

WATER MASTER PLAN STUDY
DEPARTMENT OF HAWAIIAN HOME LANDS
MOLOKAI POTABLE WATER SYSTEM
HOOLEHUA AND KALAMAULA
MOLOKAI, HAWAII

PREPARED FOR:
DEPARTMENT OF HAWAIIAN HOMELANDS
STATE OF HAWAII

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EXECUTIVE SUMMARY

PURPOSE AND SCOPE OF WATER MASTER PLAN STUDY

- Conduct assessment of the existing water system and recommend improvements required to provide adequate and dependable service to the Hoolehua and Kalamaula areas.
- Determine the potable water requirements to develop the Hoolehua and Kalamaula Department of Hawaiian Home Lands (DHHL) Homesteads as shown in the Molokai Island Plan¹.

BACKGROUND OF DHHL POTABLE WATER SYSTEM

- The DHHL potable water system primarily serves the homesteads in Hoolehua and Kalamaula (**Exhibit 1 – Location Map**). Non-DHHL customers serviced by the water system include Molokai Airport, Molokai High School, Kualapuu Elementary School, Maui Department of Water Supply (DWS) Kalae Water System, Molokai Ranch, and Meyer Estate. Existing (2005) average demand of the potable water system is as follows².

○ Hoolehua Homesteads	156,737 gpd
○ Kalamaula Homesteads	80,400 gpd
○ Non-DHHL Customers	119,916 gpd
○ Total	357,053 gpd
- Kauluwai Well #1 (State Well No. 0801-01, 600 gpm) and Kauluwai Well #2 (State Well No. 0801-02, 750 gpm) are the two sources servicing the DHHL potable water system (**Exhibit 6 – DHHL Water System Map**).
 - Both wells currently pump a combined average daily demand (2005) of 0.569 mgd which exceeds the current DHHL allocation of 0.367 mgd permitted by the Commission on Water Resource Management (CWRM) (**Table 1**).
 - Chloride concentration of water pumped from both wells has increased over the last 20 years³. Chloride concentration is commonly used as an indicator of water salinity.

¹ *Molokai Island Plan*, Department of Hawaiian Homelands, State of Hawaii, prepared by Group 70 International, June 2005

² *State Water Projects Plan*, Volume 4 – SWPP for Islands of Lanai/Maui/Molokai, Commission on Water Resource Management, prepared by Fukunaga & Associates, Inc., February 2003, pg. 2-20

³ Numerical Simulation of the Hydrologic Effects of Redistributed and Additional; Groundwater Withdrawal, Island of Molokai, Hawaii, U.S. Geological Survey, Report 2006-5177, page 17

- DHHL has a reservation allocation from the Kualapuu Aquifer of 2.905 mgd⁴.

FUTURE POTABLE DEMAND (*Molokai Island Plan*)

Based on the land use described in the Molokai Island Plan, by Group 70 International dated June 2005, the potable water demand for Hoolehua and Kalamaula are as follows:

Area	Ave. Day Demand*	Max. Day Demand*
Hoolehua	1,035,600 gpd	1,553,400 gpd
Kalamaula	679,800 gpd	1,019,700 gpd
Total	1,715,400 gpd	2,573,100 gpd

*Based on Maui County DWS Standard Consumption Guidelines

EXISTING WATER SYSTEM DEFICIENCIES AND LIMITATIONS

- Rising chloride levels in water produced by the two DHHL wells have been recorded.
- For 2005, there is a 210,000 gpd discrepancy between the average volume of water pumped into the system and the average volume of water consumed by users.
- Existing 0.1 MG tank at the DHHL well site is too small to ensure dependable water service to its users under high demand conditions.
- No backup power sources are available for the well pumps in the event of a power failure.
- Well pump operation is scheduled to avoid the peak periods of Maui Electric Company’s power rate schedule. This puts a limitation on water system operation.
- Existing 1.0 MG gallon Kauluwai tank effluent line profile rises above the floor elevation of the tank. This condition decreases the operational volume of the tank.
- Booster pumps at the well site are operated using manually set timers.

⁴ *Island Water Use Permit Index*, Commission on Water Resource Management, Department of Land and Natural Resources, State of Hawaii

- Flow from the 1.0 MG Kauluwai tank to the two 3.5 MG Hoolehua tanks is manually operated through a gate valve. System operators must use judgment in throttling down the valve to avoid completely draining the Kauluwai tank.
- No existing booster pumps to move water back up to the 1,000,000 gallon Kauluwai tank from the two 3,500,000 gallon Hoolehua tanks. System operators predict that the 6" transite transmission main connecting these two tanks cannot hold any pressure higher than the current conditions.
- Under-utilization of the non-potable Molokai Irrigation System in Hoolehua. Leads to higher potable water use.

EXISTING OPERATIONAL CONCLUSIONS (C) & RECOMMENDATIONS (R)

- C:** Current pump records show that DHHL, and Maui DWS are all exceeding their water allocation permitted by CWRM for the Kualapuu Aquifer. Rising chloride concentrations observed at the two DHHL wells and Maui County's well indicate that these wells may be negatively influencing each other due to their close proximity. It may also indicate that the wells may have exceeded their respective safe pumping capacities.
- R:** Conduct a coordinated verification test of the DHHL and Maui DWS wells. The goal of this test will be to confirm the safe pump operating capacity of each well to preserve aquifer integrity. Once confirmed, the pump capacities will establish a baseline of planning for future development.
Probable Cost = \$200,000
- C:** Comparisons between well pump meter records and customer meter records indicate a 210,000 gpd water loss.
- R:** Conduct a water loss investigation of the existing system to determine the causes of the water loss and establish a baseline of current water usage.
Probable Construction Cost = \$100,000
- C:** Well pumps are constrained to operate during the MECO off-peak rate periods to prevent higher electrical costs. This condition requires the DHHL system to pump at a higher rate than required if there were no constraints.
- R:** Install a permanent diesel generator to be the well pumps primary power source, and use the existing electrical power as backup. The generator will allow DHHL to pump as needed, and not be constrained by power rate schedules. At minimum, a diesel generator should be provided at the well site for back up power in the event of an electrical power failure.
Probable Construction Cost = \$200,000

- C:** Existing 0.1 MG tank at the well site is too small to adequately support the current operation of the water system
- R1:** Increase the storage capacity at the well site to a minimum of 200,000 gallons
Probable Construction Cost = \$800,000
- R2:** An alternate recommendation would be to upgrade the existing well pumps and 4,200 l.f. of 8-inch transmission main to have the wells pump up to the 1.0 MG tank and backfeed down to the 0.1 MG tank and Kalamaula
Probable Construction Cost = \$800,000-\$1,000,000
- C:** Current system, including wells and booster pumps, is operated through manual controls. Over filling and emptying of the tanks have occurred in the past. This lack of adequate controls leads to an overall inefficient water system and water losses.
- R:** Install a SCADA control system to provide greater system control and monitoring, leading to increased operational efficiency and reliability.
Probable Construction Cost = \$200,000
- C:** Profile of the outlet pipe at the 1.0 MG Kauluwai tank is higher than the floor of the tank. This condition prohibits approximately 4' of the tank volume to be usable.
- R:** Lower the profile of the outlet pipe at the 1.0 MG Kauluwai tank.
Probable Construction Cost = \$100,000

FUTURE DEVELOPMENT CONCLUSIONS AND RECOMMENDATIONS

- C:** Projected water storage requirement for the full build-out of Kalamula is 1,000,000 gallons. The current 200,000 gallon tank is inadequate to support the future development.
- R:** Provide 800,000 gallons of additional storage to support the proposed land uses shown for Kalamaula in the Molokai Island Plan
Probable Construction Cost = \$2,000,000
- C:** The two existing 485 gpm booster pumps that supply water to the 1,000,000 gallon Kauluwai tank from the well site does not have the capacity to support the future demands on the Kauluwai tank.
- R:** Increase the booster pump capacity to meet the future needs or develop a new well site at a higher elevation near the Kauluwai tank.
Probable Construction Cost to be Determined
- C:** The existing 6" transite transmission main connecting the Kauluwai tank to the Hoolehua tanks does not have the capacity to service the future demands of the Hoolehua area.
- R:** Increase the size of the transmission main to a 12" pipe.
Probable Construction Cost to be Determined
- C:** DHHL is currently exceeding their well pumping allocation. Additional source development is required to maintain existing demands and meet future development needs.
- R:** DHHL to study source development options including constructing a well on its own, or partnering with Maui DWS or Molokai Ranch.
Probable Construction Cost to Construct Each Well = \$4-6 million

I. INTRODUCTION

- a. Purpose and Scope of Study
 1. Conduct assessment of the existing water system and recommend improvements required to provide adequate and dependable service to the Hoolehua and Kalamaula areas (**Exhibit 1**).
 - a) Research available information on the Department of Hawaiian Home Lands (DHHL) potable water system, including interviews with staff from DHHL and Pacific Electro-Mechanical¹.
 - b) Identify the relationships between the DHHL potable water system and the other potable water systems of Molokai.
 - c) Identify operational shortcomings of the existing DHHL potable water system.
 - d) Identify future improvement projects that would upgrade the existing DHHL potable water system.
 2. Determine the potable water requirements to develop the Hoolehua and Kalamaula DHHL Homestead areas as shown in the Molokai Island Plan².
 - a) Determine water demand requirements for full build-out of land uses presented in the Molokai Island Plan for the Hoolehua and Kalamaula Homesteads.
 - b) Determine if existing sources of potable water are adequate to supply full-build out of the Molokai Island Plan for the Hoolehua and Kalamaula Homesteads.
 - c) Determine source and infrastructure improvements required to support the full-build out development as planned.

¹ Pacific Electro-Mechanical provides maintenance services to DHHL for the Molokai Water System

² *Molokai Island Plan*, Department of Hawaiian Homelands, State of Hawaii, prepared by Group 70 International, June 2005

b. Background Information

1. Kualapuu Aquifer (**Exhibit 2**)

- a) The Kualapuu aquifer has an estimated sustainable yield of 5 million gallons per day³ (mgd). The current allocations are shown in **Table 1**.

**TABLE 1
CWRM WATER PERMIT INDEX**

Date	Owner	State Well No.	Well Name	Allocation (MGD)
9/15/1993	State DHHL	0801-01	DHHL 1	0.367
9/15/1993	State DHHL	0801-02	DHHL 2	
9/15/1993	Mauī DWS	1059-01	Waikalae Tunnel	0.036
3/14/1995	State DHHL	----- Reservation -----		2.905
10/20/1995	Mauī DWS	0801-03	Kualapuu Mauka	0.516
12/19/2001	Kaluakoi Land, LLC	0901-01	Well #17	1.018
Total allocated:				4.842
Kualapuu Sustainable Yield:				5
Available Allocation:				0.158

Source: Commission on Water Resource Management, Department of Land and Natural Resources, State of Hawaii, July 2006

- b) The Kualapuu Aquifer is has 4 existing wells:

- DHHL Kauluwai #1 (State Well No. 0801-01)
- DHHL Kauluwai #2 (State Well No. 0801-02)
- DWS Kualapuu Mauka (State Well No. 0801-03)
- MPL Well #17 (State Well No. 0901-01)

Pump tests have shown that despite the close proximity of all the wells, Well #17 has no influence on the other 3 wells.

- c) The current allocation DHHL has for pumping the Kualapuu Aquifer is 0.367 mgd. However, pumping records (**Appendix C-1**) show an average of 0.569 mgd (2005) and that up to 0.800 mgd is currently being pumped.
- d) DHHL has a 2.905 mgd reservation in the Kualapuu aquifer that has not been allocated.

³ Commission on Water Resource Management, Department of Land and Natural Resources, State of Hawaii

2. DHHL Potable Water System (**Exhibit 6**)

a) In 2005, The DHHL potable water system primarily served users in Hoolehua and Kalamaula.

▪ Hoolehua	232,474 gpd	(65.1%)
▪ Kalamaula	124,579 gpd	(34.9%)
▪ Total	357,053 gpd	

b) In 2005, the water demand from Non-DHHL users accounted for 33.6% of the total system demand.

▪ Non-DHHL Hoolehua	75,737 gpd
▪ Non-DHHL Kalamaula	44,179 gpd
▪ Non-DHHL Total	119,916 gpd

Largest Non-DHHL Users:

▪ Maui DWS	32,584 gpd
▪ Molokai Ranch	18,822 gpd
▪ LDS Church Hawaii	11,444 gpd
▪ Molokai Plumeria	11,310 gpd
▪ Molokai High School	8,866 gpd
▪ SDA Church	6,277 gpd
▪ R.W. Meyer	6,934 gpd
▪ Hawaiian Research	4,734 gpd
▪ Maui Electric Co.	2,452 gpd
▪ Molokai Airport	2,016 gpd

3. Maui Department of Water Supply System (**Exhibit 5**)

a) The Maui DWS Kaunakakai Water System has two potable water sources serving the system.

- Kualapuu Mauka Well (State Well No. 0801-03)
- Kawela Shaft (State Well No. 0457-01)

b) The current water allocation by the Commission on Water Resource Management (CWRM) for the Kualapuu Mauka Well is 0.516 mgd. Pumping records provided by CWRM shows the January-July 2006 average to be 0.697 mgd, which exceeds the current allocation.

c) The Maui Department of Water Supply (DWS) is currently researching sites to drill an additional

potable well source for the Kaunakakai water system due to the following reasons:

- Kualapuu Mauka well has been over pumping its allocation to meet current water demands.
- Kualapuu Mauka well has shown rising salinity levels.
- The Kawela Shaft has shown rising salinity levels.

4. Molokai Properties, Ltd. System

- a) Molokai Properties, Ltd., (MPL) owns and operates Well #17 (State Well No. 0901-01).
 - Well pump capacity of 1800 gpm using a 600 hp motor.
 - The current water allocation for Well #17 by CWRM is 1.018 mgd.
 - CWRM pumping records show the average to be 0.827 mgd (Jan. – May 2006)
- b) MPL currently pumps potable water from Well #17 into the Molokai Irrigation System's (MIS) 1.4 billion gallon Kualapuu Reservoir. This water is transported through the MIS and extracted to the west near Mahana for use in Molokai Properties' west Molokai developments. Only 90% of the water inserted into the MIS can be extracted primarily due to evaporation losses in the open air reservoir. This extracted water is then treated for potable use.

II. EXISTING DHHL WATER SYSTEM – Exhibit 6

a. Sources

1. Kauluwai Well No. 1 (State Well No. 0801-01) – Well was drilled in 1948 and has been in use since 1953. It is outfitted with a 200 hp motor with a 600 gpm pump.
2. Kauluwai Well No. 2 (State Well No. 0801-02) – Well was drilled in 1979 and has been in use since 1981. It is outfitted with a 300 hp motor with a 750 gpm pump.

b. Storage

1. 100,000 gallon Well Site tank (O.F. Elev. = 1029.50)
Serves as storage for the two well water sources to supply water into the distribution system.
2. 1,000,000 gallon Kauluwai tank (O.F. Elev. = 1432.00)
Primarily serves as an intermediate pass-through tank to provide water to the two 3.5 MG tanks that serve Hoolehua.
3. 3,500,000 gallon Hoolehua tanks (O.F. Elev. = 1040.00)
These two 3.5 MG reservoirs serve as the water storage for users in the Hoolehua service area.
4. 200,000 gallon Kalamaula reservoir (O.F. Elev. = 247.60')
Serves as the water distribution storage tank for the Kalamaula service area.

c. Transmission Mains

1. To Kalamaula – A 12" main transports water from the 100,000 gallon tank at the well site down to the 200,000 gallon storage tank that serves Kalamaula. A pressure reducing valve (PRV) is located on the transmission main at near the 720' elevation (Upstream pressure = 180 psi, Downstream pressure = 38 psi).
2. To Kauluwai – An 8" cast iron main transports water from the 100,000 gallon tank at the well site up to the 1,000,000 gallon Kauluwai reinforced concrete tank. Two 100 HP, 485 gpm booster pumps located at the well site boosts the water up when needed.
3. To Hoolehua – A 6" transite pipe delivers water from the 1,000,000 gallon Kauluwai tank to the two 3,500,000 gallon

Hoolehua tanks. A parallel 6" cast iron pipe was also utilized in the past, but deterioration has caused it to be abandoned.

d. Connections to Other Water Systems

1. The DHHL water system has an emergency connection to the DWS water system where the two systems cross paths north of the Kalamaula PRV. Gate valves control the opening and closing of the inter-connection. The DHHL tank (O.F. = 1029.50 F.F. = 1015.00) is lower than the DWS tank (O.F. = 1058.00 F.F. = 1040.00), making it possible to move water from the DWS to DHHL tank in an emergency. This connection also enables DHHL to provide water to the DWS Kaunakakai tank (O.F. Elev. = 253.20), if needed.

III. OTHER MOLOKAI POTABLE WATER SYSTEMS

a. Maui Department of Water Supply (DWS) – Exhibit 5

The Maui County Department of Water Supply has four water systems currently in use on Molokai.

1. Kawela-Kaunakakai System
2. Kalae System
3. Ualapue System.
4. Halawa System

The Kawela-Kaunakakai System is the largest and provides water along the South coast from Kaunakakai to Kawela through two sources, the Kualapuu Mauka Well (State Well No. 0801-03) and the Kawela Shaft (State Well No. 0457-01).

Kalae System is serviced by the DHHL Hoolehua water system. A booster pump at the 1.0 MG DHHL Kalae tank brings water to the DWS 100,000 gallon reservoir above Kalae.

b. Molokai Properties, Ltd. (MPL) – Exhibit 5

MPL operates Well #17 (State Well No. 0901-01), which is located approximately 500' west of the two DHHL wells. Well #17 currently has a pump capacity of 1800 gpm which is capable of producing up to 1,728,000 gpd.

MPL's primary demand areas are in the west Molokai areas of Maunaloa and Kaluakoi. Potable water from Well #17 is put into an adjoining transmission line of the non-potable Molokai Irrigation System (MIS). The water is transported west via the MIS and then extracted and treated for potable use.

1. Molokai Irrigation System

The Molokai Irrigation System originates in Waikolu Valley and extends westward though Hoolehua in the Kualapuu Sector. The system is owned and operated by the State of Hawaii, Department of Agriculture and serves DHHL homesteads, Molokai Agricultural Park, Molokai Ranch, and private diversified farmers. The sources of the MIS include ground water wells and stream diversions in Waikolu Valley.

As stated in the previous section, MPL transports water through the MIS to supply potable water to its developments on west Molokai. Potable water is pumped from Well #17 into a 30" MIS transmission line that fills the open air, 1.4 billion gallon, Kualapuu Reservoir. The non-potable water from the Kualapuu reservoir travels through a 24" pipe that goes through the south side of the DHHL Hoolehua homesteads to the Mahana Booster Pump Station. MPL extracts 90% of the water inserted into the MIS by Well #17, and pumps it into the 7,000,000 gallon Puu Nana Reservoir. The reduction in extracted water is due to 10% evaporation losses incurred during storage in the open-air Kualapuu Reservoir. After extraction, MPL treats the non-potable water for potable use and puts the treated potable water into their Kaluakoi, Maunaloa, and lower Manawainui water systems for consumption.

IV. DHHL LAND USE PLAN

a. Molokai Island Plan

1. The land use proposed for Hoolehua and Kalamaula described in the Molokai Island Plan is illustrated in **EXHIBIT 3 and 4** summarized in **Appendix A-1 and B-1**.
2. Water Demand for the planned land uses in the Molokai Island Plan is summarized as follows:
 - a) Average Day Demand
 - Hoolehua = 1,035,600 gpd
 - Kalamaula = 679,800 gpd
 - **Total = 1,715,400 gpd**
 - b) Maximum Day Demand
 - Hoolehua = 1,553,400 gpd
 - Kalamaula = 1,019,700 gpd
 - **Total = 2,573,100 gpd**
3. The proposed land uses in the Molokai Island Plan are described in **Table 2**.

