COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII

IN RE:	)	HA - WMA 2013-1
	)	
UNITED STATES NATIONAL PARK	)	PRELIMINARY FINDINGS OF FACT
SERVICE PETITION TO DESIGNATE	)	
THE KEAUHOU AQUIFER SYSTEM,	)	
KONA, HAWAII AS A GROUND-WATER	)	
MANAGEMENT AREA	)	

PETITION TO DESIGNATE
KEAUHOU AQUIFER SYSTEM AREA, KONA, HAWAII
(STATE AQUIFER CODE 80901)
AS A GROUND-WATER MANAGEMENT AREA

PRELIMINARY FINDINGS OF FACT

DECEMBER 10, 2014

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXHIBITS

PRELIMINARY

I. INTRODUCTION

On September 13, 2013, the United States National Park Service ("NPS") (Tammy A. Duchesne, Superintendent, Kaloko-Honokohau National Park) submitted a petition to the Commission on Water Resource Management ("Commission") to designate the Keauhou Aquifer System Area, Kona, Island of Hawaii as ground water management area under the Hawaii Water Code ("Water Code"), Hawaii Revised Statutes ("Haw. Rev. Stat.") chapter 174C, Part IV Regulation of Water Use.

Pursuant to Haw. Rev. Stat §174C-41(b), the Commission's Chairperson must either 1) make a recommendation to the Commission for or against the continuance of the process for designation within 60 days after receipt of the petition, or 2) recommend "such additional time as may be reasonably necessary to determine that there is factual data to warrant the proposed designation."

On October 16, 2013, the Commission voted to extend the time period from November 20, 2013 to December 31, 2014 in order to undertake further "scientific investigations and study" that would provide a better factual basis on which to decide whether to continue the process for designation.

Immediately thereafter, the Commission's staff began to monitor the progress of technical studies and other information, including articles and individual testimony. Commission staff attended public forums, received technical information on the scientific and other issues, and sought technical information on the subject.

On September 17, 2014 and October 9, 2014 the Commission made site visits and held informational meetings in Kona to become familiar with the conditions in Keauhou and to receive information from experts, government officials, and individuals with special knowledge of the area.

On November 19, 2014, the Commission received additional information from the Hawaii County Planning Department and Hawaii Department of Water Supply ("HDWS") regarding projected water demand, "authorized planned uses" of water, County-approved projects, and planned land use developments.

These Preliminary Findings of Fact ("FOF") have been prepared for the Commission in its consideration whether to proceed to the next step in the process to designate the Keauhou Aquifer System Area, Kona, Hawaii as a ground water management area under the Water Code. The FOF are not final and may be further revised.

This Preliminary FOF summarize the Commission staff's investigations and research, written and oral comments by the public at public meetings and through correspondence, existing information on file with the Department of Land and Natural Resources ("DLNR"), information and comments from consultation with the County of Hawaii, government studies, and technical experts.

The Preliminary FOF is a brief summary of a much more complex and technical record. There are new questions, including climate change conditions, the relationship and mixing of high-level and basal ground water, the projected water demand (and "authorized planned use") of different land use scenarios, the state (and the Department of Hawaiian Home Lands) project water requirements, the sequencing, location, and development of infrastructure, and the incorporation of traditional and customary practices.

The Commission on Water Resource Management directed its staff to investigate the Keauhou Aquifer System Area, Kona, Hawaii for possible designation as a ground water management area and prepare Preliminary Findings of Fact pursuant to the requirements of the Hawaii Water Code, Haw. Rev. Stat. chapter 174C, Part IV Regulation of Water Use.

II. STATUTORY FRAMEWORK

The Water Code, Haw. Rev. Stat. §174C-44, provides that in designating an area for ground water use regulation, the Commission shall consider the following:

1. Whether an increase in water use or authorized planned use may cause the maximum rate of withdrawal from the ground-water source to reach ninety percent of the sustainable yield of the proposed water management area;

2. There is an actual or threatened water quality degradation as determined by the department of health;

3. Whether regulation is necessary to preserve the diminishing ground-water supply for future needs, as evidenced by excessively declining ground-water levels;

4. Whether rates, times, spatial patterns, or depths of existing withdrawals of ground water are endangering the stability or optimum development of the ground-water body due to upconing or encroachment of salt water;

5. Whether the chloride contents of existing wells are increasing to levels which materially reduce the value of their existing uses;

6. Whether excessive preventable waste is occurring;

7. Serious disputes respecting the use of ground-water resources are occurring; or

8. Whether water development projects that have received any federal, state, or county approval may result, in the opinion of the Commission, in one of the above conditions.

III. CHRONOLOGY

FROM FILING TO THE PRESENT DATE

On September 13, 2013, NPS files petition with the Commission to designate. Within 60 days the Commission's Chairperson must recommend whether to proceed with or deny the petition, or extend the time in which to make a decision.

From September 14, 2013 to October 16, 2013, the staff requested comments on the petition from the Hawaii County Mayor, County Council, and the Department of Water Supply. The Mayor, County Council, and the Department of Water Supply requested more information regarding the aquifer and the designation process.

On October 16, 2013, the Commission voted to extend the time for scientific investigation and study from November 20, 2013 to December 31, 2014, in order to complete and evaluate four technical studies still in progress.

The Commission's staff began to monitor the progress of technical studies, public records, comments, information, articles, and individual testimony. The Commission staff attended public forums, received public and technical information, and consulted with government and private experts.

On September 17, 2014 and October 9, 2014 the Commission made site visits and held informational meetings in Kona to become familiar with the conditions in Keauhou and to receive comments and information from experts, government officials, and individuals with special knowledge of the area.

On November 19, 2014, the Commission received additional information from the Hawaii County Planning Department and Department of Water Supply regarding projected water demand, "authorized planned uses" of water, County-approved projects, and planned land use developments.

In late 2014, the Commission scheduled a regular meeting for December 10, 2014 in Keauhou, Kona, Hawaii to hear public testimony and decide whether to proceed or extend the process.

FROM PRESENT GOING FORWARD

If the Commission continues the designation process, then the following steps will be scheduled:

(1) A public hearing will be scheduled in Keauhou

(2) Complete staff investigation in cooperation with County and Federal agencies

(3) Consult with Mayor, County Council, and Department of Water Supply

(4) Complete Findings of Fact (following comments from County)

(5) Chairperson makes a recommendation to Commission for or against designation and schedules public meeting in Keauhou for a final decision

IV. KEAUHOU AQUIFER SYSTEM: GROUND WATER ISSUES

The Keauhou Aquifer System Area (State Aquifer Code 80901) is located on the southwest facing flank and along the shore of Hualalai Volcano in North Kona, Island of Hawaii. The aquifer system area includes perched, high-level and basal ground water bodies. In places the high-level water extends seaward, trapped between confining layers of lava that dip many hundreds of feet below sea level. These layers are overlain by both salt and basal water. Except at Kahaluu (in the south) and Huehue Ranch (in the north), only brackish water exists in the basal aquifer. Much of the current and almost all of the future potable water needs in Keauhou will be developed from high-level water tapped by wells located at about 1,200 feet elevation. High-level water has also been found at lower elevations in a deep confined artesian zone overlain by hundreds of feet of saltwater. Development and management of this high-level ground water as a sustainable resource are in the early, exploratory stages.

The Hawaii Department of Water Supply's ("HDWS") primary source of water, the Kahaluu Shaft (8-3557-005), taps the basal aquifer and is subject to saltwater encroachment. Pumping 4 million gallons per day ("mgd") from the shaft has caused the chloride concentration to reach critical levels. Water delivered by the HDWS is reaching its upper limit of acceptability. To reduce reliance on the Kahaluu shaft and to meet current and projected water demands in Kona over the next 20 years, HDWS plans to develop 8 mgd of potable water from existing and new wells in the high-level area from Kalaoa to Kainaliu.

Kaloko-Honokohau National Park ("Park") is located on the Keahole lava delta in the northern part of the Keauhou Aquifer System Area between Kaahumanu Highway and the Pacific Ocean. The County has approved urban development to the north and east of the Park. HDWS proposes to develop wells where some portion of the ground water may naturally flow through the Park. The Park includes the Kaloko and Aimakapa fish ponds and many anchialine ponds, as well as the coastal environment itself. The ponds contain brackish water which varies in salinity depending on many factors. This brackish water is roughly a mixture of two-thirds freshwater to one-third seawater. Some studies by the National Park Service ("NPS") suggest that pumping from HDWS's proposed wells could reduce the amount of freshwater flowing through the Park. This in turn could increase the salinity of the brackish water. Other studies by the NPS suggest that saltier ground water could damage the natural habitat provided by the fishponds, anchialine ponds, and the near-shore ocean for native and endangered species.

NPS petitioned the Commission to designate the Keauhou Aquifer System Area as a ground water management area to bring ground water under greater oversight and control.

V. DESIGNATION BACKGROUND AND NEXT STEPS

The State Water Code process for designation is outlined in Haw. Rev. Sat. §174C-41 to 46. The process and history is summarized in the following sections.

On September 13, 2013 the National Park Service ("NPS") submitted a petition to the Commission requesting designation of the Keauhou Aquifer System Area as ground-water management area. A copy of the petition is attached in Exhibit A. Haw. Rev. Stat. §174C-41(b).

In September 2013, the Commission staff mailed letters to the Mayor, County Council, and the Hawaii Department of Water Supply ("HDWS"), as required by the Code, requesting comments on the petition. See Exhibit C for responses to Commission's request for comments. Haw. Rev. Stat. §174C-41(b).

On October 16, 2013, the Commission voted to extend the time for investigation and study of four matters (including the U.S. Geological Survey ("USGS") high level isotope study) from November 19, 2013 to December 31, 2014. A copy of the staff submittal is attached in Exhibit B. Haw. Rev. Stat. §174C-42.

The extension gave the various county agencies and stakeholders more time to review and offer comments on the petition. In addition, the extension gave the Commission staff time to investigate the hydrologic and biologic conditions and authorized planned use, resulting in the Preliminary FOF. This Preliminary FOF was submitted to the Commissioners and posted on the Commission website on December 9, 2014. County consultation is listed in Exhibit C. Haw. Rev. Stat. §174C-43, 44, and 46

On December 10, 2014, the Commission will hold a public meeting in Keauhou to hear public testimony and consider whether to dismiss the petition, continue the designation process, or continue the scientific investigation and study. Haw. Rev. Stat. §174C-42.

If the decision is made to continue, a public hearing is required and will be scheduled. Notices for the public hearing will be published in the local newspaper. The Commission will hold the public hearing in Kona on the island of Hawaii to receive public testimony concerning designation of the Keauhou Aquifer System Area. Haw. Rev. Stat. §174C-42. If there is new information, the Commission may always initiate a new petition to designate.

After the public hearing and completion of staff investigations, the Commission staff will prepare a revised Findings of Fact. This revised version will be circulated to the Mayor, County Council, HDWS, and the petitioner for comments. This draft will also be posted on the Commission website for public access. Haw. Rev. Stat. §174C-43, 44, and 46.

After further consultation with the Mayor, County Council, and HDWS, the Commission staff will prepare a Findings of Fact and submit it to the Commission for consideration and decision making. Haw. Rev. Stat. §174C-43, 44, and 46.

VI. KEAUHOU AQUIFER SYSTEM AREA

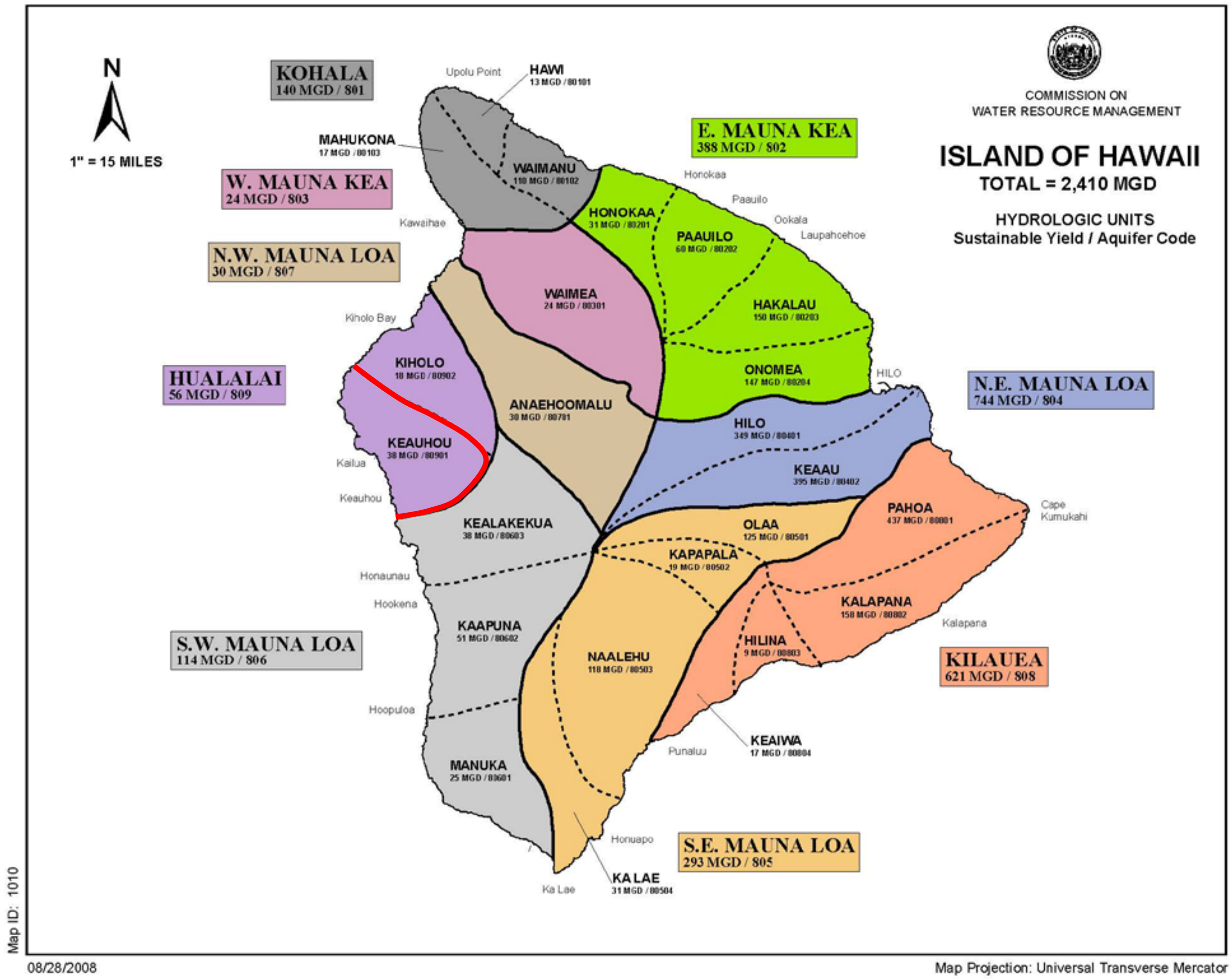
GEOGRAPHIC SCOPE

The Keauhou Aquifer System Area ("KASA") embraces the southwestern slopes of Hualalai Volcano.

