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STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

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OFC. OF ENVIRONMENTAL QUALITY CONTROL

File No.: HA-2673

FEB 10 1994

MEMORANDUM

TO: Director
Office of Environmental Quality Control

FROM: Roger C. Evans, Administrator
Office of Conservation and Environmental Affairs

SUBJECT: Negative Declaration for Non-Potable Irrigation System for Kaupulehu Resort

We have reviewed the comments received during the 30-day public comment period which began on November 23, 1993. We have determined that this project will not have significant environmental effect and have issued a negative declaration. Please publish this notice in the February 23, 1994 OEQC Bulletin.

We have enclosed a completed OEQC Bulletin Publication Form and four copies of the final EA.

Please contact Don Horiuchi at 587-0381 if there are any questions.

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1994-02-23-HI-RFEA-Kaupulehu Resort
Non Potable Irrigation System

Revised Final Environmental Assessment

Non-Potable Irrigation Line, Irrigation Lake, Service Road, and Highway Crossing

for

Kaupulehu Resort

Kaupulehu, North Kona, Hawaii
TMK Third Division, 7-2-03: portion 3
Conservation District Subzone: General

Applicant:
Kaupulehu Land Company

Accepting Agency:
Board of Land and Natural Resources

Applicant's Agent:
Belt Collins Hawaii

February 10, 1994

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1. INTRODUCTION

This section presents background on the proposed project and how it relates to previous permit approvals for the Kaupulehu Resort project. It also includes a detailed description of the proposed project.

1.1 PURPOSE AND CONTENT OF THIS DOCUMENT

This Environmental Assessment (EA) has been prepared to support an application for a Conservation District Use Permit by Kaupulehu Land Company, the developer of the Kaupulehu Resort. The property is owned by Trustees of the Bernice Pauahi Bishop Estate and leased to PIA-Kona Limited Partnership.

This EA complies with the provisions of Hawaii Revised Statutes (HRS) Chapter 343 and Title 11, Department of Health, Chapter 200, Environmental Impact Rules, Sections 11-200-5 through 11-200-11. It is triggered by Section 11-200-6 paragraph b-1-b, which states that an EA is required when an action involves the use of land in a Conservation District. Agencies consulted during its preparation include the Department of Land and Natural Resources, State of Hawaii; the County of Hawaii Planning Department; and the County of Hawaii Water Supply Department.

1.2 REGIONAL SETTING

The project area constitutes a portion of the ahupua'a of Kaupulehu situated on the mauka side of the Queen Ka'ahumanu Highway in North Kona on the Island of Hawaii (see Figure 1). It is situated approximately 13 miles north of the Keahole Airport and 17 miles south of Kawaihae harbor. The project area is identified as tax map key Third Division, Zone 7, Section 2, Plat 3, portion of Parcel 3, as depicted in Figure 2, and extends across lands designated as State Conservation District (General Subzone) and State Agriculture District.

1.3 DEVELOPMENT OVERVIEW

In July 1962, the State Land Use Commission granted a special permit for the development of 62 acres of land along the shoreline at Kaupulehu as the Kona Village Resort. In 1978, the County of Hawaii upgraded Kaupulehu from a Retreat Resort to an Intermediate Resort as part of a

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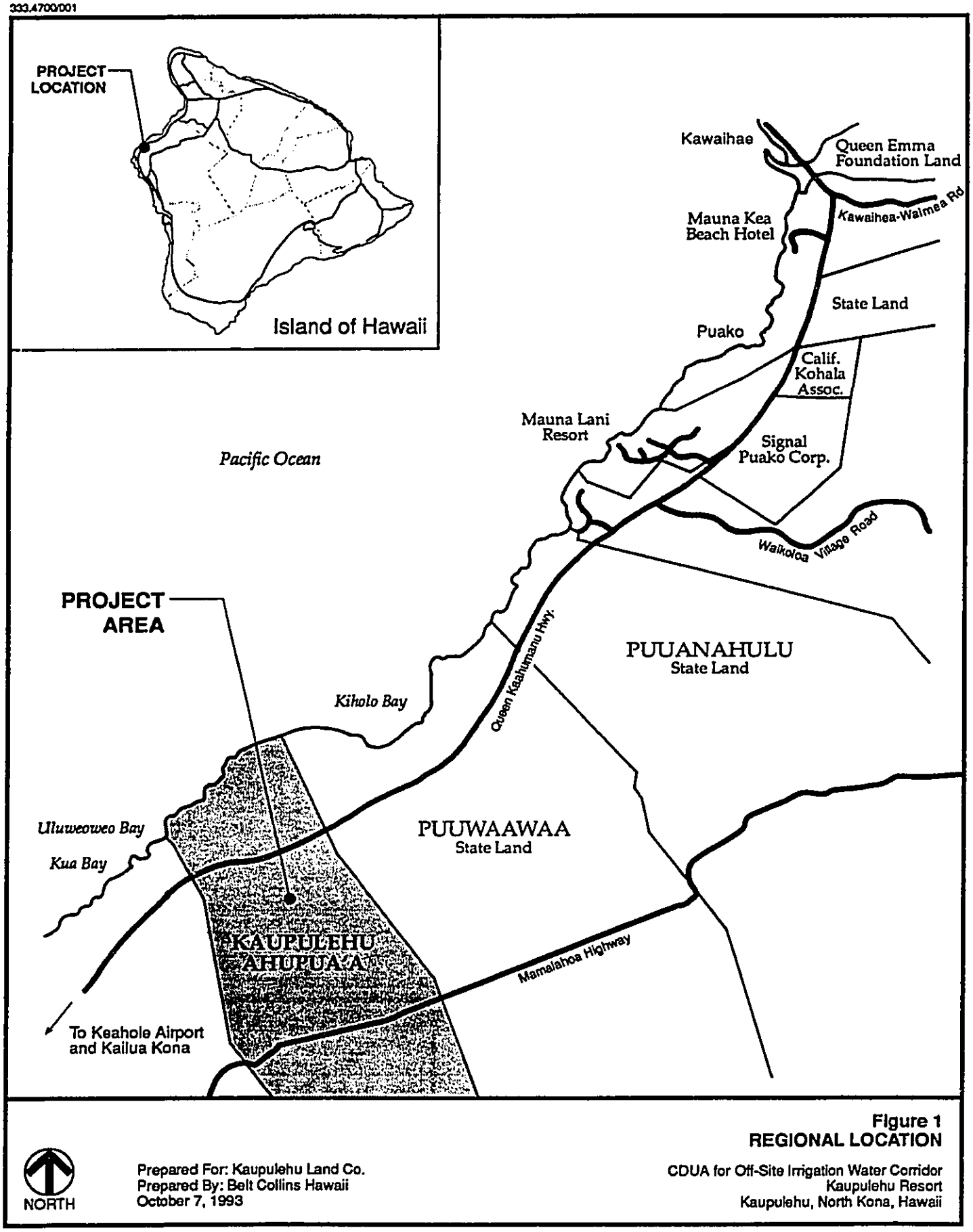

Prepared For: Kaupulehu Land Co.
Prepared By: Belt Collins Hawaii
October 7, 1993

Figure 1
REGIONAL LOCATION

CDUA for Off-Site Irrigation Water Corridor
Kaupulehu Resort
Kaupulehu, North Kona, Hawaii

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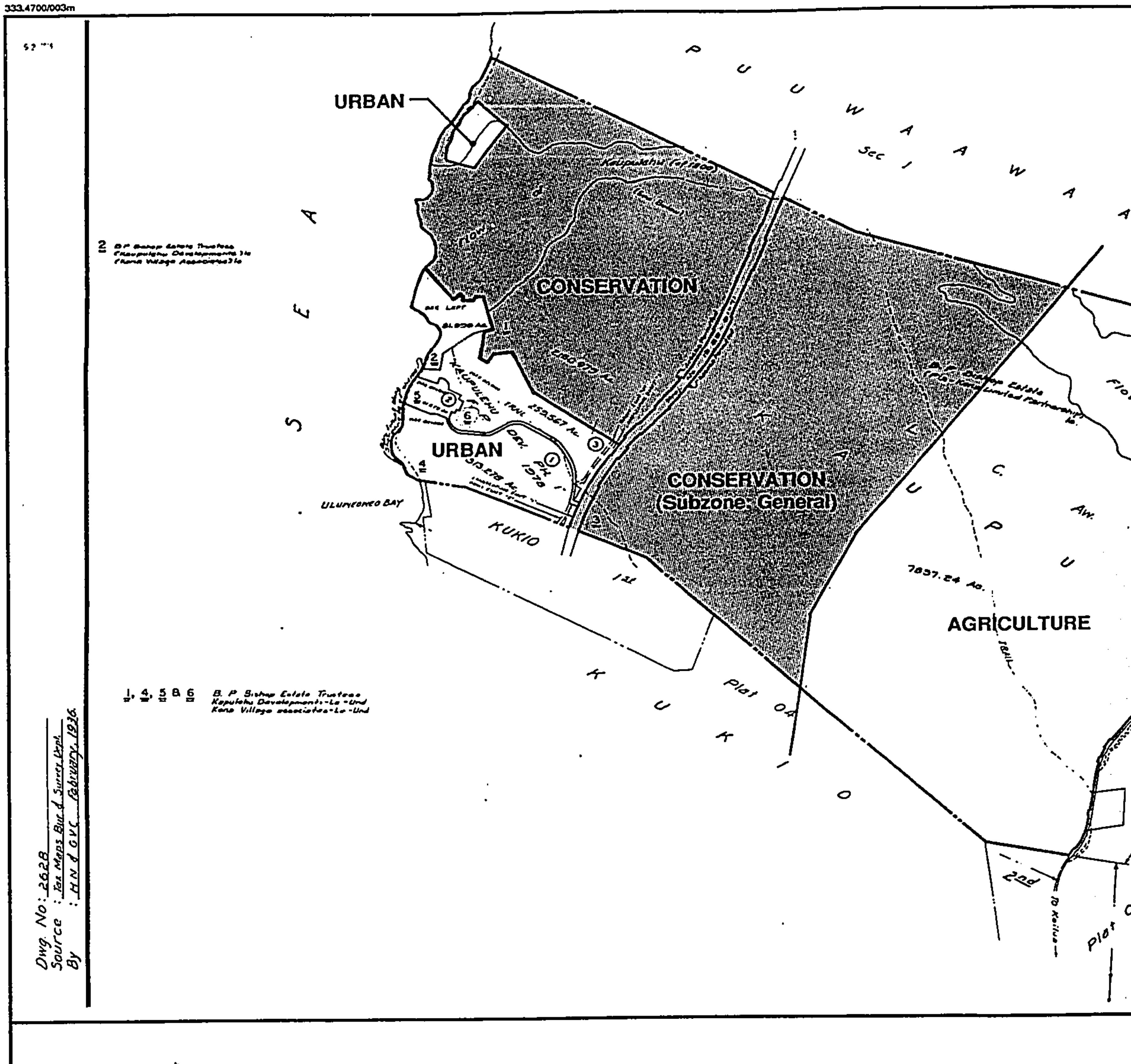

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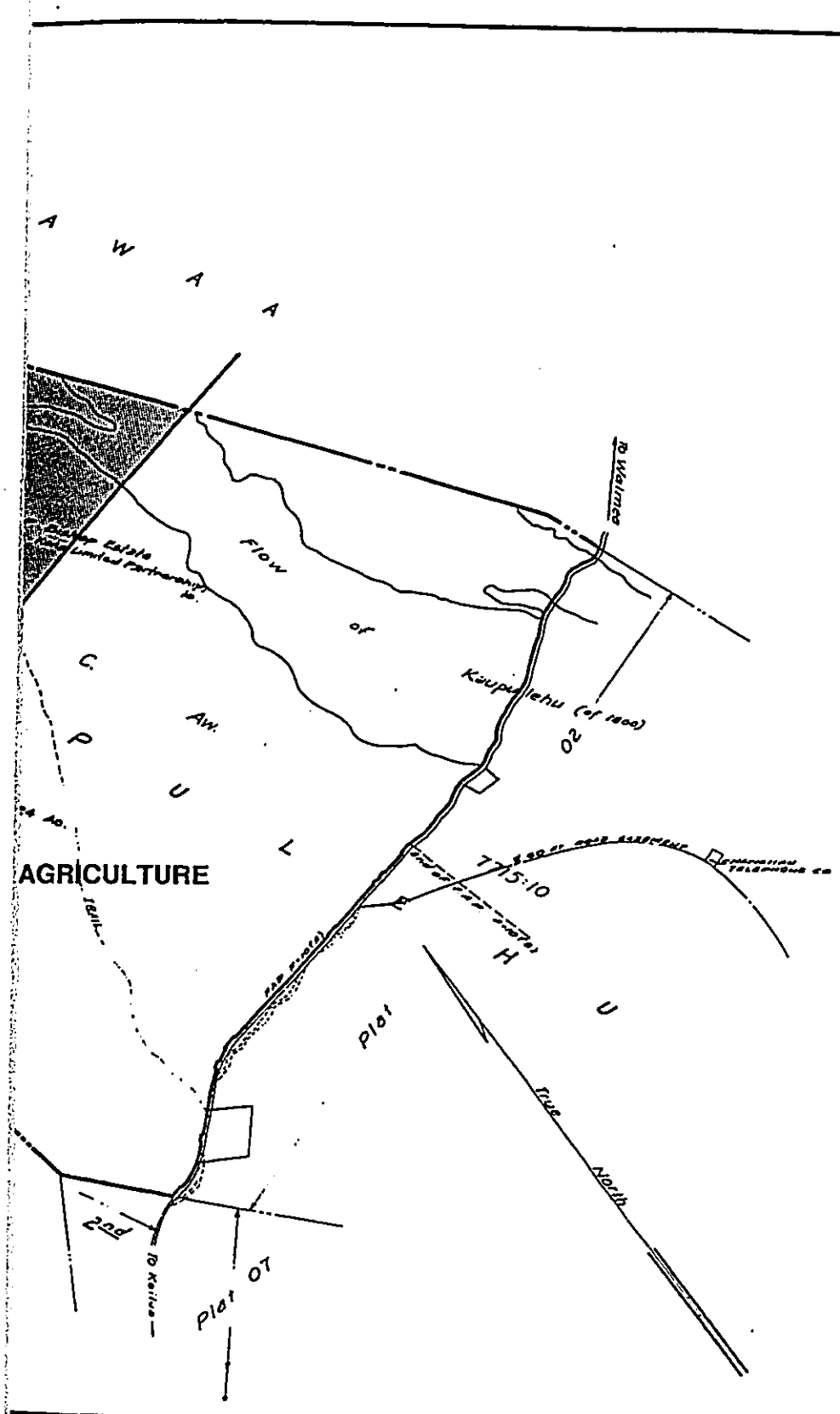

Figure 2
TAX MAP KEY 7-2-03 AND STATE LAND USE DESIGNATIONS

CDUA for Off-Site Irrigation Water Corridor
Kaupulehu Resort
Kaupulehu, North Kona, Hawaii

General Plan revision and update program. The revision allowed the development of up to 1,500 resort units. In 1986, the State Land Use Commission approved a boundary amendment for an Urban District within the makai portion of the Kaupulehu ahupua'a. A Zone Change Ordinance and Special Management Area permit for the resort were both granted in 1988. Presently, the Four Seasons Hotel and an 18-hole golf course are under construction within the resort's Urban District. Since 1989, three Conservation District Use Permits (#HA-3/16/89-2252, #HA-2463, and #HA-9/13/91-2517) have been granted by the Board of Land and Natural Resources for the development of infrastructure to support the resort, including a mauka utility corridor, an access easement, access road, and irrigation lake.

1.4 REQUESTED GOVERNMENT ACTION

The requested government action is the issuance of a Conservation District Use Permit (CDUP) to allow construction of a non-potable irrigation water line, irrigation lake, service road, two observation/production wells, and appurtenant facilities within Conservation District lands.

1.5 PURPOSE AND DESCRIPTION OF THE PROPOSED ACTION

The purpose of the proposed action is to permit the delivery of non-potable water from two existing wells to the Kaupulehu Resort golf course which is presently under construction on the makai Kaupulehu lands, and to other areas to be landscaped in the resort. The existing wells are situated in the State Agriculture District between the 845-foot and 865-foot elevation mauka of Queen Ka'ahumanu Highway. The irrigation line must cross the Conservation District to reach the Urban District where the Kaupulehu Resort project is located. Thus, the pipe line alignment crossing the Conservation District represents only a portion of the entire project (see Figure 3).

The objective of the proposed project is to provide an environmentally effective and cost efficient means of transporting irrigation water from the existing wells to the proposed golf course. Following is a detailed description of the various elements of the proposed project.

1.5.1 Non-Potable Irrigation Line

The irrigation water line will consist of two segments; a ductile iron pipe, 12 inches in diameter, extending downslope from a 30,000 gallon head tank near the existing wells to the

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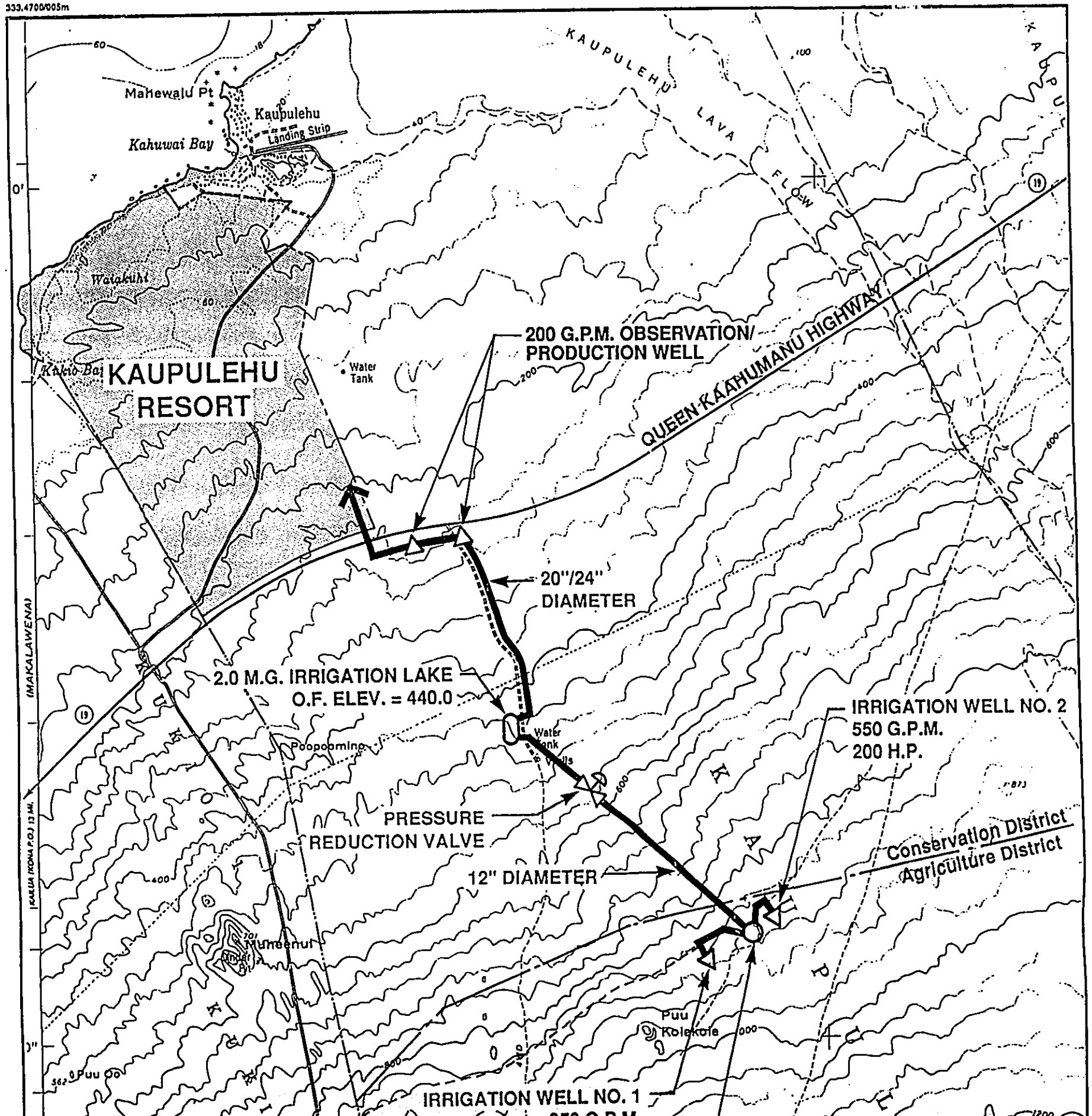

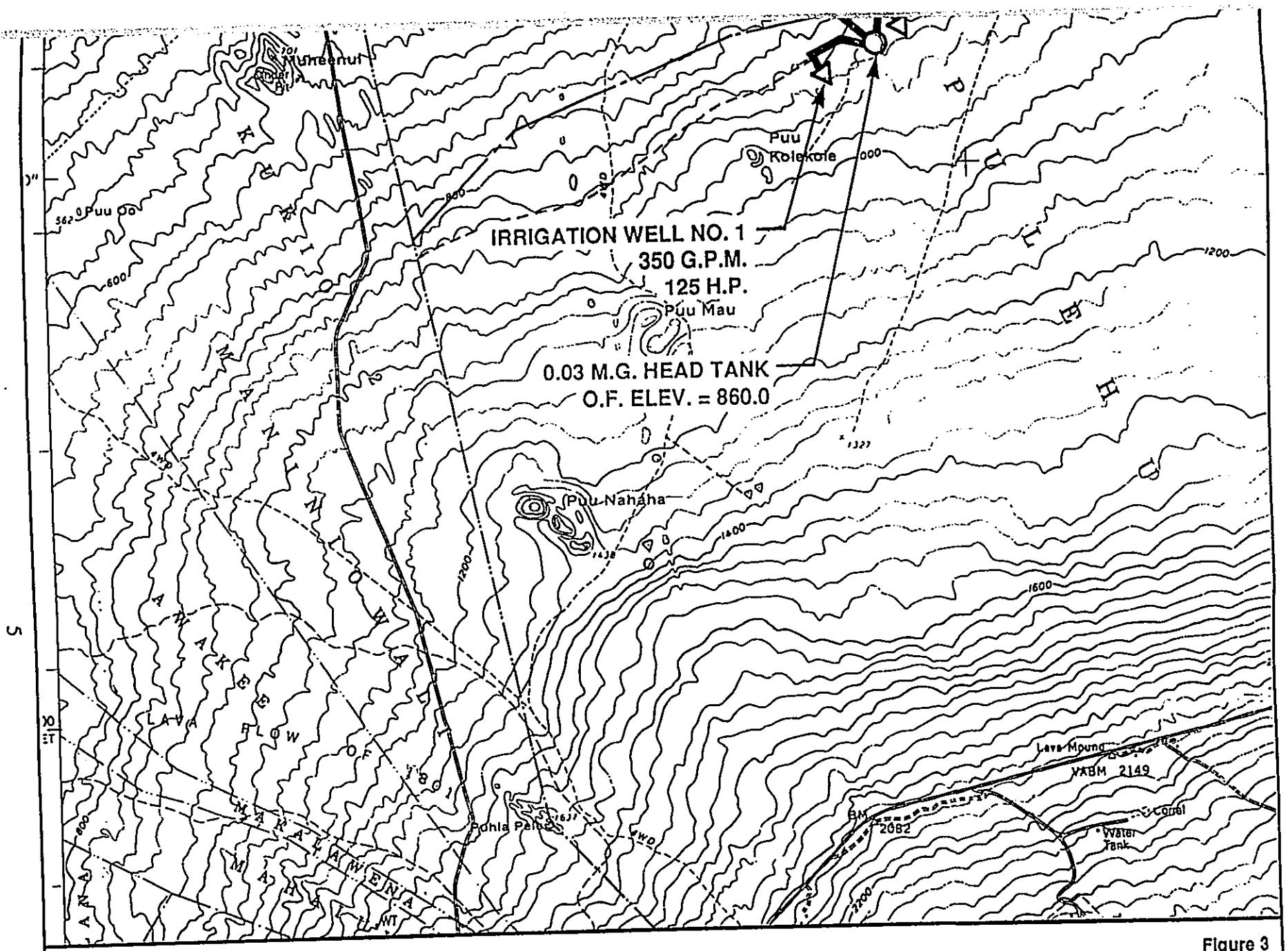

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Prepared By: Belt Collins Hawaii
October 7, 1993

Figure 3
ALIGNMENT OF PROPOSED PROJECT

CDUA for Off-Site Irrigation Water Corridor
Kaupulehu Resort
Kaupulehu, North Kona, Hawaii

proposed irrigation lake (hereinafter the "upper section"), and a ductile iron pipe, either 20 inches or 24 inches in diameter, extending downslope from the irrigation lake to the makai edge of the Queen Ka'ahumanu Highway right-of-way (hereinafter the "lower section"). The entire length of the upper and lower sections, including connecting pipe between wells Number 1 and 2, is approximately 12,000 feet. The length of the proposed pipeline aligned within the Conservation District will be approximately 10,200 feet.