**TABLE 2
DEPARTMENT OF HAWAIIAN HOMELANDS
LAND USE DESIGNATIONS**

SETTING/INTENT PURPOSE		LOT SIZE	MINIMUM INFRASTRUCTURE
Residential (Homestead)	Residential Subdivisions built to County standards in areas close to existing infrastructure.	≤ 1 acre	County Standards
Subsistence Agriculture (Homestead)	Small lot agriculture. Lifestyle areas intended to allow for home consumption of agricultural products. Occupancy optional.	≤ 5 acres	Water (catchment or potable or surface), Road Access
Supplemental Agriculture (Homestead)	Large lot agriculture. Intended to provide opportunities for agricultural production for supplemental income & home use. Occupancy optional. Farm plan & 2/3 cultivation required.	≤ 40 acres	Water (catchment or surface), Road Access
Pastoral (Homestead)	Large lot agriculture specifically for pastoral uses. Occupancy optional. Ranch plan and fencing required.	≤ 100 acres	Road Access, livestock drinking water
General Agriculture	Intensive or extensive farming or ranching allowed. Uses subject to HRS Chapter 205. May serve as interim use until opportunities for higher and better uses become available.	TBD	N/A
Special District	Areas requiring special attention because of unusual opportunities and/or constraints. E.g. natural hazard areas, open spaces, raw lands far from infrastructure (difficult to improve), mixed use areas, greenways	TBD	TBD
Community Use	Common areas for community uses. Includes space for parks & recreation, cultural activities, CBED, & other public amenities.	TBD (see standards)	County Standards
Conservation	e.g. watersheds, endangered species, sensitive historic & cultural sites.	TBD	N/A
Commercial	e.g. retail, business, and commercial activities	TBD (see standards)	County Standards
Industrial	e.g. processing, construction, manufacturing, transportation, wholesale, and warehousing	TBD	County Standards

Source: Molokai Island Plan, Department of Hawaiian Homelands, State of Hawaii, prepared by Group 70 International, June 2005, page 2-7

V. WATER SYSTEM CONSTRAINTS AND OPPORTUNITIES/REMEDIES

a. Source

1. Constraints

- a) CWRM records indicate that DHHL pumps 0.569 mgd (2005) from the two existing wells, which exceeds their permitted water allocation of 0.367 mgd.
- b) The cluster of 3 wells, including the two DHHL wells and County DWS well, has shown rising chloride levels.
- c) Occasional electrical power failures on Molokai have been known to occur. DHHL currently has no backup power sources to use in the event of a prolonged power outage, which would keep the source wells out of service.
- d) DHHL well pump operation protocol is primarily based on Maui Electric Company's power rate schedule. DHHL attempts to only operate the well pumps during the off-peak power rate periods to avoid high power costs. This limitation on pump operation often leads to low tank water levels.
- e) Presently, DHHL well sources are not adequate to support the full build-out of the land uses in Hoolehua and Kalamaula presented in the Molokai Island Plan. Source development is a primary requirement.
 - o Full-Build out average day demand
 - i. 1,715,400 gpd
 - o Current CWRM Water Allocation
 - i. 367,000 gpd
 - o 2005 avg. day production
 - i. 569,000 gpd
- f) Increasing production from the existing wells may not be feasible due to their close proximity and increasing chloride concentrations at the current pumping rate.
- g) Pacific Electro-Mechanical provides servicing to various components of the water system. Their records indicate that the venturi flow meters at the well site were last calibrated in November of 2005.

They have made repairs in May 2004 and August 2006 to the flow meters due to corrosion blockage at the pressure ports.

2. Opportunities/Remedies

a) Perform testing of the three wells (DHHL and DWS) to determine the feasible pumping rate of each well. Once established, further conclusions can be made to determine the number of additional sources needed to service existing users and planned future development.

b) Molokai Properties, Ltd. current pumping capacity at Well 17 is 1,728,000 gpd. MPL has stated that it needs 1,000,000 gpd for its development needs and has a surplus of 500,000 gpd. MPL is willing to offer the 500,000 gpd surplus to DHHL in return for a water line easement through DHHL lands that would allow MPL to increase the size of their current water transmission main.

Under the 2005 demands, an additional 500,000 gallons per day would provide enough water for DHHL to reduce pumping volume at the Kualapuu wells to within the CWRM permitted allocation. This condition would have positive effects on the aquifer and also reduce DHHL's power cost to produce the water.

c) Purchase a generator to be used in case of a power failure to ensure continuous water service to the DHHL Water System.

d) Purchase a diesel generator to be the primary source of power to the well pumps. This will remove any constraints on the pumping procedures that are caused by the Maui Electric Company's power rate schedule. In addition, DHHL currently pays \$1.59 per 1,000 gallons in electrical power costs. The estimated diesel power cost is \$1.45 per 1,000 gallons. **(See Appendix F)**

e) Calibrate, inspect, and repair and/or replace the flow meters at the well pump station.

b. Storage

1. Constraints

- a) The existing 100,000 gallon reservoir at the well site is inadequate to service the entire Hoolehua water system.
 - Both of DHHL's well sources for the water system pump into the 100,000 gallon tank.
 - The 200,000 Kalamaula tank and 1,000,000 gallon Kauluwai tank both receive water from the 100,000 gallon tank, with the Kalamaula tank having the higher priority. During periods of high demand, the booster pump that serves the Kauluwai tank could be locked out of additional water due to high demand in Kalamaula.
- b) The 1,000,000 gallon Kauluwai tank has approximately 4' of unusable water storage volume. The outlet pipe from the tank is 4' higher than the floor of the tank.
- c) There are no existing booster pumps to bring water back up from the two 3,500,000 gallon Hoolehua tanks to the 1,000,000 gallon Kauluwai tank.

2. Remedies

- a) Increased storage capacity at the well site would provide more flexibility for the entire system and create a more reliable water system.
- b) Lower the outlet pipe at the 1,000,000 gallon Kauluwai tank to enable use of the entire tank volume.

c. Transmission

1. Constraints

- a) The existing 6" transite pipe connecting the 1.0 MG Kauluwai tank to the two 3.5 MG Hoolehua tanks is aging and may not be able to carry pressure higher than the existing conditions.

- b) The 6" transite pipe does not have the capacity to support the full build-out demand of the Hoolehua area.
- c) Two existing 500 gpm booster pumps serving the Kauluwai tank does not have the capacity to support the full-build out of the Hoolehua area.

2. Remedies

- a) Replace the existing 6" transite pipe with a larger 12" transmission main.
- b) Increase the capacity of the booster pumps at the well site.
- c) Develop a new water source that will either feed into the 1.0 MG Kalae tank or the two 3.5 MG tanks in Hoolehua. This will reduce or eliminate the need to transmit water from the existing Kauluwai wells to Hoolehua.

d. Operational

1. Constraints

Interviews with the DHHL operations and maintenance staff⁸ of the water system have revealed the following concerns:

- a) Increase the storage capacity at the well site to ensure water can be supplied to the 200,000 gallon Kalamaula tank and the 1,000,000 gallon Kauluwai tank during periods of high demand. When tank level drops too low, booster pumps cannot boost water up to Kauluwai tank.
- b) Booster pumps that bring water from the well site to the 1.0 MG Kauluwai tank are operated using manual timers. Operations crew must estimate the time needed to fill the upper tank and set the timers accordingly. This system commonly leads to over or under filling of the Kauluwai tank.

⁸ George Maioho and Larry Sagario, August 29, 2006. See Appendix for Meeting Minutes.

- d) There is no altitude valve controlling flow from the Kauluwai tank to the Hoolehua tanks. Flow is controlled manually via two gate valves at the Kauluwai tank site. One valve is throttled down to achieve the desired flow rate, while the second valve opens or closes the flow through the pipe. Overfilling of the Hoolehua tanks or draining of the Kauluwai tank has been known to occur.
- e) There is a 210,000 gpd water loss throughout the system. Based on the 569,000 gpd average pumping for 2005, the system loses nearly 37% of the pumped water.

2. Remedies

- a) Increased storage capacity at well sites would provide more storage for the entire DHHL water system and create a more reliable water system.
- b) Install a SCADA system to improve system control and monitoring capabilities.
- c) Perform a water loss study to determine the cause of the water loss.

VI. MAUI COUNTY DEPT. OF WATER SUPPLY POTABLE WATER SYSTEM DESIGN STANDARDS

a. Consumption Guidelines

1. The unit consumptions for the various land uses are shown below and are based on the Maui County 2002 Water System Standards.

<u>Land Use</u>	<u>Average Daily Demand</u>
Single Family	600 gallons/unit
Commercial/Cummnunity Use	6000 gallons/acre

2. See **Appendix A-1 and B-1 – POTABLE WATER DEMAND SUMMARY**
3. See **Table 2** for a description of the land uses shown in the Molokai Island Plan.
4. The MIS will provide non-potable water for agricultural uses. This report assumes one single family unit for residential and subsistence agriculture zoned land. There are no potable water demands for supplemental agriculture, general agriculture, and pastoral zoned land.
5. Deviation from Maui County Standards
 - a) The following adjusted average daily demands were derived based on DHHL meter readings for 2005 (**Appendix D**).
 - Residential (Hoolehua) – 500 gpd
 - Residential (Kalamaula) – 800 gpd
 - Commercial – 1000 gallons/acre
 - Community Use – 1000 gallons/acre
6. Calculations were completed using both the Maui County Standard demands and the adjusted demands. The results can be found in **Section VII** and **Appendix A and B**.

b. Demand Factors

1. Maximum Daily Demand = 1.5 x Average Day Demand
2. Peak Hour Demand = 3.0 x Average Day Demand

c. Fire Flow Requirements

1. Rural Residential = 1000 gpm for 2-hours
2. Commercial Areas, Schools = 2000 gpm for 2-hours

d. Pipe Sizing

1. Maximum daily flow plus fire flow with residual pressure of 20 psi at critical fire hydrant.
2. Peak hour flow with a minimum residual pressure of 40 psi.
3. In determining the capacity of the mains, the "C" value to be applied are as follows:

<u>Diameter</u>	<u>"C" Value</u>
8" & 12"	110
16" & 20"	120
24" & 30"	130

4. Maximum velocity in distribution main (without fire flow) is 6-feet per second.
5. Maximum static pressure or pumping pressure, whichever is greater, shall not exceed 125 psi.

e. Reservoir Capacity

1. Meet maximum day consumption. Reservoir fills at the beginning of the 24-hour period with no source input to the reservoir.
2. Meet maximum day consumption plus fire flow for duration of fire. Reservoir $\frac{3}{4}$ -full at start of fire, with credit for incoming flow from pumps.
3. Minimum reservoir size shall be 100,000 gallons. Reservoir size shall be as specified in Section 105.10 – RESERVOIR, Subsection A – Size.
4. Where there are two or more reservoirs serving the same system, the design shall be made on the basis of the combined protection by all facilities available.

f. Well Pump Capacity

1. Meet average day demand with an operating time of 16-hours or meet maximum day demand with an operating time of 24 hours with larger pump unit on standby and not contributing to flow requirements.

VII. WATER SYSTEM ANALYSIS SUMMARY

The proposed water system improvements and proposed operation criteria based on discussed in (**See CHAPTER VI – MAUI COUNTY DEPT. OF WATER SUPPLY POTABLE WATER SYSTEM DESIGN STANDARDS**) and the water system hydraulic calculations in the Appendices are as follows:

- a. Water Source Requirements – **Maui DWS Standards (Appendix A-1 and B-1)**
 1. The Molokai Island Plan water demand requirements, based on Maui County DWS Standards, for Hoolehua and Kalamaula are as follows:
 - a) Hoolehua Average Day Demand = 954,600 gpd
Kalamaula Average Day Demand = 679,800 gpd
Total Average Day Demand = 1,634,400 gpd
 - b) Hoolehua Max. Day Demand = 1,431,900 gpd
Kalamaula Max. Day Demand = 1,019,700 gpd
Total Max. Day Demand = 2,451,600
 - c) Hoolehua Peak Hour Demand = 2,863,800 gpd
Kalamaula Peak Hour Demand = 2,039,400 gpd
Total Peak Hour Demand = 4,903,200 gpd
 2. Well Pump Capacity
 - a) Average Day Demand = 1,634,400 gpd
1,765,750/16-hours/60 min. per hr. = 1702.5 gpm
 - b) Maximum Day Demand = 2,451,600 gpd
2,648,625/24-hours/60 min. per hr. = 1702.5 gpm

Source required = 2.451 mgd = 1,703 gpm

Kauluwai Well #1 = 700 gpm
Kauluwai Well #2 = 650 gpm

Existing installed pump capacity = 1350 gpm
Existing CWRM permitted allocation = 367,000 gpd

Additional pump capacity required = 350 gpm
Additional allocation required = 2.085 mgd

b. Water Source Requirements – **Modified Demand Standard (Appendix A-3 and B-3)**

1. The proposed water demand requirements, based on the modified Maui County DWS Standards, for Hoolehua and Kalamaula are as follows:

- a) Hoolehua Average Day Demand = 696,000 gpd
Kalamaula Average Day Demand = 468,400 gpd
Total Average Day Demand = 1,164,400 gpd
- b) Hoolehua Max. Day Demand = 1,044,000 gpd
Kalamaula Max. Day Demand = 702,600 gpd
Total Max. Day Demand = 1,746,600 gpd
- c) Hoolehua Peak Hour Demand = 2,088,000 gpd
Kalamaula Peak Hour Demand = 1,405,200 gpd
Total Peak Hour Demand = 3,493,200 gpd

2. Well Pump Capacity

- a) Average Day Demand = 1,164,400 gpd
1,138,400/16-hours/60 min. per hr. = 1212.9 gpm
- b) Maximum Day Demand = 1,746,600 gpd
1,707,600/24-hours/60 min. per hr. = 1212.9 gpm

Pump capacity required = 1,200 gpm

Kauluwai Well #1 = 700 gpm

Kauluwai Well #2 = 650 gpm

Existing installed pump capacity = 1350 gpm

Existing CWRM permitted allocation = 367,000 gpd

Additional pump capacity required = 0 gpm

Additional allocation required = 1.380 mgd

c. Reservoir Capacity Requirements –Maui DWS Standards

1. Kalamaula Reservoir at elevation 217'

- a) Case A: Meet max day demand in 24-hours
Size Required = 1,019,700 gallons

- b) Case B: Meet max day + fire flow, reservoir $\frac{3}{4}$ -full
Max. day rate = 1,019,700 gpd = 708 gpm
Fire flow = 2000 gpm for 2-hours
Max. day rate + fire flow for 120 minutes is 2708 gpm
x 120 min. = 324,960 gallons
Assume no flow from pumps
Size Required = $324,960 / .75 = \underline{433,280 \text{ gallons}}$

Case A governs:

Minimum Reservoir Capacity = 1,000,000 gallons

Existing Kalamaula Reservoir = 200,000 gallons

Additional Storage Required = 800,000 gallons

2. Hoolehua Reservoir at elevation 1020'

- a) Case A: Meet max day demand in 24-hours
Size Required = 1,431,900 gallons
- b) Case B: Meet max day + fire flow, reservoir $\frac{3}{4}$ -full
Max. day rate = 1,431,900 gpd = 995 gpm
Fire flow = 2000 gpm for 2-hours
Max. day rate + fire flow for 120 minutes is 2995 gpm
x 120 min. = 359,400 gallons
Assume no flow from pumps
Size Required = $359,400 / .75 = \underline{479,200 \text{ gallons}}$

Case A governs:

Minimum Reservoir Capacity = 1,500,000 gallons

Existing Hoolehua Reservoir = 7,000,000 gallons

Additional Storage Required = 0 gallons

d. Transmission Main Requirements

- 1. Three transmission mains that bring water from the well site to the distribution networks.
 - a) Pipe A – 12" from well site to Kalamaula tank
 - b) Pipe B – 8" from well site to Kauluwai tank
 - c) Pipe C – 6" from Kauluwai tank to Hoolehua tanks

2. All transmission main capacities are sufficient to meet existing demands.
3. Improvements to the transmission mains will be needed to meet the water requirements of the Molokai Island Plan.
 - a)

VIII. CONCLUSIONS AND RECOMMENDATIONS

Based on the information presented in this report, the following recommendations are made for improving the existing operational capabilities of the water system and ensuring DHHL's ability to adequately provide water needed to implement their Molokai Island Plan.

a. Existing Potable Water System

1. Kualapuu Aquifer Safe Pumping Yield

a) Conclusion

Current pump records show that DHHL and Maui DWS are over pumping their water allocation permitted by CWRM for the Kualapuu Aquifer. Rising chloride concentrations observed at the two DHHL wells and Maui County's well indicate that these wells may be negatively influencing each other due to their close proximity. It may also indicate that the wells may have exceeded their respective safe pumping yields.

b) Recommendation

Conduct a coordinated verification-test of the DHHL and Maui DWS wells to confirm the safe pump operating capacity to preserve the integrity of the aquifer. The safe operating capacities of the wells will establish a baseline of water resource for future development.

Probable Cost = \$200,000

2. Unaccounted Water

a) Conclusion

For 2005, the two DHHL well pumps produced an average of 570,000 gpd. During the same period, the recorded consumer meter readings show an average consumption of 350,000 gpd. This shows a discrepancy of over 200,000 gpd between the water being put into the system and the water being consumed by users. As a part of this study, the well pump meters have been calibrated and shown to be accurate.

b) Recommendation

Conduct a water loss investigation of the existing system to determine the causes of the water loss and establish a baseline of current water usage.

Probable Cost = \$100,000

3. Additional Source Development

a) Conclusion

DHHL is currently exceeding their well pumping allocation to meet existing demands. Additional water source development is required to maintain service to existing customers and conform to the water allocation set by CWRM.

b) Option #1

DHHL develops a well to supplement the two existing wells.

Probable Cost = \$4,000,000 to \$6,000,000

c) Option #2

Maui DWS is currently searching for a site to develop a well to replace and/or supplement its existing well. DHHL partners with Maui DWS to have the well located in DHHL land in a location determined by a hydro-geologist and that is beneficial to DHHL's interests.

Probable Cost to be Determined.

d) Option #3

DHHL partners with Molokai Ranch to receive excess water (500,000 gpd) from Well #17. Well #17 is a proven water source with no apparent influence on the existing DHHL and Maui DWS wells. This option will require DHHL to negotiate easements to the west end of the island for Molokai Ranch's interests and is very controversial.

Probable Cost to be Determined.

4. Electrical Power System

a) Conclusion

DHHL operates its well and booster pumps during the off-peak hours according to Molokai Electric Company's rate schedule. This is done to keep electrical costs down, but it restricts efficient and proper operation of the DHHL water system and is the main cause of complex system operation. In addition, power outages in the past have kept the well pumps out of service long enough to drop the Kalamaula and Kauluwai tank levels very low.

b) Recommendation

Purchase a diesel generator to be the primary power source for the well pumps. This will eliminate any pumping restrictions created by Maui Electric Company's power rate schedule, and the system will not be affected by electric power outages. At minimum, the system needs a stand-by generator to ensure continued water service during extended power outages. Electrical power can be used as the back up power source.

Probable Construction Cost = \$200,000

5. Well Site Water Storage Capacity

a) Conclusion

The existing 100,000 gallon tank at the well site receives all the water produced by the well pumps and distributes water to both Kalamaula and Hoolehua. It is too small to adequately support the current operation of the water system. A larger tank would greatly enhance the dependability of the water system during periods of high demand.

b) Recommendation

Increase the storage capacity at the well site to a minimum of 200,000 gallons.

Probable Construction Cost = \$800,000

6. System Control and Operation

a) Conclusion

Currently, the well and booster pumps at the well site are operated using manual timers. The transmission of water from the 1.0 MG Kauluwai Tank to the Hoolehua Tanks is controlled manually through a gate valve. Both of these conditions lead to tank over filling or under filling and lowering the overall efficiency of the system.

b) Recommendation

Install a SCADA control system to provide greater system control and monitoring, leading to increased operational efficiency.

Probable Construction Cost = \$200,000

7. 1,000,000 gallon Kauluwai tank

a) Conclusion

Floor of the existing 1,000,000 Kauluwai tank is approximately 4' lower than the high point of the outlet pipe. This condition decreases the operational volume of the tank.

b) Recommendation

Lower the profile of the outlet pipe at the 1,000,000 gallon Kauluwai tank.

Probable Construction Cost = \$100,000

8. Minimizing Agricultural Use of Potable Water

a) Conclusion

The DHHL homesteads in Hoolehua have a dual water system available that provides potable water via DHHL's water system and irrigation water via the MIS. There are homestead lessees that are only utilizing the potable water system, mainly due to the \$3,000 cost of installing a MIS meter. Currently, the cost of potable water is \$0.70 per 1,000 gallons and irrigation water is \$0.32 per 1,000 gallons. Maximizing use of the MIS (lawns, plants, agriculture, etc.), where available, would decrease the demand on the potable water system.

b) Recommendation

Encourage the use of MIS water for irrigation purposes. Subsidizing the \$3,000 cost to install a MIS meter for lots not currently serviced by the MIS would help homesteaders overcome the up-front cost. Increasing the use of MIS water will decrease potable water demand from the existing users. This will make more potable water available for additional development.

Probable Construction Cost to be Determined

b. Development Potable Water System Improvements

1. Potable Water Source

a) Conclusion

The projected average day water demand to support the full-build out of the land uses presented in the Molokai Island Plan in Hoolehua and Kalamaula is 1,715,400 gallons per day. This demand will require total well pump capacity of about 1700 gpm. DHHL currently has an installed pump capacity of 1350 gpm, but its permitted allocation is only 367,000 gallons per day. Considering the close proximity of the wells and increasing chloride levels, the sustainable yield of each well needs to be determined and verified before the permitted allocation can be increased.

b) Recommendation

Develop the water sources necessary to satisfy the 1700 gpm water required to implement the Molokai Island Plan. If the costs associated with source development are infeasible or the aquifer cannot sustain the required pumpage, the Molokai Island Plan will need to be revised based on available source capacity.

