NORTH KOHALA EXPLORATORY & OBSERVATION WELLS

SITE A 7345-03M
SITE B 7347-01M
SITE C 7345-02M
SITE D 7445-01M
SITE E 7347-02M
SITE F 7448-06 7448-01M,02M
SITE G 7448-03M
SITE H 7449-01M
SITE I 7549-01M
CONTOUR INTERVAL 40 FEET
DATE IS MEAN SEA LEVEL
DEPTH CURVES IN FEET, Datum IS MEAN LOWER LOW WATER
SHORELINE CURVES REFERENCED TO WATER LEVEL OF DEPTH CURVES
Contour Interval 40 Feet, Datum Is Mean Sea Level
Depth Curves in Feet, Datum Is Mean Lower Low Water
Shoreline Curves Referenced to Water Level of Depth Curves

This Map Complies with National Map Accuracy Standards
By U.S. Geological Survey, Denver, Colorado 80225, or Reston, Virginia 22092
A Folder Describing Topographic Maps and Symbols Is Available On Request

HAWI, HAWAII
N2007.5-W115459X7.5
1982
CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL
DEPTH CURVES IN FEET; DATUM IS MEAN LOW WATER
SHORELINE SHOWN REPRESENTS THE ALONGSHORE
THE MEAN RANGE OF TIDE IS APPROXIMATELY 1 FOOT

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
BY U.S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

ROAD CLASSIFICATION
Medium duty
Light duty
Unimproved dirt
State Route
CONTOUR INTERVAL 40 FEET

DATUM IS MEAN SEA LEVEL

DEPTH CURVES IN FEET; DATUM IS MEAN LOWER LOW WATER

THE RELATIONSHIP BETWEEN THE TWO DATUMS IS VARIABLE

SHOWING SHORELINE REPRESEN'TS THE APPROXIMATE LINE OF MEAN HIGH WATER

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS

BY U.S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092

A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

HAWI, HAWAII

N2007.5 - W15405.9 X 7.5

1982
AGENDA

FOR THE MEETING OF THE
COMMISSION ON WATER RESOURCE MANAGEMENT

DATE: June 14, 1989
TIME: 2:00 P.M.
PLACE: KALANIMOKU BUILDING
BOARD ROOM, ROOM 132
1151 PUNCHBOWL STREET
HONOLULU, HAWAII

Approval of May 17, 1989 Minutes


2. United States Geological Survey Application for Well Construction Permits, North Kohala Observation Wells, North Kohala, Hawaii

3. James Huang Application for Well Construction Permit, Waiawa- Huang Well, Waiawa, Oahu

4. Southwest Slopes, Inc. Application for Well Construction Permit, Ophihali Well, South Kona, Hawaii

5. Honolulu Board of Water Supply Application for Pump Installation Permits, Opana Wells 1 & 2, Kahuku, Oahu

6. Division of Water and Land Development Application for Well Construction Permit, Pia Exploratory Well, Niu Valley, Oahu

7. Amfac Property Investment Corp. Application for Well Permits, Kaanapali Wells P-1 and P-2, Kaanapali, Maui

8. Other Business
Chairperson and Members
Commission on Water Resource Management  June 14, 1989
MINUTES OF THE MEETING OF THE
COMMISSION ON WATER RESOURCE MANAGEMENT
DATE:       June 14, 1989
TIME:       2:00 p.m.
PLACE:      Kalanimoku Building
            Board Room, Room 132
            1151 Punchbowl Street
            Honolulu, Hawaii

ROLL CALL
Chairperson Paty called the meeting of the Commission on Water Resource Management to order at 2:30 p.m.

The following were in attendance:

MEMBERS:  Chairperson William W. Paty
           Dr. Michael Chun
           Mr. Richard Cox
           Dr. John Lewin
           Mr. Guy Fujimura

EXCUSED:  Mr. Robert Nakata

STAFF:    Mr. Manabu Tagomori
           Mr. George Matsumoto
           Mr. Gordon Akita
           Mr. Edwin Sakoda
           Ms. Sherrie Samuels
           Mr. Sterling Chow
           Mr. Andrew Monden

OTHERS PROVIDING TESTIMONY:
William Tam                      Mr. Dean Anderson
Mr. Stephen Tom                  Ms. Susan Miller
Mr. William Tam                  Prof. Williamson Chang
Mr. Kelvin Kai                    Mr. Roland Talon
Mr. David Penn                    Mr. Don Fujimoto

APPROVAL OF MAY 17, 1989 MEETING MINUTES
Unanimously approved (Chun/Cox).

ITEM 1  RESUBMITAL: ISLAND POWER COMPANY, INC., PETITION TO AMEND INTERIM INSTREAM FLOW STANDARD, APPLICATIONS FOR A
Chairperson and Members  
Commission on Water Resource Management  
June 14, 1989  
There will be no modifications to the tunnel other than for it to be cleaned.

Referring the Island Power's letter of June 9th, Mr. Fujimura asked if they also recognized there may be water rights in Hanalei which would have priority over diversions and that there are other issues beyond water rights, as well as the approval of the Commission in terms of the modification of the interim instream flow project would not precondition what would be happening in Hanalei. They understand that they will have to reapply for a water license which is currently issued to Lihue Plantation, replied Mr. Anderson.

Prof. William Chang introduced two law students (Roland Talon and David Penn) and commented on the project. He stated that they basically agree with the staff's report that the data is in but it would take time to sort out the information. He added that they could not adequately determine what appurtenant rights and riparian uses were being claimed by the farmers. Mr. Penn briefly described his project on the proper amount of water to be devoted to appurtenant rights. At the May 17th meeting, the applicant concurred with the request that the deadline for the permit be extended for the purpose of gathering more information, but requested that it be addressed at this meeting. Prof. Chang stated they were not able to complete their data as they had hoped because of the volume of registration turned in and commented that more time would be needed to study and verify the registrations that were submitted.

Mr. Fujimura asked if Island Power could respond because the basic request is related to the idea of how Island Power is going to incorporate the potential risks or impacts to the project. Mr. Anderson replied that the problem is that if they are delayed two to three months, they would not be able to meet the permitting requirements and deadlines to start the final engineering and construction next spring during the dry weather. They would not break ground without doing the best they can using consultants to ascertain what kind of risks they are looking at if the appurtenant rights are claimed and exercised.

Mr. Chang commented that the factual error in Mr. Anderson's statement is appurtenant rights, whether they are used or not, are protected. His client, Mina Morita, has taro lands but is not growing taro. She is still entitled to the full duty of water.

If ground breaking is planned for spring of next year, would that be enough lead time to resolve these issues, asked Mr. Fujimura. Mr. Chang said if there was a commitment that ground breaking would not disturb the status quo of the issue they don't have a problem with the permit being approved. Susan Miller had two comments: As a member of the steering committee for the Hawaii Stream Assessment Project, she felt if major commitments were made for waters from streams that have a high probability of being on the list
Chairperson and Members
Commission on Water Resource Management  June 14, 1989
Unanimously approved (Chun/Cox).

ITEM 4  SOUTHWEST SLOPES, INC., APPLICATION FOR WELL CONSTRUCTION PERMIT, OPHIHALI WELL, SOUTH KONA, HAWAII
Unanimously approved with the correction of a discrepancy in the depth of the well, the "Total Depth" should read "1230 feet" instead of "1225 feet". (Cox/Lewin).

ITEM 5  HONOLULU BOARD OF WATER SUPPLY APPLICATION FOR PUMP INSTALLATION PERMITS, OPIANA WELLS 1 & 2, KAUKUKO, OAHU
Unanimously approved (Cox/Chun).

ITEM 6  DIVISION OF WATER AND LAND DEVELOPMENT APPLICATION FOR WELL CONSTRUCTION PERMIT, PIA EXPLORATORY WELL, NIU VALLEY, OAHU
Mr. Cox asked if there was a problem when DOWALD is requesting and recommending a project if this function would be transferred to some other division of government in the future. Mr. Paty replied there is no organizational approach that would take the engineering aspect (which is an integral part of our work) out and give it to some other agency and yet continue other work which also has engineering and geologic in-house concerns. Mr. Tagomori added that similar to ITEM 2 the purpose of exploratory well drilling is not necessarily for water development but directed towards gathering information to understand groundwater hydrology. Therefore, it is not purely a development function that conflicts with the Commission's regulatory function.
Dr. Chun asked who the landowner was for this parcel. Mr. Sakoda replied that BWS was the owner.
Unanimously approved (Fujimura/Chun).

ITEM 7  AMFAC PROPERTY INVESTMENT CORP. APPLICATION FOR WELL CONSTRUCTION PERMITS, KAANAPALI WELLS P-1 AND P-2, KAANAPALI, MAUI
Is the applicant cognizant of the needs of the County, the total needs of the community, asked Mr. Cox. Mr. Don Fujimoto of AmFac Maui answered they are working with Maui County on the Water Use and Development Plan. Mr. Cox then asked if the other well that is shown on the map was a County well or an AmFac well. Mr. Fujimoto said it was an AmFac well that is used to irrigate the golf course.
SCALE 1:24000 1 MILE

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL
DEPTHS CURVES IN FEET—DATUM IS MEAN LOWER LOW WATER
DEEP depression in the land above the mean lower low water
Shoreline which represents the approximate line of mean low water
The mean range of tide is approximately 1 foot

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

ROAD CLASSIFICATION

Medium-duty
Light-duty
Unimproved dirt

State Route

HAWI, HAWAII
N2007.5=W115455/8K7.5
1982
To: Linnel Nishioka
CWRM
Fr: John Stubbart
Date: 30 Sep 99
Re: Makapala Well #1 Permit Application

The Hawaii Dept. of Water Supply sent us a copy of the memo you sent them on 23 Sep 99 regarding the well permit application for Makapala Well. We offer a response to items 1-3 below.

1. The EA has been completed and we have sent this to you for your records under separate cover. All filings with OEQC have been completed.

2. On the issue that the application is for one well or two, on the permit it states that the application is for Makapala Well #1 – Exploration Well (see section 2). In Section 10 it refers to only one well, singular. In the text above the well section, it refers to only one well, singular. In the drawing at the end, we show Well #1 and Well #2 as a reference for location and siting, as we thought the commission would want to know where the wells would be going and the relationship other wells planned. No where did we reference two wells for construction in this permit.

On the TMK issue, parcel 10 is the County DWS property where the wells are planned to go; however, the DWS may purchase some surrounding lands to expand the site from parcel 01. This has not been finalized and the exact well location on the lot will be finalized when the negotiations are complete. So for practical purposes, only the parcel 10 should be used, as the DWS will acquire the property into that parcel. I have attached notes on the first page of the permit and site plan for your review.

3. Pahala Well #2 (No. 1229-02) has not been constructed. The land acquisition with the neighboring lands has not gone through. The DWS is now considering a revision to the plan and constructing the well on the existing site. We are processing revisions now and you should be receiving an addendum to the plan by the end of the year.

Other issues raised will be responded to by the DWS under separate cover. Please contact us if you have any questions regarding these matters.

Mahalo.

Cc: Milton Pavao, Glenn Ahuna
### APPLICATION FOR PERMIT:

- **Well Construction Permit**
- **Pump Installation Permit**

### Applicant Information:
- **Well Owner:** County of Hawaii, Dept. of Water Supply
  - Contact Person: Milton Pavao
  - Phone: 808-679-4321
  - Fax: 808-679-4323
- **Land Owner:** County of Hawaii, Dept. of Water Supply
  - Contact Person: Milton Pavao
  - Phone: 808-679-4321
  - Fax: 808-679-4323

### Pump Information:
- **Make, Model, and Manufacturer:**
  - Make:
  - Model:
  - Manufacturer:

### Well & Pump Information:
- **Well Location:** Makapala, Hawaii
  - Address:
  - Well Owner:
  - Phone: 808-679-4321
  - Fax: 808-679-4323

### Proposed Work:
- **Drill New Well**
- **Modify Existing Well**
- **Install New Pump**
- **Deepen**
- **Abandon/Seal**

### Other Important Information:
- **Proposed Use:**
  - Municipal (including hotels, stores, etc.)
  - Industrial
  - Domestic (pumps for residential use only)
  - Irrigation
  - Other

### Method of Flow Measurement:
- **Flow meter:**
- **Open well:**
- **Closed well:**
- **Other:**

### Necessity of Flow Measurement:
- **Proposed Amount of Water:**
- **Annual:**

---

### Conclusion:
- This well is to be used as a production well. If exploration is successful and the well is fully developed, a standby well may be drilled nearby.
July 26, 1996

Director  
Office of Environmental Quality Control  
220 S. King Street, Suite 400  
Honolulu, HI 96813

SUBJ: NEGATIVE DECLARATION FOR MAKAPALA EXPLORATORY WELL NO. 1  
MAKAPALA, HAWAII  
TMK 5-2-05:10

Dear Director:

The Department of Water Supply, County of Hawaii, has reviewed the comments received during the 30 day public comment period. The Department of Water Supply has determined that this project will not have significant environmental effect and has issued a negative declaration. Please publish this notice in the OEQC Bulletin.

We have enclosed a completed OEQC Bulletin Publication Form and four copies of the final Environmental Assessment. Please contact Mr. Glenn Akuna, Engineer, Department of Water Supply, at 961-8660, if you have any questions.

Sincerely,

Milton D. Pavao, P.E.  
Manager
MAKAPALA EXPLORATORY WELL
EXPLORATORY WELL DRILLING
MAKAPALA, HAWAII

FINAL ENVIRONMENTAL ASSESSMENT

Proposing Agency:
Department of Water Supply
County of Hawaii

MAY 1998

By:
Waimea Water Services Inc.
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SECTION 1
INTRODUCTION AND SUMMARY

The Department of Water Supply (DWS), County of Hawaii proposes to drill an exploratory deep well in Makapala in the North Kohala District of the Big Island of Hawaii and to explore the groundwater for drinking water purposes. If the exploratory well proves to be productive, it will be out-fitted to a production well to provide water to the existing Makapala Water System now supplied by the Maulua (or Murphy #7145-02) tunnel, south (mauka) of the town of Makapala.

The few negative impacts which have been identified in this Environmental Assessment can be adequately minimized by the suggested mitigative measures. In accordance with Chapter 343, Hawaii Revised Statutes, it has been determined that an Environmental Impact Statement is not required for the proposed Makapala Exploratory Well project. Therefore, this document constitutes a notice of anticipated Negative Declaration.

1.1 PROPOSING AGENCY
Department of Water Supply, County of Hawaii

1.2 AGENCIES CONSULTED IN MAKING THE ASSESSMENT
1. Commission on Water Resources Management, Department of Land and Natural Resources, State of Hawaii
2. Hawaii State Land Use Commission
3. Hawaii State Office of Environmental Quality Control
4. Historic Sites Preservation Office, Department of Land and Natural Resources, State of Hawaii
5. Safe Drinking Water Branch, Hawaii State Department of Health
6. Department of Water Supply, County of Hawaii
7. Planning Department, County of Hawaii
SECTION 2

PROJECT DESCRIPTION

The Department of Water Supply (DWS), County of Hawaii proposes to drill an exploratory deep well in Makapala in the North Kohala District of the Big Island of Hawaii and to explore the basal groundwater for drinking water purposes. If the exploratory well proves to be productive, it will be out-fitted to a production well to provide water to the existing Makapala Water System now supplied by Murphy tunnel, south (mauka) of the town of Makapala.

2.1 PROJECT SITE

The project site is located in the north region of the Big Island of Hawaii, near the town of Makapala, as shown in Figure 2-1. The well site is situated on the northern slope of the Kohala Mountain, next to the existing DWS storage tank servicing the DWS Makapala-Keokea system #560. The well site is located next the existing DWS storage tank on a dirt access and utility road at an elevation of 400' feet above mean sea level (MSL), as shown in Figure 2-2. Access to the well site is via Highway 270, a two-lane rural street, and just after Aamakao Gulch, and before Makapala Town there is an access and utility road running mauka to the site. The existing 50,000 gallon reservoir is situated next to the project site.
Map 1
Figure 2-1
LOCATION MAP

Makapapa Exploratory Well - Environmental Assessment Page # 6
Figure 2-2
TOPO MAP

Proposed Well Site
Proposed Well Site

Figure 2-4
TMK MAP
The existing DWS property, with TMK 5-2-05:10, is currently owned by the Board of Water Supply, County of Hawaii. The well site is next to the existing tank site. The existing DWS lot size is 0.229 acres and is adjacent to land owned by Chalon International of Hawaii, Inc.; TMK 5-2-05:01. Additional lands of about 10,000 sq feet will need to be purchased from Chalon International to construct the well as shown in Figure 2-3.

2.2 PROPOSED FACILITIES

The proposed exploratory well project involves drilling, casing, and testing an exploratory well. The depth of the well is expected to be 450’ (elev. 400’). If the yield and water quality are acceptable to the DWS, the well will be placed into production well. The following improvements will need to be included to put the well into production as part of the DWS system: preparatory site work; fencing relocation; deep well pump installation, including piping and controls; site piping, connections to the reservoir; electrical system, including electric power, motor controls, lighting, and telemetering. A chlorination system and control building are already on site and will be utilized, but may require some upgrades.

The Department of Water Supply plans to pump at a rate of 50 gallons per minute (gpm) and up to 60,000 gallons per day. However, the actual use of the well will be determined by the results of the exploratory well pump test. Current average consumption’s in the system are 21,750 average gallons per day demand (gpd) and a max day demand of 32,625 gallons per day (gpd). There are currently 86 accounts/customers on this system. This equals an average of 253 gpd per account.

The footprints of the concrete pad for the production well and well head piping are approximately 200 square feet in area. Figure 2-3 shows the location of the well in reference to its surroundings and land divisions.

2.3 DEVELOPMENT SCHEDULE AND COST

Construction is scheduled to begin in early 1999. The construction cost for this project is estimated at $300,000.

2.4 PROJECT NEED

The current water demands in the Makapala area are met with chlorine treated tunnel water from the Murphy #7145-02 Tunnel. The Murphy tunnel discharges about 250,000 gallons per day (gpd) at an elevation of 1,250 feet. The tunnel source is considered under the influence of surface water and by federal and State regulations must be treated more extensively. The average flow of the tunnel is about 250,000
gpd, a portion of which is diverted for use in the Makapala Water System. The Makapala System serves the town of Makapala only. This system's current capacity is a 50,000 gallon tank fed by a 2.5" pipeline, however, the tunnel is not a reliable source during dry weather. The well will provide a reliable groundwater source, that will only require disinfection. Site planning allows for an additional well to be developed on the site as a back up well to this planned well.

Groundwater from the aquifer is a viable source for the DWS in this region as the USGS developed and tested a small observation well at the site as part of the “Ground-water Availability from the Hawi Aquifer in the Kohala Area, Hawaii”, USGS, Water Resources Investigations Report 95-4113, 1995. The water quality of the aquifer is reliable and does not require any treatment except disinfection for the system needs as per sampling records. Traces of toluene and xylene were found near detection levels but well below the EPA maximum contaminate levels. (note: MCL means a maximum contaminant level of a contaminant in the water which is delivered to any user of a public water system. MCLs are the only federally enforceable drinking water standards.) The USGS indicated that the presence of these compounds could have been the result of sampling or testing error, as no additional samples were tested.

Drilling the deep well and pumping the water results in high capital and operations energy costs as compared to the tunnel source. However, the alternatives to a well are limited to extensive surface water treatment facilities, which are expected to be both more expensive and have greater environmental and treatment impacts. Section 5 discusses the alternatives to the development of the deep well.

SECTION 3
EXISTING CONDITIONS

This section describes the existing conditions of the project including the existing land use designation, surrounding land uses, climate, geology and topography, soils, hydrology, flood hazards, earthquake hazards, flora and fauna, and archaeological and historic sites.

3.1 EXISTING LAND USE DESIGNATIONS

The Makapala exploratory well drilling project boundaries fall within the State Agricultural Land Use District. Therefore, a Conservation District Use Permit is not required. The lands are not “Ceded Lands” of the Office of Hawaiian Affairs.

The County land use zoning designation is A-20a, which refers to agricultural lots greater than 20 acres.
The County Planning Department, Russell Kokubun, Deputy Director, stated on 17 Sept 98, there are small subdivision projects in the North Kohala region, but very little activity in the Makapala area. All activity conforms to current zoning and is mostly farm dwelling units. The planning dept. does not expect much increase in density in this area and is prepared for the expected growth.

The water source is planned to service the current population. The water system and source is not being expanded, only the source capability is being made more reliable. No expected increase in population could be attributed to this well project.

3.2 SURROUNDING LAND USES

The surrounding grazing lands had been previously extensively used for sugar agriculture. A Conservation District/Forest Reserve is located 12,000 feet to the south (mauka) of the project site. The town of Makapala is located about 2,500 feet to the north (makai) of the project.

3.3 CLIMATE

The project area receives an average of 70 inches of precipitation per year, most of which occurs during the winter months. Due to the elevation of the project site, the average annual temperature is 74 F.

3.4 GEOLOGY AND TOPOGRAPHY

The project site sits upon a formation formed by the Polulu basalt flows from the Kohala Mountain laid down in prehistoric time, containing a few inter-stratified beds of volcanic ash.

The water level at the well site stands at about elevation 10' MSL and likely varies only slightly. There are no producing wells in the near vicinity.

The Makapala well site is located on the slopes of the Kohala Mountain. The well site is best characterized as gently sloping makai. A topographic map of the area is shown in Figure 3-1.
3.5 **SOILS**

The soil at the project site is classified as Ainakea (AaD) Silty clay loam with slopes of 12 to 20 percent. This soil overlays the bedrock to a depth of 2 to 3.5 feet and consists of silty clay loams, often underlain by cinders. Runoff is medium and erosion hazard is moderate.

3.6 **HYDROLOGY**

The geology and known hydrology of the area confirms the presence of a basal aquifer within the basalt lavas of the Kohala Mountain. The aquifer is a basal lens which is formed by fresh water floating on brackish and salt water. The water table stands at about 10 feet above mean sea level.

The USGS drilled a well at this site as part of the “Groundwater Availability from the Hawai Aquifer in the Kohala Area, Hawaii” study (attached to this report). The results were published in the Water Resources Investigations Report #95-4113. Well #7345-04 was pump tested and water quality analysis done. This report concluded that up to 10 million gallons per day per mile of aquifer width flows to the coast line.

The pumping from this well should only impact the aquifer slightly as the withdrawal of 60,000 gpd is only 0.6% of the flow in one mile of the Hawai aquifer system, which has been estimated at up to 10 Mgal/d per mile (USGS, Rpt. 95-4113, 1995).

According to the State Department of Health, November 1993 map of the Island of Hawaii, Upper Aquifer Development Stage and Utility Status, the existing well and proposed wells are above the UIC line and are in an area designated as “Potential Use”.

The only operating well in the area is the DWS Hawi well #7449-02 a with capacity of 1,000,000 gpd. This well is some 5 miles to the northwest of the proposed site. Other wells in areas were operated in the past when intensive sugar cane agriculture was active. These no longer are in service.

Hydrologic Unit Status: The following chart depicts the hydrologic unit status of current use, installed capacity of well pumps and pending installed capacity for proposed wells.
Contamination Analysis: The Office of Hazard Evaluation and Emergency Response (HEER) reports on 23 Sep 98, that there are no files available on spills or contamination incidents in this area. Traces of toluene and xylene were found in the USGS test well at the site. These traces were near detection levels but well below the EPA maximum contaminant levels. (note: MCL means a maximum contaminant level of a contaminant in the water which is delivered to any user of a public water system. MCLs are the only federally enforceable drinking water standards.) The USGS indicated that the presence of these compounds could have been the result of sampling or testing error, as no additional samples were tested and contamination was not found in other test wells in the region.

Well head protection is provided by the fact that there are no industrial users up gradient of the well site. Extensive agricultural practices, such as sugar cane production, are no longer using the mauka properties. The well will be constructed as to mitigate contaminates from entering the well bore and will draw water from the deeper portions of the aquifer.

3.7 FLOOD HAZARDS

Flood Insurance Rate Maps (FIRM) were used to evaluate the potential flooding for the study area. Based on map number 155-166-0100C dated September 16, 1988, the project site is designated as "other areas, Zone X - areas which are determined to be outside of the 500-year flood plain".

3.8 EARTHQUAKE HAZARDS

The entire island of Hawaii is classified as a Seismic Zone 3 area, as per the Uniform Building Code (1991). Given that the least active zone is Zone 0, and the most active zone is Zone 4, the possibility of an earthquake occurring on the Island of Hawaii
is fairly high. All new structures will be designed and constructed to resist stresses produced by lateral forces which apply to the Seismic Zone 3. There is no known damage to the existing wells in the area have been damaged by earth quakes.

3.9 FLORA AND FAUNA

Most of the plant species in the area are introduced, and there are no rare or endangered flora species at the project site. The area around the site was cultivated and planted in sugar and currently grazed by cattle. Grass, guava, and Christmas Berry were evident.

No rare or endangered fauna species are known to live at the project site. Common species which could be found nearby include feral pigs, mynas, pheasant, quail, plovers, mongoose, and mice and other exotic species.

3.10 ARCHAEOLOGY AND HISTORIC SITES

According to the Department of Land and Natural Resources, State Historic Preservation Division (letter from Don Hibbard, dated 5 June 98, see Appendix B) the probability of finding any historic or archaeological site in the vicinity of the well site is unlikely. The site has been severely altered and used as a well and tank site while the surrounding areas were used for production of sugar and is now in pasture. However, should burials be found during construction, work must stop and the State Historic Preservation office must be contacted immediately.

SECTION 4

PROJECT IMPACTS AND MITIGATIVE MEASURES

The project impacts and their mitigative measures are discussed in the following sections. Some of the impacts discussed are construction noise, air quality, flora and fauna, surface water and groundwater quality, archaeological and historic, traffic, public health and safety, and socioeconomic.

4.1 SHORT-TERM IMPACTS AND MITIGATIVE MEASURES

Short-term impacts will result from site clearing, grubbing and grading, well drilling and installation, pumping station, building construction, and landscaping. These activities will be limited to the project site during the well construction period of approximately five to six months. The following sections discuss the short-term impacts and their mitigative measures.
4.1.1 Construction Noise

Noise generated from the mobilization of equipment along the access road, and the drilling of the exploratory well will be the primary impact during construction at the Makapala well site. Mobilization of equipment, as well as the well drilling, should be done only during daylight hours. Nearby residences may be as close as 1000 feet to the well site, and the noise impact on the nearby residential areas should not be significant.

In order to mitigate any noise impacts during pumping tests, the use of muffled construction equipment is recommended. Construction equipment is also expected to be properly maintained. Heavy vehicles must be in compliance with Title III Administrative Rules, Department of Health (DOH), Chapter 42, Vehicular Noise Control for Hawaii. Construction work will most likely not be done during the weekends and holidays.

4.1.2 Air Quality

Short-term air pollution from dust/dirt due to clearing, grubbing and grading, along with vehicular emissions from construction equipment, is expected to be insignificant. All operations will be conducted in conformance with the State Department of Health regulations regarding vehicular emissions.

Water trucks will be used to minimize the levels of dust in the air. Areas which have been graded should be grassed as soon as possible to prevent dust from becoming a nuisance. All construction equipment shall be equipped with adequate emission control. All open-bed trucks shall be covered when transporting materials, which have the potential to become airborne. Overall, the project is not expected to have significant impacts on air quality.

4.1.3 Flora and Fauna

No known rare or endangered species of flora and fauna are found at the site. Therefore, no short-term impacts are expected.

4.1.4 Surface Water and Groundwater Quality

Impacts on surface water and groundwater are expected to be insignificant as reported in the large amounts of groundwater flow in the area and the USGS study reported in Report #95-4113. The nearest surface water feature is an intermittent stream bed (Aamakoa Gulch) to the west of the well site. The gulch collects storm water runoff mauka of the surrounding lands and is approximately 1,100 feet from the well site.
Any storm runoff from the site during construction can be mitigated by erosion control measures including building berms around the project site to contain storm water runoff, installing silt fences as needed, immediately landscaping areas which have been graded, and grading during dry weather. Dewatering is not necessary for this project. Drilling fluid and discharge from pump testing will be disposed of by the drilling contractor in accordance with the requirements of the Department of Health, Clean Water Branch. An NPDES permit is not required for this type of discharge. The water from the well site drains into an existing drainage ditch, which may be used by the contractor. No flooding is expected to be caused by the contractor or run off water due to the capacity of the stream.

If the well testing is successful, the next phase is to outfit the well into a production source. For this next phase, the design will specify for the installation of a shallow drainage well to take the initial surge water from the well.

Impacts on the groundwater are considered insignificant as the capacity of the well production is well below the groundwater flow in the area. Also well annulus will be grouted to sea level or below to negate surface contamination in the well.

4.1.5 Archaeological and Historical

No archaeological or historic sites are known to exist at the well site, and no short-term impacts due to construction are expected.

4.1.6 Traffic

The two-lane Akoni Pule Highway passes north of the town of Makapala. Traffic along this road may backup slightly during transport of the drilling equipment and construction materials, but the infrequent occurrences should not greatly affect the surrounding residents. Mobilization will be done during low traffic flow hours.

4.1.7 Public Health and Safety

The construction contractor shall be responsible for implementing appropriate measures to ensure public health and safety during the construction period. Construction areas will be delineated.
4.1.8 Socioeconomic

Construction of the production well and related improvements will provide several related jobs for the local workers. The purchase of materials from local suppliers will help the local building economy.

4.2 LONG-TERM IMPACTS AND MITIGATIVE MEASURES

No long-term impacts are expected for the exploratory well. If the results of the pumping test and water quality analysis are favorable, the use of the well for production of potable water to the existing water system is within the sustainable yield of the aquifer.

The following sections describe the production well’s long-term impacts on noise, flora and fauna, drainage, stream flow, infrastructure, socioeconomic, land use and planned development.

4.2.1 Noise

Very little noise at the well site will be generated from the pumping of the production well as the pumping equipment at the well is removed from any residence area and produces very low noise levels. Similar equipment is currently used in similar and more populated areas.

4.2.2 Flora and Fauna

Since there are no rare or endangered plant or animal species at the project site, no significant long-term impacts are expected.

4.2.3 Drainage

The minimal amount of additional runoff generated from the project improvements will be allowed to sheet flow into existing natural drainage ways or into drywells constructed on the site. No significant impacts on drainage are expected.

4.2.4 Stream Flow

The withdrawal of up 50 gpm (gallons per minute), or 60,000 gallons per day of groundwater by the well will have no impact on any stream flows as reported by the USGS report #95-4113 (Appendix C). Thus the development of the proposed deep well should have no significant effect on stream flow.
4.2.5 Infrastructure

Power will be required to operate the pump motor and control center. Because there is no well motor demand at the site presently, additional power consumption is expected and there will be an increase on HELCO’s existing power grid. HELCO has indicated that this increase can be accommodated. It is estimated that the increase will be less than 10 horse power (hp).

The road leading to the site will need to be improved for access of equipment to the site. It is currently a dirt road that is eroded in some areas.

4.2.6 Socioeconomic

The Department of Water Supply (DWS), County of Hawaii is responsible for providing safe drinking water in a reliable manner to the people of the island of Hawaii. To increase the reliability of water delivery in dry weather and to use groundwater as the source and not surface water, a well will assure the ability for DWS to provide its support for the residential, commercial and agricultural water users of the Makapala-Keokea water system service area.

4.2.7 Land Use and Planned Development

The proposed well facility is expected to remain consistent with the land use designation of the area. Both the County and State designations fall under agriculture.

SECTION 5
ALTERNATIVES TO THE PROPOSED ACTION

Four alternatives were considered for this project:

1) no action,
2) delayed action,
3) alternate sites, and
4) alternate sources.

These alternatives are discussed below.

5.1 NO ACTION

A no-action alternative is not practical, because the Department of Water Supply may not be able to meet the demands of the existing system during dry weather or failure of the existing tunnel source, possibly resulting in water shortages. The benefits
of providing the public with redundancy to the existing system is vital to the mission of the DWS.

5.2 DELAYED ACTION

Delayed action is also not a practical alternative. It would create a reduced service to customers during dry spells.

5.3 ALTERNATE SITES

The well site was selected by the Department of Water Supply based on its proximity to the existing reservoir and the ease of site development. There is only one reservoir servicing the system, thus this is the only practical economical site.

5.4 ALTERNATE SOURCES

The expanded development of tunnels or surface water sources would be unreliable and prone to drought conditions. The purpose of the well is to provide a reliable source to the existing tunnel source and provide redundancy. The use of surface water and additional tunnel supplies might also require treatment under the Surface Water Rules of the Safe Drinking Water Act and its amendments. Such alternatives may cost as much as $1 million to place in service and include significant maintenance and operations, regardless of the actual use.

The Department of Water Supply emphasizes the development of available and reliable groundwater as one of its primary sources of potable water.

SECTION 6
NEGATIVE DECLARATION DETERMINATION

The few negative impacts which have been identified in this Environmental Assessment for Makapala Exploratory Well. Well construction should be adequately minimized by the suggested mitigative measures. In accordance with Chapter 343, Hawaii Revised Statutes, it has been determined that this project will not have significant environmental effect and an Environmental Impact Statement is not required. This constitutes a negative declaration.

Description of the Proposed Action

The Department of Water Supply (DWS), County of Hawaii proposes to design and construct a exploratory deep well in Makapala in the Kohala District of the Big Island of Hawaii. If the exploratory well proves to be productive, it will be outfitted to a production well to provide groundwater to the existing Makapala-Keokea water system
north of the proposed well site and to explore the groundwater. Other alternatives have been explored but do not provide the redundancy required to insure a safe and sufficient water supply.

The few negative impacts which have been identified in this Environmental Assessment for Makapala Exploratory Well Drilling should be adequately minimized by the suggested mitigative measures. In accordance with Chapter 343, Hawaii Revised Statutes, it has been determined that this project will not have significant environmental effect and an Environmental Impact Statement is not required. This constitutes a negative declaration.

D. Determination and Reasons Supporting the Determination

The proposed project would not have a significant effect on the environment and therefore preparation of an environmental impact statement is not required. The "Significance Criteria," Section 12 of Hawaii Administrative Rules Title 11, Chapter 200, "Environmental Impact Statement Rules," were reviewed and analyzed. Based on the analysis, the following were concluded:

1. **No irrevocable commitment to loss or destruction of any natural or cultural resource would result.** The lands for construction and access right-of-way is in former sugar agriculture lands and now pasture lands. No significant natural resources are present. No known cultural resources would be impacted. The State Division of Historic Preservation was contacted.

2. **The action would not curtail the range of beneficial uses of the environment.** The project, while certainly making use of groundwater resources, would increase the reliability of the supply of water to the Makapala-Keokea water system and what is extracted will not significantly impact the sustainable yield of the aquifer.

3. **The proposed action does not conflict with the State's long-term environmental policies or goals and guidelines.** The State's environmental policies and guidelines are set forth in Chapter 344, Hawaii Revised Statutes, "State Environmental Policy." Two broad policies are espoused: conservation of natural resources, and enhancement of the quality of life. The proposed project does not consume significant natural resources in land or groundwater as this is a well to provide an alternative water source to the existing tunnel source. It would include mitigative measures to minimize various categories of pollution, while promoting general welfare and improving the reliability of providing quality water to the Makapala-Keokea water system; allowing fulfillment of the social, economic and other requirements of residents in Makapala.
4. The economic or social welfare of the community or state would not be substantially affected. Construction of the well would result in temporary economic benefits to the well drilling construction industry and indirectly to other economic sectors as well. The redundancy of the water source would allow the population a degree of reliability in its water supply, and possibly increase the potential for economic investments in the area.

5. The proposed action does not substantially affect public health. The project would improve the reliability of a safe and sufficient water source to Makapala. It will facilitate provisions for water supply backup for the DWS and other public services.

6. No substantial secondary impacts, such as population changes or effects on public facilities, are anticipated. The well project arises from the need established to provide a reliable water source to the present population. The total capacity of the source is not increased, limiting the population expected to be serviced. The County Planning Department, Russell Kokubun, Deputy Director, stated on 17 Sept 98, there are small subdivision projects in the North Kohala region, but very little activity in the Makapala area. All activity conforms to current zoning and is mostly farm dwelling units. The planning dept. does not expect much increase in density in this area and is prepared for the expected growth. The water source is planned to service the current population. The water system and source is not being expanded, only the source capability is being made more reliable. No expected increase in population could be attributed to this well project.

7. No substantial degradation of environmental quality is anticipated. The project area is unremarkable in terms of environmental resources, and standard mitigation measures would suffice to protect ambient environmental quality. Proper mitigation of construction noise and drilling water discharge would take place. The project is not expected to result in concentrations of air pollutants exceeding State or federal standards for ambient air quality as standard utility electric power will power the pump.

8. The proposed action does not involve a commitment to larger actions, nor would cumulative impacts result in considerable effects on the environment. The proposed project is self-contained and independent of other water systems. The project solves a redundancy need for the existing water source and increases the ability to provide safe and sufficient water to customers.
9. No rare, threatened or endangered species or their habitats would be affected. No known endangered, threatened or candidate floral species would be affected by the project.

10. Air quality, water quality or ambient noise levels would not be detrimentally affected. There is no impact on local air quality. No significant water quality impacts are anticipated either during construction or operation of the well. Proper well construction methods and materials are expected to be specified and used.

11. The project would not affect environmentally sensitive areas, such as flood plains, tsunami zones, erosion-prone areas, geologically hazardous lands, fresh waters or coastal waters. No environmentally sensitive areas would be affected. The project site is on slightly sloped land well inland of the coast. Tsunami inundation is very unlikely. Seismic risks are not expected if proper construction is used. The existing facilities have not experienced any damage. The volcanic hazards are comparable to those in Hawi or Kamuela.

SECTION 7
LIST OF NECESSARY PERMITS AND APPROVALS

The following permits and approvals are anticipated for the development of the proposed Makapala Exploratory Well project:

1. Plan Approval - Department of Water Supply, County of Hawaii.
2. Well Construction Permit - Commission of Water Resource Management, State DLNR.
5. State Historic Preservation Office Review Department of Land and Natural.

REFERENCES

2. Letter from Don Hibbard, Department of Land and Natural Resources, State Historic Preservation Division. 5 June 1998.


5. State of Hawaii, *Environmental Assessment Booklet*


APPENDIX A

PHOTOS OF WELL SITE

View makai (north) from entry to reservoir site at access road

View west at entry to Makapala reservoir site

View east across reservoir site to entry

View mauka (north) at control building and reservoir

Proposed well site marked by person, west of existing Makapala reservoir site

View of proposed well site in relation to existing reservoir site

View of USGS observation well #7345-03 makai (north) or reservoir site

View of USGS test well #7345-04 at north-west corner of reservoir site
View makai (north) from entry to reservoir site at access road

View west at entry to Makapala reservoir site
View east across reservoir site to entry

View mauka (north) at control building and reservoir
Proposed well site marked by person, west of existing Makapala reservoir site

View of proposed well site in relation to existing reservoir site
View of USGS observation well #7345-03 makai (north) or reservoir site

View of USGS test well #7345-04 at north-west corner of reservoir site
APPENDIX B

LETTERS OF CORRESPONDENCE

DLNR, State Historic Preservation Division, Office of Environmental Quality Control
Waimea Water Services, Inc.
June 5, 1998

Mr. John Stubbart
Waimea Water Services, Inc.
P.O. Box 326
Kamuela, Hawaii 96743

Dear Mr. Stubbart:

SUBJECT: Makapala Well Site
Makapala, North Kohala, Hawaii Island

This is in reply to your letter of May 20, 1998 in which you asked for a letter indicating the possibility of finding historic sites in the immediate area of the existing Makapala Well.

Your letter indicates that the area was formerly planted in sugar cane and is now used for grazing. This information, combined with the photographs that you enclosed, indicates to us that there is a very low probability of finding historic sites because of the degree of previous ground disturbance. If the area was to be used to expand the existing operation we believe that it would have "no effect" on significant historic sites.

If you have any questions please contact our Hawaii Island archaeologist, Patrick McCoy (587-0006).

Aloha,

DON HIBBARD, Administrator
State Historic Preservation Division

PM. amk
GROUND-WATER AVAILABILITY FROM THE HAWI AQUIFER IN THE KOHALA AREA, HAWAII

By Mark R. Underwood, William Meyer, and William R. Souza

U.S. GEOLOGICAL SURVEY
Water-Resources Investigations Report 95-4113

Prepared in cooperation with the
DEPARTMENT OF WATER SUPPLY COUNTY OF HAWAI'I

Honolulu, Hawaii
1995
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**Temperature** is given in degrees Celsius (°C), which can be converted to degrees Fahrenheit (°F) by using the equation:

\[ °F = (1.8 \times °C) + 32 \]

**Abbreviations used in water quality descriptions:**

- µg/L, micrograms per liter
- mg/L, milligrams per liter
- ppm, parts per million
- µS/cm, microsiemens per centimeter at 25°C Celsius
GROUND-WATER AVAILABILITY FROM THE HAWI AQUIFER IN THE KOHALA AREA, HAWAII

by

Mark R. Underwood, William Meyer, and William R. Souza

ABSTRACT

A ground-water study consisting of test-well drilling, aquifer tests, and numerical simulation was done to investigate ground-water availability in the basal part of the Hawi aquifer between the western drainage divide of Pololu Valley and Upolu Point in Kohala, Hawaii. The test well drilling provided information on geology, water levels, water quality, vertical extent of the freshwater, and the thickness of the freshwater-saltwater transition zone in that aquifer. A total of 12 test wells were drilled at eight locations. Aquifer tests were done at five locations to estimate the hydraulic conductivity of the aquifer. Using information on the distribution of recharge, vertical extent of freshwater, hydraulic conductivity, and geometry of the basal aquifer, a numerical model was used to simulate the movement of water into, through, and out of the basal aquifer, and the effect of additional pumping on the water levels in the aquifer.

Results of the modeling indicate that ground-water withdrawal of 20 million gallons per day above the existing withdrawal of 0.6 million gallons per day from the basal aquifer is hydrologically feasible, but that spacing, depth, and pumping rates of individual wells are important. If pumping is concentrated, the likelihood of saltwater intrusion is increased. The additional withdrawal of 20 million gallons per day would result in a reduction of ground-water discharge to the ocean by an amount equal to pumpage. Although model-calculated declines in water-level outside the area of pumping are small, pumping could cause some reduction of streamflow near the mouth of Pololu Stream.
INTRODUCTION

The Kohala area of the island of Hawaii is the northwest peninsula of the island (fig. 1). The area is dominated by the asymmetrical, elongated Kohala Mountain. Kohala Mountain is an extinct volcanic dome reaching an altitude of 5,605 ft and is the oldest of the five volcanoes forming the island. The Hawaii Water Resources Protection Plan (George A.L. Yuen and Associates, Inc., 1992) delineated three aquifer systems in the Kohala area: Hawi, Waimanu, and Mahukona (fig. 1). Ground water in these systems is found as basal ground water along the flanks of the volcanic dome, and as high-level water in the rift zones (Stearns and Macdonald, 1946) (fig. 2). The basal ground water extends from the outer edges of the rift zones to a discharge area seaward of the shoreline, and is a roughly lens-shaped body of freshwater floating on seawater. The maximum altitude of the water table of the basal water is unknown.