The upper section of the pipe line trench (between the existing wells and the proposed irrigation lake) will be constructed at-grade and anchored to the ground with concrete footings. The pipeline alignment along the upper section will also include a control wire conduit approximately 2 inches in diameter. This conduit will be buried a few inches below the ground and will contain electrical control wires needed to connect water level control switches at the proposed irrigation lake and the existing wells. In addition, a pressure reducing station will be located at the 600-foot elevation to reduce water pressure in the piping. The station will be constructed on a concrete pad and include pressure reducing valves and system piping.

The lower section of the line will be buried approximately 2.5 feet below the surface. To accomplish this, a trench approximately 3.5 feet wide and 3.5 feet deep will be excavated. It is estimated that approximately 3,000 cubic yards of material will be excavated from the trench. When construction is completed, the trench will be filled and the pipe line covered with the previously excavated material. Any remaining material can be transported to the Kaupulehu Resort development site and used as fill for golf course or residential development.

1.5.2 Irrigation Lake

The proposed irrigation lake will be situated between an elevation of 450 and 500 feet above mean sea level near the existing Kona Village water tank. It will be designed to contain approximately 2 million gallons of non-potable water, delivered to the lake from the wells. The surface area of the lake will be approximately one acre and will measure approximately 240 feet by 180 feet (see Figure 4). It's average depth will be about 7 feet. The lake will be constructed by excavating approximately 17,500 cubic yards of material from the upper end and utilizing it to create a berm around the lower end and sides to a maximum height of 10 to 15 feet. As is the case with the proposed trench, excavated material in excess of what is need for fill at the proposed project can be transported to the Kaupulehu Resort development site for use as fill there. The

bottom of the lake area will be lined with high density polyethylene liner.

An 8 to 10-foot deep stilling well will be constructed near the lake to enclose the water level switches. The purpose of the stilling well is to monitor the water level of the lake and activate the well pumps via the electrical control wires discussed above when additional water is needed. The stilling well will consist of a 12-inch diameter pipe topped by an 18-inch by 24-inch box constructed at-grade. A flow regulating station will also be provided adjacent to the lake to control the rate of water flow into the lake from the wells. It will be constructed at-grade on a concrete pad with an area of approximately 150 to 200 square feet and will contain influent piping and control valves.

1.5.3 Service Road

The lower section of the proposed pipe line will be situated adjacent to an existing jeep trail which extends from Queen Ka'ahumanu Highway past the existing Kona Village water tank situated at the 505-foot elevation and up to Mamalahoa Highway. In the general vicinity of the water tank, the jeep trail turns to the south and continues uphill to Mamalahoa Highway, while the pipe line will turn to the northeast and continue uphill to the existing wells.

The proposed service road is intended to provide access to the upper portion of the water line not accessible from the existing jeep trail. It will be situated on the northern side of the pipe line and will consist of a graded 18-foot right-of-way. Construction will include approximately 10 feet of compacted surface and a 4-foot compacted shoulder on either side. The service road is not proposed to be paved at this time. The decision to pave the road's surface in the future will be based upon an evaluation of the impact which utility vehicles may have upon its stability. If it is determined that the roadway is prone to ruts or erosion, spot paving may be necessary. If paving is eventually utilized, it would consist of a base course with bituminous asphalt treatment.

1.5.4 Highway Crossing

Queen Ka'ahumanu Highway was constructed through portions of the Conservation District in the early 1970's pursuant to a Conservation District Use Permit (#HA 6/8/72-338). The proposed highway crossing will consist of a 2.5 foot wide trench excavated perpendicular to the highway's entire right-of-way. The pipe line will be buried in the trench at a minimum depth of 4

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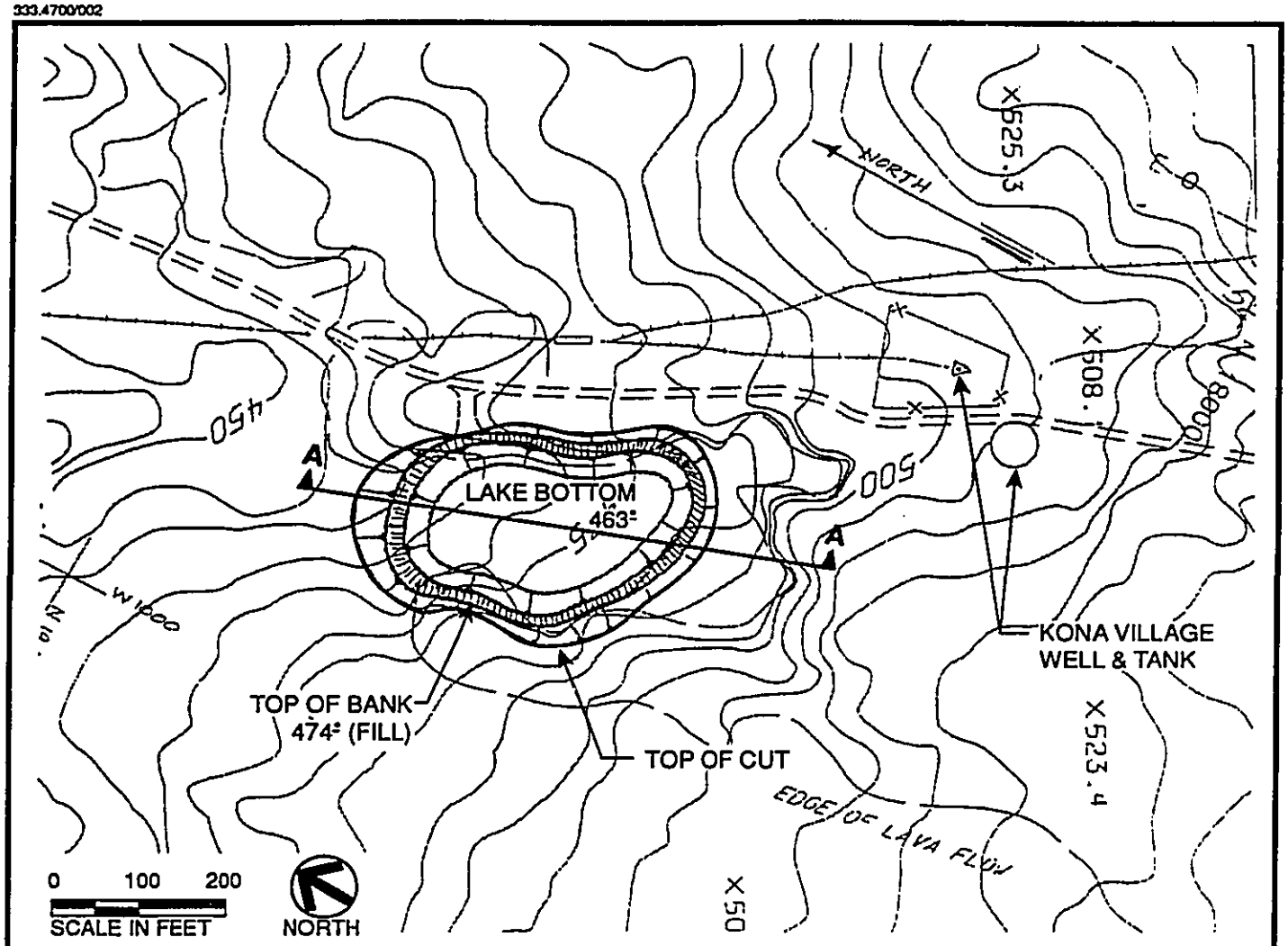

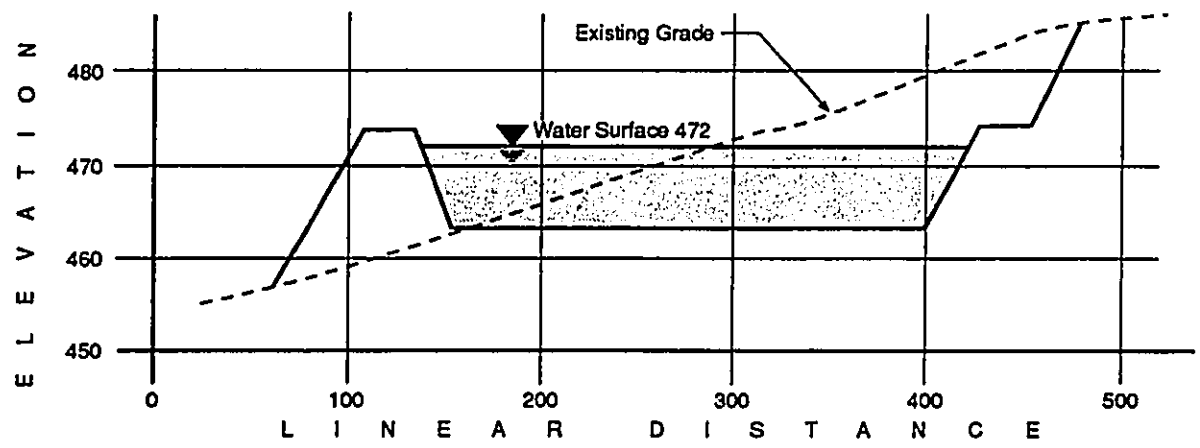

SCALE IN FEET

SECTION A-A

Figure 4
PROPOSED IRRIGATION LAKE DESIGN

Prepared For: Kaupulehu Land Co.
Prepared By: Belt Collins Hawaii
October 7, 1993

CDUA for Off-Site Irrigation Water Corridor
Kaupulehu Resort
Kaupulehu, North Kona, Hawaii

feet and will be covered with fill conforming to Department of Transportation specifications (see Figure 5). Within the highway's paved area, the trench will be repaved to match the existing pavement of the highway and will conform to Department of Transportation specifications. Once trenching is completed within the highway's right-of-way, the trench will be filled to match the surrounding landscaping.

1.5.5 Observation/Production Wells

Two 200 gallon/minute (gpm) wells are also proposed to be situated within the alignment of the pipeline corridor that parallels the Queen Kaahumanu Highway. If these wells produce the low-salinity brackish water anticipated, they will be used to offset the volume of irrigation water to be provided by the existing wells in the Agricultural District. As indicated in Figure 3, one of the proposed wells would be located at the "elbow" of the corridor within which the pipeline is to be aligned. The second well would be located midway along the alignment paralleling the highway. Both wells would be equipped with submersible pumps to ensure that no portion of the pumps or pipeline protrudes above the ground. Once construction of the wells and pumps are completed, the cleared area around them will be restored to match the appearance of the surrounding lava fields. Restoration may include sporadic placement of fountain grass.

2. CHARACTERISTICS OF THE PROJECT AREA

This section discusses the socioeconomic and environmental setting of the proposed project. How construction and operation of the project may impact the environment and specific recommendations to mitigate any potentially negative impacts are discussed in Section 3.

2.1 REGIONAL SOCIAL AND ECONOMIC CONDITIONS

The general social and economic conditions in the region of the proposed project are discussed in the Kaupulehu Resort Final Environmental Impact Statement (BCA, 1986). Due to the relative lack of development in the Kaupulehu region, current socioeconomic conditions remain similar to what they were in 1986 when the EIS was published.

The project site is situated in United States Census Tract 215.01. According to the 1990

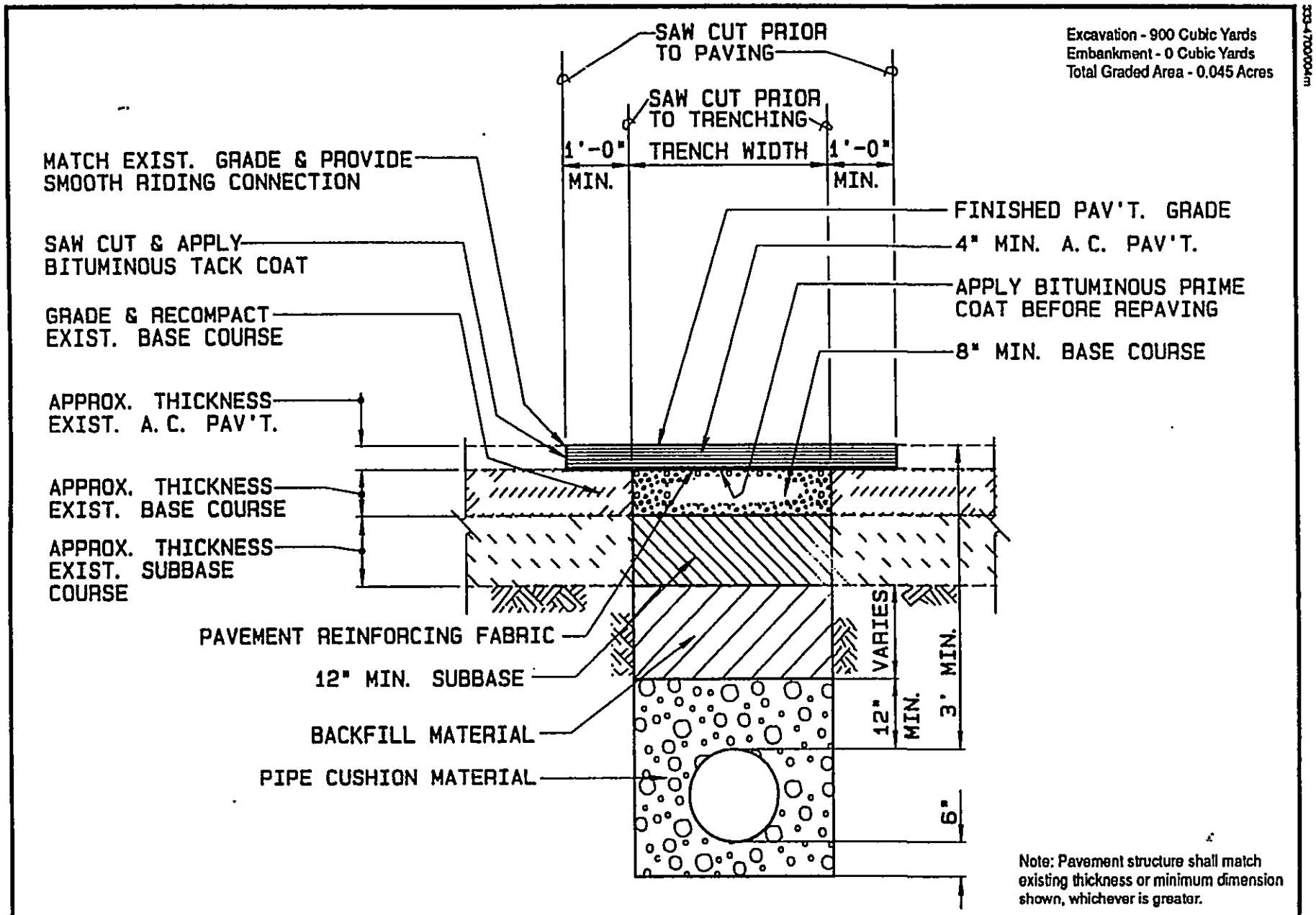

Figure 5
TYPICAL TRENCH AT PROPOSED HIGHWAY CROSSING

NOT TO SCALE

Prepared For: Kaupulehu Land Co.
Prepared By: Belt Collins Hawaii
October 7, 1993

CDUA for Off-Site Irrigation Water Corridor
Kaupulehu Resort
Kaupulehu, North Kona, Hawaii

census, this census tract had a population of 6,486 and was made up of 2,166 households.[1] Within the district of North Kona, population increased 184.5% between 1970 and 1980; from 4,832 to 13,748. Between 1980 and 1990, North Kona's population increased 62.1% to 22,284.

Due to the relatively limited population of the area, information concerning economic conditions is generally aggregated by the State to an islandwide perspective. In Hawaii County, the civilian labor force increased from 43,550 in 1980 to 61,550 in 1990. During the same period, civilian unemployment decreased from 6.2% to 3.8%. In 1990, the service industry employed 31% of Hawaii County's labor force. Wholesale and retail trades employed nearly 28%, while total agricultural employment (wage, salary, and self-employed) employed about 12%. (source: DBED&T, 1992 Data Book)

2.2 ENVIRONMENTAL CONSIDERATIONS

2.2.1 Geology and Topography

The Kaupulehu ahupua'a is located on the northern slope of Hualalai volcano, the second oldest on the island. The proposed project site is situated on prehistoric lava flows which have covered one another to create the characteristic shape of Hualalai. Lava types in the vicinity of the proposed project include both a'a and pahoehoe. Due to the general lack of rainfall in the area, the lava is not significantly eroded by vegetative growth or inundated by storm runoff, and consequently, there is very little soil or ground cover.

The topography of the mauka lands is relatively uniform with the exception of three prominent hills, Puu Kolekole, Puu Mau, and Puu Nahaha, situated 9,000 to 12,000 feet up-slope from Queen Ka'ahumanu Highway. The nearest of these three hills is over 3,000 feet from the furthest mauka point of the proposed project. The land upon which the project will be constructed has a slope from 6 percent to 7.5 percent and is characterized by a relatively flat lower area gradually sloping upwards to a uniformly sloped area in the vicinity of the existing wells.

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1 Due to redistricting in 1990 by the Census Bureau, CT 215.01 is a newly created subdistrict of the old tract (215). Therefore, comparable numbers are not available for historic population growth in the area.

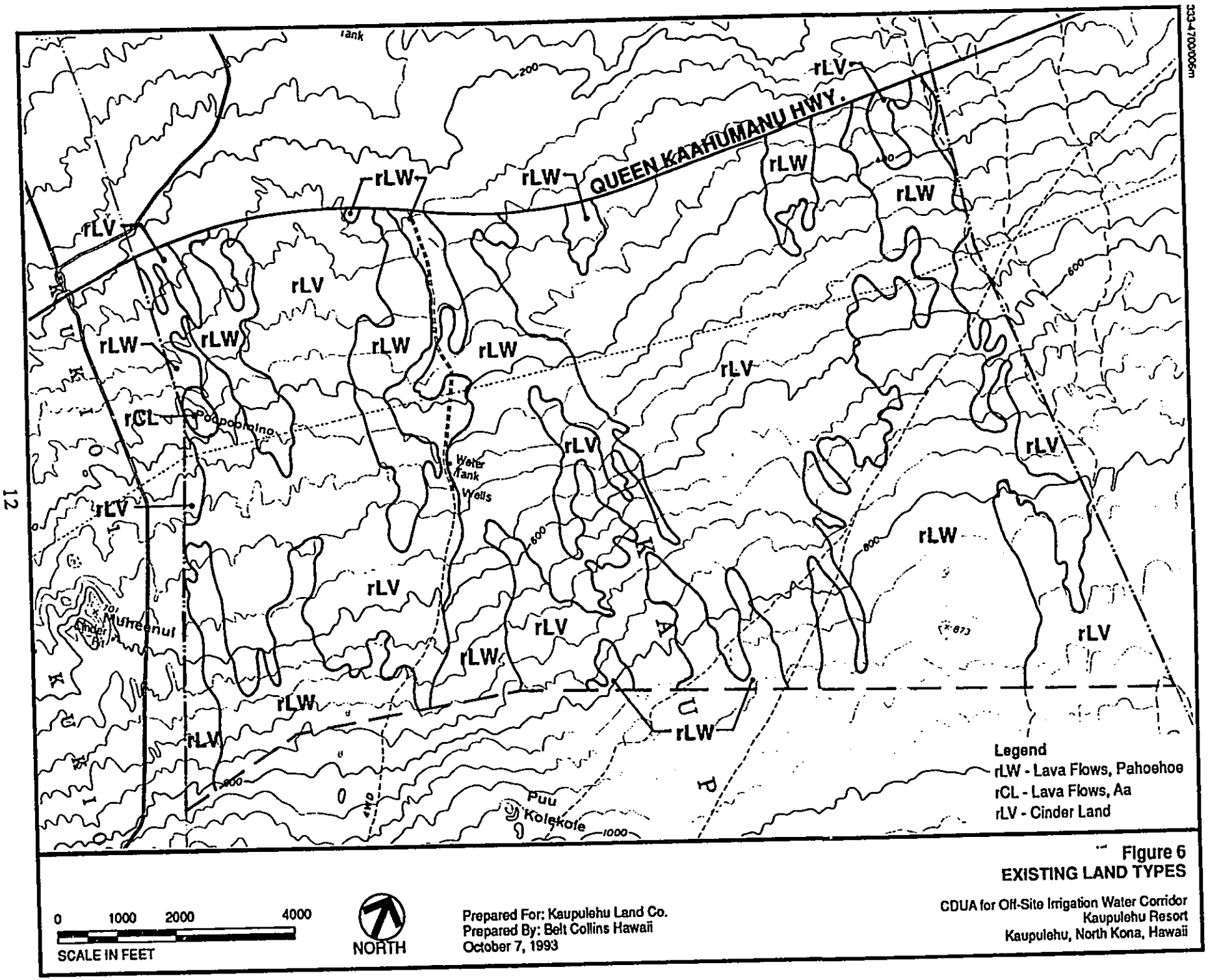

Figure 6
EXISTING LAND TYPES

CDUA for Off-Site Irrigation Water Corridor
Kaupulehu Resort
Kaupulehu, North Kona, Hawaii

2.2.2 Soils and Agricultural Potential

As discussed in the Kaupulehu Resort Final EIS (BCA, 1986), four land types have been identified on the mauka lands of the Kaupulehu ahupua'a within which the proposed project is situated (see Figure 6). None of the four are agriculturally significant. Following is a description of the land types:

(1) A'a Lava Flows (rLV). This lava has practically no soil cover and is generally bare of vegetation. The surfaces of a'a flows are masses of clinkery, hard, sharp pieces piled in tumbled heaps that are difficult to traverse on foot. It has been demonstrated that the clinkery a'a surface can be easily moved and crushed by bulldozers into relatively smooth surface cobbles one to four inches in size.