Probable Construction Cost = \$2,000,000

2. Maui DWS Standards Consumption Guidelines

a) Conclusion

The Maui DWS Standards specify that the average daily demand for residential lots shall be 600 gpd and commercial land uses shall be 6000 gallons per acre. However, 2005 DHHL meter data for Molokai **(Appendix D)** show Hoolehua lots using 500 gpd, Kalamaula lots using 800 gpd, and the majority of commercial users consuming less than 1000 gallons per acre of potable water.

b) Recommendation

Use modified standard consumptions of 500 gpd for Hoolehua residences, 800 gpd for Kalamaula residences and 1000 gallons per acre for commercial land uses. This modified consumption standard can be used for future development studies and is more representative of the actual consumption conditions of existing commercial users.

3. Kalamaula Water Storage

a) Conclusion

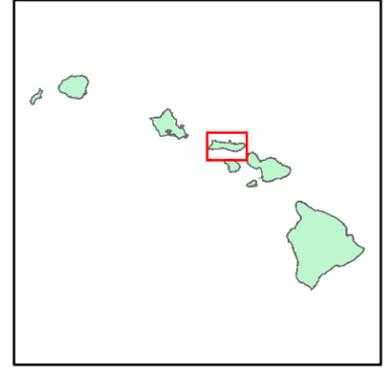
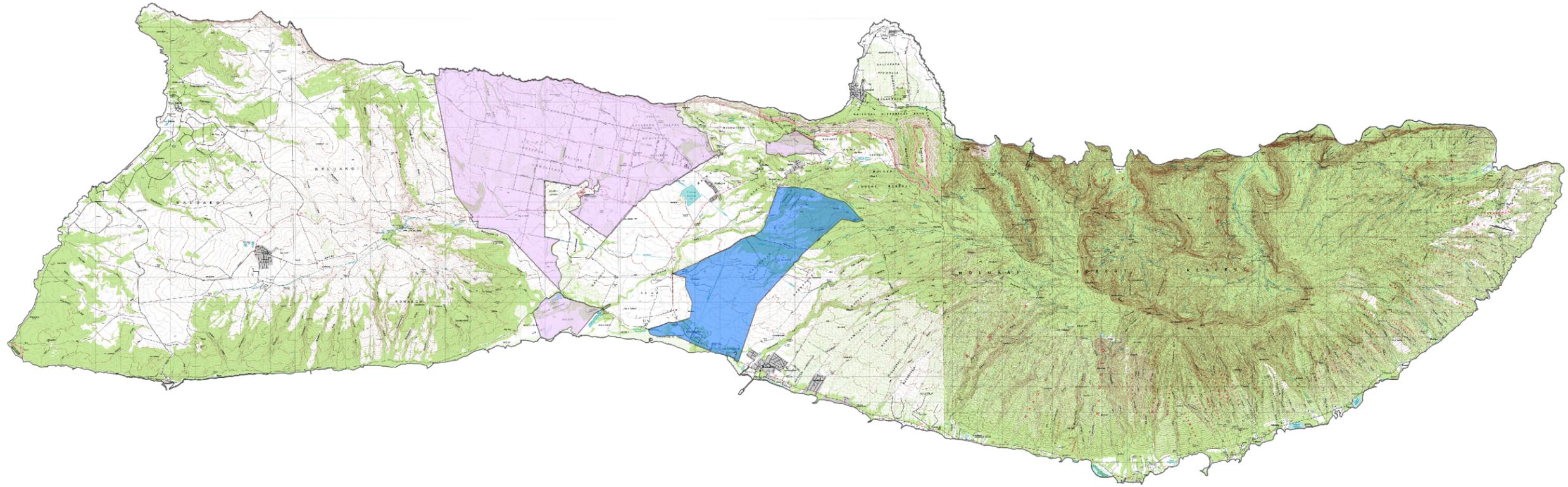
The projected maximum day water requirement for the full-build out of Kalamaula is 1,019,700 gpd, which would require a minimum storage tank volume of 1,000,000 gallons. The existing tank serving Kalamaula is 200,000 gallons and will be inadequate to support the planned future development. An additional 800,000 gallons of water storage will be needed.

b) Recommendation

Provide 800,000 gallons of additional storage to support the future development of Kalamaula shown in the Molokai Island Plan.

Probable Construction Cost = \$2,000,000

EXHIBITS



Legend

NAME

	DHHL - Kalamaula
	DHHL - Hoolehua-Palaau

DHHL MOLOKAI WATER MASTER PLAN

LOCATION MAP

PREPARED BY: AKINAKA & ASSOCIATES, LTD.

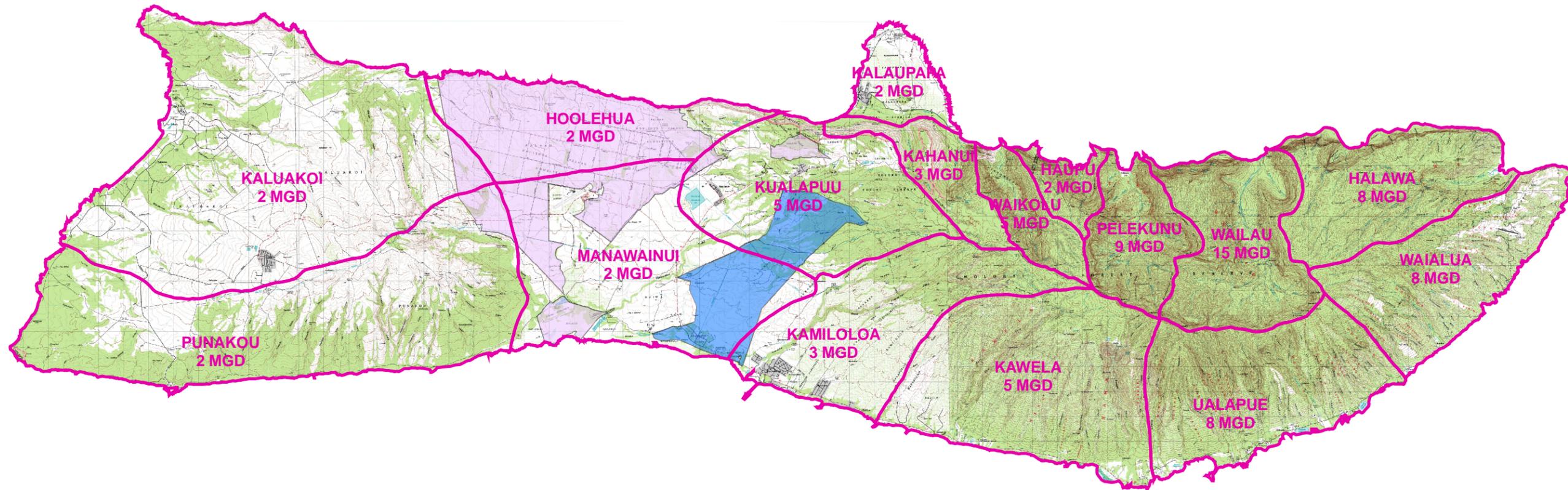
CONSULTING ENGINEERS



EXHIBIT

1

Date: 12/1/2006



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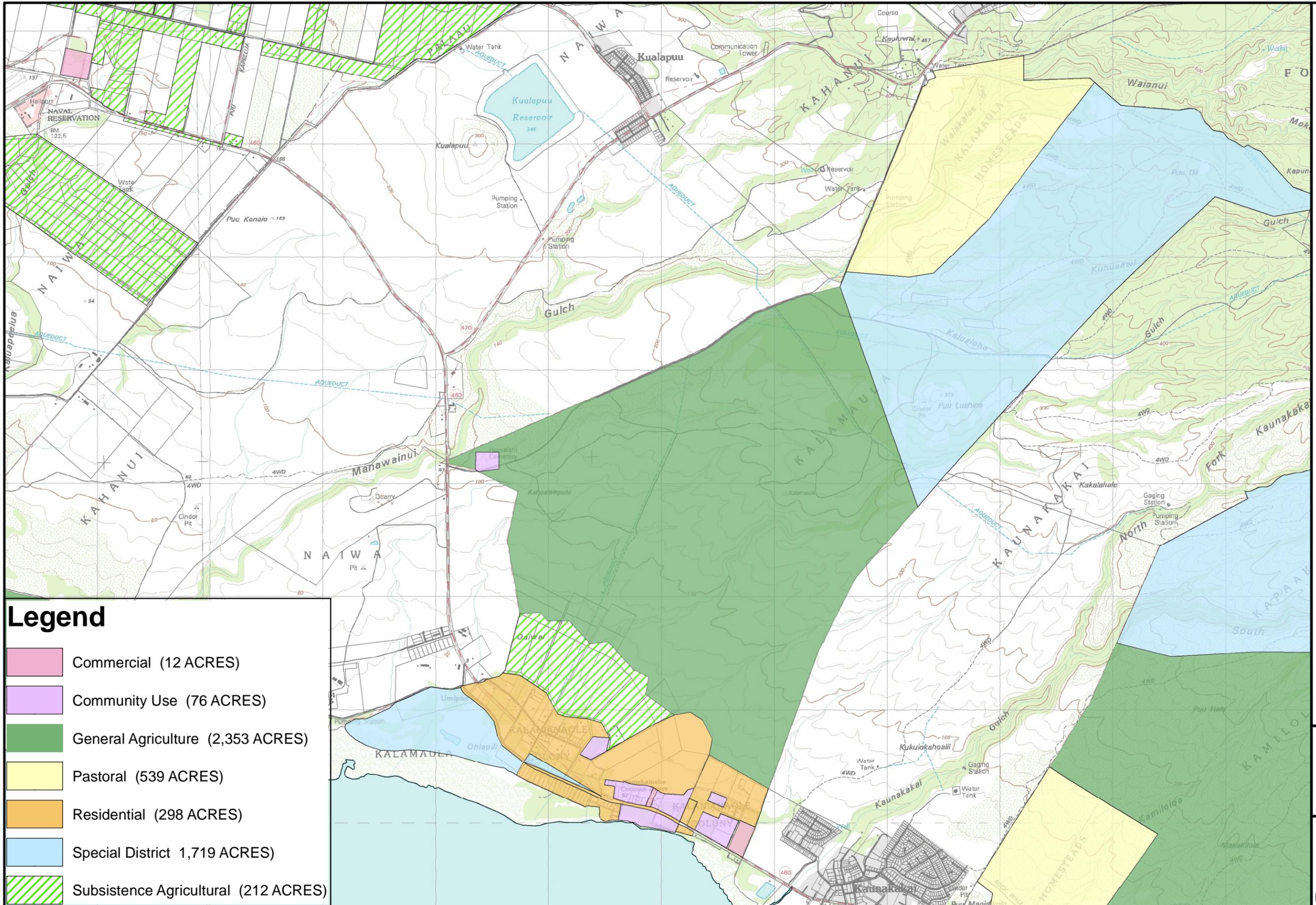
- Aquifer Boundaries (DLNR)
- DHHL - Kalamaula
- DHHL - Hoolehua-Palaau

SUSTAINABLE YIELD MAP



EXHIBIT

2



Legend

- Commercial (12 ACRES)
- Community Use (76 ACRES)
- General Agriculture (2,353 ACRES)
- Pastoral (539 ACRES)
- Residential (298 ACRES)
- Special District 1,719 ACRES)
- Subsistence Agricultural (212 ACRES)

DHHL MOLOKAI WATER MASTER PLAN

KALAMAULA LAND USE PLAN

CONSULTING ENGINEERS

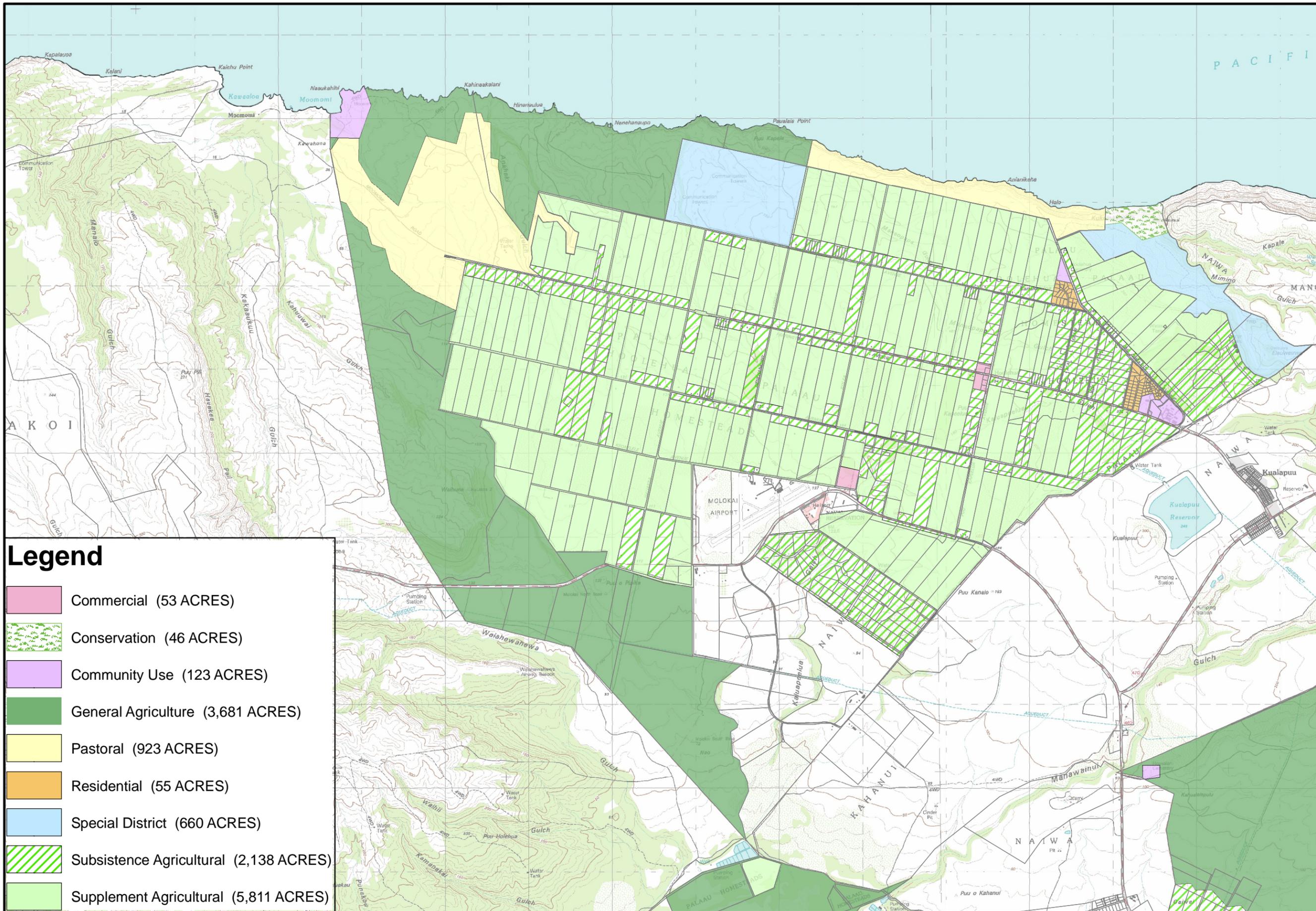
PREPARED BY: AKINAKA & ASSOCIATES, LTD.



EXHIBIT

3

Date: 12/1/2006



Legend

- Commercial (53 ACRES)
- Conservation (46 ACRES)
- Community Use (123 ACRES)
- General Agriculture (3,681 ACRES)
- Pastoral (923 ACRES)
- Residential (55 ACRES)
- Special District (660 ACRES)
- Subsistence Agricultural (2,138 ACRES)
- Supplement Agricultural (5,811 ACRES)

DHHL MOLOKAI WATER MASTER PLAN

HOOLEHUA LAND USE PLAN

CONSULTING ENGINEERS

PREPARED BY: AKINAKA & ASSOCIATES, LTD.