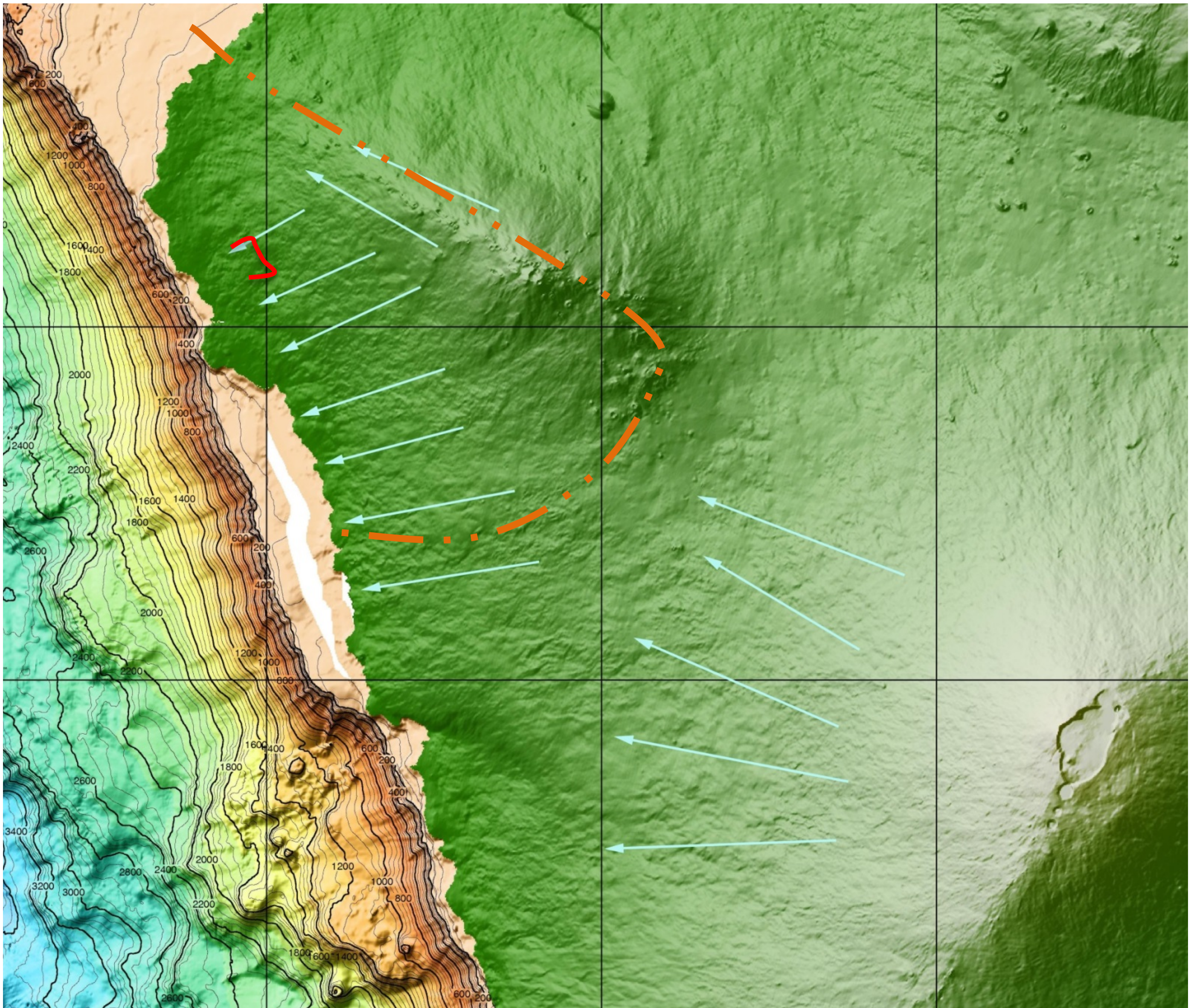
It extends (1) along the coastal stretch from Kawili Point (4.3 miles north of Kona International Airport) south to Pa'ao'ao Point at Kainaliu (4 miles north of Kealakekua Bay), (2) from Kainaliu inland to an elevation of approximately 5,000 feet, and (3) north along Hualalai

Volcano's Southwest Rift Zone to its summit and following along the Northwest Rift zone to the coast at Kawili Point. Except for the low-lying lava delta between Kailua-Kona town and the airport, the slopes of North Kona are steep, ranging from 10 to 20 percent (averaging 15 percent). The steep slopes result from the viscous post-shield building alkali lavas that form the flanks of Hualalai. These viscous and predominantly a'a lava flows cover the more fluid shield building lavas that built the bulk of the volcanic edifice and which occur deep in the subsurface.

The system's boundaries are shown in Figure 1. The Commission follows the boundaries in its State Water Resource Protection Plan ("WRPP") and the County of Hawaii uses the boundaries in its Hawaii County Water Use and Development Plan ("WUDP"). Figure 2 shows the topographic relief of the area and the generalized directions of ground water flow (Thomas 2014, Exhibit D). Figure 3 shows the location of the pumping wells and the average pumping rates in 2014.

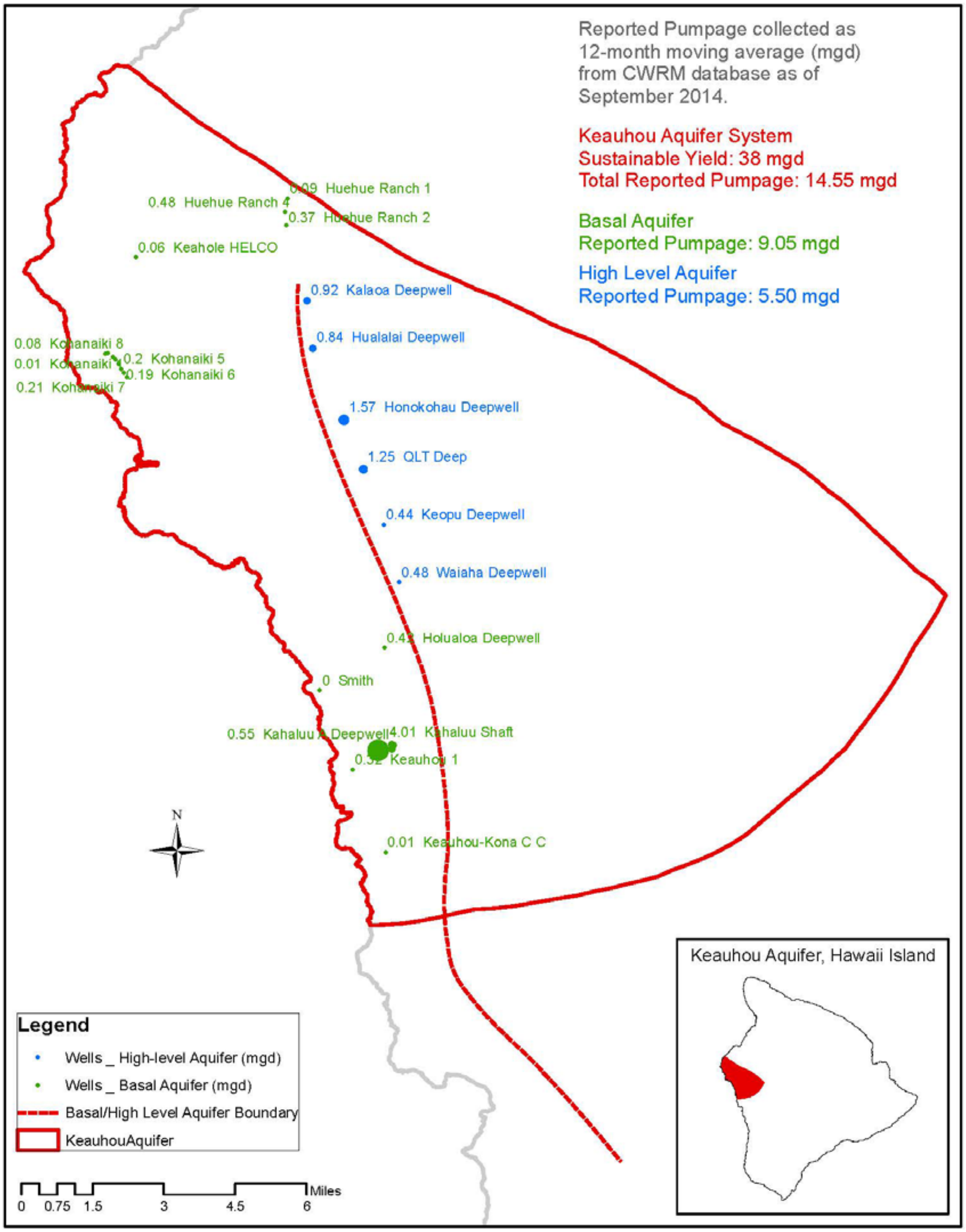


FOF Figure 1. Location of Keauhou Aquifer System Area – Big Island



FOF Figure 2. Map of Keauhou showing topographic relief and generalized directions of generalized ground water flow. (Thomas, 2014)

Reported Pumpage from Keauhou Aquifer System Area



FOF Figure 3. Map showing Keauhou Aquifer System Area with high-level pumping wells and reported pumpage in 2014

VII. GROUND WATER RECHARGE AND SUSTAINABLE YIELD

The current sustainable yield for the Keauhou Aquifer System Area (“KASA”) is based on a 1990 recharge study which estimated that recharge of the KASA as 87 mgd.

The latest and most comprehensive calculation of ground water recharge for the island of Hawaii was produced by the USGS in 2011 (Engott, 2011) which yielded a recharge rate of 152 mgd. Engott’s 2011 calculation of baseline recharge used 2008 land cover and updated rainfall information (1984-2008). Figure 4 shows the rainfall distribution from which ground water recharge is derived. Figure 5 shows the resulting distribution of ground water recharge. The high-level aquifer pumping wells shown in Figure 3 are in the lower part of the rainfall belt where annual rainfall is about 60 inches per year and ground water recharge is about 30 inches per year. Ground water flow through the KASA is the recharge amount of 152 mgd plus several mgd from the slopes Mauna Loa (see Figure 2).

Considering scenarios of future climate change, Engott’s work calculates ground water recharge under current conditions and also for those of the late 21^{st} century. Engott’s Class II scenario where land cover is based on full development of urban parcels in the Land Use Pattern Allocation Guide (“LUPAG”) (County of Hawaii, 2005) with estimated rainfall for late 21st century based on the mean of the six-model ensemble from Timm and others (2009), yielded a rate of recharge to the KASA as 183 mgd. This is about 96 mgd greater than the estimate for current conditions and 30 mgd more than the 2011 estimates. These results reflect simulations of future rainfall based on climate change models. These models predict that drier areas will become drier and wetter areas will become wetter. Evidently, the rain belt on the flanks of Hualalai, (where most ground recharge occurs) falls into the “wetter” category (so the distribution may vary more).

6 A Water-Budget Model and Assessment of Groundwater Recharge for the Island of Hawai'i

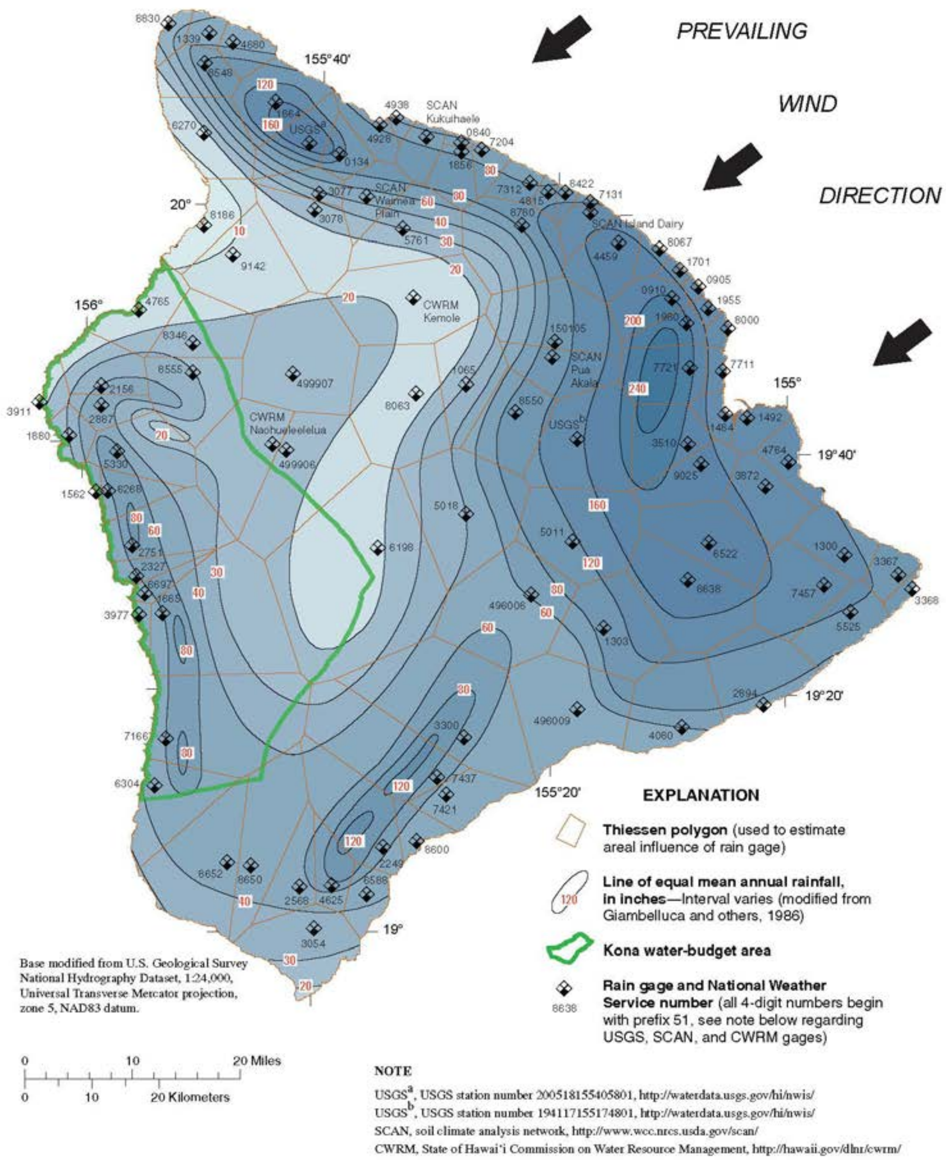


Figure 3. Mean annual rainfall and locations of rain gages used in the water-budget calculation for the Island of Hawai'i.

FOF Figure 4. Map of mean annual rainfall and locations of rain gages on Hawaii Island, from Engott, 2011

Model Randomness 29

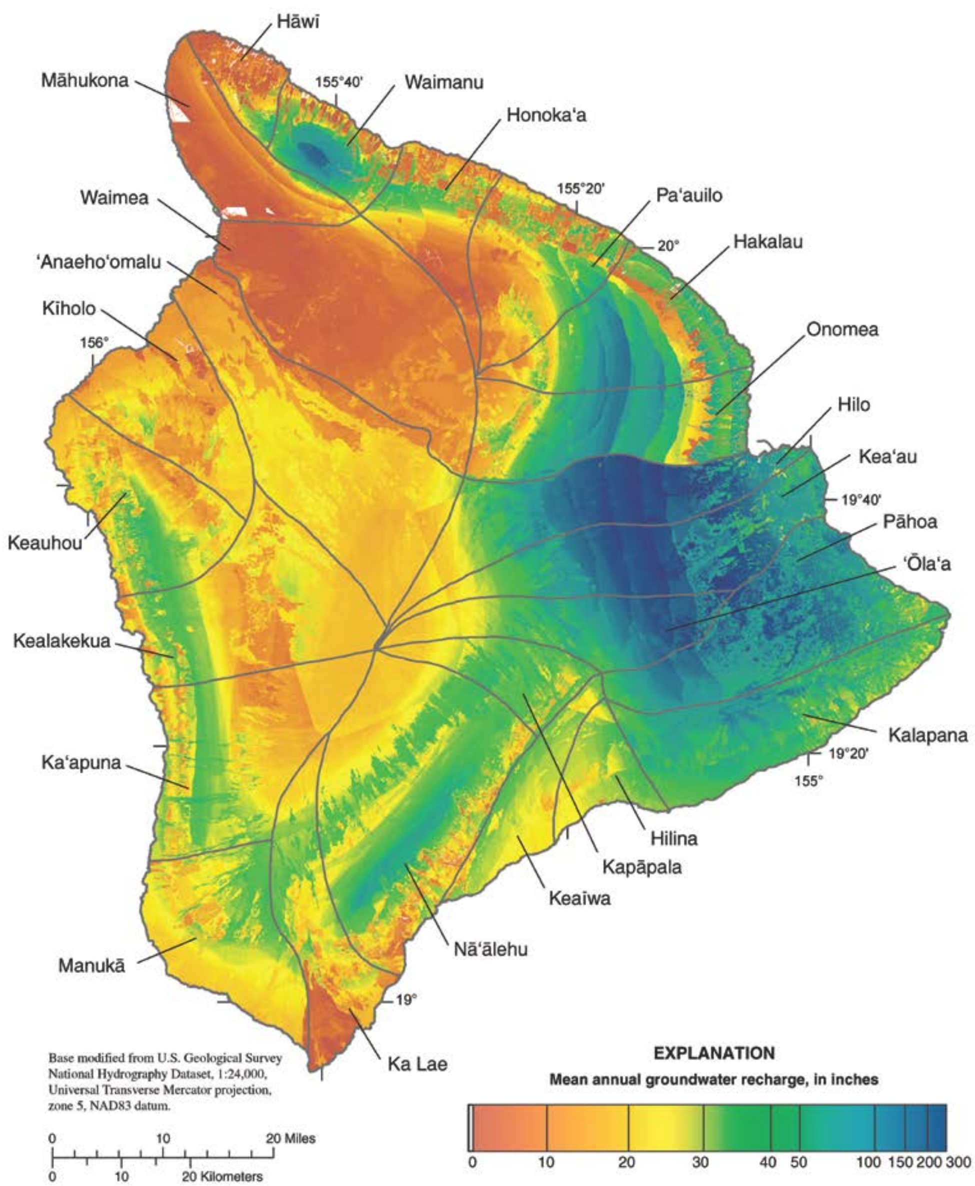


Figure 13. The distribution of mean annual groundwater recharge for baseline conditions on the Island of Hawai'i calculated using the water-budget model. Areas of zero recharge appear as white. Boundaries of named aquifer systems (State of Hawai'i, 2008) are shown in gray.