(2) Pahoehoe Lava Flows (rLW). Pahoehoe lava flows, similar to the a'a flows, are a miscellaneous land type with meager soil covering. The surface of pahoehoe lava is generally much smoother than the a'a lava. The only soil in this land type is found in cracks and depressions, having been transported there by wind and storm runoff.

(3) Rock Land (rRO). Rock land is another miscellaneous land type that consists of pahoehoe bedrock covered in places with a thin layer of transported soil. The little soil that is present is generally confined to holes and cracks in the bedrock. Lava outcrops are exposed over 50 to 90 percent of the surface.

(4) Cinder Land (rCL). Cinder land is also a miscellaneous land type consisting of bedded cinders, pumice and ash. These materials are black, red, yellow, brown or variegated. The particles have jagged edges and a glassy appearance and show little or no evidence of soil development. Cinder land commonly supports some grass, but it is not good pasture land because of its loose consistency and poor trafficability. This land is a source of materials for surfacing roads.

As discussed in the Detailed Land Classification, Island of Hawaii, University of Hawaii, Land Study Bureau, 1972, the mauka lands of the Kaupulehu ahupua'a are classified by the codes E287, E319 and E324. The "E" classification indicates lack of suitability for agricultural purposes.

2.2.3 Surface Water and Drainage

There is no surface water in the vicinity of the project. Due to location of the Kaupulehu lands in the lee of Mauna Kea, rainfall is characteristically limited. Because of the general lack of surface water runoff, no naturally occurring drainageways exist in the area impacted by the proposed project. All of the proposed project's soil and land types are classified as well drained due to the naturally porous character of the lava.

2.2.4 Groundwater and Hydrology

As discussed in the Kaupulehu Resort Final EIS (BCA, 1986), the Kaupulehu lands can be divided into three hydrogeological sectors. The first sector falls between Queen Ka'ahumanu Highway and the coast. The second sector extends from Queen Ka'ahumanu Highway inland to an undefined boundary lying in the rift zone between Puu Kolekole and Puu Nahaha at an elevation between 1,000 and 1,200 feet above mean sea level. The third sector is restricted to the rift zone where subsurface geological discontinuities occur. The project is situated within the second sector which is characterized by basal groundwater with moderate to weakly brackish quality.

2.2.5 Natural Hazards

Flooding due to surface runoff is unlikely to occur because of the well drained character of the land and soil types in the project area. However, the proposed project could be subjected to potential natural hazards including volcanic eruptions and earthquakes. Hualalai volcano is designated by the United States Geological Survey (USGS) as Lava Flow Hazard Zone 4 (on a scale of 1 to 9, where 1 is the zone of greatest potential hazard). Less than 15 percent of Hualalai volcano has been covered by flows in the last 750 years, and about 5 percent of the volcano has been covered by lava since 1800 (USGS, 1990). It last erupted in 1800-1801 from several vents on its northwest rift zone. One of these flows, today known as the Kaupulehu Lava Flow, covered eastern portions of the Kaupulehu ahupua'a. The Keahole airport is built on another of these flows. According to the USGS, the flanks of Hualalai do not have a distinctly lower hazard than its rift zones because the distance from the vents to the coast is short and the upper slopes are relatively steep.

Hualalai volcano is also identified by the USGS as being the location of potentially damaging earthquakes. The last large earthquake occurred on October 5, 1929 and had a magnitude of 6.5 on the Richter scale, based upon eye witness accounts of the earthquake's effects and reports of damage. Historical data indicates that earthquakes of a level of 6.4 magnitude occur on an average of once every 62 years at Hualalai.

2.2.6 Climate and Meteorology

The climate is generally warm and dry. Rainfall below the 1,000 foot elevation averages

less than 10 inches per year. The mean annual temperature in the project area is about 78 degrees F. with relatively small daily and seasonal variations. The daily climate is characterized by relatively clear mornings and cloudy afternoons as clouds build up around the lee side of Hualalai at about the 6,000 foot elevation. Winds tend to be light and variable due to the shielding influence of Mauna Kea mountain upon the northeast trades. Local wind conditions are characterized by on-shore breezes at night and off-shore breezes during the day.

2.2.7 Air and Noise Quality

The area's air quality is generally good due to the relative lack of human activity or development. Existing air quality is impacted by vehicular traffic on the Queen Ka'ahumanu Highway. In addition, during seasonal conditions when the northeaster trade winds diminish and are replaced by southerly, or Kona winds, volcanic fumes from eruptive activity at Kilauea volcano on the southeastern flank of Mauna Loa are blown around the southern portion of the island and up the leeward coast. During these conditions, a heavy volcanic haze known as vog is readily visible.

The existing noise quality is generally characterized by the sound of the wind blowing through the fountain grass, except in the vicinity of Queen Ka'ahumanu Highway, where traffic noise predominates.

2.2.8 Visual Attributes

The Conservation district extends up-slope from Queen Ka'ahumanu Highway (elevation approximately 250 feet) about 8,000 linear feet to an elevation of about 850 feet. The entire area is visible from the highway and may be generally characterized as a vacant mountain slope consisting of historic and prehistoric lava flows partially vegetated with low grasses and shrubs.

2.2.9 Flora and Fauna

A botanical field survey of the study area was conducted in mid-September 1993 to determine the presence of any threatened or endangered plant species. The findings of the survey are presented as an appendix to this document. Following is a summary of the survey.

For the most part, the proposed project will cross over very sparsely vegetated a'a lava

flows. Where the project crosses over pahoehoe flows, the vegetation consists of dense mats of fountain grass (Pennisetum setaceum), an introduced species. About 30% to 40% of the project site crosses over this low rolling grassland, and in this area the grass cover varies from about 60% to 80% along the corridor.

None of the plants found along the irrigation line corridor, on the irrigation lake site, on the connecting pipeline site, or on the well sites are listed threatened and endangered species; nor are any proposed or a candidate for such status. All of the plants can be found in similar dry, lowland situations through the Hawaiian Islands. Other recent botanical studies conducted on the mauka property, or on adjacent lands have recorded similar findings (Char 1984, 1985, 1988, 1991).

The fauna of the general area was surveyed in conjunction with the 1986 Final EIS for Kaupulehu Resort (BCA, 1986), and a 1989 Conservation District Use Application for a utility corridor situated approximately 4,400 feet west of the proposed project. The results of both surveys confirmed the presence of exotic bird species, goats, and donkeys in the area. No threatened or endangered species were encountered. The 1989 survey indicated that no endemic birds or resident indigenous seabirds were recorded in the general area. A total of ten species of exotic birds were recorded in the mauka area, the most abundant of these being the Japanese White-eye (*Zosterops japonicus*). The short-eared owl or Pueo (*Asio flammeus sandwichensis*) is relatively common in the area and could occur within the study area, although none has been observed. No mongoose (*Herpestes auropunctas*), rats, mice, cats, or dogs were recorded but may also inhabit the area. Similarly, no evidence of the endemic and endangered Hawaiian Hoary Bat (*Lasirus cinerus semotus*) was found.

2.2.10 Historic and Archaeological Resources

An archaeological inventory survey of the study area was conducted in September 1993 to determine the presence of historic or archaeological resources. None were found within the study area, which included a 50-foot wide corridor on either side of the proposed irrigation line alignment, a 4-acre area around the site of the proposed irrigation lake, and a 50-foot wide corridor on either side of the connecting line proposed to be located between the existing wells. The complete report of the surveying archaeologist is attached as an appendix to this EA.

2.2.11 Access

The lower section of the proposed water line alignment is presently accessed by an existing jeep trail extending from Queen Ka'ahumanu Highway past the Kona Village water tank. The existing wells are accessed by a jeep trail from Mamalahoa Highway. Both of these jeep trails are routinely chained and public access is restricted.

2.2.12 Wastewater and Solid Waste Disposal

There are no existing wastewater disposal systems or solid waste disposal sites in the vicinity of the proposed project and none associated with the proposed project.

2.2.13 Electrical Power and Communications

The Kaupulehu ahupua'a is presently transversed by overhead 69kv electrical transmission lines about 3,000 feet inland from the highway at an elevation of about 425 feet above MSL.

2.2.14 Public Facilities

Public facilities serving the Kaupulehu region, including schools, health care facilities, police, highways, and fire services are discussed in the Kaupulehu Final EIS (BCA, 1986).

3. SUMMARY OF MAJOR IMPACTS RESULTING FROM THE PROPOSED ACTION AND RECOMMENDED MEASURES FOR MITIGATION OF NEGATIVE IMPACTS

This section addresses the socioeconomic and environmental consequences of the proposed project. The process of designing the project's various components has included meeting with government officials to identify regulatory requirements and an analysis of the subject property to identify existing or potential constraints that may impact the project. Thus, the project as it is described in Section 1 represents the applicant's efforts to avoid significant environmental impacts to every extent practicable.

To determine potential impacts, a study area was defined around the alignment of the proposed project. The study area extends 50 feet to each side of the entire pipe line alignment. The study area also includes an area measuring approximately 350 feet by 550 feet within which

the 1-acre irrigation lake will be sited. The total study area consists of approximately 28 acres.

This section discusses the identifiable socioeconomic impacts in the North Kona district as well as physical impacts within the study area. Where potential impacts are deemed to be significant, this section recommends a course of action for reducing or eliminating any negative consequences. Recommended 'mitigation measures' are presented in bold face **(bold face)** type.

3.1 SOCIAL AND ECONOMIC CONSIDERATIONS

Development of the Kaupulehu Resort will contribute to continued population growth and economic development in North Kona in the next decade. The effects of this general growth are expected to be significant and are described in detail in the Kaupulehu Resort Final EIS (BCA, 1986). That document concludes that the socioeconomic effects of the resort project will be positive due to its contributions to regional employment and increased revenues.

The proposed action and the construction of a non-potable irrigation line, in and of itself, will not have a significant impact upon the socioeconomic character of the area. The pipe line will not generate any direct increase in population. Construction of the proposed wells will not generate any direct or indirect increase in population, since the wells are intended to offset pumpage from the existing non-potable wells. Construction of the proposed project will provide a limited number of short-term construction jobs which are expected to be filled from the existing labor pool. Thus, no new construction jobs are foreseen. An indirect impact of the proposed project will be the operation of the golf course which represents a new source of employment for the area. Therefore, the proposed project will have a positive indirect impact upon the economy of the area, both in terms of new jobs and increased tax revenues associated with real property and excise taxes.

3.2 GEOLOGY AND TOPOGRAPHY

The proposed project will have no impact upon the geology of the Kaupulehu region. Impacts upon topography will be limited to the construction of the irrigation lake which will alter approximately one acre of land with excavation and the construction of a berm up to fifteen feet in height. However, this impact is not viewed as significant due to the size of the berm relative to the surrounding area, its slope, and the varying heights and dimensions of the a'a rubble.

3.3 SOILS AND AGRICULTURAL POTENTIAL

The proposed project will not result in a net loss of any soils or excavated lava rock, nor will it impact any land identified under the state's classification system known as Agricultural Lands of Importance to the State of Hawaii (ALISH).

3.4 SURFACE WATER AND DRAINAGE

The proposed project will have no significant impact upon drainage in the area. If the proposed surface road is eventually paved, it may increase runoff in the immediate vicinity of its shoulders. However, the porous character of the surrounding a'a will absorb any runoff. The lack of defined drainage channels will inhibit sheet flow potential. Furthermore, due to the relative lack of rainfall in the area, any runoff generated by the service road would be negligible.

3.5 GROUNDWATER AND HYDROLOGY

The proposed project will have little impact on the underlying groundwater aquifer. The well pumps for the existing wells will be designed to withdraw a maximum of 1.29 million gallons a day. The State Commission on Water Resource Management (CWRM) has determined the sustainable yield for the Hualalai Sector of the Kiholo Groundwater System (Code No. 80902) to be 18 million gallons a day. Current use is 0.360 million gallons a day. The additional draft for this project will bring the total use to 1.65 million gallons a day. Table 1 presents a summary of the wells in this sector. Each of the proposed wells will be designed to withdraw a maximum of .288 million gallons per day. If the water from these wells proves to be adequate for irrigation purposes, it will offset the volume of water to be pumped from the existing wells.

3.6 NATURAL HAZARDS

The proposed project may potentially be impacted by earthquakes and volcanic activity associated with Hualalai volcano. An earthquake of extreme intensity may result in damage to the irrigation lake berm. However, because the irrigation lake is to be situated at least 3,700 feet up-slope from the nearest development (Queen Ka'ahumanu Highway), the accidental release of water will have no serious consequence or impact. Utilizing a conservative estimate for the porosity of a'a lava (5 gallons per minute), and identifying the potential drainage basin to be approximately

555,000 square feet (a 150-foot wide corridor extending downslope from the irrigation lake to the highway), in one minute this narrow drainage basin could absorb approximately 2.775 million gallons of water. Nevertheless, the potential occurrence of a damaging earthquake will be taken into account in the design of the berm protecting the makai side of the irrigation lake. Final design of the berm will be coordinated with all applicable government agencies including the DLNR.

With regard to volcanic activity and lava flows, inundation of the proposed facilities would result in physical damage but would not necessarily threaten human lives.

Table 1: Existing Wells in the Kiholo Aquifer System, Hualalai Sector, Island of Hawaii

State Well No.	Well Owner	Current Use (MGD)	Prospective Future Use
4558-01	Hue Hue Ranch Associates	Not in Use	HR - No. 3
4558-02	Hue Hue Ranch Associates	Not in Use	HR - No. 5
4650-01	Puuwaawaa Ranch*	0.061 MGD	Uses will continue
4658-01	Kaupulehu Land Company	Not in Use	Potable supply for the Kaupulehu Resort
4658-02	Kaupulehu Land Company	Not in Use	
4757-01	Kaupulehu Land Company	Not in Use	Irrigation for Kaupulehu Resort Golf Course
4757-02	Kaupulehu Land Company	Not in Use	
4759-01	Hue Hue Ranch Associates	Not in Use	Irrigation supply for Kukio Resort
4759-02	Hue Hue Ranch Associates		
4759-03	Hue Hue Ranch Associates		
4850-01	Puu Lani Ranch Estates*	0.050 MGD	Uses will continue
4858-01	Kona Village	Not in Use	Non-potable irrigation use will continue; future potable supply will be provided by Kaupulehu Resort
4858-02	Kona Village*	0.009 MGD	
4858-03	Kona Village*	0.240 MGD	
4950-01	Big Island Country Club	Not in Use	Will provide potable and golf course irrigation supply
4953-01	State DOWALD	Not in Use	

* Current use from the Commission on Water Resource Management staff, September 1993.

3.7 CLIMATE AND METEOROLOGY

Construction and operation of the project will have no impact upon climatic conditions.

3.8 AIR AND NOISE QUALITY

The proposed project may be classified as an "indirect source" of air pollution as defined in the federal Clean Air Act of 1977 due to the potential for increased vehicular traffic associated with the proposed service road. However, because the service road will be chained and access to it will be limited to maintenance crews, the actual increase in vehicles utilizing the service road will be on the order of six vehicle-trips a week, and the resulting impact on air quality will be negligible.

Excavation of the proposed trench and irrigation lake, as well as grading of the proposed service road and well drilling areas will result in short-term impacts upon air quality, principally in the form of dust generated by construction vehicles. However, the relative absence of top soil in the area will greatly limit the volume of dust generated and consequently, the potential for a significant impact. Exhaust emissions from construction vehicles will also have a short-term impact on air quality. **To ensure that fugitive dust is adequately controlled, the construction site will be frequently watered by a tanker truck.**

Because of the relatively low density of human activity in the area, the ambient noise quality of the Kaupulehu is undermined only by vehicular traffic along Queen Ka'ahumanu Highway. Construction of the proposed project will produce a short-term negative impact on noise quality. Long term operation and periodic maintenance of the pipe line and irrigation lake will, on the other hand, have no measurable impact. The anticipated low volume of vehicular traffic on the service road will have no appreciable impact on noise quality.

3.9 VISUAL ATTRIBUTES

No significant visual impacts will result from construction or operation of the proposed project. **The upper section of the proposed water line to be located at-grade will not be visible from Queen Kaahumanu Highway due to the presence of two natural lava berms that obscure it from view. The lower section of the line will be buried and, therefore, will not be visible. White lettering on the naturally**

black iron pipe will be painted out on the at-grade pipe with non-toxic paint to prevent potential contamination from flaking paint. The fill material used to cover the line will match the surrounding lava rock. The irrigation lake will generally not be visible from the highway because the berm forming its makai end will be covered with a'a rubble in a manner consistent with the character of the surrounding area. The proposed wells will be fitted with submersible pumps. No mechanical equipment associated with the proposed wells will protrude above ground. Portions of the proposed service road and the existing jeep trail will be visible from the highway. If paved, its visual impact will be lessened to a great degree by the color of its paved surface which in time will blend with the surrounding lava rock. Because the control wires will also be buried, no poles or lines are necessary. This will further help to reduce the visual impact of the road.

3.10 FLORA AND FAUNA

Development of the proposed project will result in the loss of some vegetation in the immediate vicinity of the proposed trench, service road, and irrigation lake. However, the loss of this vegetation is not considered to be significant because it is commonly found throughout the region and in similar environmental conditions around the state. Mitigation measures to minimize the impact are, therefore, not warranted. Fountain grass or shrub ilima will re-establish itself naturally along the corridor, the edge of the service road, and around the proposed well sites.

No bird or mammal habitats have been identified in the study area. Although birds and mammals do frequent the area, the proposed project is unlikely to impact them. No significant impacts are anticipated. Donkeys observed in the area will not be disturbed. Their continued use of the existing jeep road will not be cut off or restricted by this project. The upper section of the proposed irrigation line located at-grade will not prevent or restrict the donkeys in their movement because its total height will be less than 20 inches above ground (12-inch diameter pipe + less than 8 inches to bracket and anchor it).

3.11 HISTORIC AND ARCHAEOLOGICAL RESOURCES

No archaeological or historic resources have been identified within the study area, thus the proposed project will have no impact on known archaeological resources. Nevertheless, if

subsurface archaeological resources are discovered during the course of grading, construction will be halted and an archaeologist will be consulted to determine the significance of the discovery, according to procedures established by the Historic Preservation Division of the DLNR.

3.12 ACCESS

Access to the service road will be restricted and limited to maintenance personnel via the existing unimproved intersection of the jeep trail with Queen Ka'ahumanu Highway. At a point immediately outside of the highway right-of-way, the service road will be chained, as is the current practice.

3.13 WASTEWATER DISPOSAL

The proposed facilities will not generate any wastewater. However, the provision of the irrigation line will enable the proposed Kaupulehu Resort's golf course to operate. Wastewater generated at the golf course will be treated at a private wastewater treatment plant to be located on the resort property makai of Queen Ka'ahumanu Highway. Thus, construction of the proposed irrigation line will have an indirect impact upon wastewater disposal at the proposed resort. For a detailed description of the resort's proposed wastewater collection and disposal system, refer to the Kaupulehu Resort Final EIS (BCA, 1986).

3.14 SOLID WASTE DISPOSAL

This proposed project will have no direct impact upon solid waste collection or disposal in the Kaupulehu area. However, as is the case with wastewater, construction of the irrigation line is required for the successful operation of the golf course. It is expected that the golf course will generate limited amounts of solid waste for collection and disposal. A full discussion of solid waste disposal is presented in the Kaupulehu Resort Final EIS (BCA, 1986).

3.15 ELECTRICAL POWER AND COMMUNICATIONS

The proposed project will not require electrical transmission or communications facilities to cross the Conservation district. Electricity for the pumps to be installed at the existing wells will be provided via transmission lines from Mamalahoa Highway. The underground control wires

discussed earlier eliminate the necessity of installing communications equipment at the proposed irrigation lake. Regulation of the existing and proposed well pumps and control of water flow will be entirely automated.

3.16 PUBLIC FACILITIES

The proposed project will not affect the existing or future operation of schools, health care facilities, police or emergency facilities. Construction of the proposed irrigation line will, however, have a short term impact upon traffic flow along the Queen Ka'ahumanu Highway. The trench which will contain the buried irrigation line must cross the highway's 300-foot right-of-way to reach the Kaupulehu Resort's golf course.

To mitigate the short-term impact that construction will have upon traffic flow, excavation of the crossing will occur in two segments. This may require the temporary closure of one traffic lane to allow excavation to the highway's center line. Once this portion of the line is properly buried and the trench refilled, the lane will be reopened to traffic while the opposite lane is closed to allow completion of the crossing. However, it is likely that two-way traffic will be continued throughout the construction phase by utilizing the highway shoulder area as a temporary by-pass. The trench will be repaved to match the existing pavement of the highway and will conform to Department of Transportation specifications. Once trenching is completed within the highway's right-of-way, the trench will be filled to match the surrounding landscaping. Signage and a flagman will likely be used to control traffic flow during construction of the crossing. Construction of the trench across the highway is expected to require approximately 6 working days.

3.17 RECREATIONAL RESOURCES

The proposed water line will enable the operation of the proposed Kaupulehu Resort golf course. The course is intended to serve as an important recreational facility for the proposed resort. Thus, construction of the water line will have a positive impact on the provision of a new recreational resource in the region.