EXHIBIT

4

Date: 12/1/2006

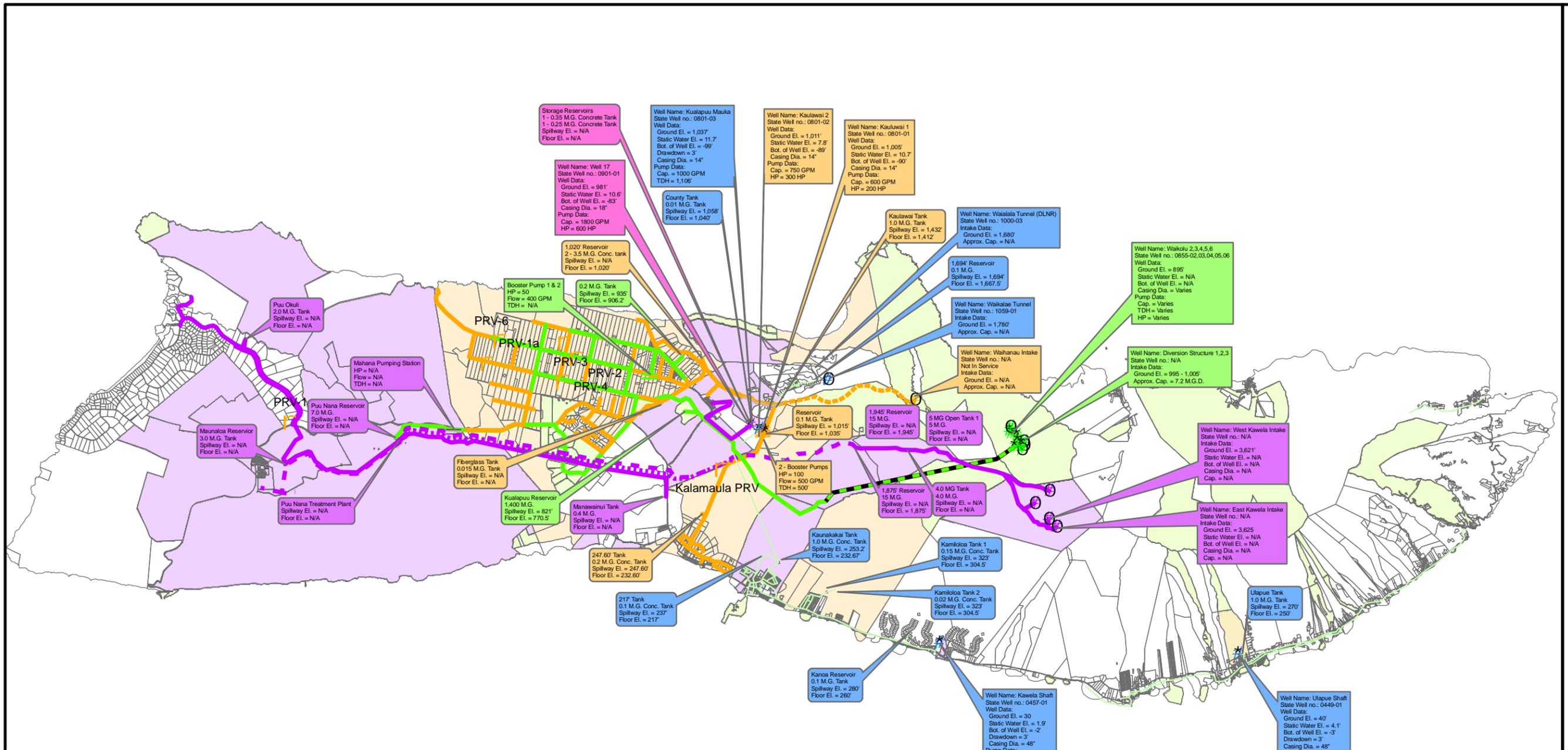
DHHL MOLOKAI WATER MASTER PLAN

OVERALL MOLOKAI WATER SYSTEMS MAP

EXHIBIT

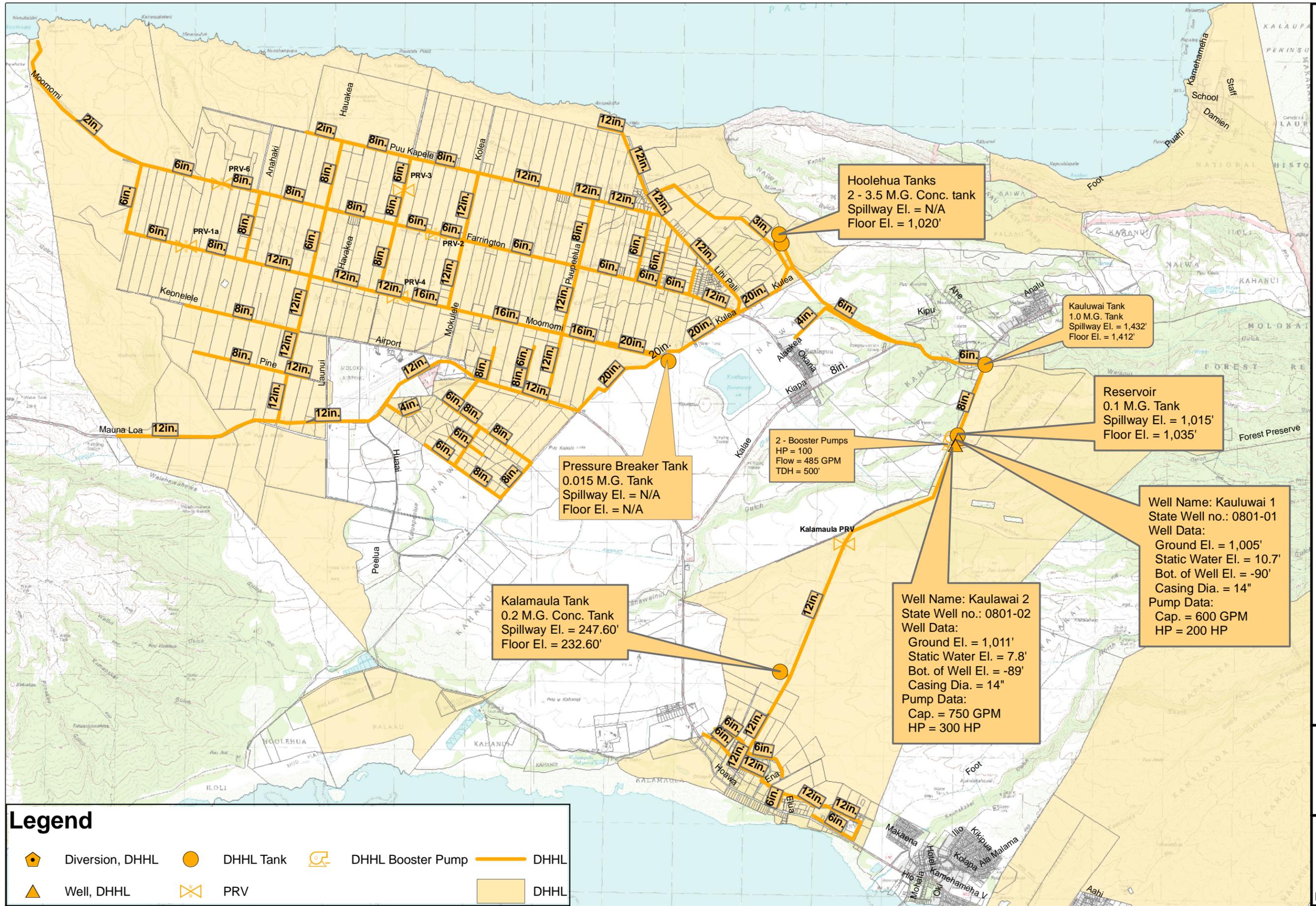
5

Date: 12/1/2006



SOURCES		STORAGE		PIPES	
TYPE, OWNER		STORAGE, OWNER		OWNER	
	Intake, DHHL (Disconnected)		RESERVOIR, Molokai Irrigation		00County of Maui
	Intake, Molokai Irrigation		RESERVOIR, Molokai Ranch		00DHHL
	Intake, Molokai Ranch		TANK, County of Maui		00DHHL (Disconnected)
	Tunnel, County of Maui (Disconnected)		TANK, DHHL		00DHHL/MIS
	Well, County of Maui		TANK, Del Monte		00Kaula Koi
	Well, DHHL		TANK, Kalua Koi		00Meyers Subdivision
	Well, Kalua Koi		TANK, Molokai Irrigation		00Molokai Irrigation
	Well, Maui County		TANK, Molokai Ranch		00Molokai Irrigation (Tunnel)
	Well, Molokai Irrigation				00Molokai Ranch (DRY)
					00Molokai Ranch (Non-Potable)
					00dhhl

PUMP		PIPES	
LABEL, OWNER		OWNER	
	PRV		Molokai_Ranch
	Booster Pump 1, Molokai Irrigation		DHHL
	Booster Pump 2, Molokai Irrigation		State_Lands
	DHHL 1, DHHL		
	DHHL 2, DHHL		
	Mahana Pumping Station, Molokai Ranch		



Legend

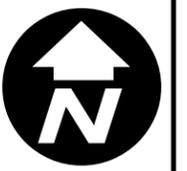
- Diversion, DHHL
- DHHL Tank
- DHHL Booster Pump
- DHHL
- Well, DHHL
- PRV
- DHHL

DHHL MOLOKAI WATER MASTER PLAN

DHHL MOLOKAI WATER SYSTEM MAP

CONSULTING ENGINEERS

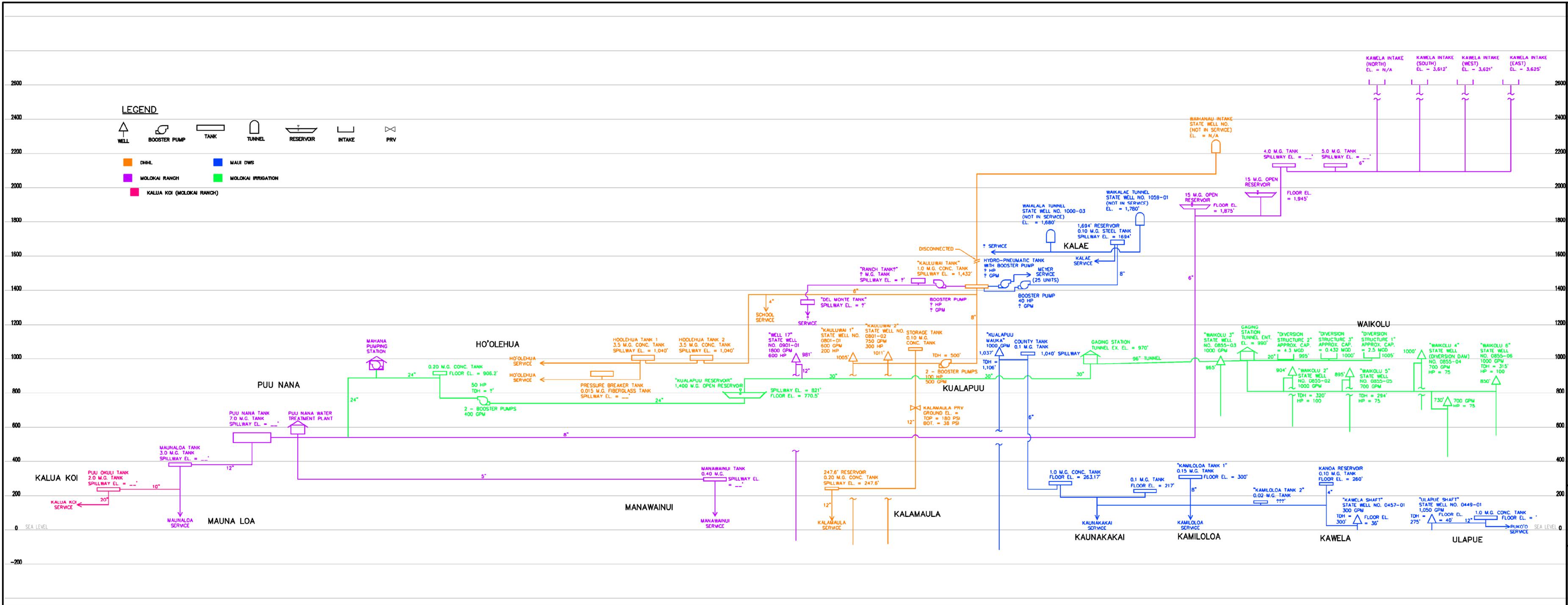
PREPARED BY: AKINAKA & ASSOCIATES, LTD.

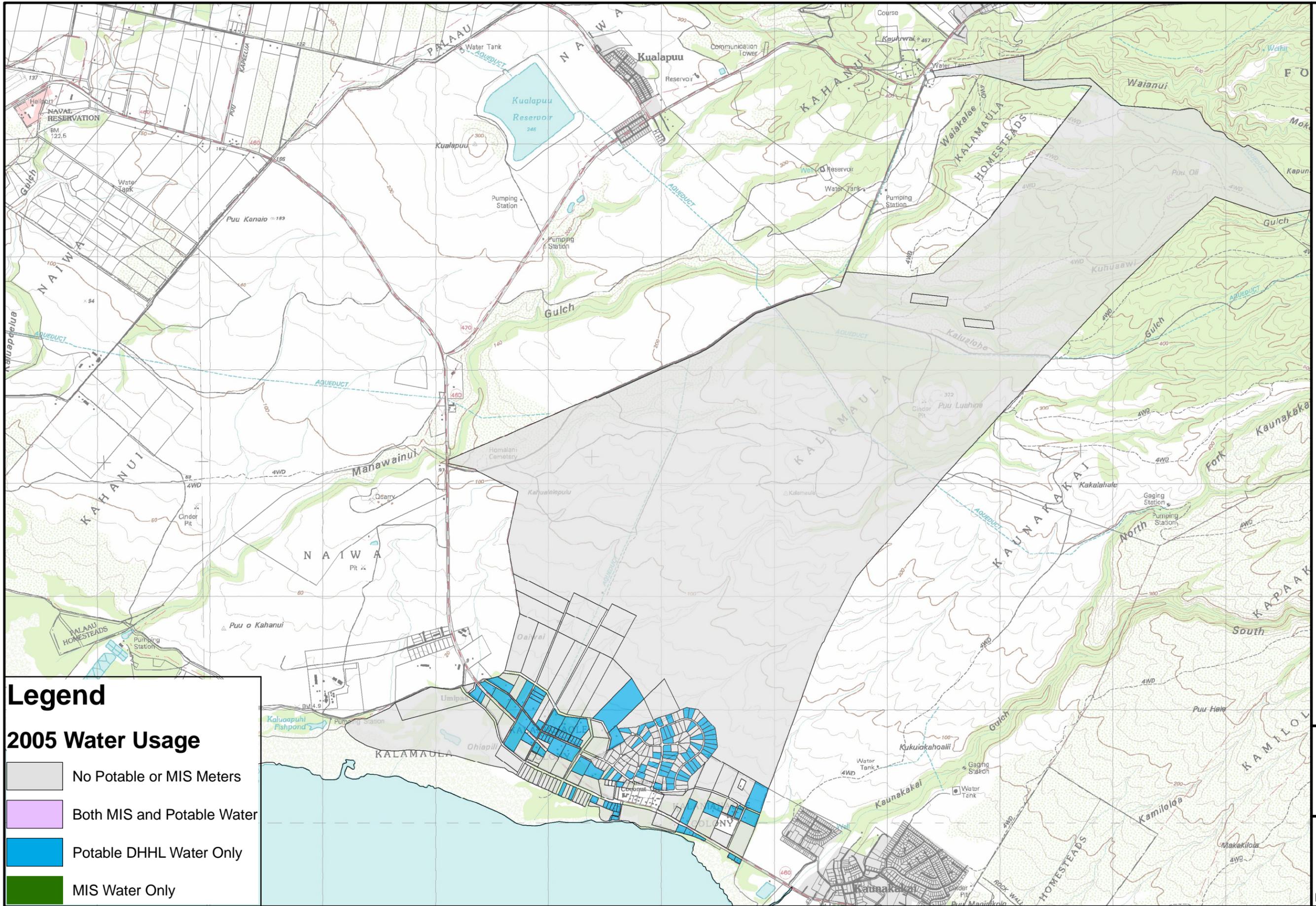


EXHIBIT

6

Date: 12/1/2006





Legend

2005 Water Usage

- No Potable or MIS Meters
- Both MIS and Potable Water
- Potable DHHL Water Only
- MIS Water Only

DHHL MOLOKAI WATER MASTER PLAN

2005 KALAMAULA WATER USE

CONSULTING ENGINEERS

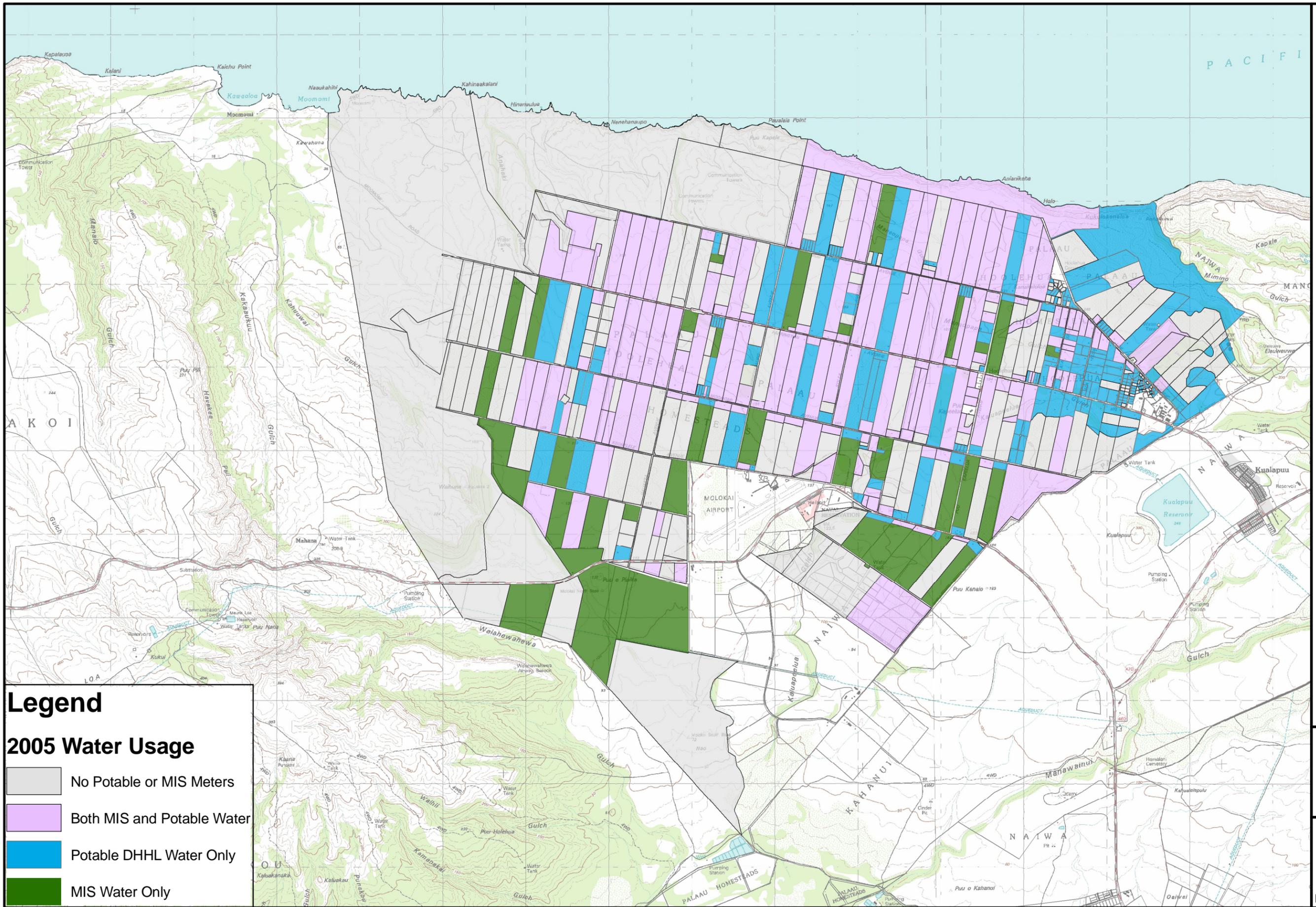
PREPARED BY: AKINAKA & ASSOCIATES, LTD.



EXHIBIT

8

Date: 5/14/2007



Legend

2005 Water Usage

- No Potable or MIS Meters
- Both MIS and Potable Water
- Potable DHHL Water Only
- MIS Water Only

2005 HOOLEHUA WATER USE



APPENDIX A-1

MOLOKAI ISLAND PLAN
PROJECTED WATER DEMAND SUMMARY FOR KALAMAULA
MAUI DWS STANDARDS

**MOLOKAI ISLAND PLAN
WATER SYSTEM MASTER PLAN
POTABLE WATER SYSTEM
WATER DEMAND - MAUI COUNTY DWS STDS.
KALAMAULA**

LAND USE	ACRES	NO. OF UNITS	GAD	GPD/ UNIT	AVE. ANNUAL DAY RATE (GPD)	MAXDAY RATE 1.5 X AVE. (GPD)	PEAK HR RATE 3.0 X AVE. (GPD)
POTABLE WATER							
EXIST'G RESIDENTIAL (1.0 AC.)	210.0	123		600	73,800	110,700	221,400
RESIDENTIAL (1.0 AC)	88.0	57		600	34,200	51,300	102,600
SUBSIST. AGRICULTURE (2-4 ACS.)	212.0	63		600	37,800	56,700	113,400
COMMUNITY USE	76.0		6000		456,000	684,000	1,368,000
SPECIAL DISTRICT - NRMSAA	1344.0				0	0	0
SPECIAL DISTRICT - WETLAND	363.0				0	0	0
SPECIAL DISTRICT - FLOOD CTRL	12.0				0	0	0
COMMERCIAL	13.0		6000		78,000	117,000	234,000
CONSERVATION	46.0						
POTABLE TOTAL =	2364.0	243			679,800	1,019,700	2,039,400

NOTES:

1. Source of information:
 - a) Molokai Island Plan, Baseline Information Report by Group 70, Dec. 2004
 - b) DHHL Molokai Island Plan by Group 70, June 2000
2. 2002 Water System Standards (Maui County DWS)

APPENDIX A-2

MOLOKAI ISLAND PLAN
PROJECTED WATER DEMAND SUMMARY FOR KALAMAULA
MODIFIED STANDARDS

**MOLOKAI ISLAND PLAN
WATER SYSTEM MASTER PLAN
POTABLE WATER SYSTEM
WATER DEMAND - ADJUSTED COUNTY STANDARDS
KALAMAULA**

LAND USE	ACRES	NO. OF UNITS	GAD	GPD/ UNIT	AVE. ANNUAL DAY RATE (GPD)	MAXDAY RATE 1.5 X AVE. (GPD)	PEAK HR RATE 3.0 X AVE. (GPD)
POTABLE WATER							
EXIST'G RESIDENTIAL (1.0 AC.)	210.0	123		600	73,800	110,700	221,400
RESIDENTIAL (1.0 AC)	88.0	57		600	34,200	51,300	102,600
SUBSIST. AGRICULTURE (2-4 ACS.)	212.0	63		600	37,800	56,700	113,400
COMMUNITY USE	76.0		4000		304,000	456,000	912,000
SPECIAL DISTRICT - NRMSAA	1344.0				0	0	0
SPECIAL DISTRICT - WETLAND	363.0				0	0	0
SPECIAL DISTRICT - FLOOD CTRL	12.0				0	0	0
COMMERCIAL	13.0		3000		39,000	58,500	117,000
CONSERVATION	46.0						
POTABLE TOTAL =	2364.0	243			488,800	733,200	1,466,400

NOTES:

1. Source of information:
 - a) Molokai Island Plan, Baseline Information Report by Group 70, Dec. 2004
 - b) DHHL Molokai Island Plan by Group 70, June 2000
2. 2002 Water System Standards (Maui County DWS)

APPENDIX B-1

MOLOKAI ISLAND PLAN
PROJECTED WATER DEMAND SUMMARY FOR HOOLEHUA
MAUI DWS STANDARDS

**MOLOKAI ISLAND PLAN
 WATER SYSTEM MASTER PLAN
 POTABLE WATER SYSTEM
 WATER DEMAND - MAUI COUNTY DWS STDS.
 HO'OLEHUA**

LAND USE	ACRES	NO. OF UNITS	GAD	GPD/ UNIT	AVE. ANNUAL DAY RATE (GPD)	MAXDAY RATE 1.5 X AVE. (GPD)	PEAK HR RATE 3.0 X AVE. (GPD)
POTABLE WATER							
EXIST'G RESIDENTIAL (0.5 TO 5 AC.)	55.0	44		600	26,400	39,600	79,200
SUBSIST. AGRICULTURE (5 ACS.)	1572.0	135		600	81,000	121,500	243,000
SUBSIST. AGRICULTURE (2 ACS. S.)	185.0	65		600	39,000	58,500	117,000
SUBSIST. AGRICULTURE (2 ACS. N.)	83.0	29		600	17,400	26,100	52,200
SUBSIST. AGRICULTURE (NA'IWA.)	298.0	58		600	34,800	52,200	104,400
COMMUNITY USE	73.0		6000		438,000	657,000	1,314,000
COMMUNITY USE - MO'OMOMI PRESERVE	50.0				0	0	0
SPECIAL DISTRICT - NATURE	660.0				0	0	0
COMMERCIAL - TOWN CENTER	40.0		6000		240,000	360,000	720,000
COMMERCIAL - DOT AIRPORTS	13.0		6000		78,000	117,000	234,000
CONSERVATION	46.0				0	0	0
POTABLE TOTAL =	3075.0	331			954,600	1,431,900	2,863,800

