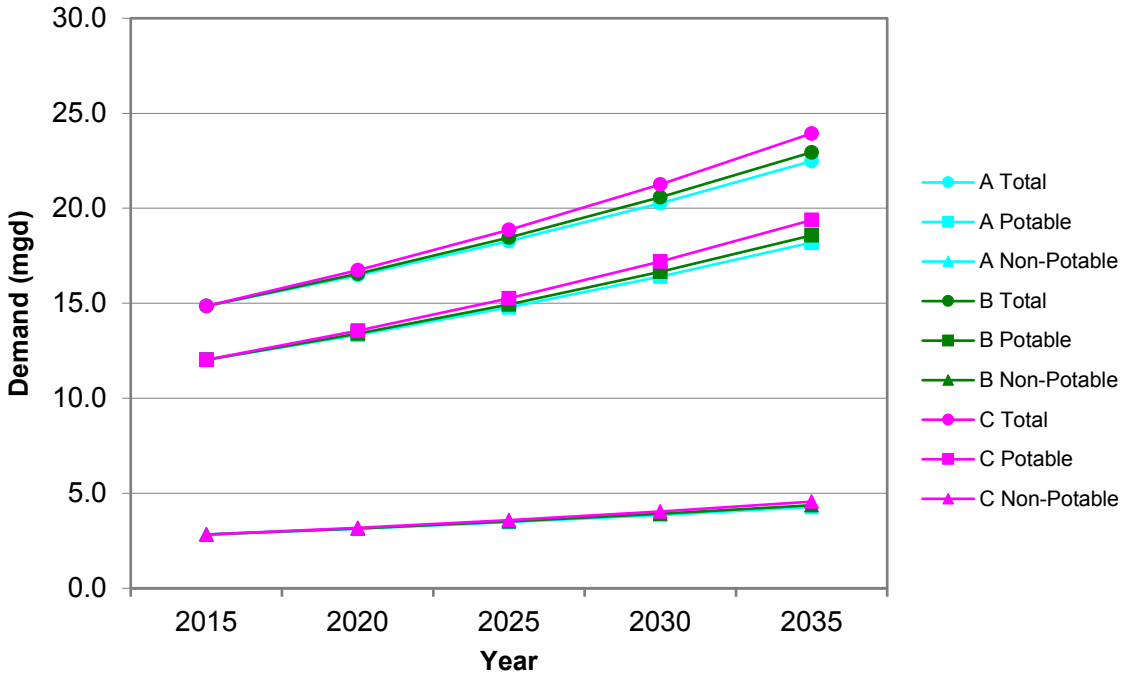
Consulting Engineers
1357 Kapiolani Boulevard, Ste. 1530, Honolulu, Hawaii 96814

Table 3-18: Growth Rates A, B, C Water Demand Projections – Keauhou ASYA

Growth Rate		2015 (MGD)	2020 (MGD)	2025 (MGD)	2030 (MGD)	2035 (MGD)
A – Low	Total	14.86	16.48	18.27	20.27	22.48
	Potable	12.03	13.34	14.79	16.41	18.20
	Non-potable	2.83	3.14	3.48	3.86	4.28
B – Medium	Total	14.86	16.56	18.46	20.58	22.94
	Potable	12.03	13.41	14.95	16.66	18.57
	Non-potable	2.83	3.15	3.52	3.92	4.37
C – High	Total	14.86	16.74	18.86	21.25	23.94
	Potable	12.03	13.55	15.27	17.20	19.38
	Non-potable	2.83	3.19	3.59	4.05	4.56

Figure 3-12: Growth Rates A, B, C Water Demand Projections – Keauhou ASYA



CHAPTER 4 RESOURCE AND FACILITY STRATEGIES

4.1 OVERVIEW AND WATER SOURCE ADEQUACY

One of the criteria for designation of a ground water hydrologic unit is if ground water pumpage reaches 90% of the sustainable yield (SY), which would be 34.2 MGD for the Keauhou ASYA. As indicated in the Chapter 3, the projected demand for the anticipated demand scenario is 28.07 MGD, the zoning water demand scenario is 28.54 MGD, and the 5-year incremental water demand for Growth Rate B (medium growth) projection scenario is 22.94 MGD in 2035. All of these scenarios result in values below the 90% trigger for designation. Conventional ground water well source development would therefore be able to meet the projected demands of all three development scenarios without the need to designate the aquifer system. Source development strategies presented in this Chapter will focus on meeting the anticipated demand scenario.

The implementation strategies provide guidance for further integration and planning coordination of water resource management with the development of land use policies to ensure sustainable management of water resources. The vast majority of development associated with the anticipated demand scenario is expected to be supplied by the HDWS system; hence, source development will principally involve HDWS and include its partnerships with private entities and State agencies. Because development timetables are difficult to predict since development projects are often market and economically driven, conceptual options for long-term source development and infrastructure improvements linked to possible land development scenarios are provided. However, more detailed projects and strategies are provided for HDWS and its partnerships' near-term needs through the 5-year Capital Improvement Program (CIP).

4.2 HDWS FACILITY IMPROVEMENT PROGRAM

4.2.1 History and Objectives

The basal Kahaluʻu Shaft was developed by the State and turned over to HDWS with the intent that it would produce up to 10 MGD which would supply the North Kona area. The original transmission system was built with the intent to run the source water from the Shaft along the lower elevations where water use is typically greater and to pump uphill, from makai to mauka, as needed. However, the production of the Shaft fell well short of expectations due to the increase in chlorides upon pumping in excess of 3-4 MGD, and HDWS has subsequently shifted its priority to developing "high-level" wells in the 1,500 – 1,800 foot elevation range. This has presented several different challenges, such as the need for smaller sized pumps and/or larger motors due to the increased water lift and thus increased power requirements. Also, adapting to the high-level wells reversed the "bottom-up" water transmission to "top-down" water transmission, resulting in the need for development of new mauka-makai water transmission pipelines and storage infrastructure. The added infrastructure allows HDWS to deliver the high-level water to the greater use areas at the lower elevations and, also, to blend the higher quality, high-level water with the basal source water to improve overall water quality. HDWS endeavors to significantly reduce the use and dependence on basal well sources.

4.2.2 Implementation of HDWS Long Range Master Plan

In 2006, HDWS developed a 20-year Water Master Plan (WMP) which would serve as a long-range planning tool to guide the development of its water service areas and the use of its resources. The WMP identified the projects expected to be required by HDWS during the 2007–2026 planning period. This WMP was intended to be comprehensive in its scope; however it also noted that the list of projects identified would invariably change over time due to the difficulty in anticipating all projects and because new projects were almost certain to arise during the planning period.

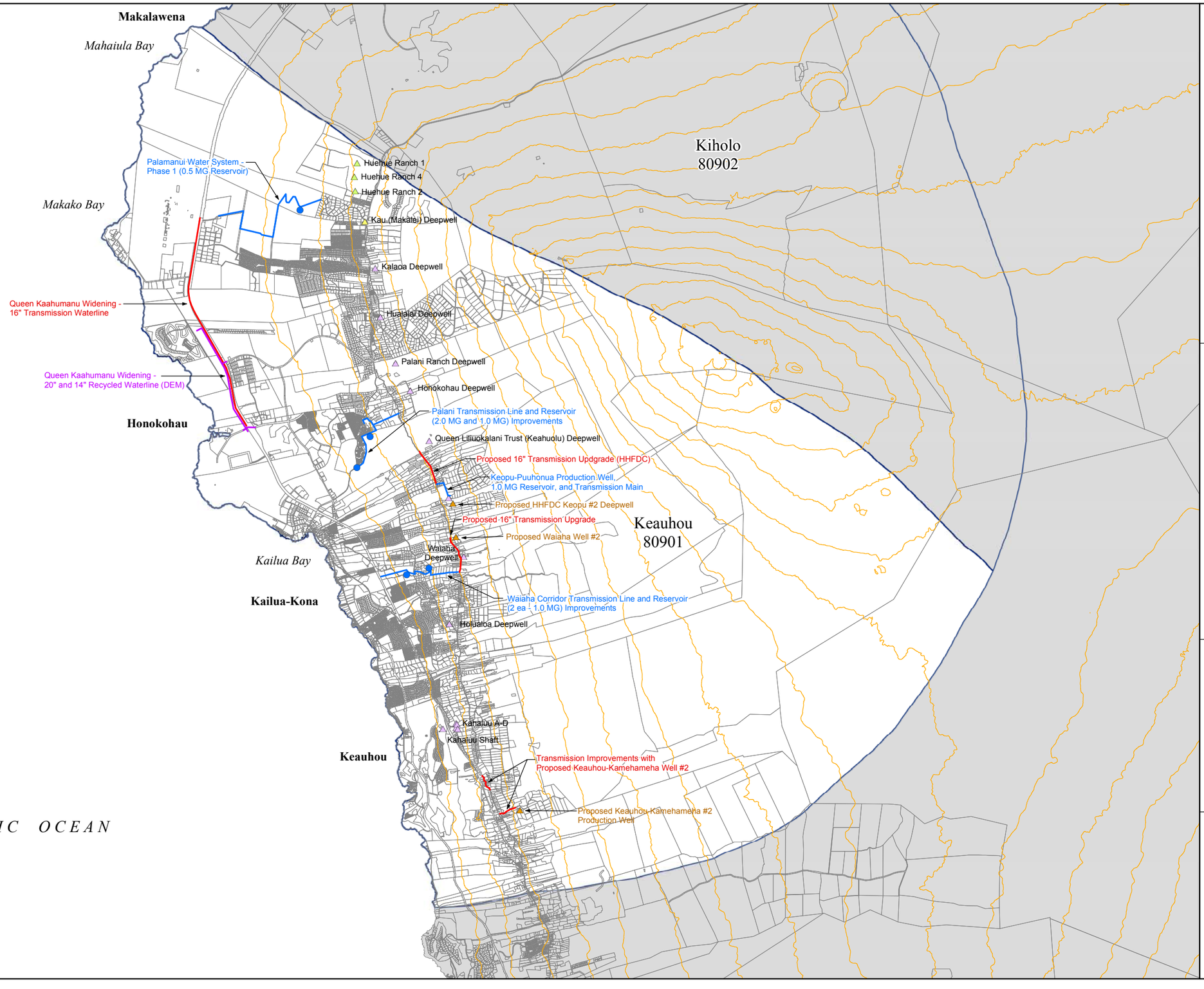
HDWS has already implemented several of the CIP projects outlined in the WMP for the North Kona Water System, including:

- Palani Transmission System, which included transmission water mains and 2.0 MG and 1.0 MG reservoirs to transmit high-level water from three separate sources directly to the Kailua-Kona and Kealakehe areas.
- Pālamanui Water System Phase 1, which included a transmission water main and 0.5 MG reservoir to provide a backup connection between the mauka and makai water systems.
- Waiʻaha Corridor Improvements, which was a private/public project that included a transmission water main and two 1.0 MG reservoirs to bring high-level water from the Waiʻaha well down to the lower elevations and allow blending with the basal water.
- Keopu-Puʻuhonua Production Well and 1.0 MG Reservoir, including transmission main, to bring high level water to the north where it can be transmitted down to lower elevations via the Palani and Hina Lani transmission systems.

These projects are shown on Figure 4-1. Some departures from the WMP have occurred for these projects, such as changes in storage capacity and transmission infrastructure size and alignment. Certain projects proposed in the WMP were not completed for the following reasons:

- Kaʻū No. 1 Well, a potential basal source north of the Makalei Well, was not developed due to poor water quality.
- ʻOʻoma Well, a potential high-level source between the high-level Kalaoa and Hualālai wells, was not pursued because the proposed development associated with the well did not proceed.

Other projects that have been completed but were not part of the WMP include the Palani Ranch Deepwell, which was a public-private project where HDWS participated financially in upsizing the reservoir that was part of the project in order to better serve the needs of the North Kona community. These departures from the WMP demonstrate the difficulty in predicting specific future water system infrastructure improvement projects.



Hawaii County
Department of Water Supply

DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

Job No. 2014-0802

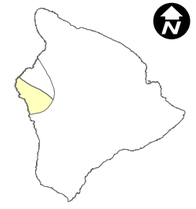
LEGEND:

- 500 ft contours
- TMK
- DEM Recycled Waterline
- Completed Transmission CIP
- Proposed Transmission CIP
- Completed Storage CIP
- Proposed Wells

Well Use

- MUNCO
- MUNPR
- UNU

1 0.5 0 1
Miles



INDEX MAP - Island of Hawaii

FIGURE 4-1

AQUIFER SECTOR HUALALAI - 809

Aquifer Systems
Keauhou - 80901

HDWS Completed and Future CIP Projects

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4.2.3 HDWS Capital Improvement Program

Proposed HDWS 5-year CIP projects are focused on increasing high-level source capacity, which will ultimately reduce the use of basal sources, and transmission projects to increase the utilization of existing sources. These projects were also not part of the WMP and are shown on Figure 4-1. They are as follows:

- Proposed 16" Transmission Upgrade, funded by the Hawai'i Housing Finance & Development Corporation (HHFDC), which will increase the size of the transmission main south of the QLT high-level well.
- Proposed 16" Wai'aha Transmission Upgrade, which will increase the size of transmission main between the Wai'aha mauka-makai corridor and proposed Wai'aha wells.
- Proposed Keauhou-Kamehameha #2 Production Well, a new high-level well.
- Keauhou Transmission Improvements, which will deliver water from the proposed Keauhou-Kamehameha #2 well.
- Queen Ka'ahumanu Widening 16" Transmission Waterline.
- North Kona Well (Wai'aha Well #2).

4.3 CONCEPTUAL SOURCE DEVELOPMENT STRATEGIES

Figure 4-2 depicts the additional water demands, not including existing developed parcels, associated with the anticipated water demand scenario developed in Chapter 3. The total of these "future" anticipated water demands is 13.21 MGD. The bulk of the water demand is located at elevations 500 feet or lower and in the mid-to northern area of the Keauhou ASYA. Arrows represent the general direction of water transmission from existing and proposed sources to accommodate future anticipated water demands. Conceptual source development strategies will focus on qualitative aspects of developing sources, delivering, and meeting anticipated demands.

4.3.1 Source Development Program

The source development program will employ conventional supply-side measures to meet projected demands, including ground water, and source conveyance and storage.

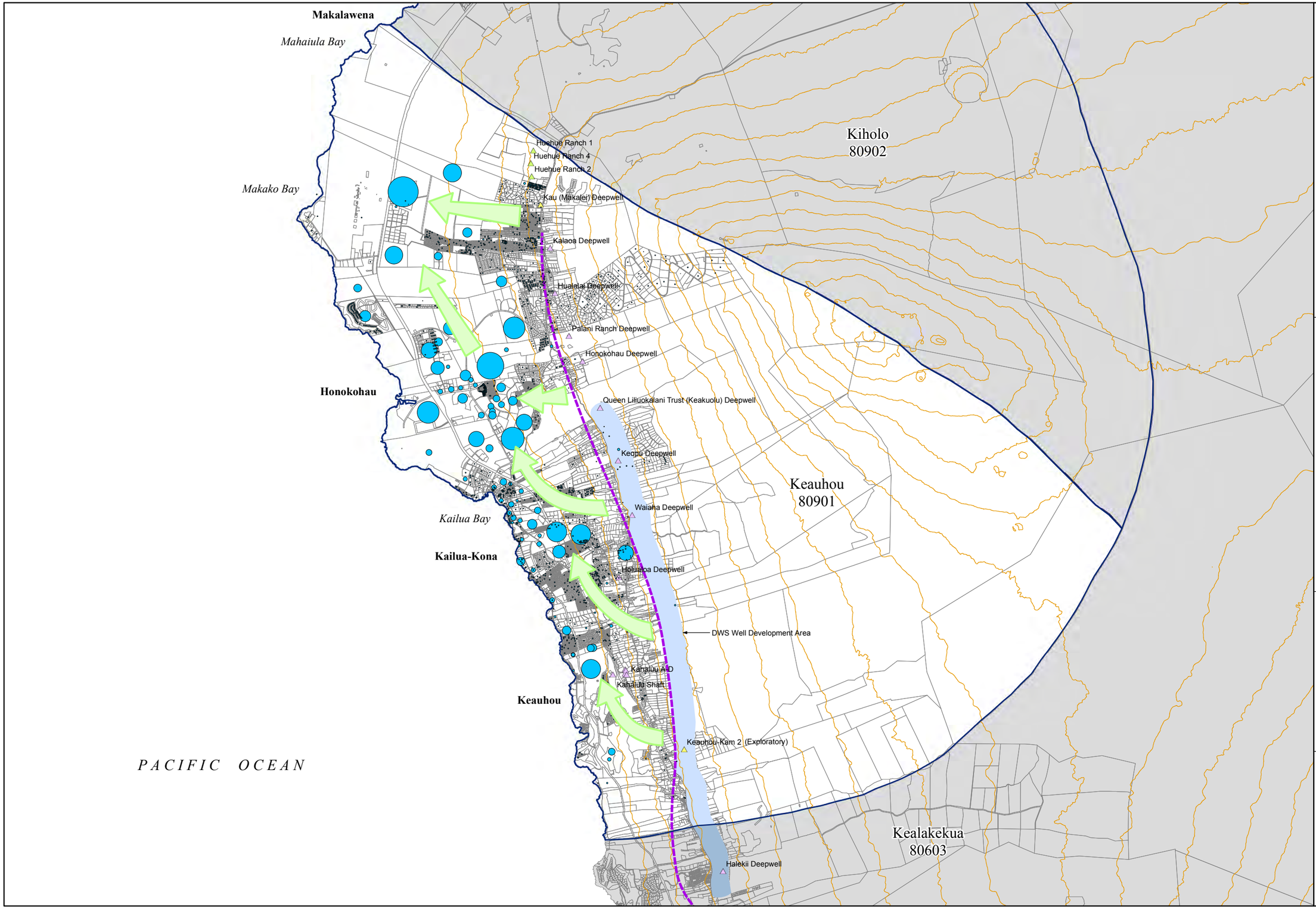
4.3.1.1 Ground Water

Development of future high-level wells for the HDWS system is encouraged in areas generally between 1,500 foot and 1,800 foot ground elevations mauka of Māmalahoa Highway, generally in the vicinity between the QLT Deepwell in the Keauhou ASYA and the Haleki'i Deepwell in the Kealakekua ASYA with the overall goal of sustainability throughout the region. The goal of this source development strategy is to accommodate the future anticipated demands depicted in Figure 4-2 and to replace basal sources with high-level sources. As discussed in Section 4.2.3, HDWS anticipates development of two wells, the Keauhou-Kamehameha #2 Production Well and the North Kona Well, within the next 5 years.