4. ALTERNATIVES CONSIDERED

Conceptual planning for infrastructure development includes a determination of the most cost-effective alternative available. Such a determination typically includes an analysis of environmental impacts. This section discusses the alternatives that were considered during the early design stages of the project.

4.1 IRRIGATION LINE ALTERNATIVES

4.1.1 No Action

As discussed in the Final EIS for the Kaupulehu Resort (BCA, 1986), each of the resort's two proposed golf courses will require approximately 800,000 gallons of non-potable water per day for irrigation. Brackish wells to be developed within the mauka Kaupulehu property were proposed in the Final EIS as the source of this water. As a result of project approvals granted for Kaupulehu Resort in the late 1980's, two brackish wells were completed. These are the wells referred to in this document as 'the existing wells'.

Grading of the first proposed resort golf course has recently begun pursuant to permit approvals granted by the County of Hawaii. Irrigation water will be necessary to support turf grow-in once the shaping of the course is completed.

The No Action alternative would entail not building the proposed irrigation line. If the proposed line were not built, an alternative source for irrigation water would be necessary because the proposed golf course could not be operated or maintained without a reliable source of irrigation water. The use of potable water for irrigation purposes would not be environmentally responsible and, therefore, is not considered to be a viable alternative.

Because of the high salinity of the aquifer in the immediate vicinity of the proposed golf course, development of a new source of non-potable irrigation water would require new wells to be dug in the mauka region of the Kaupulehu property. This would result in the same general impacts as the existing project since the new water line would also have to cross the Conservation District to reach the resort's Urban District boundary. Such a line could be situated within the previously approved utility corridor southwest of the current project area. However, installing the irrigation line in this corridor would require a considerably greater length of pipe line and would be significantly more expensive. The cost of obtaining irrigation water from an off-site source (either

a neighboring property owner or through an alternative technology such as desalination) is considerably higher than the cost of the proposed irrigation line. For these reasons, the No Action alternative was rejected.

4.1.2 Irrigation Line Design

Consideration was given to laying the lower section of the proposed water line at-grade or slightly elevated as an alternative to burying it in a trench. Most of the impacts associated with the proposed project are directly attributable to trench construction. In addition, the cost of burying the line is somewhat higher than laying it at-grade. However, the applicant believes that the visual impact created by an iron pipeline from 20 to 24 inches in diameter extending down the mountain slope from the irrigation lake would be intrusive to the natural character of the area, especially in the proximity of the Queen Kaahumanu Highway. Efforts to mitigate the visual impact of an at-grade water line would require a combination of landscaping and/or some form of protective visual berm, both of which would be costly and inconsistent with the character of the existing vegetation. Therefore, the decision was made to lay the pipe line at-grade only in the area above the irrigation lake where the it would be a smaller diameter pipe (12 inches),well over a mile from the highway, and protected from view by natural lava berms.

The alternative of reducing the potential impacts of trench construction by downsizing the diameter of the line has also been evaluated and found to be ineffective. To provide a sufficient volume of water to the resort golf course on a daily basis, the pipe line must be of an adequate size. For these reasons, the design alternatives discussed above were rejected.

4.2 IRRIGATION LAKE ALTERNATIVES

4.2.1 Location

The proposed location of the irrigation lake is dependent upon two principle considerations; the location of the water line and the existing topography of the area. Since the proposed alignment of the water line generally represents the most direct route, it would be quite costly to locate the lake some place other than immediately adjacent to the line. To do so would increase the relative degree of environmental impacts associated with the project, because as the length of the water line increases, so would the size of the physical area to be impacted by it.

The irrigation lake is presently proposed to be situated in a natural depression in the lava. By taking advantage of this topographic condition, costs associated with excavation and construction of a protective berm are reduced. The relocation of the lake to a less advantageous site would result in increased development costs. Furthermore, if the irrigation lake is not situated in a natural depression, the protective berm needed to retain the water will likely have a greater visual impact than that which is currently proposed, due to the likely increase in height. For these reasons, these alternatives were rejected.

4.2.2 Irrigation Lake Design

A potential design alternative for the project is to utilize a water tank instead of an irrigation lake to store the well water. To store 2 million gallons of water, a tank approximately 130 feet in diameter and 20 feet high would be required. This alternative was rejected, however, because the visual impact was deemed unacceptable. In addition, the cost of constructing the irrigation lake should be considerably less than constructing an enclosed tank.

4.3 SERVICE ROAD ALTERNATIVES

4.3.1 Location

The alignment of the proposed service road includes a section of existing jeep trail. A route that does not utilize the existing jeep trail would increase construction costs because additional grading would be required to prepare the service road. It would also result in increased impacts upon the existing vegetation and topography. For these reasons, this alternative was rejected. Use of the existing jeep trail helps to reduce the amount of construction related to the service road.

4.3.2 Service Road Design

A reduction in the width of the proposed service road would reduce the physical area impacted by the grading of the roadway. However, this alternative is not deemed acceptable because any reduction in roadway would likely increase the hazard potential for service vehicles utilizing the road and jeopardize the safety of the vehicles' occupants.

4.3.3 Service Road Surface

The service road is not proposed to be paved at this time. The decision to pave the road's surface in the future will be based upon an evaluation of the impact which utility vehicles may have upon its stability. If it is determined that the roadway is prone to ruts or erosion, spot paving may be necessary. The alternative to pave the road at the time of its construction was rejected for two reasons; visual impact and excessive cost.

4.4 RESOURCE ALTERNATIVES

Recent drilling tests conducted at observation well sites located within the Urban district just makai of the highway indicate that the salinity of the brackish water in the vicinity of the proposed well sites may be less than what was originally anticipated. If the quality of the brackish water produced by the proposed 200 gpm wells proves to be adequate for irrigation purposes, they will be used to offset the volume of water to be pumped from the existing wells in the Agricultural District. However, the proposed wells would not replace the existing wells as a source for non-potable water. Rather, they would reduce the volume of water to be pumped from them.

5. DETERMINATION

Based upon the information available and the proposed design of the physical components of the proposed project, it has been determined that development of the non-potable irrigation line, irrigation lake, and service road has described herein would result in positive socioeconomic benefits and would not have a significant negative impact upon the environment. Furthermore, the preparation of this EA is in full compliance with the environmental disclosure process, as defined in Chapter 343, Hawaii Revised Statutes, and Chapter 200, Department of Health Environmental Impact Statement Rules. Therefore, no environmental impact statement is required for the proposed action.

6. FINDINGS AND REASONS SUPPORTING DETERMINATION

In designing the components of the proposed project, the applicant has considered the sum effects of the project on the quality of the environmental and socioeconomic conditions in the area to be impacted, including its cumulative effects. The applicant has considered every phase of the

proposed project, the expected consequences, both primary and secondary, and short-and long-term effects of the proposed action. As a result of these considerations, it is determined that:

a. The proposed project does not involve an irrevocable commitment to loss or destruction of any significant natural, historical, archaeological, or cultural resource.

b. The proposed project increases the range of beneficial uses of the environment.

c. Approval of the requested action would be consistent with the goals, policies, and courses of action of the Hawaii County General Plan.

d. The proposed project does not adversely affect the economic or social welfare of the community, county, or state.

e. The proposed project does not involve substantial secondary impacts, such as population changes that are not already contemplated and accommodated by the Hawaii County General Plan.

f. The proposed project does not increase the demand for public services or facilities that are not already contemplated.

g. The proposed project does not substantially affect public health.

h. The proposed project does involve substantial degradation of the natural environment.

i. The proposed project does not substantially affect rare, threatened, or endangered species or habitats.

j. The proposed project does not detrimentally affect air or water quality or ambient noise levels.

k. The proposed project does not substantially affect an environmentally sensitive area such as a flood plain, tsunami zone, special management area, erosion-prone area, geologically hazardous land, estuary, coastal waters, or inland waters.

l. The proposed project does not involve a larger commitment for further actions.

The proposed project has been designed to be compatible with the locality and surrounding area and is appropriate to the physical conditions characterizing the area. The mitigation measures proposed will ensure that the existing environmental character of the area will be preserved. The applicant will be responsible for, and comply with, all applicable statutes, ordinances, and rules of federal, state, and county governments.

7. REFERENCES

Belt Collins & Associates. 1986. Final Environmental Impact Statement, Kaupulehu Resort, Kaupulehu, North Kona, Hawai'i.

Belt Collins & Associates. 1989. Conservation District Use Permit Application and Environmental Assessment for the Kaupulehu Development's Utility Corridor, Kaupulehu Resort, North Kona, Island of Hawaii.

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Land Study Bureau, University of Hawai'i. 1972. Detailed Land Classification, Island of Hawai'i.

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Paul H. Rosendahl, Ph.D., Inc. 1993. Archaeological Inventory Survey Kaupulehu Mauka Lands Project Area.

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8. PUBLIC AND AGENCY REVIEW OF DRAFT ENVIRONMENTAL ASSESSMENT

A notification of availability of the Draft EA was published on November 23, 1993 in the Bulletin of the Office of Environmental Quality Control. During the 30-day review and comment period, the Department of Land and Natural Resources, accepting agency for the EA, received eight comment letters. These letters are included below together with responses prepared by the applicant's agent, Belt Collins Hawaii.

As a result of the recent drilling tests in the Urban District (discussed above in Section 4.4), the Final Environmental Assessment was revised to include the provision for the two proposed 200 gpm observation/production wells to be constructed within the irrigation line corridor. To ensure that all interested parties were adequately informed of the proposed revision, staff members of the Department of Land and Natural Resources, the Office of Environmental Quality Control, the Office of State Planning, the Department of Transportation, and the Water Commission were contacted. No objections or substantive comments were received from any of these parties.

5986

D.H

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December 16, 1993

Mr. Keith W. Ahue
Board of Land and Natural Resources
Dept. of Land and Natural Resources
P. O. Box 621
Honolulu, HI 96809

Dear Mr. Ahue:

This letter is in response to your memorandum no. HA-2673 (Requests for Comments on Draft Environmental Assessment report entitled "Non-Potable Irrigation Line, Irrigation Lake, Service Road, and Highway Crossing"). We have reviewed the report, and based on the information contained, we find no major hazards to the environment, wild habitats, and human settlements stemming from the proposed development.

Sincerely yours,

Richard K. Paglinawan

Richard K. Paglinawan
Administrator

LM:lm

cc Clayton H.W. Hee
Chairman, BOT

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& ASSOCIATES
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January 20, 1994
333.4700/94P-29

Mr. Dante Carpenter, Administrator
Office of Hawaiian Affairs
711 Kapiolani Boulevard, Suite 500
Honolulu, Hawaii 96813-5429

Dear Mr. Carpenter:

Conservation District Use Application (HA-2673)
Non-Potable Irrigation Line, Irrigation Lake,
Service Road, and Highway Crossing
Kaupulehu Resort, North Kona, Hawaii

I am writing regarding your staff's December 16, 1993 review of the Draft Environmental Assessment for the above project. Thank you for your participation in the public and agency review process.

Should you require any additional information concerning the proposed project, please contact Mr. Roger Harris of the Kaupulehu Land Company at 325-0808, or me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Lee William Sichter

cc: Roger Harris
Don Horiuchi

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

December 3, 1993

LOG NO: 10002
DOC NO: 9311ks11

MEMORANDUM

TO: Roger Evans, Administrator
Office of Conservation and Environmental Affairs

FROM: Don Hibbard, Administrator
State Historic Preservation Division

SUBJECT: **Chapter 6E (HRS) Compliance--CDUA, Non-Potable Irrigation Line, Irrigation Lake, Service Road, and Highway Crossing for Kaupulehu Resort**
Kaupulehu, North Kona, Island of Hawaii
TMK: 7-2-03: 003 (por.)

HISTORIC PRESERVATION PROGRAM CONCERNS:

Our office has reviewed the accompanying PHRI archaeological inventory survey report(1427-100193: "*Archaeological Inventory Survey, Kaupulehu Resort Irrigation Project, Land of Kaupulehu, North Kona District, Island of Hawaii*) by Goodfellow (1993). We find the survey was adequately undertaken to locate all the historic sites in the project area and we agree, as was expected given the results of the background research, that no historic sites were present. Hence, the subject undertaking will have "no effect" on historic sites.

KS:amk

c: Paul Rosendahl, PHRI
Anne Mapes, Belt Collins & Associates

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January 20, 1994
333.4700/94P-30

Mr. Don Hibbard, Administrator
State Historic Preservation Division
Department of Land and Natural Resources
33 South King Street
Honolulu, Hawaii 96813

Dear Mr. Hibbard:

Conservation District Use Application (HA-2673)
Non-Potable Irrigation Line, Irrigation Lake,
Service Road, and Highway Crossing
Kaupulehu Resort, North Kona, Hawaii

I am writing regarding your December 3, 1993 review of the Draft Environmental Assessment for the above project. Thank you for your participation in the public and agency review process.

Should you require any additional information concerning the proposed project, please contact Mr. Roger Harris of the Kaupulehu Land Company at 325-0808, or me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Lee William Sichter

cc: Roger Harris
Don Horiuchi

OFFICE OF STATE PLANNING

Office of the Governor

MAILING ADDRESS: P.O. BOX 3540, HONOLULU, HAWAII 96811-3540
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FAX: Director's Office 587-2848
Planning Division 587-2824

Ref. No. C-382

November 29, 1993

MEMORANDUM

TO: The Honorable Keith W. Ahue, Chairperson
Department of Land and Natural Resources

SUBJECT: Review of Draft Environmental Assessment
Kaupulehu Resort Irrigation System
North Kona, Hawaii, File No. HA-2673

We have reviewed the referenced document and have the following comments:

The primary coastal management concerns for this project relate to scenic and open space resources. We believe that the above-ground portion of the proposed pipeline may become visually intrusive.

As the referenced document states: "the entire area is visible from the highway and may be generally characterized as a vacant mountain slope consisting of ... lava flows partially vegetated with low grasses and shrubs." View studies should demonstrate how the pipeline, and other above-ground structures associated with this project, will be sited and/or designed so that the new irrigation system is visually compatible with its natural environment. It seems that merely painting the pipeline may not be adequate to camouflage it. Also, there is no assurance that it will be repainted when necessary. If the paint is improperly applied, or as the paint ages, there is the possibility of it flaking off and contributing to pollution of run-off. The area surrounding the Kaupulehu Resort could potentially become more urbanized within the anticipated lifetime of the pipeline, and thus become more visually exposed.

According to the referenced document (page 25), the difference in cost between burial and above-ground placement is not very great. Therefore, consideration should be given to other mitigative measures, especially burial, as an alternative to the cosmetic one of painting structures. Although there may be additional short-term impacts ensuing from burial relative to above-ground placement, we believe the long-term impacts would be less.

We appreciate very much the opportunity to review the proposal. If you have any questions, please contact Terry Hildebrand at 587-2881.

Harold S. Masumoto
Director

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January 20, 1994
333.4700/94P-31

Mr. Harold S. Masumoto, Director
Office of State Planning
P.O. Box 3540
250 South Hotel Street, 4th Floor
Honolulu, Hawaii 96811-3540

Dear Mr. Masumoto:

Conservation District Use Application (HA-2673)
Non-Potable Irrigation Line, Irrigation Lake,
Service Road, and Highway Crossing
Kaupulehu Resort, North Kona, Hawaii

I am writing regarding your November 29, 1993 review of the Draft Environmental Assessment for the above project. We acknowledge your concern about the potential visual impact of the proposed project and wish to assure you that the project will not be visually intrusive.

It is important to understand that although the subject property is a vacant mountain slope and is, therefore, visible from the Queen Kaahumanu Highway, its topography and vegetative ground cover are not uniform. The combination of historic and prehistoric a'a and pahoehoe lava flows which have inundated the area has resulted in a topography consisting of small mounds of rubble, plateaus, ridges, swales, depressions, and ravines. As discussed in the Environmental Assessment (EA), 30%-40% of this landscape is covered with fountain grass, an aggressive exotic species, with up to 80% coverage in the proposed roadway/irrigation line corridor. Because the fountain grass is especially concentrated in the swales, depressions, and ravines where moisture is more abundant, it creates an illusion of uniform slope by infilling depressions and smoothing out what is actually a very harsh and jagged topography. Thus, the fountain grass conceals the pitched character of the lava field beneath it. This is significant because together the lava and fountain grass provide a natural means of mitigating the potential visual impact of the irrigation line.

As stated in the EA, the section of the proposed irrigation line to be located between the highway and the proposed reservoir will be buried. Consequently, it will not be visible. Therefore, as we understand them, your concerns about visual impact are limited to the above-ground elements of the project, beginning at the proposed reservoir near the existing Kona Village water tank and extending up to the source wells #1 and #2.

To address your concerns, we have conducted a recent field inspection and photographic analysis of the subject property. Presently, a 6-inch galvanized steel water line is visible from Queen Kaahumanu Highway. It extends upslope to the water tank perpendicular to the highway. As evidenced in Photo A, the 6-inch line extends about 100 feet mauka from the highway before it disappears over a small lava ridge and enters an area covered with fountain grass. Although the line actually extends in a relatively straight line another 1.8 miles uphill, only the first section of it is visible. The line is concealed the rest of the way by variations in the lava's topography and by fountain grass. Although the proposed pipe line will be buried between the highway and the proposed reservoir, Photo A demonstrates the concealing nature of the topography and vegetation and demonstrates that there will be no visual impacts created by the upper or lower section of pipe.

The existing water tank is located about 4,200 feet inland from the highway but is not visible from the highway, despite its height of about 15 feet, because it is concealed by a natural a'a lava flow berm located about 600 feet inland from the highway. Photo B illustrates the presence of a second berm just mauka of the water tank. This berm screens most of the upland area from view including the location of the existing wells #1 and #2 and the land between them and the water tank. Thus, the two berms together will screen all exposed components of the proposed irrigation line when viewed from the highway.

With regard to your concerns about painting, this matter has been reviewed. As a result, the EA has been revised to indicate that painting of the at-grade portion of the pipe line will be limited to the one-time painting out of white lettering on the pipe. The ductile iron pipe is naturally black with white lettering painted on it at the factory. It does not need to be painted to prevent deterioration from exposure. Thus, the entire pipe need not be painted. The paint used to cover the white lettering will be non-toxic to address your concerns about possible contamination resulting from flaking paint.

Upon further consideration, it has been determined that the natural process of vegetative growth will result in the fountain grass eventually concealing the at-grade pipeline. Therefore, no further mitigative measures concerning its visual impact are warranted. This decision also addresses your concerns about burial of the upper section of pipe line. We have determined that allowing the pipe to be naturally concealed by the fountain grass is preferable to burial. The aggressive nature of the fountain grass will ensure that the pipe line and the area graded and cleared for its construction will eventually be hidden beneath a canopy of grass. Staff from the DLNR's Forestry Division indicate this process could easily occur within one year. The protective berms discussed above contribute an additional level of assurance that no visual impacts will result.

Finally, with regard to the matter of future urbanization around the Kaupulehu Resort, please note that the resort is situated makai of the highway at a lower elevation. Additional urbanization around the resort will not increase the potential for visual exposure of the pipeline. Since the proposed pipeline and reservoir cannot be seen from the highway due to natural lava berms, they will remain concealed from viewing points

located further makai and downslope of the highway. At such time that development occurs on the mauka Kaupulehu lands in proximity to the pipeline, and it is believed that the pipeline is a visual problem, the applicant will consider covering, burying, or otherwise disguising the visual problem.

Should you require any additional information concerning the proposed project, please contact Mr. Roger Harris of the Kaupulehu Land Company at 325-0808, or me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Lee William Sichter

cc: Roger Harris
Don Horiuchi

Attachments

Photo A—The existing 6-inch galvanized pipe extends vertically through the left third of the photo but disappears over the small lava ridge and is concealed under fountain grass for much of its remaining alignment. The new requested pipeline will be underground from the highway up to the reservoir approximately .8 miles mauka of the highway.

Photo B—The existing Kona Village water tank is visible at far right center of the photo. The cylinder in front of the water tank is a former Kona Village water tank, now abandoned. The crest of the hill extending across the middle of the photo acts as a protective berm, screening view of upland slopes.

JOHN WAIHEE
GOVERNOR

REX D. JOHNSON
DIRECTOR

DEPUTY DIRECTORS
KANANI HOLT
JOYCE T. OMINE
AL PANG
CALVIN M. TSUDA

IN REPLY REFER TO:

HWY-PS
2.9270

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

DEC - 1 1993

TO: Keith W. Ahue, Chairperson
Board of Land and Natural Resources

FROM: Rex D. Johnson, Director
Department of Transportation

SUBJECT: CONSERVATION DISTRICT USE APPLICATION HA-2673, NON-POTABLE IRRIGATION LINE, IRRIGATION LAKE, SERVICE ROAD, AND HIGHWAY CROSSING, KAUPULEHU RESORT, NORTH KONA, TMK: 7-2-03: POR. 3

Thank you for your memorandum of November 2, 1993, requesting our review of the subject application.

We have the following comments:

1. The irrigation line's plan and profile across the State highway right-of-way should take into account the future widening of Queen Kaahumanu Highway.

2. The trench backfill and roadway repaving must conform to applicable State highway specifications. All work and repairs must be provided at no cost to the State.

3. There is an existing 24-inch corrugated metal pipe that crosses Queen Kaahumanu Highway within about 1,000 feet of the estimated crossing point. If the developer wishes to use the existing 24-inch pipe in lieu of trenching, he should coordinate with the Highways Division through the Hawaii District office.

4. Plans for construction work within the State highway right-of-way must be submitted for our review and approval.

BCA
BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 96813-5406
Phone: (808) 521-5361, Fax: (808) 538-7819
Hawaii • Singapore • Australia • Hong Kong • Thailand • Saipan

January 20, 1994
333.4700/94P-32

Mr. Rex D. Johnson, Director
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

Dear Mr. Johnson:

Conservation District Use Application (HA-2673)
Non-Potable Irrigation Line, Irrigation Lake,
Service Road, and Highway Crossing
Kaupulehu Resort, North Kona, Hawaii

I am writing regarding your December 1, 1993 review of the Draft Environmental Assessment for the above project. Thank you for your participation in the public and agency review process.

In response to your comments, the location of the proposed irrigation line and highway crossing takes into account the future widening of Queen Kaahumanu Highway. As indicated on page 9 of the EA, the trench backfill and roadway repaving will conform to applicable State highway specifications. All work and repairs on the highway will be provided at no cost to the State. With regard to the use of an existing 24-inch corrugated metal pipe as an alternative to trenching, if the developer elects to pursue this option, he will coordinate activities with the Highway Division through the Hawaii District office. Finally, plans for construction work within the State highway right-of-way will be submitted to the Highways Division for review and approval before any construction work will commence.