The windward (northern) side of Kohala Mountain is relatively cool and wet, receiving more than 160 in/yr of rainfall near the summit (fig. 3). The leeward (southern) side of the mountain is in the rain shadow of Kohala Mountain. Average rainfall is less than 10 in/yr along the coast near Kawaihae. Tourism on the leeward side of the Kohala area is expected to grow considerably because of the dry, warm climate. One of the primary limitations for growth and development in this area is the availability of water. The Hawaii County Department of Water Supply (DWS) estimates that water demand in the year 2005 will increase by about 20 Mgal/d more than the present use of 0.6 Mgal/d (Thompson, 1988). Ground water is the preferred source to supply the projected demand, because of its quality, reliability, and lack of required treatment as compared with surface water.

To address an increased demand for water, the DWS and the U.S. Geological Survey (USGS) began a cooperative study to investigate ground-water availability from the basal part of the Hawi aquifer. This area was selected because of its high rainfall and because of the known existence of an extensive basal aquifer. This report describes the results of the study and includes a summary of exploratory well drilling and aquifer tests, and numerical simulation of the changes in the aquifer resulting from increased pumpage of 20 Mgal/d.

Scope

The primary study area for the field investigations was the basal part of the Hawi aquifer between the western drainage divide of Pololu Stream and Upolu Point (fig. 1). This basal aquifer extends to the southeast beyond the Pololu drainage divide and is contiguous with the basal part of the Waimanu aquifer. The Waimanu aquifer was not considered for ground-water development because of its rugged terrain; however, the Pololu drainage basin, which is within the Waimanu aquifer (fig. 1), was included in the numerical ground-water flow model constructed for this study. Because the basal aquifers are part of a larger ground-water system within the Kohala area, it was necessary to quantify rates of ground-water movement into the basal aquifers from areas adjacent
Figure 1. Hawaiian islands and aquifer systems in the Kohala area, Island of Hawaii (aquifer systems are from George A. L. Yuen and Associates, Inc., 1992).
Figure 2. Generalized section of Kohala Mountain showing basal aquifer and direction of ground-water movement.
Figure 3. Mean annual rainfall, Kohala area, island of Hawaii (from Giambelluca and others, 1986).
to the basal aquifers. This information was provided in a study of ground-water recharge for the entire Kohala area by Shade (in press).

A program of test-well drilling was instituted in the Hawi basal aquifer to obtain information on geology, water levels, water quality, and vertical extent of freshwater and the transition zone. A total of 12 test wells were drilled at eight locations at altitudes ranging from about 108 to 630 ft above sea level (see fig. 7). Aquifer tests were done at five locations to estimate the horizontal hydraulic conductivity of the aquifer. Using information on the distribution of recharge, vertical extent of freshwater, horizontal hydraulic conductivity, and geometry of the basal aquifer, a numerical model was constructed to simulate the movement of water into, through, and out of the basal aquifer. The model was then used to estimate the hydrologic feasibility of developing 20 Mgal/d of fresh ground water in addition to the existing use of 0.6 Mgal/d.

Previous Investigations

Early studies in the Kohala area focused on streamflow in the area southeast of Pololu Stream. During a 10-month period in 1890, Lydgate measured streamflow in Waipio Valley (Davis and Yamanaga, 1963). During a 5-month period in 1889 and 1890, Brunner (Davis and Yamanaga, 1963) measured flow in the 17 streams that are tributary to Honokane Nui Stream (fig. 4). In 1901 and 1902, Tuttle (Martin and Pierce, 1913) investigated water resources in the Honokean Nui and Waipio Valleys as well as regions southeast of Waipio Valley by collecting information on streamflow, springs, and wells. Systematic streamflow measurement in the Kohala area was begun in 1907. Since 1912, stream and irrigation discharge ditch data have been published annually by the USGS. Many of the stream and ditch measurements were discontinued when sugarcane production was halted in the early 1970's.

The geology and ground-water resources of the island of Hawaii were described by Stearns and Macdonald (1946) who also provided a conceptual model of the hydrologic system of the Kohala area. Hydrologic information provided by Stearns and Macdonald (1946) was updated by Davis and Yamanaga (1963). A thorough inventory of basic water resources and historical records was compiled by the State of Hawaii (1970).

A project by the Kohala Sugar Company in 1964 drilled five successful observation holes into the Hawi basal aquifer between Upolu Point and Pololu Stream (Bowles and others, 1974). A water-level map was drawn from the data obtained from these holes and from existing data from wells in the area. Bowles and others (1974) evaluated surface-water and ground-water resources in the Kohala area with a focus on the flow in the Kohala ditch (fig. 4). Using a simplified water budget and Darcy's law they estimated that 40 to 45 Mgal/d flowed through the Hawi aquifer; of that quantity, 30 to 35 Mgal/d (75 percent of flow through the system) was available for development.
Figure 4. Streams, ditches, and tunnels in the Kohala area, Island of Hawaii.
DESCRIPTION OF STUDY AREA

The Hawi basal aquifer is bounded along the southeast by the Pololu drainage divide and along the north and northwest by the Pacific Ocean. The southern and southwestern boundary is the rift zone along the crest of Kohala Mountain that extends from the summit toward the coast near Upolu Point (fig. 1). A slightly extended study area for modeling purposes included the continuation of the basal aquifer into the drainage area of Pololu Stream (fig. 4).

Altitude of the land surface on the Kohala Mountain increases gradually from sea level at the shoreline to 5,605 ft above sea level at the mountain summit (fig. 1). In general, the surface relief of the study area is moderately dissected. It is covered dominantly by pastures and orchards, with forests covering upland areas. Sugarcane was produced over much of this area from the early 1900's until the early 1970's. Two major irrigation ditches, Kohala and Kehena (fig. 4), were constructed in the early 1900's to transport water from the area east of Pololu Stream into the study area to support agriculture.

The Kohala ditch, constructed in 1901-02 by the Kohala Sugar Company, presently diverts water from the east branch of Honokane Nui Stream at an altitude of 2,000 ft. The ditch carries the water for 18 mi northwest, mostly as tunnel, toward Hawi where it delivers most of its water to the intake of a hydroelectric plant near Hawi (fig. 4). The ditch also captures minor flows from springs and streams west of Pololu Stream.

During 1928-60, median monthly flow rates in the Kohala ditch out of Honokane Nui Stream ranged from 21.9 to 31.9 Mgal/d (Bowles and others, 1974). Present flow rates are about 10 to 15 Mgal/d. Much of the decline in flow in recent years can be attributed to the loss of water previously derived from streams east of Honokane Nui Stream. At the hydroelectric plant at Hawi, the water released by the plant is injected into the basal aquifer through a holding pond into a row of five shallow injection wells located about 1.7 mi inland at about 520 ft altitude. Depths of these injection wells range from 160 to 240 ft altitude and lateral spacing between them is about 35 ft. The average rate of injection is about 8 Mgal/d.

The Kehena ditch diverts water from an intake at Honokane Nui Stream above the canyon rim at an altitude of about 4,200 ft (fig. 3) and carries the water westward for about 8 mi. Discharge measurements were made in the ditch from 1917 through 1919 and from 1928 through 1966. Average discharge in the ditch for these periods was 7.38 Mgal/d. In recent years the ditch has fallen into disrepair and does not flow continuously.

The extended study area, included for purposes of ground-water modeling, contains the Pololu Stream drainage area. As discussed by Stearns and Macdonald (1946, p. 228), the source of water in Pololu Stream is from springs in its canyon walls below the dike zone and Stearns and Macdonald have described these springs as perched. Pololu Stream is sufficiently entrenched near the ocean to presumably intersect the basal aquifer. If this occurs, the area near the mouth of the stream would be expected to gain water from the Waimanu basal aquifer.
The geohydrologic setting of that part of the Waimanu aquifer beyond Pololu Valley is highly complex and to some extent poorly understood. The work of Stearns and Macdonald (1946) remains the definitive report for the area, but even so, the extent of the high-level and basal aquifers and the relation between surface water and ground water is unclear. Stearns mapped numerous dikes and dike-associated springs and described an area of high-level water about 6 mi wide underlying the higher part of Kohala Mountain (Stearns and Macdonald, 1946, p. 228). This width would extend the high-level aquifer considerably into the Waimanu aquifer. Stearns' description, however, does not allow the extent of the high-level aquifer to be closely delineated. Ground water discharging from behind dikes causes streams to gain along their entire course to the ocean, indicating that most of the area may consist of high-level water. However, Stearns and Macdonald mapped much of the area as basal aquifer. Three streams, Pololu, Waimanu, and Waipio may intersect the basal aquifer near the ocean, but the other streams are hundreds to thousands of feet above sea level along their entire courses and discharge to the ocean from high cliffs.
Kohala Mountain was formed by volcanic rocks derived from the now-extinct Kohala Volcano. The mountain is composed mainly of basaltic and andesitic (Pololu Basalt and Hawi Volcanics, respectively) lavas that erupted from two main rift zones that trend N 35° W and S 65° E from Kohala summit. These rift zones are referred to as the northwest and southeast rift zones, respectively. The estimated location and orientation of the central part of the rift zones are shown in figure 5. The estimated outer margin of the rift zone in the Waimanu aquifer, on the basis of mapped dikes (Stearns and Macdonald, 1946, plate 1), is also shown (figs. 1 and 3). The southern flanks of Kohala Mountain merge with Mauna Kea Volcano and form a saddle that slopes toward the eastern and western coasts of the island of Hawaii.

Pololu Basalt.—The Pololu Basalt contains a thick sequence of basalt lava flows composed of hundreds of individual pahoehoe and aa lava flows that range from a few to 50 ft in thickness and dip from 3 to 10 degrees away from the rift area (Stearns and Macdonald, 1946, p. 174). The basal aquifer is contained within lava flows of the Pololu Basalt. Lavas of the Pololu Basalt make up most of Kohala Mountain above sea level, and, because of subsidence of the island, extend an unknown distance below sea level.

Most of the eruptive areas of the Pololu Basalt have been buried by later lava flows of the Hawi Volcanics. Typically the upper 50 to 200 ft of the Pololu Basalt is decomposed from weathering processes (Stearns and Macdonald, 1946, p. 174). Greater weathering occurred in the wet areas and where the rocks were not covered by the later flows. Intercalated soils greater than a few inches thick are rare below the upper part of the Pololu Basalt, indicating that periods of time between flows were short. Thin vitric ash beds can be found throughout the basalts but rarely on the windward slopes of Kohala Mountain (Stearns and Macdonald, 1946).

In general, the Pololu Basalt resembles the Koolau Basalt on Oahu, which forms aquifers with high transmissivities. The clinker areas on either side of aa flows have high horizontal hydraulic conductivities as do the interflow faces between pahoehoe flows, fractures, and cooling joints in the rock. Because these lavas are layered and nearly horizontal, horizontal hydraulic conductivity is likely to be greater than the vertical hydraulic conductivity. Aquifer tests and numerical studies in the Pearl Harbor aquifer of Oahu indicate that the greatest-to-least (horizontal-to-vertical) hydraulic conductivity ratios, or anisotropy ratios, are from 10:1 to 1,000:1. In an analysis of the Pearl Harbor aquifer, Souza and Voss (1989) estimated a ratio of horizontal to vertical hydraulic conductivity of 200:1.

Intrusive dikes cut the Pololu Basalt flows in the deep canyons on the northeast slope. Dikes trend N 50° to 80° W and dip about 75° northeast (Stearns and Macdonald, 1946, p. 175). Widths of Pololu dikes range from a few inches to 10 ft and average about 2 ft. Dike concentrations become greater with depth and closeness to the rift areas. Their dense composition, late-stage intrusion, and
Figure 5. Surficial geology of the Kohala area, island of Hawaii (modified from Langenheim and Clague, 1987, and Stearns and Macdonald, 1946).
near-vertical emplacement give dikes relatively low horizontal hydraulic conductivity that impedes ground-water flow. On the basis of a description of the area between Pololu Stream and Waipio Stream (fig. 4) by Stearns and Macdonald (1946), the northern margin of the southeast rift zone, and the associated high-level water, may extend more than 4 mi from the summit area towards the ocean (fig. 5). As discussed, Stearns and Macdonald (1946) indicate a total width of about 6 mi for high-level water in the area of the Waimanu aquifer.

_Hawi Volcanics._—The Hawi Volcanics form a cap over most of the rift zone and cover about a third of the northeast slope and about half of the southwest slope below the rift zone (fig. 5). Lava flows of the Hawi Volcanics were composed almost entirely of highly viscous aa that flowed onto the existing Pololu Basalt surface. An unconformity, that in places is marked by a red soil, exists between the Pololu Basalt and the overlying Hawi Volcanics. The red soil prevails on the southeastern slopes and indicates that most of the original topographic slopes were not eroded before being covered by lava flows of the Hawi Volcanics.

Only a few lava flows of the Hawi Volcanics extend to the coast. Thickness of individual lava flows range from 10 to 150 ft and average about 40 ft. In up-slope areas, flows overlap to reach a composite thickness as great as 500 ft near the summit. Many of the Hawi flows followed existing topography and filled the shallow canyons. Thin, ashy soils and gravel can be found between individual Hawi flows indicating longer periods of time between flows than in the Pololu Basalt. Soils that form on Hawi rocks are gray and can exceed 3 ft in thickness. These soils support agriculture when adequate moisture is present.

_Alluvium._— Alluvial deposits are found in the floors of the larger canyons on the windward side of Kohala Mountain (Stearns and Macdonald, 1946). These deposits consist of unconsolidated deposits of poorly sorted silts, sands, and boulders; landslide deposits characterized by blocks of volcanic rock in an earthy mix; and consolidated alluvium consisting of poorly sorted boulder conglomerates that form terraces in the lower stretches of the larger canyons and gulches. Stearns and Macdonald (1946, p. 172) indicate a thickness for the consolidated alluvium on the order of 500 ft and thickness of the unconsolidated deposits of about 25 ft. Both deposits are thought to be poorly permeable.
GROUND-WATER OCCURRENCE

The general movement of water in the Kohala area is from the mountainous areas toward the ocean. A schematic representation of this movement is shown in figure 2. In the mountainous areas, the movement of water is impeded by the presence of dikes within the rift zones. This impedance results in relatively high water levels in the rift zone that can be more than 2,000 ft above sea level (Stearns and Macdonald, 1946). Orientation of dikes is subparallel to the main orientation of the rift zone so that intersecting dikes are common and ground water is compartmentalized between the dikes. In Hawaii, this water is referred to as high-level water.

The water budget for the study area was estimated by Shade (in press). The major source of water to the basal part of the Hawi aquifer is from direct infiltration of precipitation. Recharge derived from this source is 53.1 Mgal/d on a mean annual basis. The movement of water into the basal aquifer from the adjacent rift zone constitutes another source of water that equals 6.9 Mgal/d on a mean annual basis. Mean annual recharge from infiltration of precipitation falling on the basal aquifer in the Pololu Stream drainage area is 7.2 Mgal/d and mean annual recharge to this aquifer from the rift zone above it is 1.2 Mgal/d. The actual rate of recharge at any point is dependent on the rate of precipitation minus water lost to evapotranspiration, direct runoff, and soil-moisture storage. Each of these factors varies from location to location. The areal distribution of ground-water recharge for the entire area is shown in figure 6.

A small amount of ground-water recharge is derived from water that infiltrates from the Kohala ditch. Discharge measurements made in the ditch during this study indicate a seepage loss ranging from 0.16 to 0.33 Mgal/d per mile with a total loss of about 2.0 Mgal/d in the study area. An additional source of recharge to the aquifer is derived from the injection of an estimated 8 Mgal/d at the Hawi hydroelectric plant.

Ground water moves out of the rift zone into the basal aquifer where the direction of ground-water motion is mainly horizontal. The altitudes of water levels in the basal aquifer measured on March 22, 1990 in the test wells drilled for this study ranged from a high of 11.3 ft above sea level to a low of 2.5 ft (fig. 7). Water levels higher than those shown in figure 7 would be expected inland toward the rift zone. As indicated by the water levels, there is a general northerly movement of water in the basal aquifer. Existing hydrologic conditions in the basal aquifer in terms of recharge and discharge from the aquifer have not changed significantly for many years, indicating that water levels shown in figure 7 would represent equilibrium or near-equilibrium conditions, although seasonal variations in water levels would be expected. Extensive agriculture and irrigation of crops ceased in the mid-1970's and water previously used for irrigation has been injected at the Hawi hydroelectric plant since about 1979. The only regularly pumped well in the basal aquifer is the DWS well. Production at this well (7449-02; see fig. 9) averages about 0.6 Mgal/d. Water levels were regularly measured in shaft 7652-01 from 1972 to 1995 and periodically measured in well 7347-02 (see fig. 9) from 1986 to February 1991 (fig. 8). This data supports the concept that equilibrium conditions exist in the aquifer.
Figure 6. Ground-water recharge, Kohala area, island of Hawaii (Shade, in press).
Figure 7.Observed ground-water levels in the Hawi basal aquifer and test-well sites, Kohala area, Island of Hawaii.
Ground water discharges from the basal aquifer into the ocean and, near the shoreline, there is an upward component of ground-water flow. The upper 50 to 250 ft of the basaltic basal aquifer is largely decomposed by weathering, but it is not known if the weathered layer extends under the ocean. Waves along the coast may have eroded all or part of this layer. If a weathered layer exists, it would help impede the movement of ground water from the basal aquifer into the ocean because the hydraulic conductivity of weathered basalt is generally much lower than that of fresh basalt. Sedimentary deposits similar to those found along the shoreline of other islands in Hawaii are not present along the Kohala shoreline because of the relatively young age of the basalts in the area.

Springflow in the study area occurs primarily between 600 and 1,800 ft altitude and has been described by Stearns and Macdonald (1942) as perched water that, for the most part, issues from a clinker zone at the bottom of the Hawi Volcanics and above the red soil at the top of the Pololu Basalt.

Figure 8. Water levels measured in well 7347-02 and shaft 7652-01, Kohala area, island of Hawaii.
Ground-Water Development

The locations of wells, shafts, and test holes constructed in the Hawi basal aquifer prior to this study are shown in figure 9. Altogether there are four wells, four shafts, and five test holes. With the exception of the DWS well (well 7449-02) near Hawi, all of the other wells, shafts, and test holes were drilled by sugar plantations. The first well (7448-01) was drilled in 1898 by the Kohala Sugar Company (State of Hawaii, 1970). Water from the well was used for sugar mill supply in 1901, but the well was ultimately abandoned (Davis and Yamanaga, 1963). Between 1899 and 1901 three shafts (Kohala, Alaalae, and Hoea) were sunk to sea level for water for sugarcane irrigation; a fourth shaft (Waikane) was constructed in 1920. Well 7347-02 was drilled in 1948 for domestic use and the Union Mill #1 well was drilled in 1965 with the intent of using the water for irrigating sugarcane. The wells were drilled at altitudes ranging from 310 to 540 ft. Finally, the five test holes described by Bowles and others (1974) were drilled in 1964. These holes were drilled at altitudes ranging from 170 to 362 ft. The shafts were constructed at low altitudes near the coast.

The present source of domestic water in the Kohala area comes primarily from the DWS well (0.6 Mgal/d) and three tunnel systems that have been dug to tap spring discharge: the Bond 1 tunnel, discharging at altitudes of about 1,000 ft and 1,400 ft; the Watt 1 tunnel, discharging at 1,700 and 1,800 ft; and the Murphy tunnel, discharging at about 1,250 ft. The greatest flows are from the Bond and Watt tunnel systems, which have discharges as large as 1.25 Mgal/d each. The Murphy tunnel discharges about 0.25 Mgal/d. The greatest untapped springflow is about 0.15 Mgal/d from the west branch of Halawa Gulch (fig. 4) (State of Hawaii, 1970). The total average flow for all tunnels and springs is 4 to 5 Mgal/d with a maximum total flow of 17 to 18 Mgal/d and a minimum total flow of about 1 Mgal/d (Stearns and Macdonald, 1946).

Sufficient data are not available to recreate the historical distribution and rates of groundwater development, although the general pattern of this development from 1940 to 1961 is discussed by Davis and Yamanaga (1963), and the pattern from 1962 through 1967 is available in State of Hawaii (1970). The following summarizes information in those two reports.

From 1940 through 1961 the average pumpage of ground-water from the aquifer was about 7.5 Mgal/d and most of the water was used to irrigate sugarcane (Davis and Yamanaga, 1963). The range in use during this time was 2.2 to 14.2 Mgal/d. Shaft pumpage from 1962 to 1967 was about 3.2 Mgal/d (State of Hawaii, 1970), about half of that from 1940 through 1961. Davis and Yamanaga (1963) indicated that chloride concentrations in one of the shafts averaged about 400 ppm and at another averaged about 1,500 ppm. Given that the shafts were constructed at low altitudes near the coast, and given their rate of pumpage, the relatively high chloride concentrations are to be expected. At the time of this study (1989-90) and as of 1995, the DWS well is the only well regularly pumped in the basal aquifer.
Figure 9. Locations of existing and historic wells, existing tunnels, and historic test holes in the Kohala area, Island of Hawaii.
Ground-Water Quality

The quality of water in the basal aquifer was investigated by analyzing water samples from five of the eight test-well sites (A, B, E, F, and H in fig. 7) for concentrations of common ions. Samples were analyzed at the U.S. Geological Survey Central Laboratory according to standard methods (Fishman and Friedman, 1989, Wershaw, and others, 1987). Results show that the ground water in Kohala is typical of water from Hawaiian basalt aquifers (Swain, 1973). Dissolved ion concentrations were low, with specific conductance values ranging from 165 to 245 μS/cm and chloride concentrations ranging from 19 to 36 mg/L (table 1).

At three sites (A, B, and F), water samples were also collected for analysis for 18 dissolved metals and as many as 79 organic compounds, including agricultural chemicals, volatile constituents of fuel, and solvents (table 2). No dissolved metals or organic compounds were found at concentrations exceeding maximum contaminant levels (U.S. Environmental Protection Agency, 1991).

Iron and aluminum were the metals found in highest concentrations, as might be expected given their abundance in basalt. Iron and aluminum may also have been released into the water samples from the iron well casing, metal pump, and aluminum discharge line. The other metals were either not detected or detected at low (10 μg/L or less, except for barium) concentrations that are typical of ground water from basalt aquifers (Halbig and others, 1986; Eyre, 1994).

Samples were free of significant anthropogenic organic compounds. The only organic compounds reported were from well A, where toluene and xylene were found at or near the level of detection (0.2 μg/L). This concentration is far below the USEPA limit of 1,000 μg/L (U.S. Environmental Protection Agency, 1991). Given these low levels, it is possible that the presence of these compounds was the result of sample contamination during collection, false detection in the laboratory, or possible local contamination of the water during well drilling. Further sampling at this location would be necessary to verify the existence of the compounds.
Table 1. Concentrations of common ions and other water-quality characteristics of water samples from
the Hawi basal aquifer, Kohala area, island of Hawaii

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<td>H</td>
<td>E</td>
<td>F</td>
<td>B</td>
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<td>Silica, dissolved (mg/L as SiO₂)</td>
<td>37</td>
<td>51</td>
<td>41</td>
<td>44</td>
<td>44</td>
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<tr>
<td>Solids, sum of constituents, dissolved (mg/L)</td>
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<td>148</td>
<td>18</td>
<td>174</td>
<td>133</td>
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<tr>
<td>Iron, dissolved (µg/L as Fe)</td>
<td>55</td>
<td>6</td>
<td>27</td>
<td>41</td>
<td>16</td>
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<td>Manganese (µg/L as Mn)</td>
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<td>&lt;1</td>
<td>1</td>
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Table 2. Concentrations of trace metal and organic compounds in water samples from the Hawi Basal aquifer, Kohala area, Island of Hawaii

[All values in micrograms per liter; <, actual value is less than value shown]

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<tr>
<td>Time</td>
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<td>2</td>
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</table>
Table 2. Concentrations of trace metal and organic compounds in water samples from the Howl basal aquifer, Kohala area, Island of Hawaii—Continued

(All values in micrograms per liter; <, actual value is less than value shown)

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Vertical Extent of Freshwater

Saltwater underlies freshwater in the basal aquifer. When water is pumped from the basal aquifer, the lowering of ground-water levels associated with pumping will result in an upward movement of the saltwater. Ultimately, the amount of water that can be developed from the basal aquifer is constrained by the salinity of the water. To address the constraint on ground-water availability imposed by salinity, two wells (D and I, fig. 7) were designed to measure the vertical extent of freshwater and the upper part of the transition zone. Observation well D, located about 0.4 mi from the coast at an altitude of 108.5 ft, was completed at a depth of 351 ft below sea level. Observation well I, located about 0.7 mi from the coast at an altitude of 299.5 ft, was completed at a depth of 137 ft below sea level. The wells were open to the aquifer below the water table.

To estimate the thickness of freshwater and the upper transition zone, water samples were collected in March 1990 from several depths in each well and analyzed for chloride concentration (an indicator of salinity) (fig. 10). For this report, freshwater is defined as ground water containing water with a chloride concentration less than 250 mg/L (U.S. Environmental Protection Agency, 1991). Seawater collected around the Hawaiian Islands has a chloride concentration of about 19,600 mg/L (Wentworth, 1939). The change in salinity between freshwater and seawater at depth is not abrupt, rather, freshwater and seawater mix and the change is somewhat gradual through a transition zone. The entire transition zone from freshwater to seawater includes all water with a chloride concentration between 250 mg/L and about 19,600 mg/L.

Through the transition zone, the density of the mixed water also varies from that of freshwater (about 1.000 g/ml) to that of seawater (about 1.025 g/ml). On the basis of this density difference, freshwater may be assumed to extend below sea level to a depth 40 times the water level above sea level. This is referred to as the Ghyben-Herzberg relation (Bear, 1979, p. 560). In practice, the depth defined by the Ghyben-Herzberg relation approximates the mid-point of the transition zone (Lau, 1962). The mid-point of the transition zone is at a chloride concentration of about 9,800 mg/L. Thus, the upper transition zone includes water with a chloride concentration between 250 and 9,800 mg/L.

In well D, the depth to a chloride concentration of 250 mg/L and thus the estimated thickness of freshwater is about 265 ft. The depth of the mid-point of the transition zone was about 345 ft below the water table, making the upper transition zone about 80 ft thick (fig. 10). In well I, the depth to a chloride concentration of 250 mg/L and thus the estimated thickness of freshwater is about 83 ft. No water samples were obtained at or below the mid-point of the transition zone in well I. On the basis of an extrapolation of the existing data, the depth of the mid-point of the transition zone was about 145 ft below the water table, making the thickness of the upper transition zone about 62 ft (fig. 10).

The preceding analysis is based on the assumption that the salinity profiles logged in the wells are representative of the salinity of water in the surrounding aquifer. However, each well is
Figure 10. Chloride concentrations and depth for test wells D and I, Kohala area, Island of Hawaii.
open to the aquifer for the entire depth below the water table, providing an open conduit through the pre-existing aquifer layers. If vertical hydraulic gradients exist in the aquifer, water will flow vertically within the well bore, entering from aquifer zones with greater hydraulic head and exiting to zones with lesser head. If ground-water flow in the aquifer is predominantly horizontal and vertical flow in the well bore is inconsequential, the salinity profile in the well can be expected to correspond closely to the salinity profile in the aquifer. However, vertical flow in the well could be of sufficient magnitude to distort the salinity profile and thickness of the transition zone in the well bore from that in the aquifer.

Test wells D and I are located between 0.4 and 0.7 mi from the shore, and here the dominant direction of ground-water movement is expected to be horizontal. As a result, vertical flow in the aquifer, and thus in the test wells would not be significant. If vertical flow does occur, it would most likely be upward because of the wells proximity to the shoreline where freshwater begins to discharge upward into the ocean. Upward flow within the well bore would tend to bring saltwater to higher altitudes in the well bore than exist in the aquifer. Accordingly, the salinity profile as logged in the well bore would be displaced upward by some unknown amount. Thus the well bore salinity profile would indicate that the top of the transition zone is shallower than it actually is in the aquifer.
HYDRAULIC CONDUCTIVITY OF THE BASAL AQUIFER

Estimates of the horizontal hydraulic conductivity of the basal aquifer were obtained from aquifer tests at five wells: A, E, F, H, and Union Mill #1 (fig. 11). Aquifer tests were done in wells drilled during the present study, and also in several wells drilled prior to this study. Similarly, aquifer-test data were mostly from tests done during the present study but also from data from several earlier tests (not done by USGS) that were reanalyzed as part of this study. A summary of well characteristics is shown in table 3.

Each test site consisted of a pumped well and an observation well. Each observation well was installed so that the depth of penetration into the aquifer was about the same as that of the corresponding pumped well. None of the wells fully penetrated the aquifer, the thickness of which is unknown. For an aquifer test, it is desirable to have the deepest possible well penetration that allows sufficient withdrawal without inducing an unacceptable saltwater upconing. As a result, the penetration of each pumped well drilled for this study is about one third of the estimated freshwater thickness, as approximated from the Ghyben-Herzberg relation. By avoiding the withdrawal of salty or brackish water, the complicating effects of variable-density fluid flow on hydraulic analysis were avoided.

Two types of aquifer tests were done at each site: a step-drawdown test and a 12-hour continuous pumping-rate test. The step-drawdown test involved measuring the drawdown induced in the pumped well at each of three to five successively higher pumping rates. Each step lasted about 1 hour. The sustained 12-hour test involved pumping the well at a steady rate for 12 hours and measuring the drawdown induced in both the pumped and the observation well over this time. Tests done during this study included step-drawdown tests at sites A, E, and F, and sustained pumping tests at site A, E, F, and H. Earlier tests included a step-drawdown test done in 1975 at site H by the County of Hawaii Department of Water Supply (unpub. data in files of U.S. Geological Survey, Honolulu), and a step-drawdown test and a sustained pumping test at Union Mill #1 in 1964 (Akinaka and others, 1975).

The step-drawdown data were analyzed to estimate the two components of drawdown in the pumped well: (1) the hydraulic head loss in the aquifer, (2) the hydraulic head loss from friction and turbulence within and near the well column, and (3) well entrance losses at the screen. An empirical relation between drawdown and pumping rate developed by Jacob (1947) allows a well efficiency at a desired pumping rate to be calculated. The measured drawdown in the well is then adjusted on the basis of the efficiency, and the resulting value represents the drawdown due only to hydraulic head loss in the aquifer. This adjusted value of drawdown is then used in subsequent equations of aquifer analysis.
Figure 11. Aquifer-test values for horizontal hydraulic conductivity, Kohala area, island of Hawaii.
Table 3. Summary of characteristics of wells used for exploration and aquifer testing of the Hawi basal aquifer, Kohala area, island of Hawaii

[Includes exploratory wells drilled for this study and pre-existing wells used in the aquifer tests. Well number refers to the State of Hawaii numbering system. "Test pumping" wells were pumped during aquifer tests only and are not permanent withdrawal wells; --, no data]

<table>
<thead>
<tr>
<th>Test site or well (figs. 7 and 11)</th>
<th>State well number</th>
<th>Well use</th>
<th>Land surface altitude (feet)</th>
<th>Depth drilled (feet)</th>
<th>Water-table altitude (feet)</th>
<th>Altitude of open interval (feet)</th>
<th>Type of open interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>7345-03</td>
<td>observation (water level)</td>
<td>395.3</td>
<td>440</td>
<td>10.2</td>
<td>175 to -45</td>
<td>open hole</td>
</tr>
<tr>
<td>A</td>
<td>7345-04</td>
<td>test pumping</td>
<td>395.9</td>
<td>495</td>
<td>10.3</td>
<td>-44 to -99</td>
<td>open hole</td>
</tr>
<tr>
<td>B</td>
<td>7347-04</td>
<td>observation (water level)</td>
<td>630.4</td>
<td>730</td>
<td>11.4</td>
<td>530 to -100</td>
<td>open hole</td>
</tr>
<tr>
<td>B</td>
<td>7347-05</td>
<td>test pumping</td>
<td>628.2</td>
<td>720</td>
<td>11.4</td>
<td>18 to -102</td>
<td>perforated steel/open hole</td>
</tr>
<tr>
<td>D</td>
<td>7445-01</td>
<td>observation (salinity profile)</td>
<td>108.5</td>
<td>460</td>
<td>7.5</td>
<td>74 to -352</td>
<td>open hole</td>
</tr>
<tr>
<td>E</td>
<td>7847-02</td>
<td>withdrawal</td>
<td>344</td>
<td>505</td>
<td>--</td>
<td>-8 to -161</td>
<td>open hole</td>
</tr>
<tr>
<td>E</td>
<td>7347-03</td>
<td>observation (water level)</td>
<td>340.5</td>
<td>405</td>
<td>9.8</td>
<td>261 to -64</td>
<td>open hole</td>
</tr>
<tr>
<td>F</td>
<td>7448-06</td>
<td>observation (water level)</td>
<td>411.6</td>
<td>440</td>
<td>8.0</td>
<td>289 to -28</td>
<td>open hole</td>
</tr>
<tr>
<td>F</td>
<td>7448-07</td>
<td>test pumping</td>
<td>414.8</td>
<td>429</td>
<td>8.1</td>
<td>8 to -22</td>
<td>steel perforated</td>
</tr>
<tr>
<td>H</td>
<td>7449-02</td>
<td>withdrawal</td>
<td>541.4</td>
<td>591</td>
<td>--</td>
<td>7 to -50</td>
<td>perforated steel/open hole</td>
</tr>
<tr>
<td>H</td>
<td>7440-03</td>
<td>observation (water level)</td>
<td>541.2</td>
<td>585</td>
<td>7.0</td>
<td>451 to -44</td>
<td>open hole</td>
</tr>
<tr>
<td>I</td>
<td>7549-03</td>
<td>observation (salinity profile)</td>
<td>299.5</td>
<td>436</td>
<td>2.3</td>
<td>169 to -137</td>
<td>open hole</td>
</tr>
<tr>
<td>J</td>
<td>7451-01</td>
<td>observation (water level)</td>
<td>566.6</td>
<td>632</td>
<td>4.2</td>
<td>463 to -65</td>
<td>open hole</td>
</tr>
<tr>
<td>J</td>
<td>7451-02</td>
<td>test pumping</td>
<td>566.8</td>
<td>632</td>
<td>4.8</td>
<td>7 to -65</td>
<td>perforated steel/open hole</td>
</tr>
<tr>
<td>Union Mill #1</td>
<td>7448-03</td>
<td>observation (water level)</td>
<td>306.3</td>
<td>402</td>
<td>4.9</td>
<td>306 to -96</td>
<td>open hole</td>
</tr>
<tr>
<td>Union Mill #1</td>
<td>7448-04</td>
<td>withdrawal</td>
<td>312</td>
<td>412</td>
<td>--</td>
<td>0 to -100</td>
<td>perforated steel/open hole</td>
</tr>
</tbody>
</table>
The adjusted drawdown data from the step-drawdown test were then analyzed using equation 1 (Harr, 1962; Polubarinova-Kochina, 1962):

\[
K = \frac{Q \ln \left( \frac{1.6 L}{r_w} \right)}{2\pi L s_w}
\]  

(1)

where:  
\( K \) is horizontal hydraulic conductivity, in feet per day;  
\( Q \) is pumping rate, in cubic feet per day;  
\( \ln \) is natural logarithm (base \( e = 2.718 \));  
\( L \) is length of the open interval of the well, in feet;  
\( \pi \) is the number pi, equal to 3.1415;  
\( r_w \) is radius of the well, in feet; and  
\( s_w \) is drawdown in the pumped well, in feet, adjusted for well loss.

Equation 1 describes steady-state flow to a pumped well that partially penetrates an aquifer that is much thicker than the depth of the well, a condition met by the wells in this study. The geometry of flow is such that lines of equal drawdown in the aquifer take the shape of ellipses; thus the equation is referred to herein as the elliptical equation. This equation was solved for values of \( K \) using drawdown data from the step-drawdown tests, adjusted for well loss as described above.

Drawdown data from the 12-hour sustained pumping-rate tests were analyzed by the Thiem equation, which assumes steady, radial flow and requires measurements of drawdown in two observation wells. Differences in well construction required use of both the confined and unconfined forms of the Thiem equation (Todd, 1980):

\[
K = \frac{Q \ln \left( \frac{r_2}{r_1} \right)}{2\pi b (s_1 - s_2)} \quad \text{(confined)}; \\
K = \frac{Q \ln \left( \frac{r_2}{r_1} \right)}{\pi \left[ h_2 - h_1 \right]} \quad \text{(unconfined)},
\]

(2)  

(3)

where:  
\( K \) is horizontal hydraulic conductivity, in feet per day;  
\( Q \) is pumping rate, in cubic feet per day;  
\( \ln \) is natural logarithm (base \( e = 2.718 \));  
\( r_1 \) is radial distance to observation well 1 (closer to the pumped well), in feet;  
\( r_2 \) is radial distance to observation well 2, in feet;  
\( \pi \) is the number pi, equal to 3.1415;  
\( b \) is aquifer thickness, in feet.
$s_1$ is drawdown in observation well 1, in feet;
$s_2$ is drawdown in observation well 2, in feet;
$h_1$ is thickness of flow at observation well 1, in feet; and
$h_2$ is thickness of flow at observation well 2, in feet.

Several qualifications regarding application of the Thiem equation are pertinent. First, the pumped well was considered to be observation well 1, and the radius of the pumped well and the adjusted drawdown (computed from the step-drawdown analysis) were used. Next, because the thickness of the aquifer in the Kohala area is unknown, the submerged open length of the pumped well was substituted for aquifer thickness, $b$ (flow is presumed to be horizontal and radial within the depth interval corresponding to the open length of the pumped well). The confined form of the Thiem equation was used for sites E, H, and Union Mill #1, sites where there was no drawdown-induced dewatering of the pumped interval because solid casings in the pumped wells extend below the level of drawdown. The unconfined form of the Thiem equation was used for sites A and F, sites where the pumped wells are open at the water table and drawdown caused dewatering of the pumped interval. Here, drawdown was subtracted from the pre-pumping submerged open length of the well to obtain the thickness of flow, $h$. Lastly, the Thiem equation assumes that steady-state, or equilibrium, flow has been attained. Typically, this constraint is closely approximated within a few hours in the permeable lavas of Hawaii at the short radial distances of these tests. Also relevant is the work of Bennett and others (1967), who conducted pumping tests in the Punjab region of West Pakistan. Using drawdown measurements in observation wells both within and outside the pumping interval, they demonstrated that the slope of the cone of depression within a few hundred feet of the pumped well stabilized after a few hours of pumping even though the cone of depression continued to expand. It was concluded that the flow to the pumped well was dominantly horizontal within the depth range of the open interval of the pumped well at radial distances of a few open-interval lengths, once the hydraulic gradient stabilized within this region. Consequently, the Thiem equation could be used to analyze this data.

Values of hydraulic conductivity ($K$) obtained from the aquifer tests ranged from 610 to 6,400 ft/day (table 4, fig. 11). Differences between values obtained by the two analytical methods at a given site ranged from 0 to 44 percent of the mean of the two values. Within the area of the tests (fig. 11), hydraulic conductivity seems to increase progressively in the northwest direction.
Table 4. Summary of aquifer-test data and results, Kohala area, island of Hawaii  
[ftld, feet per day; r, radius from center of pumped well; K, horizontal hydraulic conductivity of aquifer]

<table>
<thead>
<tr>
<th>Test well site or well (fig. 11)</th>
<th>Pumped well</th>
<th>Length of pumping interval (feet)</th>
<th>Distance at observation well from pumped well (feet)</th>
<th>Number of steps</th>
<th>K&lt;sub&gt;calculated using elliptical equation (ftld)&lt;/sub&gt;</th>
<th>Pumping rate, Q (gal/min)</th>
<th>Duration of pumping (hours)</th>
<th>Drawdown (feet)</th>
<th>K&lt;sub&gt;calculated using Theim equation&lt;/sub&gt; (ftld)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 7345-04</td>
<td>55</td>
<td>50</td>
<td>6</td>
<td>610</td>
<td>900</td>
<td>71</td>
<td>14.5</td>
<td>4.5</td>
<td>0.29</td>
</tr>
<tr>
<td>E 7347-02</td>
<td>153</td>
<td>40</td>
<td>5</td>
<td>910</td>
<td>1,240</td>
<td>14</td>
<td>7.5</td>
<td>1.6</td>
<td>0.31</td>
</tr>
<tr>
<td>F 7448-07</td>
<td>22</td>
<td>50</td>
<td>4</td>
<td>940</td>
<td>400</td>
<td>16</td>
<td>--</td>
<td>2.6</td>
<td>0.13</td>
</tr>
<tr>
<td>H 7449-02</td>
<td>57</td>
<td>55</td>
<td>4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4,300</td>
<td>495</td>
<td>72</td>
<td>3.1</td>
<td>0.32</td>
<td>0.13</td>
</tr>
<tr>
<td>Union Mill #1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>100</td>
<td>73</td>
<td>3</td>
<td>1,800</td>
<td>2,000</td>
<td>365</td>
<td>8.7</td>
<td>1.9</td>
<td>0.8</td>
</tr>
</tbody>
</table>

K<sub>average</sub> = 1,700  
K<sub>median</sub> = 940  
K<sub>average</sub> = 2,300  
K<sub>median</sub> = 1,100

<sup>a</sup> Step-drawdown test was done at time of completion of well construction in 1975; data reported by Hawaii County Department of Water Supply (1975).

<sup>b</sup> Union mill #1 aquifer tests were done in 1965-66; data used in analysis reported in Akinaka and others (1975).
NUMERICAL SIMULATION OF THE BASAL AQUIFER

Ground-water flow in the basal aquifer was simulated using the two-dimensional areal ground-water model AQUIFEM-SALT (Voss, 1984), which is a finite-element numerical model that simulates an aquifer containing freshwater that floats on saltwater of greater density. The model simulates water-levels and movement of the freshwater only. The saltwater is assumed not to flow and to have a hydrostatic pressure distribution. It is assumed that the boundary between the freshwater and saltwater is a sharp interface and that the two waters do not mix. It is further assumed that the location of the interface in the model represents the mid-point of the transition zone of the aquifer. The position of the interface in the model is determined so that the hydrostatic pressure in both freshwater and saltwater are equal on both sides of the interface.