HDWS has initiated close monitoring of the water levels in the high-level wells to assure that they will remain sustainable. Utilization of monitoring well data will allow HDWS and CWRM to analyze the effects of new wells developed in the proposed well development area and adjust parameters such as well spacing and withdrawal rates accordingly to avoid interference with other wells. Published groundwater levels in the proposed water source development area are significantly higher than those in the area to the north, which may indicate a greater recharge. HDWS is studying the correlation between rainfall events and response times relating to increase in ground water well levels. HDWS has also contracted a consultant to conduct an assessment of the interaction of the high-level and basal aquifers. The scope of work of that contract includes determination if pumpage from the high-level aquifer has a discernible impact to the basal lens, determination if lateral hydraulic connection between high-level compartments can be identified, and demonstration that ongoing monitoring of high-level and basal groundwater is sufficient to identify if, when, and to what degree impacts to basal groundwater have occurred as a result of pumping high-level groundwater. In addition, CWRM will require, for the development of all new ground water sources, pump tests to determine well yield and monitoring of nearby wells during these tests. CWRM will review these test results for possible interference as part of its Well Construction and Pump Installation Permit Application (WCPIPA) process.

Supply of the future anticipated demands from the proposed well source development area will require additional water system infrastructure generally transmitting water from the south to the north and from mauka to makai, a concept that has already been demonstrated through HDWS' completed and future transmission and storage CIP projects. This regional water system development plan will also provide backup source and storage capabilities, as well as system operational flexibility for the entire region. Future development of wells by private developers to be turned over to HDWS will need to consider transmission and storage improvements necessary to deliver the source water to the development area and potentially other water needs in the area known at that time and, where feasible, be consistent with the overall south-north mauka-makai concept. Wells developed outside of the proposed well source development area will need to be further evaluated for long-term sustainability and potential impacts on adjacent wells. HDWS intends to partner with these developers as they come forth to address their needs based on their development timelines and plans to require developers to include a traditional and customary native Hawaiian rights (T&C) impact assessment as a condition of agreement. Private wells developed that are not integrated into the HDWS system will be vetted for T&C impacts through ʻAha Moku and for interference with other wells through review of pump tests during the CWRM's WCPIPA process. Discussion of strategies to vet T&C impacts are presented in Chapter 5. HDWS will also participate in the vetting of proposed private wells to ensure that they will not interfere with nearby existing HDWS wells.

In June 2014, Dr. Don Thomas of the University of Hawaiʻi at Hilo prepared a report that re-evaluated the groundwater hydrology of Hawaiʻi Island and presented evidence that a multi-layered fresh/saline groundwater system extending well below sea level could exist in the Kona area. Wells in the mid-elevation range, the Kamakana Well and the Keopu Well, encountered a second freshwater layer between 600 feet and 1,100 feet below sea level under strong artesian pressure. Initial indications are that this aquifer is confined below sea level and would have minimal, if any, impact on the basal aquifer. Development of this aquifer may have several



Hawaii County
Department of Water Supply

DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

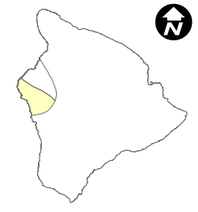
Job No. 2014-0802

LEGEND:

Well Use Type
- MUNCO
- MUNPR
- UNU
- High Level Boundary
- 500 ft contours
- DWS Well Development Area (Kealakekua ASYA)
- DWS Well Development Area

Future Anticipated Demand (GPD)
- 100
- 1,000
- 10,000
- 100,000
- 1,000,000
- TMK

1 0.5 0 1
Miles



INDEX MAP - Island of Hawaii

FIGURE 4-2

AQUIFER SECTOR HUALALAI - 809

Aquifer Systems
Keauhou - 80901

Conceptual Ground Water Source Development and Anticipated Water Demands Map

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advantages, such as reduced energy costs. Further investigation of this aquifer as a potential source to replace the basal sources that supply makai areas in the Keauhou ASYA is recommended.

4.3.1.2 Source Conveyance and Storage

The proposed water source development plan incorporates a system that includes both conveyance (transmission and distribution lines) and storage (reservoir tanks), continuing the conceptual system already implemented in the Kona Water System. Source conveyance within the Keauhou ASYA is already occurring via the extensive North Kona Water System transmission network. Possible extension of the DWS system to incorporate potential well sources south toward the Kealakekua ASYA could be explored. The benefits of developing an integrated water network in this region would be the capability of sharing not only sources, but storage and transmission facilities that could provide backup capacity during times of equipment failure and pipeline breaks. The increased storage capacity in the regional system would allow more normalized (steady-state) pumping, avoiding the need to increase pumping rates during instances of high (peak) demand.

It should be noted that the HDWS South Kona Water System in the Kealakekua ASYA is already connected to the North Kona Water System and separated by a closed valve; however, infrastructure changes, such as upsizing the transmission mains, would be required to carry an increased quantity of water. Any well sources developed within the Kealakekua ASYA would not count towards the SY of the Keauhou ASYA.

4.3.2 Non-Potable Source Strategies

Non-potable source strategies include surface water and alternative water resource enhancement measures, such as recycled water, rainwater and desalination.

4.3.2.1 Surface Water

Surface water in the Keauhou ASYA is extremely limited. The spring sources in the vicinity of the perennial Waiʻaha Stream may continue to provide localized needs but are unlikely to be developed on a larger scale. Surface water thus is not deemed a viable resource to meet anticipated demands.

4.3.2.2 Recycled Water

Recycled water is a valuable resource enhancement measure, and increase in its use may lower the dependence on potable sources. There are five existing wastewater reclamation facilities (WWRF) within the Keauhou ASYA; there are also two wastewater treatment plant facilities (WWTP) operated by the Department of Environmental Management (DEM) with the potential to provide recycled water. These facilities are shown of Figure 4-3.

DEM is undertaking a regional effort to upgrade the existing Kealakehe WWTP to produce R-1 recycled water for irrigation/non-potable uses. DEM anticipates an initial capacity to produce 1.0 MGD of R-1. Phase 1 of the upgrade is anticipated to include irrigation of the buffer parcel surrounding the WWTP and a joint effort between DEM, QLT and the County to construct a

recycled water distribution line from the WWTP to the Makaeʻo Park which could replace the existing irrigation demand from the HDWS system. Future phases may include the installation of recycled water distribution lines to serve Honokōhau Small Boat Harbor and Kohanaiki Golf & Ocean Club, and potential future development areas such as a regional park, QLT, and an industrial area. HDWS provided a 1.0 MG reservoir near the WWTP that could be utilized for recycled water storage. DEM is participating in the Queen Kaʻahumanu Highway Widening project with the installation of a 20" and 14" recycled transmission waterline, shown on Figure 4-1, which may supply recycled water to areas served in future phases.

The Kaloko Housing WWTP is a package treatment plant serving an affordable housing community on Hina Lani Street owned by the Office of Housing and Community Development (OHCD) but currently operated by DEM. The facility was originally intended to provide R-2 recycled water to irrigate the grounds; however, the treatment process is unstable, and the effluent is currently discharged into injection wells. DEM is proposing to replace the WWTP, and if approved, would consider utilizing the R-1 effluent as recycled water.