FOF Figure 5. Map of the distribution of mean annual ground water recharge (Engott, 2011).

VIII. SUSTAINABLE YIELD

These Preliminary FOF address NPS statements that the method of calculating sustainable yields used by the Commission are not appropriate because it does not explicitly consider the amount of water needed for non-consumptive public trust uses, including traditional and customary Native Hawaiian practices and the maintenance of waters in their natural state.

The Water Code, Haw. Rev. Stat. §174C-3 defines sustainable yield.

> "Sustainable yield" means the maximum rate at which water may be withdrawn from a water source without impairing the utility or quality of the water source as determined by the commission.

In determining sustainable yields, the Commission distinguishes between optimal potential development of an aquifer and the man-made limitation on withdrawals imposed by existing infrastructure. Under the Water Resource Protection Plan ("WRPP"), sustainable yields are generally derived through the use of the Robust Analytical Model ("RAM") and address the optimal potential development perspective for planning and managing purposes.

Recharge values are approximations and are intended to be used as a management tool to help guide planning and management. The amount of water that is ultimately and sustainably withdrawn from an aquifer will depend on the actual amount of ground water available. Recharge estimates may be high or low by several tens of percent. Estimates also depend on the economic, topographic, and geologic conditions which either promote or discourage ground water withdrawals, and by the efficiency of the installed infrastructure, as expressed by the number, locations, and productivity of wells as well as the size, age, and locations of water lines, storage tanks, and treatment facilities.

In the 1990 Hawaii Water Plan, the sustainable yield of the Keauhou Aquifer System Area was estimated to be 38 mgd. This is 44 percent of the estimated recharge of 87 mgd. This value of recharge was calculated not to provide the most precise result, but by the most conservative scientific method that overestimates evapotranspiration, and underestimates ground water recharge. Sustainable yields for nearly all of Hawaii's aquifer system areas are calculated by this conservative method and are less than 50 percent of the amount of the most conservative estimate of recharge. Leaving more than 50 percent of the recharge in the ground to follow its natural course acknowledges the inefficiencies of the infrastructure as well as the need to maintain a sustainable balance with the natural environment. It is, by definition, "precautionary."

Using the best available technology, Engott in 2011, calculated that recharge in the Keauhou Aquifer System Area as 152 mgd. This is 1.75 times greater than the value used by the Commission to calculate the sustainable yield of 38 mgd. Based on Engott's more precise calculations, 114 mgd of ground water (75 percent of the recharge) follows its natural course to the ocean.

As described in the Water Resource Protection Plan (2008), the Commission uses a precautionary approach in calculating and applying sustainable yield to manage Hawaii's ground water resource is very cautious. Despite the likely existence of more developable water now and in the future under various climate change scenarios, the Commission staff recommends that the updated 2015 Water Resource Protection Plan keep the sustainable yield in the Keauhou aquifer system at 38 mgd for the following reasons.

First, projected future water demands in the area are about 28.5 mgd so 38 mgd will not be a constraint on planning or development for many years into the future. See section XIV.

Second, development and management of Keauhou's high-level ground water are in early and exploratory stages. The hydrogeology is complex. If well drilling is done poorly, there is a risk that millions of gallons per day of potable water could be wasted. Keeping the sustainable yield at a cautious level will encourage efficiency. Keeping the sustainable yield at 38 mgd will discourage overly-optimistic projections of future growth while allowing for the growth that has been planned. Periodic updates in Commission's Water Resource Protection Plan allow sustainable yields to be adjusted based on experience and changing conditions.

Third, the WRPP (2008) uses the lowest estimated sustainable yield unless there is a robust monitoring program, deep monitoring wells, a numerical ground water model, and other hydrologic studies.

IX. GEOLOGY, GROUND WATER, AND MOVEMENT

Ground water in the Keauhou aquifer system occurs within the flanks of Hualalai volcano and in the Keahole lava delta. In these areas, “recent” lava flowed off the flanks and onto an ancient and submerged coastal plain (Figure 2). The physical structure of these lava accumulations contain and direct the movement of ground water.

The steep slopes of Hualalai volcano result from the viscous post-shield building alkali lavas that form the flanks of Hualalai. These viscous and predominantly a‘a lava flows (up to tens of feet thick) cover the more fluid shield building tholeiitic lavas that built the bulk of the volcanic edifice and which occur deep in the subsurface. No wells document tholeiitic lavas in their well logs. More rare (but very important locally in directing the movement of ground water) are the extremely thick (hundreds of feet thick), massive and viscous post-shield building trachyte lava flows. These are exhibited by the promontory created by the Puu Waa trachyte lava flow. Two wells in the neighboring Kiholo Aquifer System Area encountered trachyte lava flows in the subsurface, overlain by hundreds of feet of alkali a‘a lava flows. A 1993 report for the Hualalai well 8-4258-003 by Glenn Bauer states:

> The Kalaoa well and the Hualalai well both encountered massive trachyte lavas which are presumably dipping west toward the coast. Trachyte has not been found in any other wells south of Hualalai. Both wells have static water levels within the trachyte lava flows, which suggest that the trachyte may act as a restraining member to the seaward flow of ground water, much like the caprock in Honolulu. Though the water-bearing lavas contributing to the wells are below the trachyte flows.

In 2012, rock of similar appearance was encountered deep in the Kamakana well, 3959-001 (3 miles south of the Hualalai well).

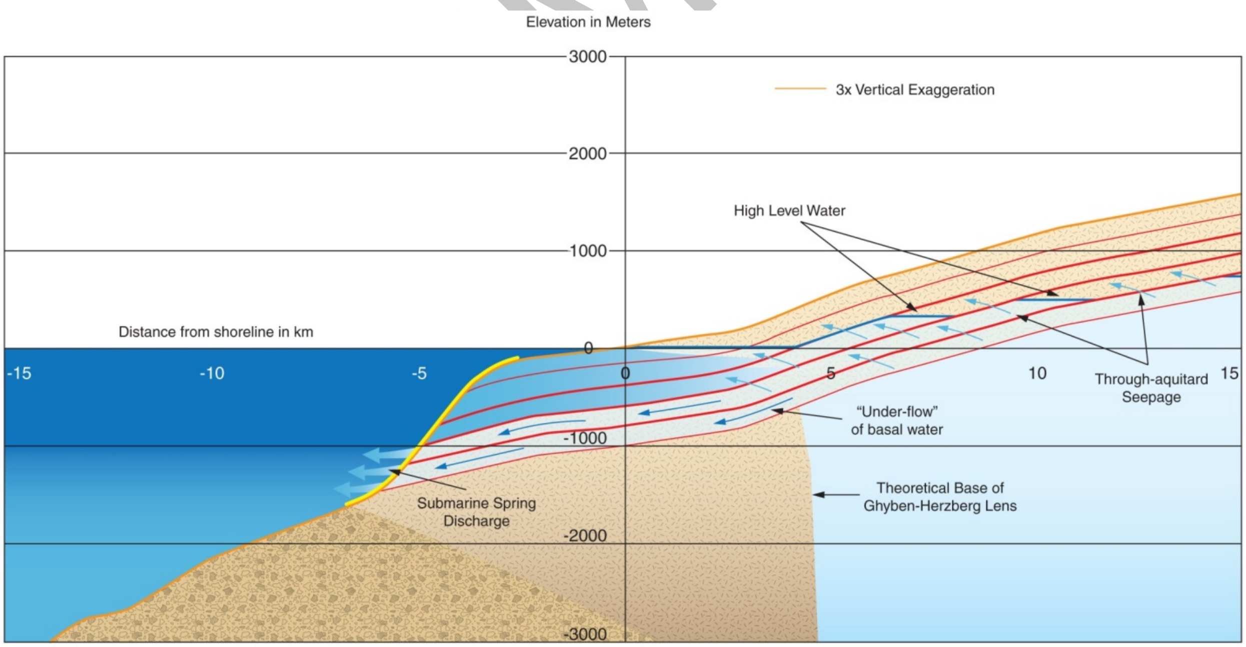
Apparently structural features such as faults and possibly dikes, along with the extreme permeability contrasts in the lavas themselves, create semi-isolated compartments/pockets and layers of ground water within the flanks of Hualalai. These conditions help explain the large variability of ground water levels over short distances, both laterally and vertically, on the flanks of Hualalai.

The Keahole lava delta is composed of recent alkali a‘a lava flows that flowed off the flanks and onto an ancient and submerged coastal plain (Figure 2). As these lavas are highly permeable and the process that formed this lava delta was relatively uniform, water levels and their distribution throughout the lava delta are low and uniform.

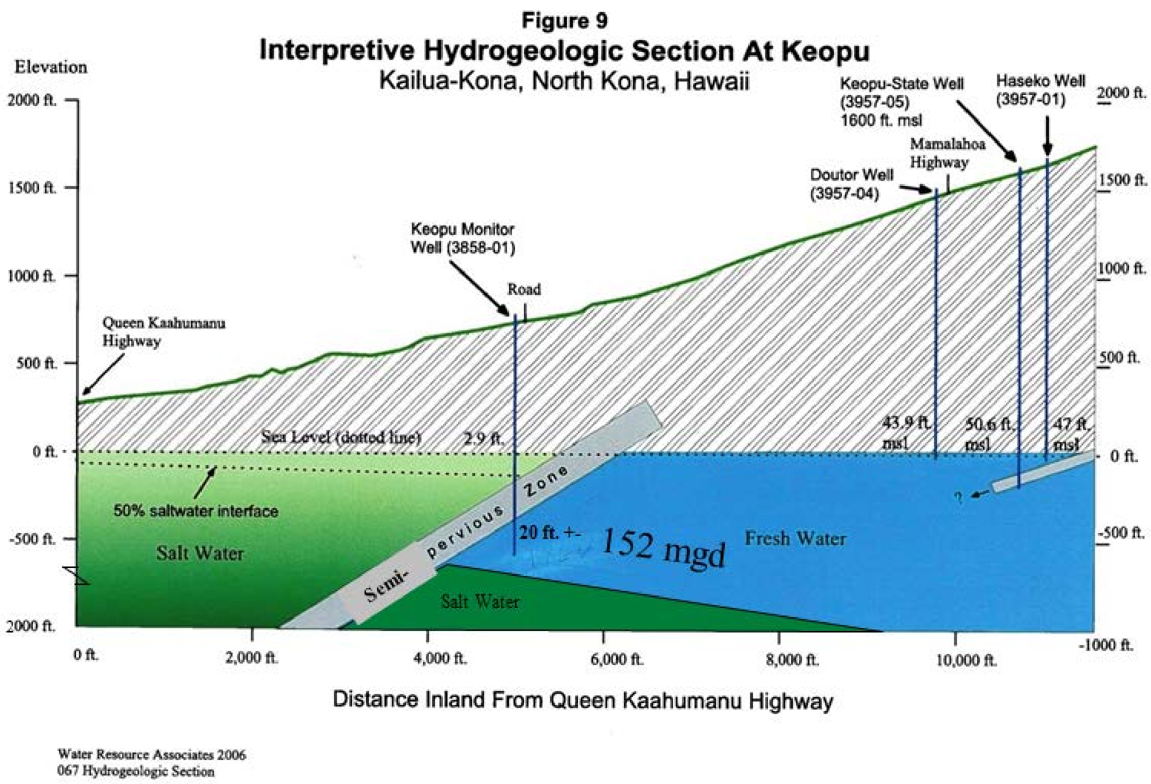
The KASA boundary provides a line from which to manage Keauhou’s water resources, but it does not appear to be a physical boundary that directs the flow of ground water. Based on available water levels and inference of the subsurface structure, the ground water flow lines shown in Figure 2 portray the hydrologic community’s best current picture of the large-scale, generalized flow of ground water through Mauna Kea and Hualalai volcanoes. Figure 2 shows that the adjacent Kealakekua Aquifer System Area contribute recharge to the Keauhou Aquifer.

Above Mamalahoa Highway, along a ground elevation contour of approximately 1,200 to 1,500 feet, is a high-level ground water body where water stands from 40 to 400 feet above sea level and extends downward to depths below sea level of approximately 40 times that height. Perched water, underlain by unsaturated rock, occurs above the saturated levels. Water levels are held to these high levels by the geologic conditions described above. In places the high-level water extends seaward, trapped between confining layers of lava that dip below sea level and which are overlain by many 100's of feet saltwater and a thin layer of brackish basal water. Water in the high-level area moves downhill to the brackish basal water body below the highway as well as into the saltwater that underlies the thin layer of brackish basal water.

The movement of ground water as described above is illustrated in Figure 6, from Thomas 2014, and in Figure 7, modified from Lum 2007. Figure 6 emphasizes the controls that layering in the lava accumulations exerts on the ground water flow paths and Figure 7 emphasizes the control that a structural feature would have on the ground water flow paths. The actual controlling geology is a combination of these. Figure 7 also presents relevant well and water level data.



FOF Figure 6. Interpretive hydrogeologic section in the Keauhou Aquifer System Area, from Thomas 2010.

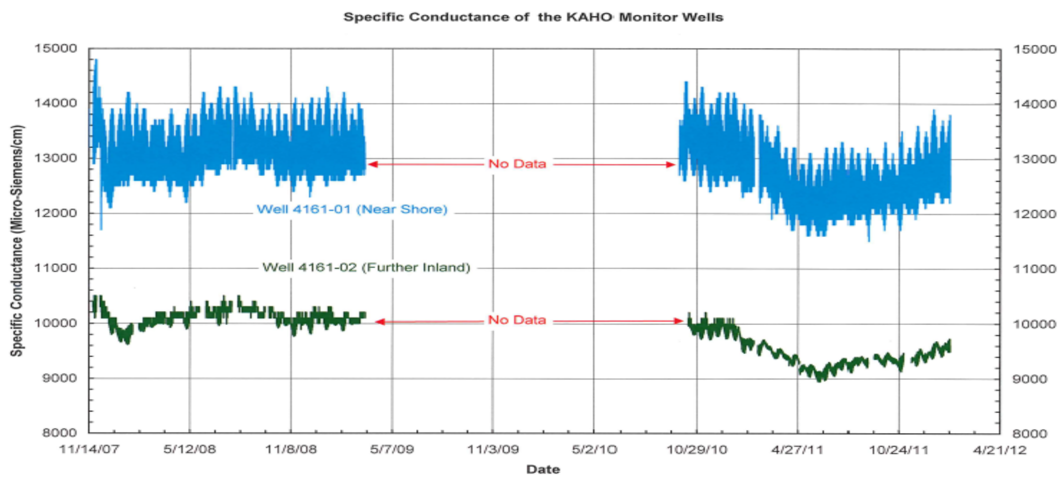


FOF Figure 7. Interpretive hydrogeologic section in the Keauhou Aquifer System Area at Keopu.