NOTES:

1. Source of information:
 - a) Molokai Island Plan, Baseline Information Report by Group 70, Dec. 2004
 - b) DHHL Molokai Island Plan by Group 70, June 2000
2. 2002 Water System Standards (Maui County DWS)

APPENDIX B-2

MOLOKAI ISLAND PLAN
PROJECTED WATER DEMAND SUMMARY FOR HOOLEHUA
MODIFIED STANDARDS

**MOLOKAI ISLAND PLAN
 WATER SYSTEM MASTER PLAN
 POTABLE WATER SYSTEM
 WATER DEMAND - ADJUSTED COUNTY STANDARDS
 HOOLEHUA**

LAND USE	ACRES	NO. OF UNITS	GAD	GPD/ UNIT	AVE. ANNUAL DAY RATE (GPD)	MAXDAY RATE 1.5 X AVE. (GPD)	PEAK HR RATE 3.0 X AVE. (GPD)
POTABLE WATER							
EXIST'G RESIDENTIAL (0.5 TO 5 AC.)	55.0	44		600	26,400	39,600	79,200
SUBSIST. AGRICULTURE (5 ACS.)	1572.0	135		600	81,000	121,500	243,000
SUBSIST. AGRICULTURE (2 ACS. S.)	185.0	65		600	39,000	58,500	117,000
SUBSIST. AGRICULTURE (2 ACS. N.)	83.0	29		600	17,400	26,100	52,200
SUBSIST. AGRICULTURE (NA'IWA.)	298.0	58		600	34,800	52,200	104,400
COMMUNITY USE	73.0		4000		292,000	438,000	876,000
COMMUNITY USE - MO'OMOMI PRESERVE	50.0				0	0	0
SPECIAL DISTRICT - NATURE	660.0				0	0	0
COMMERCIAL - TOWN CENTER	40.0		3000		120,000	180,000	360,000
COMMERCIAL - DOT AIRPORTS	13.0		3000		39,000	58,500	117,000
CONSERVATION	46.0				0	0	0
POTABLE TOTAL =	3075.0	331			649,600	974,400	1,948,800

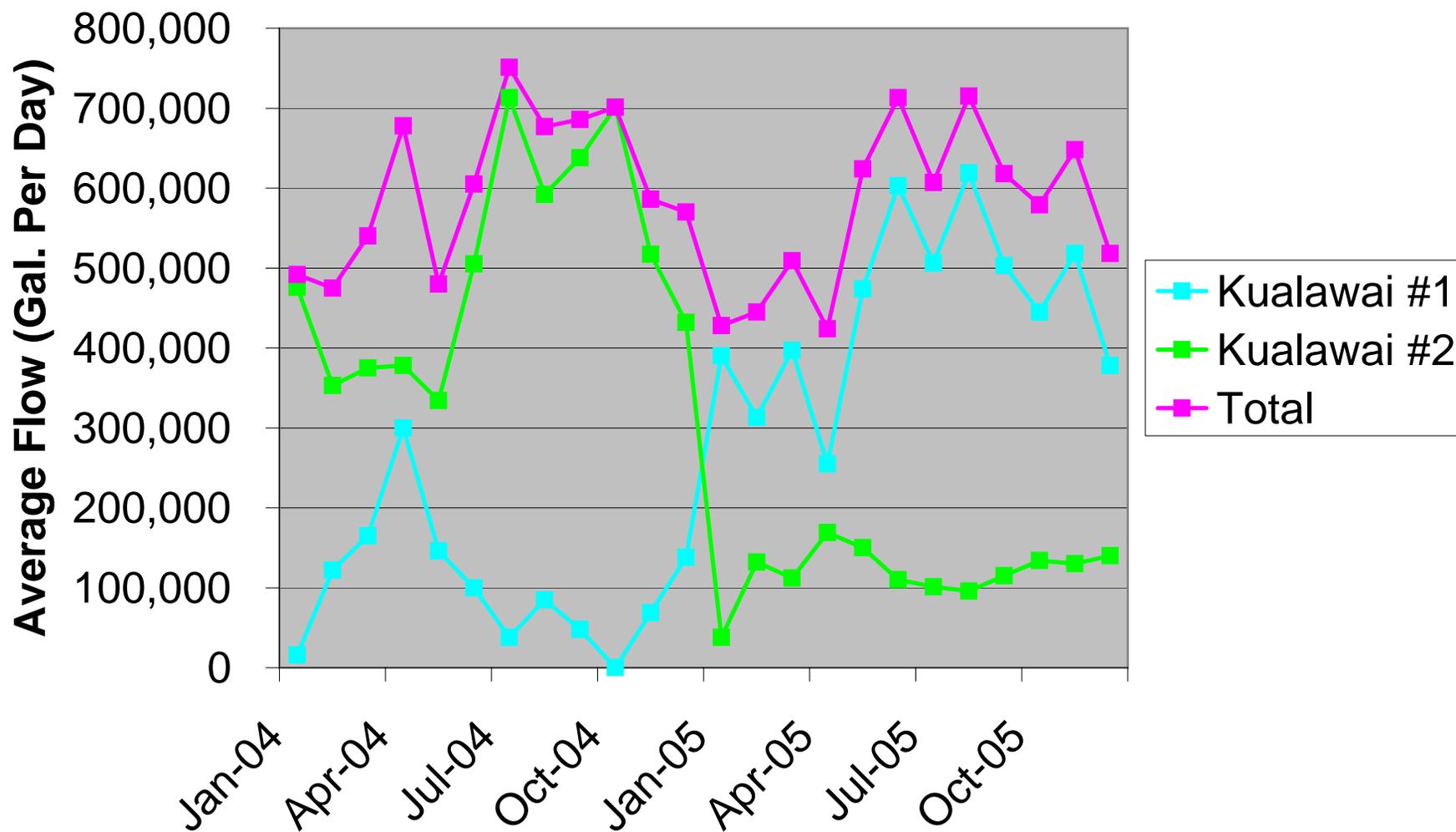
NOTES:

1. Source of information:
 - a) Molokai Island Plan, Baseline Information Report by Group 70, Dec. 2004
 - b) DHHL Molokai Island Plan by Group 70, June 2000
2. 2002 Water System Standards (Maui County DWS)

APPENDIX C-1

DHHL WELL PUMP RECORDS
DEPARTMENT OF HEALTH
COMMISSION ON WATER RESOURCE MANAGEMENT

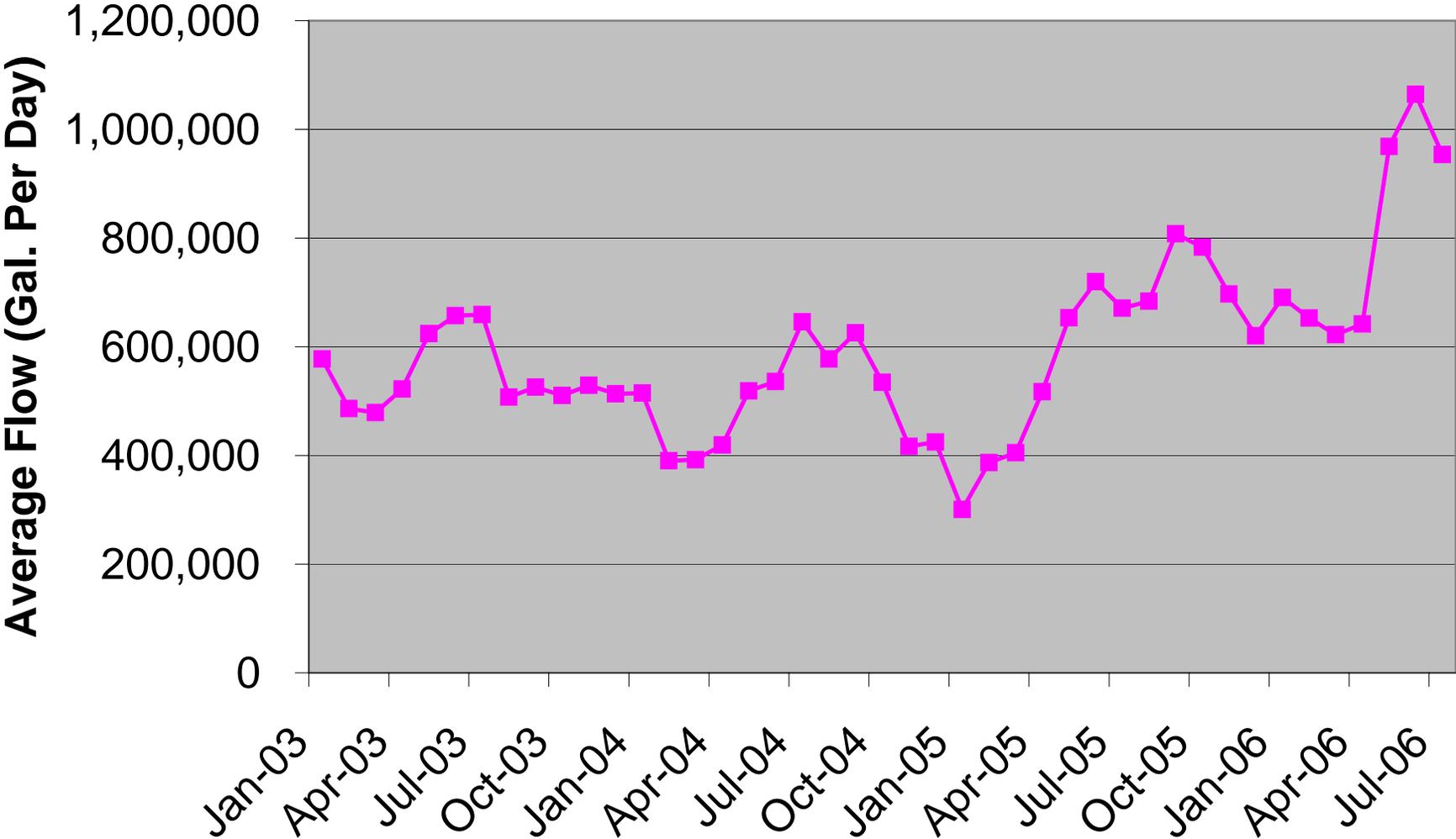
DHHL WELL PUMP DATA



APPENDIX C-2

MAUI DWS WELL PUMP RECORDS
DEPARTMENT OF HEALTH
COMMISSION ON WATER RESOURCE MANAGEMENT

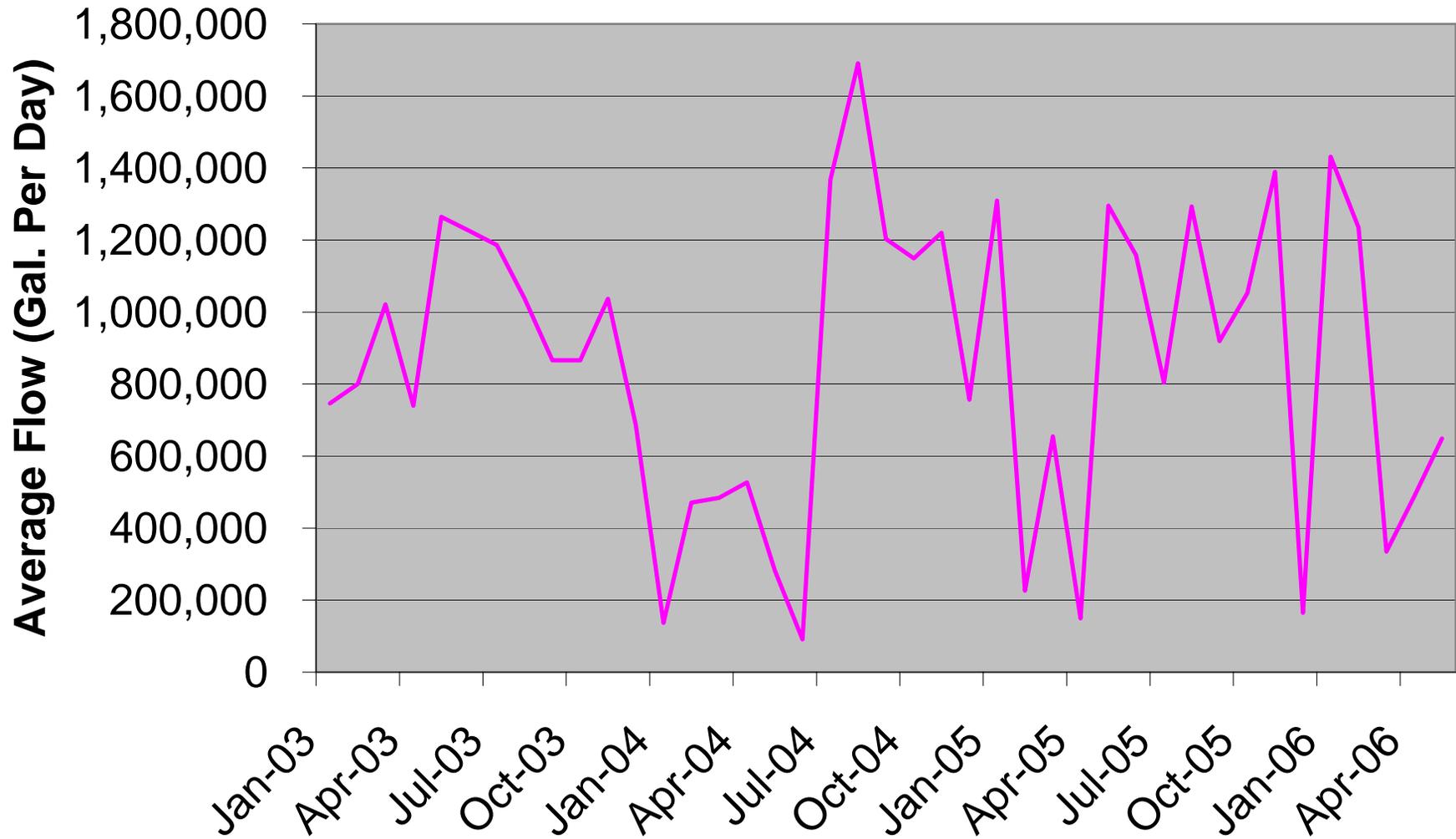
DWS Kualapuu Mauka



APPENDIX C-3

MOLOKAI PROPERTIES, LTD WELL #17 PUMP RECORDS
DEPARTMENT OF HEALTH
COMMISSION ON WATER RESOURCE MANAGEMENT

Molokai Properties, Ltd. Well #17



APPENDIX D

COMPILED DHHL POTABLE WATER CUSTOMER ACCOUNTS
INCLUDES YEAR 2005 POTABLE AND MIS (NON-POTABLE) USAGE DATA
OBTAINED FROM DHHL AND DOA

2005 DHHL Potable Water System Meter Data

TMK	MajorOwner	DHHL #	potable gpd	type	DHHL	City	MIS #	Farm_Area	MIS gpd
252032017	other	30587	0.00	res	DHHL	Kalamaula	0	0	0
252032004	other	30588	0.00	res	DHHL	Kalamaula	0	0	0
252007072	Govt. State DHHL	3000100	769.86	res	DHHL	Hoolehua	0	0	0
252027021	Govt. State DHHL	3000200	534.25	res	DHHL	Hoolehua	5001	3	11742
252008102	Govt. State DHHL	3000300	356.16	res	DHHL	Kalamaula	0	0	0
252002023	Govt. State DHHL	3000400	1189.04	res	DHHL	Hoolehua	0	0	0
252022008	Govt. State DHHL	3000500	452.05	res	DHHL	Hoolehua	0	0	0
252022014	Govt. State DHHL	3000600	208.22	res	DHHL	Hoolehua	5004	4	33
252015050	Govt. State DHHL	3000700	178.08	res	DHHL	Hoolehua	5005	2	0
252006081	Govt. State DHHL	3000800	334.25	res	DHHL	Hoolehua	0	0	0
252015035	Govt. State DHHL	3000900	5.48	res	DHHL	Hoolehua	5133	3	0
252009004	Govt. State DHHL	3001000	405.48	RES	DHHL	Kalamaula	0	0	0
252004059	Govt. State DHHL	3001100	531.51	res	DHHL	Hoolehua	0	0	0
252015034	Govt. State DHHL	3001200	926.03	res	DHHL	Hoolehua	0	0	0
252008043	Govt. State DHHL	3001300	1276.71	res	DHHL	Kalamaula	0	0	0
252006163	Govt. State DHHL	3001400	997.26	res	DHHL	Hoolehua	0	0	0
252023004	Govt. State DHHL	3001500	191.78	res	DHHL	Hoolehua	5010	5	0
252026001	Govt. State DHHL	3001600	1145.21	res	DHHL	Hoolehua	5011	2	0
252008071	Govt. State DHHL	3001700	767.12	res	DHHL	Kalamaula	0	0	0
252022012	Govt. State DHHL	3001800	147.95	res	DHHL	Hoolehua	5193	2	0
252024006	Govt. State DHHL	3001900	1490.41	res	DHHL	Hoolehua	5014	30	0
252025013	Govt. State DHHL	3002000	235.62	res	DHHL	Hoolehua	5015	2	1222
252007011	Govt. State DHHL	3002100	336.99	res	DHHL	Hoolehua	5016	2	200
252023026	Govt. State DHHL	3002200	767.12	res	DHHL	Hoolehua	0	0	0
252023011	Govt. State DHHL	3002300	835.62	res	DHHL	Hoolehua	0	0	0
252023027	Govt. State DHHL	3002400	0.00	res	DHHL	Hoolehua	0	0	0
252008123	Govt. State DHHL	3002500	750.68	res	DHHL	Kalamaula	0	0	0
252015039	Govt. State DHHL	3002600	542.47	res	DHHL	Hoolehua	5017	2	1912
252023016	Govt. State DHHL	3002700	284.93	res	DHHL	Hoolehua	5194	2	1211
252015025	Govt. State DHHL	3002800	821.92	res	DHHL	Hoolehua	5018	2	0
252007006	Govt. State DHHL	3002900	1227.40	res	DHHL	Hoolehua	0	0	0
252007065	Govt. State DHHL	3003000	0.00	AG	DHHL	Hoolehua	5020	2	0
252007003	Govt. State DHHL	3003100	210.96	res	DHHL	Hoolehua	0	0	0
252006122	Govt. State DHHL	3003200	449.32	res	DHHL	Hoolehua	0	0	0
252015042	Govt. State DHHL	3003300	150.68	res	DHHL	Hoolehua	5023	2	959
252026011	Govt. State DHHL	3003400	1172.60	res	DHHL	Hoolehua	5022	5	0
252015040	Govt. State DHHL	3003500	383.56	res	DHHL	Hoolehua	0	0	0
252015031	Govt. State DHHL	3003600	391.78	res	DHHL	Hoolehua	0	0	0
252023013	Govt. State DHHL	3003700	446.58	res	DHHL	Hoolehua	0	0	0
252015038	Govt. State DHHL	3003800	419.18	res	DHHL	Hoolehua	0	0	0
252015030	Govt. State DHHL	3003900	315.07	res	DHHL	Hoolehua	5025	2	321
252008046	Govt. State DHHL	3004000	1454.79	res	DHHL	Kalamaula	0	0	0
252015043	Govt. State DHHL	3004100	142.47	res	DHHL	Hoolehua	5028	3	175
252009006	Govt. State DHHL	3004300	835.62	res	DHHL	Kalamaula	0	0	0
252015029	Govt. State DHHL	3004400	435.62	res	DHHL	Hoolehua	5030	2	0
252015014	Govt. State DHHL	3004600	104.11	res	DHHL	Hoolehua	5258	2	4540
252015026	Govt. State DHHL	3004800	421.92	res	DHHL	Hoolehua	5215	2	0
252004010	Govt. State DHHL	3004900	312.33	RES	DHHL	Hoolehua	5224	30	4474
252007094	Govt. State DHHL	3005000	342.47	res	DHHL	Hoolehua	0	0	0
252027010	Govt. State DHHL	3005100	342.47	res	DHHL	Hoolehua	0	0	0
252024004	Govt. State DHHL	3005200	375.34	res	DHHL	Hoolehua	5032	35	707