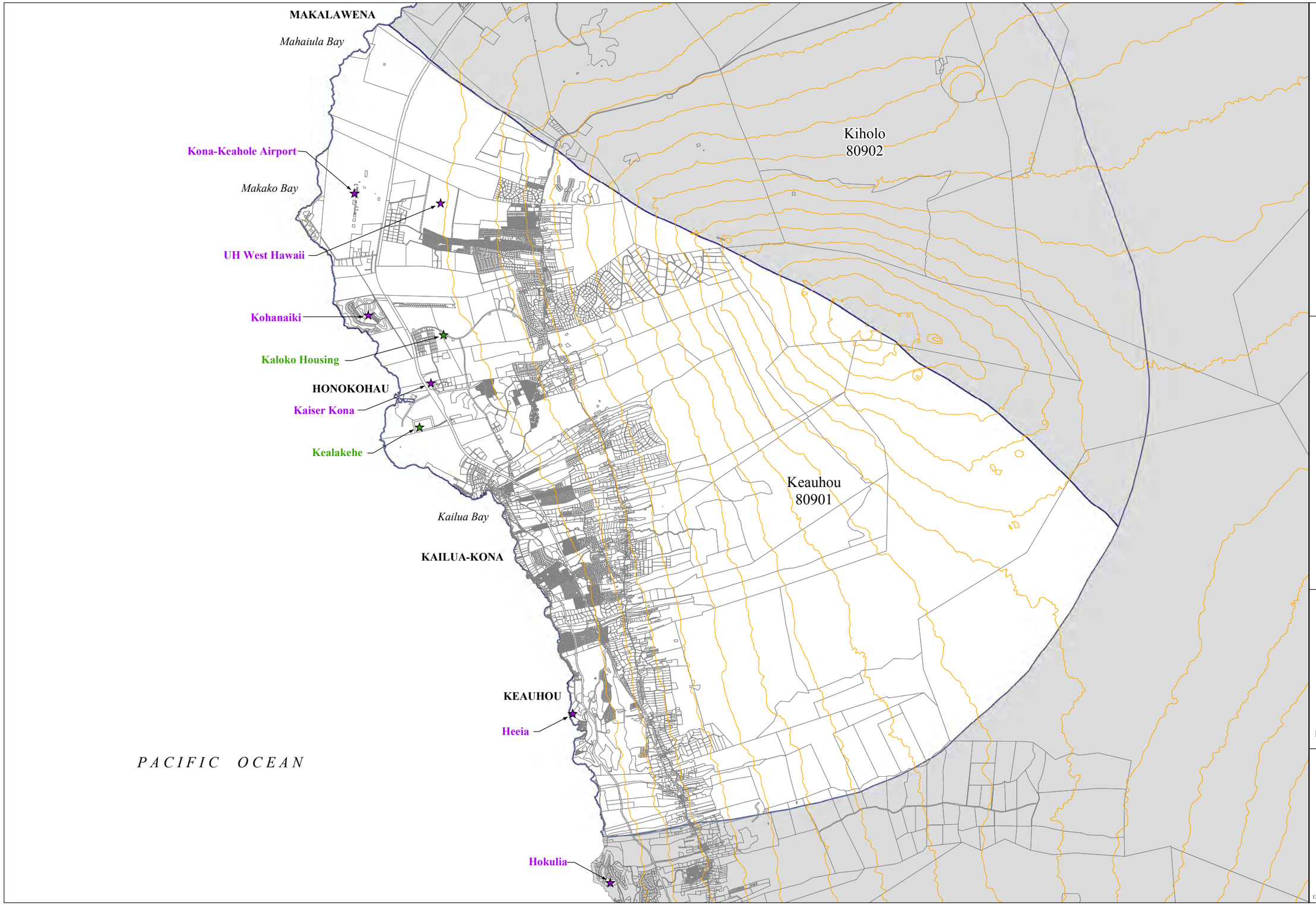
The WWRFs and WWTPs within the Keauhou ASYA and their associated recycled water design capacity or potential capacity, current recycled water use, and potential additional recycled water use, are listed in Table 4-1.

Table 4-1: Potential Recycled Water Use

Wastewater Facility	Type	Recycled Water Classification	Design Capacity (MGD)	Current Reuse Amount (MGD)	Potential Additional Reuse Amount (MGD)
Keahole-Kona Airport	WWRF	R-1	0.125	0.043	0.082
Kaiser Kona	WWRF	R-3	0.004	0.001	0.003
Heʻeia	WWRF	R-2	1.800	0.342	1.458
Kohanaiki	WWRF	R-1	0.070	0.000	0.070
Hokulia	WWRF	R-3	0.004	0	0.004
UH West Hawaiʻi	WWRF	R-3	0.008	0	0.008
Kealakehe	WWTP	R-1	1.000	0	1.000
Kaloko Housing	WWTP	R-1	0.014[1]	0	0.014

Sources: Department of Health, Wastewater Branch; County of Hawaiʻi, Department of Environmental Management, Wastewater Branch
[1]Assumed, based on current wastewater generation rate

The potential additional recycled water use quantities indicated in Table 4-1 represent the maximum amount of recycled water available considering only the difference between the design capacity of the facility and the existing usage. The actual additional recycled water use will be dependent on several factors, including the amount of wastewater generated, which may be significantly less than the design capacity, demand for recycled water and the number of viable users within close proximity of the facility.



Hawaii County
Department of Water Supply

DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

Job No. 2014-0802

LEGEND:

- 500 ft contours
- TMK
- Wastewater Treatment Plant (WWTP)
- Wastewater Reclamation Facility (WWRF)

1 0.5 0 1
Miles

INDEX MAP - Island of Hawaii

FIGURE 4.3

AQUIFER SECTOR HUALALAI - 809

Aquifer Systems
Keauhou - 80901

Wastewater Facilities

FUKUNAGA & ASSOCIATES, INC.
Consulting Engineers
1357 Kapiolani Boulevard, Ste. 1530, Honolulu, Hawaii 96814

4.3.2.3 Rainwater

Rainwater can be considered as a water resource enhancement measure in two ways. It can be harvested in rainwater catchment systems which can be utilized to supply domestic potable water needs, and it can supplement or satisfy agricultural non-potable water needs through ambient rainfall. Typically, annual ambient rainfall of 60 inches is sufficient to support both rainwater catchment and diversified agricultural crops. Within the Keauhou ASYA, the areas that receive greater than 60 inches of rainfall annually are generally limited to the area mauka of Māmalahoa Highway and south of Kaloko Mauka, as shown in Figure 4-4. Of the parcels that represent future anticipated demands, 22 are located in this area; therefore, up to 0.0088 MGD of the future anticipated demands could be supplied by rainwater catchment.

Nearly all of the agricultural area contributing to the agricultural demands associated with the Zoning demand scenario presented in Chapter 3 receives at least 30 inches of rainfall annually, and the majority of the area receives greater than 60 inches of rainfall annually. Typically, agricultural land owners grow what is feasible according to the climate, and irrigation water is only used if readily available. Most of the agricultural area is within the Kona coffee belt. Although optimal annual rainfall for coffee ranges between 60 and 85 inches, some coffee-producing areas receive as little as 30 inches of rainfall annually. It is therefore reasonable to infer that all agricultural water demands can be satisfied by ambient rainfall.

4.3.2.4 Desalination

Desalination is a costly, but viable resource enhancement measure. Generally, desalination plants favor economies of scale, which suggests that a single larger plant would be more cost-effective than several smaller satellite plants; however, small-scale desalination has already been employed in the West Hawai‘i region by private developers. Seawater desalination plants would likely not be cost-effective. The preferable location for brackish well water desalination plants would be at moderate ground elevations to reduce drilling and pumping costs, and outside the influence of potable water wells. Any increased draw on the basal aquifer is not recommended; therefore, desalination plants would need to utilize existing brackish wells. Based on CWRM well pumping records, most of these wells are currently being used for irrigation. Because of the high cost and anticipated availability of other potable water sources, desalination should be considered as one of the last recourses for resource enhancement.

4.3.3 Other Resource Enhancement Measures

4.3.3.1 Water Conservation

Water conservation, including water loss management, may reduce both existing and future water use. As the largest water user in the Keauhou ASYA, HDWS' conservation measures can have a significant effect on water use system-wide.

HDWS' supply-side measures include an active water management program to evaluate unaccounted-for water, including leaks and purge water on well startup; and installation of Variable Frequency Drives for well pumps which would reduce the amount of times that a well

shuts down and therefore reduce the amount of times the well will purge in a day. HDWS' leak detection program employs acoustic leak detection loggers within the water system to continuously monitor for leaks. HDWS is striving to improve this program by deploying additional loggers and replacing defective loggers with new units. Per Act 169, all County-owned public water systems will be required to submit annual water audits to CWRM beginning in 2018. CWRM will also be providing training and technical assistance to public water system operators. These water audits will further strengthen HDWS' water management program.

For demand-side measures, HDWS has entered into an agreement with WaterSmart, a company that uses a software data analytics platform to provide solutions through behavioral water efficiency and customer engagement. Using advanced technology such as messages and reports, customers are educated about how much water their household is using, how it compares to others (i.e., leveraging normative comparisons) and how they can save money. Customers can also be alerted to potential leaks. WaterSmart anticipates measureable outcomes of its program, including a 23% decrease in leak duration, and a 2 to 7% water savings rate. Other demand-side measures include HDWS collaborating with the State Department of Education and County of Hawai'i Department of Parks and Recreation to provide education regarding minimizing irrigation demands. The intent is to promote conservation and efficient water use, which ultimately would result in reduced source water pumping.

Other factors affecting demand-side conservation on, but not limited to, the HDWS system include the recent Uniform Plumbing Code (UPC) amendments specifying maximum allowable flow rates for certain types of plumbing fixtures, which would require the use of low-flow devices. For example, the Energy Policy Act of 1992, which became law in 1994, mandates a maximum flush volume of 1.6 gallons for toilets manufactured and installed after this date, and modern day high efficiency toilets can use even less water. Flush volumes for older toilets can be 3.5, 5, or even up to 7 gallons. The anticipated effect of these amendments would be lower water use unit rates for newer developments compared to historical use rates.

4.4 MEETING ANTICIPATED DEMANDS

Figure 4-5 and Table 4-2 present two potential scenarios to meet the 28.07 MGD anticipated demands by type of water source or resource enhancement measure. The Maximum Other Sources scenario assumes the maximum potential usage of non-potable sources and other resource enhancement measures. The Groundwater Only scenario assumes that the anticipated demands would be met entirely by ground water. These two scenarios therefore represent the minimum and maximum ground water required to supply the anticipated demands. Actual ground water required will likely be somewhere in between the two.