Should you require any additional information concerning the proposed project, please contact Mr. Roger Harris of the Kaupulehu Land Company at 325-0808, or me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Lee William Sichter

cc: Roger Harris
Don Horiuchi

Stephen K. Yamashiro
Mayor

Virginia Goldstein
Director

Norman Olesen
Deputy Director

RECEIVED
'93 DEC 1 PM 1:08
DLNR
OCEA

County of Hawaii
PLANNING DEPARTMENT
25 Aupuni Street, Room 109 • Hilo, Hawaii 96720-4252
(808) 961-8288 • Fax (808) 961-9615

RECEIVED
DLNR
OCEA

November 26, 1993

Mr. Keith W. Ahue, Chairperson
Board of Land and Natural Resources
P. O. Box 621
Honolulu, HI 96809

Dear Mr. Ahue:

Conservation District Use Application (HA-2673)
Applicant: Kaupulehu Land Company
Tax Map Key: 7-2-3:3 (por.) and 6; Kaupulehu, North Kona, Hawaii

This is in response to the above-referenced application for the proposed non-potable irrigation line, irrigation lake, service road and highway crossing for Kaupulehu Resort.

Please be informed that the project located within and mauka of Queen Ka'ahumanu Highway is situated outside of the Special Management Area (SMA). The remaining project makai of the highway is situated within the SMA. SMA Use Permit No. 271 and No. 272 were approved effective October 27, 1988 for the development of the Kaupulehu Resort including infrastructure improvements.

Should you have any questions, please feel free to contact Alice Kawaha of this office at 961-8288.

Sincerely,

Virginia Goldstein

VIRGINIA GOLDSTEIN
Planning Director

AK:mjs
1684D

xc: Mr. Roger Harris
West Hawaii Office

BCA
BELT COLLINS
& ASSOCIATES
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Landscape Architecture

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January 20, 1994
333.4700/94P-33

Ms. Virginia Goldstein
Planning Director
25 Aupuni Street, Room 109
Hilo, Hawaii 96720-4252

Dear Virginia:

Conservation District Use Application (HA-2673)
Non-Potable Irrigation Line, Irrigation Lake,
Service Road, and Highway Crossing
Kaupulehu Resort, North Kona, Hawaii

I am writing regarding your November 26, 1993 review of the Draft Environmental Assessment for the above project. Thank you for your participation in the public and agency review process.

Should you require any additional information concerning the proposed project, please contact Mr. Roger Harris of the Kaupulehu Land Company at 325-0808, or me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Lee William Sichter

cc: Roger Harris
Don Horiuchi

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HAWAII 96801

JOHN C. LEWIN, M.D.
DIRECTOR OF HEALTH

In reply, please refer to:

November 18, 1993

91-368/epo

To: The Honorable Keith W. Ahue, Chairperson
Department of Land & Natural Resources

From: John C. Lewin, M.D.
Director of Health

Subject: Request for Comments
Conservation District Use Application

Applicant: Kaupulehu Resort
File No.: HA 2673
Request: Irrigation System
Location: North Kona, Hawaii
TMK: 7-2-03: por. 3

Thank you for allowing us to review and comment on the subject request. We do not have any comments at this time.

BCA
ELT COLLINS
ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 96813-5406
Phone: (808) 521-5361, Fax: (808) 538-7819
Hawaii • Singapore • Australia • Hong Kong • Thailand • Saipan

January 20, 1994
333.4700/94P-34

Mr. John C. Lewin, M.D.
Director of Health
Department of Health
P.O. Box 3378
Honolulu, Hawaii 96801

Dear Dr. Lewin:

Conservation District Use Application (HA-2673)
Non-Potable Irrigation Line, Irrigation Lake,
Service Road, and Highway Crossing
Kaupulehu Resort, North Kona, Hawaii

I am writing regarding your November 18, 1993 review of the Draft Environmental Assessment for the above project. Thank you for your participation in the public and agency review process.

Should you require any additional information concerning the proposed project, please contact Mr. Roger Harris of the Kaupulehu Land Company at 325-0808, or me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Lee William Sichter

cc: Roger Harris
Don Horiuchi

5498

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAII
345 KEKUANAOA STREET • HILO, HAWAII 96720
TELEPHONE (808) 969-1421 • FAX (808) 969-6996

November 18, 1993

Mr. Keith W. Ahue
State of Hawaii
Department of Land and Natural Resources
P.O. Box 621
Honolulu, HI 96809

CONSERVATION DISTRICT USE APPLICATION
NON-POTABLE IRRIGATION LINE, IRRIGATION LAKE, SERVICE FOR ROAD
AND HIGHWAY CROSSING KAUPULEHU RESORT
TAX MAP KEY 7-2-3:3

We have no objections to the subject application.

H. William Sewake
Manager

WA

BCA
BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

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Hawaii • Singapore • Australia • Hong Kong • Thailand • Saipan

January 20, 1994
333.4700/94P-35

Mr. H. William Sewake, Manager
Department of Water Supply
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Sewake:

Conservation District Use Application (HA-2673)
Non-Potable Irrigation Line, Irrigation Lake,
Service Road, and Highway Crossing
Kaupulehu Resort, North Kona, Hawaii

I am writing regarding your November 18, 1993 review of the Draft Environmental Assessment for the above project. Thank you for your participation in the public and agency review process.

Should you require any additional information concerning the proposed project, please contact Mr. Roger Harris of the Kaupulehu Land Company at 325-0808, or me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Lee William Sichter

cc: Roger Harris
Don Horiuchi

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
Office of Conservation and Environmental Affairs
Honolulu, Hawaii

FILE NO.: HA-2673
180-Day Exp. Date: 4/18/94
DOC. NO.: 3660

DH

MEMORANDUM

TO: Forestry & Wildlife; Historic Preservation; Water and Land Development; Water Commission

FROM: Office of Conservation and Environmental Affairs

SUBJECT: REQUEST FOR COMMENTS
Conservation District Use Application

APPLICANT: Kaupulehu Resort

FILE NO.: HA-2673

REQUEST: Irrigation System

LOCATION: N. Kona, Hawaii

TMK(s): 7-2-03: 3 (por.)

PUBLIC HEARING: YES X NO____

DOCARE: Please conduct a field inspection on this project. Should you require additional information, please call Don Horiuchi at 7-0377.

If no response is received by the suspense date, we will assume there are no comments.

ROGER C. EVANS

Attachment(s)

BCA
BELT COLLINS
& ASSOCIATES
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680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 96813-5406
Phone: (808) 521-5361, Fax: (808) 538-7819
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January 20, 1994
333.4700/94P-36

Mr. Manabu Tagomori
Division of Water and Land Development
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Tagomori:

Conservation District Use Application (HA-2673)
Non-Potable Irrigation Line, Irrigation Lake,
Service Road, and Highway Crossing
Kaupulehu Resort, North Kona, Hawaii

I am writing regarding your November 2, 1993 review of the Draft Environmental Assessment for the above project. Thank you for your participation in the public and agency review process.

Should you require any additional information concerning the proposed project, please contact Mr. Roger Harris of the Kaupulehu Land Company at 325-0808, or me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Lee William Sichter

cc: Roger Harris
Don Horiuchi

8. PUBLIC AND AGENCY REVIEW OF DRAFT ENVIRONMENTAL ASSESSMENT

A notification of availability of the Draft EA was published on November 23, 1993 in the Bulletin of the Office of Environmental Quality Control. During the 30-day review and comment period, the Department of Land and Natural Resources, accepting agency for the EA, received eight comment letters. These letters are included below together with responses prepared by the applicant's agent, Belt Collins Hawaii.

Appendix A:

Botanical Assessment Survey -
Ka'upulehu Resort Irrigation Corridor
Ka'upulehu, North Kona District,
Island of Hawaii

BOTANICAL ASSESSMENT SURVEY
KA'UPULEHU RESORT IRRIGATION CORRIDOR
KA'UPULEHU, NORTH KONA DISTRICT, ISLAND OF HAWAI'I

by

Winona P. Char

CHAR & ASSOCIATES
Botanical Consultants
Honolulu, Hawai'i

September 1993

Prepared for: Kaupulehu Land Company
and
Belt Collins and Associates

BOTANICAL ASSESSMENT SURVEY
KA'UPULEHU RESORT IRRIGATION CORRIDOR
KA'UPULEHU, NORTH KONA DISTRICT, ISLAND OF HAWAI'I

INTRODUCTION

The proposed irrigation line corridor is located on the mauka portion (above the Queen Ka'ahumanu Highway) of property leased from the Bernice Pauahi Bishop Estate. The proposed 12-inch line will extend downslope in a southeasterly direction from two existing wells located at about the 850-foot elevation contour to a proposed irrigation lake located at an elevation of about 440 feet. From the lake, a 20- to 24-inch line will continue downslope near the alignment of an existing access road until it reaches the Queen Ka'ahumanu Highway. The line will parallel the highway for about 1,400 feet before crossing it. The proposed irrigation line corridor crosses mostly barren 'a'a lava flows and grassland dominated by fountain grass on the geologically older pahoehoe flows.

Field studies to assess the botanical resources found along the proposed irrigation line corridor, on the irrigation lake site, and along the connecting well pipeline were conducted on 17 September 1993. The primary objectives of the survey were to: 1) prepare a description of the major vegetation types on the site; 2) search for threatened and endangered as well as rare and vulnerable plants; and 3) identify areas of potential environmental problems or concerns and propose appropriate mitigation measures. The botanical assessment report will be used to analyze potential impacts of the project and will be included as an appendix to the Environmental Assessment document to be prepared by Belt Collins and Associates; a Conservation District Use Permit is required for all elements of the proposed project.

SURVEY METHODS

Prior to undertaking the field studies, a search was made of the pertinent literature to familiarize the principal investigator with other botanical studies conducted in the general area. A topographic map with the proposed irrigation line alignment, well sites, irrigation lake, and connecting well pipeline identified was examined to determine terrain characteristics, access, boundaries, and reference points. The irrigation corridor was accessed from the existing unpaved road which services a water tank and well.

The alignment for the irrigation line as well as the connecting well pipeline and the boundaries of the irrigation lake were staked and flagged by the survey engineers prior to our field studies; the stakes were numbered and set 100 feet apart. For our studies, a corridor 50 feet on each side of the staked center-line was surveyed. Around the irrigation lake, an area 100 feet around the perimeter of the lake was also surveyed. A walk-through (pedestrian) survey method was used. Notes were made on plant distributions and association, substrate types, topography, exposure, fire damage, etc. Plant identifications were made in the field; plants which could not be positively identified were collected for later determination in the herbarium (University of Hawai'i, Manoa -- HAW) and for comparison with the most recent taxonomic literature.

The species recorded are indicative of the season ("rainy" vs. "dry") and the environmental conditions at the time of the survey. A survey taken at a different time and under varying environmental conditions would no doubt yield variations in the species encountered, especially of the weedy, annual plants.

DESCRIPTION OF THE VEGETATION

There have been two recent botanical surveys on the mauka lands for water line or water-related projects (Char 1988, 1991). The 1991 survey crossed the lower portion of the irrigation corridor and the irrigation lake. Studies of the adjacent Kuki'o property to the south were conducted by Char in 1984, and a survey of the Ka'upulehu lands makai of the highway were made in 1985. Basically, the vegetation consisted of fountain grass grassland on the pahoehoe lava flows and very sparse vegetation on the 'a'a flows. In all the studies, no threatened and endangered plants were found.

These two vegetation types are recognized on the irrigation corridor, irrigation lake, and connecting well pipeline. They are described in more detail below. The plant names used in the discussion are in accordance with the most recent treatment of the Hawaiian flora by Wagner et al. (1990).

Fountain Grass Grassland

About 30 to 40% of the project site crosses over a low (1 to 3 feet tall), rolling grassland dominated almost exclusively by fountain grass (Pennisetum setaceum). The grassland is found on weathered pahoehoe flows; these are identified as "rLW" on the soil survey maps (Sato et al. 1973). Fountain grass cover varies from 60 to 80% along the corridor.

There is evidence of a relatively recent fire which occurred along the lower portion of the corridor, from about 500 feet elevation up to the 700-foot contour. Although the fountain grass has recovered very well, it is a fire-adapted species, the other plants have not fared as well. A few, dried out, small shrubs of indigo (Indigofera suffruticosa) can be found scattered here and

there and one or two 'uhaloa seedlings (Waltheria indica) can be found in shallow swales with thin soil. Charred pieces of kiawe trees (Prosopis pallida) and a thin ash crust can be found among the fountain grass.

Along the connecting well pipeline and the section of the corridor above 700 feet elevation, the grassland has not been burned. Besides 'uhaloa, the other native species found on this portion of the project site are the native persimmon or lama (Diospyros sandwicensis), and pili grass (Heteropogon contortus). Introduced or alien plants found here are Wahlenbergia gracilis, Natal red-top grass (Rhynchelytrum repens), 'ihi (Portulaca pilosa), maile hohono (Ageratum conyzoides), and indigo.

Below the existing water tank, the fountain grass also has not been burned and supports plants of kiawe, hairy spurge (Chamaesyce hirta), indigo, and 'uhaloa. Disturbed areas near the highway and around the water tank provide habitat for weedy species such as Florida beggarweed (Desmodium tortuosum), wild bittermelon (Momordica charantia), and Asiatic dogtail (Buddleia asiatica). Two natives found near the highway portion of the corridor are 'ilima (Sida fallax) and nehe (Lipochaeta lavarum).

'A'a Lava with Sparse Vegetation

The majority of the irrigation line corridor crosses over very rough, scoriaceous 'a'a lava. These flows are part of the Ka'u-pulehu Lava Flow which originated from the main vents at Hualalai in 1800 or 1801.

On the loose, jumbled heaps of 'a'a clinker, the vegetation cover is very sparse, about 1 to 3%, with the plants occurring in small, scattered pockets, usually in depressions. Again, fountain grass

is the more commonly observed plant. Small trees of kiawe, 3 to 5 feet tall, and 'uhaloa plants are rare. Where the 'a'a has been bulldozed, as alongside the access road, there are a few scattered plants of Florida beggarweed and the fountain grass is somewhat denser and greener.

DISCUSSION AND RECOMMENDATIONS

For the most part, the proposed project will cross over very sparsely vegetated 'a'a flows, part of the Ka'upulehu Lava Flow of 1800 or 1801. Where the project crosses over pahoehoe flows, the vegetation consists of dense mats of fountain grass, an introduced species. The fountain grass grassland contains a few native plants which include lama, nehe, pili grass, 'uhaloa, and 'ilima.

None of the plants found along the irrigation line corridor, on the irrigation lake site, on the connecting well pipeline, or on the well sites are listed threatened and endangered species; nor are any proposed or candidate for such status (U.S. Fish and Wildlife Service 1989, 1990, 1992, 1993). All of the plants can be found in similar dry, lowland situations throughout the Hawaiian Islands. Other recent botanical studies conducted on the mauka property, or on adjacent lands have recorded similar findings (Char 1984, 1985, 1988, 1991).

Given the findings above and the limited nature of the developments, the proposed project is not expected to have a significant negative impact on the botanical resources. There are no botanical reasons to impose any restrictions, impediments, or conditions to the project. No recommendations are proposed at this time.

LITERATURE CITED

Char, W.P. 1984. Assessment of flora, Kuki'o, North Kona. Prepared for PBR Hawaii. November 1984.

_____ . 1985. Botanical survey for Ka'upulehu Developments, Ka'upulehu, North Kona, Hawai'i. Prepared for Ka'upulehu Developments and Belt Collins & Associates. May 1985.

_____ . 1988. Botanical survey, Ka'upulehu Resort CDUA, Water line and maintenance roadway, Ka'upulehu, North Kona, Hawai'i. Prepared for Belt Collins & Associates. December 1988.

_____ . 1991. Botanical survey, Ka'upulehu Resort CDUAs, Temporary substation, water reservoir, and sewage treatment plant, Ka'upulehu, North Kona, Island of Hawai'i. Prepared for Belt Collins & Associates. February 1991.

Sato, H.H., W. Ikeda, R. Paeth, R. Smythe, and T. Takehiro, Jr. 1973. Soil survey of the island of Hawaii, State of Hawaii. U.S. Department of Agriculture, Soil Conservation Service, Washington, D.C.

U.S. Fish and Wildlife Service. 1989. Endangered and threatened wildlife and plants. 50 CFR 17.11 & 17.12.

_____ . 1990. Endangered and threatened wildlife and plants; Review of plant taxa for listing as Endangered and Threatened Species; Notice of review. Federal Register 55(35): 6184-6229.

_____ . 1992. Endangered and threatened wildlife and plants; Proposed endangered status for 22 plants from the island of Hawaii, State of Hawaii. Federal Register 57(243): 59951-59970.

U.S. Fish and Wildlife Service. 1993. Hawaiian Islands, Species listed or proposed by the Federal government as endangered or threatened. Updated: July 9, 1993. Memorandum.

Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1990. Manual of the flowering plants of Hawai'i. 2 vols. University of Hawai'i Press and B.P. Bishop Museum Press, Honolulu. B.P. Bishop Museum Special Publication No. 83.

Appendix B:

Archaeological Inventory Survey Kaupulehu Resort Irrigation Project

Report 1427-100193

Archaeological Inventory Survey
Kaupulehu Resort Irrigation Project

Land of Kaupulehu, North Kona District
Island of Hawaii

PHRI **Paul H. Rosendahl, Ph.D., Inc.**
Archaeological • Historical • Cultural Resource Management Studies & Services

Report 1427-100193

Archaeological Inventory Survey
Kaupulehu Resort Irrigation Project

Land of Kaupulehu, North Kona District
Island of Hawaii
(TMK:3-7-2-03:3)

BY

Susan T. Goodfellow, Ph.D. • Laboratory Director

PREPARED FOR

Kaupulehu Makai Venture
c/o Belt Collins Hawaii
680 Ala Moana Blvd., Suite 200
Honolulu, Hawaii 96813

OCTOBER 1993

PHRI **Paul H. Rosendahl, Ph.D., Inc.**
Archaeological • Historical • Cultural Resource Management Studies & Services
HAWAII: 305 Mohouli Street • Hilo, Hawaii 96720 • (808) 969-1763 • GUAM: P.O. Box 23305 • G.M.F., Guam 96921 • (671) 472-3117

SUMMARY

At the request of Mr. Lee Sichter of Belt Collins Hawaii, on behalf of their client, Kaupulehu Makai Venture, Paul H. Rosendahl, Ph.D., Inc. (PHRI) conducted an archaeological inventory survey of the 27.1-acre Kaupulehu Resort Irrigation Project, situated in the Land of Kaupulehu, North Kona District, Island of Hawaii (TMK:3-7-2-03:3). The overall objective of the survey was to provide information sufficient for a Conservation District Use Permit and for satisfaction of all current historic preservation review requirements of the Hawaii County Planning Department (HCPD) and the Department of Land and Natural Resources-State Historic Preservation Division (DLNR-SHPD).

The survey field work was conducted September 16-17, 1993 under the supervision of Laboratory Director Susan T. Goodfellow, Ph.D. The field work comprised a 100%-coverage pedestrian survey, using transects spaced at intervals of ten meters or less. During the survey, no cultural remains were encountered. This was not unexpected, given the predicted scarcity of cultural remains between 400-800 ft AMSL in the general area, and given the narrowness of the survey corridor. In view of the negative results of the survey, it is concluded that the project area requires no further archaeological work.

Contents

Illustrations

Tables

INTRODUCTION

BACKGROUND

At the request of Mr. Lee Sichter of Belt Collins Hawaii, on behalf of their client, Kaupulehu Makai Venture, Paul H. Rosendahl, Ph.D., Inc. (PHRI) conducted an archaeological inventory survey of the c. 27.1-acre Kaupulehu Resort Irrigation Project, situated in the Land of Kaupulehu, North Kona District, Island of Hawaii (TMK:3-7-2-03:3). The overall objective of the survey was to provide information sufficient for a Conservation District Use Permit, and sufficient to satisfy all current historic preservation review requirements of the Hawaii County Planning Department (HCPD) and the Department of Land and Natural Resources-State Historic Preservation Division (DLNR-SHPD).

The survey field work was conducted September 16-17, 1993 under the supervision of Laboratory Director Susan T. Goodfellow, Ph.D. Approximately 2.5 labor days were expended in conducting the field work.

SCOPE OF WORK

The basic objective of an inventory survey is to identify all sites and features of potential archaeological significance present within a specified project area. An inventory survey comprises an initial level of archaeological investigation. It is conducted basically to determine the presence or absence of archaeological resources within a specified project area. It indicates both the general nature and variety of archaeological remains present, and the general distribution and density of such remains. Finally, it permits a general significance assessment of the archaeological resources, and facilitates formulation of realistic recommendations and estimates for such further work as might be necessary or appropriate. Such work could include further data collection— additional data collection involving detailed recording of sites and features, and selected limited excavations; and possibly subsequent mitigation—data recovery research excavations, construction monitoring, interpretive planning and development, and/or preservation of sites and features with significant scientific research, interpretive, and/or cultural values.

The basic objectives of the survey were fourfold: (a) to identify all sites and site complexes present within the project area; (b) to evaluate the potential general significance of all identified archaeological remains; (c) to determine the possible impacts of proposed development upon the identified remains; and (d) to define the general scope of any subsequent further data collection and/or other mitigation work that might be necessary or appropriate.

The following specific tasks were determined to constitute an adequate scope of work for the current survey:

1. Review archaeological and historical literature relevant to the project area, and conduct historical documentary research (emphasis on readily available literature and documentary resources) and interviews with appropriate and available local informants;

2. Conduct 100% coverage, variable-intensity pedestrian survey of the entire project area, to find and record (a) any previously identified sites and features, and (b) any previously unidentified sites and features;

3. Conduct limited subsurface testing (manual excavation) at selected sites (a) to determine the presence or absence of potentially significant subsurface cultural features or deposits, and (b) to obtain suitable samples for age determination analyses; and

4. Analyze field and historical research data, and prepare appropriate reports.

The above tasks were formulated based on (a) a review of readily available background literature, (b) basic familiarity with the general project area, (c) extensive familiarity with the current requirements of review authorities, and (d) discussions with Mr. Lee Sichter of Belt Collins Hawaii.

The inventory survey was carried out in accordance with the current standards for inventory-level survey required by DLNR-SHPD. The significance of all archaeological remains identified within the project area was assessed in terms of (a) the National Register criteria contained in the Code of Federal Regulations (36 CFR Part 60), and (b) the criteria for evaluation of traditional cultural values prepared by the national Advisory Council on Historic Preservation (ACHP). DLNR-SHPD and HCPD both use these criteria to evaluate eligibility for the Hawaii State and National Registers of Historic Places.

