



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
**COMMISSION ON WATER RESOURCE MANAGEMENT**  
P.O. BOX 621  
HONOLULU, HAWAII 96809

**STAFF SUBMITTAL**

for the meeting of the  
**COMMISSION ON WATER RESOURCE MANAGEMENT**

September 19, 2012  
Honolulu, Oahu

Ted Nakamura  
**APPLICATION FOR A WATER USE PERMIT**  
Thurston 2011 Well (Well No. 3605-30), TMK (1) 6-2-002:003, WUP No. 955  
Future (Agricultural) Use for 0.024 mgd  
Kawailoa Ground Water Management Area, Oahu

APPLICANT:

Ted Nakamura  
P.O. Box 1032  
Haleiwa, HI 96803

LANDOWNER:

Keawe Thurston  
817 18th Avenue  
Honolulu, HI 96816

SUMMARY OF REQUEST:

The applicant requests that the Commission approve a water use permit for an allocation of **0.024** million gallons per day (mgd) of **potable basal** ground water from a **new well** to supply **10 acres with agricultural irrigation**.

LOCATION MAP: See Exhibit 1

BACKGROUND:

- January 21, 2011      The Commission on Water Resource Management (Commission) received a well construction/pump installation permit application for individual domestic use by Keawe Thurston. Permits were approved without objection or comment on April 1, 2011.
- May 11, 2012      A completed water use permit application was received from Ted Nakamura, signed by land owner Keawe Thurston by the Commission to expand uses beyond individual domestic to irrigation of the balance of the parcel, approximately 10 acres. Additional information regarding the source, use, notification, objections, and field investigation(s) is provided in Attachment A.

- May 23 & 30, 2012 Notice of the permit application was published in the Honolulu Star-Advertiser. The deadline for objections was June 10, 2012. No objections were received.
- July 25, 2012 Reimbursement for the public notice was received, enabling the permit to be taken forward to the Commission.

ANALYSIS/ISSUES:

Section 174C-49(a) of the State Water Code establishes seven (7) criteria that must be met to obtain a water use permit. An analysis of the proposed permit in relation to these criteria follows:

(1) Water availability

Through the Hawaii Water Plan, the Commission has adopted 29 mgd as the sustainable yield for the **Kawailoa** Aquifer System Area. Individual existing water use permits in this aquifer system area are shown in Exhibit 2. A summary of the current ground water conditions in the aquifer is provided in Table 1:

**Table 1. Kawailoa Aquifer System Area**

<u>ITEM</u>	<b>Kawailoa Aquifer System Area (mgd)</b>
<b>Sustainable Yield</b>	29
Less: Other Existing Water Use Permits (shown in Exhibit 2)	1.814
Reservation to DHHL	0
<b>Subtotal (Current Available Allocation)</b>	27.186
Less: Other Completed Applications	0
Less: This Application	0.024
<b>Subtotal (Potential Available Allocation/Allocation Deficit)</b>	27.162

Therefore, there is adequate water available to accommodate this application request.

(2) Reasonable-beneficial

Section 174C-3 HRS defines "reasonable-beneficial use" is  
*"...the use of water in such a quantity as is necessary for economic and efficient utilization, for a purpose, and in a manner which is both reasonable and consistent with the state and county land use plans and the public interest".*

### *I. Purpose of Use*

The applicant is requesting the use of fresh, potable ground water to irrigate 10 acres of assorted organically-grown food crops. The Declaration of Policy section, §174C-2(c) HRS, states that the Water Code shall be liberally interpreted to obtain maximum beneficial use of the waters of the State for various purposes including irrigation uses.

### *II. Quantity Justification*

The applicant is requesting a total of **2,355 gad** to irrigate asparagus, eggplant, okra, long bean, cherry tomato; grapefruits, and limes. The Irrigation Water Requirement Estimate Decision Support System (IWREDSS) is the University of Hawaii College of Tropical Agriculture data model integrating rainfall, soil type, etc. for specific parcel locations. The model run for this parcel predicts that the typical generic crop will require 3,514 gad and that the irrigation system should therefore deliver 4,134 gad. The applicant is estimating more efficient use of water. (see Exhibit 3)

### *III. Efficiency of Use*

The applicant states that its operations are as water efficient as possible using drip irrigation, eliminating leakage and in consultation with University of Hawaii experts on crop practices.

### *IV. Analysis of Practical Alternatives*

The applicant has identified **no** alternatives to the proposed use of fresh basal water. An analysis of each of the alternatives is as follows:

1. Municipal sources: Too costly for food farming
2. Wastewater reuse: Not appropriate for organic farming
3. Ditch system: Not appropriate for organic farming
4. Desalting: Not available from others/too costly to produce for food crops
5. Surface water: Not appropriate for organic farming

The 2000 Legislature amended the Water Code to include a new section, §174C-51.5 HRS that provides the Commission with the authority to require dual line (potable and non-potable) water supply systems in new industrial and commercial developments located in designated water management areas. In this case, the applicant does not have potable water service and is proposing to install only a single non-potable system. Therefore, this provision does not need to be invoked.

As a side note, §174C-51.5(3)(b) HRS requires the county boards of water supply, in consultation with the department of health, to adopt standards for non-potable water distributed through dual line water supply systems and rules regarding the use of non-potable

water. The standards and rules shall be adopted in accordance with Chapter 91 and shall protect existing water quality and the health and safety of the public. Staff will follow up with the county boards of water supply as to the status of their dual-line standards and rules adoption, so that the Commission may invoke this provision under appropriate future circumstances.

(3) Interference with other existing legal uses

There are 4 observation wells currently in use within 1 mile of this source , and one that once watered a lawn but has not been in use for many years. Makai of the project area is Ukoa Pond, one of the larger areas of natural wetlands on the Northshore, for which the Division of Forestry and Wildlife administers a Habitat Conservation Plan for endangered waterfowl. It is not anticipated that pumping for irrigation will interfere with the conservation habitat, but monitor wells may be used during pump testing of this well, which is not yet constructed. There is more concern for assuring best land management practices to avoid endangering conserved species. The water use can be conditionally permitted subject to adjustments in agricultural practices if endangered waterfowl are negatively affected by agricultural activity.