2005 DHHL Potable Water System Meter Data

TMK	MajorOwner	DHHL #	potable gpd	type	DHHL	City	MIS #	Farm_Area	MIS gpd
252025016	Govt. State DHHL	3005300	0.00	res	DHHL	Hoolehua	5228	2	36
252022007	Govt. State DHHL	3005400	57.53	res	DHHL	Hoolehua	0	0	0
252022006	Govt. State DHHL	3005500	2936.99	res	DHHL	Hoolehua	0	0	0
252008042	Govt. State DHHL	3005600	594.52	res	DHHL	Kalamaula	0	0	0
252007023	Govt. State DHHL	3005700	134.25	res	DHHL	Hoolehua	0	0	0
252008001	Govt. State DHHL	3005800	106.85	res	DHHL	Kalamaula	0	0	0
252008074	Govt. State DHHL	3005900	887.67	res	DHHL	Kalamaula	0	0	0
252024001	Govt. State DHHL	3006000	427.40	res	DHHL	Hoolehua	5035	7	0
252015024	Govt. State DHHL	3006100	57.53	res	DHHL	Hoolehua	5195	2	236
252015012	Govt. State DHHL	3006200	509.59	res	DHHL	Hoolehua	5036	2	0
252032018	other	3006300	1432.88	res	DHHL	Kalamaula	0	0	0
252015051	Govt. State DHHL	3006500	268.49	Comm	NON	Hoolehua	0	0	0
252017022	Govt. State DHHL	3006600	24.66	Comm	NON	Hoolehua	0	0	0
252026009	Govt. State DHHL	3006700	265.75	res	DHHL	Hoolehua	5038	10	0
252008045	Govt. State DHHL	3006800	698.63	res	DHHL	Kalamaula	0	0	0
252023029	Govt. State DHHL	3006900	156.16	res	DHHL	Hoolehua	5041	15	4992
252032008	other	3007100	0.00	res	DHHL	Kalamaula	0	0	0
252015022	Govt. State DHHL	3007300	301.37	RES	DHHL	Hoolehua	0	0	0
252004044	Govt. State DHHL	3007400	336.99	res	DHHL	Hoolehua	5043	3	3693
252032043	other	3007500	0.00	res	DHHL	Kalamaula	0	0	0
252004018	Govt. State DHHL	3007600	257.53	res	DHHL	Hoolehua	5260	2	0
252015023	Govt. State DHHL	3007700	808.22	res	DHHL	Hoolehua	0	0	0
252025010	Govt. State DHHL	3008300	1854.79	res	DHHL	Hoolehua	0	0	0
252008122	Govt. State DHHL	3008400	1043.84	res	DHHL	Kalamaula	0	0	0
252015016	Govt. State DHHL	3008500	452.05	res	DHHL	Hoolehua	0	0	0
252008064	Govt. State DHHL	3008700	616.44	res	DHHL	Kalamaula	0	0	0
252004021	Govt. State DHHL	3008800	416.44	res	DHHL	Hoolehua	0	0	0
252002031	Govt. State DHHL	3008900	131.51	res	DHHL	Hoolehua	5078	2	2090
252015032	Govt. State DHHL	3009000	394.52	res	DHHL	Hoolehua	0	0	0
252027015	Govt. State DHHL	3009100	1227.40	res	DHHL	Hoolehua	5046	2	0
252004080	Govt. State DHHL	3009200	884.93	res	DHHL	Hoolehua	5047	2	0
252004043	Govt. State DHHL	3009500	216.44	res	DHHL	Hoolehua	5048	3	444
252007028	Govt. State DHHL	3009600	2556.16	res	DHHL	Hoolehua	0	0	0
252008124	Govt. State DHHL	3009700	65.75	res	DHHL	Kalamaula	0	0	0
252022021	Govt. State DHHL	3009800	613.70	res	DHHL	Hoolehua	0	0	0
252007009	Govt. State DHHL	3009900	282.19	res	DHHL	Hoolehua	5196	2	0
252006164	Govt. State DHHL	3010000	424.66	res	DHHL	Hoolehua	0	0	0
252027014	Govt. State DHHL	3010100	701.37	res	DHHL	Hoolehua	0	0	0
252023005	Govt. State DHHL	3010300	0.00	res	DHHL	Hoolehua	5052	2	0
252021009	Govt. State DHHL	3010600	600.00	res	DHHL	Hoolehua	5253	12	0
252023018	Govt. State DHHL	3010700	432.88	res	DHHL	Hoolehua	5053	2	523
252007012	Govt. State DHHL	3010800	400.00	res	DHHL	Hoolehua	5055	3	551
252007101	Govt. State DHHL	3010900	410.96	res	DHHL	Hoolehua	0	0	0
252004013	Govt. State DHHL	3011000	82.19	res	DHHL	Hoolehua	5058	2	2258
252017023	Govt. State DHHL	3011200	213.70	res	DHHL	Hoolehua	0	0	0
252005014	Govt. State DHHL	3011300	290.41	res	DHHL	Hoolehua	5240	2	1690
252008038	Govt. State DHHL	3011400	468.49	res	DHHL	Kalamaula	0	0	0
252008120	Govt. State DHHL	3011500	1134.25	res	DHHL	Kalamaula	0	0	0
252007095	Govt. State DHHL	3011800	641.10	res	DHHL	Hoolehua	5065	2	0
252007032	Govt. State DHHL	3012000	235.62	res	DHHL	Hoolehua	0	0	0
252004009	Govt. State DHHL	3012100	0.00	res	DHHL	Hoolehua	0	0	0

2005 DHHL Potable Water System Meter Data

TMK	MajorOwner	DHHL #	potable gpd	type	DHHL	City	MIS #	Farm_Area	MIS gpd
252021011	Govt. State DHHL	3012300	479.45	res	DHHL	Hoolehua	0	0	0
252015011	Govt. State DHHL	3012500	98.63	res	DHHL	Hoolehua	5067	2	33
252006060	Govt. State DHHL	3012600	416.44	res	DHHL	Hoolehua	0	0	0
252004079	Govt. State DHHL	3012800	304.11	res	DHHL	Hoolehua	5068	3	0
252008065	Govt. State DHHL	3012900	553.42	res	DHHL	Kalamaula	0	0	0
252023014	Govt. State DHHL	3013100	547.95	res	DHHL	Hoolehua	5070	26	0
252015019	Govt. State DHHL	3013300	230.14	res	DHHL	Hoolehua	0	0	0
252027024	Govt. State DHHL	3013400	323.29	res	DHHL	Hoolehua	5198	3	0
252002017	Govt. State DHHL	3013500	0.00	res	DHHL	Hoolehua	5072	3	1970
252027003	Govt. State DHHL	3013600	868.49	res	DHHL	Hoolehua	0	0	0
252004011	Govt. State DHHL	3013700	378.08	res	DHHL	Hoolehua	0	0	0
252006062	Govt. State DHHL	3013800	0.00	res	DHHL	Hoolehua	5231	2	0
252008090	Govt. State DHHL	3013900	2528.77	res	DHHL	Kalamaula	0	0	0
252015033	Govt. State DHHL	3014000	408.22	res	DHHL	Hoolehua	0	0	0
252008068	Govt. State DHHL	3014100	824.66	res	DHHL	Kalamaula	0	0	0
252006058	Govt. State DHHL	3014200	638.36	res	DHHL	Hoolehua	5073	2	5460
252015059	Govt. State DHHL	3014300	580.82	res	DHHL	Hoolehua	0	0	0
252007060	Govt. State DHHL	3014400	197.26	res	DHHL	Hoolehua	0	0	0
252027019	Govt. State DHHL	3014500	328.77	res	DHHL	Hoolehua	5074	2	1485
252008002	Govt. State DHHL	3014600	391.78	res	DHHL	Kalamaula	0	0	0
252007040	Govt. State DHHL	3014700	336.99	res	DHHL	Hoolehua	0	0	0
252008027	Govt. State DHHL	3014800	2372.60	res	DHHL	Kalamaula	0	0	0
252008028	Govt. State DHHL	3014900	800.00	res	DHHL	Kalamaula	0	0	0
252022004	Govt. State DHHL	3015000	983.56	res	DHHL	Hoolehua	0	0	0
252021006	Govt. State DHHL	3015100	569.86	res	DHHL	Hoolehua	5079	2	0
252023015	Govt. State DHHL	3015200	1145.21	res	DHHL	Hoolehua	0	0	0
252004020	Govt. State DHHL	3015300	1189.04	res	DHHL	Hoolehua	5080	2	7425
252004057	Govt. State DHHL	3015400	863.01	res	DHHL	Hoolehua	5081	3	0
252009005	Govt. State DHHL	3015500	1561.64	res	DHHL	Kalamaula	0	0	0
252007102	Govt. State DHHL	3015700	745.21	res	DHHL	Hoolehua	0	0	0
252008031	Govt. State DHHL	3015800	2153.42	res	DHHL	Kalamaula	0	0	0
252008036	Govt. State DHHL	3015900	1602.74	res	DHHL	Kalamaula	0	0	0
252006124	Govt. State DHHL	3016000	553.42	res	DHHL	Hoolehua	0	0	0
252026012	Govt. State DHHL	3016100	306.85	res	DHHL	Hoolehua	5082	40	926
252005024	Govt. State DHHL	3016200	271.23	res	DHHL	Hoolehua	0	0	0
252007091	Govt. State DHHL	3016300	567.12	res	DHHL	Hoolehua	0	0	0
252015009	Govt. State DHHL	3016400	147.95	res	DHHL	Hoolehua	0	0	0
252015007	Govt. State DHHL	3016500	347.95	res	DHHL	Hoolehua	0	0	0
252008069	Govt. State DHHL	3016600	720.55	res	DHHL	Kalamaula	0	0	0
252006152	Govt. State DHHL	3016900	334.25	res	DHHL	Hoolehua	0	0	0
252026010	Govt. State DHHL	3017000	432.88	res	DHHL	Hoolehua	5084	22	1071
252006165	Govt. State DHHL	3017100	906.85	res	DHHL	Hoolehua	0	0	0
252007004	Govt. State DHHL	3017200	873.97	res	DHHL	Hoolehua	0	0	0
252026005	Govt. State DHHL	3017300	82.19	res	DHHL	Hoolehua	5085	2	99
252004056	Govt. State DHHL	3017400	542.47	RES	DHHL	Hoolehua	0	0	0
252009010	Govt. State DHHL	3017500	1156.16	res	DHHL	Kalamaula	0	0	0
252022010	Govt. State DHHL	3017600	465.75	res	DHHL	Hoolehua	5207	2	0
252004098	Govt. State DHHL	3017700	169.86	res	DHHL	Hoolehua	5182	2	0
252007061	Govt. State DHHL	3017800	356.16	res	DHHL	Hoolehua	0	0	0
252023010	Govt. State DHHL	3017900	1068.49	res	DHHL	Hoolehua	0	0	0
252006057	Govt. State DHHL	3018000	468.49	res	DHHL	Hoolehua	5185	2	0

2005 DHHL Potable Water System Meter Data

TMK	MajorOwner	DHHL #	potable gpd	type	DHHL	City	MIS #	Farm_Area	MIS gpd
252008062	Govt. State DHHL	3018100	334.25	res	DHHL	Kalamaula	0	0	0
252004014	Govt. State DHHL	3018200	230.14	res	DHHL	Hoolehua	0	0	0
252004022	Govt. State DHHL	3018300	317.81	res	DHHL	Hoolehua	0	0	0
252015048	Govt. State DHHL	3018400	284.93	res	DHHL	Hoolehua	5251	2	104
252021003	Govt. State DHHL	3018500	249.32	res	DHHL	Hoolehua	5091	2	1849
252024007	Govt. State DHHL	3018600	134.25	res	DHHL	Hoolehua	5093	2	556
252006150	Govt. State DHHL	3018700	369.86	res	DHHL	Hoolehua	0	0	0
252007036	Govt. State DHHL	3018800	117.81	res	DHHL	Hoolehua	5095	2	93
252008063	Govt. State DHHL	3018900	610.96	res	DHHL	Kalamaula	0	0	0
252004055	Govt. State DHHL	3019000	731.51	res	DHHL	Hoolehua	5187	7	6559
252004019	Govt. State DHHL	3019100	564.38	RES	DHHL	Hoolehua	0	0	0
252007059	Govt. State DHHL	3019200	1030.14	res	DHHL	Hoolehua	5100	2	0
252006151	Govt. State DHHL	3019300	652.05	res	DHHL	Hoolehua	0	0	0
252027017	Govt. State DHHL	3019500	487.67	res	DHHL	Hoolehua	5101	15	2077
252027005	Govt. State DHHL	3019600	1035.62	res	DHHL	Hoolehua	0	0	0
252023019	Govt. State DHHL	3019700	5.48	res	DHHL	Hoolehua	5206	2	0
252008004	Govt. State DHHL	3019800	539.73	res	DHHL	Kalamaula	0	0	0
252022015	Govt. State DHHL	3019900	358.90	res	DHHL	Hoolehua	0	0	0
252022002	Govt. State DHHL	3020000	197.26	RES	DHHL	Hoolehua	5103	2	1101
252007103	Govt. State DHHL	3020100	328.77	res	DHHL	Hoolehua	0	0	0
252022005	Govt. State DHHL	3020200	54.79	res	DHHL	Hoolehua	0	0	0
252027022	Govt. State DHHL	3020300	567.12	res	DHHL	Hoolehua	5105	19	0
252015021	Govt. State DHHL	3020400	380.82	res	DHHL	Hoolehua	5246	2	1329
252008032	Govt. State DHHL	3020500	1487.67	res	DHHL	Kalamaula	0	0	0
252021005	Govt. State DHHL	3020600	246.58	res	DHHL	Hoolehua	5107	5	696
252027001	Govt. State DHHL	3020700	430.14	res	DHHL	Hoolehua	0	0	0
252025001	Govt. State DHHL	3020800	539.73	res	DHHL	Hoolehua	5227	3	8
252022001	Govt. State DHHL	3020900	172.60	res	DHHL	Hoolehua	5177	3	907
252008025	Govt. State DHHL	3021000	906.85	res	DHHL	Kalamaula	0	0	0
252007042	Govt. State DHHL	3021100	0.00	res	DHHL	Hoolehua	0	0	0
252002025	Govt. State DHHL	3021200	443.84	res	DHHL	Hoolehua	5109	2	904
252007085	Govt. State DHHL	3021300	547.95	res	DHHL	Hoolehua	0	0	0
252007100	Govt. State DHHL	3021400	986.30	res	DHHL	Hoolehua	0	0	0
252027013	Govt. State DHHL	3021500	334.25	res	DHHL	Hoolehua	0	0	0
252007093	Govt. State DHHL	3021600	435.62	res	DHHL	Hoolehua	0	0	0
252022011	Govt. State DHHL	3021800	172.60	res	DHHL	Hoolehua	5110	2	1704
252021016	Govt. State DHHL	3021900	413.70	res	DHHL	Hoolehua	0	0	0
252015020	Govt. State DHHL	3022000	597.26	res	DHHL	Hoolehua	5112	2	0
252008070	Govt. State DHHL	3022100	476.71	res	DHHL	Kalamaula	0	0	0
252008005	Govt. State DHHL	3022200	293.15	res	DHHL	Kalamaula	0	0	0
252004023	Govt. State DHHL	3022300	950.68	res	DHHL	Hoolehua	5113	6	523
252006059	Govt. State DHHL	3022400	312.33	res	DHHL	Hoolehua	0	0	0
252021007	Govt. State DHHL	3022600	693.15	res	DHHL	Hoolehua	5119	2	4334
252027020	Govt. State DHHL	3022700	317.81	res	DHHL	Hoolehua	5118	2	408
252004027	Govt. State DHHL	3022800	427.40	res	DHHL	Hoolehua	5181	5	5778
252015028	Govt. State DHHL	3022900	93.15	res	DHHL	Hoolehua	5120	2	521
252024011	Govt. State DHHL	3023200	153.42	res	DHHL	Hoolehua	5124	21	638
252023020	Govt. State DHHL	3023300	761.64	res	DHHL	Hoolehua	5230	2	68
252008060	Govt. State DHHL	3023400	438.36	res	DHHL	Kalamaula	0	0	0
252025005	Govt. State DHHL	3023500	364.38	res	DHHL	Hoolehua	5126	2	1811
252009007	Govt. State DHHL	3024200	627.40	res	DHHL	Kalamaula	0	0	0

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TMK	MajorOwner	DHHL #	potable gpd	type	DHHL	City	MIS #	Farm_Area	MIS gpd
252007020	Govt. State DHHL	3024300	164.38	res	DHHL	Hoolehua	0	0	0
252008035	Govt. State DHHL	3024400	1112.33	res	DHHL	Kalamaula	0	0	0
252025004	Govt. State DHHL	3024500	345.20	res	DHHL	Hoolehua	0	0	0
252007035	Govt. State DHHL	3024600	123.29	res	DHHL	Hoolehua	0	0	0
252008072	Govt. State DHHL	3024800	701.37	res	DHHL	Kalamaula	0	0	0
252017005	Govt. State DHHL	3025000	756.16	res	DHHL	Hoolehua	5132	2	0
252007007	Govt. State DHHL	3025100	460.27	res	DHHL	Hoolehua	0	0	0
252007008	Govt. State DHHL	3025200	191.78	res	DHHL	Hoolehua	0	0	0
252008030	Govt. State DHHL	3025300	73.97	res	DHHL	Kalamaula	0	0	0
252008047	Govt. State DHHL	3025400	1394.52	res	DHHL	Kalamaula	0	0	0
252008067	Govt. State DHHL	3025500	961.64	res	DHHL	Kalamaula	0	0	0
252025002	Govt. State DHHL	3025600	238.36	res	DHHL	Hoolehua	5135	2	192
252023023	Govt. State DHHL	3025700	73.97	res	DHHL	Hoolehua	5128	30	0
252021001	Govt. State DHHL	3025800	109.59	res	DHHL	Hoolehua	5134	2	0
252015005	Govt. State DHHL	3026000	49.32	res	DHHL	Hoolehua	0	0	0
252004024	Govt. State DHHL	3026100	539.73	res	DHHL	Hoolehua	5136	2	236
252008081	Govt. State DHHL	3026200	304.11	res	DHHL	Kalamaula	0	0	0
252004054	Govt. State DHHL	3026400	1276.71	res	DHHL	Hoolehua	0	0	0
252002024	Govt. State DHHL	3026500	517.81	res	DHHL	Hoolehua	5138	3	68
252004029	Govt. State DHHL	3026600	336.99	res	DHHL	Hoolehua	5139	2	0
252008006	Govt. State DHHL	3026700	339.73	res	DHHL	Kalamaula	0	0	0
252008037	Govt. State DHHL	3026800	490.41	res	DHHL	Kalamaula	0	0	0
252005026	Govt. State DHHL	3026900	2.74	res	DHHL	Hoolehua	0	0	0
252010003	Govt. State DHHL	3027000	476.71	res	DHHL	Hoolehua	0	0	0
252015008	Govt. State DHHL	3027300	679.45	res	DHHL	Hoolehua	0	0	0
252022013	Govt. State DHHL	3027400	463.01	res	DHHL	Hoolehua	5140	2	1753
252009021	Govt. State DHHL	3027500	789.04	res	DHHL	Kalamaula	0	0	0
252002018	Govt. State DHHL	3027600	167.12	res	DHHL	Hoolehua	5199	2	0
252024005	Govt. State DHHL	3027800	1698.63	res	DHHL	Hoolehua	5142	2	0
252021002	Govt. State DHHL	3027900	290.41	res	DHHL	Hoolehua	5143	2	0
252008055	Govt. State DHHL	3028000	1315.07	res	DHHL	Kalamaula	0	0	0
252025012	Govt. State DHHL	3028100	0.00	res	DHHL	Hoolehua	5148	16	0
252008029	Govt. State DHHL	3028200	3175.34	res	DHHL	Kalamaula	0	0	0
252007010	Govt. State DHHL	3028400	24.66	res	DHHL	Hoolehua	5150	2	1310
252021010	Govt. State DHHL	3028500	400.00	res	DHHL	Hoolehua	5200	2	0
252024002	Govt. State DHHL	3028600	452.05	res	DHHL	Hoolehua	5151	3	811
252004012	Govt. State DHHL	3028700	227.40	res	DHHL	Hoolehua	5153	330	1436
252027011	Govt. State DHHL	3028800	717.81	res	DHHL	Hoolehua	0	0	0
252015004	Govt. State DHHL	3028900	638.36	res	DHHL	Hoolehua	0	0	0
252025009	Govt. State DHHL	3029000	657.53	res	DHHL	Hoolehua	0	0	0
252023028	Govt. State DHHL	3029100	471.23	res	DHHL	Hoolehua	0	0	0
252023024	Govt. State DHHL	3029200	528.77	res	DHHL	Hoolehua	5233	2	101
252004034	other	3029300	21.92	res	DHHL	Hoolehua	0	0	0
252022016	Govt. State DHHL	3029400	197.26	res	DHHL	Hoolehua	5115	5	33
252007033	Govt. State DHHL	3029500	534.25	res	DHHL	Hoolehua	5157	2	3197
252007031	Govt. State DHHL	3029600	358.90	res	DHHL	Hoolehua	5159	2	8299
252027012	Govt. State DHHL	3029900	1800.00	res	DHHL	Hoolehua	0	0	0
252022017	Govt. State DHHL	3030100	542.47	res	DHHL	Hoolehua	5244	2	10208
252027018	Govt. State DHHL	3030200	550.68	res	DHHL	Hoolehua	5161	5	5252
252008075	Govt. State DHHL	3030300	375.34	res	DHHL	Kalamaula	0	0	0
252015013	Govt. State DHHL	3030400	473.97	res	DHHL	Hoolehua	0	0	0