Below Mamalahoa Highway brackish basal ground water floats on the underlying saltwater and flows to the shore. It is referred to as "basal" because it floats on the base level (i.e. the ocean). No geologic features hold this water to higher levels than the level required to move the water to the shore. Because the lavas are very permeable, water levels in the brackish basal lens of the Keahole lava delta are between 1 to 3 feet above sea level. At Kahaluu (in the south) and in the Huehue area (in the north), "basal" wells tap the flank of Hualalai volcano rather than the Keahole lava delta. Geologic features resist the flow of ground water in these areas, resulting in higher heads (4 to 10 feet above sea level) and fresher ground water. Last, normal tidal fluctuations have significant influence on the ground water movement and salinities along the coast (Figure 8).

X. CONTRIBUTION OF HIGH-LEVEL WATER TO BRACKISH BASAL WATER

The NPS petition to designate the KASA is based on the concern that pumping water from the high-level water body will deprive the brackish basal water body of freshwater. The concern is that a decreased amount of freshwater in the brackish water lens will lead to an increase in salinity in the Park's ponds and near-shore ocean waters, which in turn would threaten the habitats and life-cycles for birds, opaeula, the orange-backed damsel fly, the coral in the ocean, and other life forms. From 2007 to 2012, the water at Kaloko-Honokohau National Park has freshened. There has been a **decrease, not an increase**, in salinity in the brackish basal lens at Kaloko-Honokohau National Park from 5 to 10 percent (Figure 8). It is difficult to explain the freshening because of the uncertainties and many variables that affect the hydrology of the KASA. Whatever the reason, hydrologic studies performed in the past year, as well as an evaluation of the literature and the judgment of technical experts on hydrology, species biology, and habitat indicate that pumping high-level water will, at most, have a negligible effect on the brackish basal water body at Kaloko-Honokohau National Park and its biota.



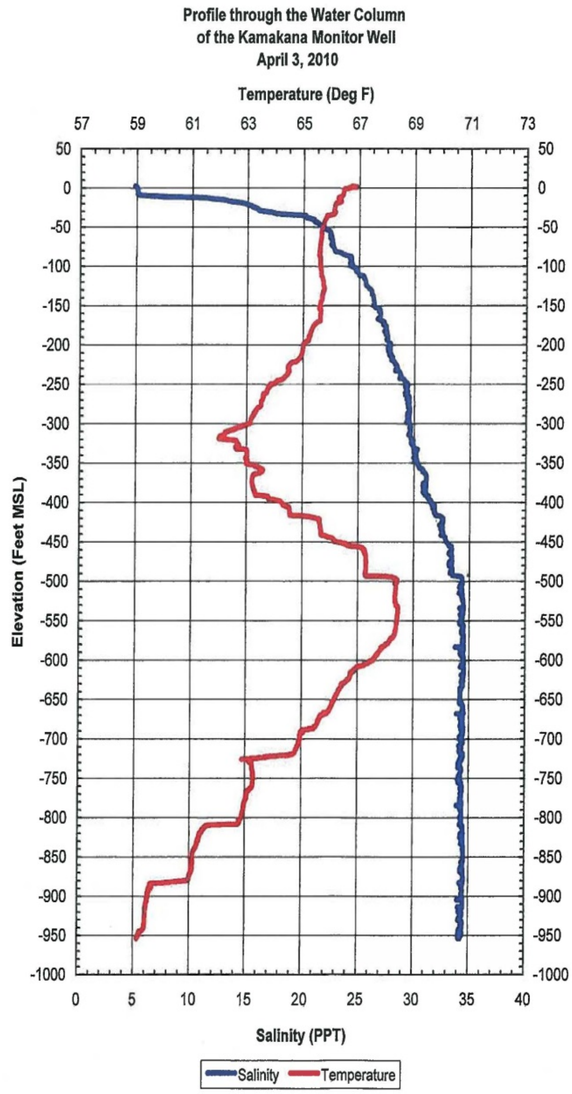
FOF Figure 8. Graph of specific conductance of the brackish lens at NPS monitor wells; 2007-2012 from NPS data file.

Current knowledge indicates that most of the high-level water does not flow to the brackish basal lens. Where most of the water goes is still under investigation, but a reasonable hypothesis is that most of the high-level water flows to depth, into the saltwater that underlies the brackish basal lens. As a consequence, pumping from the high-level water body is likely to reduce the flow of freshwater into deep saltwater more than it will reduce the flow of freshwater into the brackish water lens.

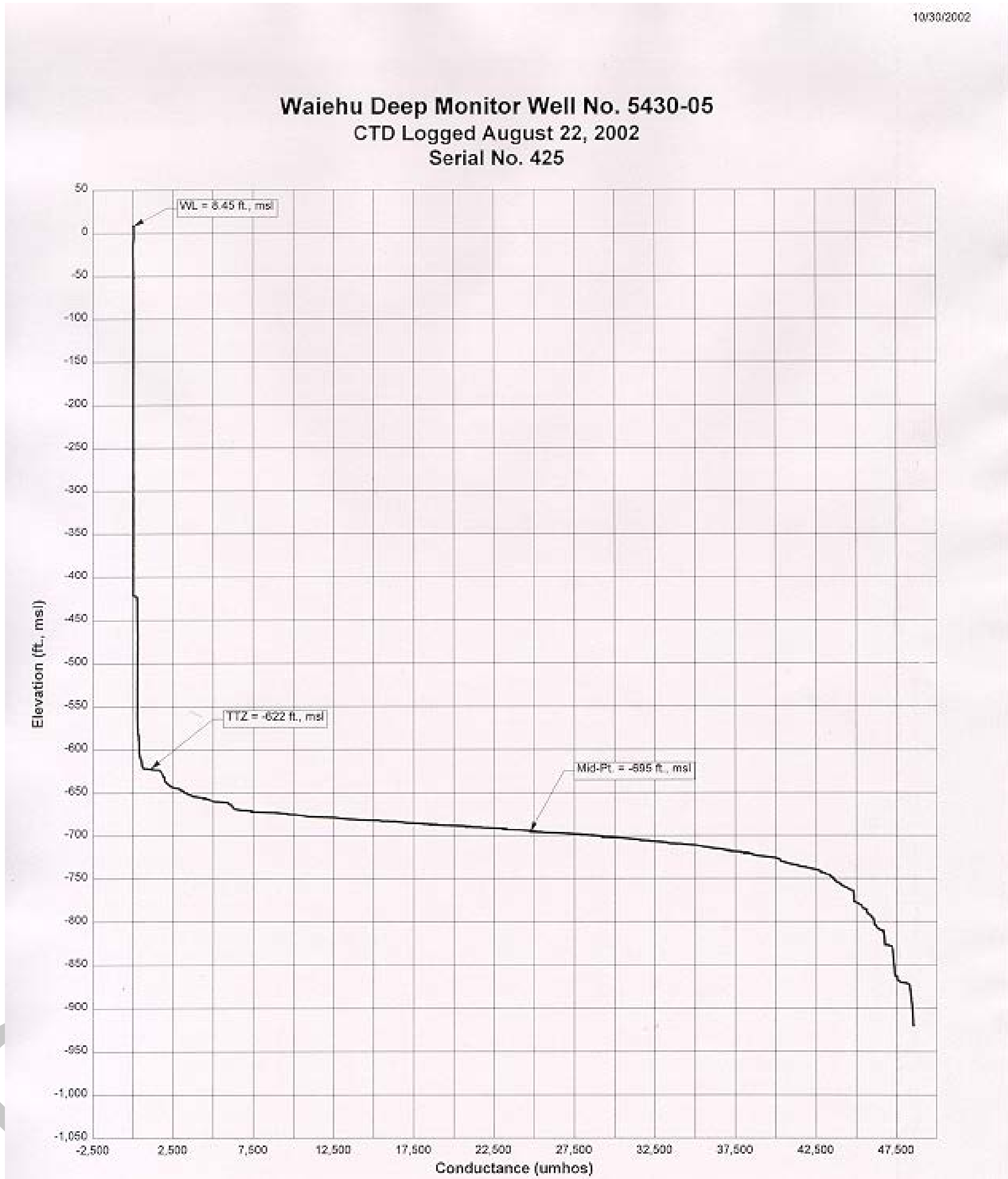
The most direct evidence for this hypothesis of ground water movement is that no potable water exists in the brackish basal lens. The freshest water is found 4 miles inland at the Kalaoa N. Kona Well (8-4360-001). This well penetrates only 22 feet below sea level and encountered a chloride concentration of 600 milligrams per liter ("mg/L") which rose to 782 mg/L in 1968 after a

150 gallons per minute (“gpm”) pumping test. Closer to the shore the chloride concentration rises to about 7,000 mg/L and then to 20,000 mg/L at the ocean.

At the Kamakana well (two miles inland from the shore at Kaloko-Honokohau National Park), the salinity at the water table is 5 parts per thousand or about 3000 mg/L chloride (Figure 9). Deeper below sea level and into the underlying saltwater, freshwater appears to be mixing with seawater. Typical profiles of a basal lens’ salinity/conductivity with depth (as shown in text books and in many deep monitor wells throughout the state) have a smooth “S” shape from the upper fresher section to deeper saltier section (as shown in Figure 10). At the Kamakana well, the profile is skewed to the fresh side at depths from 100 to 500 feet, suggesting an influx of freshwater from the high-level water body, which is known to extend to these depths and deeper.



FOF Figure 9. Salinity and temperature profiles with depth through the brackish basal aquifer at the Kamakana deep monitor well



FOF Figure 10. Conductance profile through a typical freshwater-saltwater transition zone

CWRM estimated that pumping 6 mgd from five high-level wells inland of the Park (based on County 2030 projections) would reduce groundwater flow through the Park by 0.7 mgd (an 8% reduction of the 9 mgd natural discharge when there was no pumping). These wells (inland from Keahole and Honokohou) extend four miles along the high-level boundary from the Kalaoa to the Honokohau wells. The 0.7 mgd reduction in ground water flow is based on KASA (Fig. 11), the 2010 isotope studies by USGS (Oki et al, 2014), and SOEST (Fackrell and Glenn, 2014). *See* Exh. D. Recharge areas contain or are down-gradient from the five wells between Kalaoa and Honokohau (Fig. 11). Basal recharge is 8 mgd. High-level recharge is 47 mgd (CWRM, Exh. D).

The isotope studies showed that only a fraction of the 47 mgd of high-level water flows into the brackish basal aquifer. The SOEST study concluded that the brackish basal lens was composed of 49% high-level water, 30 % recharge local rainfall over the basal area, and 21% seawater. The USGS study provided similar findings: 20% to 70% of the fresh water in the basal area is from high-level water. By simple algebra, if recharge from local rainfall over the basal area is 8 mgd and this is 30% of all the water in the brackish aquifer, then the total quantity of water in the brackish aquifer is 26.7 mgd (8 mgd divided by 0.30). Since the brackish aquifer is composed of 49 percent high-level water, the high-level component in the brackish aquifer is 13 mgd (28% of 47 mgd).

In the next 15 years, pumping wells inland from the park may increase to 6 mgd (Fig. 10) thereby decreasing the basal water flow and the coastal discharge by 1.7 mgd (0.28 x 6 mgd) along the 4.5 mile shoreline between Honokohau Harbor and Keahole Point. This equates to a 0.7 mgd decrease in coastal discharge along the 1.5 miles of shoreline at Kaloko-Honokohau National Park.

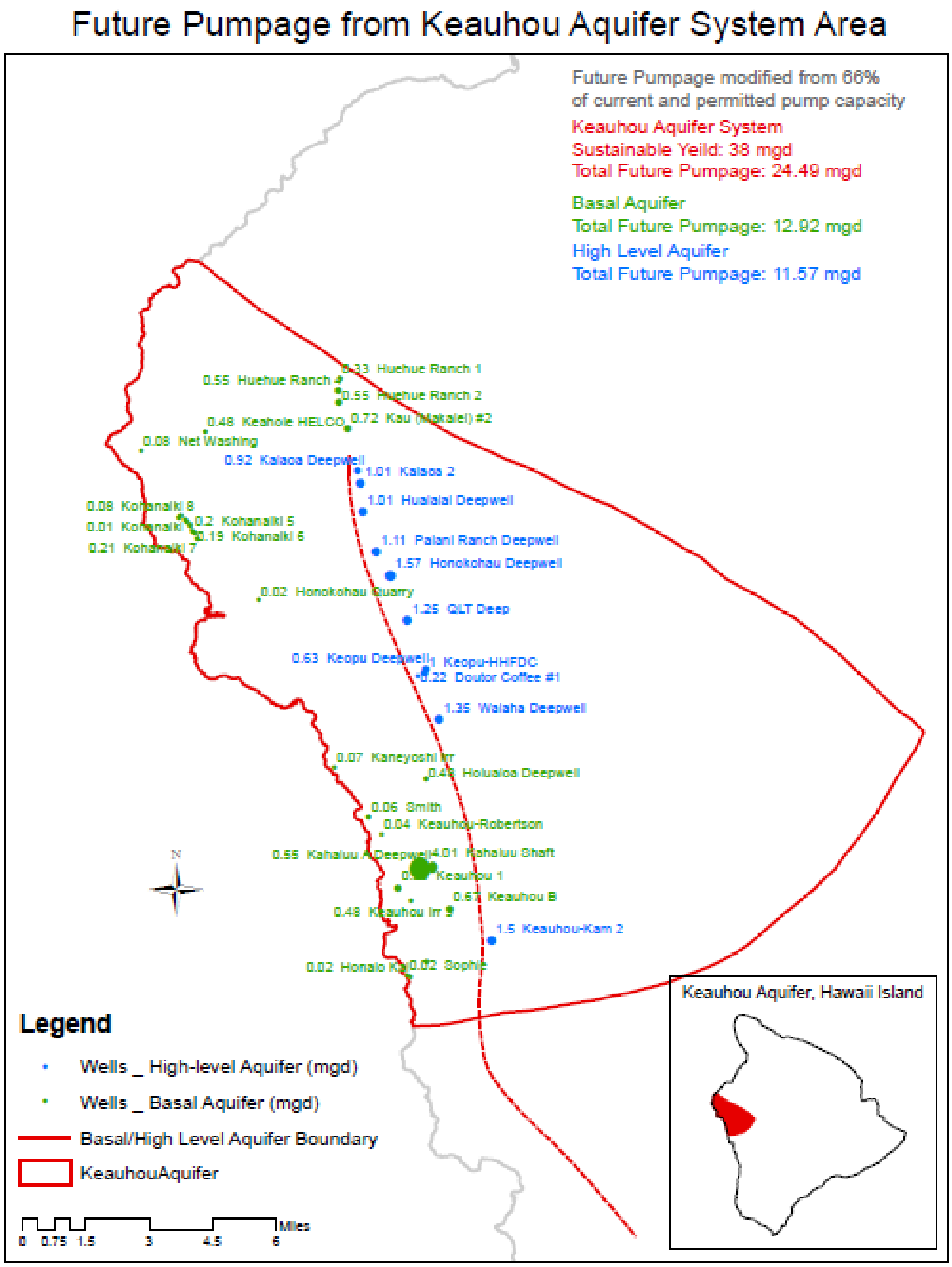
FOF Figure 11. Approximate areas in the high-level and brackish basal aquifers that contribute ground water flow to the shoreline between Honokohau Harbor and Keahole Point.

In a worst case scenario, results of the State Department of Health ("DOH") Source Water Assessment Program's ("SWAP") ground water flow model show that flow through the basal aquifer in the vicinity of Kaloko-Honokohau National Park could decline by 17 percent as a result of pumping the full sustainable yield from the aquifer. The rates and location of these projected pumping wells are shown in Figure 10. Discussion of the estimates and location of future pumping is presented in the section XIV on Ground water Development: Wells and Water Demand.