Hawaii County
Department of Water Supply

DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

Job No. 2014-0802

Makalawena

Mahaiula Bay

Makako Bay

Honokohau

Kiholo
80902

Keauhou
80901

Kailua Bay

Kailua-Kona

Keauhou

PACIFIC OCEAN

20"
30"
39"
20"
30"
39"
49"
59"
79"
30"
39"
49"
59"

LEGEND:

- Annual Rainfall
- Hawaiian Home Lands
- Existing Water Service
- Important Agricultural Land (IAL)
- IAL Diversified Ag Supported by Rainfall

Agricultural Zoning:

A-1a+	1 thru 10 acres
A-20a	20 acres
A-35a	35 acres
A-40a	40 acres
A-80a	80 acres
A-200a+	200 thru 255 acres
A-500a	500 acres
A-600a	600 acres
A-900a	900 acres
TMK	

1 0.5 0 1
Miles

INDEX MAP - Island of Hawaii

FIGURE 4-4

AQUIFER SECTOR HUALALAI - 809

Aquifer Systems
Keauhou - 80901

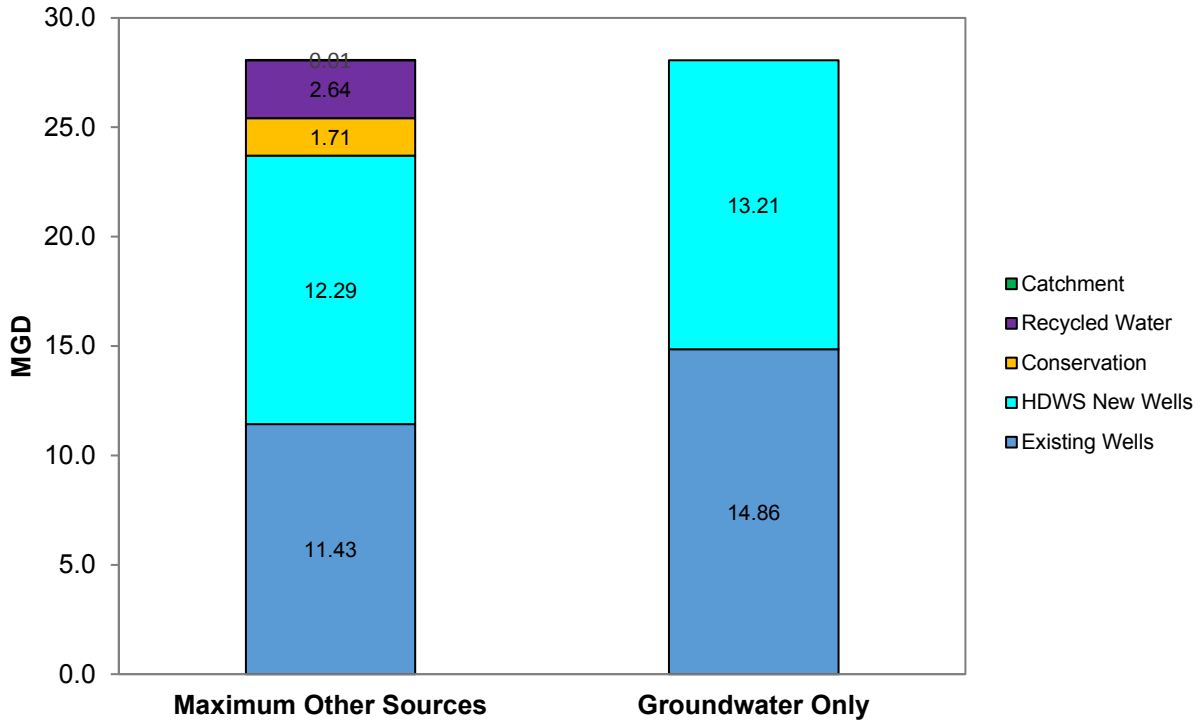
Agricultural Lands Supplied by Ambient Rainfall

FUKUNAGA & ASSOCIATES, INC.
Consulting Engineers
1357 Kapiolani Boulevard, Ste. 1530, Honolulu, Hawaii 96814

Table 4-2: Source Development Scenarios to Meet Anticipated Demands

Source / Resource Enhancement Type	Maximum Other Sources Scenario	Groundwater Only Scenario
Recycled Water	• Maximum potential recycled water usage per Section 4.3.2.2 and Table 4-1, assumed to replace use from existing wells ***2.64 MGD***	• None
Rainwater Catchment	• 22 parcels per Section 4.3.2.3, assumed to replace use from existing wells ***0.01 MGD***	• None
Existing Wells	• Reduced by recycled water usage and rainwater catchment usage, then reduced by 7% conservation of HDWS sources ***14.86 – 2.64 – 0.01 – 11.18 * 7%*** ***= 11.43 MGD***	• From Chapter 3 ***11.18*** *(HDWS)* ***+ 3.79*** *(Other)* ***= 14.86 MGD***
HDWS New Wells (well source development area)	• Reduced by 7% water conservation ***13.21 * 93% = 12.29 MGD***	• ***13.21 MGD***
Water conservation	• Maximum 7% conservation assumed for existing HDWS well sources and maximum 7% conservation for new HDWS well sources per Section 4.3.3.1 ***11.18 * 7% + 13.21 * 7% = 1.71 MGD***	• None

Figure 4-5: Anticipated Demands by Source Type



It should be noted that the potential ground water that could be developed in the well source development area should be more than enough to meet the anticipated demands under both scenarios.

4.5 IMPLEMENTATION PLAN

A plan to implement the resource and facility strategies for the near-term, medium-term and long-term is described below.

4.5.1 Near-Term

The near-term (next 5 years) implementation plan includes HDWS 5-year CIP projects, implementation of the WaterSmart program (water conservation), continued monitoring and reduction of non-revenue water losses, including compliance with CWRM's water audit program through Act 169, and a DEM recycled water project. HDWS 5-year CIP projects discussed in Section 4.2.3 are focused on increasing high-level source capacity with the installation of two production wells in the source development area identified in Figure 4-2, and four transmission main improvement projects to increase the utilization of existing sources. HDWS, through its partnership with WaterSmart, has recently mailed out invitation letters to its customers within the North Kona Water System to participate in the WaterSmart Program through a survey. Participants will have their water consumption analyzed and compared to other users with similar background information and then offered suggestions on how they can conserve and use water efficiently.

The near-term implementation plan also includes installation of the DEM 20" and 14" recycled transmission waterline as part of the Queen Kaʻahumanu Highway Widening project. As discussed in Section 4.3.2.2, this waterline may provide recycled water to future reuse projects upon completion of the Kealakehe WWTP upgrade to produce R-1 recycled water. DEM has executed a contract to begin preliminary design and an Environmental Impact Statement for the WWTP upgrade.

4.5.2 Medium-Term and Long-Term

The medium-term (5-10 years) and long-term (10-20 years) implementation plan includes development of new wells in the source development area identified in Figure 4-2. Specific location of the well sites and magnitude of ground water produced will depend on several factors, such as land ownership, accessibility, and most importantly, cumulative effects on ground water. These effects will be evaluated using monitoring wells. HDWS proposes to seek funding and explore partnerships for monitoring wells. Implementation of new wells will be as needed based on timelines of future development. HDWS may also consider development of wells in the mid-elevation range drawing fresh ground water from a confined aquifer well below sea level, should studies prove this to be a viable option.

The medium-term and long-term implementation plan includes the upgrade of the existing Kealakehe WWTP to produce R-1 recycled water for irrigation/non-potable uses, which will initially provide 1.0 MGD of R-1, although a timetable for completion is not yet available. The plant may be expanded to provide additional R-1 water to future reuse areas, such as Honokōhau Small Boat Harbor and Kohanaiki Golf & Ocean Club, and potential future development areas such as a regional park, QLT, and an industrial area; however, DEM has stated that future expansion will be on an as-needed basis. DEM is also proposing to replace the existing OHDC Kaloko Housing WWTP, and if approved, would consider a treatment system to produce R-1 effluent.

The medium-term and long-term implementation plan also includes the realization of measurable outcomes of the HDWS WaterSmart Program, for example, a 23% decrease in leak duration, and a 2 to 7% water savings rate.

CHAPTER 5 ENVIRONMENTAL AND CULTURAL ISSUES & PUBLIC CONSULTATION

This section explores methods to identify traditional and customary native Hawaiian rights, cultural uses or other public trust purposes related to, affected or impacted by ground water development and to determine how those impacts should be mitigated.

5.1 PRELIMINARY T&C RESEARCH

The County of Hawai‘i Department of Water Supply (HDWS) conducted an initial assessment on cultural and environmental issues pertaining to groundwater use in the Keauhou ASYA. The assessment was an amended condition of approval of the submittal made by HDWS at a Commission on Water Resource Management (CWRM) meeting. The assessment was done using available published information, including Environmental Assessments (EA) and Environmental Impact Statements (EIS). HDWS looked at approximately 200 EAs and EISs filed since 1990, 47 of which were reviewed in greater detail, looking for content related to native Hawaiian traditional and customary (T&C) practices and groundwater withdrawal. Most of the cultural issues that were discussed in these documents dealt with archaeological sites or paths through development sites, and only one report addressed the potential impact of groundwater withdrawal on T&C practices and habitat concerns: the more recent Palani Ranch Well No. 1 project.