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TMK	MajorOwner	DHHL #	potable gpd	type	DHHL	City	MIS #	Farm_Area	MIS gpd
252009003	Govt. State DHHL	3030500	673.97	res	DHHL	Kalamaula	0	0	0
252025007	Govt. State DHHL	3030600	402.74	res	DHHL	Hoolehua	5163	2	2184
252023008	Govt. State DHHL	3030700	487.67	res	DHHL	Hoolehua	5234	2	5756
252015017	Govt. State DHHL	3030800	249.32	res	DHHL	Hoolehua	0	0	0
252008089	Govt. State DHHL	3030900	652.05	res	DHHL	Kalamaula	0	0	0
252004042	Govt. State DHHL	3031100	126.03	res	DHHL	Hoolehua	5164	4	126
252009008	Govt. State DHHL	3031200	249.32	res	DHHL	Kalamaula	0	0	0
252008033	Govt. State DHHL	3031300	1284.93	res	DHHL	Kalamaula	0	0	0
252017006	Govt. State DHHL	3031400	221.92	res	DHHL	Hoolehua	0	0	0
252007038	Govt. State DHHL	3031500	364.38	RES	DHHL	Hoolehua	5216	2	1019
252023012	Govt. State DHHL	3031600	202.74	res	DHHL	Hoolehua	0	0	0
252007002	Govt. State DHHL	3031900	232.88	res	DHHL	Hoolehua	0	0	0
252009002	Govt. State DHHL	3032000	2079.45	res	DHHL	Kalamaula	0	0	0
252002021	Govt. State DHHL	3032100	1057.53	res	DHHL	Hoolehua	5111	2	729
252017004	Govt. State DHHL	3032200	153.42	res	DHHL	Hoolehua	5167	2	129
252007022	Govt. State DHHL	3032300	408.22	res	DHHL	Hoolehua	5168	2	537
252015049	Govt. State DHHL	3032400	923.29	res	DHHL	Hoolehua	0	0	0
252026004	Govt. State DHHL	3032500	128.77	res	DHHL	Hoolehua	5166	3	197
252017021	Govt. State DHHL	3032600	487.67	res	DHHL	Hoolehua	0	0	0
252022018	Govt. State DHHL	3033000	76.71	res	DHHL	Hoolehua	0	0	0
252027002	Govt. State DHHL	3033100	402.74	RES	DHHL	Hoolehua	5252	2	85
252002014	Govt. State DHHL	3033200	279.45	res	DHHL	Hoolehua	5169	35	1718
252008066	Govt. State DHHL	3033300	397.26	res	DHHL	Kalamaula	0	0	0
252015015	Govt. State DHHL	3033400	646.58	RES	DHHL	Hoolehua	0	0	0
252008061	Govt. State DHHL	3033500	734.25	res	DHHL	Kalamaula	0	0	0
252007096	Govt. State DHHL	3033600	265.75	res	DHHL	Hoolehua	5254	2	674
252004061	Govt. State DHHL	3033700	550.68	res	DHHL	Hoolehua	5217	2	2288
252008073	Govt. State DHHL	3033800	652.05	res	DHHL	Kalamaula	0	0	0
252008041	Govt. State DHHL	3033900	1895.89	res	DHHL	Kalamaula	0	0	0
252007029	Govt. State DHHL	3034000	24.66	res	DHHL	Hoolehua	0	0	0
252022024	Govt. State DHHL	3034100	890.41	res	DHHL	Hoolehua	5172	3	3041
252008076	Govt. State DHHL	3034400	1117.81	res	DHHL	Kalamaula	0	0	0
252015037	Govt. State DHHL	3034500	1468.49	res	DHHL	Hoolehua	0	0	0
252007021	Govt. State DHHL	3034600	789.04	res	DHHL	Hoolehua	5034	2	0
252008119	Govt. State DHHL	3034700	454.79	res	DHHL	Kalamaula	0	0	0
252008034	Govt. State DHHL	3034800	783.56	res	DHHL	Kalamaula	0	0	0
252023022	Govt. State DHHL	3035100	635.62	res	DHHL	Hoolehua	5179	2	762
252005042	Govt. State DHHL	3035300	630.14	res	DHHL	Hoolehua	5267	2	30
252015041	Govt. State DHHL	3035400	93.15	res	DHHL	Hoolehua	5175	2	1099
252007030	Govt. State DHHL	3035500	224.66	res	DHHL	Hoolehua	0	0	0
252007013	Govt. State DHHL	3035600	706.85	res	DHHL	Hoolehua	0	0	0
252005039	Govt. State DHHL	3035700	0.00	res	DHHL	Hoolehua	5201	2	633
252015044	Govt. State DHHL	3035900	54.79	res	DHHL	Hoolehua	0	0	0
252022003	Govt. State DHHL	3036000	424.66	res	DHHL	Hoolehua	5183	3	33
252027004	Govt. State DHHL	3036100	284.93	res	DHHL	Hoolehua	0	0	0
252007097	Govt. State DHHL	3036200	260.27	res	DHHL	Hoolehua	0	0	0
252022020	Govt. State DHHL	3036300	106.85	res	DHHL	Hoolehua	5205	2	1452
252023006	Govt. State DHHL	3036400	515.07	res	DHHL	Hoolehua	5210	2	0
252030006	Govt. State DHHL	3036700	0.00	res	DHHL	Hoolehua	0	0	0
252017025	Govt. State DHHL	3036800	386.30	res	DHHL	Hoolehua	0	0	0
252030060	Govt. State DHHL	3036900	736.99	res	DHHL	Hoolehua	0	0	0

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TMK	MajorOwner	DHHL #	potable gpd	type	DHHL	City	MIS #	Farm_Area	MIS gpd
252030052	Govt. State DHHL	3037000	10.96	res	DHHL	Hoolehua	0	0	0
252030064	Govt. State DHHL	3037100	326.03	res	DHHL	Hoolehua	0	0	0
252030062	Govt. State DHHL	3037200	668.49	res	DHHL	Hoolehua	0	0	0
252030050	Govt. State DHHL	3037300	630.14	res	DHHL	Hoolehua	0	0	0
252004001	Govt. State DHHL	3037400	427.40	res	DHHL	Hoolehua	5086	22	4677
252002056	Govt. State DHHL	3037500	82.19	res	DHHL	Hoolehua	5087	8	0
252030046	Govt. State DHHL	3037600	523.29	res	DHHL	Hoolehua	0	0	0
252002069	Govt. State DHHL	3037700	583.56	res	DHHL	Hoolehua	5180	4	225
252024012	Govt. State DHHL	3037800	1134.25	res	DHHL	Hoolehua	5000	3	0
252027029	Govt. State DHHL	3038000	0.00	res	DHHL	Hoolehua	0	0	0
252030040	Govt. State DHHL	3038100	600.00	res	DHHL	Hoolehua	0	0	0
252004036	Govt. State DHHL	3038200	158.90	res	DHHL	Hoolehua	5229	2	1156
252030053	Govt. State DHHL	3038300	172.60	res	DHHL	Hoolehua	0	0	0
252002061	Govt. State DHHL	3038400	687.67	res	DHHL	Hoolehua	0	0	0
252002019	Govt. State DHHL	3038500	728.77	res	DHHL	Hoolehua	5197	2	833
252030022	Govt. State DHHL	3038600	0.00	res	DHHL	Hoolehua	0	0	0
252030024	Govt. State DHHL	3038700	534.25	res	DHHL	Hoolehua	0	0	0
252030058	Govt. State DHHL	3038800	471.23	res	DHHL	Hoolehua	0	0	0
252030054	Govt. State DHHL	3038900	227.40	res	DHHL	Hoolehua	0	0	0
252026002	Govt. State DHHL	3039000	400.00	res	DHHL	Hoolehua	5063	2	825
252002010	Govt. State DHHL	3039100	205.48	res	DHHL	Hoolehua	5075	2	18907
252007071	Govt. State DHHL	3039200	663.01	res	DHHL	Hoolehua	0	0	0
252022026	Govt. State DHHL	3039300	926.03	res	DHHL	Hoolehua	5204	2	27
252030038	Govt. State DHHL	3039400	358.90	res	DHHL	Hoolehua	0	0	0
252015057	Govt. State DHHL	3039500	8.22	res	DHHL	Hoolehua	0	0	0
252007044	Govt. State DHHL	3039700	698.63	res	DHHL	Hoolehua	5236	2	249
252021013	Govt. State DHHL	3039800	419.18	res	DHHL	Hoolehua	0	0	0
252030063	Govt. State DHHL	3039900	243.84	res	DHHL	Hoolehua	0	0	0
252027034	Govt. State DHHL	3040000	271.23	res	DHHL	Hoolehua	5212	2	15967
252024010	Govt. State DHHL	3040100	361.64	res	DHHL	Hoolehua	5123	30	26129
252022022	Govt. State DHHL	3040200	1010.96	res	DHHL	Hoolehua	0	0	0
252002013	Govt. State DHHL	3040300	1488.89	res	DHHL	Hoolehua	0	0	0
252024015	Govt. State DHHL	3040400	654.79	res	DHHL	Hoolehua	0	0	0
252002065	Govt. State DHHL	3040500	115.07	RES	DHHL	Hoolehua	5013	3	30
252002039	Govt. State DHHL	3040600	0.00	res	DHHL	Hoolehua	5083	30	10096
252027028	Govt. State DHHL	3040700	293.15	res	DHHL	Hoolehua	0	0	0
252023017	Govt. State DHHL	3040800	243.84	res	DHHL	Hoolehua	5248	2	0
252004025	Govt. State DHHL	3040900	668.49	res	DHHL	Hoolehua	0	0	0
252002048	Govt. State DHHL	3041000	915.07	res	DHHL	Hoolehua	0	0	0
252002058	Govt. State DHHL	3041100	468.49	res	DHHL	Hoolehua	5220	2	5942
252024014	Govt. State DHHL	3041200	460.27	res	DHHL	Hoolehua	0	0	0
252025011	Govt. State DHHL	3041300	613.70	res	DHHL	Hoolehua	5262	2	33
252025018	Govt. State DHHL	3041400	605.48	res	DHHL	Hoolehua	0	0	0
252002032	Govt. State DHHL	3041500	452.05	res	DHHL	Hoolehua	0	0	0
252030001	Govt. State DHHL	3041600	0.00	res	DHHL	Hoolehua	0	0	0
252030003	Govt. State DHHL	3041700	0.00	res	DHHL	Hoolehua	0	0	0
252030059	Govt. State DHHL	3041800	454.79	res	DHHL	Hoolehua	0	0	0
252002020	Govt. State DHHL	3041900	473.97	res	DHHL	Hoolehua	5012	35	1186
252017035	Govt. State DHHL	3042000	369.86	res	DHHL	Hoolehua	0	0	0
252030039	Govt. State DHHL	3042500	632.88	res	DHHL	Hoolehua	0	0	0
252030020	Govt. State DHHL	3042600	0.00	res	DHHL	Hoolehua	0	0	0

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TMK	MajorOwner	DHHL #	potable gpd	type	DHHL	City	MIS #	Farm_Area	MIS gpd
252030044	Govt. State DHHL	3042700	421.92	res	DHHL	Hoolehua	0	0	0
252002003	Govt. State DHHL	3042800	854.79	res	DHHL	Hoolehua	5261	2	2690
252030019	Govt. State DHHL	3042900	249.32	res	DHHL	Hoolehua	0	0	0
252015006	Govt. State DHHL	3043100	1567.12	res	DHHL	Hoolehua	0	0	0
252030056	Govt. State DHHL	3043400	1005.48	res	DHHL	Hoolehua	0	0	0
252030002	Govt. State DHHL	3044400	254.79	res	DHHL	Hoolehua	0	0	0
252030045	Govt. State DHHL	3044500	279.45	res	DHHL	Hoolehua	0	0	0
252030015	Govt. State DHHL	3045200	610.96	res	DHHL	Hoolehua	0	0	0
252002008	Govt. State DHHL	3045300	523.29	res	DHHL	Hoolehua	5250	2	5044
252002034	Govt. State DHHL	3045400	0.00	res	DHHL	Hoolehua	5218	2	0
252002011	Govt. State DHHL	3045500	202.74	res	DHHL	Hoolehua	0	0	0
252030025	Govt. State DHHL	3045600	131.51	res	DHHL	Hoolehua	0	0	0
252026014	Govt. State DHHL	3045800	213.70	res	DHHL	Hoolehua	0	0	0
252004124	Govt. State DHHL	3045900	356.16	res	DHHL	Hoolehua	0	0	0
252005038	Govt. State DHHL	3046100	10.96	res	DHHL	Hoolehua	5259	2	0
252030021	Govt. State DHHL	3046200	284.93	res	DHHL	Hoolehua	0	0	0
252025003	Govt. State DHHL	3046500	0.00	res	DHHL	Hoolehua	5026	2	8
252030018	Govt. State DHHL	3046600	8.22	res	DHHL	Hoolehua	0	0	0
252030014	Govt. State DHHL	3046700	572.60	res	DHHL	Hoolehua	0	0	0
252015036	Govt. State DHHL	3046800	0.00	res	DHHL	Hoolehua	0	0	0
252002073	Govt. State DHHL	3046900	657.53	res	DHHL	Hoolehua	0	0	0
252030035	Govt. State DHHL	3047300	764.38	res	DHHL	Hoolehua	0	0	0
252017026	Govt. State DHHL	3047500	246.58	res	DHHL	Hoolehua	0	0	0
252008125	Govt. State DHHL	3047600	1216.44	res	DHHL	Kalamaula	0	0	0
252030031	Govt. State DHHL	3047700	257.53	res	DHHL	Hoolehua	0	0	0
252015060	Govt. State DHHL	3047900	756.16	res	DHHL	Hoolehua	0	0	0
252030051	Govt. State DHHL	3048100	1501.37	res	DHHL	Hoolehua	0	0	0
252015058	Govt. State DHHL	3048300	364.38	res	DHHL	Hoolehua	0	0	0
252023025	Govt. State DHHL	3048400	0.00	res	DHHL	Hoolehua	0	0	0
252032049	other	3048700	887.67	res	DHHL	Kalamaula	0	0	0
252032013	other	3048800	956.16	res	DHHL	Kalamaula	0	0	0
252002033	Govt. State DHHL	3048900	0.00	res	DHHL	Hoolehua	5249	2	0
252032006	other	3049000	0.00	res	DHHL	Kalamaula	0	0	0
252032022	other	3049100	0.00	res	DHHL	Kalamaula	0	0	0
252032038	other	3049200	0.00	res	DHHL	Kalamaula	0	0	0
252032066	other	3049300	0.00	res	DHHL	Kalamaula	0	0	0
252032059	other	3049400	334.25	res	DHHL	Kalamaula	0	0	0
252033008	other	3049500	0.00	RES	DHHL	Kalamaula	0	0	0
252030034	Govt. State DHHL	3049600	139.73	res	DHHL	Hoolehua	0	0	0
252015010	Govt. State DHHL	3049700	0.00	res	DHHL	Hoolehua	0	0	0
252027007	Govt. State DHHL	3049800	0.00	res	DHHL	Hoolehua	0	0	0
252032047	other	3049900	1038.36	res	DHHL	Kalamaula	0	0	0
252030055	Govt. State DHHL	3050000	169.86	res	DHHL	Hoolehua	0	0	0
252008098	Govt. State DHHL	3050100	1443.84	res	DHHL	Kalamaula	0	0	0
252032029	other	3050200	0.00	res	DHHL	Kalamaula	0	0	0
252033006	other	3050300	0.00	RES	DHHL	Kalamaula	0	0	0
252032067	other	3050400	0.00	RES	DHHL	Kalamaula	0	0	0
252033022	other	3050500	0.00	RES	DHHL	Kalamaula	0	0	0
252002040	Govt. State DHHL	3050600	347.95	res	DHHL	Hoolehua	5056	60	0
252008014	Govt. State DHHL	3050700	0.00	res	DHHL	Kalamaula	0	0	0
252032057	other	3050800	0.00	RES	DHHL	Kalamaula	0	0	0

2005 DHHL Potable Water System Meter Data

TMK	MajorOwner	DHHL #	potable gpd	type	DHHL	City	MIS #	Farm_Area	MIS gpd
252033028	other	3050900	1298.63	RES	DHHL	Kalamaula	0	0	0
252033035	other	3051000	0.00	RES	DHHL	Kalamaula	0	0	0
252032026	other	3051100	221.92	res	DHHL	Kalamaula	0	0	0
252032051	other	3051200	0.00	res	DHHL	Kalamaula	0	0	0
252008011	Govt. State DHHL	3051300	0.00	res	DHHL	Kalamaula	0	0	0
252032028	other	3051400	0.00	res	DHHL	Kalamaula	0	0	0
252030012	Govt. State DHHL	3051600	93.15	res	DHHL	Hoolehua	0	0	0
252032015	other	3051700	983.56	res	DHHL	Kalamaula	0	0	0
252033001	other	3051800	0.00	RES	DHHL	Kalamaula	0	0	0
252033053	other	3051900	0.00	RES	DHHL	Kalamaula	0	0	0
252025017	Govt. State DHHL	3052000	756.16	res	DHHL	Hoolehua	0	0	0
252032012	other	3052200	0.00	res	DHHL	Kalamaula	0	0	0
252015003	Govt. State DHHL	3052500	25.00	res	DHHL	Hoolehua	0	0	0
252017002	Govt. State DHHL	3052600	471.23	RES	DHHL	Hoolehua	0	0	0
252030033	Govt. State DHHL	3052700	246.58	res	DHHL	Hoolehua	0	0	0
252030017	Govt. State DHHL	3052800	336.99	res	DHHL	Hoolehua	0	0	0
252033051	other	3052900	189.04	RES	DHHL	Kalamaula	0	0	0
252004096	Govt. State DHHL	3053000	0.00	res	DHHL	Hoolehua	0	0	0
252032053	other	3053100	0.00	res	DHHL	Kalamaula	0	0	0
252032054	other	3053200	0.00	res	DHHL	Kalamaula	0	0	0
252032035	other	3053500	0.00	res	DHHL	Kalamaula	0	0	0
252002075	Govt. State DHHL	3053600	734.25	res	DHHL	Hoolehua	5213	2	0
252030032	Govt. State DHHL	3053700	0.00	res	DHHL	Hoolehua	0	0	0
252032030	other	3054000	0.00	res	DHHL	Kalamaula	0	0	0
252033055	other	3054100	0.00	RES	DHHL	Kalamaula	0	0	0
252032016	other	3054200	756.16	res	DHHL	Kalamaula	0	0	0
252032042	other	3054300	0.00	res	DHHL	Kalamaula	0	0	0
252007106	Govt. State DHHL	3054800	0.00	res	DHHL	Hoolehua	0	0	0
252007068	Govt. State DHHL	3054900	953.42	res	DHHL	Hoolehua	0	0	0
252007105	Govt. State DHHL	3055000	0.00	res	DHHL	Hoolehua	0	0	0
252007104	Govt. State DHHL	3055100	0.00	res	DHHL	Hoolehua	0	0	0
252007107	Govt. State DHHL	3055200	0.00	res	DHHL	Hoolehua	0	0	0
252007108	Govt. State DHHL	3055300	38.36	res	DHHL	Hoolehua	0	0	0
252017040	Govt. State DHHL	3055600	0.00	res	DHHL	Hoolehua	0	0	0
252033020	other	3055800	0.00	RES	DHHL	Kalamaula	0	0	0
252032055	other	3055900	0.00	res	DHHL	Kalamaula	0	0	0
252032058	other	3056000	632.88	res	DHHL	Kalamaula	0	0	0
252032014	other	3056100	364.38	res	DHHL	Kalamaula	0	0	0
252030065	Govt. State DHHL	3056200	0.00	res	DHHL	Hoolehua	0	0	0
252024003	Govt. State DHHL	3056300	178.08	res	DHHL	Hoolehua	0	0	0
252030013	Govt. State DHHL	3056400	0.00	res	DHHL	Hoolehua	0	0	0
252004105	Govt. State DHHL	3056600	882.19	res	DHHL	Hoolehua	0	0	0
252002071	Govt. State DHHL	3056700	0.00	res	DHHL	Hoolehua	0	0	0
252033029	other	3056800	0.00	RES	DHHL	Kalamaula	0	0	0
252032007	other	3056900	0.00	res	DHHL	Kalamaula	0	0	0
252032011	other	3057000	0.00	res	DHHL	Kalamaula	0	0	0
252032048	other	3057300	0.00	res	DHHL	Kalamaula	0	0	0
252032040	other	3057400	0.00	res	DHHL	Kalamaula	0	0	0
252032003	other	3057500	205.56	res	DHHL	Kalamaula	0	0	0
252017036	Govt. State DHHL	3057600	0.00	res	DHHL	Hoolehua	0	0	0
252032023	other	3057700	0.00	res	DHHL	Kalamaula	0	0	0