(4) Public interest

Public interest is defined under §174C-2 - Declaration of policy, as follows:

*“(c) The state water code shall be liberally interpreted to obtain maximum beneficial use of the waters of the State for purposes such as domestic uses, aquaculture uses, irrigation and other agricultural uses, power development, and commercial and industrial uses. However, adequate provision shall be made for the protection of traditional and customary Hawaiian rights, the protection and procreation of fish and wildlife, the maintenance of proper ecological balance and scenic beauty, and the preservation and enhancement of waters of the State for municipal uses, public recreation, public water supply, agriculture, and navigation. Such objectives are declared to be in the public interest.”*

The proposed organic farming use, with its low fertilizer and pesticide inputs is consistent with habitat conservation.

Additionally, there have been Public comments on this application (other than state & county general plans and land use designation comments noted in criteria (5)), which are summarized as follows:

1. The Department of Hawaiian Home Lands noted that its homestead development may require additional reserves from areas where water availability remains ample, and where homesteading may become in demand in the future. Both may be true for the Kawaihoa area. This application makes a small withdrawal from a very large unused supply of allocations for future reservations.

Therefore, this application **meets** the public interest.

(5) State & county general plans and land use designations

The proposed uses are in the State **Agriculture** District, and the county zoning is **Ag-1**. Therefore, the proposed use is consistent with these land use designations.

Normal agency review includes:

- 1) the State's Department of Land and Natural Resources (DLNR) and its State Parks, Aquatic Resources, Historic Preservation, and Land Divisions; the Department of Health (DOH) with its Clean Water, Safe Drinking Water, and Wastewater Branches; the Department of Hawaiian Home Lands (DHHL), and Land Use Commission (LUC); and the Office of Hawaiian Affairs (OHA).
- 2) the Office of the Mayor, Department of Planning and Permitting, and Board of Water Supply;

Comments have been noted. No objections have been made through this review. These proposed uses are consistent with the state and county general plans and land use designations.

Therefore, this application **meets** the state & county general plans and land use designations.

(6) County land use plans and policies

Again normal County review includes Office of the Mayor, Department of Planning and Permitting and the Board of Water Supply. No comments or objections have been made.

Therefore, this application **meets** the county land use plans and policies.

(7) Interference with Hawaiian home lands rights

All permits are subject to the prior rights of Hawaiian home lands. The Department of Hawaiian Home Lands (DHHL) and the Office of Hawaiian Affairs have reviewed this application; its comments are noted. Further, standard water use permit conditions 3.g., 6., and 9.f. notify all water use permittees that their permits are subject to and cannot interfere with Hawaiian home land rights.

Therefore, this application **will not** interfere with Hawaiian home lands rights.

(8) Other issues

*I. Chapter 343 – Environmental Assessment (EA) Compliance*

**EA Triggers**

In accordance with §HRS 343-5(a), the applicant's proposed action does not trigger the need for an EA.

**Cumulative Impacts §HAR11-200-8.B.**

Even where a categorical exemption appears to include a proposed action, that action cannot be declared exempt if the cumulative impact of planned successive action in the same place, over time, is significant, or when an action that is normally insignificant in its impact on the environment may be significant in a particularly sensitive environment. For this reason, staff believes that this proposed water use permit is appropriately conditioned on performance consistent with the continuing viability of the conservation habitat.

**Pump Installation Permitted before Water Use Permit Approval**

The normal sequence of permitting a well in a water management area involves issuance of a water use permit prior to approval pump installation in accordance with declaratory rulings DEC-ADM92-G0 & DEC-ADM94-G2. In this case, the well was earlier represented to be for the public trust use of individual domestic use, which is exempted from a water use permit. However, just under 6 weeks after the well permit approvals the applicant then requested a water use permit for additional agricultural use. Therefore this created the circumstance where a new pump installation permit was issued prior to its associated water use permit.

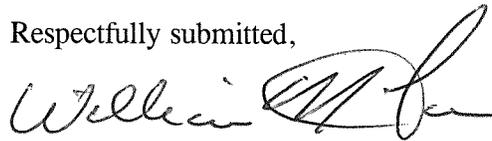
Fortunately, the relatively small size of this pump is not anticipated to cause immediate and significant negative impacts. In this case, the 40 gpm pump will not require pump testing in accordance with the Hawaii Well Construction and Pump Installation Standards. Also, the Ukoa pond concerns raised by DOFAW did not result in a formal objection to the use. This interference issue (see Analysis Item (3), above) can be managed by habitat conservation monitoring. Standard Conditions 4 and 9 of any water use permit and Standard Condition 7 of the well construction permit provide that use of the well will not adversely affect other legal uses. Therefore, staff recommends no further modifications or suspensions to the pump permit but highlight this concern via Special Condition 4 of this water use permit.

**RECOMMENDATION:**

- A. Due to its meeting the criteria for reasonable beneficial water use of potable ground water, staff recommends that the Commission approve the issuance of water use permit no. 955 to Ted Nakamura for the reasonable and beneficial use of 0.024 million gallons per day of Potable water for Agricultural from the Thurston 2011 Well (Well No. 3605-30), subject to the standard water use permit conditions listed in Attachment B and the following special conditions:
1. The permittee shall observe best land management practices to avoid creating any short-term or cumulatively adverse effect on the conservation habitat at Ukoa Pond. Independent observation wells are in place to monitor some effects, and the permittee shall coordinate and cooperate with the Division of Forestry administration of the Kawaihoa Wind Power Habitat Conservation Plan.
  2. Should an alternate permanent source of water be found for this use, then the Commission reserves the right to revoke this permit, after a hearing.

3. In the event that the tax map key at the location of the water use is changed, the permittee shall notify the Commission in writing of the tax map key change within thirty (30) days after the permittee receives notice of the tax map key change.
4. In accordance with well construction permit Standard Condition 7 and water use permit Standard Conditions 4 and 9, if pumpage from this well is found to adversely impact the Habitat Conservation Plan, pumpage is subject to reduction or revocation, after a hearing.