**Description of the Model**

**Boundary conditions.**—The inland extent of the basal aquifer terminates at the rift zones of Kohala Mountain. Although water moves through the rift zone into the basal aquifer, hydraulic conductivity of the dikes in the rift zone is orders of magnitude less than that of the basal aquifer. As a result, the rift zone was not included as part of the modeled area, but the discharge of water from it into the basal aquifer was accounted for in the model by specifying additional recharge to the model elements adjacent to the rift zone (fig. 12).

Discharge of ground water along the shoreline of the modeled area is simulated using a head-dependent flux boundary. Ground-water discharge into the ocean through the ocean floor occurs in model elements along of the shoreline (fig. 12). Such discharge occurs because there is a hydraulic connection between the basal aquifer and the ocean, and the freshwater head in the aquifer is higher than the head at the ocean floor. The rate at which water discharges is controlled by the difference between the freshwater head in the aquifer, the equivalent freshwater head at the ocean floor, and the thickness and vertical hydraulic conductivity of the basalt and the weathered zones in the basalt, if the latter exist on the ocean floor.

The model was extended beyond the primary study area to include the entire Pololu drainage area, because simulated pumpage in the Hawi basal aquifer was close to this area and drawdowns induced by pumping would be expected to extend into it and possibly beyond it. Because the geohydrologic setting of the area east of Pololu Stream is highly complex and not completely understood, the model was not extended into this area. Given the lack of detailed knowledge concerning the relation between the Waimanu basal aquifer and Pololu Stream, the stream was not simulated on the model. Model-simulated drawdowns at the mouth of Pololu Stream resulting from pumping 20 Mgal/d in the Hawi basal aquifer are discussed, however, in order to qualitatively evaluate the possible effect of pumping on this stream.
Figure 12. Model grid and boundaries used in the numerical simulation, Kohala area, island of Hawaii.
The basal aquifer is made up of hundreds of thin permeable lava flows that, because of subsidence of the island, now extend from the land surface to well below sea level. The depth of the bottom of the aquifer is not known. However, it is likely that the permeable lava flows extend several thousand feet below sea level because most Hawaiian volcanoes have subsided 6,000 to 12,000 ft (Moore, 1987). As a result, the model uses a single layer with a total thickness of 3,000 ft. This is not to indicate that freshwater extends to this depth. This depth represents only the estimated depth of permeable rock and conceptually, the total aquifer thickness includes both freshwater and saltwater. In the model, however, freshwater flows only in the interval between the water table and the freshwater-saltwater interface. The freshwater-saltwater interface as calculated by the model defines the bottom of the aquifer and is a no-flow boundary at a depth that is a function only of the local head in the aquifer.

Recharge.--Water is input into the model as ground-water recharge distributed areally over the modeled area using the distribution of mean annual recharge rates estimated by Shade (in press). Total recharge to the model is 78.4 Mgal/d. Recharge to the model from direct infiltration of rainfall on the basal aquifer, 60.3 Mgal/d, was distributed on the basis of values shown in figure 6. Recharge to the basal aquifer derived from that part of the rift zone between the topographic divide at the crest of Kohala Mountain and the boundary of the modeled area (8.1 Mgal/d) is accounted for by augmenting the recharge in the elements along the model boundary adjacent to the rift zone (fig. 12). Recharge to the basal aquifer from the Hawi hydroelectric plant injection wells (8 Mgal/d) was simulated as a constant flux to the model node where the injection wells are located. The estimated seepage loss from Kohala ditch (2 Mgal/d) was modeled as augmented recharge in elements along the ditch (fig. 12).

Ground-water pumpage.--The withdrawal of ground water at the DWS well (7449-02) was simulated as a constant rate of withdrawal equal to 0.6 Mgal/d. The location of the pumping node is shown in figure 12.

Hydraulic conductivity.--Values of hydraulic conductivity of the basal aquifer calculated during this study provided a range from 610 to 6,400 ft/d (table 4). The average value of hydraulic conductivity calculated from the aquifer test using the Thiem method is 2,300 ft/d; the median value is 1,100 ft/d. However, among the aquifer-test sites, higher values of hydraulic conductivity were obtained in the northwestern part of the basal aquifer than in the southeastern part (fig. 11). This variability was investigated and is discussed in the calibration section of the report. The hydraulic properties of the basal aquifer in Pololu Valley are not known, so that the hydraulic properties of the basal aquifer in this area were assumed to be the same as the southeastern part of the Hawi basal aquifer. In addition it is possible that the regular, tabular structure of basalt lava flows may cause the hydraulic conductivity to be greater along the lava flow direction than across it, making the aquifer areally anisotropic.
Shoreline discharge.--One of the most important considerations in boundary conditions is the nature of the discharge of freshwater from the basalt aquifer through the ocean floor. This discharge is impeded because, near the shoreline, ground-water movement is predominantly vertically upward and across the layering of the basalt flows. There is resistance to vertical movement because the freshwater must flow through the dense, less permeable interior part of individual lava flows. There would be additional resistance to vertical movement if the basalt layers are weathered or there are ocean bottom sediments overlying the basalt. Also, freshwater must discharge against the saltwater head at the ocean floor. In the model, the saltwater head would be expressed as an equivalent freshwater head, \( h_a = (1.025z - z) \) for \( z \) equal to the depth below sea level to the ocean floor. Because AQUIFEM-SALT does not distinguish between freshwater and saltwater, the model will use the ocean as a source of freshwater to the aquifer if the calculated freshwater equivalent head at the ocean floor in the discharge area of the model (fig. 12) exceeds the head in the underlying basalt aquifer. To avoid this, the freshwater equivalent head of the ocean was set to zero in the discharge area. Thus, in any simulation, the aquifer head would be greater than the head at the modeled discharge area. The effect on the simulation is a small error in the simulated hydraulic connection between the ocean and the basal aquifer. This error would tend to make the model overestimate water-level declines associated with pumpage and thus make the model more conservative when estimating ground-water availability.

Near the shoreline, ground water moves upward from the basal aquifer to discharge into the ocean. This movement is resisted by the vertical hydraulic conductivity \( (K') \) of the basalts and by the weathered zone at the top of the basalt if it exists. Discharge is proportional to the effective vertical hydraulic conductivity of the basalt and weathered zone (assuming it exists) divided by the thickness of the zone of discharge \( (m') \). As discussed previously, the vertical hydraulic conductivity of basalts in Hawaii is assumed to fall within a range of about one tenth to one thousandth of the horizontal hydraulic conductivity. On the basis of results of the aquifer tests for the Hawi basal aquifer, this would result in a range of values for the vertical hydraulic conductivity of the basalt between 0.6 to 640 ft/d. The thickness of the zone of discharge can be approximated by estimating the freshwater thickness at the shoreline. Water levels near the shoreline are about 5 ft, indicating a freshwater thickness of about 200 ft. For modeling purposes, it can be assumed the vertical distance over which discharge occurs is one-half this distance, or 100 ft. Assuming that the weathered zone does not exist, the value for \( K'/m' \) would fall between 0.006 and 6.4 ft/d/d \( (d^{-1}) \). The ratio \( K'/m' \) is referred to as the hydraulic connection between the basal aquifer and the ocean.
Calibration of the Steady-State Model

The model was calibrated by comparison of model-calculated water levels with water levels measured in the basal aquifer at the test wells (fig. 7) on March 22, 1990. Two parameters were varied during the calibration procedure: the horizontal hydraulic conductivity, \(K\), of the basal aquifer, and the hydraulic connection of the basal aquifer with the ocean \((K'/m')\). Despite being varied, the simulated values for the horizontal hydraulic conductivity of the aquifer were kept within the general range of values obtained from the aquifer tests and ultimately varied spatially in the same manner as indicated by the test results. Thus, the major uncertainty in modeled parameters was the hydraulic connection of the aquifer with the ocean.

The first step in the calibration analysis was to make a series of simulations where the simulated \(K\) was held constant while the simulated value of \(K'/m'\) was varied over a range from 0.0005 to 10.0 ft/d/ft. The model was run to steady state for each value of \(K'/m'\), and the values of model-calculated water levels at the test wells were recorded. Three sets of simulations were made using simulated values for \(K\) of 500, 1,000, and 5,000 ft/d. Results of this series of simulations are shown in figure 13.

The relation between the model-calculated water levels and water levels observed at the test wells varied spatially, falling into two groups (fig. 13). The plot of model-calculated water levels compared with the simulated value of \(K'/m'\) shown for test well E (fig. 13) is representative for wells E, A, B, D, and F, all of which are located in the eastern part of the basal aquifer. A similar plot for test well H (fig. 13) is representative for wells H, I, and J, all of which are in the western part of the basal aquifer.

As shown in figure 13, it was possible to match water levels observed at test wells E, A, B, D, and F for all simulated values of \(K\), although the value for \(K'/m'\) ranged from about 0.004 to 0.1 ft/d/ft. On the other hand, as shown in figure 13, values of \(K\) greater than 1,000 ft/d are necessary in order to match water levels observed in test holes H, I, and J regardless of the simulated value for \(K'/m'\). At test well H, a match between model-calculated and observed water levels was obtained for \(K\) equal to 5,000 ft/d and the \(K'/m'\) equal to about 0.006 ft/d/ft.

Several conclusions are possible from the above information. First, larger values for \(K\) are required in the model for the western part of the basal aquifer compared with the eastern part. This corresponds to the distribution of hydraulic conductivity indicated by the aquifer tests. Second, the range in values of \(K'/m'\) that resulted in model-calculated water levels matching observed (0.004 to 0.1 ft/d/ft) are within the general range of values previously calculated for this parameter (0.006 to 6.4 ft/d/ft) assuming vertical movement of ground water is resisted only by the vertical hydraulic conductivity \((K')\) of the basalt flows.

The spatial variability of \(K\) of the basal aquifer necessary to allow a closer match between model-calculated and observed water levels was investigated further, initially by using the results
Figure 13. Model-calculated water levels at test wells E and H, for selected values of horizontal hydraulic conductivity and hydraulic connection, $K'/m'$, between the basal aquifer and the ocean, Kohala area, Island of Hawaii (location of wells shown in figure 7).
of three of the model simulations from the initial series. These three simulations used a value for $K$ of 500; 1,000; and 5,000 ft/d, and a value for $K'/m'$ equal to 0.01 ft/d/ft. Model-calculated and observed water levels were plotted on a scatter diagram (fig. 14A). The scatter diagram indicates any bias or trends in model-calculated water levels, such as all of the model-calculated water levels being higher or lower than observed.

The simulated value for $K'/m'$ used for the above models (0.01 ft/d/ft) was selected for several reasons. First, as shown in figure 13, model-calculated water levels for all the wells are relatively insensitive to values of $K'/m'$ greater than about 0.1 ft/d/ft, and model-calculated water levels become sensitive to values lower than 0.1 ft/d/ft. The model becomes increasingly sensitive to values of $K'/m'$ less than about 0.01 ft/d/ft and for values lower than about 0.004 ft/d/ft, model-calculated water levels rise sharply beyond observed water levels for all values of simulated $K$. Second, when pumping is simulated, lower values of $K'/m'$ result in greater model-simulated drawdowns and freshwater-saltwater interface rise for a given distribution and rate of ground-water pumpage, other things being equal. Therefore, for lower values of $K'/m'$, the model becomes more conservative for estimation of ground-water availability. Finally, the value used for this analysis (0.01 ft/d/ft) also fell within the range of values (0.004 to 0.1 ft/d/ft) that resulted in model-calculated water levels matching observed water levels.

As expected, these simulations did not produce an acceptable match to observed water levels. For $K$ equal to 500 ft/d, all of the model-calculated water levels were significantly higher than observed water levels. For $K$ equal to 1,000 ft/d, a strong bias existed in the distribution of water levels; model-calculated water levels were significantly higher than observed on the western side of the aquifer (wells I, J, and H; fig. 14A) and very close to observed water levels on the eastern side (wells E, F, D, A, and B). For $K$ equal to 5,000 ft/d, model-calculated water levels were somewhat higher than observed on the western side of the aquifer and significantly lower than observed on the eastern side. These trends in the model-calculated water levels indicate that to match observed water levels a relatively low $K$ is required in the eastern part of the model and a relatively high $K$ is required in the western part.

On the basis of the above analyses, the value of $K$ of the aquifer was then varied spatially on the model with higher values in the western part of the model and lower values on the eastern part of the aquifer while $K'/m'$ was held constant at 0.01 ft/d/ft. Various ranges and distributions of $K$ (ranging from 250 to 8,000 ft/d across the model) were tested and nearly all of these simulations improved the model. The best match in this series of simulations resulted in a model with $K$ varying from 650 to 5,000 ft/d (fig. 14B). The average difference between model-calculated and observed water levels for this distribution was 0.8 ft. Water levels calculated by the model were still relatively high at test wells I and J. To improve the match, $K'/m'$ was increased from 0.01 to 0.1 ft/d/ft in the western part of the model (fig. 15); this resulted in a much better fit between model-calculated and observed water levels (fig. 14B). The average difference between model-calculated
Figure 14. Model-calculated water levels and observed water levels for selected values of horizontal hydraulic conductivity (K) and the hydraulic connection between aquifer and ocean (K'/m'), Kohala area, Island of Hawaii.
Figure 15. Distribution of horizontal hydraulic conductivity and hydraulic connection between the aquifer and ocean as modeled, Kohala area, Island of Hawaii.
and observed water levels was about 0.5 ft and this version of the model was accepted as the best representation of the aquifer based on available data. Increasing $K/\text{m}^2$ in the western part of the model was believed to be justified because of the higher value of $K$ of this area as compared with the eastern part of the model. Model-calculated water-levels were compared with those from field data and are shown in figure 16. Model-calculated depth of the freshwater-saltwater interface is shown in figure 17.

The sources and discharges characterizing the steady-state simulation described above are summarized in table 5. The magnitude of the flow components shown in the table represent mean annual conditions. Shade (in press) has shown that these conditions vary significantly during an average year, but even so, the time response of the aquifer, in terms of changes in water levels is small (1 ft or less) relative to seasonal changes in the magnitude of the individual components of the water budget.

<table>
<thead>
<tr>
<th>Ground-water sources</th>
<th>Million gallons per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct infiltration of precipitation</td>
<td>60.3</td>
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<td>High-level discharge into the basal aquifer</td>
<td>8.1</td>
</tr>
<tr>
<td>Kohala ditch seepage</td>
<td>2.0</td>
</tr>
<tr>
<td>Hydroelectric plant injection wells</td>
<td>8.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>78.4</strong></td>
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</tbody>
</table>

<table>
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<tr>
<th>Ground-water discharges</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Into ocean</td>
<td>77.8</td>
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<tr>
<td>Existing pumpage</td>
<td>0.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>78.4</strong></td>
</tr>
</tbody>
</table>
Figure 16. Model-calculated and observed ground-water levels, Kohala area, island of Hawaii.
Figure 17. Model-calculated depth of the freshwater-saltwater interface, Kohala area, island of Hawaii.
Response of the Basal Aquifer to Ground-Water Pumping

The response of the basal aquifer to pumping 20 Mgal/d above that currently being withdrawn from the aquifer was simulated for two pumping scenarios. In each scenario, there are six pumping sites aligned roughly parallel to the coast, with the four inside sites each pumping 4 Mgal/d and two outside sites each pumping 2 Mgal/d. The location of pumping sites and pumping rates are shown in figure 18. The only difference between the two scenarios is the areal distribution of pumping. In the first scenario, the six pumping sites were located over a distance of 5 mi with the four sites pumping 4 Mgal/d in the middle 3 mi. In the second scenario, the six pumping sites were located over a distance of 3 mi with the four sites pumping 4 Mgal/d concentrated in the middle 1.5 mi. In general, the simulations show that increasing ground-water pumping results in (1) a decrease of discharge to coastal discharge boundary equal to the amount of pumpage (see tables 5 and 7); (2) a decline in water-table altitude (see figs. 19 and 20); and (3) a decrease in the depth to the freshwater-saltwater interface (see figs. 17, 21, and 22).

In analyzing the model results in terms of water-level declines and the resulting rise in the freshwater-saltwater interface, a distinction needs to be made between model-calculated drawdown for a model node and the actual drawdown that would occur in a well or wells. The model-calculated drawdown represents the average drawdown in an area around the model node (see fig. 12) and in all cases drawdown in a well or wells will be greater. The actual difference between the two will depend on the number of wells that the withdrawal in a given node represents, the pumping rate of individual wells, and the construction details of the well. The model assumes full penetration of the pumped well and for a pumping rate of 1.0 Mgal/d per well, application of an equation developed by Prickett (1967) indicates that drawdown in a well would be about 0.3 ft greater than the model-calculated drawdown at a node. Wells in basal aquifers are typically constructed to depth ranging from 50 to 200 ft below sea level rather than penetrating the entire freshwater thickness of the aquifer, however, and the effects of partial penetration would increase actual drawdown in a well above values calculated from Prickett’s equation. These considerations indicate that the model cannot directly address the subject of individual well yields compared with well depth and that this information must be gained from actual field experience or from more detailed "local scale" model analysis.

Model-calculated changes in water level.--The decline in ground-water levels estimated by the model for scenarios 1 and 2 are shown in figures 19 and 20, respectively. Water-level declines for the first scenario range from about 1 to 3.5 ft at the pumping centers and to about 0.1 ft near the extreme northwestern edge of the model. Water-level declines in the extended study area are about 1 ft.

Water-level declines for the second model scenario are similar to those of scenario 1 except that drawdown at the pumping centers ranges from about 2 to almost 5 ft, an increase of as much as 1.5 ft over the first scenario. The increase in drawdown is a result of more localized pumping.
Figure 18. Pumping rates used for the two simulated pumping scenarios, Kohala area, island of Hawaii.
Figure 19. Model-calculated drawdown for pumping scenario 1, Kohala area, island of Hawaii.
Figure 20. Model-calculated drawdown for pumping scenario 2, Kohala area, island of Hawaii.
Once again, model-calculated decline in water-level in Pololu drainage area is about 1 ft. The termination of the model at the eastern drainage divide of Pololu Stream precludes the induced movement of ground water from the excluded area into the modeled area, which would be presumed to occur under actual pumping conditions. The exclusion of this induced movement of ground water toward the pumping centers results in the model over-estimating water-level declines by about 0.5 ft. Over-estimating water-level declines makes model calculations of ground-water availability conservative.

**Model-calculated changes in depth to freshwater-saltwater interface.**—As a result of pumping and subsequent decline of water levels, the freshwater-saltwater interface moves upward. The location of the interface is important because it is the best indicator of the limits on available water at the pumping sites. If the freshwater-saltwater interface rises near or into wells, the salinity of water pumped by the well may increase to levels unacceptable for domestic uses.

The pre-pumping position of the model-calculated freshwater-saltwater interface near the pumping sites is shown in figure 17 and the model-calculated position of the interface resulting from scenario 1 is shown in figure 21. The model-calculated position of the interface resulting from scenario 2 is shown in figure 22. Information on pre-pumping and pumping water levels and model-calculated depth to the freshwater-saltwater interface below sea level are given for each of the simulated pumping nodes in table 6 for scenarios 1 and 2.

The greatest model-calculated decline in water level for scenario 1 is about 3.5 ft at pumping node P-7 and the resulting model-calculated rise in the interface is about 140 ft. Depth to the freshwater-saltwater interface is least (227 ft below sea level) at pumping node P-9. If the thickness of the brackish zone above the interface is assumed to be about 80 ft as indicated at well D, the range in freshwater thickness at the pumping nodes would be about 153 to 252 ft.

The greatest model-calculated decline in water levels for scenario 2 is about 4.7 ft at pumping node P-6 and the resulting model-calculated rise in the interface is about 188 ft. Depth to the freshwater-saltwater interface is least (228 ft below sea level) at pumping node P-7. Using a thickness for the brackish zone equal to 80 ft above the interface as for scenario 1, the resulting range in freshwater thickness from is about 154 to 234 ft.

As discussed previously, wells in basal aquifers are typically constructed to depths ranging from about 50 to 200 feet below sea level. The above results indicate that if ground water is withdrawn in the areas simulated in the two model scenarios, deeper wells (about 200 ft below sea level) would likely experience saltwater intrusion at least at some locations, while shallower wells would tend to maintain a greater buffer of freshwater between the wells and the transition zone. The amount of freshwater buffer would depend on the actual depth, spacing, and pumping rates of these wells. Results also indicate that, as would be expected, the potential for saltwater intrusion increases as pumpage is concentrated.
Figure 21. Depth of model-calculated freshwater-saltwater interface for pumping scenario 1, Kohala area, Island of Hawaii.
Figure 22. Depth of model-calculated freshwater-saltwater interface for pumping scenario 2, Kohala, Hawaii.
Table 6. Water levels and interface locations at simulated pumping sites, Kohala area, island of Hawaii

| Simulated pumping site (fig. 18) | Non-pumping | | Pumping | |
| | Water level (ft above sea level) | Interface depth (ft below sea level) | Approximate thickness of freshwater below water table (feet) | Water level (ft above sea level) | Interface depth (ft below sea level) | Approximate thickness of freshwater below water table (feet) | Water-level change (feet) |
| P-1 | 10.3 | 413 | 343 | 8.1 | 324 | 252 | 2.2 |
| P-3 | 10.3 | 412 | 342 | 7.0 | 281 | 208 | 3.3 |
| P-5 | 10.9 | 436 | 367 | 7.5 | 300 | 228 | 3.4 |
| P-7 | 10.1 | 405 | 335 | 6.6 | 266 | 193 | 3.5 |
| P-8 | 9.0 | 360 | 289 | 5.9 | 236 | 162 | 3.1 |
| P-9 | 7.0 | 281 | 208 | 5.7 | 227 | 153 | 1.3 |

Scenario 1

P-2 | 10.3 | 414 | 344 | 7.6 | 306 | 254 | 2.7 |
| P-4 | 10.1 | 406 | 336 | 5.8 | 232 | 158 | 4.3 |
| P-5 | 10.9 | 436 | 367 | 6.4 | 255 | 181 | 4.5 |
| P-6 | 10.5 | 422 | 352 | 5.8 | 234 | 160 | 4.7 |
| P-7 | 10.1 | 405 | 335 | 5.7 | 228 | 154 | 4.4 |
| P-8 | 9.0 | 360 | 289 | 6.6 | 264 | 191 | 2.4 |

Scenario 2

Table 7. Steady-state ground-water budget (existing plus simulated pumpage) for the numerical model, Kohala area, island of Hawaii

<table>
<thead>
<tr>
<th>Sources</th>
<th>Million gallons per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct infiltration of precipitation</td>
<td>60.3</td>
</tr>
<tr>
<td>High-level discharge into the basal aquifer</td>
<td>8.1</td>
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<td>2.0</td>
</tr>
<tr>
<td>Hydroelectric plant injection wells</td>
<td>8.0</td>
</tr>
<tr>
<td>Total</td>
<td>78.4</td>
</tr>
</tbody>
</table>

Ground-water discharges

<table>
<thead>
<tr>
<th></th>
<th>Million gallons per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Into ocean</td>
<td>57.8</td>
</tr>
<tr>
<td>Existing pumpage</td>
<td>0.6</td>
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<tr>
<td>Proposed pumpage</td>
<td>20.0</td>
</tr>
<tr>
<td>Total</td>
<td>78.4</td>
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</table>
Model results.--The main emphasis of this study was to determine if 20 Mgal/d of ground water can be withdrawn from the Hawi basal aquifer in addition to the existing use of 0.6 Mgal/d. The previous discussion indicates that this withdrawal is feasible, but spacing, depth, and pumping rates of individual wells are important considerations in planning ground-water development. It is desirable to maintain as thick a body of freshwater beneath the wells as possible.

For existing conditions, water levels range from about 10 ft to 7 ft (see fig. 7) from east to west in the area of simulated pumpage shown in figure 18. Model-calculated steady-state water levels resulting from pumping an additional 20 Mgal/d for scenarios 1 and 2 are shown in figures 23 and 24. As can be seen, water levels are still highest (about 8 ft) in the eastern part of the area of simulated pumpage. Water levels in the western part of the area of simulated pumpage are about 6 ft.

Table 7 shows the components of the steady-state ground-water budget for the modeled area following the simulation of the 20 Mgal/d of additional pumpage for both scenarios. Comparison of table 7 with table 5 indicates that the source of water to the additional pumpage is from reduced ground-water discharge to the ocean by an amount equal to pumpage. Other components of the water budget are the same.

For both pumping scenarios, the model calculates a water-level decline of slightly more than 1 ft near the mouth of Pololu Stream where the stream discharges into the ocean. In this area, it is possible that Pololu Stream is hydraulically connected to the basal aquifer. As a result, a decline in water level near the mouth of Pololu Stream would be sufficient to cause a reduction in streamflow. Because the model terminates along the Pololu watershed boundary, the model would be expected to over-estimate the water-level decline in the area of Pololu Stream, perhaps by as much as 0.5 ft; but even so, the stream would still be affected assuming a hydraulic connection exists with the basal ground-water system.
EXPLANATION

- 6 - LINE OF EQUAL MODEL-CALCULATED GROUND-WATER LEVEL - Interval 2 feet. Datum is mean sea level.

* PUMPED WELL AND IDENTIFIER

Figure 23. Model-calculated ground-water levels for pumping scenario 1, Kohala area, Island of Hawaii.
Figure 24. Model-calculated ground-water levels for pumping scenario 2, Kohala area, island of Hawaii.
SUMMARY AND CONCLUSIONS

Model results indicate that ground-water withdrawal of 20 Mgal/d above the existing 0.6 Mgal/d withdrawal at the Hawaii County Department of Water Supply well is feasible from the Hawi basal aquifer, but that spacing, depth, and pumping rates of individual wells are important. If pumping is concentrated, the likelihood of saltwater intrusion is increased. Model results indicate that concentrating as much as 16 Mgal/d in a 1.5 mile stretch roughly parallel to the coast on the eastern side of the basal aquifer, and withdrawing an additional 2 Mgal/d within a mile on either side of this would provide a freshwater thickness of 154 to 234 ft below the areas of withdrawal. In this case, wells with depths of greater than 200 ft below sea level would likely experience saltwater intrusion. If the area of concentrated pumpage is increased from 1.5 to 3 miles and another 2 Mgal/d withdrawn on either side within a distance of about three-quarters of a mile from the area of concentrated pumpage, the freshwater thickness in the area of withdrawal would increase slightly to between 153 and 252 ft.

Under existing conditions, water levels in the basal aquifer range from about 10 to 7 ft above sea level in the area of simulated pumpage. Model results indicate that water levels would range from about 8 to 6 ft above sea level after water-level declines induced by the additional 20 Mgal/d of pumpage stabilized.

The model cannot directly address the subject of individual well yields compared with depth, and this information must be gained from field experience. Even so, it is clear from model results that 20 Mgal/d of additional ground-water withdrawal from the basal part of the Hawi aquifer is possible if pumping centers are spaced adequately apart and well depths are limited.

The withdrawal of 20 Mgal/d would result in a reduction of ground-water discharge to the ocean by an amount equal to pumpage. It is possible that pumping could cause some reduction of streamflow near the mouth of Pololu Stream, but because of a lack of field data concerning the hydraulic connection of this stream with the basal aquifer, the magnitude of the reduction cannot be addressed at this time.
REFERENCES CITED


Thompson, W.Y., 1988, Feasibility study for a Kohala coastal water system, Department of Water Supply, County of Hawaii, 21 p.


Mr. Glenn Akuna, Engineer  
County of Hawai‘i  
Department of Water Supply  
25 Aupuni Street  
Hilo, Hawai‘i 96720

Dear Mr. Akuna:

Having reviewed the draft environmental assessment (DEA) entitled Makapala Exploratory Well No. 1, Exploratory Well Drilling and Testing, TMK 5-2-05:10 and 5-2-05:01, North Kohala, Island of Hawai‘i, we submit the following comments for your response.

1. **DATA TABLE:** In the final environmental assessment, please gather the data contained within the environmental assessment in tabular format as described in on page 2, and Appendix 1 of the attached Draft Guidelines for Assessing Water Well Development Projects.

2. **CONTAMINATION ANALYSIS:** Please consult with the Office of Hazard Evaluation and Emergency Response (HEER), and include in the final environmental assessment a record of spills or contamination incidents in the Makapala area and surrounding localities. Also, please provide a record of contamination problems in aquifer or hydrologic unit including but not limited to saltwater intrusion, turbidity, heavy metals, inorganic and organic chemicals, microbiological agents, water quality parameters (such as pH, alkalinity, calcium, conductivity and temperature), and radioactivity. If contamination exists, the sources and duration of the contamination should be listed. Water quality data from nearby wells should be presented as well as any anticipated need for treatment or filtering systems. Discuss past and existing land uses within the likely wellhead protection area and the potential for future contamination from those uses. Any hazardous material used and/or produced during drilling and treatment should be described. The method of handling these hazardous materials should also be disclosed.

3. **CUMULATIVE AND INDIRECT IMPACTS:** Please consult with the County Planning Department on proposed developments and future plans for Makapala and the North Kohala region. Then, discuss indirect and cumulative impacts of the proposed project including but not limited to:

   A. Population in the Makapala area and the North Kohala Region. Discuss whether the proposed project could lead to an increase in population.

   B. Discuss the projected uses of water in the area (e.g., resort, golf courses, intensive agriculture, commercial activity, housing development, etc.). Please provide statistics showing the breakdown of water users in the Makapala Region, and the North Kohala Region.
4. **CEDED LANDS:** If the project is on ceded lands (see Section 5, Admission Act of 1959), please consult with the Office of Hawaiian Affairs.

Please include a copy of this letter and your response to it and all other timely-received comment letters in the final environmental assessment and notice of determination for this project. If there are any questions, please call Leslie Segundo, Environmental Health Specialist, at 586-4185.

Sincerely,

GARY GILL
Director

Enclosure

c: Mr. John Stubbart, Waimea Water Services, Inc.
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Approval Signature Information

PLEASE:

- See Me
- Review & Comment
- Take Action
- Type Draft
- Type Final
- File and Follow
- Xerox copies

Kevin Moore & Land Division is O.K. all this draft.
Mr. Edward Boteilho  
P.O. Box 190  
Hawi, HI 96719  

Dear Mr. Boteilho:  

Activating USGS Observation Wells on TMK 5-5-006:003 for Cloverleaf Dairy, Inc.  

Thank you for your January 14, 2010 letter requesting our advice on how to proceed with using one of two U.S. Geological Survey (USGS) observation wells as a backup water supply for your agricultural irrigation needs. We appreciate the concern as these wells reside on state land.  

I understand that during early December 2009, your normal source of water, the Kohala Ditch, suffered damage at its Honokane intake, which triggered a request to the USGS to use one of their observation wells on an emergency basis to serve as an alternative backup source to the ditch. The USGS and Waimea Water Services, Inc. (WWSI) have been working on an agreement to allow access to the USGS Upolu J-B Well (State well no. 8-7451-02) for purposes of installing a pump, measuring water levels, collecting water samples, and/or making borehole measurements and video logging. However, to date there is no formal agreement.  

Staff from the department’s Commission on Water Resource Management (Commission) had followed up with WWSI to inform them that a pump installation permit and possibly a water lease agreement, through our Land Division, would be part of implementing this solution. We understand that project may be funded, in part, by Civil Defense as the continuing Kohala Ditch problems can be linked to the October 15, 2006 Kiholo earthquake disaster and subsequent emergency proclamation from the governor. Though repairs to the existing ditch may be properly linked to the governor’s emergency proclamation, we do not believe the new backup well also qualifies under the proclamation; hence, the pump installation permits and water leases from our department need to be processed. Additionally, an environmental assessment may be necessary as part of the water lease.  

WWSI has informed us that they are planning to have the pumps in place by the spring, which is soon. We also understand that Hoea Agricultural Park, a privately owned non-profit organization, will be operating the well. We highly recommend that these entities work with us on meeting their legal obligations towards using the public trust ground water resource from this well.  

Please feel free to call the Commission staff at 587-0225 regarding pump permitting questions and the Land Division staff at 974-6203 regarding water lease questions.  

Sincerely,  

Laura H. Thielen  
Chairperson  

STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
POST OFFICE BOX 421  
HONOLULU, HAWAII 96809  

March 10, 2010  

LINDA LINGLE  
GOVERNOR OF HAWAII

LAURA H. THIELEN  
CHAIRPERSON  
COMMISSION ON WATER RESOURCE MANAGEMENT  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
POST OFFICE BOX 421  
HONOLULU, HAWAII 96809

EDWARD K. TSUJI  
ASSISTANT DIRECTOR  
HISTORIC PRESERVATION AND CONSERVATION  
STATE PARKS  
KTALEWA ISLAND RESERVE COMMISSION  
LAURA H. THIELEN  
CHAIRPERSON  
COMMISSION ON WATER RESOURCE MANAGEMENT  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
POST OFFICE BOX 421  
HONOLULU, HAWAII 96809
Using water up to 1,000,000 past due lands.

Probably you should talk to Carl for your land.
Ms. Laura H. Thielen  
Chair, Dept. of Land and Natural Resources  
Kalanimoku Building  
1151 Punchbowl St.  
Honolulu, HI 96813

Aloha Director Thielen:

Ref.: Activating the well at Cloverleaf Dairy (Botelho Hawaii Enterprises, Inc.) for the purpose of irrigation, north Kohala, TMK (3) 5-5-6-2,3,4,15.

For more than 3-5 years, our dairy operation, Cloverleaf Dairy Inc. (a division of Botelho Hawaii Enterprises, Inc.) have been operating at the site. We have consistently produced above our quota and supplied fresh local milk to Big Island residents. The earthquake of October 2006 cut off our water supply. As we await for the repairs to the Kohala ditch, we toiled hard to make it possible to remain farming. We had to dig deep into our operations and it helped us realize that we need to have a back water supply for the farm. Without water, we cannot operate. Without water, all the feed we need in our dairy has to be imported. The shipping is not always reliable and the costs keep going up. (Only today Matson Inc. is raising fuel charges by another 27%). Although the water flow from the Kohala ditch has resumed, we had experienced several setbacks which interrupted the water supply. Hence, we are requesting your cooperation to allow us to proceed to evaluate USGS Well 8-7451-02. Water drawn form this well will be used for irrigation of agriculture activities; especially in times when water supply is interrupted.

Please advise us as to how best we can begin the exploration of the water supply.

Thank you,

Edward Botelho  
address: Box 190  
Hawaii, Hi. 96719  
tel. 808-386-9975  
e-mail: edbotelho@netzero.com
No.

From: Roy Hardy
Sent: 03/08/2010 07:21 AM HST
To: Stephen Anthony
Subject: Re: Fw: Agreement for access to USGS Well 8-7451-02 (Upolu Point, Hawaii)

Hi Steve, so did Steve submit a signed agreement with you folks yet? -Roy

Hi Roy, Below is most recent communication from Steve Bowles regarding subject well... Steve

Attached is from our well files. Hope it helps... Steve

From: "Stephen Bowles" <resources@wws-lus.com>
To: "Stephen S Anthony" <santhony@usgs.gov>
Date: 02/16/2010 01:54 PM
Steve,

Sorry for the delay. We will follow up with the details. I had hoped we would proceed earlier but we are waiting for Hoe'a decisions. Have a Merry Christmas and Mahalo for all your help. Steve Bowles

From: Stephen S Anthony [mailto:santhony@usgs.gov]
Sent: Monday, December 07, 2009 11:42 AM
To: Stephen Bowles
Subject: Fw: Agreement for access to USGS Well 8-7451-02 (Upolu Point, Hawaii)

Hi Steve,

Just checking to make sure that you received the message below sent on Saturday. We need to have a signed agreement in place to allow you access to our well.

Thanks, Steve

Fr: Stephen S Anthony/WRD/USGS/DOI
To:
Cc: resources@wws-ius.com

C: <GGreenly@scd.hawaii.gov>, "Jeannette Saalfeld" <js@saalfeldholding.com>, "Ken Kawahara (E-mail)" <Ken.C.Kawahara@hawaii.gov>, mtk@hoeaagpark.com, <mk@hoeaagpark.com>, "Stephan S Anthony" <santhony@usgs.gov>, "Michael V Shulters" <shulters@usgs.gov>, "Jeffrey A Keay" <jkeay@usgs.gov>, "William L Cunningham" <wcunning@usgs.gov>, Gordon W Tribble/WRD/USGS/DOI@USGS, Roy.Hardy@hawaii.gov

S Agreement for access to USGS Well 8-7451-02 (Upolu Point, Hawaii)
going. The well sits on DLNR land leased to Ed Boteilho (Cloverleaf Dairy). May be Steve could give me a call this AM to keep the issue moving forward. Thanks for the supportive and prompt assistance. Steve Bowles

From: Gordon W Tribble [mailto:gtribble@usgs.gov]
Sent: Thursday, December 03, 2009 7:21 PM
To: Stephen Bowles
Cc: GGreenly@sc.hawaiL.gov; Ken Kawahara (E-mail); MPavao@hawaiidws.org; Stephen S Anthony
Subject: Re: USGS Well next to Upolu Road

Hi Steve,

I'm out of the water office for a while and Steve Anthony is in charge there for now. We'll look into this tomorrow and get back to you pretty soon. My recollection is that we have two wells at that site. The smaller diameter well needs to remain within USGS as an observation well. The larger diameter (8 or 10 inches) can be turned over to the landowner if (to cut through a lot of stuff) it makes sense. The other option is that we can permit a pump installation if there is an "emergency declaration" but that's a temporary measure.

In any event, it seems your immediate request is to run a videolog of the well. This is also Steve Anthony's kuleana, and (again) we'll get back to you soon but this should not be a problem. We'll want a copy of the video and some other manin/insensible things.

Raining steady in S. Oahu ... Gordon

Gordon Tribble
Acting Director, USGS Pacific Island Ecosystems Research Center
808-587-2405

Gordon, We just suffered major damage to the intake of the Kohala Ditch in Honokane again. We feel this will be an on going crises. We are in the process of creating a non-profit ag park at Hoa and we would like to see if there is any way the well could be leased. Rented or other means to provide emergency source for the farming community. It is on state land and I spoke with Milton to see how they felt and he indicated no problem. I'd like to access it and run a TV to see its condition. We have a source
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October 7, 1999

Milton D. Pavao, Manager
Department of Water Supply
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Pavao:

SUBJECT: EMERGENCY APPROVAL FOR THE MAKAPAULA OBSERVATION WELL
STATE WELL NO. 8-7345-04

It has come to our attention that the emergency approval issued by the Department of Health on September 28, 1999 for the Makapala Observation Well contains typographical errors. The emergency approval should read as follows:

The Department of Health, Safe Drinking Water Branch, acknowledges receipt of your August 5, 1999 letter regarding the emergency use of the Makapala Observation Well. Due to the serious drought condition in the North Kohala District, the Department of Health hereby grants conditional approval for the use of the Makapala Observation Well as drinking water source until midnight, December 31, 1999. In addition, the use of this well as drinking water source shall be subject to the following conditions:

1. The Makapala Observation Well shall deliver potable water of the quality in compliance with Hawaii Administrative Rules, Title 11, Chapter 20, Rules Relating to Potable Water Systems. The water quality shall be subject to verification by the Department of Health.

2. The Hawaii Department of Water Supply, in its operation of the Makapala Observation Well, shall comply with all other relevant provisions of Hawaii Administrative Rules, Title 11, Chapter 20, Rules Relating to Potable Water Systems.

3. The Hawaii Department of Water Supply shall notify the Department of Health of any condition which may arise or be revealed that may contaminate the sources and pose a threat to human health.
Mr. Milton D. Pavao, Manager
Department of Water Supply
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Pavao:

SUBJECT: PUBLIC WATER SYSTEM NO. 129, DWS NORTH KOHALA
EMERGENCY APPROVAL FOR THE MAKALAPA OBSERVATION WELL
STATE WELL NO. 8-7345-04

The Department of Health, Safe Drinking Water Branch, acknowledges receipt of your August 5, 1999 letter regarding the emergency use of the Makalapa Observation Well. Due to the serious drought condition in the North Kohala District, the Department of Health hereby grants conditional approval for the use of the Makalapa Observation Well as drinking water source until midnight, December 31, 1999. In addition, the use of this well as drinking water source shall be subject to the following conditions:

1. The Makalapa Observation Well shall deliver potable water of the quality in compliance with Hawaii Administrative Rules, Title 11, Chapter 20, Rules Relating to Potable Water Systems. The water quality shall be subject to verification by the Department of Health.

2. The Hawaii Department of Water Supply, in its operation of the Makalapa Observation Well, shall comply with all other relevant provisions of Hawaii Administrative Rules, Title 11, Chapter 20, Rules Relating to Potable Water Systems.

3. The Hawaii Department of Water Supply shall notify the Department of Health of any condition which may arise or be revealed that may contaminate the sources and pose a threat to human health.

4. The Makalapa Observation Well shall be properly disinfected prior to entry into the distribution system.
August 19, 1998

Mr. Michael D. Wilson, Chairperson
Commission on Water Resource Management
State of Hawaii
Department of Land and Natural Resources
P.O. Box 621
Honolulu, HI 96809

PUMP INSTALLATION PERMIT
KAIEIE MAUKA WELL (WELL NO. 4708-02)
MAKAPALA WELL (WELL NO. 7345-04)
ISLAND OF HAWAII

The wells listed above have pump installation permits that have ninety (90)-day deadline expirations (July 26, 1998).

The drought has ended and the Department does not intend to use these wells unless another drought appears. The Department will retain the permits for future reference.

The point of contact for the Department on this matter is Mr. Owen Nishioka at (808) 961-8660.

Milton D. Pavao, P.E.
Manager

...Water brings progress...
AGENDA
FOR THE MEETING OF THE
COMMISSION ON WATER RESOURCE MANAGEMENT

DATE: June 14, 1989
TIME: 2:00 P.M.
PLACE: KALANIMOKU BUILDING
BOARD ROOM, ROOM 132
1151 PUNCHBOWL STREET
HONOLULU, HAWAII

Approval of May 17, 1989 Minutes.