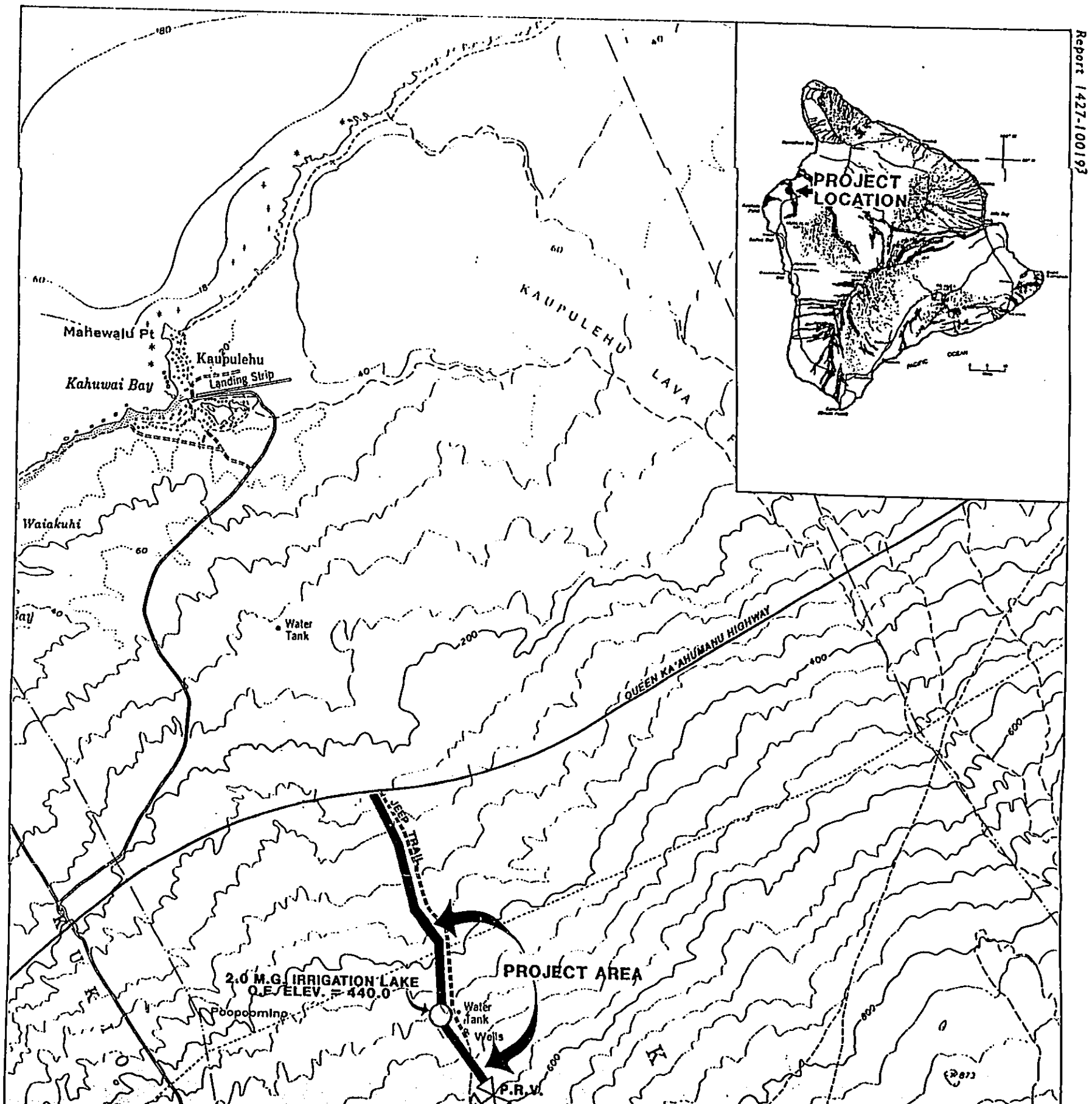
To further facilitate client management decisions regarding the subsequent treatment of resources, the general significance of all archaeological remains identified during the survey was also evaluated in terms of three PHRI Cultural Resource Management (CRM) value modes which are derived from the previously mentioned federal evaluation criteria.

PROJECT AREA DESCRIPTION

The project area is a c. 100 ft wide corridor extending 1.9 miles (c. 10,200 ft), from Queen Kaahumanu Highway southeast to the 800 ft contour (Figure 1). The project area comprises c. 27.1 acres and includes a 3.7-acre irrigation lake. From Queen Kaahumanu Highway to about the area of the water tank, located at 450 ft AMSL, the corridor is paralleled by a northwest-southeast trending jeep trail.

The project area terrain ranges in elevation from c. 320 ft AMSL (above mean sea level) to c. 800 ft AMSL. The terrain is described in detail in the following composite description derived from several sources and presented in Walker and Rosendahl (1990):

> The terrain of the project area is generally rugged, gently sloping pahoehoe, and includes very broken terrain, such as aa lava flows. The geologic base of the project area is comprised of Recent (in a geologic time-frame) and Historic Hualalai basaltic lava flows of the Hualalai Volcanic Series. The majority of Recent flows age between 1,000-3,000 years before present (B.P.) with a small area near Puu Kolekole dating between 3,000-5000 years B.P. The Historic flows date to AD 1800 and 1801. Both aa and pahoehoe



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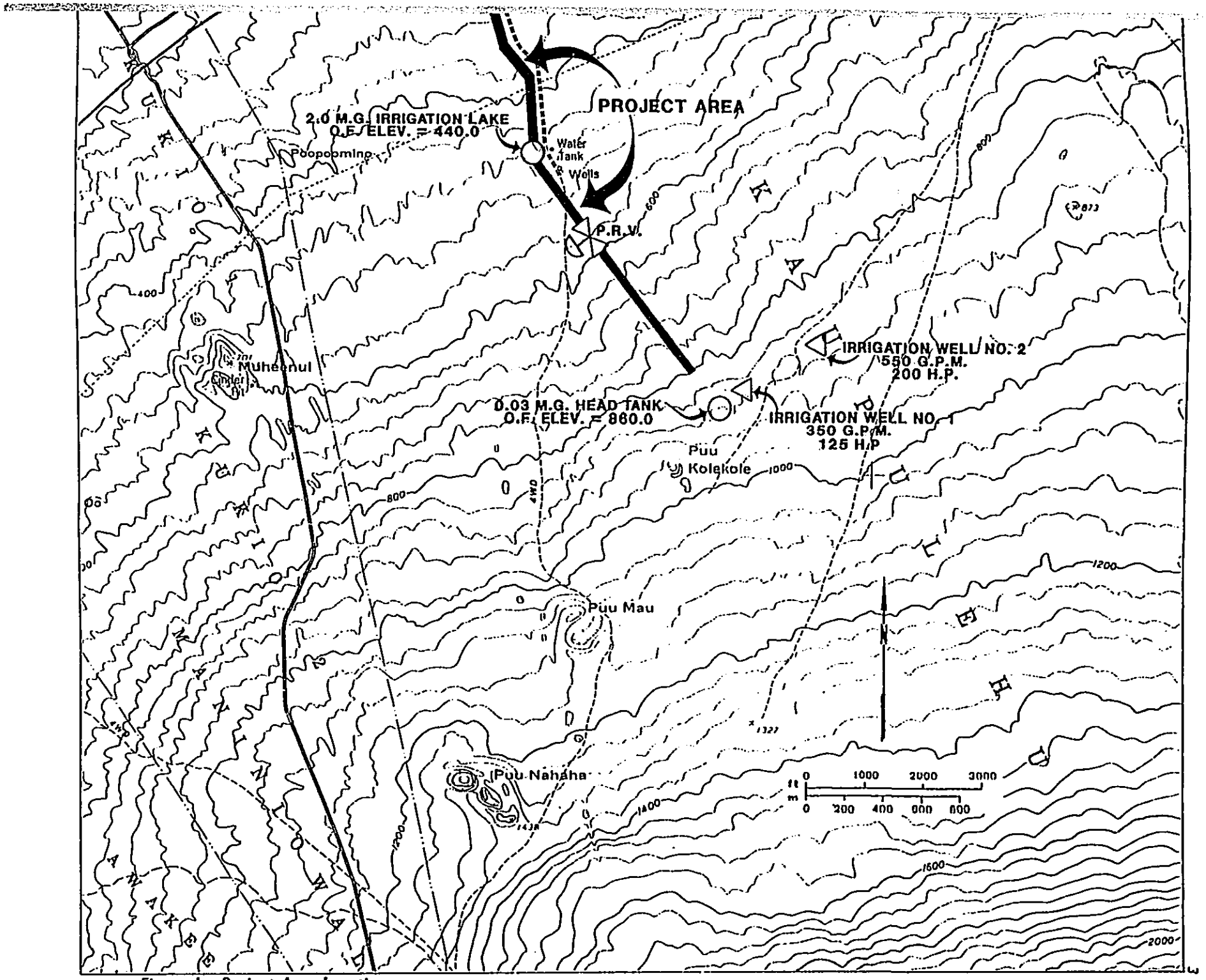


Figure 1. Project Area Location

flows are present within the project area. The aa and pahoehoe flows are generally poorly weathered and exhibit little or no soil development.

In their 1990 Archaeological Resources Assessment of the Kaupulehu Phase II Master Plan, Walker and Rosendahl note seven classifications of soil/terrain types present in their project area (Walker and Rosendahl 1990:4-6). Descriptions of the soils and terrain types and their distribution were based on (a) Sato et al. (1973), (b) color infra-red aerial photos (1979 and 1989; 1"=1,600' approx. scale), and (c) field observations made during earlier archaeological work. It is noted in Walker and Rosendahl (1990) that the distribution shown on the soil/terrain map is generalized and is subject to future modification. Of the seven soil/terrain types presented, two are within the current project area (Aa Lava Flows [includes historic aa flows] and Pahoehoe Lava Flows). These types are shown on Figure 2 and are discussed further below:

Aa Lava Flows - Comprises approximately 40% of the project area. This soil/terrain type includes the historic flow from Puhi-a-Pele (AD 1801). According to Sato et al. "[t]his lava has practically no soil covering and is bare of vegetation, except for mosses, lichens, ferns, and few small ohia trees...is rough and broken...[i]t is a mass of clinkery, hard glassy, sharp pieces piled in tumbled heaps" (Sato et al. 1973:34).

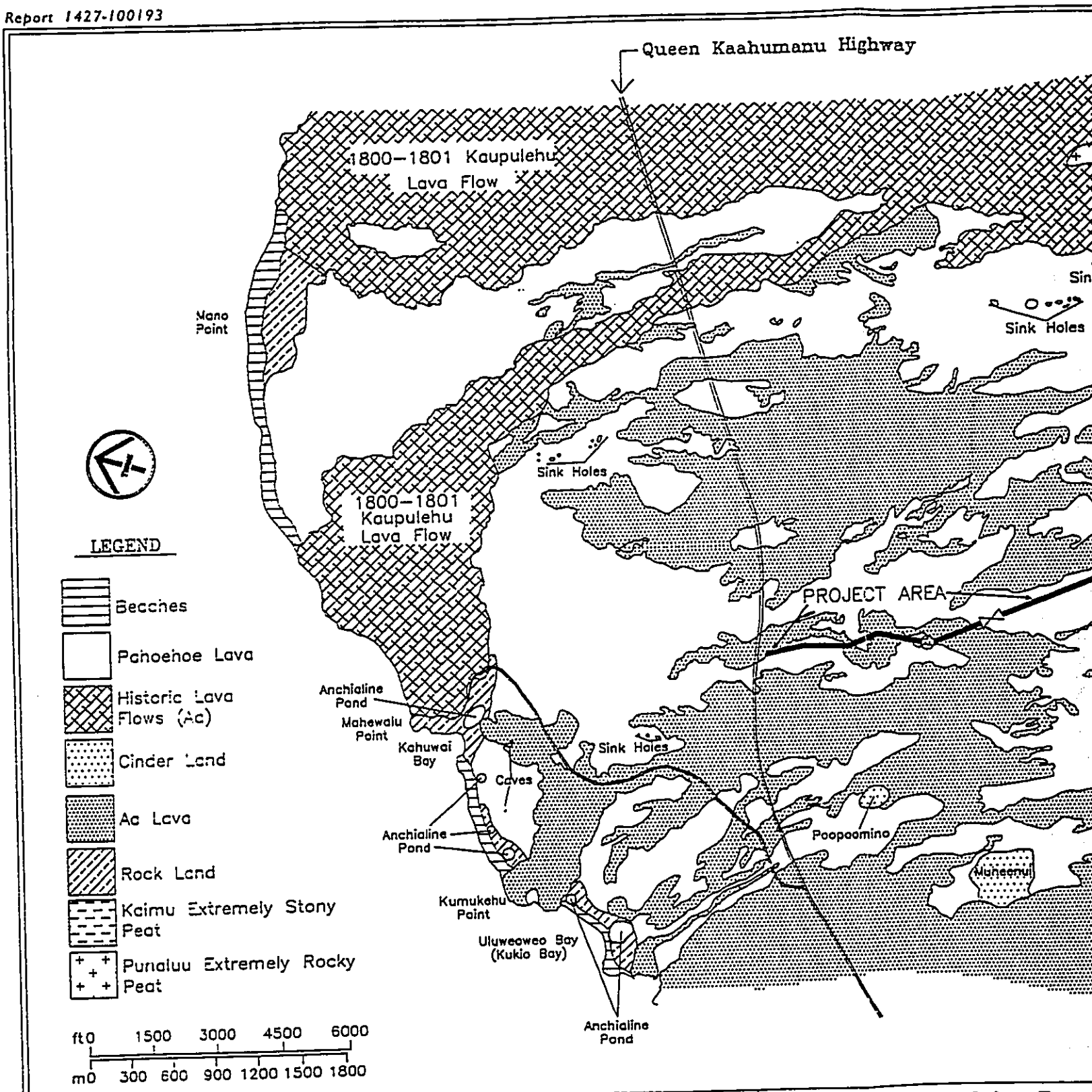
Pahoehoe Lava Flows - Comprises approximately 60% of the project area. This soil/terrain type consists solely of prehistoric period flows. According to Sato et al., "[t]his lava has a billowy, glassy surface that is relatively smooth..[i]n some areas, however, the surface is rough and broken, and there are hummocks and pressure domes. Pahoehoe lava has no soil covering and is typically bare of vegetation except for mosses and lichens. In areas of higher rainfall, however, scattered *`ohi`a* trees, *ohelo* berry, and *a`alii* have gained a foothold in cracks and crevices" (1973:34).

Annual rainfall in the general vicinity of the project area is an estimated 10-20 inches (Armstrong 1983). Vegetation in the project area consists almost entirely of fountain grass (*Pennisetum setaceum* [Forsk.] Chiev.), with mosses and lichens occurring on small portions of the pahoehoe flows.

A vegetation map initially presented in Walker and Rosendahl (1990) has been modified to show the bounds of the present project area (Figure 3). The intent of this map is to (a) show the relationship between vegetation and survey areas examined, (b) show the relationship between vegetation and site distribution patterns, if sites are identified, and (c) show the locations and extents of relatively unweathered lava flows barren of vegetation. The original map was prepared using (a) a botanical survey report prepared for Potomac Investment Associates by Camara (1989), (b) black-and-white (R.M. Towill Corp. 1988, 1"=200' approx. scale) and color infra-red (1979 and 1989, 1"=1600' scale approx.) aerial photographs, and (c) field observations made during previous surveys. The vegetation map should be considered as generalized and subject to modification.

There are three major vegetation types in the project area:

1. Barren Lava with No/Sparse Vegetation - This vegetation type is present at all elevations throughout the project area. The unnamed AD 1801 lava flow is included within this zone. The substrate of this vegetation type consists entirely of aa lava. The vegetation consists predominately of



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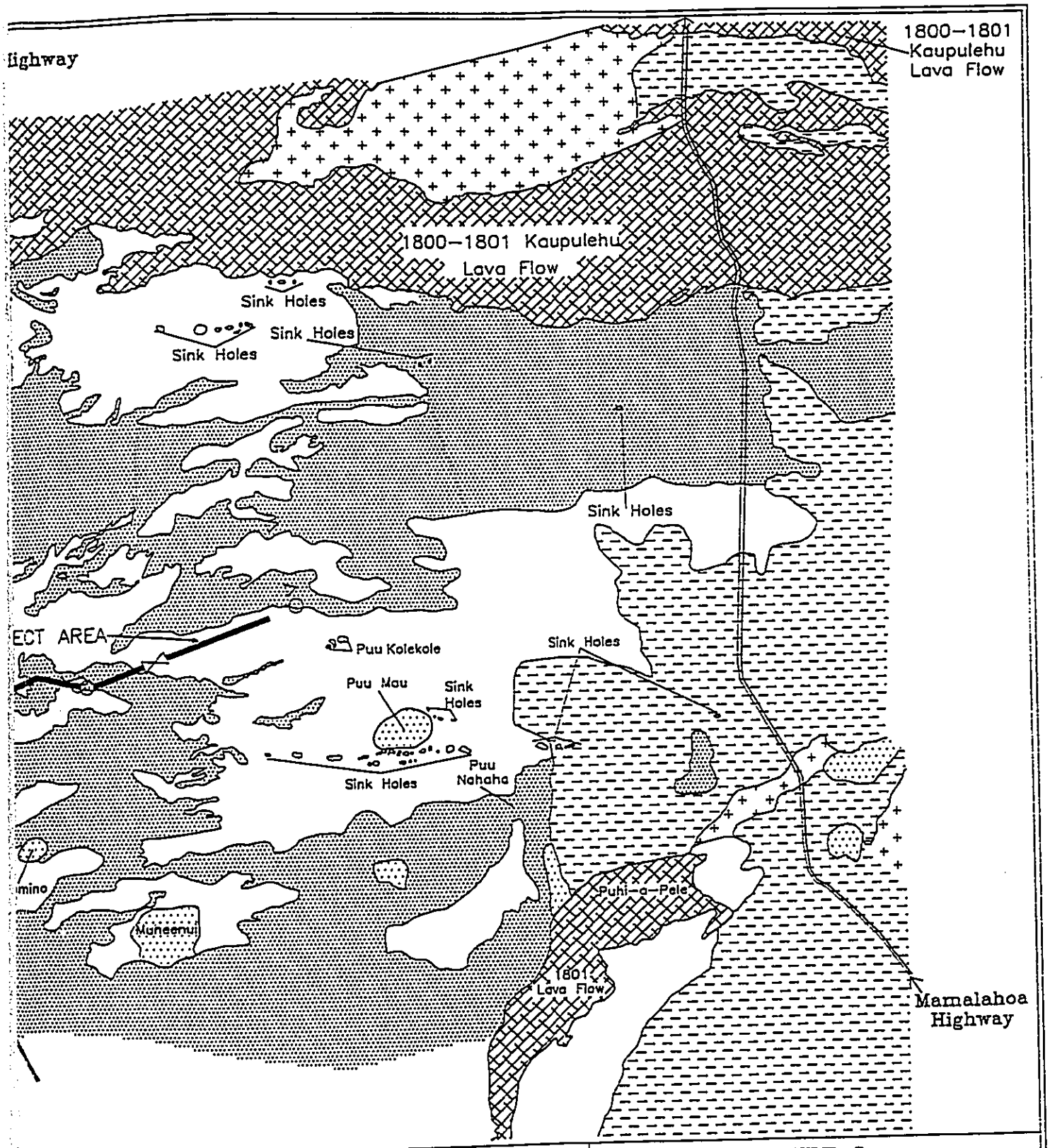
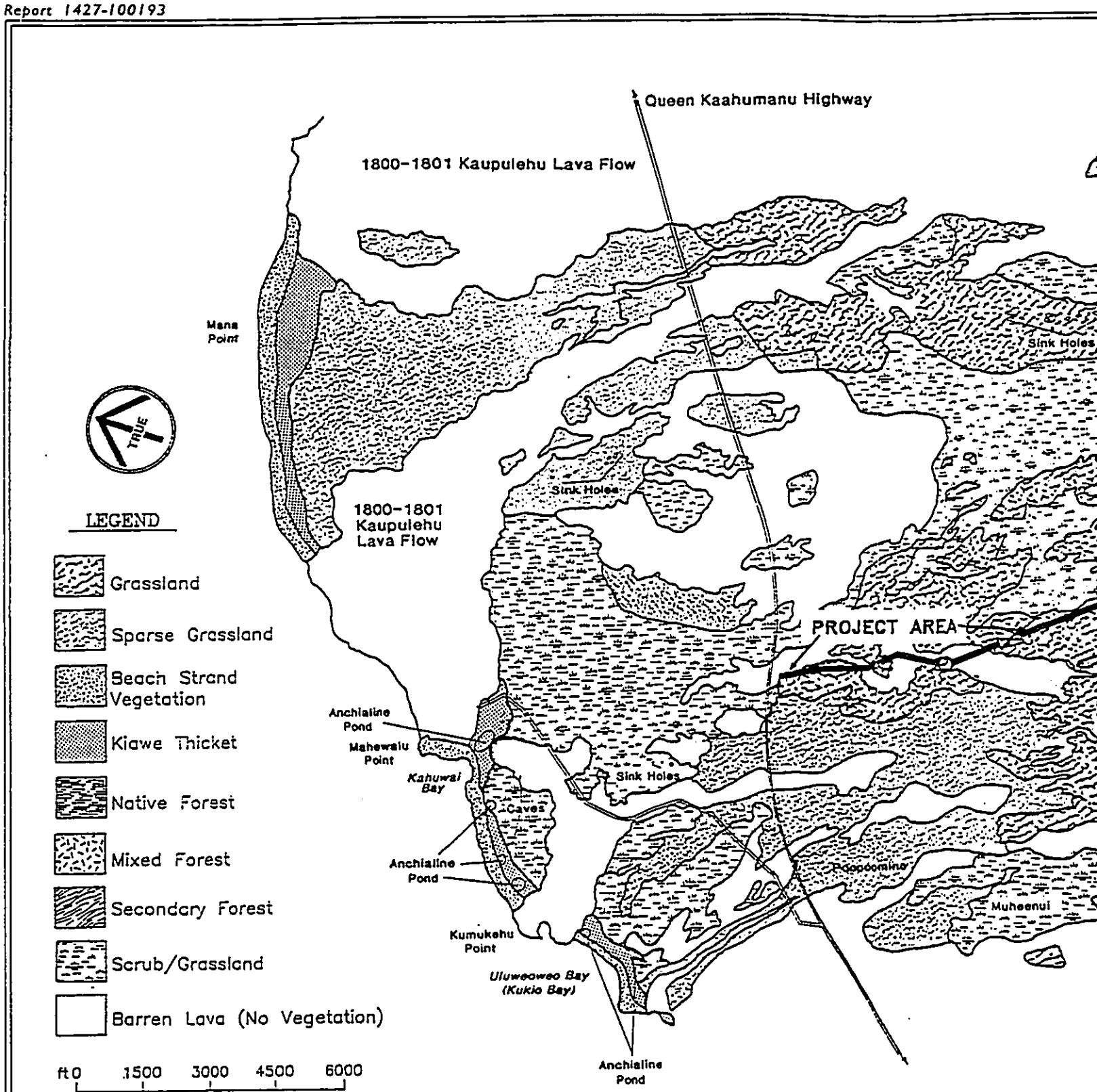