Respectfully submitted,



WILLIAM M. TAM  
Deputy Director

Attachment(s):      A (Water Use Permit Detailed Information)  
                              B (Water Use Permit Standard Conditions)  
                              C (Well Construction Permit Standard Conditions)

Exhibit(s):            1 (Location Map)  
                              2 (Existing Water Use Permits and 12-Month Moving Average Withdrawal)  
                              3 (IWREDDS Summary)

APPROVED FOR SUBMITTAL:



WILLIAM J. AILA, JR.  
Chairperson

**WATER USE PERMIT DETAILED INFORMATION**

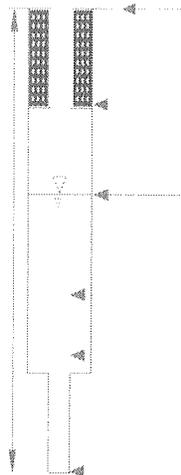
Source Information

**AQUIFER:** Kawaiiloa System, North Sector, Oahu  
 Sustainable Yield: 29 mgd  
 Existing Water Use Permits: 1,549 mgd  
 Available Allocation: 27,451 mgd  
 Total other pending applications: 0 mgd  
 This application: 0.024 mgd

**WELL:** Thurston 2011 Well (Well No. 3605-30)  
 Location: Kawaiiloa, Oahu, TMK: (1) 6-2-002:003  
 Year Drilled: 2011  
 Casing Diameter: 6 in.  
Elevations (msl = 0 ft.)  
     Water Level: 40 ft.  
     Ground: 80 ft.  
     Bottom of Solid Casing: 40 ft.  
     Bottom of Perforated: 80 ft.  
     Bottom of Open Hole: 0 ft.

Total Depth: 80 ft.  
 Grouted Annulus Depth: 30 ft.

Pump Capacity 40 gpm



Use Information

Quantity Requested:	0.024 gallons per day.
Future Type of Water Use:	Agricultural
Place of Water Use:	TMK: (1) 6-2-002:003
Reported Water Usage:	0 gpd
Nearby Similar Water Usage:	1.549 gpd
Kawailoa Aquifer System	
Current 12-Month Moving Average Withdrawal (See Exhibit 2):	1.549 mgd

Nearby Surrounding Wells and Other Registered Ground Water Use

See ANALYSIS, Item (3)

Public Notice

In accordance with HAR §13-171-17, a public notice was published in the Honolulu Advertiser on May 23, 2012 and May 30, 2012 and a copy of the notice was sent to the Office of the Mayor. Copies of the completed application were sent to the Honolulu Board of Water Supply, Department of Planning and Permitting, Department of Health, Department of Hawaiian Home Lands, Office of Hawaiian Affairs, the various divisions within the Department of Land and Natural Resources, and other interested parties for comments. Written comments and objections to the proposed permit were to be submitted to the Commission by June 10, 2012.

Objections

The public notice specifies that an objector meet the following requirements: (1) state property or other interest in the matter; (2) set forth questions of procedure, fact, law, or policy, to which objections are taken; (3) state all grounds for objections to the proposed permits, (4) provide a copy of the objection letter(s) to the applicant, and (5) submit objections meeting the previous requirements to the Commission by June 10, 2012.

To the best of staff's knowledge there are no objectors who have property interest within the Kawailoa Aquifer System or who will be directly and immediately affected by the proposed water use.

Briefs in Support

Responses to objections, or briefs in support, regarding the application are required to be filed with the Commission ten (10) days after an objection is filed and, presumably, copies are served to the applicant. No briefs in support were filed with the Commission.

**STANDARD WATER USE PERMIT CONDITIONS**

1. The water described in this water use permit may only be taken from the location described and used for the reasonable beneficial use described at the location described above. Reasonable beneficial uses means "the use of water in such a quantity as is necessary for economic and efficient utilization which is both reasonable and consistent with State and County land use plans and the public interest." (HRS § 174C-3)
2. The right to use ground water is a shared use right.
3. The water use must at all times meet the requirements set forth in HRS § 174C-49(a), which means that it:
  - a. Can be accommodated with the available water source;
  - b. Is a reasonable-beneficial use as defined in HRS § 174C-3;
  - c. Will not interfere with any existing legal use of water;
  - d. Is consistent with the public interest;
  - e. Is consistent with State and County general plans and land use designations;
  - f. Is consistent with County land use plans and policies; and
  - g. Will not interfere with the rights of the Department of Hawaiian Home Lands as provided in section 221 of the Hawaiian Homes Commission Act and HRS § 174C-101(a).
4. The ground water use here must not interfere with surface or other ground water rights or reservations.
5. The ground water use here must not interfere with interim or permanent instream flow standards. If it does, then:
  - a. A separate water use permit for surface water must be obtained in the case an area is also designated as a surface water management area;
  - b. The interim or permanent instream flow standard, as applicable, must be amended.
6. The water use authorized here is subject to the requirements of the Hawaiian Homes Commission Act, as amended, if applicable.
7. The water use permit application and submittal, as amended, approved by the Commission at its September 19, 2012 meeting are incorporated into this permit by reference.
8. Any modification of the permit terms, conditions, or uses may only be made with the express written consent of the Commission.
9. This permit may be modified by the Commission and the amount of water initially granted to the permittee may be reduced if the Commission determines it is necessary to:
  - a. protect the water sources (quantity or quality);
  - b. meet other legal obligations including other correlative rights;

- c. insure adequate conservation measures;
- d. require efficiency of water uses;
- e. reserve water for future uses, provided that all legal existing uses of water as of June, 1987 shall be protected;
- f. meet legal obligations to the Department of Hawaiian Home Lands, if applicable; or
- g. carry out such other necessary and proper exercise of the State's and the Commission's police powers under law as may be required.

Prior to any reduction, the Commission shall give notice of its proposed action to the permittee and provide the permittee an opportunity to be heard.

- 10. An approved flowmeter(s) must be installed to measure monthly withdrawals and a monthly record of withdrawals, salinity, temperature, and pumping times must be kept and reported to the Commission on Water Resource Management on forms provided by the Commission on a yearly basis (attached).
  - 11. This permit shall be subject to the Commission's periodic review of the **Kawailoa** Aquifer System's sustainable yield. The amount of water authorized by this permit may be reduced by the Commission if the sustainable yield of the **Kawailoa** Aquifer System, or relevant modified aquifer(s), is reduced.
  - 12. A permit may be transferred, in whole or in part, from the permittee to another, if:
    - a. The conditions of use of the permit, including, but not limited to, place, quantity, and purpose of the use, remain the same; and
    - b. The Commission is informed of the transfer within ninety days.
- Failure to inform the department of the transfer invalidates the transfer and constitutes a ground for revocation of the permit. A transfer which involves a change in any condition of the permit, including a change in use covered in HRS § 174C-57, is also invalid and constitutes a ground for revocation.
- 13. The use(s) authorized by law and by this permit do not constitute ownership rights.
  - 14. The permittee shall request modification of the permit as necessary to comply with all applicable laws, rules, and ordinances which will affect the permittee's water use.
  - 15. The permittee understands that under HRS § 174C-58(4), that partial or total nonuse, for reasons other than conservation, of the water allowed by this permit for a period of four (4) continuous years or more may result in a permanent revocation as to the amount of water not in use. The Commission and the permittee may enter into a written agreement that, for reasons satisfactory to the Commission, any period of nonuse may not apply towards the four-year period. Any period of nonuse which is caused by a declaration of water shortage pursuant to section HRS § 174C-62 shall not apply towards the four-year period of forfeiture.