2. United States Geological Survey Application for Well Construction Permits, North Kohala Observation Wells, North Kohala, Hawaii

3. James Huang Application for Well Construction Permit, Waiawa–Huang Well, Waiawa, Oahu

4. Southwest Slopes, Inc. Application for Well Construction Permit, Opihihali Well, South Kona, Hawaii

5. Honolulu Board of Water Supply Application for Pump Installation Permits, Opana Wells 1 & 2, Kahuku, Oahu

6. Division of Water and Land Development Application for Well Construction Permit, Pia Exploratory Well, Niu Valley, Oahu

7. Amfac Property Investment Corp. Application for Well Construction Permits, Kaanapali Wells P–1 and P–2, Kaanapali, Maui

8. Other Business
MINUTES OF THE MEETING OF THE
COMMISSION ON WATER RESOURCE MANAGEMENT

DATE: May 17, 1989
TIME: 2:00 P.M.
PLACE: Kalanikou Building
Board Room, Room 132
1151 Punchbowl Street
Honolulu, Hawaii

ROLL CALL
Chairperson Paty called the meeting of the Commission on Water Resource Management to order at 2:15 p.m.

The following were in attendance:

MEMBERS: Chairperson William W. Paty
Dr. Michael Chun
Mr. Richard Cox
Dr. John Lewin
Mr. Guy Fujimura
Mr. Robert Nakata

STAFF: Mr. Manabu Tagomori
Mr. George Matsumoto
Mr. Edwin Sakoda
Mr. Dan Lum
Ms. Sherrie Samuels
Mr. Sterling Chow
Mr. Roy Hardy

OTHERS:
Mr. William Tam
Mr. Bert Hatton
Mr. Mark Cramer
Mr. Sam Keala
Mr. Quentin Kawanakaoa
Mr. Kazu Hayashida
Mr. Hugh Morita
Mr. Linda Rosehill
Mr. Dean Anderson
Ms. JoAnn Yamada
Mr. Charlie Reppun
Mr. Williamson Chang
Ms. Lori Nishimura
Mr. Peter Nottage
Mr. Nelson Lee
Mr. O. K. Stender
Mr. Eric Onizuka
Mr. Ron Demura
Mr. Randa Kim
Ms. Sallie Edmunds
Mr. Richard Porlocke
Mr. Dan Davidson
Ms. Mina Morita
Mr. David Oshiro
Mr. Brian Kim
Mr. Tats Fujimoto
Mr. Les Hoag
Mr. Clark Champion
Mr. Herbert Minakami
Mr. Jim Wriston
Mr. Michael Burke
Mr. Andy Yamaguchi
Ms. Cynthia Takahashi
Mr. Brad Mosman
Mr. Clarence Tanonaka
Ms. Meredith Ching
Mr. Miles Nishijima
Mr. Douglas W. MacDougal
Mr. Wally Miyashira
Mr. Matt Higashida
Ms. Patrice Tottori
Ms. Susan Miller
Ms. Carol Wilcox
Mr. Kelvin Kae
Ms. Elizabeth Martin
ITEM 1  RESUBMITTAL: ADJUSTMENT TO PERMITTED USES. PEARL HARBOR WATER MANAGEMENT AREA, OAHU

Mr. Tagomori recommended the following amendments to the "Staff Analysis" and "Recommendation":

Staff Analysis

First paragraph, line 5: delete "October 1990", insert "December 1990".

Third paragraph, line 3: delete "coincides", insert "incorporates Oahu Sugar's current optimum water demand of 81 mgd".

Recommendation

Item 1, insert after the last word: "(for the Waianae Aquifer, the sustainable yield is 25 mgd)".

Delete Item 2 in its entirety.

Item 3: delete "reduction", insert "adjustments", delete "final termination of an Oahu Sugar lease or sub-lease, whichever occurs later", and insert "discontinuance of agricultural uses".

Item 4: after "adjustment" insert "for the Waianae Aquifer by December 1990 and the Koolau and Schofield High-Level Aquifers".

Mr. Tagomori introduced Roy Hardy to assist in answering the questions of the Commission.

Mr. Cox asked if the numbers for the million gallons per day shown on the exhibits is a limit each day or the average over the year. Mr. Hardy replied that it was on the average over the year. Mr. Tagomori added that this was consistent with the management of the Pearl Harbor Ground Water Management under Chapter 177.

With regard to the floor amendments, Mr. Fujimura asked if the concerns of the major users had been addressed. Mr. Tagomori replied discussions with the major users addressed all of the significant concerns.

Mr. Cox asked if the in-district sources should also be eliminated to reflect amendments made by the staff. Mr. Tagomori agreed that would be consistent with the amended recommendation and that all references (In-District Source, Export to Honolulu, Export to Ewa-Waianae) wherever they occur in the exhibits should also be deleted.

In regards to the Recommendation 1, Chairperson Paty asked if the 25 mgd, instead of the 17 mgd, was in keeping with the Commission's indication to reexamine the sustainable yield of the Waianae Aquifer. Mr. Tagomori agreed that the review by 1990 would allow for additional pumpages over 17 mgd for the interim. He also added that BWS will be allowed more flexibility to select wells to meet certain needs.

Mr. Fujimura asked if it would be possible that the amount of water used be higher at a given moment than the number staff has cultivation practices. Yes, replied Mr. Tagomori. Would it be possible to continue agricultural use...
but with a lower water use crop, asked Dr. Chun. Mr. Tagomori answered that replacement crops would be permissible. Mr. Bert Hatton of Oahu Sugar Co. commented that although staff has worked with them on coming to agreeable numbers, there are still some concerns about Oahu Sugar and other plantations around the State because this is the first major reallocation decision that the Commission is making. He stated that they have preserved uses, existing uses, and that these should be protected beyond prospective uses and he did not believe they are being protected if the action is taken. He added he was also concerned with their allocations for the two pumps in the Waianae Aquifer which is proposed to go from 13 to 9.3 mgd. Their actual Waianae usage per day in 1988 was 11.5 mgd. They are currently refurbishing a booster pump in that area and planning to plant an additional 100 acres to cane to solve a tax problem. Therefore, if their allocation is raised to 25, they can plant the additional acreage. He is also concerned about the schedule over time of the take-down of cane and would like to have the staff continue working with them on a regular basis.

Mr. Kazu Hayashida of the Board of Water Supply, in looking over the reduced pumpage figures for export to Waianae and Honolulu questioned if they could do that. He asked the staff to work with them to see if they can meet the 92.01 to 87.41 reduction. Chairperson Paty assured Mr. Hayashida that the staff would work with him.

Mr. Cox mentioned he understood that the pumpage from anyone well could be adjusted provided the pumping did not interfere with nearby wells. Mr. Tagomori agreed that staff regularly evaluates pumpages to assure there is no interference to the surrounding wells.

Mr. Oz Stender of the Ewa Plain Water Development Corporation commended the staff and Commission with dealing with the issue. He also stated that although no one will be completely happy if the Commission adopts what is presented by the staff it will be a step in the right direction. Mr. Stender added that Oahu Sugar's remaining a viable operation is important and that withdrawals should dovetail with plantation operations. Ewa Plain Water Development will work with them on whatever problems occur. They would also like to work towards more precise information, therefore they propose additional studies be made to confirm or determine the aquifer limits and would like to offer their participation in that process.

Mr. Charlie Reppun stated that the allocations should be done under the Water Code – to allocate water someone should request the water, stating what the water is to be used for, criteria to be met, etc. He has heard of BWS applying for a permit and whether all the changes are being done under the permit process (Mr. Reppun then quoted from the Water Code rules). He stated the Commission did not have the legal right to cut Oahu Sugar's water back if no one applied for a permit and by turning the planning process to an agency of the City whose policy is "first come first served" it will be a "planning mess". Mr. Reppun added that by allocating up to the sustainable yield without a margin of error, the Commission is not following proper procedure.

Mr. Fujimura suggested the question be addressed to Mr. Tam.

Chairperson Paty stated registration questions would be answered on the registration item on the agenda, but Mr. Tam could comment.

Mr. Tam stated there are two laws that are in effect: Chapter 177 is in effect until July 1st. Under 177, whether preserved uses or permitted uses, under water shortage section there can be modifications of those permits. Section IV talks about interim permits that will be in existence under the Code and for new designated areas: there has to be applications but it is not clear under the statutes whether existing uses in an existing water
management area are deemed to be existing applications and therefore given priority over a new decision.

Mr. Reppun commented that if allocation is cut back on one party it cannot be given to another party without their coming in for a permit, especially no if permit was formally requested. He asked what the BWS was going to use the allocation for because under the Code a use will need to be stated.

Mr. Hayashida answered that the statement was not correct because by the Code it would have to go by project to project and by looking at their records, which are public records, whatever information is needed is available.

Chairperson Paty intervened by saying the Commission would take Mr. Reppun's comments into consideration on their deliberation of the item.

Mr. Reppun stated he knows BWS does not have to come on a project by project basis, but also that it was not the intent of the Code to get a blanket allocation. He would still like to know about the margin of error on allocations. He would like answers to these two questions.

Mr. Cox asked for clarification if the BWS allocation is going up or down in the proposal and that if there is a reduction they would have to come in for a permit for additional water. Mr. Tagomori, referring to the tables, replied that there is a reduction in the allocation and that the Board would have to come for a permit for new withdrawals.

Mr. Tagomori added that in 1984 Oahu Sugar's allocation (115 to 92.5 mgd., a 22.5 mgd. reduction over a three-year period) was reallocated under Chapter 177 by the Board of Land and Natural Resources due to reduction in plantation size from 18,000 acres to 14,000 acres and change in irrigation method from furrow to drip.

Mr. Reppun commented that the bulk of the reallocation is coming from Oahu Sugar, almost 30 mgd. He then asked if that 30 mgd. is automatically transferred to BWS because theoretically it is available for someone else to claim since everyone is not cut back equally.

Dr. Chun replied he did not see it that way. Dr. Lewin added that the overall water use is being reduced over a period of time and that everyone except the military is gradually reduced; Oahu Sugar is where the bulk of the reduction is coming from.

Chairperson Paty said the staff is trying to come up with the best balance and intend to do everything they can to assure that Oahu Sugar will not suffer any reduction in yields on lands that they are currently farming. The Ewa Plains people, the staff, all involved are trying to take care of the situation.

Dr. Chun wanted to clarify his statement "first come, first served" is made on the basis of the Land Use planning by the City Council, so your land is properly zoned before water is given to you. It is not a haphazard decision, it's tied into the Land Use Plan. The actual allocations given to the BWS will be through a water use or withdrawal permit system.

Mr. Hatton added that withdrawal of water from Waiahole Ditch would create a water shortage and Oahu Sugar would need to pump more water. It is not a problem at the moment but it may be in the future.

Dr. Chun moved to accept staff recommendations as amended. Mr. Nakata asked to amend Recommendation 1 to add "subject to review by December 1990" at the end of the recommendation.

Unanimously approved as amended (Chun/Fujimura).
ITEM 2
PETITION TO DESIGNATE THE ISLAND OF LANAI AS A WATER MANAGEMENT AREA, LANAI

Mr. Cox acknowledged the concern of the residents of Lanai, but he was also concerned about the staff time needed over the next six months due to the problem of the certification of the water use program.

Mr. Fujimura supported the staff recommendation on the basis of continuing the process to gather more information but was hesitant to accept the recommendation because the staff does not have the tools to deal with the specific concerns that motivated the petition.

Mr. Nakata also supported the staff recommendation but recognizes Mr. Cox's concern about staff time. He stated he would hate to see the Commission turn down the request on that basis, therefore he would suggest approaching the Legislature for more staffing.

Dr. Chun moved for acceptance, second by Mr. Nakata; Dr. Lewin and Mr. Fujimura voted for acceptance. Chairperson Paty voted "No". The motion carried.

ITEM 3
REGISTRATION OF EXISTING WELLS AND STREAM DIVERSION WORKS AND DECLARATION OF WATER USE

Mr. Tagomori amended the date to file one year from the effective date of the rules as required by the Code to May 30th (the first working day after the weekend and holiday) instead of May 27th which is a Saturday.

Mr. Cox asked if there was any other date that could be chosen since the extension time seems quite long. Mr. Tagomori said the majority of the registrations being submitted at this late date involves the Hawaiian Community. They requested the extension.

Mr. Cox asked if staff was assisting the people in filing the forms. Mr. Tagomori replied they have conducted public information meetings on all islands to explain how the forms are to be filled and where inquiries are received the staff has worked on a one to one basis. They were also told the process calls for confirmation of the information submitted and if they are not able to record the actual flows, staff will measure the flows when they go to those areas.

Mr. Williamson Chang introduced Quentin Kaawanakoa and Elizabeth Martin and described the Native Hawaiian Legal Council's project to provide legal and hydrological assistance to people needing help with their registrations. He felt, as a private attorney, it was unwise to extend the registration because it would add more confusion rather than a benefit. As he understood the law, it would take an act of the Legislature to extend the Code and that if the Commission acted it would be considered a rule making procedure and would require a 20-day notice for a public hearing. The legitimacy of an extension wouldn't be clear until it is ruled upon by the courts, therefore, even if the Commission (in its best intentions) promulgated a rule today on the extension the validity of it could be open to challenge.

Mr. Cox asked Mr. Tam for clarification on the proposal that the Commission is not taking out the deadline, but waiving the penalty. Mr. Tam replied Mr. Chang is correct in that the Legislature has set the standard in terms of filing and the Commission cannot waive the standard but there is no express penalty for filing late. If the Commission's wish is to accommodate the purpose of gathering information and if some filed later, they can make the determination not to penalize that person. A third party might argue to the Commission or court the legal implications, but that would be for a later discussion.
Mr. Chang added that the ruling which says "this is not a penalty or violation under the act, therefore there shall be no fining of $1000 per day for late filings" is within the Commission's power. The statement that "there shall be no adverse consequences" might be a little misleading because you have no control over how a third party would use the law, so the Commission may wish to limit themselves to declaring the late filing not to be a violation and not subject to the $1000 fine.

Mr. Tam added a point that the critical date is the certification, when the Commission has to certify the use is reasonable, beneficial, and the amount being used will be more important trigger than the actual declaration date.

Mr. Fujimura asked if there wouldn't be an assumption that it would extend only as far as the Commission could extend it, that they cannot legislate or tell the court what to do.

Mr. Tam answered that it was within the authority of the Commission to determine that there should be no penalties or adverse consequences in terms of its own proceedings.

Mr. Fujimura stated that the intent of the Commission subsequent to the deadline is to encourage people to file even if they missed the deadline. He felt it would be better if the deadline to file be May 30th (the next legal workday) rather than December because people who had intended to file would put off filing till December.

Mr. Chang wanted clarification from Mr. Tam if the Commission promulgates the process it would be considered a rule. Mr. Tam answered that it would not constitute a rule but rather and internal administrative procedure on how papers are to be processed.

In response to Mr. Cox's question about putting an advertisement in the paper to publicize the May 30th deadline, Mr. Chang responded that it would be a good idea.

Mr. Chang said there may be confusion publicizing the May 30th deadline because there were already two other dates posted, May 27th and May 28th. But the operating rule should be that May 30th is the real deadline and just treat everything on that date as valid.

In regards to getting rid of the "adverse consequences", you mentioned it would take an act of legislature. If we asked the next session of the legislature, is there anything that would prevent that from being affected asked Mr. Nakata.

No, replied Mr. Chang, but the Code says that within six months the Commission shall start acting on the certifications and then legal thought would have to be given to those certifications that try to come in before the next legislature.

Mr. Fujimura felt the intent of the Commission in getting all existing uses registered has been achieved if those people that do not have their paperwork together but send in what information they have on scratch paper, with no tax map key and draws a small map saying details to follow. Mr. Chang replied there is a rule that says anything that is not filed in substantial conformity may be refused by the Commission. Therefore, in the next session the definition of substantial conformity needs to be clarified.

Mr. Tam added that there is a law allowing Commissions to extend times created by law upon showing good cause and the statutory period is computed to be the first business day after the time period has passed. So there should be no problem with the Commission recognizing May 30th.
Mr. Chang also brought up the problem of the Code's rule that all filing be done in triplicate and were wondering how the Commission would handle that because the maps would be difficult. It was agreed that a single copy would be sufficient.

Chairperson Paty stated a notice will be provided to encourage everyone to come in and file and call the staff or the Native Hawaiian Legal Council for information or assistance.

The Chairperson deferred action on the recommendation to waive all penalties but unanimously approved the close of business on May 30th as the deadline to file registrations and water use declarations.

ITEM 4 HONOLULU BOARD OF WATER SUPPLY, APPLICATION FOR A WELL CONSTRUCTION PERMIT, MAAKUA WELL, HAULUA, OAHU

Mr. Cox asked why BWS was not pumping the other wells 4/10 mile away. Mr. Sakoda replied wells not being used are not BWS but irrigation wells.

Mr. Nakata asked how much water was coming from the other BWS well. Mr. Sakoda did not have that information, so Mr. Herb Minakami of BWS came forward and said about half a million gallons is being pumped. Mr. Nakata then asked if the stream was going to be monitored. Mr. Minakami replied it is a dry stream so it would not be monitored.

Unanimously approved (Cox/Fujimura).

ITEM 5 EWA PLAIN WATER DEVELOPMENT CORPORATION, APPLICATION FOR WELL CONSTRUCTION PERMIT, HONOLIULI WELL 6, HONOLIULI, OAHU

Mr. Cox asked if the other wells in the area would be monitored since they are fairly close together. Mr. Sakoda replied that they would be monitored.

Mr. Cox asked that it be added to the conditions for this permit.

Unanimously approved with condition (Nakata/Cox).

ITEM 6 GENTRY DEVELOPMENT COMPANY, APPLICATION FOR WELL CONSTRUCTION PERMITS, EWA-GENTRY EXPLORATORY CAPROCK WELLS, EWA, OAHU

Unanimously approved (Cox/Paty).

ITEM 7 WAIKOLOA WATER COMPANY, APPLICATION FOR WELL CONSTRUCTION PERMITS, WAIKOLOA (LOTS 2 & 7) WELLS, WAIKOLOA, S. KOHALA, HAWAII

Unanimously approved (Cox/Nakata).

ITEM 8 GCR/VMS MAUI 670, APPLICATION FOR WELL CONSTRUCTION PERMITS, WAILEA-GCR/VMS WELLS, WAILEA, MAUI

Mr. Cox asked if there was an estimate of what the flux was for that area. Mr. Sakoda replied the Division does not have anything published on the flux. Representing Wailea, Mr. Clark Champion stepped forward to answer questions of the Commission. Regarding Mr. Cox's question on flux, he said they do not have precise information but have been utilizing the resource in the area and have been studying it for almost 20 years. They can estimate that they are running a little less than a million gallons per mile of shoreline.
in that general area. One of the concerns they have on the conditions recommended by the staff is the monitoring of more than just the three wells makai of the proposed wells. Their experiences had indicated that it is a fragile, limited aquifer in that area and that there seems to be a very tight, inter-relationship between their integrated system of wells and they felt it would be important to monitor at least five of the wells in that immediate area. Mr. Cox then asked if they would assist in monitoring those wells. Mr. Champion replied that they would assist in monitoring. In regards to the proposal to utilizing sewage effluent for irrigation, Mr. Champion said preliminary discussions have been started.

Mr. Cox asked that the following be made a part of the conditions:

"The applicant and Wailea Resort Company Ltd. shall conduct a study to minimize possible negative impacts of the proposed wells on existing wells in the area."

Mr. Fujimura asked that the following also be added to the conditions:

"That communication be sent to the appropriate planning body of the County regarding the conditions and concerns of the Commission in approving the request and representations made by the applicants."

Unanimously approved with amendments (Cox/Nakata).

ITEM 9 DAVID W. CURTIS, APPLICATION FOR WELL CONSTRUCTION PERMIT, KAMALO-CURTIS WELL, KAMALO, MOLOKAI

Unanimously approved (Cox/Nakata).

ITEM 10 DENNIS O'SHEA, APPLICATION FOR WELL CONSTRUCTION PERMIT, KEALIA-O'SHEA WELL, KEALIA, SOUTH KONA, HAWAII

Unanimously approved (Fujimura/Cox).

ITEM 11 BASIN PROJECT, INC, APPLICATION FOR WELL CONSTRUCTION PERMIT, KEWALO SALT WATER WELL, KEWALO BASIN, OAHU

Unanimously approved (Nakata/Cox).

ITEM 12 JAMES LAWHEAD, APPLICATION FOR PUMP INSTALLATION PERMIT, MOLOAA-LAWHEAD WELL, MOLOAA, KAUAI

Mr. Cox stated he recalls approving the drilling of this well in February. At that time, it was to be a solid casing of 40 feet but now it is a slotted casing and double the depth. He wanted to know if staff monitors what is approved and what is built. Mr. Sakoda said a proposal is given but an "as built" is required. He explained that as they drilled they found changes were necessary because they had to get through a sedimentary layer to get to the water which they did not foresee. This was reported to the staff; the Kauai engineer checked the well and took a water sample.

Unanimously approved (Nakata/Cox).

ITEM 13 DIVISION OF WATER AND LAND DEVELOPMENT, APPLICATION FOR WELL CONSTRUCTION PERMIT, HONOKAA WELL A, HONOKAA, HAWAII

Unanimously approved (Cox/Nakata).
ITEM 14  DIVISION OF WATER AND LAND DEVELOPMENT, APPLICATION FOR WELL CONSTRUCTION PERMIT, KAWAIHAE EXPLORATORY WELL, KAWAIHAE, HAWAII

Mr. Cox recommended that the addition of the following condition:

"If the water is for potable use, the applicant shall notify the DOH, to comply with the DOH's Drinking Water Program."

Unanimously approved (Nakata/Fujimura).

ITEM 15  ISLAND POWER COMPANY, INC., PETITION TO AMEND INTERIM INSTREAM FLOW STANDARD, APPLICATIONS FOR STREAM CHANNEL ALTERATION PERMIT AND DIVERSION WORKS PERMIT, UPPER WAILUA HYDROELECTRIC PROJECT, WAILUA, KAUA'I

Staff made the following amendment to Part A of the recommendation to read as follows:

A. That the Commission approve an amendment of the interim instream flow standard for Maheo Stream to allow a reduction of the present augmented streamflow to a level consisting of the natural flow of the stream and the release of all Hanalei Tunnel flow not utilized by the Upper Wailua Hydroelectric Project, that is all tunnel flows less than 8 cfs.

Mr. Cox asked if the study on the shearwater, bat, etc. was done and what the status was on the unresolved forms; such as AmFAC agreement, FERC, etc. Mr. Matsumoto and Ms. Samuels did not have the information on the shearwater study, but replied that the applicant may be able to provide that information. Mr. Matsumoto then replied that FERC had stated it had no jurisdiction in the Upper Wailua Basin and the issue between the applicant and the Lihue Plantation is subject to negotiation.

The applicant, Dean Anderson, said the survey for bird species and bat was just completed and that some shearwaters were found above the weir (the intake to the Hanalei Tunnel) area but none were to be impacted by the project. But should they find nesting shearwaters in the penstock route, they would take appropriate steps to avoid them. In regards to FERC, they have petitioned FERC for declaration of non-jurisdiction. He stated that Board of Land and Natural Resources approved the CDUA subject to conditions and that he concurred with the permit conditions they are proposing. Subject to approval of stream alteration permits, they will apply for the water license. They have the prior legislative approval for the water rights and will work towards the public auction on the water rights.

Chairperson Paty stated that if there was an increase of taro growing in the valley the taro growers have first rights to the water and asked if Mr. Anderson was aware of any indication of an increase in taro growing. Mr. Anderson replied he did not know. Mr. Cox asked Deputy A.G. Tam what would be the effect if the taro growers required additional water. Mr. Tam replied that it would be wise for the applicant to look into the amount of acreage and if the current flow can handle that increase. He added that under common law and the Constitution the appurtenant rights have the highest priority.

Mr. Paty asked who would be doing the actual work. Mr. Anderson said he was talking to local firms, but none has been chosen to date. The pen stock will also be purchased locally, but the turbine will come from off-island.
Mr. Williamson Chang and Ms. Mina Morita provided testimony for Waiola, herself, and Rodney Haraguchi of Hanalei Valley (president of Kauai Taro Growers Association). They asked that the Commission deny the permit based on the lack of information provided by the final impact statement and the clouded legal issues in regards to the related water license and the question of appurtenant water rights.

Mr. Cox asked Mr. Tam if by the Commission’s approving the change in the instream standard for Mahea Stream it would affect the appurtenant rights. Mr. Tam replied that it would not.

Mr. Fujimura clarified that what happens in the Upper Wailua Project will not impact what happens in Hanalei, however, what happens in Hanalei could affect what happens in Upper Wailua Project. For example, if more lois are put into production and water is diverted there could be an impact as to how much water is available for diversion. This would mean there may not be enough water available to operate the hydro project. Therefore, he would hesitate to see construction of a project be approved if it turns out that the project cannot be built.

In answer to Mr. Cox’s question on when the project is expected to start, Mr. Anderson said they are planning to start next year to take advantage of the dry season.

Mr. Fujimura asked if it was possible to get information on taro fields being proposed in terms of (1) what kinds of flow they need, (2) whether the water is available, (3) etc. Mr. Chang suggested the Commission wait until after May 27, because that information should be coming in and a detailed assessment can be made.

Mr. Kelvin Kai of Kauai Electric stepped forward to point out the benefits of the project. He said Kauai Electric would be purchasing the power that would be generated, it would replace approximately 60,000 barrels of oil. This “clean power” would reduce the “greenhouse affect” that people are concerned about. If they continue to add diesel turbines to keep up with the growth on Kauai, they will only be adding to the air pollution. The hydropower project would provide a tremendous benefit to Kauai.

Mr. Fujimura commented that perhaps the applicant could look at the questions that are raised and develop a response in terms of his willingness to deal with some of the problems and the Commission would be able to work with their concerns. Dr. Lewin said he would also like more information on the other hydroelectric interests on the Hanalei River and their status.

Mr. Michael Burke of Lihue Plantation stated that if the application is approved it is subject to whatever rights they have under General Lease 3827, the East Kauai Water License. They currently divert water from Hanalei Stream through the tunnel and the water comes out in the Wailua Basin. If there is any alteration to the diversion at Hanalei as a result of the project they would like the requirement that no conservation flow is required from that change because currently there is no conservation flow required under their license and practices. In regards to appurtenant rights, they would recognize any rights downstream on Hanalei. An additional requirement they would like to see is that any of the system upstream of the Hanalei outlet be maintained by the applicant.

Mr. Anderson commented he hopes the Commission would consider the permits because it would allow them to process the permits and make the 1990 construction time; if not they would have to delay another year. He said he would watch the certification issue and would get a legal opinion of their own and make a decision on whether or not to continue. Mr. Tagomori
added that they are working against a deadline and have until the end of May on the application. Mr. Matsumoto said there is a 180-day deadline and two 90-day deadlines that are due at the end of the month. Mr. Cox asked if they could extend the permit deadline with the concurrence of the applicant. Mr. Tam said the general provisions of the Code allows the Commission to extend deadlines, especially in the event the applicant makes the request. Mr. Anderson concurred and asked for the extension with the request it be addressed at the next meeting on June 14th.

Mr. Nakata motioned for deferral, seconded by Mr. Fujimura. Mr. Fujimura moved to extend the deadline to the next meeting, seconded by Mr. Cox. Motions carried.

ITEM 16  
HONOLULU BOARD OF WATER SUPPLY, APPLICATION FOR STREAM CHANNEL ALTERATION PERMIT FOR KALIHI STREAM WATER MAIN CROSSING, HONOLULU, OAHU

Staff recommended the deletion of Conditions 9, 10, 11 and be replaced by:

9. The applicant shall provide archaeological monitoring by having (1) a professional archaeologist flag off any archaeological sites prior to construction; (2) a professional archaeologist be present during construction to prevent inadvertent damage to flagged sites; and (3) the contractor stop work if the archaeologist needs an opportunity to record or mitigate damage to surface or subsurface sites.

Renumber Condition 12 as Condition 10.

Attachment of Exhibit A for information.

Unanimously approved (Cox/Fujimura).

ITEM 17  
STATE DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES' (SSFM ENGINEERS, INC., CONSULTANT), APPLICATION FOR STREAM CHANNEL ALTERATION PERMIT FOR WAIPAHU FLOOD CONTROL CHANNEL, (WAIKELE STREAM) WAIPAHU, OAHU

In answer to Mr. Fujimura's question regarding the indemnification clause, Mr. Matsumoto clarified that should the applicant (DAGS) assign the work to a contractor, the contractor would hold the State harmless.

Unanimously approved (Fujimura/Cox).

ITEM 18  
CITY AND COUNTY OF HONOLULU, DEPARTMENT OF PUBLIC WORKS, APPLICATION FOR STREAM CHANNEL ALTERATION PERMIT FOR WAILUPE STREAM MAINTENANCE RAMP, WAILUPE, OAHU

Unanimously approved (Fujimura/Nakata).

ITEM 19  
M&E PACIFIC, INC. FOR KANEHOE VETERANS CEMETARY, APPLICATION FOR STREAM CHANNEL ALTERATION PERMIT FOR KAWA STREAM, KANEHOE, OAHU

Mr. Cox asked for clarification of the last sentence under "BACKGROUND". Mr. Mark Cramer said the culvert would be put in the area mentioned, not graves.

Unanimously approved (Fujimura/Cox).
ITEM 20  PAREN, INC., APPLICATION FOR STREAM CHANNEL ALTERATION PERMIT FOR MANOA STREAM TRIBUTARY, MANOA VALLEY, HONOLULU, OAHU

Unanimously approved (Cox/Fujimura).

ITEM 21  DEPARTMENT OF LAND AND NATURAL RESOURCES, DIVISION OF WATER AND LAND DEVELOPMENT, APPLICATION FOR STREAM CHANNEL ALTERATION PERMIT FOR DREDGING OF HALAWA STREAM, HALAWA, OAHU

Mr. Cox asked if it was a stream or if it was an estuary. Mr. Matsumoto answered that it was a stream.

Mr. Cox also asked if DLNR comes to the Commission for an application, should the DOWALD staff present and recommend for approval. Mr. Tagomori explained that this is a joint State/County project and that the County would be the administering agency. In the arrangement with the County, DOWALD was to handle the permit application. The County should have been present, but to expedite processing it was done through our staff.

Unanimously approved (Cox/Nakata).

ITEM 22  OTHER BUSINESS

None.

ADJOURNMENT

The meeting was adjourned at 5:50 p.m.

Respectfully submitted,

SHARON KOKUBUN
 Secretary
Chairperson and Members
Commission on Water Resource Management
State of Hawaii
Honolulu, Hawaii

Gentlemen:

RESUBMITAL

At its May 17, 1989 meeting, the Commission on Water Resource Management deferred action until June 14, 1989 on Commission approvals related to Island Power Company's proposal to construct and operate a hydroelectric power plant on the Wailua River, Kauai (Upper Wailua Hydroelectric Project). The project description and requested Commission approvals were described in the May 17, 1989 submittal to the Commission and are incorporated in this resubmittal as Exhibit A.

Commission action on this item was deferred in order to allow further study of the availability of water for the project. The Commission felt that future appurtenant water right claims in Hanalei Valley may affect the adequacy of the water supply diverted from Hanalei Valley into Hanalei Tunnel for the project. It was suggested that the Department's current registrations of stream diversion works and declarations of water use could provide timely information on the use and potential use of water in the Hanalei basin.

Water Use Information

Information collected under the State Water Code's registration program is not available for inclusion with this submittal. DOWALD staff is currently organizing and filing the 7000-plus registration forms received before the May 30, 1989 registration deadline.

Analysis

The approvals requested of the Commission are for (1) an amendment of the interim instream flow standard, (2) a stream channel alteration permit application, and (3) a diversion works permit application. The proposed project will utilize water that is available through the East Kauai Water License issued to Lihue Plantation Company.

The availability of sufficient water for the project hinges upon future claims of others to the use of the current water that is diverted through Hanalei Tunnel. It is the project developer who risks the viability of his project if adequate water becomes unavailable in the future. Here, the developer has indicated that he fully understands that the Hanalei Tunnel flow is subject to the conditions of the current

ITEM 1
State water license issued to Lihue Plantation Company and to future water rights claims of others in Hanalei Valley.

Staff believes that the approvals requested of the Commission may be acted upon at this time without first determining the availability of future flows from Hanalei Tunnel, notwithstanding the possibility faced by the applicant that future circumstances may impact the viability of his proposed project.

RECOMMENDATION

In view of the above analysis, staff recommends:

A. That the Commission approve an amendment of the interim instream flow standard for Maheo Stream to allow a reduction of the present augment streamflow to a level consisting of the natural flow of the stream and the release of all Hanalei Tunnel flow not utilized by the Upper Wailua Hydroelectric Project; that is, all tunnel flow less than 8 cfs".

B. That the Commission approve the issuance of a stream channel alteration permit and a diversion works permit for the construction and operation of the Upper Wailua Hydroelectric Project consisting of a modification of the existing diversion structure on Hanalei River and the construction of a concrete diversion structure at the outlet of the Hanalei Tunnel and a penstock, a powerhouse, and related structures on Maheo Stream. These permits shall be valid for a period of two years from the date of approval, June 14, 1989, and shall be subject to the following conditions:

(1) The applicant shall comply with all other applicable statutes, ordinances, and regulations of the Federal, State, and Kauai County governments.

(2) The applicant, his successors, and his assigns shall indemnify, defend, and hold the State of Hawaii harmless from and against any loss, liability, claim for property damage, personal injury, or death, arising out of any act or omission of the applicant or his successors, assigns, officers, employees, contractors, and agents under these permits or related to the granting of these permits.

(3) The applicant shall notify the Department, by letter, of the actual dates of project initiation and completion.

(4) Before proceeding with any work authorized by the Commission, the applicant shall submit to the Department two copies of the construction plans and specifications for approval as to consistency with the conditions of the permits and the declarations set forth in the permit applications.

(5) The applicant shall utilize appropriate erosion control measures during construction to minimize turbidity (such as scheduling of work during periods of low streamflow) and prevent debris and construction materials, including cement, petroleum products, and other pollutants from entering the stream. Wash and dust control water shall be properly disposed of.
(6) The applicant shall implement all mitigation measures noted in the Final Environmental Impact Statement for the project, and required in the Board of Land and Natural Resources approval of CDUA File No. KA-2155.

(7) Construction work shall be limited to low flow periods to limit the discharge or suspended sediments.

(8) In the event that any previously unidentified historic sites or remains such as artifacts, shell, bones or charcoal deposits, human burials, rock or coal alignments, paving, and wells are encountered, the applicant shall stop work immediately and contact the Department of Land and Natural Resources Historic Sites Preservation Office.

(9) At the proposed powerhouse location, the grass shall be cleared (not using heavy machinery) and a professional archaeologist shall then determine if significant historic site are present. Findings shall be submitted to the Department's Historic Sites Section in report format. If significant historic sites are present, an acceptable mitigation plan shall be developed and be approved by the Historic Sites Section. This plan shall be executed prior to any construction at this location.

(10) The modification of the existing diversion structure of Hanalei River shall result in a diversion capacity no greater than that of the present structure.

(11) The design of the penstock and access road stream crossings shall be modified to ensure that the movement of native diadromous species remains unimpeded.

(12) The design of fish screens and ladder structures shall meet the specifications determined by the Department's Division of Aquatic Resources and the U.S. Fish and Wildlife Service aquatic biologists.

Respectfully submitted,

MANABU TAGOMORI
Deputy Director

APPROVAL FOR SUBMITAL:

WILLIAM W. PATY, Chairperson
Chairperson and Members
Commission on Water Resource Management
State of Hawaii
Honolulu, Hawaii

Gentlemen:

Island Power Company, Inc.: Upper Wailua Hydro-Electric Project, Wailua, Kauai

(1) Petition to Amend Interim Instream Flow Standard
(2) Application for Stream Channel Alteration Permit
(3) Application for Stream Diversion Works Permit

Island Power Company, Inc., proposes to construct the Upper Wailua Hydroelectric Project utilizing land and water in the Wailua River basin owned by the State of Hawaii for the purpose of generating electricity. The proposed project will utilize flow from an existing Lihue Plantation Company irrigation water system which diverts water from the Hanalei River basin to the Wailua River basin via the intervening Hanalei Tunnel. Water exiting Hanalei Tunnel enters Maheo Stream and thence flows to the North Fork of Wailua River and to the Stable Storm Ditch for subsequent use elsewhere by Lihue Plantation Company. The proposed project will tap the water system at the Hanalei Tunnel outlet (See Exhibit A).

APPROVALS REQUESTED OF COMMISSION

Island Power Company is seeking the following Commission approvals:

1. Interim Instream Flow Standard. The Commission's interim instream flow standard specifies that the flows of Maheo Stream and all other Kauai streams shall be maintained at their present levels, but provides that the Commission may amend the standard to allow future diversions. Island Power Company, Inc. has petitioned the Commission to amend the interim standard.

2. Stream Channel Alteration Permit. The Water Code requires that no stream channel be altered until an application for a stream channel alteration permit has been approved by the Commission. The Water Code administrative rules provide that: (1) channel alterations that would adversely affect the quantity and quality of the stream water or the stream ecology should be minimized or not be allowed; and (2) where instream flow standards or interim instream flow standards have been established, no permit shall be granted for any channel alteration which diminishes the quantity or quality of stream water below the minimum established to support identified instream uses.

3. Stream Diversion Works Permits. The Code further states that no person shall construct or alter a stream diversion works, other than in the course of normal maintenance, without first obtaining a stream diversion works permit from the Commission. A proposed channel alteration should not interfere substantially and materially with existing instream or non-instream uses or with channel alterations previously permitted.

ITEM 15

JUNE 14, 1989 - EXHIBIT A
PROJECT DESCRIPTION

The proposed project would divert water at the Hanalei Tunnel outlet by means of a 5-foot-high, 30-foot-wide concrete diversion weir located at an elevation of 1,210 feet above mean sea level (msl). The water will be conveyed through an 8,925-foot-long pressure penstock. Penstock diameter will vary from 32 to 48 inches.

Hanalei Tunnel flows within the range of 8 to 48 cfs will be diverted for the project; i.e., flows below 8 cfs (5.2 mgd) and above 48 cfs (31.2 mgd) will be bypassed into Maheo Stream. The bypassed flows will combine with naturally occurring flows. Essentially, the developer emphasizes that flows in Maheo Stream will be returned to their natural pattern with an augmentation of flows from the Hanalei Tunnel when tunnel flows are less than 8 cfs or greater than 48 cfs.

The penstock will convey the diverted water to a powerhouse sited on the west bank of Maheo Stream at an elevation of 710 feet msl. The 40' wide x 40' long x 20' high powerhouse will contain one pelton turbine and generator with a maximum capacity of 1260 KW. Water from the penstock will be discharged back into Maheo Stream at the powerhouse site by way of a 50-foot long tailrace.

An above-ground 12KV transmission line, 3 miles long, will interconnect the project to existing power transmission lines near the project. The electricity produced will be sold to Kauai Electric, a Division of Citizens Utility Company, who will then distribute it to its customers. The proposed project would produce approximately 7.2 million KW hours of electrical power each year.

In addition to the diversion, penstock, powerhouse, and tailrace structures, penstock and access road stream crossings will be required and are considered to be stream channel alterations included in the overall project application. Up to 80% of the penstock will be buried within the access road right-of-way. The above-ground portions of the penstock will be supported on pre-constructed saddles. Penstock stream crossings will either span the stream channel at sufficient height to avoid high streamflow or will be buried in a permanent gully crossing - referred to as an "Irish crossing". The proposed Irish crossings are designed to be overtopped by freshets, but are provided with culverts to facilitate fish passage during normal flows.

The project and its impact on the environment are fully described in the final Environmental Impact Statement, which has been accepted by the Department of Land and Natural Resources.

AGENCY REVIEW

The project developer's petition to waive the interim standard and his applications for stream channel alterations and a diversion works permit were sent to the following agencies. Each agency's comments are summarised.

The U.S. Corps of Engineers indicated that a Department of Army permit is required for the project, but also indicated that the applicant should be advised to contact the Federal Energy Regulatory Commission (FERC) to determine whether the Corps of Engineers or the FERC has the lead Federal role in regulating the project.

The U.S. Fish and Wildlife Service indicated in January 1989 that it wished to defer comments on the petition and application until the Final EIS for the project was completed. As of May 5, 1989, no additional comments
had been received. The Final EIS was accepted by the Department of Land and Natural Resources on April 18, 1989.

On May 5, 1989, staff called the Service, which indicated that it had only recently received a copy of the Final EIS and therefore had not completed its review. The Service has indicated it would provide final comments prior to the Commission meeting. The Service's staff, however, did state that most of their concerns had been addressed. A remaining concern seemed to be the "Irish crossing".

In earlier comments dated March 30, 1988 the Service noted that while the flow will be reduced in the Maheo Stream channel that transmits water from the Hanalei Tunnel to the Stable Storm Ditch, the net effect will be a return to flow conditions existing prior to the construction of the Hanalei Tunnel. The Service further stated that provided the project does not withdraw additional water from the Hanalei River, an Instream Flow Incremental Methodology (IFIM) study to determine in-stream flow for native freshwater species may not be necessary for this project.

The Kauai Planning Department and Department of Public Works indicated that the project is located outside the Special Management Area and, as such, no SMA permit is required.

The Division of Aquatic Resources, in its comments on the Final EIS dated April 18, 1989, indicated that its concerns and comments on the Draft EIS had been addressed. It agreed that diverting most of the water from the Hanalei Tunnel would result in reduced water velocity in Maheo Stream and, therefore, enhance aquatic resource habitat conditions, as discussed below.

The Division noted that its Kauai aquatic biologist had accompanied the project consultant and participated in the aquatic resources survey conducted during February 1989 from which an IFIM evaluation was made for the affected middle reach of Maheo Stream.

The study suggests that the present discharge of water from Hanalei Tunnel (26 cfs/17 mgd) increases the velocity of stream flow, but does not increase the water area in Maheo Stream. The high flow velocity may not be beneficial to native opae and introduced smallmouth bass, e.g., the present high velocity would somewhat affect the availability of styliid shrimp, which serves as food for the smallmouth bass. Also, the opae kalaole are known to occur in various flow conditions, and the information provided indicates that the total weighted usable area for opae is greatest at flows of 5-10 cfs (3-7 mgd), which would be within the range of project conditions. Further, because of lower velocities, the 5-10 cfs flow would double the usable habitat area for smallmouth bass fry, while juvenile and adult habitat would remain about the same.

The Division of Forestry and Wildlife indicated that, conditioned on the Board's approval of CDOA KA-2155, it has no objection to amending the interim in-stream flow standard for Maheo Stream.