This is a worst case scenario because the model allowed all the high-level water to flow into the basal aquifer. If the results are adjusted based on the isotope study, the reduction in flow from natural, non-pumping conditions, will be only 28 percent of the 17 percent, or 5 percent. That would be about 0.9 mgd. This compares favorably with the estimate made from the isotope study and estimates of future pumping. The model results are in Exhibit D.

USGS has constructed a numerical model which also assumes that all high level water flows to the basal. This analysis could be used to confirm this information, but to date has not been done.

.

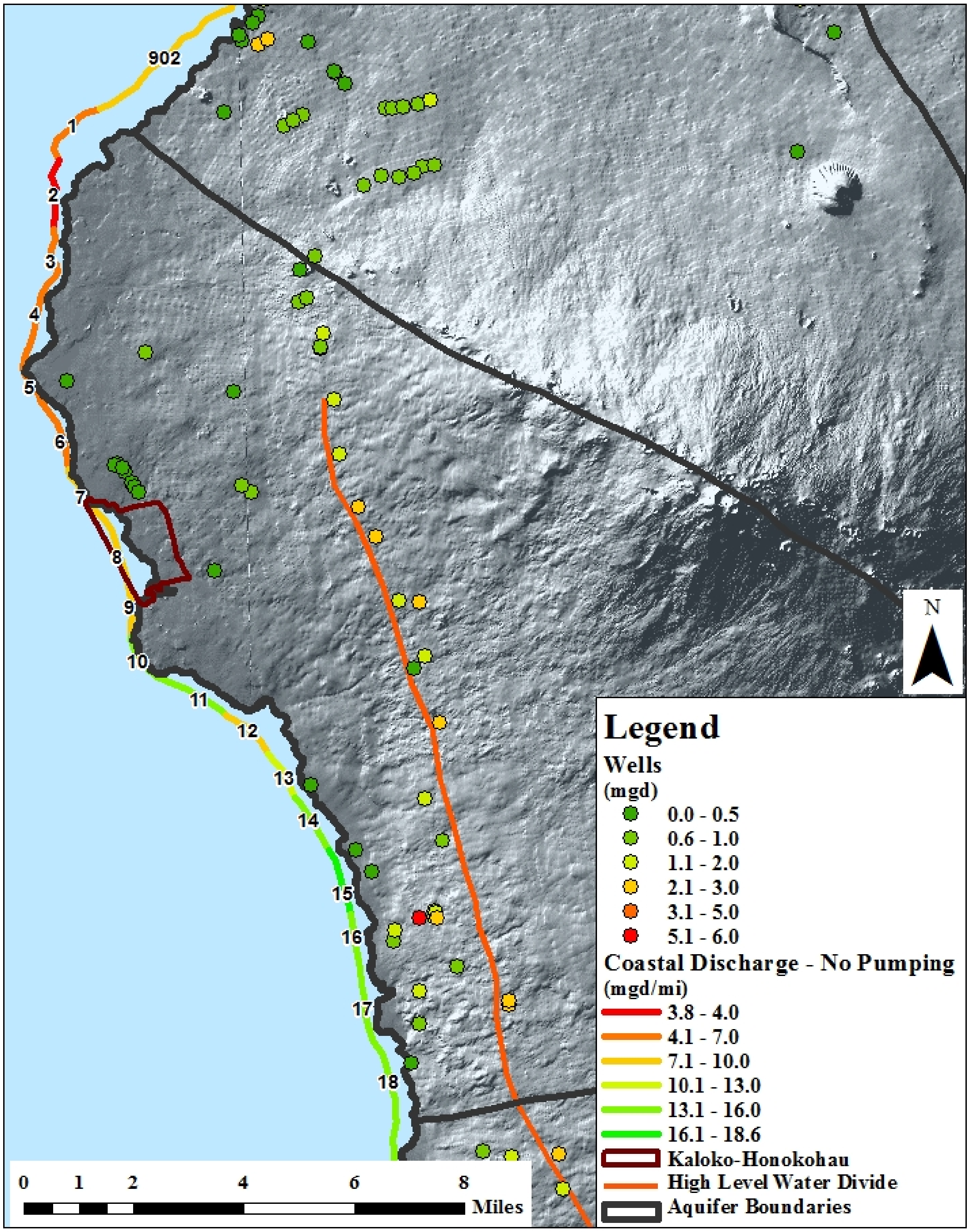


FOF Figure 12. Map of anticipated location of pumping wells and pumping rates 20 years out; for the year 2035

**Modelled Coastal Discharge in North Kona,
Including Effects of Pumpage**

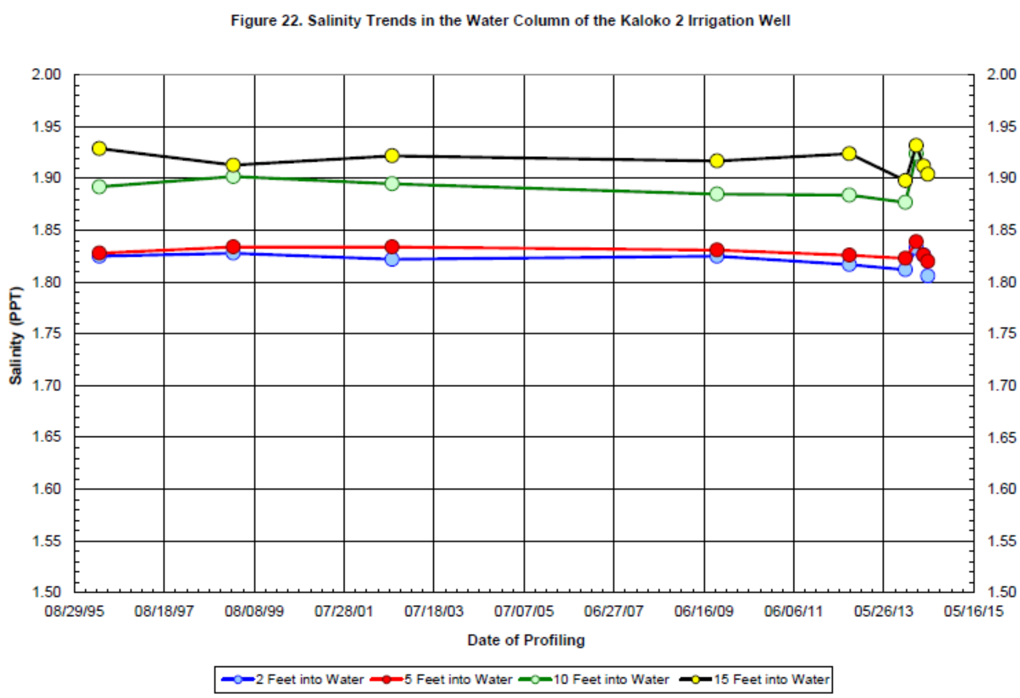
		Length	Coastal Discharge With No Pumpage		Coastal Discharge With 2014 Pumpage		Reduction wrt No Pumpage	Coastal Discharge With Pumpage at SY		Reduction wrt No Pumpage
ASA	Zone	(mi)	(mgd)	(mgd/mi)	(mgd)	(mgd/mi)	(percent)	(mgd)	(mgd/mi)	(percent)
Keauhou	1	1.37	6.00	4.40	5.50	4.03	-8.39	5.19	3.80	-13.51
"	2	1.33	5.10	3.84	4.73	3.57	-7.17	4.47	3.37	-12.39
"	3	1.12	4.84	4.33	4.32	3.87	-10.73	3.86	3.45	-20.37
"	4	1.26	6.58	5.21	6.11	4.84	-7.12	5.56	4.41	-15.46
"	5	1.28	5.45	4.27	5.09	3.99	-6.60	4.58	3.58	-16.09
"	6	1.13	**4.56**	**4.05**	**4.05**	**3.59**	-11.14	**3.27**	**2.90**	**-28.22**
"	7*	1.19	9.34	7.86	8.51	7.16	-8.88	6.85	5.77	-26.63
"	8*	1.07	9.08	8.51	8.44	7.92	-6.98	7.55	7.08	-16.82
"	9*	1.15	8.76	7.65	8.20	7.15	-6.45	7.49	6.54	-14.49
"	10	1.21	17.99	14.87	17.03	14.07	-5.35	15.88	13.12	**-11.75**
"	11	1.12	15.30	13.62	14.44	12.85	-5.64	13.38	11.91	-12.54
"	12	1.06	9.54	8.98	8.99	8.47	-5.75	8.28	7.80	-13.19
"	13	0.94	10.20	10.84	9.68	10.29	**-5.12**	8.92	9.49	-12.48
"	14	1.16	17.95	15.47	16.90	14.56	-5.86	15.55	13.40	-13.37
"	15	1.22	22.76	18.58	20.29	16.56	-10.86	17.81	14.54	-21.72
"	16	0.87	12.08	13.84	10.44	11.96	**-13.56**	8.68	9.95	-28.15
"	17	1.44	22.64	**15.67**	21.01	14.55	-7.18	18.32	12.68	-19.09
"	18	1.58	**23.88**	15.15	**23.04**	**14.62**	-3.50	**20.88**	**13.24**	-12.57
"	901	21.49	212.05	9.87	196.78	9.16	-7.20	176.53	8.21	-16.75
Kaapuna	602	16.73	243.41	14.55	242.44	14.49	-0.40	240.17	14.35	-1.33
Kealakekua	603	9.94	146.96	14.78	144.06	14.49	-1.97	136.03	13.68	-7.44
Anaehoomalu	701	5.20	40.53	7.79	37.04	7.12	-8.62	29.10	5.59	-28.22
Kiholo	902	14.39	138.84	9.65	127.22	8.84	-8.37	117.45	8.16	-15.40

Table 1. Modeled coastal discharge in North Kona, including the effects of pumpage at Sustainable Yield.



FOF Figure 13. Illustration showing DOH SWAP-modeled coastal discharge of ground water; non-pumping scenario

With a small change in ground water flow, the effect on brackish water salinity from this estimated reduction of freshwater in the brackish basal lens would also be small. The freshest water in the brackish basal lens floats at the top five feet of the lens. If the lens becomes more salty, the salty portion will be in the deeper part of the " transition zone." The fresh water rises higher in the water column. Inland from the Kaloko-Honokohau National Park (at the Kaloko 2 Irrigation Well), the movement of the transition zone has been monitored for nearly 20 years by Tom Nance Water Resources Engineering (" TNWRE"). TNWRE measured the salinity of the water at depths of 2, 5, 10, and 15 feet below the water table from 1995 to 2014. Duriong this period, pumping from the high-level water body increased from less than 1 mgd to about 5 mgd. The results (shown in Figure 14) indicate that the brackish lens has been stable for the past 20 years.



FOF Figure 14. Salinity trends in the water column of Kaloko 2 Irrigation Well. From Nance 2014

XI. SENSITIVITY OF BRACKISH WATER BIOTA TO CHANGES IN SALINITY

The Division of Aquatic Resources ("DAR") at the Department of Land and Natural Resources, conducted a biological overview which indicates that if the only freshwater recharge came from local rainfall (about 10 inches per year), there would be enough freshwater to sustain the biota (this assesment is is reproduced in its entirety in Exhibit D).

> The Kaloko-Honokohau National Historic Park provides a wide variety of aquatic resource habitats ranging from anchialine pools and fish ponds along the shoreline to nearshore coral reefs. Some of the animals that inhabit these areas may prefer brackish water environments, but they are by no means restricted to a narrow salinity range.
>
> The National Park Service states that Kaloko-Honokohau contains more than 185 anchialine pools. The aquatic animals found to inhabit these pools include 3 anchialine pool shrimp: *Halocaridina rubra*, *Metabetaeus lohena*, and *Palaemonella bumsi*. All 3 shrimp species are considered to be true anchialine pool species where they are dependent upon the anchialine pool habitat for survival. The salinity in the anchialine pools at Kaloko-Honokohau averages approximately 15 ppt. *H. rubra* and *M. lohena* have been found to inhabit anchialine pools throughout Hawaii with salinities ranging from as low as 2 ppt. to >30 ppt. which demonstrates that they are adept in inhabiting a wide salinity range and are not limited (restricted) to live within a salinity of 15 ppt. *P. bumsi* are found in anchialine pools on Maui and the Big Island with salinities ranging from 9 to 27 ppt. In fact, specimens of *P. bumsi* were collected from Kaloko Fish Pond on August 26, 1972 where salinities were measured from 24 to 27 ppt. (Holthuis 1973).
>
> The remaining species of concern by the National Park Service that utilizes the Park's anchialine pools is the orange-black damselfly, *Megalagrion xanthomelas*. The orange-black damselfly is not considered a true anchialine pool species as it is not dependent solely upon the anchialine pool environment for survival. Considered a coastal wetland species, this damselfly occupies a wide range of habitats from perennial streams to springs and seeps as well as reservoirs and ponds including, but not limited to, lower salinity anchialine pools (< 15 ppt.).
>
> Two historical fish ponds are located within Kaloko-Honokohau: Kaloko Fish Pond and Aimakapa Fish Pond. Both fishponds are spring-fed producing brackish water with a salinity of 12 ppt. Brackish water environments are important for the juvenile stages of marine fishes such as aholehole, mullet and awa providing specific food sources for these species as juveniles as well as protection from predators. However, these species are not limited to salinities of 12 ppt. These fish as juveniles have also been known to inhabit and thrive in brackish water areas that

have higher salinity at >25 ppt. In some of these areas, the higher end salinities are more conducive for the growth of diatoms providing more nutritional value for some juvenile species such as the pua or baby mullet.

Limu manauea, *Graciliaria coronopifolia*, is an endemic marine species of red algae that occurs in a wide variety of habitats. It is found on reef flats and eroded limestone, from mid-intertidal tidepools to shallow subtidal, up to 4 meters deep. Like any marine plant, high productivity occurs in areas with enhanced nutrient content of its surrounding waters. Freshwater entering the marine environment in the form of ground water seepage or terrestrial runoff from rainfall and streams provides a good source of nutrients for the growth of edible algae like limu manauea. Other non- point sources of nutrients for edible limu have been attributed to freshwater surface runoff, ground water seepage from cesspools, sewage treatment effluent, as well as agricultural runoff from agricultural crops such as sugar cane. However, with improved sewage treatment procedures and government regulatory effluent discharge requirements, and the decline of the sugar cane industry, reef areas that previously produced a high abundance of limu are no longer as productive. Prevailing ocean currents can also carry nutrients into surrounding areas increasing algae productivity as well. Limu manauea has also been cultured at the Anuenue Fisheries Research Center with seawater without the need of brackish water for growth. As long as the source of water used to produce limu manauea contains the proper nutrients it needs (regardless of salinity), this limu will continue to be productive wherever it is found in the marine environment.

The majority of the aquatic flora and fauna found in the anchialine pools and fish ponds within the boundaries of Kaloko-Honokohau National Historical Park can tolerate fluctuations in salinities within a wide range. In addition, aquatic flora and fauna found within the nearshore environment of the Kaloko-Honokohau National Historic Park are mostly marine species with only a few that can tolerate and acclimate to a brackish water environment. As long as there is some source of freshwater, whether it be from rainfall, surface runoff, or ground water flow, the biological and ecological integrity of aquatic resources within this area will not be compromised. (see Exhibit D)

Additional information supporting the DAR's understanding is found in the Summary of Scientific Research on the Northern Section of the Keauhou Aquifer Sysem. See Exhibit D. This summary listed invasive species, accumulation of organic matter in the ponds as the primary threat to native species. The summary also lists phretophytes (such as kiawe), whose roots reach the water table, as a large withdrawer of freshwater from the brackish basal lens.

XII. WATER LEVEL DECLINE IN THE HIGH-LEVEL WATER BODY

Water levels in the the high-level water body are highly variable, ranging from 40 to 400 feet above mean sea level across the area, and either increasing or decreasing with depth depending on the well and the depth (Figure 15). A slight to moderate but steady decline in water level has been observed in the KASA since 1991, when the high-level water body was discovered and began to be explored. The decline at the wells shown in Figure 15 averages about one-half of one percent of the initial water level per year, over the past 25 years.