2005 DHHL Potable Water System Meter Data

TMK	MajorOwner	DHHL #	potable gpd	type	DHHL	City	MIS #	Farm_Area	MIS gpd
252017024	Govt. State DHHL	3057800	88.89	res	DHHL	Hoolehua	0	0	0
252030042	Govt. State DHHL	3057900	5.56	res	DHHL	Hoolehua	0	0	0
252017037	Govt. State DHHL	3058000	105.56	res	DHHL	Hoolehua	0	0	0
252008129	Govt. State DHHL	3058100	33.33	res	DHHL	Kalamaula	0	0	0
252032019	other	3058200	0.00	res	DHHL	Kalamaula	0	0	0
252033010	other	3058500	0.00	RES	DHHL	Kalamaula	0	0	0
252017032	Govt. State DHHL	3058700	0.00	res	DHHL	Hoolehua	0	0	0
252030010	Govt. State DHHL	3059000	0.00	res	DHHL	Hoolehua	0	0	0
252033014	other	3060000	0.00	RES	DHHL	Kalamaula	0	0	0
252015027	Govt. State DHHL	3224200	123.29	res	DHHL	Hoolehua	5243	2	8

APPENDIX E
FIELD PHOTOS
DHHL MOLOKAI WATER SYSTEM

Kualapuu Wells #1 and #2, Million Gallon Tank, and Booster Pumps









1.0 Million Gallon Tank at Kaulawai











Twin 3.5 Million Gallon Hoolehua Tanks





APPENDIX F

FEASIBILITY STUDY FOR USING DIESEL GENERATOR

FEASIBILITY STUDY FOR USING DIESEL GENERATOR TO RUN EXISTING DHHL WELLS

I. Background

- 1) Existing DHHL allocation permitted = 0.367 mgd (For two wells total)
- 2) Two existing wells: 1 @ 600 gpm/200 HP and 1 @ 750 gpm/300 HP
- 3) Existing DHHL Operation
 - a) Monday to Friday from 9:00 am to 4:00 pm (7-hr/day)
 - b) Friday from 9:30 pm to Monday morning 7:00 am (57-hr)
Only one well operates at a time
- 4) DHHL Annual/Monthly Power Costs for 2003, 2004, 2005 & 2006
- 5) Current DHHL rates:
 - a) DHHL - \$0.70/1000 gal
 - b) DWS - \$1.55/1000 gal
 - c) Molokai Ranch - \$1.94/1000 gal (Rate increase to \$3.1826/1000 gal - PUC request)
 - d) MIS - \$0.33/1000 gal
- 6) Existing DHHL wells
 - a) Current pumping averages 0.600 mgd (3-year pumping records) = 18,000,000 gal/mon
 - b) Situation is due to operation schedule to minimize power costs
 - c) Average power cost = \$30,000+ per month
 - d) Maui Electric Co. (MECO) facilities constrain operation time
 - e) Pumps are in operation from Monday thru Friday between 9:00 am to 4:00 pm – 7-hrs/day
Friday (9:30 pm) to Monday (7:00 am) - 57+ hours
 - g) Chlorides levels are said to be rising
 - h) DHHL has 2.9 mgd in reserved allocation (not presently permitted)
- 7) Molokai Ranch Well 17
 - a) Existing allocation permitted = 1.08 mgd
 - b) Records indicate that well can produce 2.0+ mgd w/o raising chlorides (Need to confirm)
 - c) Molokai Ranch needs about 1.0 mgd for their use
 - d) Well 17 is operated with a generator versus MECO power

8) DHHL Existing Demand (Ho'olehua & Kalamaula)

- a) Current demand averages 0.350 mgd
(1) DHHL services – 0.232 mgd
(2) Non-DHHL services – 0.118 mgd

9) DHHL Planned Demand (Ho'olehua & Kalamaula)

- a) Total Demand 1.752 mgd
(1) DHHL services -1.634 mgd
(2) Non-DHHL services – 0.118 mgd

II. Analysis

1) **Option 1 – Existing Operation Schedule**

- a) Determine total gallons pumped per month
- Monthly average = 18,000,000 gallons (3-year pump records)
- b) Determine Kw-hr required for duration
- Average monthly Kw-hr = 133,000 kw-hr (4-year billing records)
- c) Power Cost
- Average monthly power cost = \$28,669 (4-year billing records)
- d) Determine power cost per gallon of water
- Cost per 1000 gallon = $\$28,669/18000 = \mathbf{\$1.59 \text{ per 1000 gallons}}$

2) **Option 2 - Proposed Generator Set, 7-day Schedule & Same Quantity as Existing**

- a) Determine pump run-time for same pumping of 18,000,000 gal/mo or 591,781 gpd
- $600 \text{ gpm} \times 60 \text{ min/hr} \times A = 591,781 \text{ gallons}$, where A = No. of hrs/day for 600 gpm pump
A = 16.43 hrs say 16.5 hours run-time
 - $750 \text{ gpm} \times 60 \text{ min/hr} \times B = 591,781 \text{ gallons}$, where B = No. of hrs/day for 750 gpm pump
B = 13.15 hrs say 13.0 hours run-time
- b) Determine total gallons pumped
- $Q_{600/200} = 600 \text{ gpm} \times 60 \text{ min/hr} \times 16.5 \text{ hrs} = 594,000 \text{ gpd}$
 - $Q_{750/300} = 750 \text{ gpm} \times 60 \text{ min/hr} \times 13.0 \text{ hrs} = 585,000 \text{ gpd}$
- c) Determine diesel fuel requirements
- $200 \text{ HP} \times 0.746 \text{ Kw/HP} \times 16.5 \text{ hr/day} \times 30.4 \text{ days/mo} = 74,839 \text{ KwH/mo}$

- $300 \text{ HP} \times 0.746 \text{ Kw/HP} \times 13.0 \text{ hr/day} \times 30.4 \text{ days/mo} = 88,446 \text{ Kwh/mo}$
 - Using $88,446 \text{ Kwh/month} \times 0.11 \text{ gal/Kwh} = 9,729 \text{ gallons/month}$
 - USE: $10,000 \text{ gal/mo}$
- d) Determine Cost of Diesel Fuel
- $10,000 \text{ gallons} \times \$2.64/\text{gallon} = \$26,400 \text{ gallon}$
- e) Power cost per gallon of water
- Cost per 1000 gallon = $\$26,400/18,000 = \mathbf{\$1.47 \text{ per 1000 gallons}}$

3) **Option 3 - Proposed Generator Set & 7-day Schedule w/in Permitted Allocation**

- a) Determine pump run-time to keep within daily allocation permitted
- $600 \text{ gpm} \times 60 \text{ min/hr} \times A = 367,000 \text{ gallons}$, where A = No. of hrs/day for 600 gpm pump
A = 10.19 hrs say 10 hours run-time
 - $750 \text{ gpm} \times 60 \text{ min/hr} \times B = 367,000 \text{ gallons}$, where B = No. of hrs/day for 750 gpm pump
B = 8.16 hrs say 8 hours run-time
- b) Determine total gallons pumped
- $Q_{600/200} = 600 \text{ gpm} \times 60 \text{ min/hr} \times 10 \text{ hrs} = 360,000 \text{ gallons}$ or $2,520,000 \text{ gallons/week}$
 - $Q_{750/300} = 750 \text{ gpm} \times 60 \text{ min/hr} \times 8 \text{ hrs} = 360,000 \text{ gallons}$ or $2,520,000 \text{ gallons/week}$
 - $Q_{ave} = 10,920,000 \text{ gallons/month}$
- c) Determine diesel fuel requirements
- $200 \text{ HP} \times 0.746 \text{ Kw/HP} \times 10 \text{ hr/day} \times 30.4 \text{ days/mo} = 45,357 \text{ Kwh/mo}$
 - $300 \text{ HP} \times 0.746 \text{ Kw/HP} \times 8 \text{ hr/day} \times 30.4 \text{ days/mo} = 54,428 \text{ Kwh/mo}$
 - $55,000 \text{ Kwh/month} \times 0.11 \text{ gal/Kwh} = 6,050 \text{ gallons/month}$
 - USE: $6,000 \text{ gal/mo}$
- d) Determine Cost of Diesel Fuel
- $6,000 \text{ gallons} \times \$2.64/\text{gallon} = \$15,840 \text{ gallon}$
- e) Power cost per gallon of water
- Cost per 1000 gallon = $\$15,840/10,920 = \mathbf{\$1.45 \text{ per 1000 gallons}}$

III. Conclusions

- a) **Option 1 – Continue Existing Operation Schedule**
- Pros
 - + Operation limited to 2.5+ days
 - + Meets existing use demand
 - Cons
 - Pumping over permitted allocation continues
 - Chloride levels rising
 - Inability to avoid peak power rates in emergency
 - Need additional source (wells) for planned development
 - Highest power-water cost
- b) **Option 2 - Proposed Generator Set, 7-day Schedule & Same Quantity as Existing**
- Pros
 - + Pumping will be same as existing
 - + Pumping 8 to 10 hours during the week may decrease chloride level
 - + Alternative may be to pump at a lower rate at longer time. Need pumping/chloride level data overtime to determine optimum
 - + Lower power-water cost
 - Cons
 - Pumping over permitted allocation continues
 - Chloride levels rising
 - Requires CIP for generator & appurtenances
 - Requires more O&M
 - Need additional source (wells) for planned development

- c) **Option 3 - Proposed Generator Set & 7-day Schedule w/in Permitted Allocation**
- Pros
 - + Pumping will be within existing permitted allocation
 - + Pumping 8 to 10 hours during the week may decrease chloride level
 - Alternative may be to pump at a lower rate at longer time, say 14 to 16 hours
 - Need pumping/chloride level data overtime to determine optimum
 - +
 - Cons
 - Requires CIP for generator & appurtenances
 - Requires more O&M
 - Option 3 water production is short of about 233,000 gallons per day when compared to the current usage.

IV. Recommendations & Discussion

- a. Implement Option 3
- Install diesel generator & appurtenances to operate the DHHL water system
 - Operate the DHHL wells on a 7-day per week schedule and monitor chloride levels to compare with prior records
 - Adjust pump rate as required to meet Dept. of Health allowable chloride level
 - Re-assess present operations & practices
 - Average daily demand for domestic use is about 500 gallons per day (gpd) for Hoolehua and 800 gallons per day for Kalamaula, which exceeds the Maui DWS demand of 600 gpd. Some use of potable water for agricultural use occurs.
 - ▶ Multi-generational habitation
 - ▶ Lawn/plants irrigation

- Current potable water for use Agricultural uses exasperates the challenge of keeping within the potable water permitted allocation of 367,000 gpd
- In Kalamaula, the average daily demand is about 800 gpd.

APPENDIX G

MEETING MINUTES

MEETING MINUTES

PROJECT: Molokai Water Master Plan

SUBJECT: Water System

A&A JOB NO: DHHL06-03

DATE: August 29, 2006

TIME: 9:30 A.M. to 11:00 A.M.

PURPOSE: Discuss Water System Concerns

ATTENDANCE: George Maioho (GM), DHHL Molokai
Larry Sagario (LS), DHHL Molokai Maintenance
Alex Bishaw (AB), DHHL Maintenance, Retired
Robert Akinaka (RYA), Akinaka & Associates, Ltd. (A&A)
Sal Quitariano (SMQ), A&A
Matthew Fujioka (MKF), A&A.

INFORMATION ITEMS:

1. History

- Alex Bishaw (AB) gave a history of the Molokai Water System regarding the surface water intake system.
- AB recalled there being stubouts for an interconnection between the DHHL water system in Kalamaula to the County water system in Kaunakakai along the coast.
- AB recommended interviewing another retired operations person named Kimo

2. System Deficiencies

- Larry Sagario (LS) stated that larger storage capacity at the well pump site would greatly improve the water system. The existing 100,000 gallon tank supplies the higher 1.0 MG tank and the lower 200,000 gallon tank that serves Kalamaula. When the tank level falls too low, the booster pumps will not turn on to pump water up to the 1.0 MG tank. A larger capacity tank would provide additional water storage in times of high demand, and simplify system operation. George Maioho (GM) agreed with LS that a larger tank at the well site would improve the system.
- GM and LS stated that there are no immediate problems regarding the operation of the DHHL water system

- Bob Akinaka (RYA) suggested that it would be a good idea to replace the existing PRV above Kalamaula with a small pressure breaker tank. GM and LS stated that they have had no problem with the operation of the PRV and have received good service from _____ when needed.
- RYA asked how often and how long do power outages occur. LS stated that maybe once a year a power outage occurs, with the longest one lasting about a day and a half. RYA suggested that a Gen. Set would be good to have as a backup power source.

3. Water System

- LS mentioned that there is an emergency connection from the county system to the DHHL system above Kalamaula, but there might not be any plans available.
- LS mentioned that booster pumps are controlled through timers. Maintenance crews estimate the time needed to fill a tank, and set the timers accordingly. This often leads to tank overflow.
- LS and GM estimated that the DHHL wells are pumping 750,000 to 850,000 gpd with approximately 19 hours of pump time.

3. Development

- GM stated that approximately 200 new lots in the Kalamaula area is planned for development. Also, there are approximately 80 existing meters in the old section.
- 40 acre farm lots in Hoolehua were further subdivided in the past to help get families onto the land. Lots would be divided into 1,5, and 15 acres to accommodate more residential units. However, irrigation water through the Molokai Irrigation System was not available to these lots

ACTION ITEMS:

NOTE: If your understanding of the Minutes of Meeting differs, please notify Akinaka & Associates, Ltd. for any revisions or additions.

Matthew Fujioka
Akinaka & Associates, Ltd.

cc: All attendees

MEETING MINUTES

PROJECT: Molokai Water Master Plan

SUBJECT: Water System

A&A JOB NO: DHHL06-03

DATE: August 29, 2006

TIME: 1:30 P.M. to 2:45 P.M.

PURPOSE: Discuss Water System Concerns

ATTENDANCE: Ellen Kraftsow (EK), Maui DOW
Arnold Imaye (AI), Maui DOW
George Maioho (GM), DHHL Molokai
Robert Akinaka (RYA), Akinaka & Associates, Ltd. (A&A)
Sal Quitariano (SMQ), A&A
Matthew Fujioka (MKF), A&A.

INFORMATION ITEMS:

1. Introduction

- Robert Akinaka (RYA) explained the role of Akinaka & Associates, Ltd with the DHHL Water Master Plan Project and PBR's Community Development Plan.

2. County Water System

- Ellen Kraftsow (EK) provided Akinaka & Associates with a CD containing past DOW/USGS presentations to the Molokai community as a reference for what was previously presented.
- EK stated that the County has GIS layers showing their water system and she can e-mail them to us if needed. SMQ replied that the layers would be very useful and to e-mail the layers to him when available.
- EK mentioned that the County is planning to create a development plan report for the island of Molokai, but it will likely not start work for one more year.

3. USGS Models

- EK stated that USGS had been contracted by the Maui County Dept. of Water Supply to perform model studies on the effect of well pumping. The models show different scenarios for which USGS could determine an estimated

drawdown in the aquifer for each well, and the effect the pumping would have on coastal activities.

- EK mentioned that the scenarios included the existing condition and numerous possible scenarios that include possible future well sites.
- EK stated that one of the problems facing the Dept. of Water's Molokai system is that the Ulapue and Kawela Shaft water sources have experienced rising salinity levels in the last few years. The cause of the rise has not been determined, but the ongoing drought could be a possible cause. The USGS models include possible replacement wells further inland that could provide higher quality potable water.

3. **Well Development**

- EK stated that the site most desirable to the Dept. of Water is a well at the East end of the Manawainui Aquifer zone. This site has little issues with accessibility and connectivity to the existing system. The only problem may be with getting MECO to provide power to the site.
- RYA showed EK the areas in which DHHL is planning to develop their lands in the future and will likely need additional water sources. EK replied that it might be an option for DHHL and DOW to have a joint interest into the well so it will provide water to more than one group.

ACTION ITEMS:

Ellen Kraftsow

1. Provide A&A with GIS layers of County water system.

NOTE: If your understanding of the Minutes of Meeting differs, please notify Akinaka & Associates, Ltd. for any revisions or additions.

Matthew Fujioka
Akinaka & Associates, Ltd.

File: 2006Aug29 Minutes DWS.doc
cc: All attendees

MEETING MINUTES

PROJECT: Molokai Water Master Plan

SUBJECT: Water System

A&A JOB NO: DHHL06-03

DATE: September 7, 2006

TIME: 1:00 P.M. to 2:45 P.M.

PURPOSE: Discuss Water Source Concerns

ATTENDANCE: Steve Bowles (SB), Waimea Water
Imeola Lindsey (IL), Waimea Water
Ben Henderson (BH), DHHL Oahu
Darrell Yagodich (DY), DHHL Oahu
Dean Nakano (DN), Water Commission
Charley Ice (CI), Water Commission
Kevin Gooding (KG) – Water Commission
Robert Akinaka (RYA), Akinaka & Associates, Ltd. (A&A)
Reid Ikemori (RKI), A&A
Matthew Fujioka (MKF), A&A.

INFORMATION ITEMS:

1. Introduction

- Robert Akinaka (RYA) explained the role of Akinaka & Associates, Ltd with the DHHL Water Master Plan Project and introduced Steve Bowles as the Water Resource sub-consultant.

2. Department of Hawaiian Homelands Objectives

- Darrell Yagodich (DY) went over the Regional Planning Structure of DHHL.
 - 22 Regions with Molokai being 1 region.
 - Short-term 3-5 year plans.
 - 9 On-going projects
 - Objective are identifying projects and organizing stakeholders to rally funding.
 - Water is 1st priority on Molokai
- Ben Henderson (BH) said DHHL interests are in identifying factual information on the water problem.

- Source salinity and viable options.
- Alternatives to new source development.
 - i. RYA brought up a rumor about DHHL taking over MIS.
 - ii. BH responded that's not a preferred option at this point.

3. Source Development

- County of Maui at Kualapuu must move to reduce salinity at Kualapuu Wells. BH agreed that DHHL has been overpumping over their allotted 0.3 MGD to approximately 0.6 MGD. The proposed replacement well locations however do not seem feasible in terms of producing potable water according to SB.
- Steve Bowles (SB) identified that all existing aquifers can not be tapped for large wells. County of Maui's proposed Manawainui well will most likely hit the same salinity as a previous Kakalahale Well report in the same general area.
 - Kakalahale had a high chloride count initially at 500 but would drop to 375 with prolonged pumpage during the test.
 - Also inferred that other proposed County of Maui wells will produce similar results.
- SB stated that large output wells can only be viable on the ridgeline though that may be economically infeasible. The alternatives:
 - For the County of Maui, should drill small output wells along the Kaunakakai, Kamiloloa, and Kawela. Small output meaning between 75 and 100 GPM.
 - New sources for DHHL would be drilling inside of or near the tunnel coming off the MIS line from Waikolu.
- Charley Ice (CI) and Dean Nakano (DN) mentioned that DHHL's water reserve in the Kualapuu region of 2.9 MGD is in addition to the currently allocated 0.3 MGD. However, this water reserve is associated with only the Kualapuu region and cannot be transferred to another aquifer region.
- Kevin Gooding stated that the salinity levels shown on the two DHHL well logs appear to be incorrect since all the logs have the same salinity readings, which is highly unlikely. RYA replied that A&A will check with DHHL.

4. Alternatives to Source Development

- BH said Molokai Ranch said they'll give 0.5 MGD from their Well 17 but may leverage that to increase their transmission line across DHHL land. DHHL's stance is they do not want to increase that transmission line.
- RYA proposed restarting the County of Maui's Waikalae tunnels to the non-potable system and restart a treatment facility.
- Desalinization plants could take care of salinity problems at brackish water wells.

ACTION ITEMS:

A&A

1. Meeting on 21th, prepare inventory and consumption data of water system on Molokai.
2. Prepare for USGS and County of Maui meeting on 27th and models on water sources.

NOTE: If your understanding of the Minutes of Meeting differs, please notify Akinaka & Associates, Ltd. for any revisions or additions.

Matthew Fujioka
Akinaka & Associates, Ltd.

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cc: All attendees

REFERENCES

List of References

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3. *Engineering Report for Molokai Water System Improvement*, Department of Hawaiian Home Lands, State of Hawaii, August 1977
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6. *Numerical Simulation of the Hydrologic Effects of Redistributed and Additional; Groundwater Withdrawal, Island of Molokai, Hawaii*, U.S. Geological Survey, Report 2006-5177