Kaupulehu Resort Irrigation
Project Inventory Survey
PHRI Project No. 93–1427

FIGURE 2.
Distribution of
Terrain Types



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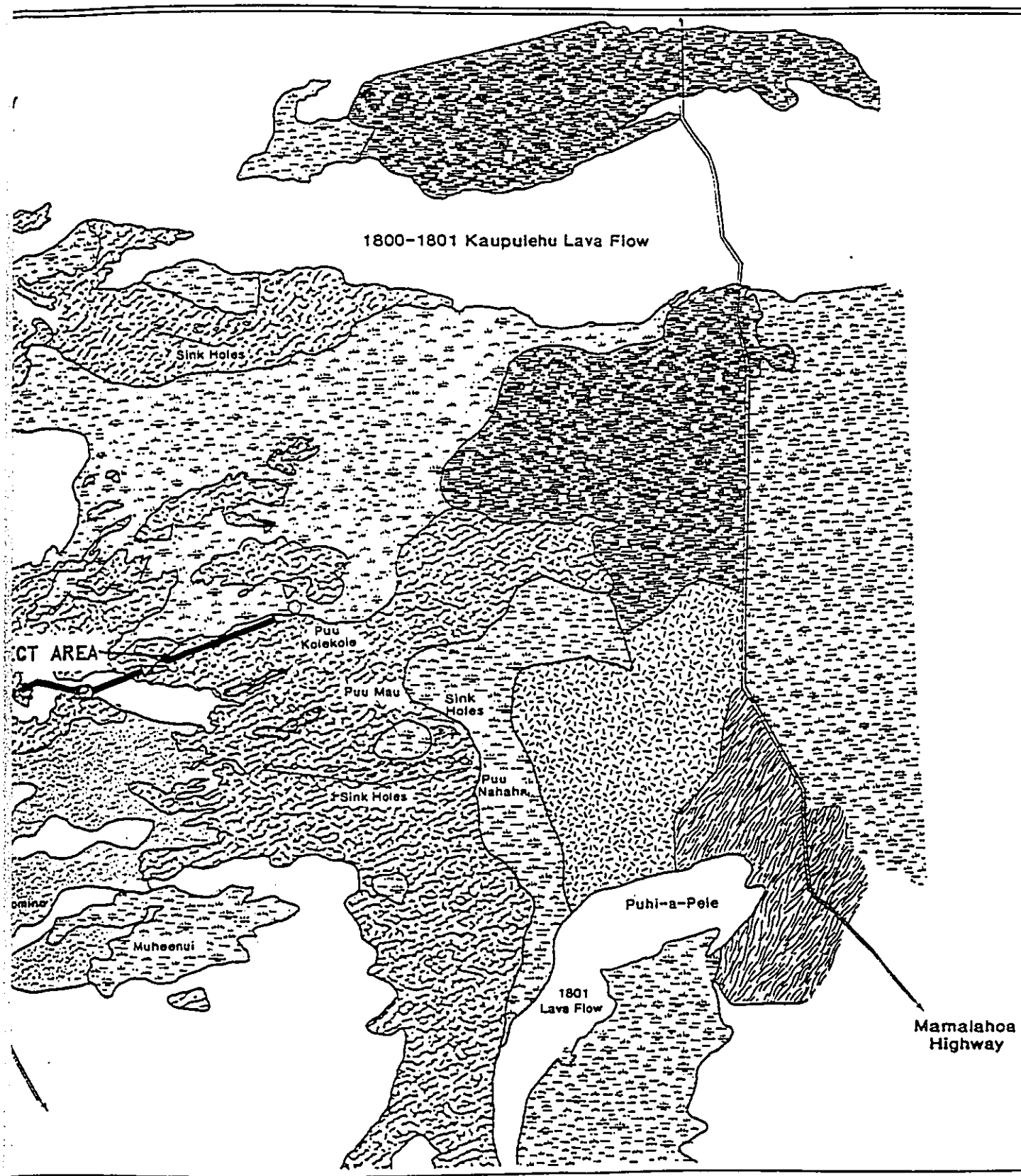

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FIGURE 3.
Distribution of
Vegetation Types

solitary specimens of *'ohia* (*Metrosideros collina* [Forst.] Gray subsp. polymorpha [Gaud.] Rock), *kiawe* (*Prosopis pallida*, and *lama* (*Diospyros* sp.);

2. Sparse Grassland - This vegetation type is present at middle to lower elevations (200-950 ft AMSL) within the project area. The substrate of the type consists of both aa and pahoehoe lavas. Vegetation consists predominately of sparse grasses, *'uhaloa* (*Waltheria* sp.), and *'ilima* (*Sida* sp). Solitary *pua-pilo* (*Capparis sandwichiana* DC.), indigo, *lama*, and *kiawe* may also be present; and

3. Grassland - Between c. 240-1,550 ft elevation. The substrate of this vegetation type consists predominately of aa and pahoehoe lava. The Grassland type differs from Scrub Grassland in that grass comprises a larger percentage of the total vegetation. Fountain grass is one of the more common species of vegetation present, but the native *pili* is also present. Also present are *'uhaloa*, *'ilima*, and pluchea (*Pluchea indica* [L.] Less.).

PREVIOUS ARCHAEOLOGICAL WORK

A full discussion of previous archaeological studies within Kaupulehu *ahupua'a* and coastal areas of North Kona and South Kohala districts has been presented in Walker and Rosendahl (1990). Most of the following discussion is taken from that source; comments relevant to the present study and other data from other sources have been interpolated in the discussion where appropriate. Table 1 presents selected information concerning the archaeological projects.

Over the years there have been a number of archaeological studies conducted within Kaupulehu Ahupua'a (Figure 4). In 1930, J.E. Reinecke, while surveying sites along the western coast of Hawaii Island for the B.P. Bishop Museum, recorded four sites (Sites 122-125) along the Pacific Coast *makai* of the current project area (Reinecke n.d.). Reinecke inspected only the immediate shoreline, no more than a few hundred feet inland, and his recording of sites was sketchy, making definite correlation of his specific features with features subsequently recorded in the area difficult. Reinecke's sites were later included in an inventory of Hawaii Island sites prepared by B.P. Bishop Museum for the HCPD (Emory 1970). That inventory was based entirely on records existing in the Bishop Museum's Department of Anthropology and did not involve any field work.

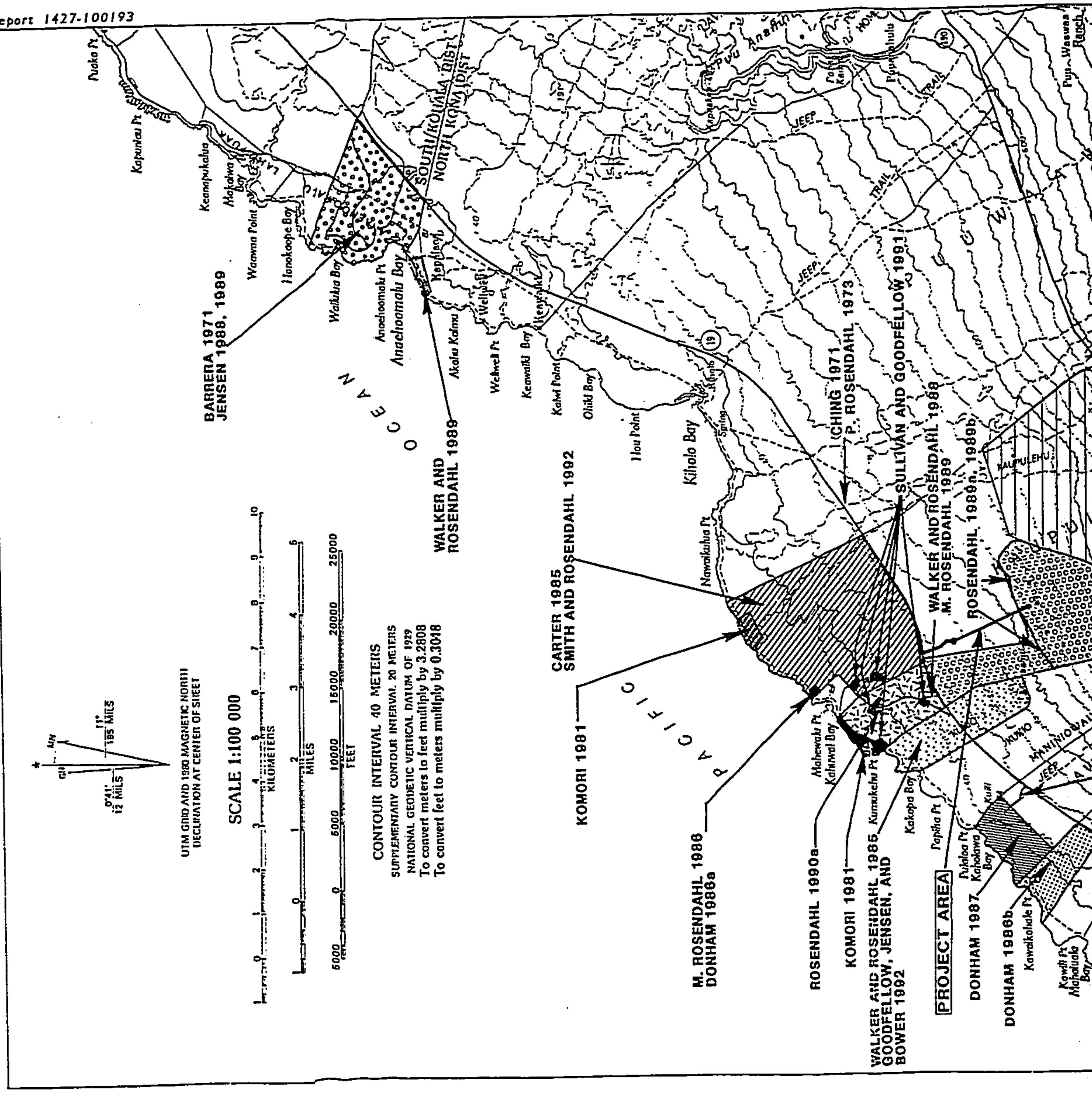
In early 1963, L.J. Soehren of Bishop Museum conducted a reconnaissance survey of Kaupulehu and Makalawena for B.P. Bishop Estate (Soehren 1963). Soehren identified 26 sites, of which 16 (Sites 1-13, 21-23) are located *makai* of the present project area. Three petroglyph sites identified by Soehren (Sites 19, 22, and 23) are also described in Cox and Stasack (1970). Soehren did not make recommendations concerning further archaeological work. Soehren's sites were later included in an inventory or Hawaii Island sites prepared in 1970 by B.P. Bishop Museum for the HCPD (Emory 1970). That inventory was based entirely on records existing in the museum's Department of Anthropology and did not involve any field work.

Between June-October 1970, the Parks Division of the DLNR conducted a surface survey of the Kailua-Kawaihae road corridor for the State Department of Transportation (Ching 1971).

Table 1.
Previous Archaeological Work in Kaupulehu and Surrounding Areas

Reference	Author(s)	Coverage	Zone	Ahupua'a
1930	Reinecke	R	C	Various
1963	Soehren	R	C	Kaupulehu/Malakawena
1970	Renger	R	C	Kaloko/Kukio 2nd
1971	Barrera	RE	CB	Anaehoomalu
1971	Ching	R	B	Various
1973	Rosendahl, P.H.	MD	B	Various
1981	Cordy	IED	CB	Kukio 1st and 2nd
1981	Komori	R	B	Kaupulehu
1985	Carter	R	CB	Kaupulehu
1985	Cordy	O	CB	Kalaoa/Ooma
1985	Walker and Rosendahl	R	CB	Kukio 1st
1986	Rosendahl, M.L.K.	R	C	Kaupulehu
1986a	Donham	R	C	Kaupulehu
1986b	Donham	R	C	Malakawena
1986	Silva	H	CBU	Malakawena
1986	Springer	ET	CBU	Awakee
1987	Springer	ET	CBU	Malakawena
1987	Donham	R	C	Awakee
1987	Silva	H	CBU	Awakee
1988	Jensen	IDR	CB	Anaehoomalu
1988	Rosendahl P.H.	R	B	Awakee
1988	Walker and Rosendahl	IED	C	Kaupulehu
1989	Jensen	DR	CB	Anaehoomalu
1989	Springer	ET	CBU	Kaupulehu
1989	Rosendahl M.L.K.	R	CB	Kaupulehu
1989	Walker, Kalima, and Rosendahl	R	C	Puuanahulu
1989a	Rosendahl, P.H.	R	B	Kaupulehu
1989b	Rosendahl, P.H.	R	B	Various
1990a	Rosendahl, P.H.	R	C	Kaupulehu
1990b	Rosendahl, P.H.	R	C	Kaupulehu
1991	Rosendahl, P.H.	R	B	Kaupulehu
1991	Sullivan and Goodfellow	MD	CB	Kaupulehu
1992	Smith and Rosendahl	R	CB	Kaupulehu
1992	Head, Goodfellow, and Rosendahl	R	BU	Kaupulehu
1992	Goodfellow and Head	ID	U	Kaupulehu
1992	Goodfellow, Jensen, and Bower	MD	CB	Kukio 1st

Key: R = Reconnaissance Survey, M = Mitigation, E = Excavation, DR = Data recovery, I = Intensive Survey, O = Regional Overview, D = Dating, C = Coastal Zone, ET = Ethnography, B = Barren Zone, H = Historical Research, U = Upland Zone


BARRERA 1971
JENSEN 1988, 1989
WALKER AND
ROSENDAHL 1989
CARTER 1985
SMITH AND ROSENDAHL 1992
KOMORI 1981
M. ROSENDAHL 1986
DONHAM 1986a
ROSENDAHL 1990a
KOMORI 1981
WALKER AND ROSENDAHL 1985
GOODFELLOW, JENSEN, AND
BOWER 1992
PROJECT AREA
DONHAM 1987
DONHAM 1986b
CHING 1971
P. ROSENDAHL 1973
SULLIVAN AND GOODFELLOW 1991
WALKER AND ROSENDAHL 1988
M. ROSENDAHL 1989
ROSENDAHL 1989a, 1989b
OCEAN
PACIFIC
SOUTH KOHALA DIST
NORTH KONA DIST
Waikoloa Bay
Anaehoomalu Bay
Kiholo Bay
Kaloko Bay
Makalawena
UTM GRID AND 1980 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET
SCALE 1:100 000
KILOMETERS
MILES
FEET
CONTOUR INTERVAL 40 METERS
SUPPLEMENTARY CONTOUR INTERVAL 20 METERS
NATIONAL GEODETIC VERTICAL DATUM OF 1929
To convert meters to feet multiply by 3.2808
To convert feet to meters multiply by 0.3048

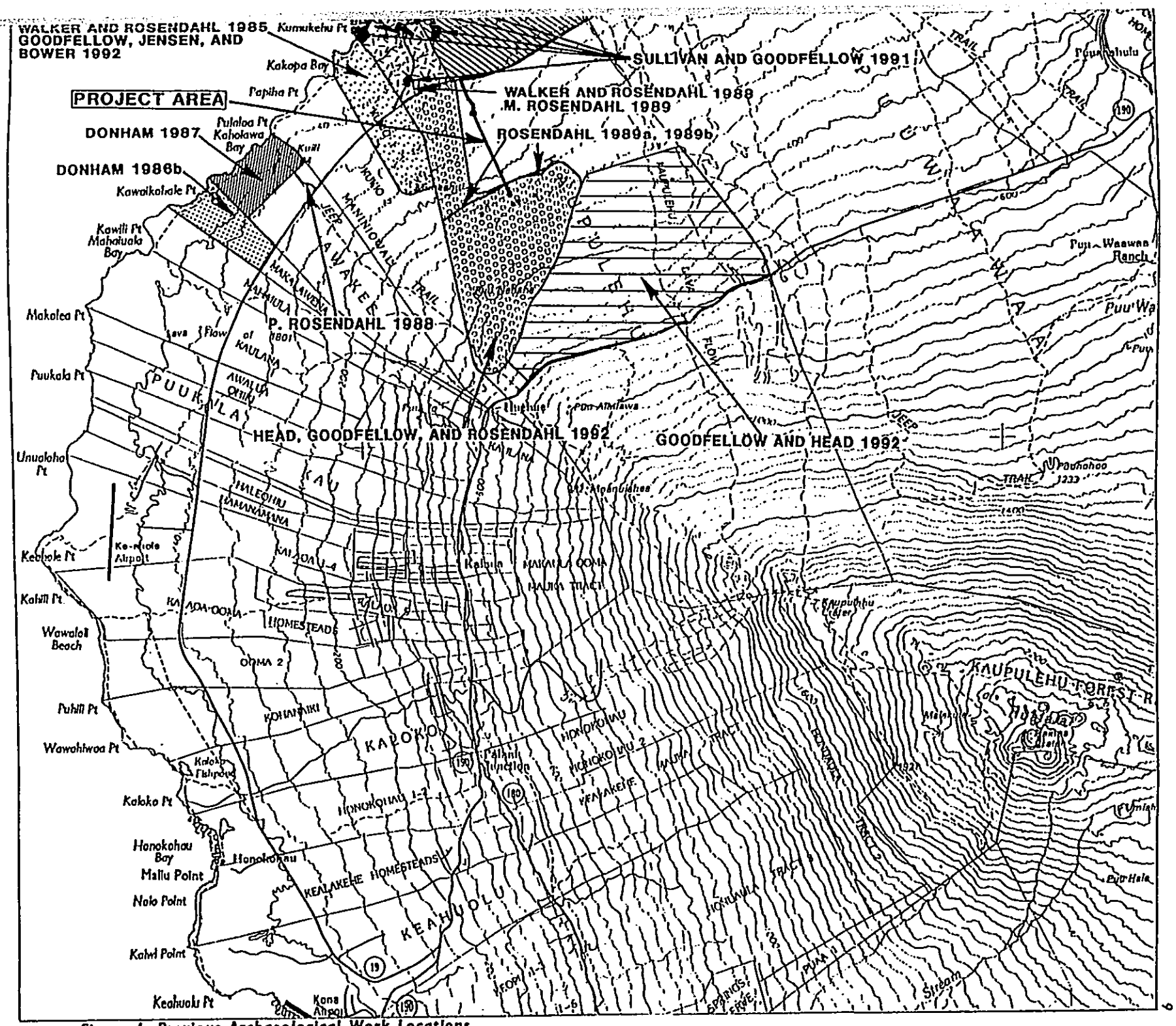


Figure 4. Previous Archaeological Work Locations

Ching identified numerous sites in his project area (SIHP Sites 1138-1141, 1143-1162, 1164-1167, 1190-1194, 1200, 1483, and 1494). Ching evaluated three sites (1140,1158 and 1160) as being of high significance and recommended the sites be saved because they were good examples of site types and were in excellent condition. Ching evaluated the remaining sites as being of low significance and recommended, with reservations, that the sites be destroyed following archaeological investigations (Ching 1971:5-7). One site, Site 1193 identified by Ching, had been previously identified as Site D21-7 in the Land of Kukio (Renger 1970).

In August 1972, in response to Ching's (1971) investigation, the Department of Anthropology, B.P. Bishop Museum, conducted archaeological salvage excavations and detailed recording of selected sites within the Kailua-Kawaihae road corridor (P.H. Rosendahl 1973). Seven sites (SIHP Sites 1140, 1141, 1157, 1158, 1160, 1162, and 1193) in the Land of Kaupulehu were included in the salvage work. Of this number, only Sites 1158 and 1160 appear to be within the present project area. Upon completion of that project, no further archaeological work was recommended for the seven sites. Based on ethnographic and ethnohistoric sources, coupled with results of the archaeological investigations, Rosendahl (1973) was able to present a model of aboriginal prehistoric Hawaiian settlement patterns for the portion of North Kona north of Kailua. Rosendahl's model is defined by four zones: a coastal habitation zone associated principally with the exploitation of various marine resources; a sloping, barren intermediate zone of recent volcanics almost devoid of soil or vegetation, associated mainly with temporary habitation and transportation between the coastal and inland zones; an upland habitation zone associated with agricultural exploitation; and an inland forest zone which was utilized but rarely inhabited. Rosendahl's upland settlement area applies principally to the slopes of Mount Hualalai, above Kailua; Rosendahl indicates that virtually nothing is known of the upland areas between the Lands of Mahaiula and Puuanahulu. Rosendahl's model was subsequently expanded upon by Hommon (1976). Hommon suggested that during the period of about AD 1400-1500, a shift in settlement patterns (inland expansion and permanent settlement) occurred through the development of permanent upland agriculture. Volcanic glass and radiocarbon age ranges from all sites investigated by Rosendahl indicate a time range of AD 1265-1855. Volcanic glass age ranges specifically from the Land of Kaupulehu yielded an overall date range of AD 1427-1763. No radiocarbon samples were submitted from the Land of Kaupulehu.

In April 1981, E. Komori of the Department of Anthropology, B.P. Bishop Museum, conducted a reconnaissance survey of two parcels of land in the coastal portion of Kaupulehu for Cambridge Pacific, Inc. Komori identified 19 sites, all of which are located seaward of the present project area. Based on the findings of his survey, Komori evaluated the sites as "not unique for the leeward coast of the Island of Hawai'i. Therefore, *in situ* preservation of the structures is not necessary" (Komori 1981:21). However, Komori recommended a program of salvage excavations (including mapping); he also recommended that any human burials found be given proper treatment prior to construction work.