16. The permittee shall prepare and submit a water shortage plan within 30 days of the issuance of this permit as required by HAR § 13-171-42(c). The permittee's water shortage plan shall identify what the permittee is willing to do should the Commission declare a water shortage in the **Kawailoa** Ground Water Management Area.
17. The water use permit shall be subject to the Commission's establishment of instream standards and policies relating to the Stream Protection and Management (SPAM) program, as well as legislative mandates to protect stream resources.
18. Special conditions in the attached cover transmittal letter are incorporated herein by reference.
19. The permittee understands that any willful violation of any of the above conditions or any provisions of HRS § 174C or HAR § 13-171 may result in the suspension or revocation of this permit.

# WELL CONSTRUCTION PERMIT

## Aloha Well, Well No. 1234-56

*Note: This permit shall be prominently displayed at the construction site until the work is completed*

In accordance with Department of Land and Natural Resources, Commission on Water Resource Management's Administrative Rules, Section 13-168, entitled "Water Use, Wells, and Stream Diversion Works", this document permits the construction and testing of Aloha Well (Well No. 1234-56) at TMK 5-5-5: 55, Island of Oahu, subject to the Hawaii Well Construction & Pump Installation Standards (HWCPIS - February 2004) which include but are not limited to the following conditions:

1. The Chairperson of the Commission on Water Resource Management (Commission), P.O. Box 621, Honolulu, HI 96809, shall be notified, in writing, at least two (2) weeks before any work authorized by this permit commences and staff shall be allowed to inspect installation activities in accordance with §13-168-15, Hawaii Administrative Rules (HAR).
2. This permit shall be prominently displayed, or made available, at the site of construction work until work is completed.
3. The well construction permit shall be for construction and testing of the well only. The permittee shall coordinate with the Chairperson and conduct a pumping test in accordance with the HWCPIS (the latest pump test worksheet can be obtained by contacting Commission staff or at [www.hawaii.gov/dlnr/cwrm/resources\\_permits.htm](http://www.hawaii.gov/dlnr/cwrm/resources_permits.htm)). The permittee shall submit to the Chairperson the test results as a basis for supporting an application to install a permanent pump. No permanent pump may be installed until a pump installation permit is approved and issued by the Chairperson. No withdrawal of water shall be made for purposes other than testing without a Certificate of Pump Installation Completion. The permitted pump capacity described on the pump installation permit **may be reduced** in the event that the pump test does not support the capacity.
4. In basal ground water, the depth of the well may not exceed one-fourth (1/4) of the theoretical thickness (41 times initial head) of the basal ground water unless otherwise authorized by the Chairperson. If it can be shown that the well does not tap basal ground water then this condition may be waived after consultation with and acceptance by Commission staff. However, in no instance can the well be drilled deeper than one-half (1/2) of the theoretical thickness without Commission approval.
5. The permittee shall incorporate mitigation measures to prevent construction debris from entering the aquatic environment, to schedule work to avoid periods of high rainfall, and to revegetate any cleared areas as soon as possible.
6. In the event that historically significant remains such as artifacts, burials or concentrations of shells or charcoal are encountered during construction, the permittee shall stop work and immediately contact the Department of Land and Natural Resources' State Historic Preservation Division. Work may recommence only after written concurrence by the State Historic Preservation Division.
7. The proposed well construction shall not adversely affect existing or future legal uses of water in the area, including any surface water or established instream flow standards. This permit or the authorization to construct the well shall not constitute a determination of correlative water rights.
8. The Well Completion Report Part I shall be submitted to the Chairperson within sixty (60) days after completion of work (please contact staff or visit [www.hawaii.gov/dlnr/cwrm/resources\\_permits.htm](http://www.hawaii.gov/dlnr/cwrm/resources_permits.htm) for current form).
9. The permittee shall comply with all applicable laws, rules, and ordinances; non-compliance may be grounds for revocation of this permit.
10. The well construction permit application and, if relevant, any related staff submittal approved by the Commission are incorporated into this permit by reference.
11. If the HWCPIS are not followed and as a consequence water is wasted or contaminated, a lien on the property may result.
12. Any variances from the HWCPIS shall be approved by the Chairperson prior to invoking the variance.
13. The work proposed in the well construction permit application shall be completed within two (2) years from the date of permit approval, unless otherwise specified. The permit may be extended by the Chairperson upon a showing of good cause and good-faith performance. A request to extend the permit shall be submitted to the Chairperson no later than the date the permit expires.
14. If the well is not to be used it must be properly capped. If the well is to be abandoned during the course of the project then the permittee must apply for a well abandonment permit in accordance with §13-168-12(f), HAR, prior to any well sealing or plugging work.
15. The permittee, its successors, and assigns shall indemnify, defend, and hold the State of Hawaii harmless from and against any loss, liability, claim, or demand for property damage, personal injury, or death arising out of any act or omission of the applicant, assigns, officers, employees, contractors, and agents under this permit or relating to or connected with the granting of this permit.
16. This permit shall apply to the location shown on the application only. If the well is to be relocated, the permittee shall apply for a new well construction/pump installation permit in accordance with §13-168-12(f), HAR.
17. Special conditions in the attached cover transmittal letter are incorporated herein by reference.

Date of Approval: **January 1, 2000**  
Expiration Date: **January 1, 2002**

\_\_\_\_\_  
WILLIAM J. AILA, JR., Chairperson  
Commission on Water Resource Management

**I have read the conditions and terms of this permit and understand them. I accept and agree to meet these conditions as a prerequisite and underlying condition of my ability to proceed and understand that I shall not commence work until I have signed, dated, and returned the permit to the Commission. I understand that this permit is not to be transferred to any other entity. I also understand that non-compliance with any permit condition may be grounds for revocation and fines of up to \$5,000 per day starting from the permit date of approval.**