The Division of State Parks, Historic Sites Section indicated that the archaeological survey (Hamman 1988, Archaeological Reconnaissance of the Upper Wailua Hydroelectric Project: Wailua, Kaua'i) found no historic sites in the project area. Based on some historical evidence and comparable surveys, there remains the possibility that agricultural terraces may be present near the confluence of two streams (which is the proposed powerhouse, staging area and access road site) where in the past dense grass prevented thorough observation of the ground surface. The consulting archaeologist had recommended that an additional survey take place at this location during the vegetation clearing, but prior to construction.
The Historic Sites Section indicated that it agrees that all other areas of the project appear to have no historic sites, but that in the one area where the streams meet more survey is needed, as stated above. This survey should be done as the consulting archaeologist recommends, but with the following concerns also met: (1) Vegetation clearing should be done without heavy equipment to avoid damage to any historic sites that might be present; (2) if sites are present, enough information must be gathered to evaluate their significance; (3) if sites are present and if they prove significant, a mitigation plan must be developed and executed prior to construction.

Regarding recreational concerns, the Division of State Parks indicated that there are no known recreation concerns affecting State Park interests. Wailua River State Park is located downstream from the subject project, but no significant impact is anticipated.

The Office of Conservation and Environmental Affairs noted that the project would be almost entirely within the Conservation District, Resources and Protective Subzones, and that a Conservation District Use Application is pending. (This application was approved by the Board of Land and Natural Resources on April 28, 1989).

The Natural Area Reserve System Commission indicated that the project will have no effect on its existing program.

PUBLIC HEARING

A joint Board of Land and Natural Resources - Commission on Water Resource Management public hearing on this project was held on January 12, 1989 at Lihue, Kauai. The concerns and questions raised at the public hearing (See Exhibit B) were considered in developing the staff recommendations below.

ANALYSIS

Maheo Stream: Three separate field investigations of aquatic resources were undertaken for this project: periphyton and detritus levels and macroinvertebrate samples in October 1988, macrofauna samples in January 1989, and an Instream Flow Incremental Method (IFIM) evaluation in February 1989. The highest level of macroinvertebrates and Atya shrimp was found near the Maheo Stream headwaters. Downstream, lower gradient sections of Maheo Stream contained variable platyfish, green swordfish and smallmouth bass. No native species were found in the downstream section of Maheo Stream. In the upper stream reaches, exotic species are replaced by native diadromous fauna, where opae kala'oe is relatively common. O'opu nakeo and o'opu nopili were also collected during sampling, but densities were very low. Upstream of the Hanalei Tunnel outlet, 'opae kala'ole were found to be abundant, while o'opu were still uncommon.

The IFIM evaluation of February 1989 studied the potential effect of the project on aquatic species and habitat. As noted in the Final EIS, the results of this study confirm that aquatic habitat in Maheo Stream is relatively insensitive to flow alteration; that is, there are no strong peaks in habitat area that occur at particular flows. Total weighted usable area for 'opae kala'ole is highest at flows between 5 and 10 cfs - a range of flows that would be present under project conditions. In fact, the addition of the average 26 -cfs flow from the Hanalei Tunnel reduces habitat area for opae by about 20 percent. Smallmouth bass habitat for fry, juvenile, and adult fish was also found to be decreased at higher flows. Fry habitat was almost
doubled under project conditions, while juvenile and adult habitat remained relatively the same, although they are also increased at flows in the project range of 10 cfs. Spawning habitat increased slowly as flow is increased up to the study limits.

The IFIM physical habitat simulation indicated that added flows to Maheo Stream from the Hanalei diversion are generally detrimental to both native opae and introduced smallmouth bass (Final EIS, Page 75). The developer states that reversion to natural, pre-Hanalei Tunnel conditions would act to increase habitat area by lowering velocities at the higher flows. The study indicated that Maheo Stream does have steep sidewalls that prevent water from expanding into a wider channel. Discharges greater than the average natural conditions provide very little increase in wetted area, so flow increases translate into higher depth and velocity to the point where habitat becomes less suitable for existing aquatic species.

Given the results of the IFIM evaluation, it appears that the reduction in flow in Maheo Stream will benefit aquatic species, such as opae and smallmouth bass, rather than prove detrimental and, as such, is a desirable change.

Hanalei River. Development of the Upper Wailua River Hydroelectric Project will not in itself change flow conditions in the Hanalei River. However, concerns expressed by reviewing agencies and the public have prompted the developer to propose modifications to the existing diversion structure on Hanalei River and the tunnel intake.

Subject to water rights negotiations with Lihue Plantation, the project developer proposes to install an "aqua-shear" fish screen with by-pass flow and make other improvements, including a "fish ladder" consisting of water flowing over exposed rocks and creating water pockets on the downstream face of the existing diversion structure in Hanalei River (intake to tunnel). These measures are intended to prevent entrainment of native species in the tunnel and provide continuous flow of water over the existing Hanalei River diversion structure for the passage of native diadromous aquatic species.

The only remaining unresolved concern is the design of the penstock and the access road crossing. Although we have no formal response from the U.S. Fish and Wildlife Service at this writing, staff understands that the Service is concerned that velocities in the pipe culverts within the Irish crossings may be too fast and the culvert walls too slick to permit native species to migrate upstream. This is a significant design consideration that must be addressed by the applicant and, for this reason, a condition requiring modification of the Irish crossing design has been included in the staff recommendation.

Staff concludes that a waiver of the interim instream flow standard for the affected Maheo Stream reach is likely to be beneficial to native species as well as the smallmouth bass recreational fishery on Maheo Stream. The construction and operation of the hydroelectric project would benefit the general public and the immediate community. As such, a waiver of the interim instream flow standard for Maheo Stream and the issuance of a channel alteration permit for the project seem appropriate and desirable.

RECOMMENDATION:

In view of the above analysis and findings, staff recommends:

A. That the Commission approve a waiver of the interim instream flow standard for Maheo Stream to allow a reduction of the present

-5-
augmented streamflow to a level consisting of the natural flow of the stream and a minimum release of 7 cfs from Hanalei Tunnel, except when natural flow conditions result in lower flows.

B. That the Commission approve the issuance of a stream channel alteration permit and a diversion works permit to Island Power Company, Inc. for the construction and operation of the Upper Wailua Hydroelectric Project consisting of the construction of a concrete diversion structure at the outlet of the Hanalei Tunnel and a penstock, a powerhouse, and related structures on Maheo Stream. These permits shall be valid for a period of two years from the date of approval, May 17, 1989, and shall be subject to the following conditions:

1. The applicant shall comply with all other applicable statutes, ordinances, and regulations of the Federal, State, and City and County of Honolulu governments.

2. The applicant, his successors, and his assigns shall indemnify, defend, and hold the State of Hawaii harmless from and against any loss, liability, claim for property damage, personal injury, or death arising out of any act or omission of the applicant or his successors, assigns, officers, employees, contractors, and agents under this permit or related to the granting of these permits.

3. The applicant shall notify the Department, by letter, of the actual dates of project initiation and completion.

4. Before proceeding with any work authorized by the Commission, the applicant shall submit to the Department two copies of the construction plans and specifications for approval as to consistency with the conditions of the permits and the declarations set forth in the permit applications.

5. The applicant shall utilise appropriate erosion control measures during construction to minimize turbidity (such as scheduling of work during periods of low streamflow) and prevent debris and construction materials, including cement, petroleum products, and other pollutants from entering the stream. Wash and dust control water shall be properly disposed of.

6. The applicant shall implement all mitigation measures noted in the Final Environmental Impact Statement for the project, and required in the Board of Land and Natural Resources approval of CDUA File No. KA-2155.

7. Construction work shall be limited to low flow periods to limit the discharge of suspended sediments.

8. In the event that any previously unidentified historic sites or remains such as artifacts, shell, bone or charcoal deposits, human burials, rock or coal alignments, paving, and wells are encountered, the applicant shall stop work immediately and contact the Department of Land and Natural Resources Historic Sites Preservation Office.

9. At the proposed powerhouse location, the grass shall be cleared (not using heavy machinery) and a professional archaeologist shall then determine if significant historic sites
are present. Findings shall be submitted to the Department's Historic Sites Section in report format. If significant historic sites are present, an acceptable mitigation plan shall be developed and be approved by the Department's Historic Sites Section. This plan shall be executed prior to any construction at this location.

(10) The design of the penstock and access road stream crossings shall be modified to ensure that the movement of native diadromous species remains unimpeded.

(11) The design of fish screens and ladder structures shall meet the specifications determined by the Department's Division of Aquatic Resources and the U.S. Fish and Wildlife Service aquatic biologists.

Respectfully submitted,

MANABU TAGOMORI  
Deputy Director

Attachments

APPROVED FOR SUBMITTAL

WILLIAM W. PATY, Chairperson
SUMMARY OF CONCERNS AND QUESTIONS RAISED
AT THE PUBLIC HEARING ON THE
PROPOSED UPPER WAILUA HYDROELECTRIC PROJECT

A complete copy of the transcript of the public hearing held on January 12, 1989 in Lihue, Kauai has been provided to each member of the Commission on Water Resource Management for their review. The following is a summary of the concerns and issues raised at the public hearing.

1. Water licensing requirements and procedure: Water license from the State of Hawaii is required.

2. Source of Water for the project and plant operation when flows are insufficient: Only water from the Hanalei Tunnel will be used; if less than 8 cfs, the plant will not operate.

3. Downstream users affected by the project: Maheo Stream is fished for smallmouth bass.

4. Stream flow data for Maheo Stream: This stream is ungaged; use of data from adjacent gaged streams were used to estimate flows on Maheo Stream. The Hanalei Tunnel diversion is gaged.

5. Revenues collected through water licensing.

6. Status of the Lower Wallua Project: Approved by BLNR, public auction still pending. (This project initially "grandfathered" under the State Water Code, will now because of FERC requirements for additional state level permits, be subject to State Water Code permit requirements. Petitions and applications for Water Code approvals have been filed and are pending).

7. Gain realized by Kauai consumers: No gain or reduction in rates.

8. Sale rate for electricity: this has not been finalized.

9. Construction of access roads and penstock: Road follows penstock but may require some switchbacks and will be 20-50 feet wide.

10. Staging area location: 6-10 acres of Lihue Plantation land.

11. Aquatic species in Maheo Stream, their dependence on water from the Hanalei Tunnel: There may be some. (Final EIS addresses species and impact as noted in Division of Aquatic Resources comments).

12. Accuracy of cost projections: There are gross estimates; final project configuration and penstock alignment would determine final costs.

13. State of development of project: Between preliminary design and design development state.

14. Distance between stream and construction: A 50-foot buffer is proposed. (Alternative 4, the preferred alternative results in an increased distance).

15. Introduction of noxious weed plants and mitigation measures to prevent introduction.

16. Adequacy of the draft EIS.

17. Potential erosion problems.

EXHIBIT B, SHEET 1
19. The project would provide "non-firm" power, so Kauai Electric will need to increase generation to provide increased demand.

20. Environmental problems on the applicant's Idaho hydro projects:
Problems were caused by one contractor and its subs, however, the applicant assumed responsibility and took corrective actions.
Chairperson and Members
Commission on Water Resource Management
State of Hawaii
Honolulu, Hawaii

Gentlemen:

United States Geological Survey
Application for Well Construction Permit
North Kohala Observation Wells, North Kohala, Hawaii

Applicant: United States Geological Survey
Water Resources Division
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

Action Requested: Permission to construct and test three 10-inch diameter observation wells (State Well Nos. 7445-02M, 7451-01M, 7451-02M).

Well Locations: The proposed wells are located in the Hawi area of North Kohala (see attached map).

Proposed Use of Wells: To construct and test three observation wells to determine the extent and character of the North Kohala aquifer.

Well Descriptions:

<table>
<thead>
<tr>
<th>Site/Well</th>
<th>Site D-Coastal (Well 7445-02M)</th>
<th>Site J, Well A (Well 7451-01M)</th>
<th>Site J, Well B (Well 7451-02M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground elevation</td>
<td>90'±'</td>
<td>518'±'</td>
<td>518'±'</td>
</tr>
<tr>
<td>Casing diameter</td>
<td>8&quot; I.D.</td>
<td>10&quot; I.D.</td>
<td>10&quot; I.D.</td>
</tr>
<tr>
<td>Solid casing depth</td>
<td>100' (80', msl)</td>
<td>570' (52', msl)</td>
<td>None (50', msl)</td>
</tr>
<tr>
<td>Screen casing depth</td>
<td>None (100', msl)</td>
<td>None (570', msl)</td>
<td>None (570', msl)</td>
</tr>
<tr>
<td>Open hole</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Open hole diameter</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Total depth</td>
<td>100' (10', msl)</td>
<td>570' (52', msl)</td>
<td>570' (52', msl)</td>
</tr>
<tr>
<td>Grouted annulus</td>
<td>0-10'</td>
<td>0-100'</td>
<td>0-50'</td>
</tr>
</tbody>
</table>

Agency Review: The application has been sent to the County Departments of Water Supply and Public Works, and to the State Department of Health for review. There have been no objections to the project.

Analysis: The three observation wells are part of a cooperative project between the United States Geological Survey (USGS) and the Hawaii Department of Water Supply (DWS) to determine aquifer characteristics and potable ground water availability in the Hawi area of North Kohala. The observation wells will be drilled by the USGS-Water Resources Division. The observation wells will be added to the present monitoring program of the USGS. There is only one well in use in the project area at this time. The DWS Hawi Well (7449-02) is used intermittently and will not be adversely affected.
RECOMMENDATION:

That the Commission approve the issuance of a well construction permit for construction and testing of the North Kohala Observation Wells, subject to the following conditions:

1. The Division of Water and Land Development (DOWALD) shall be notified before work commences.

2. The permit shall be for construction and testing only. No permanent pump may be installed and no water used from the well without the necessary pump installation permit.

3. The following shall be submitted to DOWALD within 30 days after completion of the well:
   a. Well Completion Report form.
   b. Elevation (referenced to mean sea level) survey by a Hawaii-licensed surveyor.
   c. As-built sectional drawing of the well.
   d. Plot plan and map showing the exact location of the well.
   e. Complete pumping test record; including time, pumping rate, drawdown, chloride content, and water quality data.

4. The applicant shall comply with all applicable laws, rules, and ordinances.

5. The permit may be revoked if work is not started within six months of date of issuance or if work is suspended or abandoned for six months. The work shall be completed within two years of the date of issuance.

6. Upon discontinuance of use, the applicant shall seal the wells with cement grout by permit from the Commission.

Respectfully submitted,

MANABU TAGOMORI
Deputy Director

APPROVAL FOR SUBMITTAL:

WILLIAM W. PATY, Chairperson
N KOHALA OBS WELL
SITE J-B (7451-02M)

N KOHALA OBS WELL
SITE J-A (7451-01M)
Chairperson and Members
Commission on Water Resource Management
State of Hawaii
Honolulu, Hawaii

Gentlemen:

James Huang
Application for Well Construction Permit
Waiawa-Huang Well, Waiawa, Oahu

Applicant: James Siong-Sun Huang
96-159 Waiawa Road
Pearl City, Hawaii 96782

Action Requested: Permission to construct and test a 6-inch diameter, 70 ft. deep well (well no. 2358-51) for domestic use.

Well Location: The proposed well site is near Waiawa, Oahu at Tax Map Key: 9-6-02:19 (see attached map).

Proposed Use of Well: To construct and test for a source of water for domestic use. Proposed amount of use is 1,000 gallons per day (20 gpm).

Well Description:

Ground elevation: 40± ft.
Casing diameter: 6-inch I.D.
Solid casing depth: 40± ft. (0 ft., msl)
Perforated casing depth: 70± ft. (-30 ft., msl)
Total depth: 70± ft. (-30 ft., msl)
Grouted annulus: 0-25 ft.

Agency Review: The application has been sent to the Honolulu Board of Water Supply and the State Department of Health for review. There have been no objections to the application.

Analysis: The well is expected to encounter a fresh basal lens. The well is not likely to adversely affect nearby users due to its low rate of pumpage.

RECOMMENDATION:

That the Commission approve the issuance of a well construction permit for construction and testing of Waiawa-Huang Well, subject to the following conditions:

ITEM 3
(1) The Division of Water and Land Development (DOWALD) shall be notified before work commences.

(2) The permit shall be for construction and testing only. No permanent pump may be installed and no water used from the well without the necessary pump installation permit.

(3) The following shall be submitted to DOWALD within 30 days after completion of the well:
   a. Well Completion Report form.
   b. Elevation (referenced to mean sea level) survey by a Hawaii-licensed surveyor.
   c. As-built sectional drawing of the well.
   d. Plot plan and map showing the exact location of the well.
   e. Complete pumping test record; including time, pumping rate, drawdown, chloride content, and water quality data.

(4) The applicant shall comply with all applicable laws, rules, and ordinances.

(5) The permit may be revoked if work is not started within six months of date of issuance or if work is suspended or abandoned for six months. The work shall be completed within two years of the date of issuance.

Respectfully submitted,

MANABU TAGOMORI
Deputy Director

WILLIAM W. PATY, Chairperson
Chairperson and Members
Commission on Water Resource Management
State of Hawaii
Honolulu, Hawaii

Gentlemen:

Southwest Slopes Inc.
Application for Well Construction Permit
Opihihali Well, South Kona, Hawaii

Applicant: Southwest Slopes Inc. (C. Dale Stockman)
78-7070 Alii Drive, C-303
Kailua-Kona, Hawaii 96740

Action Requested: Permission to construct and test a 12-inch diameter, 1,230 ft. deep well (well no. 1652-01) for domestic and agriculture use.

Well Location: The proposed well site is in Opihihali, South Kona, Hawaii at Tax Map Key: 8-7-14:06 (see attached map).

Proposed Use of Well: To construct and test for a source of water for domestic and agriculture use.

Well Description:

Ground elevation: 1,200 ft.
Casing diameter: 12-inch I.D.
Solid casing depth: 1,200 ft. (0 ft., msl)
Screen casing depth: 1,225 ft. (-25 ft., msl)
Open hole: 85 ft.
Open hole diameter: 13 inches
Total depth: 1,225 ft. (-25 ft., msl)
Grouted annulus: 0-200 ft.

Agency Review: The application has been sent to the State Department of Health and the Hawaii Departments of Water Supply and Public Works for review. There have been no objections to the project. If the well will supply a public water system, the applicant will be required to comply with Department of Health Administrative Rules, Title II, Chapter 20, "Potable Water Systems".

Analysis: The Opihihali Well is expected to encounter a brackish to fresh basal aquifer with a head of approximately 65 ft. Plans are to produce up to 0.20 mgd which will be verified by testing. There are no other wells in the vicinity.

ITEM 4
RECOMMENDATION:

That the Commission approve the issuance of a well construction permit for construction and testing of Opihihali Well, subject to the following conditions:

(1) The Division of Water and Land Development (DOWALD) shall be notified before work commences.

(2) The permit shall be for construction and testing only. No permanent pump may be installed and no water used from the well without the necessary pump installation permit.

(3) The following shall be submitted to DOWALD within 30 days after completion of the well:
   a. Well Completion Report form.
   b. Elevation (referenced to mean sea level) survey by a Hawaii-licensed surveyor.
   c. As-built sectional drawing of the well.
   d. Plot plan and map showing the exact location of the well.
   e. Complete pumping test record; including time, pumping rate, drawdown, chloride content, and water quality data.

(4) The applicant shall comply with all applicable laws, rules, and ordinances.

(5) The permit may be revoked if work is not started within six months of date of issuance or if work is suspended or abandoned for six months. The work shall be completed within two years of the date of issuance.

Respectfully submitted,

MANABU TAGOMORI
Deputy Director

Attch.

APPROVAL FOR SUBMITTAL:

WILLIAM W. PATY, Chairperson
Chairperson and Members
Commission on Water Resource Management
State of Hawaii
Honolulu, Hawaii

Gentlemen:

Honolulu Board of Water Supply
Application for Pump Installation Permits
Opana Wells 1 & 2, Kahuku, Oahu

Applicant: Honolulu Board of Water Supply (BWS)
630 South Beretania Street
Honolulu, Hawaii 96843

Action Requested: Permission to install 1 mgd-capacity pumps in existing Opana Wells 1 and 2 (Well Nos. 4100-03, 04) for municipal use. The applicant proposes to use 1.5 mgd.

Well Location: The proposed well site is near Hauula, Oahu at Tax Map Key: 5-7-02:1 (see attached map).

Background: The wells are being developed by the Kullima Development Company and are intended to be dedicated to the BWS for municipal use. Opana 1 (4100-04) was drilled and tested in 1986 by the Kullima Development Company. Opana 2 (4100-03) was drilled and tested in 1969 by the BWS as an exploration-production well but has remained unused.

Well Descriptions:

<table>
<thead>
<tr>
<th>Well</th>
<th>Ground Elevation</th>
<th>Casing Diameter</th>
<th>Solid Casing Depth</th>
<th>Open Hole Diameter</th>
<th>Open Hole Depth</th>
<th>Total Depth</th>
<th>Grouted Annulus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opana 1 (4100-04)</td>
<td>1332 ft.</td>
<td>12-inch I.D.</td>
<td>163 ft. (-30 ft., msl)</td>
<td>11 1/2 inches</td>
<td>263 ft. (-130 ft., msl)</td>
<td>100 ft.</td>
<td>10-163 ft.</td>
</tr>
<tr>
<td>Opana 2 (4100-03)</td>
<td>1402 ft.</td>
<td>16-inch I.D.</td>
<td>159 ft. (-19 ft., msl)</td>
<td>N/A</td>
<td>301 ft. (-167 ft., msl)</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Analysis: The Opana wells will tap a fresh dike aquifer with a head of approximately 10 ft. The BWS presently wishes to produce up to 1.5 mgd from the well-field with a total ultimate demand of 2.0 mgd. The Opana wells will not likely adversely affect other wells in the area. Well 4100-02 located approximately 1,500 feet northeast of the site is unused. Well 4100-01 located approximately 3,700 feet northeast is used for irrigation of the Turtle Bay golf course. The BWS Waialee Wells are located approximately 4,200 feet west of the site and should not be adversely affected.
RECOMMENDATION:

That the Commission approve the issuance of permits to install 1 mgd-capacity pumps in Opana Wells 1 and 2, for a proposed total amount of withdrawal of 1.5 mgd, subject to the following conditions:

1. The applicant shall comply with all applicable laws, rules, and ordinances.

2. The permit may be revoked if work is not started within six months of date of issuance or if work is suspended or abandoned for six months. The work shall be completed within two years of the date of issuance.

Respectfully submitted,

MANABU TAGOMORI
Deputy Director

Approval for submittal:

WILLIAM W. PATY, Chairperson
Chairperson and Members
Commission on Water Resource Management
State of Hawaii
Honolulu, Hawaii

Gentlemen:

Division of Water and Land Development
Application for Well Construction Permit
Pia Exploratory Well, Niu Valley, Oahu

Applicant: Division of Water and Land Development
1151 Punchbowl Street, Room 227
Honolulu, Hawaii 96813

Action Requested: Permission to construct and test a 12-inch diameter, 381 ft. deep exploratory well (well no. 1744-04) for municipal use.

Well Location: The proposed well site is in Niu Valley, Oahu at Tax Map Key: 3-7-15:64 (see attached map).

Proposed Use of Well: To construct and test for a source of water for municipal use.

Well Description:

- Ground elevation: 281± ft.
- Casing diameter: 12-inch I.D.
- Solid casing depth: 271± ft. (+10 ft., msl)
- Screen casing depth: 331 ft. (-50 ft., msl)
- Open hole: 50 ft., as required
- Open hole diameter: 11 inches
- Total depth: 381 ft. (-100 ft., msl)
- Grouted annulus: 0-245 ft.

Agency Review: The application has been sent to the State Department of Health for review. Since the well will be for municipal use, the applicant will be required to comply with Department of Health Administrative Rules, Title II, Chapter 20, "Potable Water Systems".

Analysis: The Pia Exploratory Well is an exploratory well planned by the State to locate a potable water source in Niu Valley. Pia Exploratory Well is expected to produce up to 1.0 mgd, to be verified by testing, which will be made available to the Honolulu Board of Water Supply to meet the rapidly growing water needs of the area. Other wells in the area are no longer being used.

ITEM 6
RECOMMENDATION:

That the Commission approve the issuance of a well construction permit for construction and testing of Pia Exploratory Well, subject to the following conditions:

(1) The permit shall be for construction and testing only. No permanent pump may be installed and no water used from the well without the necessary water use and pump installation permits.

(2) The issuance of the well construction permit shall in no way prejudice any future consideration by the Commission on the issuance or non-issuance of a water use permit for the well.

(3) The following shall be submitted within 30 days after completion of the well:

   a. Well Completion Report form.
   b. Elevation (referenced to mean sea level) survey by a Hawaii-licensed surveyor.
   c. As-built sectional drawing of the well.
   d. Plot plan and map showing the exact location of the well.
   e. Complete pumping test record; including time, pumping rate, drawdown, chloride content, and water quality data.

(4) The applicant shall comply with all applicable laws, rules, and ordinances.

(5) The permit may be revoked if work is not started within six months of date of issuance or if work is suspended or abandoned for six months. The work shall be completed within two years of the date of issuance.

Respectfully submitted,

[Signature]
MARABU TAGOMORI
Deputy Director

APPROVAL FOR SUBMITTAL:

[Signature]
WILLIAM W. PATY, Chairperson
Chairperson and Members
Commission on Water Resource Management
State of Hawaii
Honolulu, Hawaii

Gentlemen:

Amfac Property Investment Corp.
Application for Well Construction Permits
Kaanapali Wells P-1 and P-2, Kaanapali, Maui

Applicant: Amfac Property Investment Corp.
2530 Kekaa Drive
Lahaina, Hawaii 96761

Action Requested: Permission to construct and test two 16-inch diameter exploratory wells, Kaanapali Well P-1 (5539-01) and Kaanapali Well P-2 (5539-02), for municipal use.

Well Location: The proposed well sites are in Kaanapali, Maui at Tax Map Key: 4-4-04:01 (see attached map).

Proposed Use of Well: To construct and test for sources of water for municipal use. Proposed withdrawal from each well is 0.50 mgd.

Well Description:

<table>
<thead>
<tr>
<th>Well Description</th>
<th>Kaanapali Well P-1</th>
<th>Kaanapali Well P-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground elevation</td>
<td>950± ft.</td>
<td>920± ft.</td>
</tr>
<tr>
<td>Casing diameter</td>
<td>16-inch I.D.</td>
<td>16-inch I.D.</td>
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<tr>
<td>Solid casing depth</td>
<td>955 ft. (-5 ft., msl)</td>
<td>925 ft. (-5 ft., msl)</td>
</tr>
<tr>
<td>Screen casing depth</td>
<td>975 ft. (-25 ft., msl)</td>
<td>945 ft. (-25 ft., msl)</td>
</tr>
<tr>
<td>Open hole</td>
<td>15 ft.</td>
<td>15 ft.</td>
</tr>
<tr>
<td>Open hole diameter</td>
<td>14 inches, minimum</td>
<td>14 inches, minimum</td>
</tr>
<tr>
<td>Total depth</td>
<td>980 ft. (-40 ft., msl)</td>
<td>960 ft. (-40 ft., msl)</td>
</tr>
<tr>
<td>Grouted annulus</td>
<td>0-200 ft.</td>
<td>0-200 ft.</td>
</tr>
</tbody>
</table>

Agency Review: The applications have been sent to the State Department of Health, and the Maui Department of Water Supply for review. There have been no objections to the applications. Since the wells will be for municipal use, the applicant will be required to comply with Department of Health Administrative Rules, Title II, Chapter 20, "Potable Water Systems".

Analysis: The wells are expected to encounter a fresh basal lens with a head of around 5 feet. The applicant's consultant has conducted a study of the area and has determined that there is sufficient water available without adverse effects on other sources in the area.

ITEM 7
RECOMMENDATION:

That the Commission approve the issuance of well construction permits for construction and testing of the Kaanapali Wells P-1 and P-2, subject to the following conditions:

(1) The Division of Water and Land Development (DOWALD) shall be notified before work commences.

(2) The permits shall be for construction and testing only. No permanent pump may be installed and no water used from the wells without the necessary pump installation permits.

(3) The following shall be submitted to DOWALD within 30 days after completion of the wells:
   a. Well Completion Report forms.
   b. Elevation (referenced to mean sea level) survey by a Hawaii-licensed surveyor.
   c. As-built sectional drawings of the wells.
   d. Plot plan and map showing the exact locations of the wells.
   e. Complete pumping test record; including time, pumping rate, drawdown, chloride content, and water quality data.

(4) The applicant shall comply with all applicable laws, rules, and ordinances.

The permit may be revoked if work is not started within six months of date of issuance or if work is suspended or abandoned for six months. The work shall be completed within two years of the date of issuance.

Respectfully submitted,

MANABU TAGOMORI
Deputy Director

APPROVAL FOR SUBMITTAL:

WILLIAM W. PATY, Chairperson
Mr. Milton Pavao, P.E., Manager  
Hawaii Department of Water Supply  
25 Aupuni Street  
Hilo, Hawaii 96720

Dear Mr. Pavao:

**Pump Installation Permit Application for Well No. 7345-04**

Before we can approve your pump installation permit, we need written verification that the Environmental Review process has been satisfactorily satisfied. Specifically, we require an Exemption Declaration from your office, and a written statement by the Department of the Interior that the project is in compliance with Federal Regulations and does not require environmental review.

If you have any questions, please contact Mr. Ryan Imata of the Commission staff at 587-0255 or toll-free at 974-4000 (Hawaii), extension 70255.

Sincerely,

[Signature]

TIMOTHY E. JOHNS  
Deputy Director

RI:ss
TO: Honorable Lawrence Milke, Director  
Department of Health  
Attention: Dennis Tulang, Wastewater Branch  
William Wong, Safe Drinking Water Branch

FROM: Michael D. Wilson, Chairperson  
Commission on Water Resource Management

SUBJECT: Pump Installation Permit Application  
Makapala Well (Well No. 7345-04)

Transmitted for your review and comment is a copy of the captioned well application.

We would appreciate your comments on the captioned application for any conflicts or inconsistencies with the programs, plans, and objectives specific to your department. Please respond by returning this cover memo form by June 20, 1998.

Please find a map, attached, to locate the proposed well. If you have any questions about this permit application, request additional information, or request additional review time, please contact Mr. Ryan Imata of the Commission staff at 587-0255.

Attachment(s)

RESPONSE:

This well qualifies as a source which will serve as a source of potable water to a public water system (serving 25 or more people at least 60 days per year or has 15 or more service connections), and must receive Director of Health approval prior to its use to comply with Hawaii Administrative Rules (HAR), Title 11, Chapter 20, Rules Relating to Potable Water Systems, §11-33.57.

This well does not qualify as a source serving a public water system (serves less than 25 people or more people at least 60 days per year or 15 service connections) and if the well water is used for drinking, the private owner should test for bacteriological and chemical presence before initiating such use and routinely monitor the water quality thereafter. However, if future planned use from this source increases to meet the public water system definition then Director of Health approval is required prior to implementation.

If the well is used to supply both potable and non-potable purposes in a single system, the user shall separate cross-connections and backflow connections by physically separating potable and non-potable systems by an air gap or an approved backflow preventer, and by clearly labeling all non-potable spigots with warning signs to prevent inadvertent consumption of non-potable water. Backflow preventer devices should be routinely inspected and tested.

It does not appear that this well will be used for consumptive purposes and is not subject to Safe Drinking Water Regulations.

For the applicant’s information, a source of possible wastewater contamination is not located near the proposed well (information attached).

Other relevant DOH rules/regulations, information, or recommendations are attached.

No comments/objections

Contact Person:  
William Wong  
Phone: 587-0255

Signed:  
Date: 06/12/98
The Department of Health, Clean Water Branch has the following comments:

1. For Well-Drilling Activities

Any discharge to State waters of treated process wastewater effluent associated with well drilling activities is regulated by Hawaii Administrative Rules, Chapter 11-55, Appendix I, effective September 22, 1997. Treated process wastewater effluent covered by this general permit includes well drilling slurries, lubricating fluids wastewaters, and well purge wastewaters. This general permit does not cover well pump testing. The applicable Notice of Intent Forms and filing fee shall be submitted at least thirty (30) days before the start of discharge to the Department of Health, Clean Water Branch at 919 Ala Moana Boulevard, Room 301, Honolulu, Hawaii 96814-4920 or P.O. Box 3378, Honolulu, Hawaii 96801-3378. Inquiries may be directed to the Clean Water Branch at (808) 586-4309 or by fax at (808) 586-4352.

2. For Well Pump Testing

The discharger shall take all measures necessary to prevent the discharge of pollutants from entering state waters. Such measures shall include, if necessary, containment of the initial discharge until the discharge is essentially free of pollutants. If the discharge is entering a stream or river bed, best management practices shall be implemented to prevent the discharge from disturbing the clarity of the receiving water. If the discharge is entering a storm drain, the discharger must obtain written permission from the owner of that storm drain prior to discharge. Furthermore, best management practices shall be implemented to prevent the discharge from collecting sediments and other pollutants prior to entering the storm drain.

JS/ct
<table>
<thead>
<tr>
<th>TO:</th>
<th>INIT.</th>
<th>TO:</th>
<th>INIT.</th>
<th>FOR:</th>
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<td>BAUER, G.</td>
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<td>LUM, A.</td>
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<td>NAKAMA, L.</td>
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<td>OHYE, M.</td>
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<tr>
<td>JINNAI, R.</td>
<td></td>
<td>UYENO, D.</td>
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<td>JOHNS, T.</td>
<td></td>
<td>YODA, K.</td>
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<tr>
<td>KUNIMURA, I.</td>
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</tbody>
</table>
Mr. Milton Pavao, P.E., Manager  
Hawaii Department of Water Supply  
25 Aspuni Street  
Hilo, HI 96720  

Dear Mr. Pavao:  

Pump Installation Permit Application for Well No. 7345-04  

We acknowledge receipt, on April 27, 1998, of your completed well construction / pump installation permit application for the Makapala Well (Well No. 7345-04). You can expect your application to be processed within ninety (90) days from this date.  

For your information, the process of constructing a well is normally regulated and permitted in two (2) steps. First, a well construction permit is issued for drilling and testing purposes only. Based upon information provided by you through a Well Completion Report Part 1 (Well Construction), a pump installation permit (upon completed application) may then be issued to authorize pump work. If a pump is installed then a Well Completion Report Part 2 (Pump Installation) is required. 

If you have any questions about your permit application, please contact Mr. Ryan Imata of the Commission staff at 587-0255.  

Sincerely,  

TIMOTHY E. JOHNS  
Deputy Director
TO: Honorable Lawrence Miike, Director
   Department of Health
   Attention: Dennis Tulang, Wastewater Branch
   William Wong, Safe Drinking Water Branch
FROM: Michael D. Wilson, Chairperson
       Commission on Water Resource Management
SUBJECT: Pump Installation Permit Application
          Makapala Well (Well No. 7345-04)

Transmitted for your review and comment is a copy of the captioned well application.

We would appreciate your comments on the captioned application for any conflicts or inconsistencies with the programs, plans, and objectives specific to your department. Please respond by returning this cover memo form by June 20, 1998.

Please find a map, attached, to locate the proposed well. If you have any questions about this permit application, request additional information, or request additional review time, please contact Mr. Ryan Limata of the Commission staff at 587-0255.

RESPONSE:

[ ] This well qualifies as a source which will serve as a source of potable water to a public water system (serving 25 or more people at least 60 days per year or has 15 service connections) and must receive Director of Health approval prior to its use to comply with Hawaii Administrative Rules (HAR), Title 11, Chapter 26, Rules Relating to Potable Water Systems, §§11-10-29.

[ ] This well does not qualify as a source serving a public water system (serves less than 25 people or more people at least 60 days per year or 15 service connections) and if the well water is used for drinking, the private owner should test for bacteria and chemical presence before initiating such use and routinely monitor the water quality thereafter. However, if future planned use from this source increases to meet the public water system definition, then Director of Health approval is required prior to implementation.

[ ] If the well is used to supply both potable and non-potable purposes in a single system, the user shall eliminate cross-connections and backflow connections by physically separating potable and non-potable systems by an air gap or approved backflow preventer, and by clearly labeling all non-potable spigots with warning signs to prevent inadvertent consumption of non-potable water. Backflow prevention devices should be routinely inspected and tested.

[ ] It does not appear that this well will be used for consumptive purposes and is not subject to Safe Drinking Water Regulations.

[ ] For the applicant's information, a source of possible wastewater contamination is not located near the proposed well site (information attached).

[ ] Other relevant DOH rules/regulations, information, or recommendations are attached.

[ ] No comments/objections

Contact Person: ____________________________ Phone: ____________________________

Signed: ____________________________ Date: ____________________________
PUMP INSTALLATION PERMIT APPLICATIONS FOR DROUGHT EMERGENCY USE OF WELLS

We are sending you the original and two (2) copies each of the following pump installation permit applications:

1. Kaieie Mauka Well No. 4708-02
2. Makapala Well No. 7345-04

A pump was installed in the Kaieie Well to utilize the well as an emergency source of water for our Papaikou water system.

We are planning to install a pump in the Makapala Well in the future to utilize the well as an emergency source of water for our North Kohala water system.

Both wells are owned by the United States Department of the Interior, U.S. Geological Survey. They have offered us the use of the wells during the drought emergency.

Should you have any questions, please call Mr. Owen Nishioka at (808) 961-8660.

Dennis Lee, DWS Drought Coordinator (w/o enclosure)
APPLICATION FOR PERMIT

1. APPLICANT: (circle primary contact a, b, or c) Primary Fax: 961-8657
   (a) WELL OWNER
       Firm/Name: U.S. GEOLOGICAL SURVEY
       Contact Person: CHARLIE J. Ewart
       Address: 627 ALA MOANA BLVD., SUITE 415
       HONOLULU, HI 96813
   (b) LANDOWNER
       Firm/Name: CHALON INTERNATIONAL OF HAWAII
       Contact Person: WILL GOMES
       Address: 240 KIKI ABOABO RD., LANIKAI, HI 96762
   (c) CONTRACTOR
       Firm/Name: U.S. GEOLOGICAL SURVEY
       Contact Person: CHARLIE J. Ewart
       Address: 627 ALA MOANA BLVD., SUITE 415
       HONOLULU, HI 96813

2. WELL LOCATION/NAME: MAKAPALA
   Island/HAWAII
   Address: MAKAPALA, NORTH KORALA
   Tax Map Key 3-2-005: PUR 001
   (Attach a USGS map, scale 1"=2000", and a property tax map showing well location referenced to established property boundaries.)

3. (a) PROPOSED WORK: ☐ Drill New Well ☐ Deepen ☐ Install New Pump
       ☐ Modify Existing Well ☐ Redrill ☐ Modify Pump
       ☐ Abandon/Seal * ☐ Replace Pump
   * Be sure to complete and submit well abandonment report upon completion of work.
   (b) WELL TYPE:
       ☐ Dug ☐ Bored ☐ Driven ☐ Drilled ☐ Radial

4. PROPOSED PUMP INFORMATION: Rated Pump Capacity: 40 gallons per minute
   Pump Type: ☐ Deep Well Turbine ☐ Rotary ☐ Reciprocating
   ☐ Submersible ☐ Rotary-Displacement ☐ Reciprocating
   ☐ Centrifugal ☐ Rotary-Gear ☐ Impulse
   If Pump Replacement, Existing Pump Capacity: __________ gallons per minute

5. PROPOSED USE: ☐ Municipal (including hotels, stores, etc.) ☐ Military
       ☐ Domestic (individual, noncommercial water systems) ☐ Industrial
       ☐ Irrigation (crop) ☐ Other (explain) DROUGHT EMERGENCY USE

6. (a) PROPOSED AMOUNT OF WITHDRAWAL: 57,600 gallons per day
   (b) METHOD OF FLOW MEASUREMENT: ☐ Flow-meter ☐ Open-pipe ☐ Office Plate ☐ Weir

7. PENDING ACTIONS: ☐ CDUA ☐ SMA ☐ EIS ☐ EA ☐ NONE ☐ Other (explain)

8. REMARKS, EXPLANATIONS USGS is OFFERING THEIR TEST WELL FOR THE DEPARTMENTS USE DURING THE DURATION OF THE DROUGHT PERIOD FOR AN UNDETERMINED TIME. THE QUANTITY AND QUALITY IS ADEQUATE FOR THE DEPARTMENT'S NEEDS.

(If more space is needed, continue on back)

I understand that approval of this application attaches the following standard conditions: 1) the proposed work is to be completed within two (2) years of the approval date; 2) the contractor shall submit to the Commission a well completion/abandonment report within thirty (30) days after the completion date of the permitted work; 3) monthly water use data shall be submitted to the Commission; 4) such approval shall not constitute a determination of correlative water rights and shall not guarantee the pump capacity or future use up to the permitted pump capacity.

Well Owner: U.S. GEOLOGICAL SURVEY

Signature ___________________________ Date: ___________________________

Landowner: CHALON INTERNATIONAL OF HAWAII

Signature ___________________________ Date: ___________________________

Contractor: DEPARTMENT OF WATER SUPPLY

Signature ___________________________ Date: ___________________________

For Official Use Only:

Date Received: ___________________________

Date Accepted: ___________________________

Field Checked By: ___________________________

Date: ___________________________
PROJECT LOCATION
TMK: 5-2-5: Portion of 1
State Well No. 7345-4

PROJECT SITE
USGS TEST WELL
NO. 8-7345-4
Edwin T. Sakoda  
Geologist  
State of Hawaii  
Department of Land and Natural Resources  
P.O. Box 621  
Honolulu, HI 96809  

Dear Mr. Sakoda:

We have finally compiled all of the information from the drilling and test pumping in North Kohala, and I am now presenting it to your office along with the well construction forms. This data will also be presented in the Water Resources Investigation report which is now in review.

In addition to the hydrologic data that is presented, there are other data from the program: caliper and natural gamma logs were taken from each well; salinity and temperature logs were taken from wells 7445-01 and 7549-03 during the time of drilling, in October, 1989 and February, 1990; and rock samples were collected at about 5 ft. intervals for most of the holes. There has been no effort to describe the rock samples on account of a shortage of time. Additionally, for most of the deeper intervals of the wells, i.e. below 300 ft, circulation was lost to the formation, and there are only scattered intervals from the water-bearing formations.

If there are any questions about the project or need for further information, please feel free to contact Mark Underwood of my staff at 541-2653.

Sincerely,

William Meyer  
District Chief

Enclosures

cc: Mark Underwood, Hydrologist, USGS, WRD, Honolulu, HI
WELL COMPLETION REPORT

INSTRUCTIONS: Please print or type and submit completed report within 30 days of well completion to the Division of Water & Land Development, P.O. Box 373, Honolulu, HI 96829. An as-built drawing of the well and chemical analysis, if available, should also be submitted. If necessary, phone 548-1543, Hydrology, Geology Section for assistance.