Rainfall has decined throughout the State of Hawaii since about 1980 (Chu and Chen, 2010). The rainfall graph in Figure 15A shows that this state-wide trend is also occurring in the Keauhou area. Certainly a significant portion of the water level decline is the result of the lower rainfall recharge that has occurred since the 1980's. However, an additional cause for decilne is the act of drilling in this area of complex geology which punctures layers of rock and/or structural features that separate waters of different water levels (different heads) and that are following different flow paths.

Without proper fore-knowledge and well construction, high-head zones will be drained into lower-head zones, leading to the possible waste of water. Unnecessary loss of head will lead to a permanent decrease in pump efficiencies and aquifer storage. Many areas of the state have experienced a significant waste of water when artesian wells flowed freely onto and into Honolulu's caprock, or when Waianae, Koolau, and East Molokai dike zones were tapped by wells and tunnels and the water stored in these high-head areas was drained.

Pumping in the KASA high-level water body is not considered to be a significant cause for the water decline because pumping rates are a small fraction of the ground water flow rates and the observed water level declines are also occuring in areas where there is no pumping. The laws of physics require that a certain amount of water level decline will accompany ground water development. Concern arises if the decline is excessive and/or wasteful, which it is not.

In order to detect and prevent possible waste:

(1) Water levels must be measured frequently and a log kept as the well is drilled.
(2) At the completion of drilling, camera logs and velocity logs of the well bore must be made to determine how water is moving in the hole.
(3) Zones where waste is occuring must be grouted before the casing and pump are installed, and
(4) Existing water levels in Keauhou must be monitored carefully.

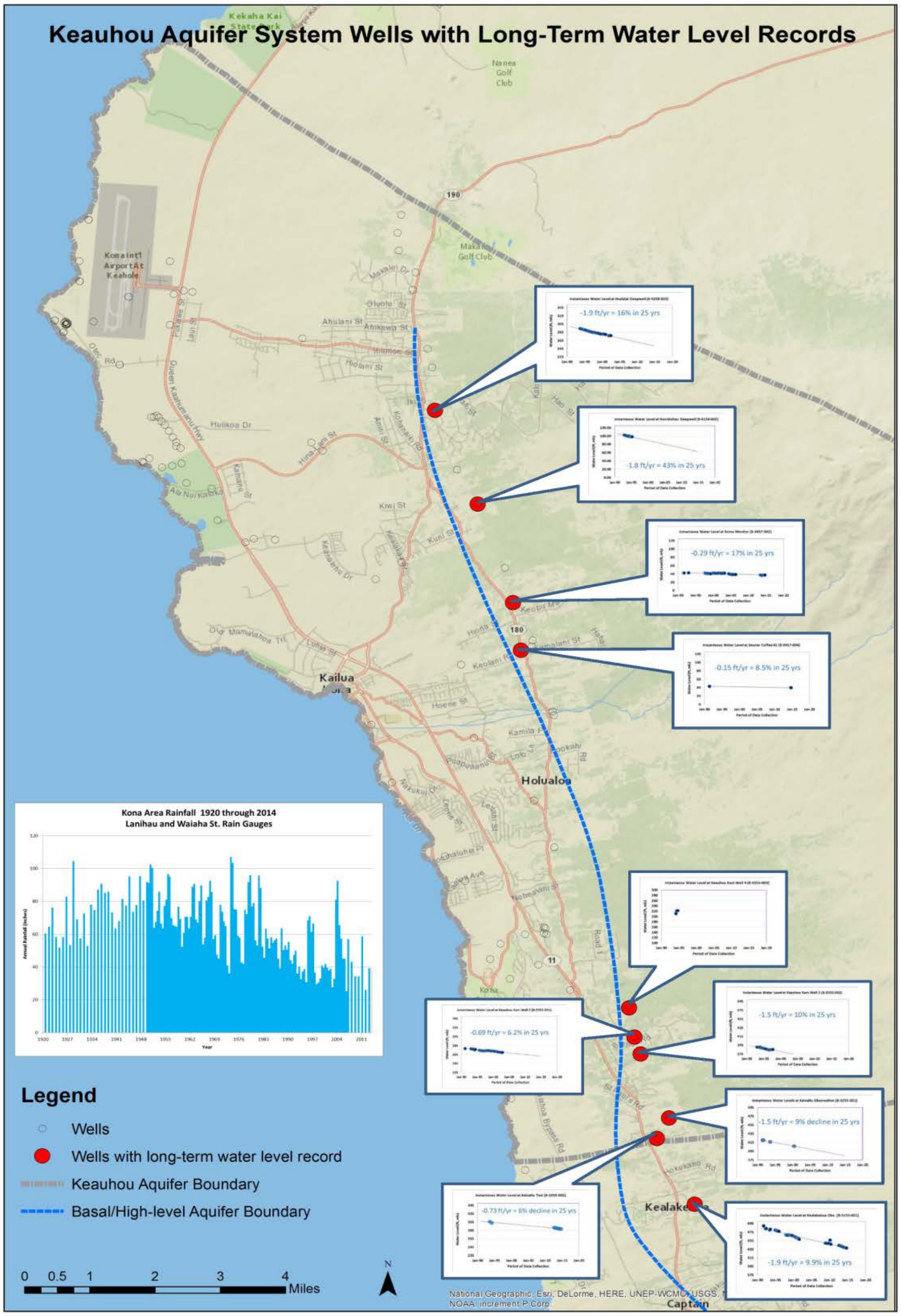
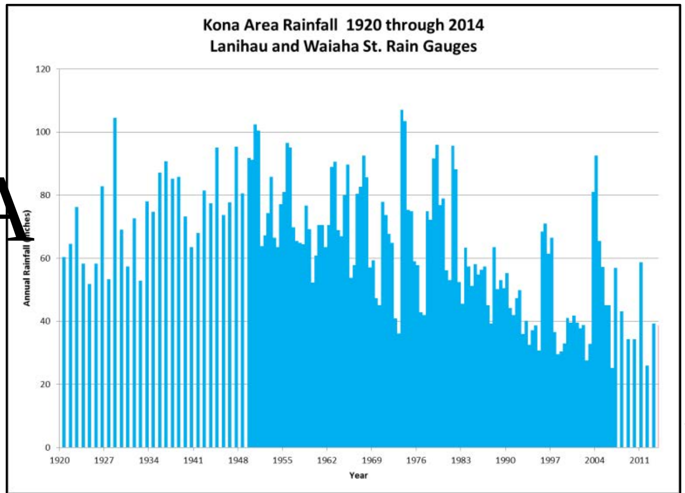


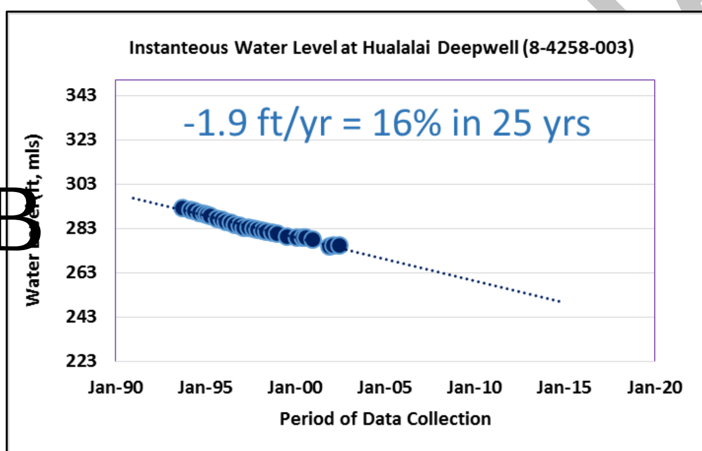
Figure 15. Map of Keauhou Aquifer System Area showing wells and long-term rainfall and ground water levels

Figures 15 A-K. Enlargements of the graphs shown in Figure 15

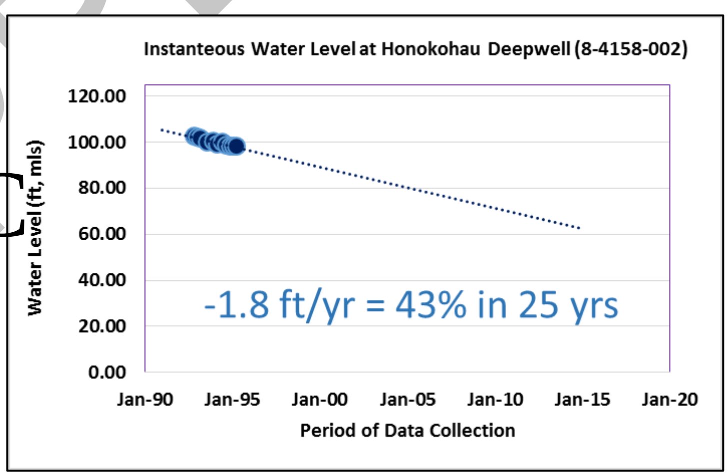
A



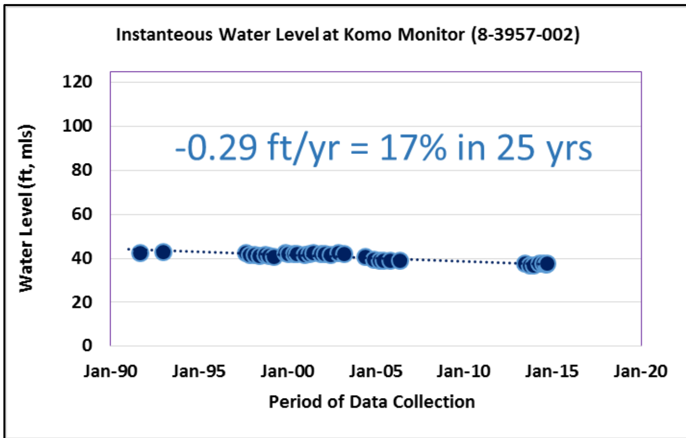
B



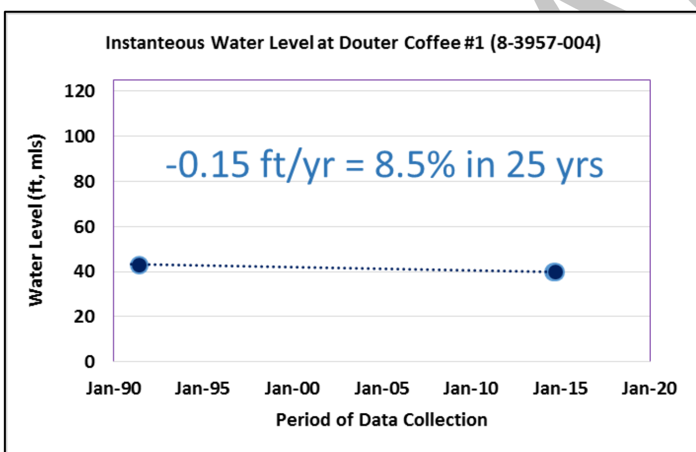
C



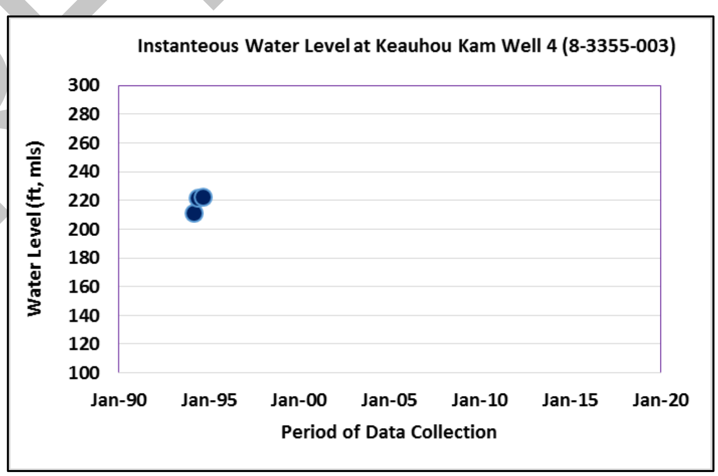
D


Instanteous Water Level at Komo Monitor (8-3957-002)
-0.29 ft/yr = 17% in 25 yrs
Water Level (ft, mls)
120
100
80
60
40
20
0
Jan-90
Jan-95
Jan-00
Jan-05
Jan-10
Jan-15
Jan-20
Period of Data Collection

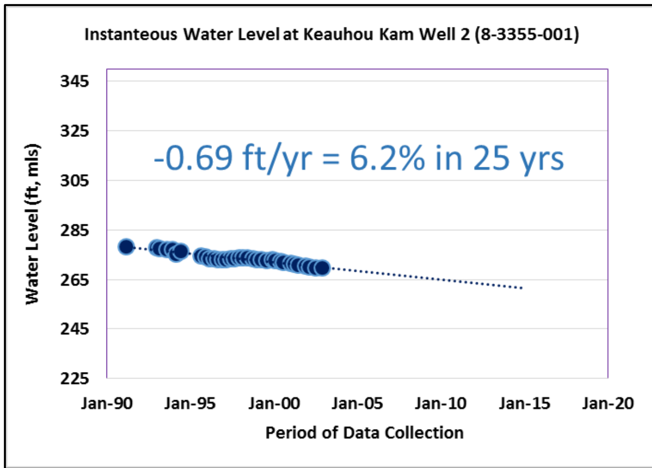
E


Instanteous Water Level at Douter Coffee #1 (8-3957-004)
-0.15 ft/yr = 8.5% in 25 yrs
Water Level (ft, mls)
120
100
80
60
40
20
0
Jan-90
Jan-95
Jan-00
Jan-05
Jan-10
Jan-15
Jan-20
Period of Data Collection

F

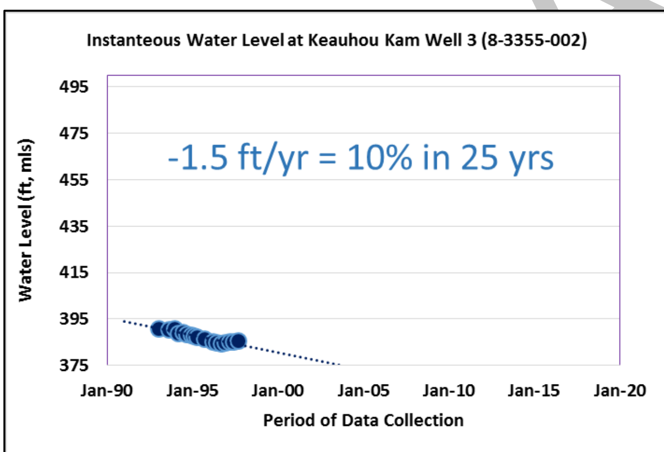

Instanteous Water Level at Keauhou Kam Well 4 (8-3355-003)
Water Level (ft, mls)
300
280
260
240
220
200
180
160
140
120
100
Jan-90
Jan-95
Jan-00
Jan-05
Jan-10
Jan-15
Jan-20
Period of Data Collection

G



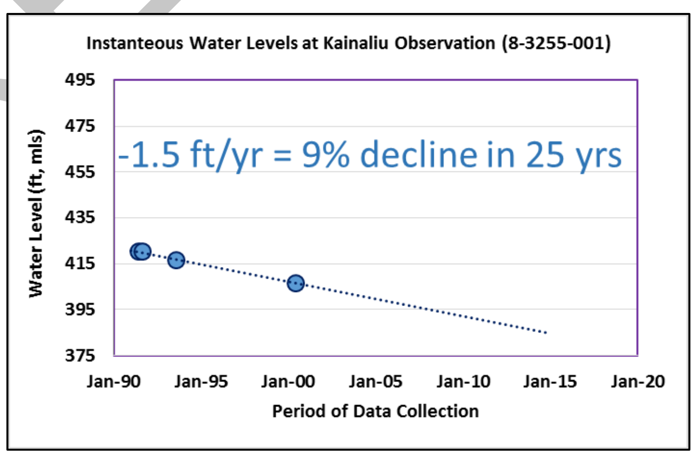
Instanteous Water Level at Keauhou Kam Well 2 (8-3355-001)
-0.69 ft/yr = 6.2% in 25 yrs
Water Level (ft, mls)
345
325
305
285
265
245
225
Jan-90
Jan-95
Jan-00
Jan-05
Jan-10
Jan-15
Jan-20
Period of Data Collection