Driller's Signature: \_\_\_\_\_ C-57 License #: **BC-0000** Date: \_\_\_\_\_

Printed Name: John Doe Firm or Title: Aloha Water Company

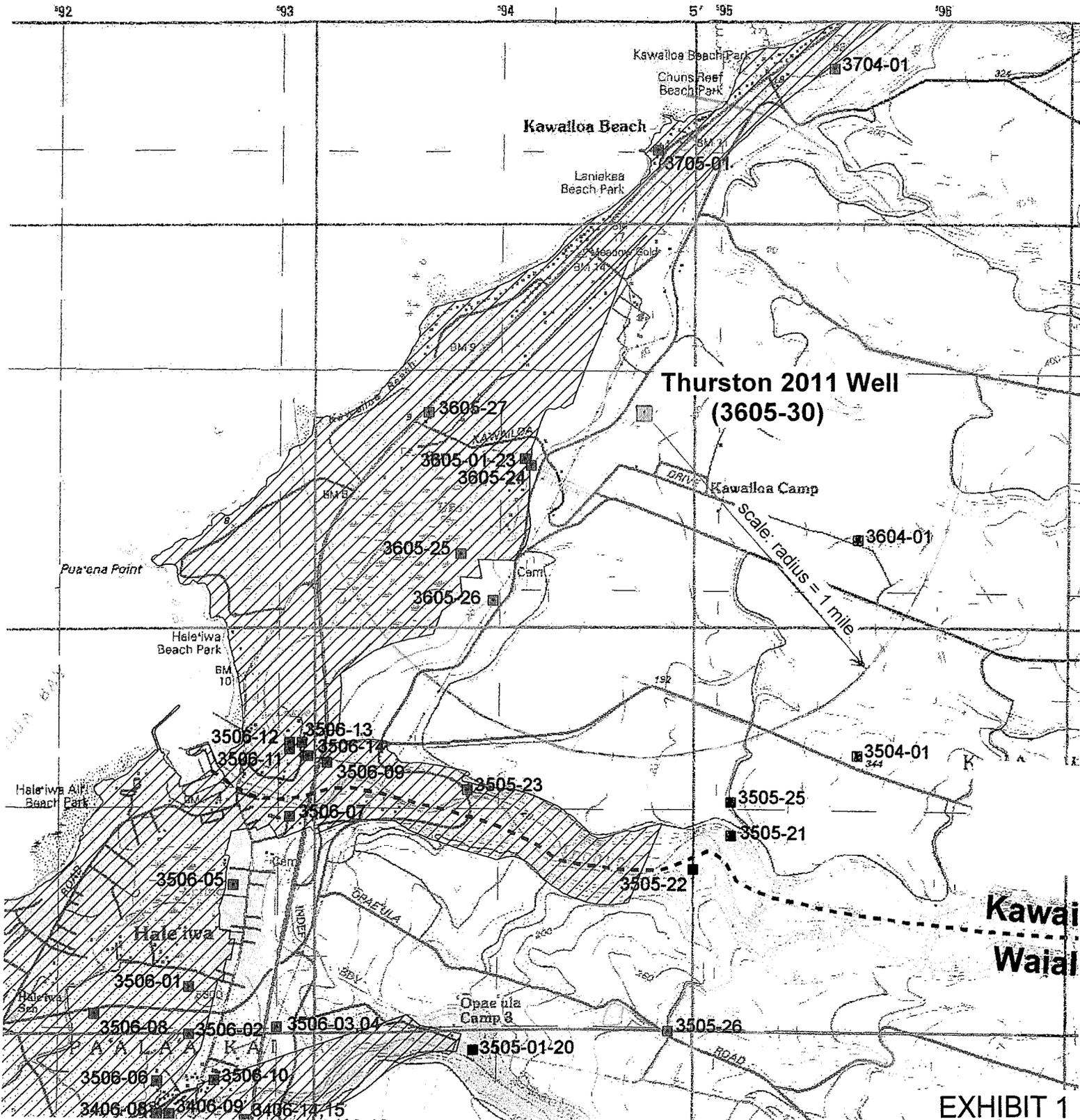
*Please sign both copies of this permit, return one copy to the Commission office, and retain the other for your records.*

Attachment

ATTACHMENT C

04/02/2007

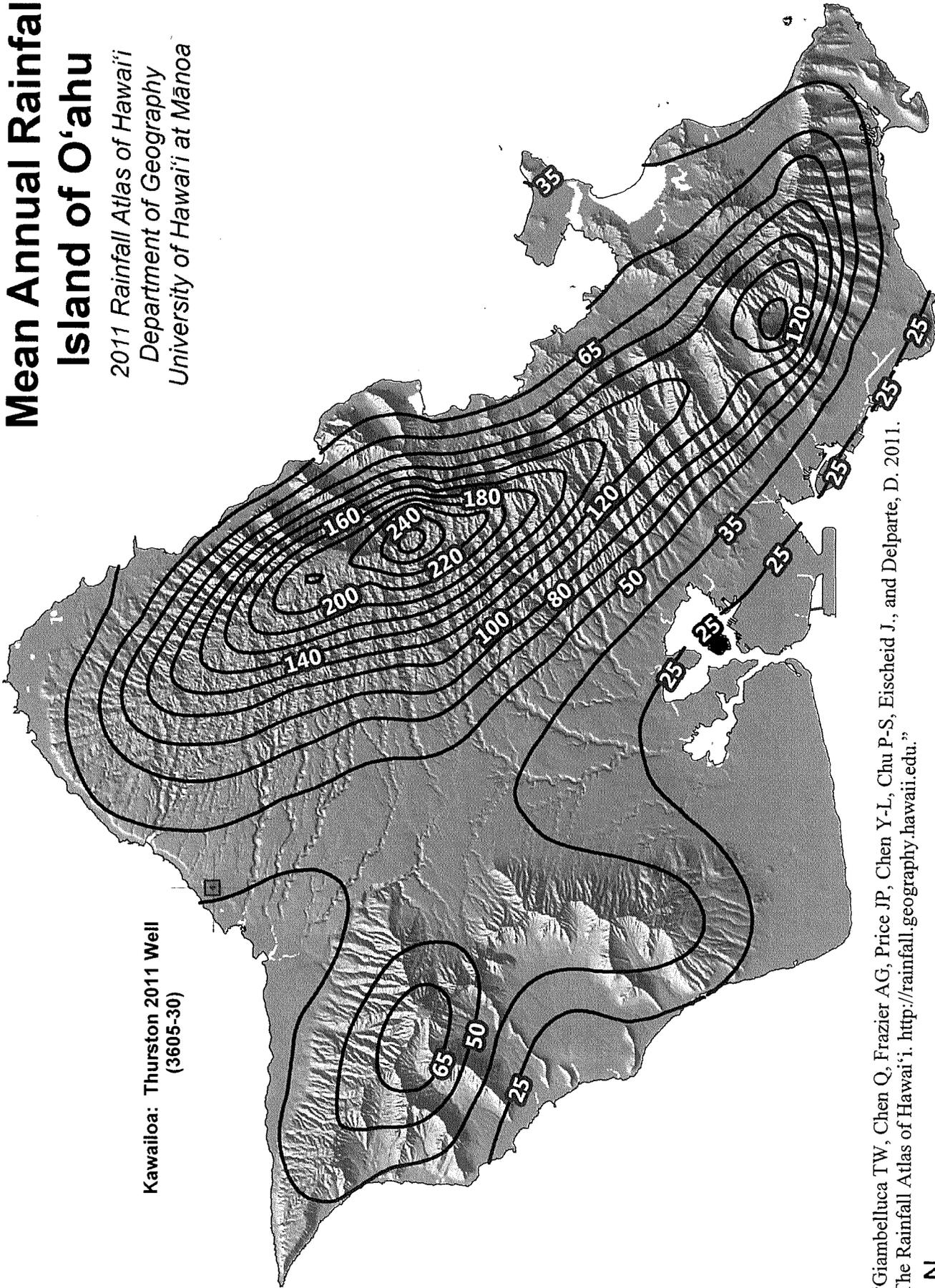
U.S. DEPARTMENT OF DEFENSE  
NATIONAL IMAGERY AND MAPPING AGENCY