A. STATE WELL NO. 8-7549-03 WELL NAME water supply - I ISLAND Hawaii

B. LOCATION Michael Harut, 8-7549-03 RT. P.

C. WELL OWNER 5

D. DRILLING OR PUMP INSTALLATION CONTRACTOR USGS

E. TYPE OF RIG rotary-air DRILLER USGS

F. DATE OF WELL COMPLETION 9-15-93 DATE OF PUMP INSTALLATION

G. GROUND ELEVATION (msl) 277.77 ft.

H. TOTAL DEPTH OF WELL BELOW GROUND 436 ft.

I. HOLE SIZE: 15-in. dia. ft. to 12-in. ft. below ground

J. CASING INSTALLED:

- 10-in. I.D. x 0.25-in. wall solid section to 120 ft. below ground
- 12-in. I.D. x 0.35-in. wall perforated section to 120 ft. below ground

K. ANNULUS:

- Grouted from 0 ft. to 130 ft. below ground
- Gravel packed from 130 ft. to 436 ft. below ground

L. PERMANENT PUMP INSTALLATION:

- Pump type, make, serial No.
- Motor type, H.P., voltage, r.p.m.
- Depth of pump intake setting ft. below which elevation is ft.
- Depth of bottom of airlift ft. below which elevation is ft.

M. PROPOSED USE drinking water, irrigation, water supply, water well, etc.

N. INITIAL CHLORIDE ppm.

O. PUMPING TESTS: Reference point (R.P.) used:

<table>
<thead>
<tr>
<th>Date</th>
<th>Start water level</th>
<th>ft. below R.P.</th>
<th>Depth of well</th>
<th>ft. below R.P.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q. DRILLER'S LOG:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REMARKS: Date 5-20-93

Submitted by (print) Mark Underwood

Title 3

Signature Mark R. Underwood

Date 5-29-90
### Table 2

**Summary of Wells Drilled During North Kohala Project**

<table>
<thead>
<tr>
<th>Site</th>
<th>Well Number</th>
<th>Well Use</th>
<th>Datum</th>
<th>Surface Casing Depth</th>
<th>Drilled Depth</th>
<th>Water-Table Head</th>
<th>Water-Table Interval</th>
<th>Pumping</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>7345-03</td>
<td>observation</td>
<td>395.30</td>
<td>220</td>
<td>440</td>
<td>385.1</td>
<td>10.2</td>
<td>open</td>
</tr>
<tr>
<td>A</td>
<td>7345-04</td>
<td>pumping</td>
<td>395.87</td>
<td>160</td>
<td>495</td>
<td>385.6</td>
<td>10.2</td>
<td>steel/open*1</td>
</tr>
<tr>
<td>B</td>
<td>7347-04</td>
<td>observation</td>
<td>628.24</td>
<td>70</td>
<td>730</td>
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<td>pumping</td>
<td>340.54</td>
<td>80</td>
<td>405</td>
<td>330.7</td>
<td>9.8</td>
<td>open</td>
</tr>
<tr>
<td>C</td>
<td>7345-01</td>
<td>salinity</td>
<td>108.5</td>
<td>182</td>
<td>460</td>
<td>101.3</td>
<td>7.5</td>
<td>--</td>
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<tr>
<td>C</td>
<td>7345-05</td>
<td>observation</td>
<td>340.54</td>
<td>80</td>
<td>405</td>
<td>330.7</td>
<td>9.8</td>
<td>open</td>
</tr>
<tr>
<td>D</td>
<td>7647-02</td>
<td>observation</td>
<td>340.54</td>
<td>80</td>
<td>405</td>
<td>330.7</td>
<td>9.8</td>
<td>open</td>
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<tr>
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<td>observation</td>
<td>340.54</td>
<td>80</td>
<td>405</td>
<td>330.7</td>
<td>9.8</td>
<td>open</td>
</tr>
<tr>
<td>E</td>
<td>7647-04</td>
<td>observation</td>
<td>340.54</td>
<td>80</td>
<td>405</td>
<td>330.7</td>
<td>9.8</td>
<td>open</td>
</tr>
<tr>
<td>E</td>
<td>7647-05</td>
<td>observation</td>
<td>340.54</td>
<td>80</td>
<td>405</td>
<td>330.7</td>
<td>9.8</td>
<td>open</td>
</tr>
</tbody>
</table>

*perf = perforated

*1 Well was cased with solid steel down to 55 feet below water table and open hole for lower 55 feet of aquifer.

*2 Well was cased with solid steel down to water table, perforated steel to 16 ft below water table, and open for lower 74 ft.

*3 Well was cased with solid steel down to water table and perforated steel for entire 22 ft aquifer interval.

*4 Well was cased with solid steel down to water table, perforated steel to 38 ft below water table, and open for lower 40 ft.
**INSTRUCTIONS:** Please print or type and submit completed report within 30 days of well completion to the Department of Land and Natural Resources, Division of Water Resource Management. An as-built drawing of the well and chemical analysis, if available, should also be submitted. If necessary, phone 548-7449, Hydrology, Geology Section for assistance.

| A. STATE WELL NO. | 8-7451-01 | WELL NAME | Drahoron | ISLAND | Hawaii |
| B. LOCATION | Upolu | W: 28, N: 12, | TAX MAP KEY |
| C. WELL OWNER | W. M. | D. DRILLING OR PUMP INSTALLATION CONTRACTOR | D. M. | E. DRILLER | W. M. |
| D. DATE OF WELL COMPLETION | 11-01-91 | DATE OF PUMP INSTALLATION | 11-01-91 |
| G. GROUND ELEVATION (ma) | 566.65 ft. | Top of Drilling Platform (ma) | 566.65 ft. | Height of drilling platform above ground surface | 566.65 ft. |
| H. TOTAL DEPTH OF WELL BELOW GROUND | 637 ft. | Bench mark and method used to determine ground elevation | 637 ft. |
| I. HOLE SIZE | 12 inch dia. from 0 ft. to 100 ft. below ground | inch dia. from 100 ft. to 102 ft. below ground | inch dia. from 102 ft. to 105 ft. below ground |
| J. CASING INSTALLED: | \( \frac{8}{1} \) in. I.D. x 0.25 in. wall solid section to 100 ft. below ground | \( \frac{8}{1} \) in. I.D. x 0.25 in. wall perforated section to 100 ft. below ground |
| K. ANNULUS: | Grouted from 0 ft. to 100 ft. below ground | Gravel packed from 100 ft. to 100 ft. below ground |
| L. PERMANENT PUMP INSTALLATION: | Pump type, make, serial No. | Capacity | gpm |
| | Motor type, H.P., voltage, r.p.m. | Depth of pump intake setting | ft. below ground |
| | Well description, ft. below ground | Depth of bottom of airlift | ft. below ground |
| M. PROPOSED USE | Observation |
| N. INITIAL WATER LEVEL | 562.7 ft. below ground. | Date and time of measurement | 11-02-91 02:11 AM |
| O. INITIAL CHLORIDE | ppm. | Date and time of sampling | 11-02-91 02:11 AM |
| P. PUMPING TESTS: Reference point (R.P.) used: | which elevation is ft. |

<table>
<thead>
<tr>
<th>Date</th>
<th>Start water level</th>
<th>ft. below R. P.</th>
<th>End water level</th>
<th>ft. below R. P.</th>
<th>Depth of well</th>
<th>ft. below R. P.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rate (gpm)</td>
<td>Drawn-down (ft.)</td>
<td>Cl. (ppm)</td>
<td>Temp. °F</td>
<td>Rate (gpm)</td>
<td>Drawn-down (ft.)</td>
</tr>
<tr>
<td></td>
<td>to</td>
<td>to</td>
<td>to</td>
<td>to</td>
<td>to</td>
<td>to</td>
</tr>
</tbody>
</table>

**Q. DRILLER’S LOG:**

<table>
<thead>
<tr>
<th>Depth, ft.</th>
<th>Rock Description &amp; Remarks</th>
<th>Water Level, ft.</th>
<th>Depth, ft.</th>
<th>Rock Description &amp; Remarks</th>
<th>Water Level, ft.</th>
</tr>
</thead>
<tbody>
<tr>
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<td>to</td>
<td>to</td>
<td>to</td>
<td>to</td>
<td>to</td>
</tr>
</tbody>
</table>

**REMARKS:** \(A:\) \(20'14'00\) \(B:\) \(155'51'06\) \(C:\) WELL NO. 7451-01

Submitted by (print) **Mark Underwood**

Title **Hydrologist – UI65**

Signature **Mark Underwood**

Date 5-29-90
WELL COMPLETION REPORT

INSTRUCTIONS: Please print or type and submit completed report within 30 days of well completion to the Division of Water & Land Development, P.O. Box 373, Honolulu, HI 96809. An as-built drawing of the well and chemical analysis, if available, should also be submitted. If necessary, phone 548-1943, Hydrology, Geology Section for assistance.

A. STATE WELL NO. 8-7451-02

B. WELL NAME: Pumping

C. LOCATION: Wahiawa, Island of Oahu, Hawaii

D. DRILLING OR PUMP INSTALLATION CONTRACTOR: UHS

E. TYPE OF RIG: Rotary - Air

F. DATE OF WELL COMPLETION: 11-07-90

G. GROUND ELEVATION (mea) 506 ft.

H. TOTAL DEPTH OF WELL BELOW GROUND

I. HOLE SIZE: 15 inch dia. from 0 ft. to 103 ft. below ground

J. CASING INSTALLED:

K. ANNULUS:

L. PERMANENT PUMP INSTALLATION:

M. PROPOSED USE

N. INITIAL WATER LEVEL: 42.6 ft. below ground

O. INITIAL CHLORIDE

P. PUMPING TESTS:

Q. DRILLER'S LOG:

R. REMARKS: L. 20' 14" AS Low. 155' 51' 06" Well no. 7451-02

Submitted by (print): Mark Underwood

Title: Hydrologist - UHS

Signature: Mark A. Underwood

Date: 5-30-90
<table>
<thead>
<tr>
<th>Site</th>
<th>Well Number</th>
<th>Well Use</th>
<th>Datum msl</th>
<th>Surface Casing Depth (ft)</th>
<th>Casing Depth (ft)</th>
<th>Water-Table Drilled Depth (ft)</th>
<th>Water-Table Head Depth (ft)</th>
<th>Water-Table Interval (ft)</th>
<th>Pumping Method</th>
<th>Perfomance Notes</th>
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<tbody>
<tr>
<td>A</td>
<td>7345-03</td>
<td>observation</td>
<td>395.30</td>
<td>220</td>
<td>440</td>
<td>385.1</td>
<td>10.2</td>
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<td>7.5</td>
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<td>562.4</td>
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<td>4.2</td>
<td>steel perf/open*4</td>
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Explanation:

- perf = perforated
- *1 Well was cased with solid steel down to 55 feet below water table and open hole for lower 55 feet of aquifer.
- *2 Well was cased with solid steel down to water table, perforated steel to 36 ft below water table, and open for lower 74 ft.
- *3 Well was cased with solid steel down to water table and perforated steel for entire 22 ft aquifer interval.
- *4 Well was cased with solid steel down to water table, perforated steel to 38 ft below water table, and open for lower 40 ft.
<table>
<thead>
<tr>
<th>Site</th>
<th>Well</th>
<th>Interval</th>
<th>Rate</th>
<th>Steps</th>
<th>Efficiency</th>
<th>K</th>
<th>Q</th>
<th>at Q</th>
<th>#</th>
<th>Well</th>
<th>Kave</th>
<th>Bennett</th>
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<td>0.8</td>
<td>1400</td>
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* Union Mill 1 pumping test was done in 1965-66; data used in analysis reported in Akinaka and others, 1975.
** Estimation of values was based on measured or calculated values from other tests.
+ Hawi step-drawdown test was done at time of completion of well construction in 1975; data reported by Hawaiian Co. DWS, 1975.

Definition of Terms:
- r = radius from center of pumping well
- K = hydraulic conductivity of aquifer
- Q = pumping discharge rate
- gpm = gallons per minute
- ft/d = feet per day
- Kave = arithmetic average value of hydraulic conductivity from above seven analyses
- obs = observation
WELL COMPLETION REPORT

INSTRUCTIONS: Please print or type and submit completed report within 30 days of well completion to the Division of Water & Land Development, P.O. Box 373, Honolulu, HI 96829. An as-built drawing of the well and chemical analysis, if available, should also be submitted. If necessary, phone 548-7543, Hydrology Section for assistance.

A. STATE WELL NO. 7449-03  WELL NAME: Hawai - Dowl obs ISLAND: Hawaii
B. LOCATION: Hawaii, N. Kailua, Hawaii  TAX MAP KEY
C. WELL OWNER: N. Kailua, Hawaii
D. DRILLING OR PUMP INSTALLATION CONTRACTOR: N. Kailua, Hawaii
E. TYPE OF RIG: Rotary - Driller
F. DATE OF WELL COMPLETION: 8-01-89  DATE OF PUMP INSTALLATION: N. Kailua, Hawaii
G. GROUND ELEVATION (ma.s.l.) 531.17 ft.  Height of drilling platform above ground surface: ft.
H. TOTAL DEPTH OF WELL BELOW GROUND: 535
I. HOLE SIZE: 1/2 inch dia. from 0 ft. to 90 ft. below ground 1/2 inch dia. from 90 ft. to 90 ft. below ground
J. CASING INSTALLED: 8 in. I.D. x 60 ft. wall solid section to 90 ft. below ground 8 in. I.D. x 60 ft. wall perforated section to 90 ft. below ground
K. ANNULUS: Grouted from 0 ft. to 90 ft. below ground Gravel packed from 90 ft. to 90 ft. below ground
L. PERMANENT PUMP INSTALLATION:
   Pump type, make, serial No.: Capacity (gpm)
   Motor type, H.P., voltage, r.p.m.:
   Depth of pump intake setting:
   Height of drilling platform above ground surface:
   Type of perforation:
   Remarks:
M. PROPOSED USE:
N. INITIAL WATER LEVEL: 531.2 ft. below ground. Date and time of measurement: 8-01-89 1:00 P.M.
O. INITIAL CHLORIDE: 61 ppm (20 ft. well) Date and time of sampling: N. Kailua, Hawaii
P. PUMPING TESTS: Reference point (R.P.) used: 320 ft. below R.P.

Q. DRILLER'S LOG:

<table>
<thead>
<tr>
<th>Depth, ft.</th>
<th>Rock Description &amp; Remarks</th>
<th>Water Level, ft.</th>
<th>Depth, ft.</th>
<th>Rock Description &amp; Remarks</th>
<th>Water Level, ft.</th>
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</thead>
<tbody>
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</tbody>
</table>

REMARKS: lat. 20 14 27' long. 155 49 41' well no. 7449-03

Submitted by (print): Mark Underwood  Title: Hydrogeologist - USGS

Signature: Mark R. Underwood  Date: 5-29-90
Table 3
Summary of Test-Pumping Results and Analyses

<table>
<thead>
<tr>
<th>Site</th>
<th>Pumping Well</th>
<th>Pumping Interval</th>
<th>Obs Well</th>
<th>STEP DRAWDOWN ANALYSIS: Steady Q at t</th>
<th>Time measured</th>
<th>Calculated</th>
<th>Measured Bennett</th>
<th>Kave (ft/L)</th>
<th>Efficiency (%)</th>
<th>Time (hrs)</th>
<th>Q at Q pump (gpm)</th>
<th>Aquifer Observation (ft)</th>
<th>DRAWDOWN AT STEADY Q:</th>
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<tr>
<td>A</td>
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</tbody>
</table>

* Union Hill 1 pumping test was done in 1965-66; data used in analysis reported in Akinaka and others, 1975.
** Estimation of value was based on measured or calculated values from other tests.

Definition of Terms:
- $r$: radius from center of pumping well
- $K$: hydraulic conductivity of aquifer
- $Q$: pumping discharge rate
- $Q$ at $Q$ pump: gallons per minute
- $t$: time
- Kave = arithmetic average value of hydraulic conductivity from above seven analyses
- ft/d = feet per day
- obs = observation
- DWS = Department of Water Supply

1.5**
<table>
<thead>
<tr>
<th>Site</th>
<th>Well Number</th>
<th>Well Use</th>
<th>Datum msl (ft)</th>
<th>Surface Casing Depth (ft)</th>
<th>Drilled Depth (ft)</th>
<th>Water-Table Depth (ft)</th>
<th>Water-Table Head (ft)</th>
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<th>Explanation</th>
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</tbody>
</table>

Explanation:

* perf = perforated

*1 Well was cased with solid steel down to 55 feet below water table and open hole for lower 55 feet of aquifer.

*2 Well was cased with solid steel down to water table, perforated steel to 36 ft below water table, and open for lower 74 ft.

*3 Well was cased with solid steel down to water table and perforated steel for entire 22 ft aquifer interval.

*4 Well was cased with solid steel down to water table, perforated steel to 38 ft below water table, and open for lower 40 ft.
<table>
<thead>
<tr>
<th>well number</th>
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<td>°F</td>
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<td>240</td>
<td>320</td>
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</table>
INSTRUCTIONS: Please print or type and submit completed report within 30 days of well completion to the Division of Water & Land Development, P.O. Box 727, Honolulu, HI 96829. An as-built drawing of the well and chemical analysis, if available, should also be submitted, if necessary. phone 548-1443, Hydrology, Geology Section for assistance.

A. STATE WELL NO. 7-19-69 WELL NAME Hoopau N8-11 ISLAND Hawaii
B. LOCATION Ko'olau, N. Kohola, Hawaii TAX MAP KEY 8-3-07
C. WELL OWNER USGS
D. DRILLING OR PUMP INSTALLATION CONTRACTOR DRILLER USGS
E. TYPE OF RIG Potomac - 8 1/2
F. DATE OF WELL COMPLETION 8-26-89 DATE OF PUMP INSTALLATION 8-26-89
G. GROUND ELEVATION (net) 11,412. ft. Top of Drilling Platform (real)
Height of Drilling platform above ground surface in ft.
Benchmark mark and method used to determine ground elevation in ft.
H. TOTAL DEPTH OF WELL BELOW GROUND 440
I. HOLE SIZE: 12 in. dia. from 0 ft. to 123 ft. below ground
8 in. dia. from 123 ft. to 440 ft. below ground
J. CASING INSTALLED: 9 in. I.D. x 0.25 in. wall solid section to 123 ft. below ground
9 in. I.D. x 0.25 in. wall perforated section to 440 ft. below ground
Type of perforation
K. ANNULUS: Grouted from 0 ft. to 123 ft. below ground
Gravel packed from 123 ft. to 440 ft. below ground
L. PERMANENT PUMP INSTALLATION:

Pump type, make, serial No.
Motor type, H.P., voltage, R.P.M.
Depth of pump intake setting in ft. below ground
Depth of bottom of suction in ft. below ground
which elevation is ft.
which elevation is ft.
M. PROPOSED USE

N. INITIAL WATER LEVEL 40.5 ft. below ground. Date and time of measurement 8-26-89 10:00 AM
O. INITIAL CHLORIDE ppm. Date and time of sampling
P. PUMPING TESTS: Reference point (R.P.) used: which elevation is ft.

Date Start water level ft. below R.P. End water level ft. below R.P. Depth of well ft. below R.P.

Elapsed Rate Draw- Rate Draw-
1 hour (gpm) down (ft.) down (ft.)

Elapsed Rate Draw- Rate Draw-
1 hour (gpm) down (ft.) down (ft.)

Q. DRILLER'S LOG:

Depth, ft. Rock Description & Remarks Water Level ft.
Depth, ft. Rock Description & Remarks Water Level ft.

REMARKS: LAT. 20° 14' 22" N. LONG. 155° 46' 02" WELL NO. 1449-06

Submitted by (print) Mark Underwood Title Hydrologist-USGS
Signature Mark R Underwood Date 5-27-90
**WELL COMPLETION REPORT**

**INSTRUCTIONS:** Please print or type and submit completed report within 30 days of well completion to the Division of Water & Land Development, P.O. Box 373, Honolulu, HI 96809. An as-built drawing of the well and chemical analysis, if available, should be submitted. If necessary, phone 548-1543, Hydrology, Geology Section for assistance.

<table>
<thead>
<tr>
<th>A. STATE WELL NO.</th>
<th>B. LOCATION</th>
<th>C. WELL OWNER</th>
<th>D. DRILLING OR PUMP INSTALLATION CONTRACTOR</th>
<th>E. TYPE OF RIG</th>
<th>F. DATE OF WELL COMPLETION</th>
<th>G. GROUND ELEVATION (msl)</th>
<th>H. TOTAL DEPTH OF WELL BELOW GROUND</th>
<th>I. HOLE SIZE</th>
<th>J. CASING INSTALLED</th>
<th>K. ANNULUS</th>
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</thead>
<tbody>
<tr>
<td>P-7458-07</td>
<td>Kapaa, N. Kohala, Hawaii</td>
<td>WGS</td>
<td>UGS</td>
<td>10/27-87</td>
<td>54.7</td>
<td>0.25 in. solid section to 100 ft. below ground</td>
<td>429 ft. below ground</td>
<td>4.5 in. dia. from 0 ft. to 100 ft. below ground</td>
<td>0 ft. to 100 ft. below ground</td>
<td>0 ft. to 100 ft. below ground</td>
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</tbody>
</table>

<table>
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<tr>
<th>L. PERMANENT PUMP INSTALLATION:</th>
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<tbody>
<tr>
<td>Pump type, make, serial No.</td>
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<table>
<thead>
<tr>
<th>M. PROPOSED USE</th>
<th>N. INITIAL WATER LEVEL</th>
<th>O. INITIAL CHLORIDE</th>
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<td>36 ppm</td>
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<th>P. PUMPING TESTS:</th>
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</tr>
<tr>
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<table>
<thead>
<tr>
<th>Total Elapsed Time (hours)</th>
<th>Rate Drawn down (ft.)</th>
<th>Chloride (ppm)</th>
<th>Temp. °F</th>
<th>Water Level</th>
<th>Rock Description &amp; Remarks</th>
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<tbody>
<tr>
<td>0</td>
<td>10</td>
<td>4.75</td>
<td>7.1</td>
<td>3.0</td>
<td>Gravel packed from 0 to 100 ft. below ground</td>
</tr>
<tr>
<td>1/2</td>
<td>1.35</td>
<td>1.15</td>
<td>2.0</td>
<td>0.3</td>
<td>Gravel packed from 100 to 200 ft. below ground</td>
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<table>
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<tr>
<th>Q. DRILLER'S LOG:</th>
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</thead>
<tbody>
<tr>
<td>Depth, ft.</td>
</tr>
<tr>
<td>to</td>
</tr>
</tbody>
</table>

**REMARKS: LAT. 20° 14' 16" N. LONG. 156° 48' 04" WELL NO. 7456-07**

Submitted by (print) **MARK UNDERWOOD**
Title **Hydrologist**
Signature **MARK UNDERWOOD**
Date **5-29-90**
Table 2
Summary of Wells Drilled During North Kohala Project

<table>
<thead>
<tr>
<th>Site</th>
<th>Well Number</th>
<th>Well Use</th>
<th>Datum Depth (ft)</th>
<th>Surface Casing Depth (ft)</th>
<th>Depth Drilled (ft)</th>
<th>Water-Table Depth Head (ft)</th>
<th>Water-Table Interval (ft)</th>
<th>Pumping Interval</th>
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<tbody>
<tr>
<td>A</td>
<td>7345-03</td>
<td>observation</td>
<td>395.30</td>
<td>220</td>
<td>440</td>
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<td>pumping</td>
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<td>observation</td>
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<td>100</td>
<td>632</td>
<td>562.4</td>
<td>4.2</td>
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<td>7551-02</td>
<td>pumping</td>
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<td>103</td>
<td>632</td>
<td>562</td>
<td>4.2</td>
<td>open</td>
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</table>

Explanation:

* perf = perforated
* 1 Well was cased with solid steel down to 55 feet below water table and open hole for lower 55 feet of aquifer.
* 2 Well was cased with solid steel down to water table, perforated steel to 36 ft below water table, and open for lower 74 ft.
* 3 Well was cased with solid steel down to water table and perforated steel for entire 31 ft aquifer interval.
* 4 Well was cased with solid steel down to water table, perforated steel to 36 ft below water table, and open for lower 48 ft.
Table 3

Summary of Test-Pumping Results and Analyses

<table>
<thead>
<tr>
<th>Site</th>
<th>Pumping Well</th>
<th>Pumping Well Interval</th>
<th>Obs Well</th>
<th>Tester</th>
<th>Well K</th>
<th>Q at Q</th>
<th>Rm</th>
<th>Drawdown at Steady Q:</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Kave (ft/L)</td>
<td>Efficiency (ft/d)</td>
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<td></td>
<td></td>
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<td></td>
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<td>measured</td>
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<td></td>
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<td></td>
<td>Bennett (ft/d)</td>
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<table>
<thead>
<tr>
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<th>f (ft)</th>
<th>Steps</th>
<th>Efficiency</th>
<th>Steady</th>
<th>Q at Q</th>
<th>Time</th>
<th>Q at Q</th>
<th>Kave=</th>
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<tr>
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<td>5</td>
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<td>810</td>
<td>1240</td>
<td>14</td>
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<tr>
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<td>5</td>
<td>21</td>
<td>810</td>
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<tr>
<td>D</td>
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<td>900</td>
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<td>1400</td>
<td>2000</td>
<td>365</td>
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<td>2.8</td>
</tr>
<tr>
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<td>1400</td>
<td>2000</td>
<td>365</td>
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<td>2.8</td>
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<td>2000</td>
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<td>2000</td>
<td>365</td>
<td>8.7</td>
<td>2.8</td>
</tr>
</tbody>
</table>

* Union Mill 1 pumping test was done in 1965-66; data used in analysis reported in Akinata and others, 1975.
** Estimation of value was based on measured or calculated values from other tests.
+ Hawaii step-drawdown test was done at time of completion of well construction in 1975; data reported by Hawaii Co. OW, 1975.

Definition of Terms:
- r = radius from center of pumping well
- K = hydraulic conductivity of aquifer
- Q = pumping discharge rate
- Qm = observation
- gpm = gallons per minute
- ft/d = feet per day
- Kave = arithmetic average value of hydraulic conductivity from above seven analyses

*Union Mill 1 pumping test was done in 1965-66; data used in analysis reported in Akinata and others, 1975.
** Estimation of value was based on measured or calculated values from other tests.
+ Hawaii step-drawdown test was done at time of completion of well construction in 1975; data reported by Hawaii Co. OW, 1975.
<table>
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<th>ELEV.</th>
<th>OF LAND</th>
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<th>SURFACE</th>
<th>DEPTF</th>
<th>FLOW</th>
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<tr>
<td>I-</td>
<td>tude</td>
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<td>OF</td>
<td>ABOVE</td>
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</tr>
<tr>
<td>I-</td>
<td>I-</td>
<td>DATE</td>
<td>TIME</td>
<td>(FT.)</td>
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<tr>
<td>CSW</td>
<td>(G/M)</td>
<td>(G/M)</td>
<td>(G/M)</td>
<td>(G/M)</td>
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<td>8-7446-04 MAKAPALA (A)</td>
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<td>135 45 20 W</td>
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<tr>
<th>Date</th>
<th>Copper, Iron, Lead, Lithium, Merecy, Nickel, Silver, Zinc</th>
<th>Recoverable As Cu</th>
<th>Recoverable As Fe</th>
<th>Recoverable As Li</th>
<th>Recoverable As Mg</th>
<th>Recoverable As Mn</th>
<th>Recoverable As Ni</th>
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</table>

<table>
<thead>
<tr>
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<th>Alkali, Alkaline Earth, Beryllium, Boron, Chromate</th>
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<th>Recoverable As Be</th>
<th>Recoverable As Ca</th>
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<th>Recoverable As Mn</th>
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<th>Recoverable As Mg</th>
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Notes: (UG/L)
# WELL COMPLETION REPORT

**INSTRUCTIONS:** Please print or type and submit completed report within 30 days of completion to the Division of Water & Land Development, P.O. Box 373, Honolulu, HI 96806. An as-built drawing of the well and chemical analysis, if available, should also be submitted. If necessary, phone 548-1943, Hydrology, Geology Section for assistance.

**A. STATE WELL NO.: 7347-03**
- **WELL NAME:** Palani Mapoi-Koki Island
- **TAX MAP KEY:**

**B. LOCATION:** Palani, Kohala, Hawaii

**C. WELL OWNER:** UI61

**D. DRILLING OR PUMP INSTALLATION CONTRACTOR:** UI61
- **DRILLER:** UI61

**E. TYPE OF RIG:**

**F. DATE OF WELL COMPLETION:** 8-10-89
- **DATE OF PUMP INSTALLATION:**

**G. GROUND ELEVATION (masl):** 340.84 ft.
- **Height of Drilling Platform:** 340.84 ft.
- **Top of Drilling Platform (DBL):** 340.84 ft.

**H. TOTAL DEPTH OF WELL BELOW GROUND:** 405 ft.

**I. HOLE SIZE:**
- **Inch dia. from 0 ft. to 50 ft. below ground:** 12
- **Inch dia. from 2 ft. to 405 ft. below ground:** 12
- **Inch dia. from 0 ft. to 50 ft. below ground:** 12

**J. CASING INSTALLED:**
- **In. I.D. x 0.25 in. wall solid section:** 50 ft. below ground
- **In. I.D. x 0.25 in. wall perforated section:** 50 ft. below ground

**K. ANNULUS:**
- **Grouted from 0 ft. to 50 ft. below ground:**
- **Gravel packed from 0 ft. to 50 ft. below ground:**

**L. PERMANENT PUMP INSTALLATION:**
- **Pump type, make, serial No.:**
- **Capacity:**
- **Motor type, R.P.M., voltage, P.H.:**
- **Depth of pump intake setting:**
- **Depth of bottom of airliner:**
- **which elevation is ft.:**

**M. PROPOSED USE:**

**N. INITIAL WATER LEVEL:** 310.7 ft. below ground.

**O. INITIAL CHLORIDE:**
- **ppm:**

**P. PUMPING TESTS:**
- **Reference point (R.P.) used:**
- **Date and time of sampling:**

<table>
<thead>
<tr>
<th>Depth of well</th>
<th>Time elapsed</th>
<th>Rate (gpm)</th>
<th>Draw down (ft.)</th>
<th>Cl- (ppm)</th>
<th>Temp. °F</th>
<th>Depth of well</th>
<th>Time elapsed</th>
<th>Rate (gpm)</th>
<th>Draw down (ft.)</th>
<th>Cl- (ppm)</th>
<th>Temp. °F</th>
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</thead>
<tbody>
<tr>
<td>ft. below R. P.</td>
<td>to</td>
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<td>ft. below R. P.</td>
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<td>ft. below R. P.</td>
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**Q. DRILLER’S LOG:**

<table>
<thead>
<tr>
<th>Depth, ft.</th>
<th>Rock Description &amp; Remarks</th>
<th>Water Level, ft.</th>
<th>Depth, ft.</th>
<th>Rock Description &amp; Remarks</th>
<th>Water Level, ft.</th>
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</thead>
<tbody>
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</tbody>
</table>

**REMARKS:** 1A1, 20°19'56"N, 155°47'01"W, WELL NO. 1347-03

Submitted by (print): **MARK UNDERWOOD**
- **Title:** Hydrologist - UI61
- **Signature:** **MARK R. UNDERWOOD**
- **Date:** 5-29-90
### Table 2
Summary of Wells Drilled During North Kohala Project

<table>
<thead>
<tr>
<th>Site</th>
<th>Well Number</th>
<th>Well Use</th>
<th>Datum msl (ft)</th>
<th>Surface Casing Depth (ft)</th>
<th>Depth Drilled (ft)</th>
<th>Water-Table Head (ft)</th>
<th>Pumping Interval</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>7345-03</td>
<td>observation</td>
<td>359.30</td>
<td>220</td>
<td>440</td>
<td>385.1</td>
<td>10.2</td>
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<tr>
<td>A</td>
<td>7345-04</td>
<td>pumping</td>
<td>359.87</td>
<td>140</td>
<td>495</td>
<td>385.6</td>
<td>10.2</td>
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<td>B</td>
<td>7347-04</td>
<td>observation</td>
<td>630.43</td>
<td>100</td>
<td>730</td>
<td>619.0</td>
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<td>7347-05</td>
<td>pumping</td>
<td>628.24</td>
<td>70</td>
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<td>11.4</td>
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<td>D</td>
<td>7449-01</td>
<td>salinity</td>
<td>180.5</td>
<td>182</td>
<td>460</td>
<td>101.3</td>
<td>7.5</td>
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<tr>
<td>E</td>
<td>7447-03</td>
<td>observation</td>
<td>340.54</td>
<td>80</td>
<td>405</td>
<td>330.7</td>
<td>9.8</td>
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<td>123</td>
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<td>pumping</td>
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<td>541.17</td>
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<td>I</td>
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<td>299.48</td>
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<td>566.03</td>
<td>103</td>
<td>632</td>
<td>562</td>
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</tbody>
</table>

Explanation:
- **Perf** = perforated
- *1 Well was cased with solid steel down to 55 feet below water table and open hole for lower 55 feet of aquifer.
- *2 Well was cased with solid steel down to water table, perforated steel to 36 ft below water table, and open for lower 74 ft.
- *3 Well was cased with solid steel down to water table and perforated steel for entire 22 ft aquifer interval.
- *4 Well was cased with solid steel down to water table, perforated steel to 38 ft below water table, and open for lower 40 ft.
Table 3

<table>
<thead>
<tr>
<th>Site</th>
<th>Well</th>
<th>Interval</th>
<th>Obs Well</th>
<th>Pumping Fund</th>
<th>STEADY DRAWDOWN ANALYSIS:</th>
<th>Steady S Time</th>
<th>measured</th>
<th>calculated</th>
<th>measured</th>
<th>Benne</th>
<th>Kave</th>
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<tbody>
<tr>
<td>A</td>
<td>7343-04</td>
<td>55</td>
<td>50</td>
<td>6</td>
<td>31</td>
<td>550</td>
<td>900</td>
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<td>14.5</td>
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<td>40</td>
<td>810</td>
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<td>1.6</td>
<td>0.31</td>
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<td>5</td>
<td>31</td>
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<td>14</td>
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<tr>
<td>D</td>
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<td>1200</td>
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<td>3</td>
<td>36</td>
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<td>2800</td>
<td>365</td>
<td>8.7</td>
<td>3.2</td>
<td>0.8</td>
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Kave=1090

* Union Mill 1 pumping test was done in 1963-64; data used in analysis reported in Akinaka and others, 1975.
** Estimation of value was based on measured or calculated values from other tests.
+ Hawi step-drawdown test was done at time of completion of well construction in 1975; data reported by Hawaii Co. DWS, 1975.

Definition of Terms:
- \( r \) = radius from center of pumping well
- \( K \) = hydraulic conductivity of aquifer
- \( Q \) = pumping discharge rate
- \( gpm \) = gallons per minute
- \( ft/d \) = feet per day
- \( obs \) = observation
- \( Kave \) = arithmetic average value of hydraulic conductivity from above seven analyses
<table>
<thead>
<tr>
<th>DATEgrund</th>
<th>TIME</th>
<th>LAT.</th>
<th>LONG.</th>
<th>WELL</th>
<th>TOTAL TANNER</th>
<th>NOD</th>
<th>FEET</th>
<th>G/M</th>
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<td>8-7345-04 MAKAPALA (A)</td>
<td>20 13 07 N 155 45 22 W</td>
<td>07-07-69</td>
<td>1530</td>
<td>386</td>
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<td>8-7345-02 RAKI (B)</td>
<td>20 14 28 N 155 44 42 W</td>
<td>08-04-69</td>
<td>0800</td>
<td>541</td>
<td>1530</td>
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<tr>
<td>8-7345-02 BALAI L MAIKAI (E)</td>
<td>20 13 32 N 155 48 06 W</td>
<td>08-15-69</td>
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<td>342</td>
<td>3100</td>
<td>1000</td>
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<tr>
<td>8-7448-07 NOMAPA (F)</td>
<td>20 14 28 N 155 48 52 W</td>
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<td>8-7447-05 BALAI L MAUKA (B)</td>
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<th>MAGNE-</th>
<th>POTT-</th>
<th>ALKA-</th>
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<tbody>
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<td>PH</td>
<td>TEMPER-</td>
<td>TOTAL DISSOL</td>
<td>DIS-</td>
<td>DIS-</td>
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<tr>
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WELL COMPLETION REPORT

INSTRUCTIONS: Please print or type and submit completed report within 30 days of well completion to the Division of Water and Land Development, P.O. Box 373, Honolulu, HI 96809. An as-built drawing of the well and chemical analysis of available, should also be submitted. If necessary, phone 548-1541, Hydrology, Geology Section for assistance.

A. STATE WELL NO. 7445 - OI
B. LOCATION (Full street address or property line)
C. WELL OWNER
D. DRILLING OR PUMP INSTALLATION CONTRACTOR
E. TYPE OF RIG
F. DATE OF WELL COMPLETION
G. GROUND ELEVATION (ft)
H. TOTAL DEPTH OF WELL BELOW GROUND
I. HOLE SIZE
J. CASING INSTALLED
K. ANNULUS
L. PERMANENT PUMP INSTALLATION
M. PROPOSED USE
N. INITIAL WATER LEVEL
O. INITIAL CHLORIDE
P. PUMPING TESTS: Reference point (R.P.) used
Q. DRILLER'S LOG
R. REMARKS

Submitted by (print) MARK UNDERWOOD
Title Hydrologist - USGS
Signature MARK R. UNDERWOOD
Date 5-29-93
### Table 2
**Summary of Wells Drilled During North Kohala Project**

<table>
<thead>
<tr>
<th>Site</th>
<th>Well</th>
<th>Water Use</th>
<th>Datum msl (ft)</th>
<th>Surface Casing Depth (ft)</th>
<th>Drilled Depth (ft)</th>
<th>Water-Table Depth (ft)</th>
<th>Water-Table Interval (ft)</th>
<th>Piping Head (ft)</th>
<th>Pumping Interval</th>
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<tr>
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<td>305.30</td>
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</table>

**Explanation:**

 perf = perforated

*1 Well was cased with solid steel down to 55 feet below water table and open hole for lower 55 feet of aquifer.

*2 Well was cased with solid steel down to water table, perforated steel to 36 ft below water table, and open for lower 74 ft.

*3 Well was cased with solid steel down to water table and perforated steel for entire 22 ft aquifer interval.

*4 Well was cased with solid steel down to water table, perforated steel to 38 ft below water table, and open for lower 40 ft.
# WELL COMPLETION REPORT

**State of Hawaii**  
Commission on Water Resource Management  
Department of Land and Natural Resources  
Division of Water Resource Management

**INSTRUCTIONS:** Please print or type and submit completed report within 30 days of well completion to the Division of Water & Land Development, P.O. Box 372, Honolulu, HI 96809. An as-built drawing of the well and chemical analysis, if available, should also be submitted. If necessary, phone 848-7641, Hydrology, Geology Section for assistance.

## A. STATE WELL NO. 73-47-04

**WELL NAME:** Holeo Naohka-05, Island: Hawaii

**TAX MAP KEY:** S-3-04

## B. LOCATION

**Location:** Holeo, N Kohala, Hawaii

## C. WELL OWNER

**Name:** USGS

## D. DRILLING OR PUMP INSTALLATION CONTRACTOR

**Name:** USGS

## E. TYPE OF RIG

**Name:** Rotary - 9 in.

**DRILLER:** USGS

## F. DATE OF WELL COMPLETION

**Date:** 10-01-89

**DATE OF PUMP INSTALLATION:**

## G. GROUND ELEVATION (sea)

**Height:** 420 ft.

**Top of Drilling Platform (ft):** 420 ft.

**Height of drilling platform above ground surface:** 11 ft.

**Weight used to determine ground elevation:** 11 ft.

## H. TOTAL DEPTH OF WELL BELOW GROUND

**Depth:** 280 ft.

## I. HOLE SIZE

**Depth:** 12 inch dia. from 0 ft. to 100 ft. below ground

**Depth:** 1 inch dia. from 100 ft. to 720 ft. below ground

## J. CASING INSTALLED

**Depth:** 8 in. I.D. x 0.35 in. wall solid section from 0 ft. below ground

**Depth:** 8 in. I.D. x 0.35 in. wall perforated section from 100 ft. below ground

**Type of perforation:**

## K. ANNULUS

**Gravel packed:**

**Grouted from:** 0 ft. to 100 ft. below ground

**Grouted from:** 100 ft. below ground

**Location:**

## L. PERMANENT PUMP INSTALLATION

**Pump type:**

**Make:**

**Model:**

**Serial No.:**

**Capacity:**

**Motor type:**

**H.P.:**

**Voltage:**

**R.P.M.:**

**Flow rate:**

**Rate (gpm):**

**Flow down (ft.):**

**Flow down (ppm):**

## M. PROPOSED USE

**Development:** 1/2

**For:**

**Name:** USGS

**Date and time of sampling:**

## N. INITIAL WATER LEVEL

**Date and time:**

**Depth:**

## O. INITIAL CHLORIDE

**Date and time:**

**Depth:**

## P. PUMP TESTING

**Date:**

**Start water level:**

**End water level:**

**Depth of well:**

**Start water level:**

**End water level:**

**Depth of well:**

## Q. DRILLER'S LOG

**Depth:**

**Rock Description & Remarks:**

**Water Level:**

## O. Remarks

**Date and time:**

**Location:**

**Type:**

**Owner:**

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</tbody>
</table>

**REFERENCES:**

**Box 373, Honolulu, HI 96809**

**Department of Land and Natural Resources**

**Division of Water Resource Management**

**State of Hawaii**

**WELL COMPLETION REPORT**

**REMARKS:**

**Date:** 5-29-90

**Submitted by:**

**Title:** Hydrologist - USGS

**Signature:**

**Date:** 5-29-90
INSTRUCTIONS: Please print or type and submit complete report within 30 days of well completion to the Division of Water & Land Development, P.O. Box 373, Honolulu, HI 96819. An as-built drawing of the well and chemical analyses, if available, should also be submitted. If necessary, phone 548-7443, Hydrology, Geology Section for assistance.