H



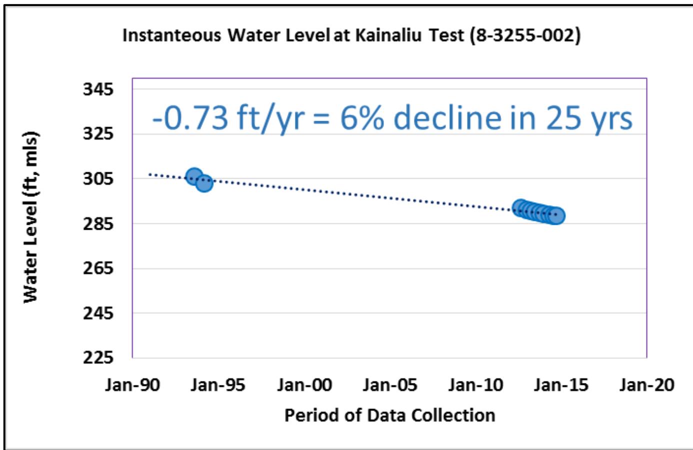
Instanteous Water Level at Keauhou Kam Well 3 (8-3355-002)
-1.5 ft/yr = 10% in 25 yrs
Water Level (ft, mls)
495
475
455
435
415
395
375
Jan-90
Jan-95
Jan-00
Jan-05
Jan-10
Jan-15
Jan-20
Period of Data Collection

I

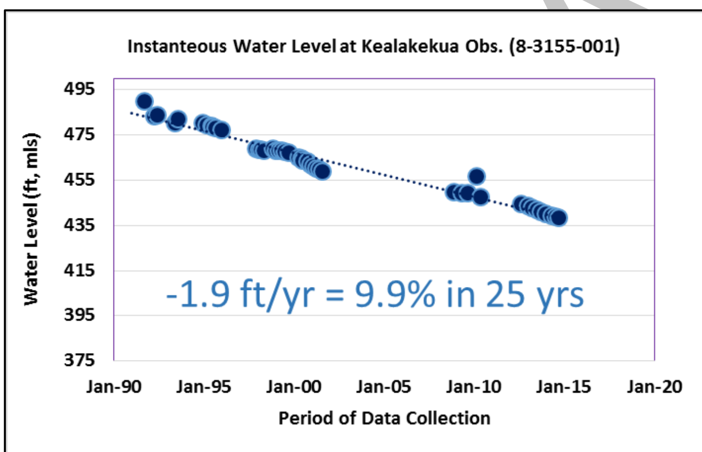


Instanteous Water Levels at Kainaliu Observation (8-3255-001)
-1.5 ft/yr = 9% decline in 25 yrs
Water Level (ft, mls)
495
475
455
435
415
395
375
Jan-90
Jan-95
Jan-00
Jan-05
Jan-10
Jan-15
Jan-20
Period of Data Collection

J


Instanteous Water Level at Kainaliu Test (8-3255-002)
-0.73 ft/yr = 6% decline in 25 yrs
Water Level (ft, mls)
345
325
305
285
265
245
225
Jan-90
Jan-95
Jan-00
Jan-05
Jan-10
Jan-15
Jan-20
Period of Data Collection

K


Instanteous Water Level at Kealakekua Obs. (8-3155-001)
-1.9 ft/yr = 9.9% in 25 yrs
Water Level (ft, mls)
495
475
455
435
415
395
375
Jan-90
Jan-95
Jan-00
Jan-05
Jan-10
Jan-15
Jan-20
Period of Data Collection

XIII. SALINITY LEVELS IN THE BRACKISH BASAL WATER BODY

In mangaging the brackish basal water body (unlike high level water), salinity measurements are more important than water level measurements. It is from the direct measurement of salinity and salinity profiles that the health of an aquifer can be determined and managed. It is nearly impossible to estimate ground water flow directions and flow rates, their changes as well as the thickness of the brackish water lens, from water levels in wells with similar heads that respond differently to the large tidal signal and which are not surveyed to a common benchmark. As discussed above, the biota in the brackish area are accustomed to a wide range of salinity. However, industrial and irrigation users of that water will be impacted by a narrower range. Thus, monitoring salinity in the basal water body is the best single test that can be done and, therefore, the most necessary.

XIV. GROUND WATER DEVELOPMENT: WELLS AND WATER DEMAND

Exhibit H presents pertinent information regarding the wells in the KASA. Figure 16 shows the locations of these wells. Figure 3 (presented earlier) shows the location of pumping wells in the area. Ground water development for municipal supply began in the late 1950's at Kahaluu. Little pumping occurred in the KASA prior to 1970. Since the 1970's pumping from the KASA has increased from about 5 mgd to 14.5 mgd in 2014 (see the value of sustainable yield in Figure 16). The current annual average pumpage of 14.5 mgd includes 11.5 mgd from HDWS sources and 3 mgd from private sources. About 5.5 mgd and 9.0 mgd are pumped from the high-level and basal aquifers respectively. The balance will shift to the high-level aquifer as new potable wells are located there. Projected future demands of an additional 8 to 13 mgd (discussed below) by 2030 are shown in Figure 18. Currently, the County only allocates $1.0 million to source development.

By the 1980s, the chloride concentration at Kahaluu Shaft (HDWS's primary source of water), varied greatly and at times exceeded 300 mg/L. By the 1990s it was clear that future needs for potable water could not be met from the basal aquifer. Exploration began at higher elevations. Figures 12-15 show the history of pumping and its distribution between basal and high-level sources in the KASA.

By 2014, the County of Hawaii Planning Department had approved projects with projected water demand that over the next 15 to 20 years will increase HDWS production of potable water by 5.5 mgd. HDWS has committed to supply water to these projects from either existing sources or sources that will be developed in the coming years. This 5.5 mgd is in addition to the current use. In addition, the Department of Hawaiian Home Lands ("DHHL") has development plans that will require about 3.5 mgd.

The 2003 State Water Projects Plan ("SWPP") lists a number of public projects in the KASA planned for construction by 2020 that will need for 4.987 mgd. This would mean the total projected 2030 use is 14.5 plus 5.5 plus 3.5 plus 5 = 28.5 mgd (75 percent of sustainable yield). Based on these calculations (other factors notwithstanding), pumping in 2030 may reach 28.5 mgd (9.5 mgd less than the 38 mgd sustainable yield).

The 2003 SWPP is almost 12 years old. It is being revised and updated by DLNR Engineering Division and is expected to be finished in 2016. State projects that meet the definition of "authorized planned use" are included in projected water demands. Projected future needs are being refined in a regional update to the SWPP focusing on the North Kona area. That update will be completed by December 2016. The County completed an island-wide WDUP in 2010. Its purpose was to identify sensitive areas for suture in-depth planning. The 2010 WUDP identified Keauhou and Waimea as the most sensitive areas, i.e., where land use plans may result in future demands that exceed the underlying aquifer sustainable yield. Accordingly, the County has begun to update their Water Use and Development Plan ("WUDP"), focusing on the KASA and Waimea. This document should provide more clarity on projected water needs.

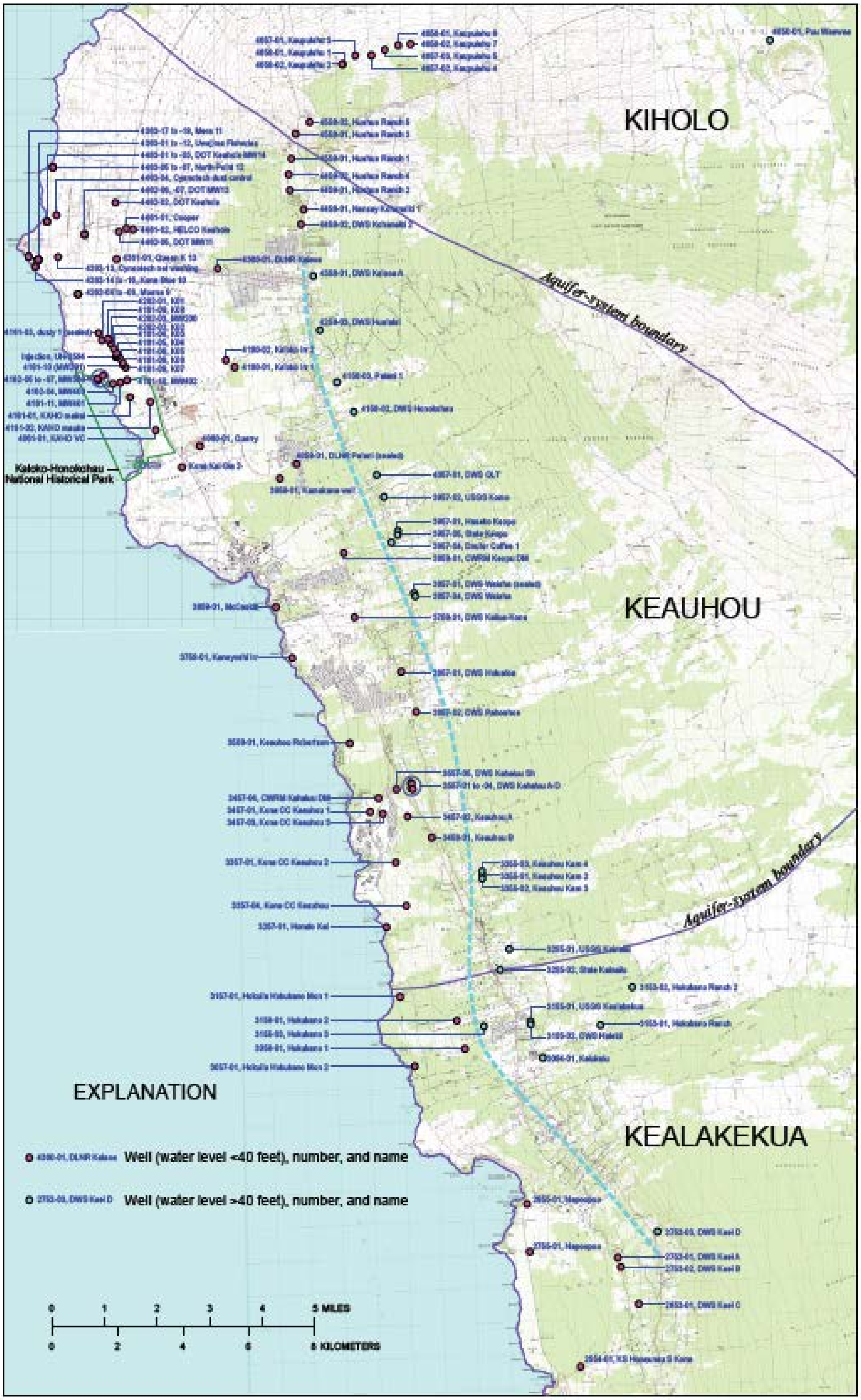


Figure 16. Location of wells in the Keauhou and adjoining Aquifer Systems

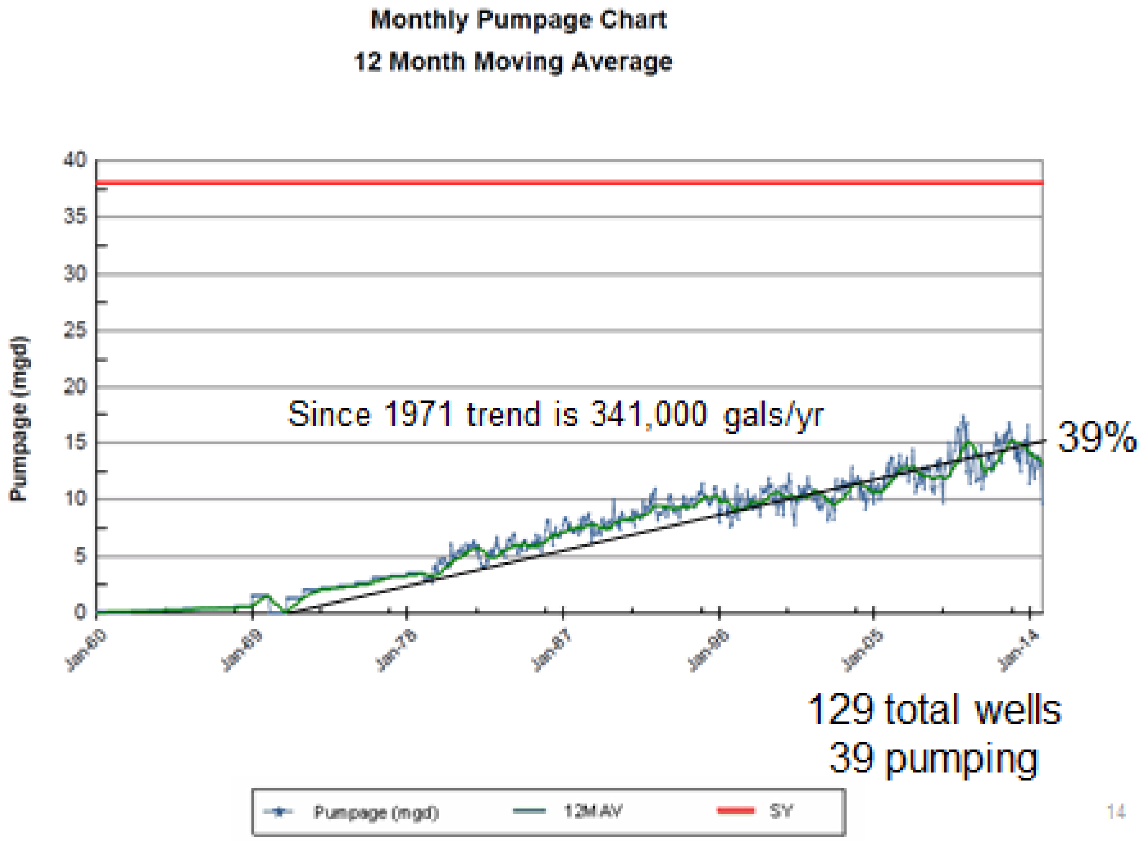
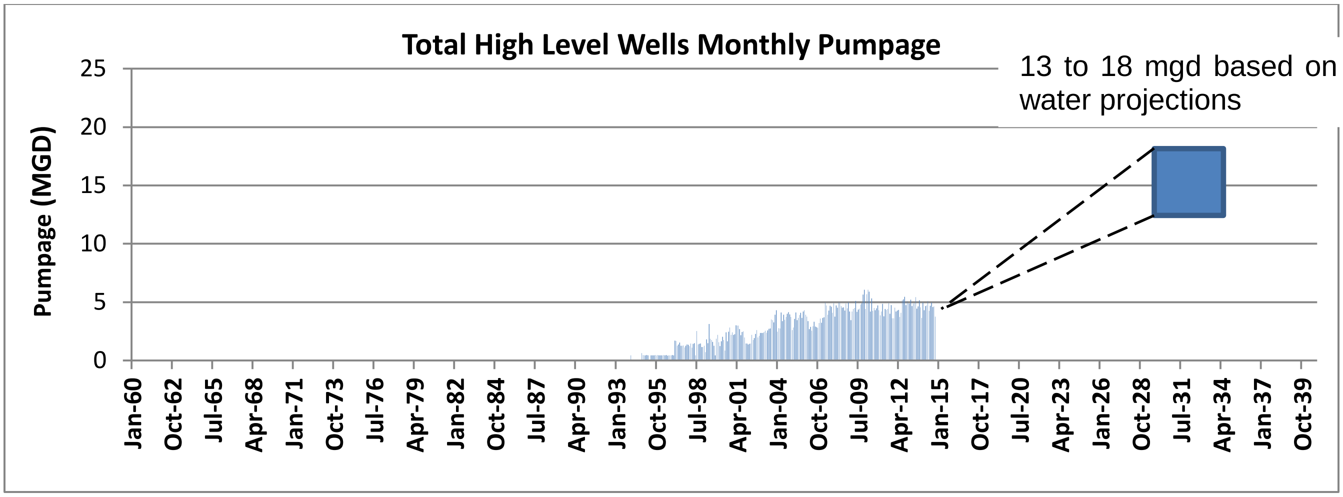
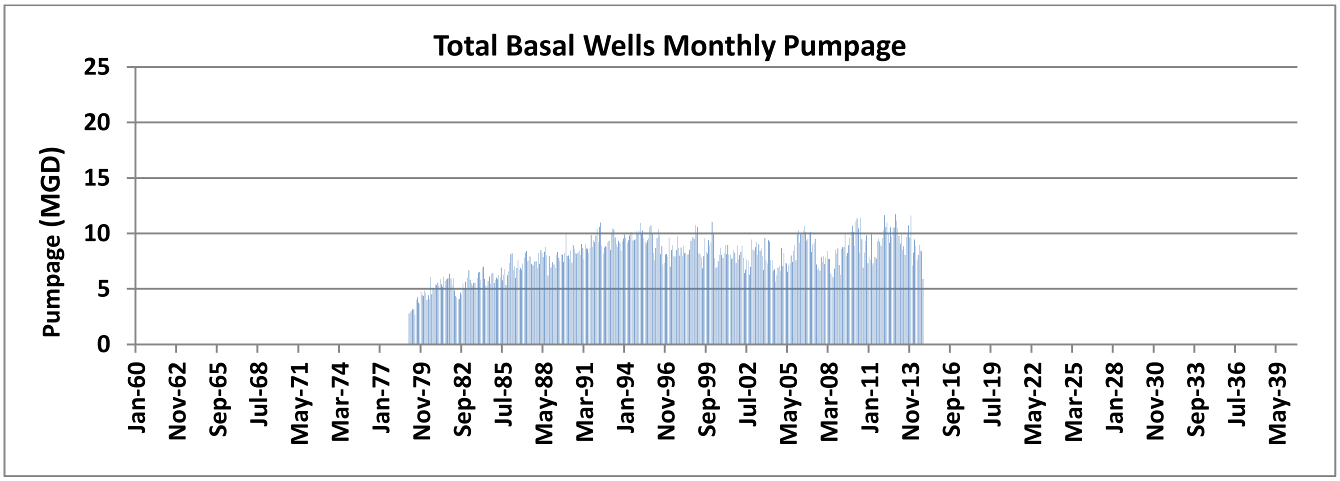