# Mean Annual Rainfall Island of O'ahu

2011 Rainfall Atlas of Hawai'i  
Department of Geography  
University of Hawai'i at Mānoa

Kawailoa: Thurston 2011 Weil  
(3605-30)



“Giambelluca TW, Chen Q, Frazier AG, Price JP, Chen Y-L, Chu P-S, Eischeid J., and Delparte, D. 2011. The Rainfall Atlas of Hawai'i. <http://rainfall.geography.hawaii.edu>.”



Isohyets in inches



**Report Parameters**

Island: Oahu  
 Applicant: All  
 Well # Prefix: All  
 Date: All  
 Aquifer: 30403 KAWAILOA  
 TMK: All  
 Aquifer Type: All

WUP = Water Use Permit, 12-MAV = 12 month moving average, Diff = WUP-12-MAV, mgd = million gallons per day

**Island of OAHU**

**Aquifer System Ground Water Management Area: 30403 KAWAILOA**  
**Sustainable Yield (mgd): 29**

WUP No	Approved	Permittee	Well No	Well Name	WUP (mgd)
56	09/11/1981	Royal Paniolo Ranch	3-3704-001	Paniolo Ranch	0.430
173	02/19/1992	Attractions Hawaii 1	3-3803-001	Waimea Falls 1	0.200
			3-3803-003	Waimea Falls 2	
179	11/18/1992	Takemitsu Nakamura	3-4002-009	Sunset-Nakamura	0.001
323	01/26/1994	Board of Water Supply, BWS	3-4101-007	Waialea I	0.339
324	01/26/1994	Board of Water Supply, BWS	3-4101-008	Waialea II	0.411
528	10/26/2000	UH DEPT OF ANIMAL SCIENCE	3-4101-010	Waialea UH	0.026
812	11/13/2007	Sean Ginella	3-4100-006	Kawela Mauka	0.102
861	11/18/1992	Patricia L. Clark	3-4002-006	Sunset-Henry F	0.005
881	08/25/2010	Sean Ginella	3-3901-001	Paumalu	0.300

Summary for KAWAILOA (10 detail records)

**Total:** 1.814  
**Available:** 27.186

kawaiiloa-Thurston.txt2.txt

2	0.4	0.4	1.06	0.9	0.0	0.00	0.84	0.8	0.8	0.9	0.9
3	0.2	0.0	2.11	0.9	0.0	0.00	0.00	0.0	0.0	0.0	0.0
4	0.2	0.0	2.11	0.9	0.0	0.00	0.00	0.0	0.0	0.0	0.0
5	0.3	0.0	1.29	0.8	0.0	0.00	1.00	0.7	0.8	0.8	0.9
6	0.3	0.0	1.62	0.9	0.0	0.00	0.00	0.0	0.0	0.0	0.0
7	0.6	0.8	0.96	1.6	0.0	0.00	0.66	0.7	1.1	1.1	1.1
8	0.7	0.8	0.53	0.9	0.0	0.00	0.75	0.8	0.9	0.9	0.9
9	0.6	0.8	0.69	0.9	0.0	0.00	0.89	0.8	0.9	0.9	0.9
10	0.5	0.8	0.87	1.0	0.0	0.00	0.96	0.8	0.9	1.0	1.0
11	0.6	0.8	0.99	1.8	0.0	0.00	0.70	0.6	1.1	1.3	1.3
12	0.6	0.4	1.21	2.0	0.0	0.00	0.80	0.5	1.2	1.3	1.3
13	0.8	0.9	0.61	1.6	0.0	0.00	0.56	0.8	1.1	1.2	1.2
14	0.6	0.8	0.69	0.9	0.0	0.00	0.94	0.8	0.9	0.9	0.9
15	0.8	0.9	0.80	1.7	0.0	0.00	0.84	0.9	1.5	1.5	1.5
16	0.8	0.8	0.36	0.9	0.0	0.00	0.89	0.8	0.9	0.9	1.0
17	1.1	0.9	0.53	1.9	0.0	0.00	0.83	1.1	1.5	1.5	1.5
18	1.1	0.9	0.35	1.8	0.8	0.00	0.76	1.1	1.5	1.5	1.5
19	1.0	0.9	0.66	1.9	0.0	0.00	0.87	1.0	1.5	1.5	1.5
20	0.8	0.9	0.83	2.0	0.0	0.00	0.89	0.8	1.4	1.5	1.5
21	1.1	0.9	0.40	1.9	0.8	0.00	0.71	1.1	1.5	1.5	1.5
22	1.3	1.3	0.35	1.8	0.8	0.00	0.86	1.2	1.5	1.5	1.5
23	1.5	1.6	0.27	2.0	0.9	0.00	0.80	1.5	1.6	1.6	1.6
24	1.4	1.7	0.34	1.9	0.8	0.00	0.80	1.3	1.7	1.7	1.7
25	1.2	0.9	0.40	1.9	0.8	0.00	0.83	1.1	1.6	1.6	1.6
26	1.5	1.7	0.29	1.8	0.9	0.00	0.68	1.5	1.6	1.6	1.6
27	1.5	1.6	0.28	2.0	0.8	0.00	0.82	1.5	1.7	1.7	1.7
28	1.6	1.8	0.35	2.4	0.8	0.00	0.86	1.6	1.7	1.7	1.7
29	1.6	1.8	0.24	1.9	0.9	0.00	0.51	1.7	1.7	1.7	1.7
30	1.5	1.6	0.28	2.0	0.9	0.00	0.81	1.5	1.7	1.7	1.7
31	1.0	0.9	0.57	2.0	0.0	0.00	0.72	0.9	1.4	1.7	1.7
32	1.6	1.8	0.48	2.6	0.0	0.00	0.69	1.6	1.7	1.7	1.7
33	1.6	1.7	0.24	2.1	0.9	0.00	0.66	1.6	1.7	1.7	1.7
34	1.5	1.8	0.44	2.0	0.0	0.00	0.46	0.0	0.0	0.0	0.0
35	1.3	1.3	0.36	1.9	0.8	0.00	0.83	1.3	1.6	1.6	1.6
36	1.7	1.8	0.25	2.1	0.9	0.00	0.64	1.7	1.7	1.7	1.7
37	1.2	1.3	0.50	1.9	0.0	0.00	0.79	1.2	1.6	1.6	1.6
38	1.5	1.7	0.34	2.0	0.8	0.00	0.85	1.4	1.4	1.4	1.4
39	1.4	1.7	0.32	1.8	0.8	0.00	0.78	1.4	1.5	1.5	1.5
40	0.8	0.8	0.66	1.9	0.0	0.00	0.60	0.8	1.2	1.3	1.3
41	1.5	1.8	0.45	2.0	0.0	0.00	0.60	1.5	1.5	1.5	1.5
42	0.9	0.9	0.66	1.7	0.0	0.00	0.80	0.9	1.2	1.2	1.2
43	0.6	0.9	0.69	1.0	0.0	0.00	0.93	0.9	0.9	1.0	1.0
44	0.9	0.9	0.51	1.9	0.0	0.00	0.56	0.9	1.1	1.1	1.1
45	0.6	0.8	0.70	0.9	0.0	0.00	0.94	0.8	0.9	0.9	1.0
46	0.8	0.8	0.67	1.8	0.0	0.00	0.76	0.9	1.1	1.1	1.1
47	0.6	0.8	0.69	0.9	0.0	0.00	0.95	0.8	0.9	0.9	0.9
48	0.6	0.4	1.37	2.6	0.0	0.00	0.77	0.4	1.0	1.0	1.0
49	0.4	0.4	1.06	0.9	0.0	0.00	0.88	0.8	0.9	0.9	0.9
50	0.5	0.4	1.16	1.7	0.0	0.00	0.78	0.6	1.0	1.0	1.0
51	0.7	0.9	0.78	1.7	0.0	0.00	0.60	0.8	0.9	0.9	0.9
52	0.7	0.8	0.84	1.7	0.0	0.00	0.72	0.7	1.0	1.0	1.0