The Office of Hawaiian Affairs (OHA) Kipuka database was also examined but did not contain information concerning T&C practices, groundwater uses or other public trust purposes. In later discussions, OHA indicated that the Kipuka database is a partial list of historic sites, but is not comprehensive and has not been updated since around 2005. The database does not include information regarding “sensitive” T&C areas, e.g. burials, traditional gathering places or information related to water use.

Also reviewed as part of the assessment was a report prepared for the National Park Service (NPS) entitled “Response to the Commission on Water Resource Management Request for Information on Traditional and Customary Practices,” dated May 29, 2015. The report provided information on historic, existing and planned practices within the Kaloko-Honokōhau National Historic Park, the use of fresh and brackish water, and the significance of fishponds within the park.

Aside from information provided by the Park report, this preliminary research did not yield sufficient information to adequately determine locations of significant T&C practices within the Keauhou ASYA. Subsequently, another strategy was developed and proposed to determine significant T&C issues and areas, by establishing consultation procedures to review and vet T&C issues related to water source development.

5.2 INITIAL OUTREACH

An initial consultation group of potential participants was developed consisting of native Hawaiian individuals and organizations, government agencies, and families with a long standing history in the Keauhou ASYA. Initially, the desired result of preliminary outreach to this group was to obtain sufficient information to develop a comprehensive geo-spatial database documenting the

significant T&C areas within the Keauhou ASYA. Understanding the difficulty in developing such a database, this initial proposed process included establishing a consultation procedure involving this core T&C consultation group to provide input on water source development and to reach out to practitioners as an additional goal.

The initial outreach yielded the following considerations:

1. The proposed consultation process should not shift the burden of reaching out to practitioners and vetting T&C issues/impacts related to water source development from the applicant to the consultation group.
2. Inclusion of the federal Native Hawaiian Organization (NHO) Notification List in the consultation group as a means to contact practitioners.
3. Obtaining information on the significant T&C areas may be difficult because practitioners may not be willing to share information up front about their practices, especially before specific detail on water source development is presented, as some of these practices are closely held family "secrets"; and because practitioners are unlikely to know the impacts of water source development on their practices.
4. Utilization of a disclosure document to notify the public as part of the process to vet T&C issues rather than placing the responsibility solely on the consultation group to identify and/or notify practitioners.
5. Implementation of a public meeting to inform the public of the HWUDP and to welcome practitioners to participate in future T&C processes, i.e. use the public meeting as a means to expand and develop the consultation group that would be notified of specific water source development projects.

5.3 PRELIMINARY FINDINGS AND PROPOSED T&C PROCESS

Based on feedback from the initial consultation group, indications pointed to the unlikelihood of developing a comprehensive database of the significant T&C areas. Subsequently, in collaboration with CWRM staff, a consultation process was proposed and could be established to evaluate how the impact of specific source development projects on T&C issues may be assessed and how such impacts could be mitigated.

The CWRM staff currently seeks input on and addresses T&C issues in its well construction/pump installation permit application (WCPIPA) process through several steps:

1. Comments it solicits from the Department of Land and Natural Resources (DLNR) State Historic Preservation Division (SHPD) and Office of Conservation and Coastal Lands (OCCL), and from County Special Management Areas (SMA).
2. Other agency and public notification of WCPIPAs is via the CWRM's monthly bulletin posted on its website and directly emailed to over 100 individuals and agencies that includes the Office of Hawaiian Affairs (OHA) and DLNR Aquatic Resources Division (DAR – Kona). Although only required for water use permit applications, the bulletin also includes information for pending well construction and pump installation permit

applications (WCPIPA) and stream diversion works permit (SDWP) applications. The applications are listed in the bulletin for 60 days after the permit is granted.

3. Staff review of OHA's online Kipuka database (http://kipukadatabase.com/kipuka/) and Papakilo (http://www.papakilodatabase.com/main/main.php).
4. Standard conditions in well construction and pump installation permits.
5. Conditions on certificates of completed well construction and pump installation.

At the time of this report, CWRM staff was in the act of developing an additional process with the intent that it would apply to water source development projects involving well construction/pump installation permit application (WCPIPA) requests through the CWRM in Keauhou. Staff proposed that T&C issues could be further vetted through the permitting process by including a more thorough Ka Paʻakai analysis in the WCPIPA. Ka Paʻakai analysis is an analytical framework to be applied when making decisions with potential impacts to T&C as directed by the Supreme Court ruling in the Ka Paʻakai o ka ʻĀina v. Land Use Commission case. The three questions to be answered under Ka Paʻakai include:

1. Identification and scope of "valued cultural, historical, or natural resources" in the impacted area, including the extent to which traditional and customary native Hawaiian rights are exercised in the area;
2. The extent to which those resources, including traditional and customary native Hawaiian rights, will be affected by the proposed actions;
3. The feasible action, if any, to be taken to reasonably protect native Hawaiian rights if they are found to exist.

These questions could be added to the WCPIPAs for the applicant to address and for staff to vet. CWRM staff identified ʻAha Moku as a potential liaison between applicants/landowners for a WCPIPA and practitioners that could be impacted by the specific project during the WCPIPA review process. Act 288, signed into law in 2012, formally recognizes the ʻAha Moku System and establishes the ʻAha Moku Advisory Committee within the Department of Land and Natural Resources (DLNR). ʻAha Moku's function is to serve in an advisory capacity on issues related to land and natural resources management through the ʻAha Moku System, and to integrate the native Hawaiian cultural and traditional values into the fabric of State policy. The ʻAha Moku System includes several tiers from the Individual Ahupuaʻa, which includes traditional practitioners within an ahupuaʻa, to the ʻAha Moku Advisory Committee, which includes a State-wide Committee of traditional practitioners consisting of one representative from each island. Vetting T&C issues using ʻAha Moku as a resource during the permitting process could therefore satisfy the Ka Paʻakai analysis. At the time of this report, CWRM staff had begun discussions with ʻAha Moku, and development of this process was ongoing.

Other steps in the aforementioned process would also need to be developed and vetted, notably the procedures by which T&C issues would be identified, reviewed and adjudicated. The latter is of particular importance, as proper dispute resolution procedures may be critical to the success of the process.

5.4 PUBLIC CONSULTATION

Although this proposed process was to be developed by CWRM staff, and was expected to apply State-wide, the HWUDP for the Keauhou ASYA could serve as a pilot case for its application prior to Hawai‘i Administrative Rule processing. At the time of this report, CWRM staff indicated that this process could also be vetted through the core T&C consultation group and through employment of public meetings within the Keauhou ASYA as part of this pilot case during development of this WUDP. Public meetings could also serve to present and vet the source development strategies, which were discussed in Chapter 4. Feedback from the first public meeting has been addressed herein.

CHAPTER 6 WATERSHED MANAGEMENT STRATEGIES

6.1 OVERVIEW

Watershed management strategies strive to achieve several goals, including providing a sustainable supply of water for sustenance, improving water quality, conserving and restoring native plants, animals and a healthy ecosystem, and protecting native Hawaiian T&C rights and practices. Nearly all of the water for sustenance within the Keauhou ASYA is provided by ground water. Accordingly, this section will focus on watershed management strategies affecting the protection of ground water resources.

6.2 WATERSHED PROTECTION

Sustainability of ground water resources in the Kona area relies on recharge from upland forested areas. Within elevations in the 1,500 to 3,000 foot range, rainfall is the primary contributor to the recharge; above 3,000 feet, fog collecting on vegetation and then dripping to the ground (fog drip) and dew contribute significantly to the recharge. Some of the water that infiltrates into the ground in these areas also contributes to springs and anchialine pools. Ungulates pose a major threat to these upland forested areas by removing and preventing regeneration of native vegetation through grazing and advancing the spread of invasive vegetative species by transporting seeds on their coats. Some non-native invasive vegetative species have the ability to take over native vegetation ecosystems, which can alter soil moisture, nutrient balance, and habitat. Many of these invasive species also contribute significantly less to the recharge and pose a greater fire risk. Wildfires can destroy extensive areas of forest quickly and therefore pose a major threat to recharge.

Over the past century, domestic and feral ungulates have considerably altered native forest communities in the area by devastating native vegetation, which in turn allowed non-native invasive vegetative species, particularly fountain grass, to proliferate. In addition to affecting the ground water recharge, the abundance of fountain grass increased the risk of wildfires due to its dried leaves and fire-adapted nature. Fire, fountain grass, and ungulates pose the most severe threats to the area. Watershed management strategies should focus on removing these threats.

The Three Mountain Alliance (TMA) is a watershed partnership of 10 members encompassing over one million acres on Hawai‘i island consisting of four priority management areas: ‘Ōla‘a-Kīlauea, Ka‘ū-Kapāpala, South Kona, and North Kona. All of the area encompassed is divided amongst 6 owner members. In the Kona area, the major land owner is Kamehameha Schools (KS), and other land owners include the State DLNR, Division of Forestry and Wildlife (DOFAW) and the National Park Service (NPS). In 2007, the TMA prepared a Management Plan that identified management goals, objectives, and operational protocols; and developed strategies for each of its four priority management areas to address the high priority management issues that affect multiple landowners and natural resources across its landscape.