A. STATE WELL NO. 7347-05
B. WELL NAME Hakului, Waikelo, Pumping Land, Hawaii
C. WELL OWNER U.S.S.
D. DRILLING OR PUMP INSTALLATION CONTRACTOR U.S.S.
E. DATE OF COMPLETION 10-12-79
F. DATE OF PUMP INSTALLATION 10-19-79
G. GROUND ELEVATION (masl) 60.4 ft.
H. TOTAL DEPTH OF WELL BELOW GROUND 730 ft.
I. HOLE SIZE
- 15 inch dia. from 0 ft. to 70 ft. below ground
- 15 inch dia. from 70 ft. to 255 ft. below ground
- 15 inch dia. from 255 ft. to 930 ft. below ground
J. CASING INSTALLED: 12 in. I.D. x 0.375 in. wall solid section to 70 ft. below ground
- 12 in. I.D. x 0.375 in. wall perforated section to 255 ft. below ground
- 12 in. I.D. x 0.375 in. wall perforated section to 930 ft. below ground
K. ANNULUS:
- Grouted from 0 ft. to 70 ft. below ground
- Gravel packed from 0 ft. to 70 ft. below ground
L. PERMANENT PUMP INSTALLATION:
- Pump type, make, serial No. Capacity gpm
- Motor type, H.P., voltage, F.P.M.
- Depth of pump intake setting ft. below which elevation is ft.
- Depth of bottom of airlift ft. below which elevation is ft.
M. PROPOSED USE:
N. INITIAL WATER LEVEL 648 ft. below ground.
O. INITIAL CHLORIDE 19 ppm.
P. PUMPING TESTS: Reference point (R.P.) used: GPS which elevation is 63.2 ft.

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Q. DRILLER'S LOG:

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REMARKS: Lat. 20° 13' 40"  Long 155° 41' 23" W. 1341.05
Table 2

Summary of Wells Drilled During North Kohala Project

<table>
<thead>
<tr>
<th>Site</th>
<th>Well Number</th>
<th>Use</th>
<th>Datum (ft)</th>
<th>Surface Casing Depth (ft)</th>
<th>Depth Drilled (ft)</th>
<th>Water-Table Depth (ft)</th>
<th>Pumping Interval</th>
<th>Remarks</th>
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</table>

Explanation:
perf = perforated

*1 Well was cased with solid steel down to 55 feet below water table and open hole for lower 55 feet of aquifer.
*2 Well was cased with solid steel down to water table, perforated steel to 36 ft below water table, and open for lower 74 ft.
*3 Well was cased with solid steel down to water table and perforated steel for entire 22 ft aquifer interval.
*4 Well was cased with solid steel down to water table, perforated steel to 38 ft below water table, and open for lower 40 ft.
Table 3
Summary of Test-Pumping Results and Analyses

<table>
<thead>
<tr>
<th>Site</th>
<th>Pumping Well number</th>
<th>Pumping Interval (ft)</th>
<th>Obs Well Interval (ft)</th>
<th>Steps Efficiency (ft/d)</th>
<th>Steady Drawdown (ft)</th>
<th>Time at Q~ing aquifer (hrs)</th>
<th>Kave (gpm)</th>
<th>K (ft)</th>
<th>Bennett</th>
<th>Drawdown at Steady Q</th>
<th>Measured</th>
<th>Calculated</th>
<th>Measured</th>
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* Union Mill 1 pumping test was done in 1965-66; data used in analyses reported in Akinaka and others, 1975.
** Estimation of value was based on measured or calculated values from other tests.
+ Hawi step-drawdown test was done at time of completion of well construction in 1975; data reported by Hawaii Co. DWS, 1975.

Definition of Terms:
- r = radius from center of pumping well
- K = hydraulic conductivity of aquifer
- Q = pumping discharge rate (gpm = gallons per minute)
- Kave = arithmetic average value of hydraulic conductivity from above seven analyses
- ft/d = feet per day
- obs = observation
<table>
<thead>
<tr>
<th>Location</th>
<th>Date</th>
<th>Time</th>
<th>Tide</th>
<th>Datum</th>
<th>Rate</th>
<th>Well</th>
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**Water Quality Data**

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**Water Composition**

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**NOTES**

- All measurements are approximate and may vary due to natural fluctuations.
- Additional water quality data is available for further analysis.
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**Notes:**
- The table above lists various chemical concentrations in different units across different dates.
- The units used are typically in parts per million (ppm) or parts per billion (ppb).
- The values indicate the concentration levels of various chemicals in the water supply.
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<th>Ethyl</th>
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</table>
The Honorable William W. Paty, Chairperson
Commission on Water Resource Management
Department of Land and Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Paty:

SUBJECT: WELL CONSTRUCTION PERMIT APPLICATIONS
NORTH KOHALA EXPLORATORY AND OBSERVATION WELLS
STATE WELL NOS. 7451-01M and 02M, and 7445-02M
NORTH KOHALA, HAWAII
(United States Geological Survey, Water Resources Division)

Thank you for the opportunity to review the subject documents. We have reviewed the applications and have the following comments to offer:

1. The permit applications indicate that the wells will be for pumping tests and/or observation purposes in a groundwater availability study. However, if any of the wells should be converted to domestic use and serve a public water system, they will be subject to the Department's Administrative Rules, Title 11, Chapter 20, "Potable Water Systems." Chapter 20 defines a public water system as a system which serves 25 or more individuals at least 60 days per year or has a minimum of 15 service connections.

2. Section 11-20-29 of Chapter 20 requires that a new source of potable water serving a public water system be approved by the Director of Health prior to its use. Such an approval is based primarily upon the submission of a satisfactory engineering report which addresses the requirements set in Section 11-20-29.

3. The state well number designations appear to be inconsistent with those assigned to the previous set of North Kohala Exploratory and Observation well construction permit applications (State Well Nos. 7345-03, 7345-01M & 2M, 7347-01M & 2M, 7445-01M, 7448-06, 7448-01M to 03M, 7449-01M, and 7549-01M). In the previous applications,
only wells designated solely for observation purposes were identified by the letter "M." Wells which were designated for pumping tests and long-term observation were not given well numbers ending with an "M."

If you should have any questions, please contact the Drinking Water Program at 548-2235.

Very truly yours,

[Signature]

For JOHN C. LEWIN, M.D.
Director of Health
TO: United States Geological Survey
Water Resources Division
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

In accordance with the Department of Land and Natural Resources Administrative Rules, Section 13-168, entitled "Water Use, Wells, and Stream Diversion Works", your application to construct and test Well No. 7451-01M within Tax Map Key: 5-5-06 is approved subject to the following conditions:

1. The Division of Water and Land Development (DOWALD), Geology-Hydrology Section, shall be notified at 548-7619, before any work covered by this permit commences.

2. The well shall be used for monitoring and testing only.

3. The following shall be submitted to DOWALD, P.O. Box 373, Honolulu, Hawaii 96809 within 30 days after completion of the well:
   a. Well Completion Report.
   b. Elevation (referenced to mean sea level) survey by a Hawaii-licensed surveyor.
   c. As-built sectional drawing of the well.
   d. Plot plan and map showing the exact location of the well.
   e. Driller's log, geologic log, and salinity log.
   f. Periodic reports of monitoring and testing results.
4. The applicant shall comply with all applicable laws, rules, and ordinances.

5. This permit may be revoked if work is not started within six months of date of issuance or if work is suspended or abandoned for six months. The work shall be completed within two years of the date of issuance.

6. Upon discontinuance of use, the applicant shall seal the well with cement grout by permit from the Commission.

JAN 22 1989
Date of Issuance

cc: Department of Health
    Drinking Water Program
    Ground Water Protection Program
    Hawaii Department of Water Supply
WELL CONSTRUCTION PERMIT

for
North Kohala Observation Well (site J, Well B)
State Well No. 7451-02M
North Kohala, Hawaii

TO: United States Geological Survey
Water Resources Division
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

In accordance with the Department of Land and Natural Resources Administrative Rules, Section 13-168, entitled "Water Use, Wells, and Stream Diversion Works", your application to construct and test Well No. 7451-02M within Tax Map Key: 5-5-06 is approved subject to the following conditions:

1. The Division of Water and Land Development (DOWALD), Geology-Hydrology Section, shall be notified at 548-7619, before any work covered by this permit commences.

2. The well shall be used for monitoring and testing only.

3. The following shall be submitted to DOWALD, P.O. Box 373, Honolulu, Hawaii 96809 within 30 days after completion of the well:
   a. Well Completion Report.
   b. Elevation (referenced to mean sea level) survey by a Hawaii-licensed surveyor.
   c. As-built sectional drawing of the well.
   d. Plot plan and map showing the exact location of the well.
   e. Driller's log, geologic log, and salinity log.
   f. Periodic reports of monitoring and testing results.
4. The applicant shall comply with all applicable laws, rules, and ordinances.
5. This permit may be revoked if work is not started within six months of date of issuance or if work is suspended or abandoned for six months. The work shall be completed within two years of the date of issuance.
6. Upon discontinuance of use, the applicant shall seal the well with cement grout by permit from the Commission.

JUN 22 1989
Date of Issuance

cc: Department of Health
    Drinking Water Program
    Ground Water Protection Program
    Hawaii Department of Water Supply
TO: United States Geological Survey
Water Resources Division
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

In accordance with the Department of Land and Natural Resources Administrative Rules, Section 13-168, entitled "Water Use, Wells, and Stream Diversion Works", your application to construct and test Well No. 7445-02M within Tax Map Key: 5-3-07 is approved subject to the following conditions:

1. The Division of Water and Land Development (DOWALD), Geology-Hydrology Section, shall be notified at 548-7619, before any work covered by this permit commences.

2. The well shall be used for monitoring and testing only.

3. The following shall be submitted to DOWALD, P.O. Box 373, Honolulu, Hawaii 96809 within 30 days after completion of the well:
   a. Well Completion Report.
   b. Elevation (referenced to mean sea level) survey by a Hawaii-licensed surveyor.
   c. As-built sectional drawing of the well.
   d. Plot plan and map showing the exact location of the well.
   e. Driller's log, geologic log, and salinity log.
   f. Periodic reports of monitoring and testing results.
4. The applicant shall comply with all applicable laws, rules, and ordinances.

5. This permit may be revoked if work is not started within six months of date of issuance or if work is suspended or abandoned for six months. The work shall be completed within two years of the date of issuance.

6. Upon discontinuance of use, the applicant shall seal the well with cement grout by permit from the Commission.

JN 2 2 1989
Date of Issuance

cc: Department of Health
Drinking Water Program
Ground Water Protection Program
Hawaii Department of Water Supply
June 9, 1989

United States Geological Survey
Water Resources Division
577 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

Gentlemen:

The Commission on Water Resource Management will be acting upon your application for well construction permit for North Kohala Observation Wells at its meeting on June 14, 1989, at 9:00 a.m. in the Board Room 117, 1151 Punchbowl Street, Honolulu. Your application will be included on the agenda as Item 2 (attached).

You, or your representative, are invited to attend the meeting.

Sincerely,

[Signature]

MUNABU TAGOMORI
Deputy Director
June 2, 1989

Mr. Manabu Tagomori
Deputy Director
Department of Land and Natural Resources
Commission on Water Resource Management
P.O. Box 621
Honolulu, HI 96809

WELL CONSTRUCTION PERMIT APPLICATIONS
NORTH KOHALA OBSERVATION WELL, SITE J, WELL A (7451-01M)
NORTH KOHALA OBSERVATION WELL, SITE J, WELL B (7451-02M)
NORTH KOHALA OBSERVATION WELL, SITE D, COASTAL (7445-02M)

We have no objections to the permit applications for the observation wells. We believe that the data obtained will assist in the determination of the extent of the ground water aquifer.

A. H. W.Ham Seiwak
Manager

...Water brings progress...
Honorable John C. Lewin, M.D.
Director of Health
Department of Health
1250 Punchbowl Street
Honolulu, Hawaii 96813

Attention: Mr. Thomas Arimani, Drinking Water Program

Dear Dr. Lewin:

Well Construction Permit Applications

In accordance with the Department of Land and Natural Resources Administrative Rules, Section 13-168-19(c), we are sending you a copy of the following permit applications:

Haenapili Wells P-1 and P-2 (5650-01.05)
N. Kohala Observation Well, Site J, Well A (7451-01)1)
N. Kohala Observation Well, Site J, Well B (7451-02)1)
N. Kohala Observation Well, Site D, Coastal (7445-01)1)

Please submit your comments to us, orally or in writing, within three weeks from the date of this letter.

If you have any questions, please contact Iwabu Tanemori at 548-7233.

Very truly yours,

WILLIAM W. PATY

Enc.
May 26, 1989

Mr. William Sewake, Manager  
Department of Water Supply  
County of Hawaii  
25 Aupuni Street  
Hilo, Hawaii 96720  

Dear Mr. Sewake:

Well Construction Permit Applications

We are sending you a copy of the following permit applications for your review and comments:

North Kohala Observation Well, Site J, Well A (7451-01M)  
North Kohala Observation Well, Site J, Well B (7451-02M)  
North Kohala Observation Well, Site D, Coastal (7445-02M)

Please submit your comments to us, orally or in writing, within three weeks from the date of this letter.

If you have any questions, please contact Dan Lum at 548-7843.

Sincerely,

[Signature]

MANABU TAGOMORI  
Deputy Director

Enc.
May 26, 1989

USGS-WRD
677 Ali Iiwaana Blvd., Suite 415
Honolulu, Hawaii 96813

Gentlemen:

We acknowledge receipt of your applications to construct three observation wells in North Kohala.

My staff is processing the applications and will contact your staff should there be any questions.

Sincerely,

[Signature]

MANABU TAGOMORI
Deputy Director

ES:ko
APPLICATION FOR

WELL CONSTRUCTION PERMIT
PUMP INSTALLATION PERMIT

INSTRUCTIONS: Please print or type and send completed application with attachments to the Division of Water & Land Development, P.O. Box 372, Honolulu, Hawaii 96813. Application must be accompanied by a non-refundable filing fee of $25.00 payable to the Department of Land and Natural Resources. (Filing fee waived for government agencies.) If necessary, phone 144-1141. Hydrology/Geology Section for assistance.

1. WELL LOCATION
   Island Hawaii
   Tax Map Key
   Address
   (Attach a USGS map (scale 1"=2000') and property tax map showing well location referenced to established property boundaries.)

2. WELL OWNER
   Landowner
   Firm Name
   Contact Person
   Address
   Phone

3. PROPOSED CONTRACTOR FOR:
   Contractor's License No.
   Well Drilling Pump Installation
   Name
   Address
   Phone

4. PROPOSED WORK
   Drill New Well
   Deepen
   Alter
   Install New Pump
   Replace Pump
   Redrill
   Abandon
   Modify Pump
   (Briefly describe the proposed work and fill in the diagram on the back of this form.)

5. PROPOSED USE
   Municipal
   Domestic
   Irrigation
   Industrial
   Other (specify) shallow, deep, injection well

6. PROPOSED AMOUNT OF WITHDRAWAL
   gallons per day

7. PROPOSED PUMP INFORMATION
   Pump Type
   Motor
   Rated Pump Capacity
   gallons per minute (gpm)
   Centrifugal
   Gas
   Electric
   Vertical Turbine
   Submersible

Well Owner (print) USGS-WE-0 Landowner (print) State of Hawaii

Signature Date

For Official Use Only:
Field Checked By
Date
Latitude
Longitude
Hydrologic Unit
State Well No. 7451-01M (G-A)
APPLICATION FOR

PUMP INSTALLATION PERMIT

INSTRUCTIONS: Please print or type and send completed application with attachments to the Division of Water and Land Development, P.O. Box 353, Honolulu, Hawaii 96802. Application must be accompanied by a non-refundable filing fee of $125.00 payable to the Department of Land and Natural Resources. If necessary, phone 541-2442, Hydrology/Gis Section for assistance.

1. WELL LOCATION

Island: Hawaii  Tax Map Key: 76, Sec 5, Pt. 1106, Lot 2, Well B
Address: Kaiulani Airport Rd. North Kohala, Hawaii

(Attach a USGS map (scale 1"=2000') and property tax map showing well location referenced to established property boundaries.)

2. WELL OWNER

Firm Name: USGS-WRO  Firm Name:
Contact Person: Mark R. Bacorn  Contact Person:
Address: 67-779 Puna Road, Suite 101  Address:
Phone: 808-935-55  Phone:

3. PROPOSED CONTRACTOR FOR:  ☑ Well Drilling  ☐ Pump Installation

Name:  Phone:
Address:  Contractor's License No.:

4. PROPOSED WORK

☑ Drill New Well  ☐ Deepen  ☐ Redrill
☐ Alter  ☐ Seal  ☐ Abandon
☐ Install New Pump  ☐ Replace Pump  ☐ Modify Pump

(Briefly describe the proposed work and fill in the diagram on the back of this form.)

5. PROPOSED USE

☐ Municipal (including hotels, stores, etc.)  ☐ Military
☐ Domestic (individual, noncommercial water systems)  ☐ Industrial
☐ Irrigation (specify)  ☐ Other (specify)  ☑ Leasing

6. PROPOSED AMOUNT OF WITHDRAWAL

______ gallons per day

7. PROPOSED PUMP INFORMATION

Pump Type:  ☑ Vertical Turbine  ☐ Submersible  ☐ Centrifugal
Motor:  ☐ Diesel  ☐ Gas  ☐ Electric:  Rated Horsepower
Rated Pump Capacity  gallons per minute (gpm)

----------

Well Owner (print): USGS-WRO  Landowner (print): State of Hawaii
Signature:  Signature:  Date:  Date:

For Official Use Only:

Field checked By:  Latitude:  Hydrologic Unit
Date:  Longitude:  State Well No.: 7451-0241 (M-8)
APPLICATION FOR

PUMP INSTALLATION PERMIT

INSTRUCTIONS: Please print or type and send completed application with attachments to the Division of Water and Land Development, P.O. Box 271, Honolulu, Hawaii 96809. Application must be accompanied by a non-refundable filing fee of $12.00 payable to the Department of Land and Natural Resources. (Filing fee waived for government agencies.) If necessary, phone 541-7432, Hydrology/Geology Section for assistance.

1. WELL LOCATION

Island Hawaii Tax Map Key 03-03-07
Address Halawa # North Kohala

(Attach a USGS map (scale 1"=2000') and property tax map showing well location referenced to established property boundaries.)

2. WELL OWNER

Landowner

Firm Name USGS-WRD
Contact Person Mark F. Underwood
Address 677 Ala Moana Blvd Suite 4F
Honolulu, HI 96813
Phone 541-2455

3. PROPOSED CONTRACTOR

Contractor: USGS
Address 677 Ala Moana Blvd Suite 4F
Honolulu, HI 96813

4. PROPOSED WORK

Drill New Well
Alter
Install New Pump
Replace Pump
Redrill
Seal
Abandon
Deepen
Modify Pump

(Briefly describe the proposed work and fill in the diagram on the back of this form.)

5. PROPOSED USE

Municipal (including hotels, stores, etc.)
Domestic (individual, noncommercial water systems)
Irrigation (specify)
Military
Industrial
Other (specify)

6. PROPOSED AMOUNT OF WITHDRAWAL

0 gallons per day

7. PROPOSED PUMP INFORMATION

Pump Type: Vertical Turbine
Motor: Diesel
Rated Pump Capacity
Rated Horsepower

For Official Use Only: Latitude Hydrologic Unit

Field Checked By S.B. (SITE 0-COASTAL)

Signature Date 5/17/93

Well Owner (print) USGS-WRD

Landowner (print) Claude Test (of the)

Signature Date 5/17/93
APPLICATION FOR

WELL CONSTRUCTION PERMIT

PUMP INSTALLATION PERMIT

INSTRUCTIONS: Please print or type and mail completed application with attachments to the address below. Application must be accompanied by a non-refundable filing fee of $50.00 payable to the Department of Land and Natural Resources. (Filing fee waived for government agencies.) If necessary, phone 808-587-4012, Hydrology/Geology Section for assistance.

1. WELL LOCATION

Island: Hawaii

Tax Map Key: 7N 5S 6U 5 Plat 106

Address: Uahau Airport Rd., North Kohala, Hawaii

(Attach a USGS map (scale 1"=2000') and property tax map showing well location referenced to established property boundaries.)

2. WELL OWNER

Firm Name: USGS-WED

Contact Person: Mark R. Ahlstrom

Address: 677 Alamoana Blvd., Suite 650

Hawaii, HI 96813

Phone: 808-228-5440

3. PROPOSED CONTRACTOR FOR: □ Well Drilling □ Pump Installation

Name: □ Landowner

Contractor’s License No. □

Address: □

Phone: □

4. PROPOSED WORK

□ Drill New Well □ Deepen □ Redrill

□ Alter □ Seal □ Abandon

□ Install New Pump □ Replace Pump □ Modify Pump

(Briefly describe the proposed work and fill in the diagram on the back of this form.)

5. PROPOSED USE

□ Municipal (including hotels, stores, etc.) □ Military

□ Domestic (individual, noncommercial water systems) □ Industrial

□ Irrigation (specify) □ Other (specify) short-term pumping, irrigation

6. PROPOSED AMOUNT OF WITHDRAWAL

□ Gallons per day

7. PROPOSED PUMP INFORMATION

Pump Type: □ Vertical Turbine □ Submersible □ Centrifugal

Motor: □ Diesel □ Gas □ Electric:

Rated Pump Capacity: □ Gallons per minute (gpm)

Well Owner (print): USGS-WED

Landowner (print): State of Hawaii

Signature: □

Date: □

For Official Use Only:

Field Checked By: □ Latitude □ Hydrologic Unit

Date: □ Longitude □ State Well No. 11451-01N (J-A)
APPLICATION FOR
WELL CONSTRUCTION PERMIT
PUMP INSTALLATION PERMIT

INSTRUCTIONS: Please print or type and send completed application with attachments to the Division of Water and Land Development, P.O. Box 337, Honolulu, Hawaii 96829. Application must be accompanied by a non-refundable filing fee of $100 payable to the Department of Land and Natural Resources. (Filing fee waived for government agencies) If necessary, phone 808-743-1271, Hydrology/Geology section for assistance.

1. WELL LOCATION
Island: Hawaii
Tax Map Key: 77S Sec 5 Lot 06
Address: Unit Prop Ed, North Kekaha, Hawaii

(Attach a USGS map (scale 1"=2000") and property tax map showing well location referenced to established property boundaries.)

2. WELL OWNER
Firm Name: USGS-WEO
Contact Person: Mark B.康
Address: 6-77Aloha Ave. #2, Honolulu, HI 96813
Phone: 808-341-2435

3. PROPOSED CONTRACTOR FOR:
Name: ____________________________
Address: ____________________________

4. PROPOSED WORK
☐ Drill New Well  ☐ Deepen  ☐ Redrill
☐ Alter  ☐ Seal  ☐ Abandon
☐ Install New Pump  ☐ Replace Pump  ☐ Modify Pump

(Briefly describe the proposed work and fill in the diagram on the back of this form.)

5. PROPOSED USE
☐ Municipal (including hotels, stores, etc.)  ☐ Military
☐ Domestic (individual, noncommercial water systems)  ☐ Industrial
☐ Irrigation (specify)  ☐ Other (specify)

6. PROPOSED AMOUNT OF WITHDRAWAL
______ gallons per day

7. PROPOSED PUMP INFORMATION
Pump Type: ☐ Vertical Turbine  ☐ Submersible  ☐ Centrifugal
Motor: ☐ Diesel  ☐ Gas  ☐ Electric
Rated Pump Capacity _______ gallons per minute (gpm)

Well Owner (print): ____________________________
Signature: ____________________________
Date: 5/11/19

Landowner (print): ____________________________
Signature: ____________________________
Date: ____________________________

For Official Use Only:
Field Checked By: ____________________________
Latitude: ____________________________ Hydrologic Unit
Date: ____________________________ Longitude: ____________________________ State Well No. 7591-08M (J-B)
APPLICATION FOR

WELL CONSTRUCTION PERMIT

PUMP INSTALLATION PERMIT

INSTRUCTIONS: Please print or type all completed application with attachments to the Division of Water and Land Development. F.O. Box 375, Honolulu, Hawaii 96823. Application must be accompanied by a non-refundable filing fee of $25.00 payable to the Department of Land and Natural Resources. (Filing fee waived for government agencies.) If necessary, phone 584-7495, Hydrogeology Section for assistance.

1. WELL LOCATION

Island: Hawaii  Tax Map Key: 05-03-07
Address: Kolea, North Kohala

(Attach a USGS map (scale 1"=2000') and property tax map showing well location referenced to established property boundaries.)

2. WELL OWNER  LANDOWNER

 Firm Name: USGS-WRD  Firm Name: Chelan, Island of Hawaii
 Contact Person: Mark R. Underwood  Contact Person: Jim Truemp
 Address: 677 Ala. Moana Blvd Suite A  Address: Hawaii, HI
 Honolulu, HI 96813
 Phone: 541-2655  Phone: 889-6257

3. PROPOSED CONTRACTOR FOR:  

Well Drilling  Pump Installation

Name: USGS  Phone: 541-2655
Address: 677 Ala. Moana Blvd Suite A  Contractor’s License No.
Honolulu, HI 96813

4. PROPOSED WORK

☐ Drill New Well  ☐ Deepen
☐ Alter  ☐ Seal
☐ Install New Pump  ☐ Replace Pump  ☐ Modify Pump

(Briefly describe the proposed work and fill in the diagram on the back of this form.)

5. PROPOSED USE

☐ Municipal (including hotels, stores, etc.)  ☐ Military
☐ Domestic (individual, noncommercial water systems)  ☐ Industrial
☐ Irrigation (specify)  ☐ Other (specify)  

6. PROPOSED AMOUNT OF WITHDRAWAL

- - - - - - gallons per day

7. PROPOSED PUMP INFORMATION

Pump Type: ☐ Vertical Turbine  ☐ Submersible  ☐ Centrifugal
Motor: ☐ Diesel  ☐ Gas  ☐ Electric:  ☐ Rated Horsepower
Rated Pump Capacity: - - - - gallons per minute (gpm)

Well Owner (print)  USGS-WRD  Landowner (print)  Chelan Islet of Hawaii
Signature: ____________________________  Signature: ____________________________
Date: 5/1/98  Date: 5/1/98

For Official Use Only:

Latitude: (N 29 54.9') 7445-02M
Hydrogeologic Unit:  

Field Checked By: ____________________________
CONTOUR INTERVAL 40 FEET

SCALE 1:24000

1 MILE

HAWEI, HAWAII
1982

HAWEI ISL.

ROAD CLASSIFICATION

Medium-
Light-
Unimproved dirt
State Route

COLOMBIA LOCATION

MEAN HIGH WATER

MEAN LOW WATER

CONTOUR INTERVAL 40 FEET

DEPTH CURVES IN FEET—DATUM IS MEAN SEA LEVEL

THE RELATIONSHIP BETWEEN THE TWO DATUMS IS VARIABLE

SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER

THE MEAN RANGE OF TIDE IS APPROXIMATELY 1 FOOD

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS

BY U.S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092

ORDER FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

1982
WELL CONSTRUCTION PERMIT

for
North Kohala Observation Well (Site A)
State Well No. 7345-01M 04
North Kohala, Hawaii

TO: United States Geological Survey
Water Resources Division
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

In accordance with the Department of Land and Natural Resources Administrative Rules, Section 13-168, entitled "Water Use, Wells, and Stream Diversion Works", your application to construct and test State Well No. 7345-01M within Tax Map Key: 5-2-05 is approved subject to the following conditions:

1. The Division of Water and Land Development (DOWALD), Geology-Hydrology Section, shall be notified at 548-7619, before any work covered by this permit commences.

2. The well shall be used for monitoring and testing only.

3. The following shall be submitted to DOWALD, P.O. Box 373, Honolulu, Hawaii 96809 within 60 days after completion of the well:

   a. Well Completion Report.

   b. Elevation (referenced to mean sea level) survey by a Hawaii-licensed surveyor.

   c. As-built sectional drawing of the well.
d. Plot plan and map showing the exact location of the well.

e. Driller's log, geologic log, and salinity log.

f. Periodic reports of monitoring and testing results.

4. The applicant shall comply with all applicable laws, rules, and ordinances.

5. This permit may be revoked if work is not started within six months of date of issuance or if work is suspended or abandoned for six months. The work shall be completed within two years of the date of issuance.

6. Upon discontinuance of use, the applicant shall seal the wells with cement grout by permit from the Commission.

MAY 15 1989

WILLIAM W. PATY

Date of Issuance

cc: Department of Health,
    Drinking Water Program
    Ground Water Protection Program
    Hawaii Dept. of Water Supply
WELL CONSTRUCTION PERMIT

for

North Kohala Exploratory Well (Site A)
State Well No. 7345-03
North Kohala, Hawaii

TO: United States Geological Survey
Water Resources Division
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

In accordance with the Department of Land and Natural Resources Administrative Rules, Section 13-168, entitled "Water Use, Wells, and Stream Diversion Works", your application to construct and test State Well No. 7345-03 within Tax Map Key: 5-2-05 is approved subject to the following conditions:

1. The Division of Water and Land Development (DOWALD), Geology-Hydrology Section, shall be notified at 548-7619, before any work covered by this permit commences.

2. The permit shall be for construction and testing only. No permanent pump may be installed and no water used from the well without the necessary pump installation permit from the Commission.

3. The following shall be submitted to DOWALD, P.O. Box 373, Honolulu, Hawaii 96809 within 30 days after completion of the well:
   a. Well Completion Report.
   b. Ground elevation (referenced to mean sea level) determined by survey by a Hawaii-licensed surveyor.
   c. As-built sectional drawing of the well.
   d. Plot plan and map showing the exact location of the well.
WELL CONSTRUCTION PERMIT
State Well No. 7345-03

4. The applicant shall comply with all applicable laws, rules, and ordinances.

5. This permit may be revoked if work is not started within six months of date of issuance or if work is suspended or abandoned for six months. The work shall be completed within two years of the date of issuance.

6. Upon discontinuance of use, the applicant shall seal the well with cement grout by permit from the Commission.

MAY 8 1989
Date of Issuance

WILLIAM W. PATY

cc: Department of Health,
Drinking Water Program
Ground Water Protection Program
Hawaii Department of Water Supply
WELL CONSTRUCTION PERMIT

for

North Kohala Exploratory Well (Site B)
State Well No. 7347-03
North Kohala, Hawaii

TO: United States Geological Survey
Water Resources Division
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

In accordance with the Department of Land and Natural Resources Administrative Rules, Section 13-168, entitled "Water Use, Wells, and Stream Diversion Works", your application to construct and test State Well No. 7347-03 within Tax Map Key: 5-3-04 is approved subject to the following conditions:

1. The Division of Water and Land Development (DOWALD), Geology-Hydrology Section, shall be notified at 548-7619, before any work covered by this permit commences.

2. The permit shall be for construction and testing only. No permanent pump may be installed and no water used from the well without the necessary pump installation permit from the Commission.

3. The following shall be submitted to DOWALD, P.O. Box 373, Honolulu, Hawaii 96809 within 30 days after completion of the well:
   a. Well Completion Report.
   b. Ground elevation (referenced to mean sea level) determined by survey by a Hawaii-licensed surveyor.
WELL CONSTRUCTION PERMIT
State Well No. 7347-03

4. The applicant shall comply with all applicable laws, rules, and ordinances.

5. This permit may be revoked if work is not started within six months of date of issuance or if work is suspended or abandoned for six months. The work shall be completed within two years of the date of issuance.

6. Upon discontinuance of use, the applicant shall seal the well with cement grout by permit from the Commission.

MAY 8 1989
Date of Issuance

WILLIAM W. PATY

cc: Department of Health,
    Drinking Water Program
    Ground Water Protection Program
    Hawaii Department of Water Supply
TO: United States Geological Survey  
Water Resources Division  
677 Ala Moana Blvd., Suite 415  
Honolulu, Hawaii 96813  

In accordance with the Department of Land and Natural Resources Administrative Rules, Section 13-168, entitled "Water Use, Wells, and Stream Diversion Works", your application to construct and test State Well No. 7448-06 within Tax Map Key: 5-4-04 is approved subject to the following conditions:

1. The Division of Water and Land Development (DOWALD), Geology-Hydrology Section, shall be notified at 548-7619, before any work covered by this permit commences.

2. The permit shall be for construction and testing only. No permanent pump may be installed and no water used from the well without the necessary pump installation permit from the Commission.

3. The following shall be submitted to DOWALD, P.O. Box 373, Honolulu, Hawaii 96809 within 30 days after completion of the well:
   a. Well Completion Report.
   b. Ground elevation (referenced to mean sea level) determined by survey by a Hawaii-licensed surveyor.
c. As-built sectional drawing of the well.
d. Plot plan and map showing the exact location of the well.
e. Complete pumping test record; including time, pumping rate, drawdown, chloride content, and water quality data.

4. The applicant shall comply with all applicable laws, rules, and ordinances.

5. This permit may be revoked if work is not started within six months of date of issuance or if work is suspended or abandoned for six months. The work shall be completed within two years of the date of issuance.

6. Upon discontinuance of use, the applicant shall seal the well with cement grout by permit from the Commission.

}\signed\n
Date of Issuance

\cc\nDepartment of Health,
Drinking Water Program
Ground Water Protection Program
Hawaii Department of Water Supply
WELL CONSTRUCTION PERMIT

for
North Kohala Observation Well (Site C)
State Well No. 7345-02M
North Kohala, Hawaii

TO: United States Geological Survey
    Water Resources Division
    677 Ala Moana Blvd., Suite 415
    Honolulu, Hawaii 96813

In accordance with the Department of Land and Natural Resources Administrative Rules, Section 13-168, entitled "Water Use, Wells, and Stream Diversion Works", your application to construct and test State Well No. 7345-02M within Tax Map Key: 5-2-06 is approved subject to the following conditions:

1. The Division of Water and Land Development (DOWALD), Geology-Hydrology Section, shall be notified at 548-7619, before any work covered by this permit commences.

2. The well shall be used for monitoring and testing only.

3. The following shall be submitted to DOWALD, P.O. Box 373, Honolulu, Hawaii 96809 within 30 days after completion of the well:
   a. Well Completion Report.
   b. Elevation (referenced to mean sea level) survey by a Hawaii-licensed surveyor.
   c. As-built sectional drawing of the well.
d. Plot plan and map showing the exact location of the well.

e. Driller's log, geologic log, and salinity log.

f. Periodic reports of monitoring and testing results.

4. The applicant shall comply with all applicable laws, rules, and ordinances.

5. This permit may be revoked if work is not started within six months of date of issuance or if work is suspended or abandoned for six months. The work shall be completed within two years of the date of issuance.

6. Upon discontinuance of use, the applicant shall seal the wells with cement grout by permit from the Commission.

Date of Issuance

cc: Department of Health,
    Drinking Water Program
    Ground Water Protection Program
    Hawaii Dept. of Water Supply
WELL CONSTRUCTION PERMIT
for
North Kohala Observation Well (Site B)
State Well No. 7347-01M
North Kohala, Hawaii

TO: United States Geological Survey
Water Resources Division
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

In accordance with the Department of Land and Natural Resources Administrative Rules, Section 13-168, entitled "Water Use, Wells, and Stream Diversion Works", your application to construct and test State Well No. 7347-01M within Tax Map Key: 5-2-05 is approved subject to the following conditions:

1. The Division of Water and Land Development (DOWALD), Geology-Hydrology Section, shall be notified at 548-7619, before any work covered by this permit commences.

2. The well shall be used for monitoring and testing only.

3. The following shall be submitted to DOWALD, P.O. Box 373, Honolulu, Hawaii 96809 within 30 days after completion of the well:
   a. Well Completion Report.
   b. Elevation (referenced to mean sea level) survey by a Hawaii-licensed surveyor.
   c. As-built sectional drawing of the well.
d. Plot plan and map showing the exact location of the well.
e. Driller’s log, geologic log, and salinity log.
f. Periodic reports of monitoring and testing results.

4. The applicant shall comply with all applicable laws, rules, and ordinances.

5. This permit may be revoked if work is not started within six months of date of issuance or if work is suspended or abandoned for six months. The work shall be completed within two years of the date of issuance.

6. Upon discontinuance of use, the applicant shall seal the wells with cement grout by permit from the Commission.

Date of Issuance

cc: Department of Health, Drinking Water Program, Ground Water Protection Program, Hawaii Dept. of Water Supply
WELL CONSTRUCTION PERMIT

for

North Kohala Observation Well (Site E)
State Well No. 7347-02M
North Kohala, Hawaii

TO: United States Geological Survey
    Water Resources Division
    677 Ala Moana Blvd, Suite 415
    Honolulu, Hawaii 96813

In accordance with the Department of Land and Natural Resources Administrative Rules, Section 13-168, entitled "Water Use, Wells, and Stream Diversion Works", your application to construct and test State Well No. 7347-02M within Tax Map Key: 5-3-07 is approved subject to the following conditions:

1. The Division of Water and Land Development (DOWALD), Geology-Hydrology Section, shall be notified at 548-7619, before any work covered by this permit commences.

2. The well shall be used for monitoring and testing only.

3. The following shall be submitted to DOWALD, P.O. Box 373, Honolulu, Hawaii 96809 within 30 days after completion of the well:
   a. Well Completion Report.
   b. Elevation (referenced to mean sea level) survey by a Hawaii-licensed surveyor.
   c. As-built sectional drawing of the well.
WELL CONSTRUCTION PERMIT
State Well Nos. 7347-02M

4. The applicant shall comply with all applicable laws, rules, and ordinances.

5. This permit may be revoked if work is not started within six months of date of issuance or if work is suspended or abandoned for six months. The work shall be completed within two years of the date of issuance.

6. Upon discontinuance of use, the applicant shall seal the wells with cement grout by permit from the Commission.

Date of Issuance

cc: Department of Health,
Drinking Water Program
Ground Water Protection Program
Hawaii Dept. of Water Supply
WELL CONSTRUCTION PERMIT

for

North Kohala Observation Well (Site D)
State Well No. 7445-01M
North Kohala, Hawaii

TO: United States Geological Survey
Water Resources Division
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

In accordance with the Department of Land and Natural Resources Administrative Rules, Section 13-168, entitled "Water Use, Wells, and Stream Diversion Works", your application to construct and test State Well No. 7445-01M within Tax Map Key: 5-3-07 is approved subject to the following conditions:

1. The Division of Water and Land Development (DOWALD), Geology-Hydrology Section, shall be notified at 548-7619, before any work covered by this permit commences.

2. The well shall be used for monitoring and testing only.

3. The following shall be submitted to DOWALD, P.O. Box 373, Honolulu, Hawaii 96809 within 30 days after completion of the well:
   a. Well Completion Report.
   b. Elevation (referenced to mean sea level) survey by a Hawaii-licensed surveyor.
   c. As-built sectional drawing of the well.
WELL CONSTRUCTION PERMIT
State Well Nos. 7445-01M

4. The applicant shall comply with all applicable laws, rules, and ordinances.

5. This permit may be revoked if work is not started within six months of date of issuance or if work is suspended or abandoned for six months. The work shall be completed within two years of the date of issuance.

6. Upon discontinuance of use, the applicant shall seal the wells with cement grout by permit from the Commission.

[Signature]
Date of Issuance

cc: Department of Health,
    Drinking Water Program
    Ground Water Protection Program
    Hawaii Dept. of Water Supply
WELL CONSTRUCTION PERMIT

for

North Kohala Observation Well (Site F)
State Well Nos. 7448-01M and 7448-02M
North Kohala, Hawaii

TO: United States Geological Survey
Water Resources Division
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

In accordance with the Department of Land and Natural Resources Administrative Rules, Section 13-168, entitled "Water Use, Wells, and Stream Diversion Works", your application to construct and test State Well Nos. 7448-01M and 02M within Tax Map Key: 5-4-05 is approved subject to the following conditions:

1. The Division of Water and Land Development (DOWALD), Geology-Hydrology Section, shall be notified at 548-7619, before any work covered by this permit commences.

2. The wells shall be used for monitoring and testing only.

3. The following shall be submitted to DOWALD, P.O. Box 373, Honolulu, Hawaii 96809 within 30 days after completion of the wells:
   a. Well Completion Reports.
   b. Elevation (referenced to mean sea level) survey by a Hawaii-licensed surveyor.
   c. As-built sectional drawings of the wells.
d. Plot plan and map showing the exact locations of the wells.

e. Driller's logs, geologic logs, and salinity logs.

f. Periodic reports of monitoring and testing results.

4. The applicant shall comply with all applicable laws, rules, and ordinances.

5. This permit may be revoked if work is not started within six months of date of issuance or if work is suspended or abandoned for six months. The work shall be completed within two years of the date of issuance.

6. Upon discontinuance of use, the applicant shall seal the wells with cement grout by permit from the Commission.

Date of Issuance: 5/4/89

WILLIAM W. PATY

cc: Department of Health,
Drinking Water Program
Ground Water Protection Program
Hawaii Dept. of Water Supply
WELL CONSTRUCTION PERMIT

for
North Kohala Observation Well (Site G)
State Well No. 7448-03M
North Kohala, Hawaii

TO: United States Geological Survey
Water Resources Division
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

In accordance with the Department of Land and Natural Resources Administrative Rules, Section 13-168, entitled "Water Use, Wells, and Stream Diversion Works", your application to construct and test State Well No. 7448-03M within Tax Map Key: 5-4-09 is approved subject to the following conditions:

1. The Division of Water and Land Development (DOWALD), Geology-Hydrology Section, shall be notified at 548-7619, before any work covered by this permit commences.

2. The well shall be used for monitoring and testing only.

3. The following shall be submitted to DOWALD, P.O. Box 373, Honolulu, Hawaii 96809 within 30 days after completion of the well:
   a. Well Completion Report.
   b. Elevation (referenced to mean sea level) survey by a Hawaii-licensed surveyor.
   c. As-built sectional drawing of the well.
d. Plot plan and map showing the exact location of the well.
e. Driller's log, geologic log, and salinity log.
f. Periodic reports of monitoring and testing results.

4. The applicant shall comply with all applicable laws, rules, and ordinances.

5. This permit may be revoked if work is not started within six months of date of issuance or if work is suspended or abandoned for six months. The work shall be completed within two years of the date of issuance.

6. Upon discontinuance of use, the applicant shall seal the wells with cement grout by permit from the Commission.

Date of Issuance: 5-7-89

WILLIAM W. PATY

cc: Department of Health,
    Drinking Water Program
    Ground Water Protection Program
    Hawaii Dept. of Water Supply
WELL CONSTRUCTION PERMIT

for

North Kohala Observation Well (Site H)
State Well No. 7449-01M
North Kohala, Hawaii

TO: United States Geological Survey
Water Resources Division
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

In accordance with the Department of Land and Natural Resources Administrative Rules, Section 13-168, entitled "Water Use, Wells, and Stream Diversion Works", your application to construct and test State Well No. 7449-01M within Tax Map Key: 5-5-02 is approved subject to the following conditions:

1. The Division of Water and Land Development (DOWALD), Geology-Hydrology Section, shall be notified at 548-7619, before any work covered by this permit commences.