\*\*\*\*\*  
 \* SUMMARY \*  
 \*\*\*\*\*

TMK : 62002003  
 SOILS: Lahaina(1.000)

-----  
 ANNUAL IRRIGATION REQUIREMENT (INCHES)  
 -----

WATER BUDGET COMPONENTS											
NIR	GIR	GAL_A	G_RAIN	N_RAIN	ER	ER21	RO	INT	ET0	ET	DR
41.4	48.8	1324.0	27.8	19.7	17.1	16.5	7.6	0.4	58.7	58.8	2.6

		GIR STATISTICS									
ACRES	UNIT	MEAN	MED.	XMAX	XMIN	50%	80%	90%	95%		
	inch/acre	48.759	51.279	55.320	36.684	49.210	55.567	58.513	60.777		
	Thou. gpd/acre	3.627	3.815	4.116	2.729	3.661	4.134	4.353	4.521		
13.43	Total thou. gpd	24.356	25.615	27.633	18.324	24.581	27.757	29.228	30.359		

		NIR STATISTICS									
ACRES	UNIT	MEAN	MED.	XMAX	XMIN	50%	80%	90%	95%		
	inch/acre	41.445	43.588	47.022	31.181	41.829	47.232	49.736	51.660		
	Thou. gpd/acre	3.083	3.243	3.498	2.320	3.112	3.514	3.700	3.843		
13.43	Total thou. gpd	20.702	21.773	23.488	15.575	20.894	23.593	24.844	25.805		

Note:- Irrigated area for the selected TRICKLE, DRIP irrigation system is 0.5 of the total area

Kawailoa-Thurston.txt2.txt

11	2.4	2.5	0.25	3.7	1.6	0.00	0.91	2.4	2.9	2.9	2.9
12	2.9	3.0	0.26	3.7	1.8	0.00	0.91	2.9	3.2	3.2	3.2
13	2.7	2.6	0.13	3.6	2.5	0.00	0.62	2.7	3.0	3.1	3.2
14	3.1	3.0	0.17	4.1	2.4	0.00	0.96	3.1	3.4	3.4	3.4
15	3.2	3.2	0.14	3.7	2.5	0.00	0.89	3.2	3.3	3.3	3.3
16	2.6	2.7	0.37	4.5	1.0	0.00	0.84	2.6	3.4	3.4	3.4
17	3.0	3.5	0.27	3.9	1.6	0.00	0.79	3.1	3.3	3.3	3.3
18	3.0	2.8	0.22	4.0	1.7	0.00	0.88	3.1	3.3	3.3	3.3
19	2.7	2.6	0.28	3.7	1.7	0.00	0.92	2.6	3.0	3.0	3.0
20	2.2	2.2	0.21	2.7	1.6	0.00	0.83	2.2	2.7	2.8	2.8
21	2.3	2.7	0.41	3.4	0.0	0.00	0.80	2.5	2.8	2.8	2.8
22	1.5	1.7	0.42	2.8	0.8	0.00	0.89	1.5	2.2	2.4	2.4
23	1.4	1.7	0.63	2.7	0.0	0.00	0.77	1.7	2.2	2.3	2.3
24	1.2	0.8	0.80	3.6	0.0	0.00	0.75	1.0	1.8	2.0	2.0
25	0.9	0.8	0.93	2.6	0.0	0.00	0.88	0.8	1.7	2.0	2.0
26	1.4	1.6	0.69	2.7	0.0	0.00	0.83	1.4	1.9	1.9	1.9

WEEKLY GROSS IRRIGATION REQUIREMENT (INCHES)