HDWS participates in the TMA and will continue to provide ongoing support for source water quality and quantity enhancement. HDWS is working with the Department of Health to identify priority watershed protection areas that serve as recharge areas for existing municipal (HDWS) sources and/or water systems. Funding for these enhancement measures would need to be

approved by the HDWS Water Board on a project-by-project basis; however HDWS is also looking at alternate sources of funding such as grants and fees.

6.3 WELLHEAD PROTECTION

The State Department of Health, Safe Drinking Water Branch (SDWB) has set aside 15% of its allotted funding for the Drinking Water State Revolving Fund (DWSRF) to be utilized for its Wellhead Protection – Financial Assistance Program. The projected available funds for each fiscal year is $500,000. The goal of the program is to support water utilities to plan and implement drinking water source protection actions. Eligible recipients include public water systems that use ground water as the source of drinking water, government agencies, and planning agencies/community groups partnered with a public water system on source water protection activities. Eligible projects involve both planning and implementation and cover a wide range of activities including planning documents, strategies, inventories, management, education, staffing and remediation.

HDWS has participated in the SDWB Wellhead Protection program with projects primarily focused on public education.

CHAPTER 7 SUMMARY AND RECOMMENDATIONS

The Hawai‘i Water Use and Development Plan Update for Keauhou Aquifer System Area promotes overall themes common to several other Hawai‘i Water Plan components:

- Public Trust Doctrine – the State holds ownership over public water resources as a trustee for the benefit of the people of the State.
- Water is a most precious resource, shall be used wisely and conserved, not wasted.
- The highest quality water shall be used for the public’s highest beneficial uses.
- Lower quality water (e.g. recycled water, surface water, brackish water) should be used whenever feasible.

Specific recommendations for the Keauhou ASYA are as follows:

1. Development of new ground water well sources is encouraged in areas within the high-level aquifer generally from the vicinity of the HDWS Queen Lili‘uokalani Trust Deepwell extending south into the Kealakekua ASYA.

2. Continue studies of the ground water hydrology in the Keauhou ASYA, particularly the mid-elevation deep water source, which potentially could be a long-term solution.

3. Water purveyors are encouraged to assist in the development of non-potable water resource enhancement measures that do not involve ground water, such as recycled water, to satisfy non-potable demands. This may reduce reliance on ground water sources.

4. State and County agencies and private entities with water interests in the Keauhou ASYA are encouraged to participate and/or coordinate with the Three Mountain Alliance major landowners (KS, DOFAW and NPS) to assist in the preservation and restoration of watersheds in the Keauhou ASYA which will ultimately protect and potentially augment the ground water resources.

5. State and County agencies are encouraged to develop and implement ground water well protection initiatives and to participate in the SDWB Wellhead Protection Financial Assistance Program.

6. HDWS will continue to work with ‘Aha Moku to ensure that its proposed source development strategies are properly vetted for T&C issues.

CHAPTER 8 REFERENCES

"20-Year Water Master Plan, County of Hawai'i, Department of Water Supply," prepared for County of Hawai'i, Department of Water Supply; by R.W. Beck, Inc., June 2006.

"2013 Update of the Hawai'i Water Reuse Survey and Report," prepared for State of Hawai'i, Department of Land and Natural Resources, Commission on Water Resource Management, by the Limtiaco Consulting Group, July 2013.

"Agricultural Water Use and Development Plan," prepared for State of Hawai'i, Department of Agriculture; by Water Resource Associates, December 2004.

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APPENDIX A

Project Description

TECHNICAL MEMORANDUM
Water Use & Development Plan Update – Keauhou and Waimea Aquifer Systems
Project Description

I. INTRODUCTION

The primary objective of the Water Use and Development Plan (WUDP) is to set forth the allocation of water to land use. As required by the Hawai`i Administrative Rules (HAR) Title 13, Chapter 170, *Hawai`i Water Plan*, each of the four counties is responsible to prepare a WUDP to include, but not be limited to the following:

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

The County of Hawai`i adopted by ordinance the current Water Use and Development Plan Update dated August 2010 (2010 HWUDP), and the Commission on Water Resource Management (CWRM) granted approval in December 2011. The 2010 HWUDP update implemented a broad, uniform approach island-wide to conservatively evaluate the County's land use policies set forth in the County General Plan and Zoning Code. The General Plan is the long-range conceptual land use plan for the island of Hawai`i; whereas the Zoning Code is the legal instrument that regulates land development, and implements the General Plan policies. The intent of the 2010 HWUDP was to guide the County in prioritization and focus of future assessment efforts.

The 2010 HWUDP identified 2 aquifer sectors to be considered for further evaluation and detailed assessment. Prioritization of the aquifer areas identified resulted in the selection of the West Mauna Kea ASEA [803]/Waimea ASYA [80301] and the Keauhou ASYA [80901] for this update.

Fukunaga & Associates, Inc.
Consulting Engineers

II. OBJECTIVE

The objective of this update is to provide a more detailed evaluation of the Keauhou Aquifer System and Waimea Aquifer System, and refine demand projections based on the best, currently available information. The update also intends to provide conceptual source development and infrastructure improvement plans to serve projected growth scenarios, generally associated with the County's community development plans.

III. PROPOSED TECHNICAL APPROACH

The update of the HWUDP for the Keauhou ASYA and Waimea ASYA will proceed in two phases. The first phase will include the refinement of the 2010 HWUDP demand projections and calculation of authorized planned use. The second phase will involve the development of source development strategies and scenarios. The County of Hawai`i proposes to implement the following technical approach.

A. Phase 1 – Demand Projections and Authorized Planned Use

The detailed evaluation will involve identification of existing developed parcels and assessment of their respective average water use, compilation and estimation of authorized planned use, evaluation of updated planning information such as the Community Development Plans, and assessment of future water use (projections).

1. Existing Use/Pumpage

All well owners, municipal and private, are required to report water use to the CWRM; and the CWRM is responsible to maintain a database. The CWRM database is the best available information and will be used to determine existing use or the current ground water well pumpage. Ground water use will be assessed based on the 12-month moving average (12-MAV), as required by CWRM to address seasonal fluctuations.

2. Planning Unit Rates for Water Demand

The planning unit rates that were used in the 2010 HWUDP are listed in **Table 1**. These rates are planning level rates used for design of water systems, including pumping, storage and distribution facilities, and should be considered conservative since they are established to properly design water systems for service reliability. These rates will be verified with recorded water meter data for a comparison with actual consumption unit rates. Preliminary analysis of meter data indicates that the Single Family long-term Average Daily Demand (ADD) water use is closer to 400 gals/unit instead of the 1,000 gals/unit previously used in the 2010 HWUDP, and

400 gals/unit is also the value used by DWS for water system design and water connection permits.

Table 1 – 2010 HWUDP Unit Rates

Zoning Designation	Average Daily Demand (ADD)
RESIDENTIAL:	
Single Family	1,000 gals/unit
Duplex	400 gals/unit
Multi-Family Low Rise	400 gals/unit
Multi-Family High Rise	400 gals/unit
COMMERCIAL:	
Commercial Only	3000 gals/acre
RESORT:	400 gals/unit or 17,000 gal/acre*
LIGHT INDUSTRY:	4000 gals/acre
SCHOOLS, PARKS:	4000 gals/acre or 60 gals/student
AGRICULTURE:	3400 gals/acre**

* Resort ADD of 17,000 gal/acre based on ADD for Maui.
** Agriculture ADD based on AWUDP.

3. Existing and Potential Non-Potable Uses

Existing information on non-potable water uses will be compiled from DWS and CWRM records for municipal and private well sources. More detailed information is available for DWS metered services, including those serving agricultural users and separate irrigation meters. These data will be analyzed to verify the validity of planning unit rates that are currently being used for demand projections, and examine potential opportunities to convert existing non-potable uses (currently using potable water sources) to non-potable sources.

4. Agricultural Water Use Projections

Agricultural water use demand projections will be estimated for agricultural areas not accounted for by authorized planned use. These projections will follow the methodology presented in the 2010 HWUDP as no further information has become available since that time. The 2010 HWUDP agricultural demands are based on the Important Agricultural Land area (as identified in the 2005 General Plan) multiplied by the agricultural use unit rate of 3,400 gallons per acre per day. This unit rate was developed by the Agricultural Water Use and Development Plan (AWUDP) and is the best available information. As stated in the 2010 HWUDP, this methodology was met with strong objection at public meetings during the 2010 HWUDP public information process. Public input suggested that

the need for irrigation water was not predicated on the classification of agricultural lands, and that users would grow what is feasible according to the climate. Projecting agricultural water use is the objective of the AWUDP, which is a major effort. Therefore, agricultural water use projections presented in this update will be the worst case scenario for lack of better information and on an interim basis, until the next phase of the AWUDP is completed.

In addition, based on initial review of the Kona CDP and discussions with the State Department of Agriculture, no intensive agricultural developments (requiring extensive irrigation) are proposed in the Keauhou study area. The requirements for proposed agricultural development in Waimea will be coordinated with the State of Hawai`i Department of Agriculture and the ongoing Agricultural Water Use and Development Plan.