2. The well shall be used for monitoring and testing only.

3. The following shall be submitted to DOWALD, P.O. Box 373, Honolulu, Hawaii 96809 within 30 days after completion of the well:
   a. Well Completion Report.
   b. Elevation (referenced to mean sea level) survey by a Hawaii-licensed surveyor.
   c. As-built sectional drawing of the well.
d. Plot plan and map showing the exact location of the well.

e. Driller's log, geologic log, and salinity log.

f. Periodic reports of monitoring and testing results.

4. The applicant shall comply with all applicable laws, rules, and ordinances.

5. This permit may be revoked if work is not started within six months of date of issuance or if work is suspended or abandoned for six months. The work shall be completed within two years of the date of issuance.

6. Upon discontinuance of use, the applicant shall seal the wells with cement grout by permit from the Commission.

Date of Issuance: 5-4-89

WILLIAM W. PATY

cc: Department of Health,
    Drinking Water Program
    Ground Water Protection Program
    Hawaii Dept. of Water Supply
WELL CONSTRUCTION PERMIT

for

North Kohala Observation Well (Site I)
State Well No. 7549-01M
North Kohala, Hawaii

TO: United States Geological Survey
Water Resources Division
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

In accordance with the Department of Land and Natural Resources Administrative Rules, Section 13-168, entitled "Water Use, Wells, and Stream Diversion Works", your application to construct and test State Well No. 7549-01M within Tax Map Key: 5-5-08 is approved subject to the following conditions:

1. The Division of Water and Land Development (DOWALD), Geology-Hydrology Section, shall be notified at 548-7619, before any work covered by this permit commences.

2. The well shall be used for monitoring and testing only.

3. The following shall be submitted to DOWALD, P.O. Box 373, Honolulu, Hawaii 96809 within 30 days after completion of the well:
   a. Well Completion Report.
   b. Elevation (referenced to mean sea level) survey by a Hawaii-licensed surveyor.
   c. As-built sectional drawing of the well.
d. Plot plan and map showing the exact location of the well.

e. Driller's log, geologic log, and salinity log.

f. Periodic reports of monitoring and testing results.

4. The applicant shall comply with all applicable laws, rules, and ordinances.

5. This permit may be revoked if work is not started within six months of date of issuance or if work is suspended or abandoned for six months. The work shall be completed within two years of the date of issuance.

6. Upon discontinuance of use, the applicant shall seal the wells with cement grout by permit from the Commission.

Date of Issuance

\[ \text{cc: Department of Health,}
\text{Drinking Water Program}
\text{Ground Water Protection Program}
\text{Hawaii Dept. of Water Supply} \]
March 21, 1989

The Honorable William W. Paty, Chairperson
Commission on Water Resource Management
Department of Land and Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Paty:

SUBJECT: WELL CONSTRUCTION PERMIT APPLICATION
NORTH KOHALA EXPLORATORY AND OBSERVATION WELLS
STATE WELL NOS. 7345-03, 7345-01M & 2M, 7347-01M & 2M,
7445-01M, 7448-06, 7448-01M TO 03M, 7449-01M, AND 7549-01M.
NORTH KOHALA, HAWAII
(UNITED STATES GEOLOGICAL SURVEY, WATER RESOURCES DIVISION)

Thank you for the opportunity to review the subject document. We have reviewed the application and have the following comments to offer:

1. The permit applications indicate that the wells will be for pumping tests and/or observation purposes in a groundwater availability study. However, if any of the wells should be converted to domestic use and serve a public water system, they will be subject to the Department's Administrative Rules, Title 11, Chapter 20, "Potable Water Systems." Chapter 20 defines a public water system as a system which serves 25 or more individuals at least 60 days per year or has a minimum of 15 service connections.

2. Section 11-20-29 of Chapter 20 requires that a new source of potable water serving public water systems be approved by the Director of Health prior to its use. Such an approval is based primarily upon the submission of a satisfactory engineering report which addresses the requirements set in Section 11-20-29.
March 21, 1989

If you should have any questions, please contact the Drinking Water Program at 548-2235.

Very truly yours,

JOHN C. LEWIN, M.D.
Director of Health
March 8, 1989

Mr. Manabu Tagomori, Deputy Director
State Department of Land and Natural Resources
Commission on Water Resources Management
P.O. Box 621
Honolulu, HI 96809

WELL CONSTRUCTION PERMIT APPLICATIONS
NORTH KOHALA

We encourage and support this program for exploratory drilling to determine the extent and character of the North Kohala aquifer.

H. William Sewake
Manager
GK

...Water brings progress...
Honorable John C. Lewin, M.D.
Director of Health
Department of Health
State of Hawaii
1250 Punchbowl Street
Honolulu, Hawaii 96813

Attn: Mr. Thomas Arisumi, Drinking Water Program

Dear Dr. Lewin:

Well Construction Permit Applications

In accordance with the Department of Land and Natural Resources Administrative Rules, Section 13-166-12(c), we are sending you a copy of the following permit applications:

North Kohala Exploratory and Observation Wells, State Well Nos. 7346-03, 7345-01M & 02M, 7347-03, 7347-01M & 02M, 7445-01M, 7448-06, 7448-01M to 03M, 7449-01M, 7549-01M.

Kipahulu-Maleo Well, State Well No. 3504-05.

Please submit your comments to us, orally or in writing, within three weeks from the date of this letter.

If you have any questions, please contact Jon Lum at 548-1648.

Very truly yours,

[Signature]

WILLIAM W. PATY

Lisa.
February 28, 1989

Mr. Hugh Y. Ono
Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Ono:

Well Construction Permit Applications

We are sending you a copy of the following permit applications for your review and comments:

North Kohala Exploratory and Observation Wells, State Well Nos. 7345-03, 7345-01M & 02M, 7347-03, 7347-01M & 02M, 7445-01M, 7445-06, 7445-01M to 03M, 7449-01M, 7549-01M.

Please submit your comments to us, orally or in writing, within three weeks from the date of this letter.

If you have any questions, please contact Dan Lum at 549-7645.

Sincerely,

[Signature]

MANABU TACHIBANA
Deputy Director

ES:ko
Eno.
February 26, 1969

Mr. William Sewake, Manager
Department of Water Supply
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Sewake:

Well Construction Permit Applications

We are sending you a copy of the following permit applications for your review and comments:

North Kohala Exploratory and Observation Wells, State Well Nos. 7345-02, 7345-01M & 02M, 7347-03, 7347-01M & 02M, 7445-01M, 7448-06, 7448-01M to 02M, 7449-01M, 7449-01M.

Please submit your comments to us, orally or in writing, within three weeks from the date of this letter.

If you have any questions, please contact Dan Lum at 546-7649.

Sincerely,

[Signature]

MANABU TAGOMORI
Deputy Director

ES:ko
Enc.
February 28, 1989

Mr. William Meyer
District Chief
U.S. Geological Survey
Water Resources Division
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

Dear Mr. Meyer:

This is to acknowledge receipt of your well construction permit applications for thirteen exploratory and observation wells in North Kohala, Hawaii, to be drilled by the USGS-Water Resources Division.

My staff is reviewing the applications and will contact your staff should there be any questions.

Sincerely,

[Signature]

MANABU TAGOMORI
Deputy Director

ES:ko
APPLICATION FOR
A WELL CONSTRUCTION PERMIT
PUMP INSTALLATION PERMIT

INSTRUCTIONS: Please print or type and send completed application with attachments to the Division of Water Resource Management, P.O. Box 272, Hilo, Hawaii 96720. Application must be accompanied by a non-refundable filing fee of $125.00 payable to the Department of Land and Natural Resources. (Filing fee waived for government agencies if necessary.) Phone: 961-9461. Division of Water Resource Management.

1. WELL LOCATION
Island: [State] Tax Map Key: 7. 3 S. 2 Plat 05 Site: A Wells: A, B
Address: [Street Name, City, State, Zip Code]
(Attach a USGS map (scale 1"=2000') and property tax map showing well location referenced to established property boundaries.)

2. WELL OWNER
Firm Name: [Company Name]
Contact Person: [Name]
Address: [Street Name, City, State, Zip Code]
Phone: [Phone Number]

3. PROPOSED CONTRACTOR FOR: □ Drilling □ Pump Installation
Name: [Contractor Name]
Address: [Street Name, City, State, Zip Code]
Phone: [Phone Number]

4. PROPOSED WORK
□ Drill New Well □ Deepen □ Redrill
□ Install New Pump □ Replace Pump □ Modify Pump
(Briefly describe the proposed work and fill in the diagram on the back of this form.)

5. PROPOSED USE
□ Municipal (including hotels, stores, etc.) □ Military
□ Domestic (individual, noncommercial water systems) □ Industrial
□ Irrigation (specify) □ Other (specify) □ Short-Term Pump

6. PROPOSED AMOUNT OF WITHDRAWAL ______ gallons per day

7. PROPOSED PUMP INFORMATION
Pump Type: □ Vertical Turbine □ Submersible □ Centrifugal
Motor: □ Diesel □ Gas □ Electric: □ Rated Horsepower
Rated Pump Capacity: ______ gallons per minute (gpm)

Well Owner (print): [Name]
Signature: [Signature]
Date: [Date]

Landowner (print): [Name]
Signature: [Signature]
Date: [Date]

For Official Use Only:
Latitude: 21° 17' 33.8" N
Longitude: 156° 03' 22.5" W
State Well No.: 7346-03
Hydrologic Unit: MAKAPALA-USGS

Chalon International of Hawaii
James Trump
341-243-33
APPLICATION FOR

1. WELL LOCATION
   Island: Hawaii
   Tax Map Key: Zn 5 Sec 2 Plots
   Address: Heloa, North Kona, Hawaii
   (Attach a USGS map (scale 1"=2000') and property tax map showing well location referenced to established property boundaries.)

2. WELL OWNER
   Firm Name: USGS-WRD
   Contact Person: John Doe
   Address: P.O. Box 123
   Phone: 541-1234
   Well Owner Landowner

3. PROPOSED CONTRACTOR FOR:
   Well Drilling
   Pump Installation
   Name: USGS-WRD
   Address: P.O. Box 123
   Phone: 541-1234
   Contractor's License No.

4. PROPOSED WORK
   Drill New Well
   Alter
   Install New Pump
   Deepen
   Seal
   Replace Pump
   Redrill
   Abandon
   Modify Pump
   (Briefly describe the proposed work and fill in the diagram on the back of this form.)

5. PROPOSED USE
   Municipal (including hotels, stores, etc.)
   Domestic (individual, noncommercial water systems)
   Industrial
   Irrigation (specify)
   Other (specify)
   Landowner Name: Chalon International of Hawaii
   Signature: ____________________________
   Date: ____________________________

6. PROPOSED AMOUNT OF WITHDRAWAL
   gallons per day

7. PROPOSED PUMP INFORMATION
   Pump Type: Vertical Turbine
   Motor: Diesel
   Gas
   Electric
   Centrifugal
   Rated Pump Capacity: liters per minute (gpm)
   Rated Horsepower

Well Owner (print): USGS-WRD
Signature: ____________________________
Date: ____________________________

Landowner (print): Chalon International of Hawaii
Signature: ____________________________
Date: ____________________________

For Official Use Only:
Latitude: __________
Longitude: __________
Hydrologic Unit: __________
State Well No. 7345-0144

Field Checked by: __________
Date: __________
APPLICATION FOR

WELL CONSTRUCTION PERMIT
PUMP INSTALLATION PERMIT

INSTRUCTIONS: Please print or type and send completed application with attachments to the Division of Water and Land Development, P.O. Box 629, Honolulu, Hawaii 96822. Application must be accompanied by a non-refundable filing fee of $1,000.00 payable to the Department of Land and Natural Resources. (Filing fee waived for government agencies.) (Contact us for a free phone 448-7543. Hydrology/Causing Section for assistance.

1. WELL LOCATION
Island: Hawaii
Tax Map Key: E 5 Sec 2 Plat 06
Address: Kauai, North Kauai, Hawaii

(Attach a USGS map (scale 1"=2000') and property tax map showing well location referenced to established property boundaries.)

2. WELL OWNER
Firm Name: USGS-WRD
Contact Person: Mark Udamov
Address: 677 Kiana Makanakai Blvd, Suite 4, Kailua, HI 96734
Phone: 808-268-511

3. PROPOSED CONTRACTOR FOR:
Name: USGS-WRD
Address: Same as above

4. PROPOSED WORK
☐ Drill New Well
☐ Alter
☐ Install New Pump
☐ Deepen
☐ Replace Pump
☐ Seal
☐ Redrill
☐ Abandon
☐ Modify Pump

(Briefly describe the proposed work and fill in the diagram on the back of this form.)

5. PROPOSED USE
☐ Municipal (including hotels, stores, etc.)
☐ Military
☐ Domestic (individual, noncommercial water systems)
☐ Industrial
☐ Irrigation (specify)
☐ Other (specify)

6. PROPOSED AMOUNT OF WITHDRAWAL
☐ Gallons per day

7. PROPOSED PUMP INFORMATION
Pump Type: ☐ Vertical Turbine ☐ Submersible
☐ Turbine ☐ Electric
☐ Gas ☐ Centrifugal
☐ Rated Pump Capacity: ☐ Gallons per minute (gpm)

Well Owner (print): USGS-WRD
Signature: William Magoon
Date: 2/14/78

Landowner (print): Chalon International of Hawaii
Signature: James Trump
Date: 2/14/78

For Official Use Only:
Field Checked By: Latitude: Hydrologic Unit:
Date: Longitude: State Well No: 7345-02M

AAMARO-USGS
APPLICATION FOR

WELL CONSTRUCTION PERMIT

PUMP INSTALLATION PERMIT

INSTRUCTIONS: Please print or type and send completed application with attachments to the Division of Water and Land Development, P.O. Box 373, Honolulu, Hawaii 96821. Application must be accompanied by a non-refundable filing fee of $25.00 payable to the Department of Land and Natural Resources. (Filing fee waived for government agencies.) For assistance, phone 944-7322, hydrology/issuance section for assistance.

1. WELL LOCATION

Island: Hawaii Tax Map Key: Z-5 Sec 3 Ran 04 Site B well A

Address: Haleiwa, North Kohala, Hawaii

(Attach a USGS map (scale 1''=2000') and property tax map showing well location referenced to established property boundaries.)

2. WELL OWNER

Firm Name: U.S. G.W.O

Contact Person: Mark Wieland

Address: 617 Puumea Rd, Unit 6A, Haleiwa, HI 96712

Phone: 547-3455

3. PROPOSED CONTRACTOR FOR: Well Drilling    Pump Installation

Name: U.S.G.W.O

Address: Same as above

4. PROPOSED WORK

Drill New Well

Alter

Install New Pump

Deepen

Seal

Modify Pump

Redrill

Install New Pump

Modify Pump

Abandon

(Briefly describe the proposed work and fill in the diagram on the back of this form.)

5. PROPOSED USE

Municipal (including hotels, stores, etc.)

Military

Domestic (individual, noncommercial water systems)

Industrial

Irrigation (specify)

6. PROPOSED AMOUNT OF WITHDRAWAL gallons per day

7. PROPOSED PUMP INFORMATION

Type: Vertical Turbine  Submersible  Centrifugal

Motor: Diesel  Gas  Electric

Pump Capacity: gpm

Rated Horsepower

Well Owner (print): U.S.G.W.O

Landowner (print): Chalon International of Hawaii

Signature: [Signature]

Date: 2/15/89

For Official Use Only:

Field Checked By: [Signature]

Date: 2/16/89

Latitude

Longitude

State Well No. 7347-03

Hydrologic Unit: [Hawaii-USGS]
APPLICATION FOR
WELL CONSTRUCTION PERMIT
PUMP INSTALLATION PERMIT

INSTRUCTIONS: Please print or type and send completed application with attachments to the Division of Water and Land Development, P.O. Box 237, Honolulu, Hawaii 96809. Application must be accompanied by a non-refundable filing fee of $40.00 pursuant to the Department of Land and Natural Resources. (Filing fee waived for government entities.) (Opposite) Phone 889-1942. Hydrology/Geology Section for assistance.

1. WELL LOCATION
Island Hawaii Tax Map Key 3N 5S 63 04 34.75°W Well B
Address Holualoa, Kona, Hawaii

(Attach a USGS map (scale 1"=2000') and property tax map showing well location referenced to established property boundaries.)

2. WELL OWNER
Firm Name USGS-WED
Contact Person James Trump
Address Phone

3. PROPOSED CONTRACTOR FOR:
Name USGS-WED
Address Phone

4. PROPOSED WORK
Drill New Well Deepen Redrill
Alter Seal Abandon
Install New Pump Replace Pump Modify Pump

(Briefly describe the proposed work and fill in the diagram on the back of this form.)

5. PROPOSED USE
Municipal (including hotels, stores, etc.) Military
Domestic (individual, non-commercial water systems) Industrial
Irrigation (specify) Other (specify)

6. PROPOSED AMOUNT OF WITHDRAWAL gallons per day

7. PROPOSED PUMP INFORMATION
Pump Type: Vertical Turbine Submersible Centrifugal
Motor: Diesel Gas Electric Rated Horsepower
Rated Pump Capacity gallons per minute (gpm)

For Official Use Only:
Field Checked By
State Well No. 7347-01M

Well Owner (print) USGS-WED Landowner (print) Chalon International of Hawaii
Signature Date 1/26/00 Signature Date 2/26/00

Latitude Hydrologic Unit
APPLICATION FOR

WELL CONSTRUCTION PERMIT

PUMP INSTALLATION PERMIT

APPLICATION FOR

WELL CONSTRUCTION PERMIT

PUMP INSTALLATION PERMIT

1. WELL LOCATION

Island: Hawaii

Tax Map Key: En 3 Sec 3 Plot 07

Address: Halaulu, North Kohala, Hawaii

(Attach a USGS map (scale 1"=2000') and property tax map showing well location referenced to established property boundaries.)

2. WELL OWNER

Firm Name: USGS-WRO

Contact Person: Mark Underwood

Address: 677 Alii Drive, Suite 415

Hilo, HI 96720

Phone: 808-935-355

3. PROPOSED CONTRACTOR FOR:

Name: USGS-WRO

Address: Same as above

Contractor's License No.

4. PROPOSED WORK

Drill New Well

Deepen

Install New Pump

Replace Pump

Redrill

Seal

Abandon

Install New Pump

Replace Pump

Modify Pump

(Briefly describe the proposed work and fill in the diagram on the back of this form.)

5. PROPOSED USE

Municipal (including hotels, stores, etc.)

Military (specify)

Domestic (individual, noncommercial water systems)

Industrial (specify)

Irrigation (specify)

Other (specify)

6. PROPOSED AMOUNT OF WITHDRAWAL:

( ) gallons per day

7. PROPOSED PUMP INFORMATION

Pump Type: Vertical Turbine

Motor: Diesel

Submersible

Electric

Centrifugal

Rated Pump Capacity: gallons per minute (gpm)

For Official Use Only:

Well Owner (print): USGS-WRO

Landowner (print): Chalon International of Hawaii

Signature: ____________________________

Date: __/__/19__

Latitude: ________________

Hydrologic Unit: ________________

Longitude: ________________

State Well No. 7347-02M

Field Checked By: ____________________________

Date: __/__/19__

( ) Vertical Turbine

( ) Diesel

( ) Submersible

( ) Electric

( ) Centrifugal

( ) Rated Horsepower
APPLICATION FOR
WELL CONSTRUCTION PERMIT
PUMP INSTALLATION PERMIT

INSTRUCTIONS: Please print or type and send completed application with attachments to the offices of Water and Land Development, P.O. Box 373, Honolulu, Hawaii 96819. Application must be accompanied by a non-refundable filing fee of $15.00 payable to the Department of Land and Natural Resources. (Filing fee waived for government agencies.) If necessary, phone 916-1511, Hydrology/Permitting Section for assistance.

1. WELL LOCATION

Island: Hawai‘i
Tax Map Key: Kaua‘i sec 3, Plat 07
Lot 1 D

(Attach a USGS map (scale 1"=2000') and property tax map showing well location referenced to established property boundaries.)

2. WELL OWNER

Firm Name: USWS-WD
Contact Person: Mark Underwood
Address: 677 Kamehameha Hwy, Suite 415
Hawaii, HI 96719
Phone: 889-6255

3. PROPOSED CONTRACTOR FOR: ☑ Well Drilling ☑ Pump Installation

Name: USWS-WD
Address: same as above

4. PROPOSED WORK

☒ Drill New Well ☐ Deepen ☐ Redrill
☒ Install New Pump ☐ Replace Pump ☐ Modify Pump

(Briefly describe the proposed work and fill in the diagram on the back of this form.)

5. PROPOSED USE

☒ Municipal (including hotels, stores, etc.) ☐ Military
☑ Domestic (individual, noncommercial water systems) ☐ Industrial
☒ Irrigation (specify) ☐ Other (specify): Residential well

6. PROPOSED AMOUNT OF WITHDRAWAL ______ gallons per day

7. PROPOSED PUMP INFORMATION

Pump Type: ☑ Vertical Turbine ☐ Submersible ☐ Centrifugal
Motor: ☑ Diesel ☐ Gas ☐ Electric
Rated Pump Capacity: ______ gallons per minute (gpm)

Well Owner (print): USWS-WD
Signature: __________________________ Date: __________

Landowner (print): Chalon International of Hawaii
Signature: __________________________ Date: __________

For Official Use Only:
Field checked by __________________________ Latitude: ________
Lot: ________ Longitude: ________ Hydrologic Unit: ________
Field No.: ________ State Well No.: ________

Field: ________ County: ________ District: ________
APPLICATION FOR

WELL CONSTRUCTION PERMIT
PUMP INSTALLATION PERMIT

INSTRUCTIONS: Please print or type and send completed application with attachments to the attention of Water and Land Development, P.O. Box 373, Honolulu, Hawaii 96809. Application must be accompanied by a non-refundable filing fee of $10 payable to the Department of Land and Natural Resources. (Filing fee waived for government agencies if necessary, phone 848-7441, Hydrology/Geology Section for assistance.)

1. WELL LOCATION

Island Hawaii Tax Map Key En 5 Sec 4 Plat 04 Site F Waia A (Attach a USGS map (scale 1"=2000') and property tax map showing well location referenced to established property boundaries.)
Address Kapeau North Kohala Hawaii

2. WELL OWNER

Firm Name USGS- WRO
Contact Person Mark Underwood
Address 677 At Moomu Rd., Suite 45
Phone 889-9685

3. PROPOSED CONTRACTOR FOR: 

Name USGS-WRO
Address

4. PROPOSED WORK

Drill New Well
Deepen
Install New Pump
Replace Pump

5. PROPOSED USE

Municipal (including hotels, stores, etc.)
Domestic (individual, noncommercial water systems)
Irrigation (specify)

6. PROPOSED AMOUNT OF WITHDRAWAL

860 gallons per day

7. PROPOSED PUMP INFORMATION

Pump Type: Vertical Turbine
Motor: Diesel
Rated Pump Capacity: 8 gpm

For Official Use Only:
Field Checked By
Latitude
Hydrologic Unit
Date

State Well No. 7446-06

Well Owner (print) USGS-WRO
Landowner (print) Chalon International of Hawaii

Signature
Date 2/7/95

Signature
Date 2/10/97

USGS-WRO-15
State of Hawaii
COMMISSION ON WATER RESOURCE MANAGEMENT
Department of Land and Natural Resources
Division of Water Resource Management

APPLICATION FOR
WELL CONSTRUCTION PERMIT
PUMP INSTALLATION PERMIT

INSTRUCTIONS: Please print or type and send completed application with attachments to the Division of Water and Land Development, P.O. Box 213, Honolulu, Hawaii 96813. Application must be accompanied by a non-refundable filing fee of $35.00 payable to the Department of Land and Natural Resources. (Filing fee waived for government agencies.) If necessary, phone 548-7542, Hydrology/Geology Section for assistance.

1. WELL LOCATION

Island Hawaii
Tax Map Key Wai I. Plt. 04
Address Kapaau, North Kohala, Hawaii
(Attach a USGS map (scale 1"=2000') and property tax map showing well location referenced to established property boundaries.)

2. WELL OWNER

Firm Name USGS-WRD
Contact Person Debra Finkler
Address 677 Aku Ave., Bldg. 411
Hamakua, HI 96713
Phone 808-326-35

LANDOWNER

Firm Name Chalon International of Hawaii
Contact Person James Trump
Address P. O. Box 140
Hauilo, HI 96719
Phone 808-6257

3. PROPOSED CONTRACTOR FOR:

☐ Well Drilling ☐ Pump Installation

Name USGS-WRD

Contractor’s License No.
Address

4. PROPOSED WORK

☐ Drill New Well ☐ Deepen ☐ Redrill
☐ Alter ☐ Seal ☐ Abandon
☐ Install New Pump ☐ Replace Pump ☐ Modify Pump

(Briefly describe the proposed work and fill in the diagram on the back of this form.)

5. PROPOSED USE

☐ Municipal (including hotels, stores, etc.) ☐ Military
☐ Domestic (individual, noncommercial water systems) ☐ Industrial
☐ Irrigation (specify)
☐ Other (specify) long-term observation well ☐

6. PROPOSED AMOUNT OF WITHDRAWAL gallons per day (6,000 = 1 MGD)

7. PROPOSED PUMP INFORMATION

Pump Type: ☐ Vertical Turbine ☐ Submersible ☐ Centrifugal
Motor: ☐ Diesel ☐ Gas ☐ Electric:
Rated Pump Capacity gallons per minute (gpm)

Well Owner (print) USGS-WRD
Signature
Date

Landowner (print) Chalon International of Hawaii
Signature
Date

For Official Use Only:
Field Checked By _______________________ Latitude __________ Hydrologic Unit __________
Date ________________ Long ___________ HHMM-01M, 02M
APPLICATION FOR

WELL CONSTRUCTION PERMIT

PUMP INSTALLATION PERMIT

INSTRUCTIONS: Please print or type and send completed application with attachments to the Commission on Water Resource Management. Application must be accompanied by a non-refundable filing fee of $125.00 payable to the Department of Land and Natural Resources. (Filing fee waived for government agencies.) If necessary, call 548-7543, Hydrology/Geology Section for assistance.

1. WELL LOCATION

Island: HAWAII
Tax Map Key: Zln 5 Sec 4 Plat 09 Site 6
Address: Union Mill, North Kohala, Hawaii HANAVA-USGS

(Attach a USGS map (scale 1"=2000') and property tax map showing well location referenced to established property boundaries.)

2. WELL OWNER

Firm Name: USGS-WRD
Contact Person: Mark R. Underwood
Address: 677 Alii Drive, Suite 404
Hawaii, HI 96713
Phone: 889-2655

3. LANDOWNER

Firm Name: Chalon International of Hawaii
Contact Person: James Trump
Address: P. O. Box 140
Hawaii, HI 96719
Phone: 689-6257

4. PROPOSED CONTRACTOR FOR:

- Drill New Well
- Alter
- Deepen
- Seal
- Redrill
- Install New Pump
- Replace Pump
- Modify
- Abandon

(Attach a USGS map (scale 1"=2000') and property tax map showing well location referenced to established property boundaries.)

5. PROPOSED USE

- Municipal (including hotels, stores, etc.)
- Military
- Domestic (individual, noncommercial water systems)
- Irrigation (specify)
- Other (specify)

6. PROPOSED AMOUNT OF WITHDRAWAL


gallons per day

7. PROPOSED PUMP INFORMATION

- Pump Type: Vertical Turbine
- Submersible
- Centrifugal
- Gas
- Electric

Rated Pump Capacity: gallons per minute (gpm)

Well Owner (print): USGS-WRD
Landowner (print): Chalon International of Hawaii

Signature: __________________________
Date: 12/5/1979

For Official Use Only:
Field Checked By: ____________________
Latitude: ____________
Hydrologic Unit: ____________________
Date: ____________
State Well No: 7448-03M

HANAVA-USGS
APPLICATION FOR
WELL CONSTRUCTION PERMIT
PUMP INSTALLATION PERMIT

1. WELL LOCATION
Island: Hawaii
Tax Map Key: Pt 5 Sec 5 Plat 02
Address: North Kala
(Attach a USGS map (scale 1"=2000') and property tax map showing well location referenced to established property boundaries.)

2. WELL OWNER
Firm Name: USGS - WBD
Contact Person: Mark Ushiro
Address: 677 Paniolo Ave, Suite 115
Phone: 808-691-2655

3. PROPOSED CONTRACTOR FOR:
Name: USGS - WBD
Address: North Kala
Contractor's License No.

4. PROPOSED WORK
- Drill New Well
- Deepen
- Install New Pump
- Replace Pump
- Modify Pump
(Briefly describe the proposed work and fill in the diagram on the back of this form.)

5. PROPOSED USE
- Municipal (including hotels, stores, etc.)
- Domestic (individual, noncommercial water systems)
- Irrigation (specify)
- Military
- Industrial
- Other (specify)

6. PROPOSED AMOUNT OF WITHDRAWAL

7. PROPOSED PUMP INFORMATION
Pump Type: Vertical Turbine
Motor: Diesel
Rated Pump Capacity: gpm
Rated Horsepower:

Well Owner (print): USGS - WBD
Signature: Date: 2/5/89

Landowner (print): Chalon International of Hawaii
Signature: Date: 2/16/89

For Official Use Only:
Latitude: 21° 31.77' Longitude: 156° 40.53'
Hydrologic Unit: 102
State Well No.: WST-49-01M
APPLICATION FOR
WELL CONSTRUCTION PERMIT
PUMP INSTALLATION PERMIT

INSTRUCTIONS: Please print or type and send completed application with attachments to the Division of Water and Land Development, P.O. Box 237, Honolulu, Hawaii 96823. Application must be accompanied by a non-refundable filing fee of $25.00 payable to the Department of Land and Natural Resources. (Filing fee waived for government agencies.) If necessary, phone 148-7403, Hydrology/Owelry Section for assistance.

1. WELL LOCATION

Island: Hawaii  Tax Map Key: 26S-5-6S-Plt-08  Section: I

(Attach a USGS map (scale 1"=2000') and property tax map showing well location referenced to established property boundaries.)

2. WELL OWNER

Firm Name: U.S.G.S-W.R.D  Contact Person: Mark Underwood
Address: 677 Alio Muna Blvd, Suite 415  Phone: 541-2655
Honolulu, HI 96813

Firm Name: Chalon International of Hawaii  Contact Person: James Trump
Address: P.O. Box 140  Phone: 689-6257  Hawi, HI 96719

3. PROPOSED CONTRACTOR FOR:

[ ] Well Drilling  [ ] Pump Installation

Name: U.S.G.S-W.R.D  Phone:

Address: 677 Alio Muna Blvd, Suite 415  Phone:

4. PROPOSED WORK

[ ] Drill New Well  [ ] Deepen  [ ] Redrill
[ ] Alter  [ ] Seal  [ ] Abandon
[ ] Install New Pump  [ ] Replace Pump  [ ] Modify Pump

(Briefly describe the proposed work and fill in the diagram on the back of this form.)

5. PROPOSED USE

[ ] Municipal (including hotels, stores, etc.)  [ ] Military
[ ] Domestic (individual, noncommercial water systems)  [ ] Industrial
[ ] Irrigation (specify)  [ ] Other (specify)

6. PROPOSED AMOUNT OF WITHDRAWAL: ________ gallons per day

7. PROPOSED PUMP INFORMATION

Motor:  [ ] Diesel  [ ] Gas  [ ] Electric
Pump Type:  [ ] Vertical Turbine  [ ] Submersible  [ ] Centrifugal
Rated Pump Capacity: ________ gallons per minute (gpm)
Rated Horsepower: ________

Well Owner (print) U.S.G.S-W.R.D  Landowner (print) Chalon International of Hawaii
Signature: ___________________________ Signature: ___________________________
Date: 1/22/89 Date: 2/11/89

For Official Use Only:

Field Checked By: ___________________________ Latitude: ________  Hydrologic Unit: ________
Date: 2/2/89  Longitude: ________  State Well No.: 7549-OIM  PAPUA-U.S.G.S.
ISLAND OF HAWAII

Scale: 10 MILE
KAPoho
ISLAND OF HAWAII

PROJECT AREA

ISLAND OF HAWAII
Briefly describe the proposed work:

Well will be used in observation of long-term changes in base thickness and water-table response.

PROPOSED SECTION OF WELL

Ground Elev. 358 ft., masl

Elevation at top of casing 360 ft., masl

Cement Grout 50 ft.
Hole Dia. 6 3/8 in.
Total Depth 560 ft.
Rock Packing 0 ft.

Solid Casing:
Material Steel
Length 50 ft.
Diameter 10 in.
Wall thickness 1/4 in.

Casing: / Perforated / Screen
Material NA
Length ft.
Diameter in.
Wall thickness in.
Openings sq. in./L.F.

Open Hole:
Length 5/0
Diameter 6 3/8 in.

*Approximate elevation at time of filing application. Final elevation (masl) by a surveyor licensed by the State must be submitted at start of construction.
Briefly describe the proposed work:

Well will be used in determination of short-term pumping depth to determine aquifer characteristics and ground water availability. Well will also be used in long-term monitoring of ground water response.

PROPOSED SECTION OF WELL

Elevation at top of casing
540 ft., msl.

Ground Elev. 538 ft., msl*

Cement Grout 50 ft.

Solid Casing:
Material:
Length 60 ft.
Diameter 10 in.
Wall thickness 3/4 in.

Hole Dia. 67/8 in.

Openings sq. in./L.F.

Total Depth 590 ft.

Casing: / Perforated / Screen
Material:
Length ft.
Diameter in.
Wall thickness in.

Rock Packing 0 ft.

Open Hole:
Length 540 ft.
Diameter 67/8 in.

Ground Elev. 538 ft., msl*

*Approximate elevation at time of filing application. Final elevation (msl) by a surveyor licensed by the State must be submitted at start of construction.
Briefly describe the proposed work:

Well used in observation of short-term pump-tests to determine aquifer characteristics and ground-water availability. Well will also be used in long-term monitoring of ground-water responses.

PROPOSED SECTION OF WELL

Elevation at top of casing
300 ft., masl.

Ground Elev. 318 ft., masl

Cement
Grout
50 ft.

1/4" adm. grout

Hole
Dia.
6 7/8 in.

Total Depth 370 ft.

Rock
Packing 0 ft.

Solid Casing:
Material Steel
Length
58 ft.
Diameter 10 in.
Wall thickness 3/4 in.

Casing: / Perforated / Screen
Material
Length
Diameter in.
Wall thickness in.
Openings sq. in./L.F.

Open Hole:
Length 320
Diameter 6 7/8 in.

*Approximate elevation at time of filing application. Final elevation (masl) by a surveyor licensed by the State must be submitted at start of construction.
Briefly describe the proposed work:

Well used in observation of short-term pump tests to determine aquifer characteristics and ground water availability. Well will also be used in long-term monitoring of ground water responses.

PROPOSED SECTION OF WELL

Elevation at top of casing: 442 ft., msl.

Ground Elev. 435 ft., msl*

Cement Grout: 50 ft.

44 in. of grout

Hole Dia.: 6 7/8 in.

Total Depth: 490 ft.

Solid Casing:

Material: Steel

Length: 50 ft.

Diameter: 10 in.

Wall thickness: 1/4 in.

Casing: / Perforated / Screen

Material:

Length: ______ ft.

Diameter: ______ in.

Wall thickness: ______ in.

Openings ______ sq. in./L.F.

Rock Packing: ______ ft.

Open Hole:

Length: 440

Diameter: 6 7/8 in.

*Approximate elevation at time of filing application. Final elevation (msl) by a surveyor licensed by the State must be submitted at start of construction.
Briefly describe the proposed work:

Well will perform short-term pump-test to determine aquifer characteristics and ground water availability. Well will also be used for long-term monitoring of changes in related lens.

PROPOSED SECTION OF WELL

Elevation at top of casing 440 ft., msl.

Cement Grout 100 ft.

Hole Dia. 10½ in.

Total Depth 500 ft.

Rock Packing 0 ft.

Ground Elev. 43½ ft., msl*

Solid Casing:

Material Steel

Length 440 ft.

Diameter 10 in.

Wall thickness 3/4 in.

Casing: 1/4 Perforated 1/4 Screen

Material Steel

Length 440 ft.

Diameter 10 in.

Wall thickness 3/4 in.

Openings Variable sq. in./L.F.

Open Hole:

Length 0

Diameter

*Approximate elevation at time of filing application. Final elevation (msl) by a surveyor licensed by the State must be submitted at start of construction.
Briefly describe the proposed work:

Well used in long-term monitoring of lens and salinity profile changes with time.

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**PROPOSED SECTION OF WELL**

Elevation at top of casing: 120 ft., msl.

Ground Elev: 118 ft., msl*

Cement Grout: 50 ft.

Hole Dia: 67/8 in.

Total Depth: 320 ft.

Rock Packing: ___ ft.

Solid Casing:
- Material: Steel
- Length: ___ ft.
- Diameter: ___ in.
- Wall thickness: ___ in.

Casing: / /Perforated / /Screen
- Material: 
- Length: ___ ft.
- Diameter: ___ in.
- Wall thickness: ___ in.
- Openings: ___ sq. in./L.F.

Open Hole:
- Length: 270 ft.
- Diameter: 67/8 in.

*Approximate elevation at time of filing application. Final elevation (msl) by a surveyor licensed by the State must be submitted at start of construction.
Briefly describe the proposed work:

Well used in observation of short-term pump-test of existing Well A. Well used in long-term monitoring of ground water responses and changes through time.

PROPOSED SECTION OF WELL

Elevation at top of casing 340 ft., msl.

Ground Elev. 738 ft., msl

Cement Grout 50 ft.

Hole Dia. 6.75 in.

Total Depth 460 ft.

Rock Packing 0 ft.

Solid Casing:
- Material: steel
- Length: 50 ft.
- Diameter: 10 in.
- Wall thickness: 1/4 in.

Casing: / Perforated / Screen
- Material: 
- Length: 
- Diameter: 
- Wall thickness: 
- Openings: sq. in./L.F.

Open Hole:
- Length: 350
- Diameter: 6.75 in.

*Approximate elevation at time of filing application. Final elevation (msl) by a surveyor licensed by the State must be submitted at start of construction.
Briefly describe the proposed work:

Well will be used in observation of short-term and long-term pumping tests to determine aquifer characteristics and ground-water availability. Well will also be used in long-term monitoring of ground-water response and change through time.

PROPOSED SECTION OF WELL

Ground Elev. 598 ft., masl

Elevation at top of casing
600 ft., masl

Cement
Grout 50 ft.

1/4 in. and 3/8 in.

Hole Dia. 6 7/8 in.

Total Depth 650 ft.

Rock Packing 0 ft.

Solid Casing:
Material
Length 50 ft.
Diameter 10 in.
Wall thickness 1/4 in.

Casing: / Perforated / Screen
Material
Length
Diameter
Wall thickness
Openings sq. in./L.F.

Open Hole:
Length 550
Diameter 6 7/8 in.

*Approximate elevation at time of filing application. Final elevation (masl) by a surveyor licensed by the State must be submitted at start of construction.
Briefly describe the proposed work:

Well will need to perform short-term pump-test to
determine aquifer characteristics and ground-water
availability and long-term monitoring. Long-term
pump-test also planned for this well.

PROPOSED SECTION OF WELL

Ground Elev. 598 ft., sl.

Elevation at top of casing 600 ft., sl.

Cement Grout

Hole Dia. 10 in.

Total Depth 650 ft.

Rock Packing 0 ft.

Solid Casing:

Material Steel
Length 600 ft.
Diameter 10 in.
Wall thickness 1/4 in.

Casing: / Perforated / Screen

Material Steel
Length 50 ft.
Diameter 10 in.
Wall thickness 1/4 in.
Openings variable sq. in./L.F.

Open Hole:

Length
Diameter

*Approximate elevation at time of filing application. Final elevation (msl) by a
surveyor licensed by the State must be submitted at start of construction.
Briefly describe the proposed work:

Well used in determination of base fluctuations.

PROPOSED SECTION OF WELL

Elevation at top of casing 450 ft., msl.

- Cement Grout: 50 ft., 14 in. grout column
- Grout Hole: 61/2 in.
- Total Depth: 500 ft.
- Rock Packing: _ ft.

Ground Elev. 448 ft., msl*

- Solid Casing:
  - Material: Steel
  - Length: 10 ft.
  - Diameter: 6 in.
  - Wall thickness: _ in.

- Casing: / Perforated / Screen:
  - Material: 
  - Length: __ ft.
  - Diameter: _ in.
  - Wall thickness: _ in.
  - Openings: _ sq. in./L.F.

- Open Hole:
  - Length: 450 ft.
  - Diameter: 6 7/8 in.

*Approximate elevation at time of filing application. Final elevation (msl) by a surveyor licensed by the State must be submitted at start of construction.
Briefly describe the proposed work:

Well used in observation of short-term pump tests to determine aquifer characteristics and ground water availability. Well will also be used in long-term monitoring of ground-water aquifer responses/changes.

**PROPOSED SECTION OF WELL**

Elevation at top of casing: 410 ft., msal.

Ground Elev. 408 ft., msal*

Cement Grout: 50 ft.

Hole Dia. 6 in.

Total Depth: 460 ft.

Rock Packing: 0 ft.

Solid Casing:
- Material: Verc
- Length: 50 ft.
- Diameter: 10 in.
- Wall thickness: 1/4 in.

Casing: / /Perforated / /Screen
- Material
- Length
- Diameter
- Wall thickness
- Openings sq. in./L.F.

Open Hole:
- Length 410 ft.
- Diameter 6.78 in.

*Approximate elevation at time of filing application. Final elevation (msl) by a surveyor licensed by the State must be submitted at start of construction.
Briefly describe the proposed work:

Well to perform short-term pump-test to determine aquifer characteristics and ground water availability. Long-term pump-test also planned for this well.

PROPOSED SECTION OF WELL

Elevation at top of casing:

410 ft., masl

Ground Elev. 408 ft., masl*

Cement Grout: 100 ft. 1/4" to end open Hole

Hole Dia. 10 7/8 in.

Total Depth: 460 ft.

Solid Casing:

Material: Steel

Length: 410 ft.

Diameter: 10 in.

Wall thickness: 1/4 in.

Casing: Perforated 11/2 Screen

Material: Steel

Length: 50 ft.

Diameter: 10 in.

Wall thickness: 1/4 in.

Openings: variable sq. in./L.F.

Open Hole:

Length: 0

Diameter: __________ in.

*Approximate elevation at time of filing application. Final elevation (masl) by a surveyor licensed by the State must be submitted at start of construction.