WATER BUDGET COMPONENTS												
WK	NIR	GIR	GAL_A	G_RAIN	N_RAIN	ER	RO	INT	ETo	ET	DR	
1	0.1	0.2	4.4	1.6	0.8	0.6	0.7	0.0	0.7	0.7	0.3	
2	0.4	0.4	11.3	0.4	0.3	0.2	0.0	0.0	0.7	0.7	0.1	
3	0.1	0.2	4.8	1.3	1.1	1.1	0.1	0.0	0.8	0.8	0.1	
4	0.1	0.2	4.6	0.6	0.4	0.4	0.0	0.0	0.7	0.7	0.2	
5	0.3	0.3	8.7	1.3	1.0	0.7	0.4	0.0	0.8	0.8	0.3	
6	0.2	0.3	6.9	0.3	0.3	0.3	0.0	0.0	0.9	0.9	0.0	
7	0.5	0.6	15.8	1.2	0.6	0.5	0.6	0.0	0.9	0.9	0.2	
8	0.6	0.7	18.6	0.1	0.1	0.1	0.0	0.0	1.0	1.0	0.0	
9	0.5	0.6	16.4	1.2	0.7	0.4	0.4	0.0	1.0	1.1	0.3	
10	0.4	0.5	14.0	0.8	0.7	0.7	0.1	0.0	1.0	1.0	0.0	
11	0.5	0.6	16.2	0.8	0.7	0.6	0.1	0.0	1.1	1.1	0.1	
12	0.5	0.6	15.1	0.8	0.6	0.4	0.2	0.0	1.1	1.1	0.2	
13	0.7	0.8	20.8	0.4	0.4	0.4	0.0	0.0	1.1	1.1	0.0	
14	0.5	0.6	16.2	0.4	0.4	0.4	0.0	0.0	1.0	1.0	0.0	
15	0.7	0.8	22.7	0.2	0.2	0.2	0.0	0.0	1.2	1.2	0.0	
16	0.7	0.8	20.9	0.4	0.4	0.4	0.0	0.0	1.2	1.2	0.0	
17	1.0	1.1	30.8	0.1	0.1	0.1	0.0	0.0	1.3	1.3	0.0	
18	1.0	1.1	30.8	0.5	0.4	0.4	0.1	0.0	1.2	1.2	0.0	
19	0.9	1.0	27.9	0.4	0.4	0.4	0.0	0.0	1.3	1.3	0.0	
20	0.7	0.8	22.3	0.6	0.4	0.4	0.2	0.0	1.3	1.3	0.0	
21	1.0	1.1	30.9	0.1	0.1	0.1	0.0	0.0	1.2	1.2	0.0	
22	1.1	1.3	35.1	0.0	0.0	0.0	0.0	0.0	1.3	1.3	0.0	
23	1.3	1.5	40.5	0.3	0.2	0.2	0.1	0.0	1.3	1.3	0.0	
24	1.2	1.4	37.8	0.0	0.0	0.0	0.0	0.0	1.4	1.4	0.0	
25	1.0	1.2	33.1	0.1	0.1	0.1	0.0	0.0	1.4	1.4	0.0	
26	1.3	1.5	40.8	0.2	0.2	0.2	0.0	0.0	1.4	1.4	0.0	
27	1.3	1.5	40.7	0.0	0.0	0.0	0.0	0.0	1.4	1.4	0.0	
28	1.4	1.6	43.5	0.0	0.0	0.0	0.0	0.0	1.4	1.4	0.0	
29	1.4	1.6	44.6	0.2	0.2	0.2	0.0	0.0	1.4	1.4	0.0	
30	1.3	1.5	41.1	0.1	0.1	0.1	0.0	0.0	1.4	1.4	0.0	
31	0.8	1.0	26.8	0.5	0.4	0.4	0.1	0.0	1.4	1.4	0.0	
32	1.3	1.6	42.7	0.2	0.1	0.1	0.0	0.0	1.4	1.4	0.0	
33	1.3	1.6	42.6	0.0	0.0	0.0	0.0	0.0	1.4	1.4	0.0	
34	1.3	1.5	40.1	0.4	0.2	0.2	0.1	0.0	1.4	1.4	0.0	
35	1.1	1.3	36.0	0.1	0.1	0.1	0.0	0.0	1.4	1.4	0.0	
36	1.4	1.7	45.2	0.1	0.1	0.1	0.0	0.0	1.5	1.5	0.0	
37	1.0	1.2	32.9	0.1	0.1	0.1	0.0	0.0	1.4	1.4	0.0	
38	1.2	1.5	39.5	0.3	0.2	0.2	0.0	0.0	1.2	1.2	0.0	
39	1.2	1.4	38.2	0.2	0.2	0.2	0.0	0.0	1.3	1.3	0.0	
40	0.7	0.8	21.4	0.4	0.3	0.3	0.1	0.0	1.1	1.1	0.0	
41	1.3	1.5	40.0	0.7	0.5	0.5	0.2	0.0	1.3	1.3	0.0	
42	0.7	0.9	23.7	0.8	0.6	0.6	0.2	0.0	1.0	1.0	0.0	
43	0.5	0.6	17.2	0.3	0.3	0.3	0.0	0.0	1.1	1.1	0.0	
44	0.8	0.9	24.6	0.5	0.4	0.4	0.1	0.0	0.9	1.0	0.0	
45	0.5	0.6	15.9	2.2	0.8	0.8	1.4	0.0	1.0	1.0	0.0	
46	0.7	0.8	23.0	2.0	1.0	0.2	1.0	0.0	0.9	0.9	0.7	
47	0.5	0.6	16.3	0.3	0.2	0.2	0.0	0.0	0.9	0.9	0.0	
48	0.5	0.6	16.5	1.3	1.0	1.0	0.3	0.0	0.8	0.8	0.0	
49	0.4	0.4	11.8	0.7	0.4	0.4	0.3	0.0	0.8	0.8	0.0	
50	0.4	0.5	13.7	0.5	0.4	0.4	0.1	0.0	0.8	0.8	0.0	
51	0.6	0.7	18.7	0.4	0.3	0.3	0.0	0.0	0.8	0.8	0.0	
52	0.6	0.7	20.1	1.2	0.8	0.5	0.4	0.0	0.8	0.8	0.3	

GIR STATISTICS												
WK	MEAN	MED.	CV	XMAX	XMIN	ZERO	RSQ	50%	80%	90%	95%	
1	0.2	0.0	2.11	0.8	0.0	0.00	0.00	0.0	0.0	0.0	0.0	