5. Authorized Planned Use

Authorized planned use is defined by the State Water Code (Hawai`i Revised Statutes Chapter 174C) as "the use or projected use of water by a development that has received the proper state land use designation and county development plan/community plan approvals." The State Land Use classification has no guidelines to identify the level of development densities within the various districts, and therefore cannot be used for water demand projections.

Authorized planned use is 1 of 8 ground water criteria considered by the CWRM for designation of an area for ground water use regulation. If authorized planned use may cause the maximum rate of withdrawal from a ground water source to reach 90% of the sustainable yield, CWRM may consider designation of the area as a ground water management area.

a. Existing Use and Entitlements

Calculation of existing water use and water entitlements in the Keauhou ASYA and Waimea ASYA will include demands associated with developments that have received or are in the process of obtaining the proper State and County approvals. Existing water use and water entitlements include the following:

- Existing Use/Current 12-MAV pumpage
- Vacant service laterals (service lateral installation charge paid)
- Approved building permits on parcels in proximity to existing distribution system

- Developer agreements
- Private well demands not reported to CWRM (estimate will be based on installed pump capacities and assume 16-hour pumping each day)

b. Updated Planning Information

The County Planning Department will cooperatively provide their latest updates and refinements of planning information for the study areas. As described in the 2005 General Plan, community development plans (CDP) are intended to be the forum for community input, and will translate the broad General Plan statements to specific actions and more detailed land use refinements as they apply to specific geographical areas. The Kona CDP and the South Kohala CDP were both adopted in 2008.

i. Kona Community Development Plan

The Kona CDP encompasses the judicial districts of North and South Kona, and delineates Urban and Rural areas where future growth should be directed. Most of the future growth should be directed to 10 compact villages identified as transit oriented development (TOD) zones and located within the Keauhou ASYA. Development outside of the Kona Urban Area should be directed to existing rural towns and villages. Outside of these Rural areas, protection of the existing agricultural land is a priority.

The Urban Area identified by the Kona CDP encompasses the area spanning from Kona International Airport to Keauhou, makai of Mamalahoa Highway, designated by the General Plan as urban expansion, high density, medium density, low density, resort node, resort area, and industrial area. It excludes the area designated resort node in Kaupulehu (located and served by sources in the Kiholo ASYA; and therefore will not be included in this study) and the medium and low density area in Holualoa. Holualoa is identified as a Rural area, and will be evaluated as such. The Urban Area TODs are listed below:

1) University Village (Regional Center)
2) Kalaoa Village (Neighborhood)
3) Kaloko Makai Village (Neighborhood)
4) Honokohau Village (Regional Center)
5) Keahuolu Village (Neighborhood)
6) Makaeo Village (Regional Center)
7) Kailua Village Redevelopment (Regional Center)

8) Puaa-Waiaha Village (Neighborhood)
9) Kahului-Puapuaa Village (Neighborhood)
10) Kahaluu Makai Village (Neighborhood)

The *Kona CDP Financing Plan for Public Facilities and Backbone Infrastructure*, dated January 2011 was prepared to evaluate the financial feasibility of the new development proposed in the Kona CDP. The financing plan provides an estimate of the number of dwelling units and commercial/industrial area proposed by the Kona CDP. This estimate will be used to project water demand associated with the Kona CDP.

ii. South Kohala Community Development Plan

The South Kohala CDP separates the district into four specific communities and outlines separate community plans for each as follows:

- Waimea Town Plan
- Waikoloa Village Plan
- Kawaihae Community Plan
- Puako Community Plan

Waimea Town is served by the County Waimea Water System, which is supplied by wells located in the adjacent Kohala ASEA to the north. Therefore, Waimea Town will not be included in the assessment of the Waimea ASYA. The remaining plans for Waikoloa, Kawaihae and Puako have varying degrees of detail on future development. These community plans and additional development master plans that are made available will be used to refine the general plan water demand projections.

iii. State Water Projects Plan Updates

The State Water Projects Plan (SWPP) is currently being updated by the State of Hawai`i, Department of Land & Natural Resources (DLNR), Engineering Division. A partial update of the SWPP, currently in the Prefinal Draft stage, covers projects for the Department of Hawaiian Homelands (DHHL). DLNR also is preparing a separate SWPP for the West Hawai`i region, focusing on projected State agency demands proposed in the area. These State agency demands will be incorporated into the projected demands for the study areas as they are made available. In particular, DHHL water needs will be explicitly addressed in accordance with regulatory and constitutional requirements.

6. Traditional and Customary Native Hawaiian Water Uses

The County will begin assessing traditional and customary native Hawaiian issues using available published information, such as Environmental Assessments and Environmental Impact Statements. Preliminary findings will be reported to the CWRM by May 30, 2015. In addition, the County proposes to begin work with the community and other stakeholders to identify known cultural and native Hawaiian uses of water in the study areas. Quantifying the amount of surface or groundwater necessary for these uses is expected to be difficult. The information gathered will be shared with the CWRM with the hope that sustainable yields for aquifers or minimum instream use values for surface waters can be adjusted to take into account these valuable needs.

B. **Phase 2 – Source Development Strategies and Scenarios**

Water is a precious resource held in trust by the State for the benefit of the citizens of the State, and is a high priority in land use policy formulation and decisions. There are several stages and approvals required for water resource development to support land development; and each stage potentially could require substantial capital investment and potentially could stop the process. Most of the major well drilling and pumping approvals are under the jurisdiction of CWRM as part of its function to protect the State's water resources. CWRM manages both municipal (County) and private wells, potable and non-potable sources. County and privately operated potable (public) water systems also must comply with the Department of Health Safe Drinking Water regulations that require system reliability, including backup capability and water quality monitoring. The following is a list of typical stages for drilling and developing a groundwater well source.

- Acquisition of potential well site
- Well drilling permit from the CWRM
- Successful well exploration
- Pump installation permit from the CWRM
- Outfitting of well with pump, piping, valves and controls
- Infrastructure or agreement with existing water system owner to store, transmit and distribute water to demand location.

Please note that this list does not include land use approvals (State Land Use Commission, Zoning, Special Management Area Permit, environmental clearances, etc.) or other utility development that may be required (access, power, etc.).

An implementation plan for the WUDP Update – Keauhou and Waimea Aquifer Systems will be developed to provide guidance for further integration of water resource management with the development of land use policies to ensure sustainable management of this vital resource. Data gaps will be identified and recommendations will be developed to further improve the County's land and water resource planning coordination.

Development timetables are difficult to predict since development projects are often market and economically driven. Therefore, the update will provide conceptual options for source development and infrastructure improvements linked to possible land development scenarios. More detailed strategies for DWS near-term needs are available through the 5-year Capital Improvement Plan (CIP), which DWS updates/approves annually. This list includes anticipated projects that are most likely to be executed during the 5-year period.

1. Source Development Strategies

The WRPP will continue to be the guiding document to establish the availability of water resources. However, whenever more current information is available, the latest data will be used to guide the strategies for source development. In line with the WUDP's guiding principles, the highest quality water shall be used for the communities' highest beneficial uses. Generally, potable groundwater will be reserved primarily for domestic uses and human consumption.

For the Keauhou ASYA, the DWS sources in the basal aquifer historically have experienced rising chloride levels with pumping. The DWS has actively been moving to reduce its dependence on the basal sources by developing high level sources and related major infrastructure such as storage and transmission in the region. The high level sources have shown to be of high quality, and thus more suitable for domestic uses and human consumption. The DWS proposed to expand its development of high level sources and interconnecting its transmission/distribution system to increase system capacity and reliability.

2. Conservation

Water is a most precious resource and shall be used wisely and shall be conserved and waste shall be minimized. The County has implemented an aggressive leak and loss detection program and will continue its efforts to prevent the waste of water. Public education programs will continue to be promoted so that the community will consistently act to achieve this goal.

3. Reuse Water

Treated wastewater, or reuse water is a resource that warrants further consideration for non-domestic needs. The County currently proposes to initiate the development of a larger scale reuse water system at the Kealakehe Wastewater Treatment Plant. More information on the proposed system will be provided as details on the system improvements and timetable are available.

4. Traditional and Customary Hawaiian Rights

Source development strategies will consider traditional and customary Hawaiian rights. Impacts to traditional and customary Hawaiian rights are often times difficult to predict, but strategies to mitigate impacts and alternative strategies will be identified.

IV. UPDATING AND ADOPTION PROCESS

This Project Description initiates the process to update the WUDP focusing on the Keauhou and Waimea Aquifer Systems for the County of Hawai`i, and notifies the CWRM of the County's intent and proposed technical approach. In accordance with the February 19, 2015 Notice of Action, a draft of the Phase 1 update will be submitted to CWRM by May 15, 2015. Additional information on the project description approach and schedule for Phase 2 will be submitted to CWRM by May 30, 2015 and will be considered an addendum to this Project Description.

A series of public informational meetings are proposed in Phase 2 with the community stakeholders, including the Kona Water Roundtable and reviving the Waimea Water Roundtable group. Two rounds of meetings will be held, one after the initial findings are compiled and the second to present the prefinal draft update. Public input will be incorporated when applicable into the Phase 2 draft documents.

The Phase 1 and Phase 2 draft plans will be presented to the County and the CWRM for review and comments. The plans will be revised to incorporate comments and submitted to CWRM for approval and adoption.