Figure 17. Graph of pumpage and Sustainable Yield in the Keauhou Aquifer System Area





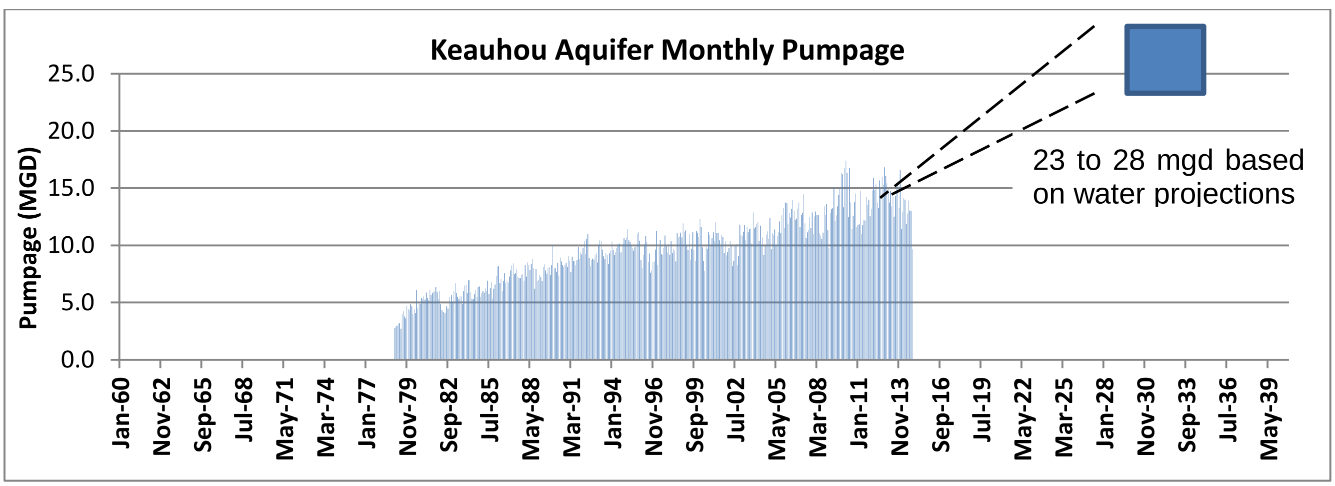


Figure 18. Annual Keauhou Aquifer System Area pumpage; high-level, basal, and total, with projection for the year 2030

XIV. COUNTY LAND USE PLANS AND "AUTHORIZED PLANNED USE"

The County of Hawaii has changed the method of calculating future water demand. It is hard to estimate future needs under these circumstances. The Hawaii County's "projected demand" is not the same as "authorized planned use" under the Water Code. They have different definitions, different meanings, and different consequences.

The NPS made a rough estimate of future demand by looking at a list of permitted wells in the Keauhou aquifer (NPS Petition Exhibit B), a list of final Environmental Impact Statements for development projects (NPS Petition Appendix C), and a list of correspondence between development project representatives and Hawaii County planning officials (NPS Petition Appendix E).

The County itself has used a variety of definitions.

a. In the County's August 2010 Water Use and Development Plan (pp 809-24 through 809- 47) (adopted by the Hawaii County Council), the projected demands exceed the sustainable yield under a number of scenarios. "Demands from existing zoning for the Keauhou aquifer System Area would exceed its sustainable yield even if agricultural demands are **not** included." [emphasis added] *See* WUPD p. 809-43.

b. At the November 19, 2014 Commission briefing, the County presented new "transit oriented development" plans for Kona. These lacked any clear definition or any ascertainable criteria.

c. Then, on November 28, 2014, the County submitted a substantial packet of materials with a whole <u>new</u> set of numbers and redefined "authorized planned use" by excluding private wells (on the grounds that the County has no jurisdiction over private wells). This is not consistent with the statutory definition nor with historical practice.

d. The County does not include a project as an "authorized planned use" until it has the zoning and a water commitment by the County. But this only leaves ministerial permits. This is far too late to do water planning. By the time zoning and water commitments are made, there is no water planning to be done. .

These changing land use definitions and water use figures reduce the ability of the Commission staff to provide any timely or coherent analysis.

XV. PRELIMINARY FINDINGS

Based on the existing data, analyses, and studies of the Keauhou hydrology and biology, projected water demand, and information submitted to the Commission, some important preliminary findings can be made. However, many of the reports, while helpful, lead invariably to more questions. And there are significant gaps in other areas that simply have not been resolved yet.

(1) The NPS petition to designate the Keauhou Aquifer System Area raises a range of issues that must be investigated and cannot be dismissed as without any merit, irrespective of what the ultimate findings may be. Haw. Rev. Stat. §§174C-41 to 46. The Water Code requires a thorough analysis. That process is still underway.

(2) The Commission set the current sustainable yield of the Keauhou Aquifer System Area at 38 mgd.

(3) Average annual pumping in Keauhou increased from 4.5 mgd (1978) to 14.5 mgd (2014). The County expects pumping to increase 13.8 mgd in the next 15 years (2030) to 28.3 mgd (74 percent of sustainable yield). The expected 13.8 mgd increase to 28.3 mgd is based on:

   a. 5.5 mgd for projects that the County expects will have 1) State and County approvals; 2) funding; and 3) HDWS water commitments in place.

   b. 3.5 mgd for the Department of Hawaiian Home Lands (DHHL) proposed projects.

   c. 5.0 mgd for proposed public projects identified in the 2003 State Water Projects Plan (the 2003 plan is currently being updated).

(4) The Commission must analyze "authorized planned uses" (Haw. Rev. Stat. `174C-44(1) which the Water Code defines as "the use or projected use of water by a development that has received the proper state land use designations and county development plan / community plan approvals." Haw. Rev. Stat. 174C-3 Definitions.

(5) The County has used a variety of definitions and changed its own calculations of "authorized planned use" (see above) These rapidly changing land use definitions and figures reduce the ability of the Commission staff to provide any timely or coherent analysis. The record on land

use plans and projected water demand is confused at this point. It is not possible to make clear statements about either with any confidence.

(6) Due to the long distances in west Hawaii, private projects often develop and manage their own stand alone water systems. They may never connect to the Department of Water Supply network and do not require County water use commitments (although the PUC may require larger systems to obtain a “certificate of public convenience and necessity”). The County HDWS has no regulatory authority over these independent systems.

(7) The 12-MAV for wells within the ahupua’a in which Kaloko-Honokohau National Park is located is 2.4 mgd. This could increase to approximately 3.7 mgd by 2030.

(8) The highest average use of water is approximately 540 gallons per day per customer (which include non-residential uses). This is based on the highest 12-MAV pumpage over the past 4 years of 15.5 mgd. The Hawaii Department of Water Supply estimates its present customer base is 28,725. The Hawaii Water Systems Standard (2002) uses 400 gpd/unit.

(9) Chloride concentrations at HDWS’s primary source of water, Kahaluu Shaft, vary, but are over 400 ppm at times. Pumping 4 mgd from the shaft is not sustainable. It will be reduced as other wells come on line.

(10) Only a fraction (about 28 percent in the Kaloko-Honokohau National Park area) of the high-level water flows to the brackish basal lens. Thus, groundwater flow in the brackish basal lens will be reduced by only a fraction of the pumping in the high-level aquifer. In the future, as a result of projected 2030 pumping, groundwater flow through the Park is expected to be 85%-90% of what it was before pumping. This relatively small reduction in flow is expected to have little-to-no effect on the brackish basal lens as a water resource or as a habitat for the various life forms for which the park has shown concern-- opaeula, orange-backed damsel flies, fish, birds, or, with respect to the ocean- coral.

(11) The brackish water at Kaloko-Honokohau National Park observation wells freshened from 2007 to 2013- during the time of nearby urban development and increased groundwater withdrawal.

(12) Current data indicate that withdrawal of high-level water will not cause a measurable increase in the salinity of the brackish water. The concern that pumping high-level water will increase the salinity of the brackish lens and threaten native and endangered species appears to be unfounded.

(13) The native biology of the park is euryhaline, i.e. adapted to a wide range of salinity. The only organism of concern in the petition that is sensitive to salinity increases is the orange-backed damsel fly. However, the brackish ponds of the park are not the native habitat for the orange-backed damsel fly. The species is not unique to the park. The damsel fly is not strongly related to traditional and customary practices. In fact, the orange-backed damsel fly prefers fresher water and is found in fresh to slightly brackish water bodies in many other parts of the state.

(14) Invasive species and organic detritus in the anchialine ponds are the major factors that threaten the native species.

(15) Traditional and customary practices occur at the park. However, NPS has closed off the Aimakapa fish pond to public access, including access by native Hawaiians wishing to practice their traditional and customary Hawaiian rights.

(16) Since their construction in the 1990's, eight high-level wells that span the length of the aquifer system are showing a moderate but steady water level decline. All of these wells (with one exception) were drilled before the initial adoption of the Hawaii Well Construction Standards in 1997. This water level decline is the result of reduced rainfall, pumping, and/or increased aquifer leakage caused by wells puncturing confining layers and allowing the water to escape. If the water level decline is caused by wells puncturing confining layers, the existing well leaks may need to be sealed to reduce water level declines occurring beyond that attributable to the decline in rainfall. New wells should be drilled in a manner to prevent leaks. In this way the valuable storage of water in the aquifer will be preserved.

(17) The Hawaii Department of Water Supply ("HDWS") can and needs to improve its monitoring/reporting of water levels and chloride concentrations. This data is the basis for evaluating the condition of the aquifer.

(18) One criteria to be considered in designating an area for ground water management under the Water Code, Haw. Rev. Stat. §174C-44(4) is

> Whether rates, times, spatial patterns, or depths of existing withdrawals of ground water are endangering the stability or optimum development of the ground-water body due to upconing or encroachment of salt water.

Of the approximately 20 pumping wells throughout the aquifer, only the Kahaluu Shaft meets this condition. HDWS will remedy this problem by shifting pumping to new, high-level sources as they come on line.

(19) A second criteria to be considered in designating an area for ground water management under the Water Code, Haw. Rev. Stat. §174C-44(6) is "[w]hether excessive preventable waste of water is occurring." This condition may be occurring at the high-level wells where water levels have moderately, but steadily declined since the 1990's. An assessment of the vertical flow of water in these wells is needed to indicate whether or not leakage is occurring or whether water levels are simply declining in response to the decreased rainfall over the past 40 years. A review of all high-level drilling, testing, and monitoring records will help to eliminate the possibility that these wells are leaking and wasting water. This is a well construction and data collection issue. If excessive preventable waste is occurring, it will have been brought about by water development projects that have received federal, state, or county approval. The well owners are responsible for preventing waste.

(20) A third criteria to be considered in designating an area for ground water management under the Water Code, Haw. Rev. Stat. §174C-44(8) is

> Whether water development projects that have received any federal, state, or county approval may result, in the opinion of the commission, in one of the above conditions.

XVI CRITERIA FOR DESIGNATION

Haw. Rev. Stat. §74C-44 lists 8 criteria that the Commission consider in designating a ground-water management area.

(1) Whether an increase in water use or authorized planned use may cause the maximum rate of withdrawal from the ground-water source to reach ninety percent of the sustainable yield of the proposed water management area.

Existing uses plus projected water demands for projects in the next 20 years plus state projects, 3.5 mgd reserved for DHHL total 28.5 (75 percent of the 38 mgd sustainable yield). Kona is a designated growth area. Other projects (not included in the projection) may add more demand in the next 20 year. The Commission periodically re-evaluates projected demand and pumping rates in light of the criteria to limit pumping below the sustainable yield. "Authorized Planned Use" is a term of art under the Water Code. It is not the same as the County's projected demand (although it may include many of the same uses). It is a moving target that must be monitored and periodically reevaluated.

(2) There is actual or threatened water quality degradation as determined by the Department of Health.

Commission staff consulted with the Department of Health as to their determination of actual or threatened water quality. The Department of Health has not found any evidence at this time that indicates there is actual or threatened water quality degradation. *See* December 9, 2014 letter from DOH Deputy Director Gary Gill.

(3) Whether regulation is necessary to preserve the diminishing ground-water supply for future needs, as evidenced by excessively declining ground-water levels.

Groundwater levels are not declining at an excessive rate. There appears to be sufficient groundwater supply to meet projected needs by 2030. The regional update of the WUDP, guided by data from continued monitoring efforts would identify and propose specific preferred and alternate strategies to meet future demands as future conditions indicate. Based on the strategies presented, the revisit water management if the data justifies such action.

(4) Whether rates, times, spatial patterns, or depths of existing withdrawals of ground water are endangering the stability or optimum development of the ground-water body due to upconing or encroachment of salt water.

Only the Kahaluu Shaft, of the approximately 20 pumping wells throughout the aquifer, meets this condition. HDWS will remedy this problem by shifting pumping to new, high-level sources as they come on line.

(5) Whether the chloride contents of existing wells are increasing to levels which materially reduce the value of their existing uses.

Only the Kahaluu Shaft, of the approximately 20 pumping wells throughout the aquifer, meets this condition. HDWS will remedy this problem by shifting pumping to new, high-level sources as they come on line.

(6) Whether excessive preventable waste is occurring.

This condition may be occurring at the high-level wells where water levels have moderately, but steadily declined since the 1990's. An assessment of the vertical flow of water in these wells is needed to indicate whether or not leakage is occurring or whether water levels are simply declining in response to the decreased rainfall over the past 40 years. If an effective program of careful drilling, testing, and monitoring cannot be implemented to eliminate the possibility that these wells are leaking to waste, designation would be an option for initiating such a program.

(7) Serious disputes respecting the use of ground-water resources are occurring.

These Preliminary FOF indicate that it is unlikely that NPS fears will be realized. Although NPS may disagree, the record does not support a claim a serious harm is likely to occur or that problems will arise due to water salinity rather than management practices within the control of NPS.

(8) Whether water development projects that have received any federal, state, or county approval may result, in the opinion of the Commission, in one of the above conditions.

The Commission has no information on this. Further investigation is required.