In September of 1984, the Department of Anthropology, B.P. Bishop Museum, conducted a reconnaissance survey of the entire seaward portion of the Land of Kaupulehu (between Queen Kaahumanu Highway and the Pacific Ocean) for Barnwell Industries, Inc. (Carter 1985). The primary objectives of that survey were (a) to locate and record previously undocumented sites, (b) to relocate previously recorded sites, noting present condition, (c) to identify and locate areas with probable subsurface deposits, and (d) to recommend appropriate work for subsequent phases of archaeological investigations. Carter states in her report that objective (b), due to time constraints, was only partially met, and that previously identified Sites 1-5, 25, 26, 28, 29, 39, 41, 42, 43, and 202 were not field-checked. She also indicates that

her survey did not cover coastal areas (which had been examined previously) and lava flow interiors (1985:1,4). Carter's survey located 195 sites—47 previously identified and 148 newly identified (Carter states 151 new sites were found but she includes three sites [Sites 79, 80, and 91] previously recorded by Ching 1971 [Sites 1146-1152, 1144, and 1161]). Carter also states the identified sites contained numerous component features, but she does not say exactly how many (Carter 1985:5). Of the 195 sites, none are located within the present project area; Carter's *mauka* boundary (Queen Kaahumanu Highway) also forms the *makai* limits for the current project. Based on the findings of her 1984 survey, Carter recommended a program of "extensive survey" (including test excavations), intensive mapping, and treatment of human remains for one general and eight specific study areas (Carter 1985:29-33). She concludes that "recommendations regarding the preservation of specific sites will be contingent upon the results of extensive (Phase I) survey" (Carter 1985:27).

Within Carter's report is Marion Kelly's "Notes on the History of Kaupulehu" (Kelly 1985; Appendix C). Kelly describes Kekaha (*'aina malo'o*; a dry sunbaked land), which includes Kaupulehu, as an extensive lava-covered land of low rainfall and sparse vegetation encompassing a portion of Kona north of Kailua. Kelly's report includes discussions of (a) cultivation in Kekaha, (b) the meaning of the place name "Kaupulehu," (c) the *konohiki* of Kaupulehu, (d) petroglyphs at Kaupulehu, (e) Lono in Kona, (f) Kane at Kaupulehu, and (g) leases and development. In her report are also two short sub-appendices "The Destruction of the Great Fishpond of Paaiea" and "Kameeiamoku Captures the Fair American."

Kelly has indicated there is evidence that Kekaha land, though arid today, was once cultivated. Kelly quotes Ellis, who in 1842 noted that "...small gardens were seen among the barren rocks...wherever soil could be found sufficient to nourish sweet potato, the watermellon [sic], or even a few plants of tobacco..." (Ellis 1963:30-31). Kelly notes that, although their vegetable diet came mainly from the uplands of their *ahupua'a*, people may have been able to at least seasonally cultivate certain crops (Kelly 1985:89).

Kelly indicates the name "Kaupulehu" may mean "the roasted breadfruit," the 'u being short for *'ulu*; or according to another source (Pukui and Elbert 1971:128,184), the name could be divided into the words *ka'upu* (meaning a kind of bird) and *lehu* (meaning numerous), together meaning "many birds of this kind" (Kelly 1985:89).

Kelly also indicates that Hawaiian chief Kameeiamoku, advisor to Kamehameha, resided in Kaupulehu and was involved in foreign trade. Her report also includes mythological references to Kaupulehu. The most prominent reference is to the god Lono, who is associated with Kona. Lono is said to have introduced the main food plants to Hawaii Island. Another supernatural figure referenced is the god Kane. Kane, in one legend, disguises himself as a young man and marries a chief's daughter at Kaupulehu. Eventually, he reveals his true identity and provides the villagers with a spring for drinking and healing (Kelly 1985:92,93).

While discussing the leases and development pertaining to Kaupulehu, Kelly indicates that in 1961, Bishop Estate leased for 65 years 18,228 acres of Kaupulehu Ahupua'a to Hualalai Development. In October of 1961, Hualalai Development subleased 62 acres of the land, the site of the Kona Village, to John M. Jackson, and in 1962 the same company subleased 7,000 acres to Gardner Anthony (Kelly 1985:93). In 1963, Jackson assigned the 62-acre sublease to his family-owned Copra and Trading Company, Inc., which later merged with Kona Village Property, Inc. (the merged companies retained the name of Island Copra and Trading Company, Inc.). Later the 62 acres were attained by a subsidiary of Cambridge Pacific, Inc.; in 1983, the same parcel, reduced to about 60 acres, was leased by Bishop Estate to Kona Village Partnership (AF Properties and AAE, Ltd., Colorado) (Kelly 1985:93).

In 1968, the lease on the bulk of Kaupulehu Ahupua'a went from Hualalai Development Corp. to Signal Oil Corp.; then in 1979, the lease went to Cambridge Pacific (Canada). Finally, in 1984, Barnwell Hawaiian Properties went into partnership with Cambridge Pacific, Inc., and the lease was assigned to Kaupulehu Development, a subsidiary of the partnership (Kelly 1985:94).

In her conclusion, Kelly recommends more documentation of 20th-century land use for Kaupulehu Ahupua'a. She also recommends more areal historical documentation be performed.

In April of 1986, PHRI conducted an archaeological field inspection of the Kona Village Expansion Site (M.L.K. Rosendahl 1986). The project area was situated on the AD 1801 Kaupulehu Lava Flow. The only site identified (Site 230-1) was a historic foot trail defined as a Type "A" single-file foot trail (M.L.K. Rosendahl 1986:2). Subsequently, PHRI inspected a revised Kona Village Expansion Site project area (Donham 1986a). With the exception of the previously identified trail (Site 230-1), no new archaeological sites were identified (Donham 1986a:2). Although physical preservation of the trail was not required, it was recommended that the trail's location be accurately plotted, limited historical documentary research be conducted, and that site preservation and incorporation of representative trail sections into the overall landscape design be considered.

Between February 10-March 6, 1986, PHRI conducted archaeological survey and test excavations at Kaupulehu Makai Resort project area, located in the coastal portion of the Lands of Kaupulehu (Walker and Rosendahl 1988). During the survey and testing, 53 sites (201 component features) were located. Of the 53 sites, 46 (139+ features) had been previously recorded and seven sites (63+ features) were newly identified. Formal features types encountered in the project area include walled shelter, walled enclosure, trail, lava formation, wall, cairn, platform, pit, cleared/leveled area, rock alignment, terrace, overhang shelter, pahoehoe clearing, walled pahoehoe clearing, petroglyph, burial, and ramp (possible). Functional types encountered in the project area include habitation, foot trail, transportation, pond wall, fishtrap (possible), boundary marker, ceremonial, quarry, marker, drift wall (possible), and indeterminate.

Thirty-six test units (57.75 sq m) were excavated at sites in the Walker and Rosendahl (1988) project area. The units yielded a variety of cultural remains, including portable artifacts, midden, and dating samples. The portable artifact collection (1,260 items) included fishing gear, tools, domestic implements, flaked stone, and miscellaneous modified lithic, bone, organic, and marine gastropod remains (c. 81%), miscellaneous invertebrate remains (c. 13%), bivalvia remains (3.5%), vertebrate remains (1.6%), and vegetal remains (0.97%). Ten radiocarbon and 44 volcanic glass dating samples were submitted for age determination analysis. The radiocarbon dates spanned a 925-year period (AD 1030-present); the volcanic glass dates spanned a 538-year period (AD 1282-1820).

Overall, the Walker and Rosendahl (1988) studies provided data useful in understanding both occupation and exploitation of the Kaupulehu coastal zone. The work documented both prehistoric and historic sites and indicated that early occupation in Kaupulehu most likely took place primarily near the coast. Included in the conclusion is a discussion addressing the nature of occupation (variety and distribution of functional site types, resources, and cultural activities; and age, duration, and intensity of occupation), intra-site comments, and regional development comments.

Of the eight sites Walker and Rosendahl identified in the Kaupulehu Makai Resort project area, six were assessed as significant only for information content (Sites 1161, 10964-10967,

and 10990). No further work was recommended for these six sites. For the remaining two sites further work in the form of additional data collection, preservation, and interpretive development was recommended.

In December of 1988, PHRI conducted an archaeological inventory survey of the Kaupulehu Resort Utility Corridor project area (M.L.K. Rosendahl 1989). The 100-foot wide corridor is situated adjacent to and immediately northeast of the Kaupulehu-Kukio boundary. It begins on the seaward end at Queen Kaahumanu Highway and extends inland ending at the Conservation District boundary (c. 850 ft AMSL). With the exception of two previously identified trails, Site D21-7/1193 (Renger 1970/Ching 1971) and Site 10977 (Walker and Rosendahl 1988), no new sites were identified. Sites 1193 and 10977 were evaluated as being significant for information content, cultural value, and as excellent examples of a site type (interpretive value), and they were recommended for preservation "as is" (M.L.K. Rosendahl 1989:12).

Phase II (Archaeological Data Recovery Work) of the Phased Mitigation Program for the Kaupulehu Makai Resort project area was conducted during October-November 1989. During the field work, one new site (14659) consisting of a single feature was identified, and additional features were identified at Sites 10948, 10955, 10959, 10991, and 10992 (Sullivan and Goodfellow 1991). Subsurface investigations consisted of formal excavation units placed at ten of the 12 sites identified as requiring further work, and a series of shovel tests placed along the coastal portion of the project area. One hundred eighty-three samples, including charcoal, soil/flotation, pollen, and ecofactual samples were collected during the excavations and were processed for the final report; and more than 2,000 portable artifacts were recovered *in situ* or during the processing of samples. All relevant structural features in the project area were mapped and recorded; where necessary, excavations were backfilled and excavated features were reconstructed for preservation (Sites 10947, 10968, 10969, 10991, and 10992).

Finally, as part of the data recovery work, several sites containing human remains were investigated. Data recovery at three of the known burial sites (10959, 10986, 10987) involved disinterment of the remains; this procedure was carried out in compliance with the guidelines established by the Burial Treatment Plan (Jensen and Rosendahl 1989) and in accordance with a State Department of Health permit. Following the identification of three of the individuals interred at Site 10991 by a lineal descendant (Mr. Robert Keakealani, since deceased), and at his request, Site 10991 was scheduled for preservation and was sealed to protect the burials. The osteological report for this project area was issued under separate cover (Kalima 1991).

The Phase II findings indicated that initial use of the Kaupulehu Makai Resort project area occurred between AD 1000-1300. Prehistoric activity appears to have been associated with exploitation of marine resources, with most features exhibiting evidence of temporary rather than permanent habitation.

In November of 1989, PHRI conducted Phase I (Site Identification) of an archaeological inventory survey of the irrigation system portion of the Kaupulehu Resort Mauka Utility Corridor project area (P.H. Rosendahl 1989a). The 100-ft wide corridor and two well pad sites are situated c. 1.3 miles inland of Queen Kaahumanu Highway, inland of and roughly parallel to the existing State Conservation District boundary, and they extend generally along the same elevation contour (850-900 ft AMSL). The corridor was c. 8,300 ft long and the well pads each measured c. 100 ft by 100 ft. A total of 19 sites and site complexes (c. 52 component features) were identified during the survey work. Formal site types included cairn, pahoehoe excavation,

enclosure, cave, surface midden scatter, trail, pahoehoe slab pile, and overhang. The majority of the sites consisted of pahoehoe excavations and cairns (42 features). Formal feature types included quarry (pahoehoe excavations), agriculture, temporary habitation, and transportation. One site, Site 720-12, previously identified as Site 1319 by Ching (1971), is a branch of Kiholo-Kaupulehu Trail. Although inventory survey-level recording and mapping (Phase II - Data Collection) were not carried out, it was apparent the sites would be evaluated as being significant for information content (P.H. Rosendahl 1989a). Because the corridor alignment could be modified, it was recommended that the sites be avoided and thus temporarily be preserved "as is." It was further recommended that (a) the alternative alignment centerline and well pad site deviations determined by the archaeologist during the site identification field work be utilized, and (b) that archaeological monitoring of all initial grubbing and grading be conducted by a qualified archaeologist (P.H. Rosendahl 1989a:2).

In May 1990 PHRI conducted an archaeological inventory survey of additional Kaupulehu Resort Utility Corridor areas (Rosendahl 1990; Letter Report 720-051090). The areas consisted of two corridor sections, a proposed reservoir site, and an electrical substation site. During the survey two previously identified sites (trail sections) and three newly identified sites (pahoehoe excavations and a blister cave) were identified within or immediately adjacent to the project area. Of the five sites, two trail sections were assessed as valuable as examples of site types and as culturally significant. Preservation "as is" was recommended for the trail sections. No further work was recommended for the remaining three sites.

In December of 1989, PHRI conducted Phase I (Site Identification) of an archaeological inventory survey of the expanded Kaupulehu Resort Mauka Utility Corridor and Proposed Reservoir Site project area (P.H. Rosendahl 1989b). The 100-ft wide corridor, situated 1.6-2.7 miles inland of Queen Kaahamanu Highway, measures c. 8,270 ft in length, and ranges in elevation from c. 850-1,350 ft AMSL. The proposed reservoir site consists of c. 2.1 acres situated at about 1,350 ft AMSL. The inventory survey identified one new site (Site 720-20; cave) and two previously recorded sites (Sites 1193 and 1319; trails) within or in the vicinity of the project area. Although no physical evidence of Sites 1193 and 1319 were observed during the survey, background research indicated they were within or in the vicinity of the project area. Site 720-20 was evaluated as being significant solely for information content, while Sites 1193 and 1319 were evaluated as being significant for information content, cultural value, and as excellent examples of site types (interpretive value). Because the corridor alignment could be realigned, it was recommended that Site 720-20 be avoided and thus temporarily preserved "as is." It was recommended that the approximate locations of Sites 1193 and 1319 (based on previous archaeological work, cartographic resources, and local informant information) be accurately plotted in the field with the aid of an archaeologist. Following accurate locational plotting, it was recommended that if the trails did cross the project area, areas they crossed should then be preserved, and pedestrian access to them be allowed (P.H. Rosendahl 1989b:2).

In early 1990, PHRI conducted an archaeological resources assessment study of the Kaupulehu Phase II Master Plan project area, consisting of c. 9,350 acres located in the Land of Kaupulehu. The objective of the survey was to provide information concerning archaeological resources within the general project area appropriate to and sufficient for preliminary development planning and preparation of a Conceptual Master Plan. In this project, 168 sites were identified. This total number included 159 sites that been previously identified and nine new sites. Kaupulehu Ahupua'a contained 15 sites that had minimally undergone inventory-level survey work and general significance assessments for them had been made previously. For the remainder of the sites, it was stated that inventory-level survey of the sites must be

conducted prior to assessing and presenting specific recommendations for them. The project area was then divided into three areas varying in potential (low-high) of potential for archaeological sites (archaeological sensitivity). The areas were depicted on a map which was estimated to be quite reliable, and it was recommended that this map be used as a guideline for future development planning and archaeological work within the area (Walker and Rosendahl 1990:ii).

In June 1990 PHRI conducted Phase I - Site Identification of an archaeological Inventory Survey of the Kaupulehu Phase II Mauka Utility Corridor (Rosendahl 1990c). Two sites were identified during the field work: Site 851-1, a habitation complex; and Site 1193, a trail.

In October-December 1990, PHRI conducted an archaeological inventory survey of the Kaupulehu Mauka Lands project area (Head *et al.* 1992). During the survey, 77 sites with 190 component features were located. Of the 77 sites, 17 had been previously located (but not recorded) and 60 were newly identified. The sites included the following formal feature types: alignment, C-shape, lava tube cave, cairn, cleared area, cupboard, enclosure, excavation, hearth, trail, mound, overhang, pahoehoe excavation, petroglyph, platform, terrace, upright, and wall. The feature types comprised the following functional types: temporary habitation, habitation, marker, indeterminate, agriculture/animal husbandry, agriculture, storage, water catchment, quarry, burial, habitation/possible burial, transportation, animal husbandry, boundary, ceremonial/marker, ceremonial/storage, habitation/burial, habitation/transportation, and recreation. Dating results indicated that the project area was initially utilized during prehistoric times, potentially as early as AD 1423, and that occupation continued through the historic period. Based on the interpretation of site distribution patterns and portable remains recovered from several of the sites, use of the project area was primarily associated with temporary habitation, dryland agriculture, and transportation.

In January 1991, PHRI conducted an archeological inventory survey of the Kaupulehu Makai Resort Intersection project area (P.H. Rosendahl 1991). The project area is at an elevation of 170-230 ft AMSL and consisted of about 20 acres *makai* of Queen Kaahumanu Highway. Four sites were identified during survey work. Formal feature types included lava tube cave (modified), charcoal concentration, and pahoehoe excavation. More recently, PHRI conducted an aerial and pedestrian site identification survey of the approximately 2,184-acre Ka'upulehu Makai - Lot 4 project area. This Phase I archaeological survey identified 197 sites consisting of 518 component features. Formal feature types identified included C-shape, double C-shape, U-shape, double U-shape, L-shape, J-shape, T-shape, crescent, enclosure, terrace, platform, possible shrine, wall, cairn, trail, cave, overhang, petroglyph, *papamu*, salt pan, modified outcrop, modified depression, pahoehoe excavations (with modification and or midden/cultural deposit), mound, alignment, and midden/cultural deposit.

The feature types were assigned the following functional types: habitation, possible habitation, burial, possible burial, transportation, marker, rock art, recreation, possible ceremonial, agriculture, possible agriculture, quarry, and indeterminate. In addition, c. 1,500 pahoehoe excavations (some with associated waterworn basalt hammerstones) were identified and were tabulated by survey sweep. One site (a previously identified trail) was found in the center of the project area, on the 1801 lava flow, and another was found in a *kipuka* of the other major *'a'a* flow (Smith and P.H. Rosendahl 1992).

PHRI also conducted an inventory survey of the c. 3,192-acre Ka'upulehu Mauka Lands Golf Course II Area and Remaining Area. During this examination of Barren Zone and Upland Zone lands, 33 sites consisting of 278+ component features were identified. One site (Site

1319, Kiholo-Ka'upulehu Trail) had been recorded previously. The following feature types were recorded: pahoehoe excavation, lava tube, enclosure, C-shape, mound, platform, cairn, modified outcrop, terrace, and slab-lined depression. Some features were composites of various formal types; e.g., lava tube caves with terraces, alignments, etc. Functional types included habitation (long-term and temporary), agriculture/animal husbandry, marker, quarry, transportation, and indeterminate. The data from this project indicated that the project area was occupied both historically and prehistorically, possibly as early as 1213 AD. Most of the occupations appeared to have been temporary (Goodfellow and Head 1992).

Archaeological work previously conducted in the general vicinity of the project area includes, but is not limited to, survey and testing along the coast of the Lands of Kukio 1st and 2nd and Maniniowali (Cordy 1981), reconnaissance surveys in Kaupulehu (outside the present project area), Kukio 1st, Awakee, Makalawena, and Kapalaoa (Renger 1970; Walker and Rosendahl 1985; Donham 1986b, 1987; P.H. Rosendahl 1990a,b; Walker and Rosendahl 1989), reconnaissance survey and data recovery excavations at Anaehoomalu (Barrera 1971; Jensen 1988, 1989), preliminary historical documentary research and regional notes on Makalawena and Awakee (Silva 1986, 1987; Springer 1986, 1987, 1989), and an overview of Hawaiian Island archaeology for the Ooma and Kalaoa area of North Kona (Cordy 1985). Cordy (1985) also includes notes relating to environmental zones, chronological information, site patterning, limited archival research, regional development/interpretation comments, and future considerations.

HISTORIC DOCUMENTARY RESEARCH *by Kepa Maly*

Introduction

The *ahupua'a* of Kau'pulehu is located in the North Kona District of the island of Hawai'i. Bounded on the north by Pu'uwa'awa'a Ahupua'a and on the south by Kukio Ahupua'a, Ka'upulehu extends westward from the sea to Mount Hualalai, which rises to an elevation of about 8,251 feet.

Ka'upulehu has a rich and varied history and many documents dealing with this area are available. This project deals with Ka'upulehu Mauka, or the upland zone of Ka'upulehu, and so the focus of this report will be on this area.

The name Ka'upulehu is translated by some sources as the roasted breadfruit, the '*u* being short for '*ulu* (Pukui et al. 1974:96). Eliza D. Maguire said the name Ka'upulehu is a contraction of Ka-imu-pulehu-a-ke-akua, the oven in which the god was roasted (1926:39). Various sources offer other interpretations of the name, many of them drawn from legends associated with the area. These legends will be discussed in detail below.

Place Names in Kau'pulehu

Place names have played an important role in the culture and history of the Hawaiian Islands. In ancient times, place names were important links between an area and a certain story or theme. Places often received their names according to the features of that area, or the kind of work done there. There are a number of places with interesting names in and around Ka'upulehu Ahupua'a.

The entire portion of North Kona which lies between Honokohau and Kapalaoa was once known as Kekaha (Soehren 1963:1). Kekaha (where food does not grow) was a waterless land, often ravaged by Pele. Natives of the land often gave to these barren lava fields such epithets as Kekaha wekaweka (black Kekaha) and Kekaha wai 'ole (waterless Kekaha) (ibid.).

One Hawaiian saying concerns the beginning of the new fishing season off Kekaha:

> *Ola akula ka 'aina kaha, ua pua ka lehua i kai.*
>
> Life has come to the *kaha* lands for the lehua blooms are seen at sea.
>
> "Kaha Lands" refers to Kekaha, Kona, Hawaii. When the season for deep-sea fishing arrived, the canoes of the expert fishermen were seen going and coming (Pukui 1983:271).

Kekaha was also known as a land where the gusty Ho'olua wind blew. John Papa I'i, a 19th century Hawaiian historian and member of the court of Kamehameha III, wrote:

> A little more frequent was a cold wind from Kekaha, the Hoolua. Because of the calm of that land, people often slept outside of the tapa drying sites at night. It is said to be a land that grows cold with a dew-laden breeze, but perhaps not so cold as in Hilo when the Alahonua blows (I'i 1973:122).

The following names are listed in Soehren's report as being from the Boundary Cert. No. 160. They also appear on the Bishop Estate Map No. 2212. They are listed beginning at the shore between Ka'upulehu and Pu'uwa'awa'a and continuing clockwise around Ka'upulehu. Soehren notes:

> Interpretation of place names is often difficult without a knowledge of the local history. Descriptive names generally present no problems, but those which are commemorative can rarely be translated correctly without reference to the mo'olelo or story of its origin. The name Ka'upulehu is an excellent example. In the following lists, therefore, translations are not offered for all names (Soehren 1963:18).

Pohaku-o-ka-hae	banner rock
Ke-ahu-kau-pua'a	mound for placing pig
'Owe'owe	rattle; a *kipuka*
Pulu-'ohia	'ohia's mulch
Puako-wai	—
Pohaku-loa	long rock
Mawae	fissure
Pu'u Nahaha	broken hill
Maile-hahei	maile worn across shoulders
Pu'u Honua'ula	red earth hill
Palahalaha	level
Ka-wai-o-ka-la'i-puna	the water of the tranquil spring
Pulehu	cook in embers
Moa-nui-ahea	—
Puha-a-Pele	Pele's steaming
Po'opo'o-mino	dented hollow

The following names are also found within the boundaries of Ka'upulehu:

Kumu-kea Point	white base
Wai-a-kuhi Pond	—
Kahu-wai Bay	contraction of Kahua wai, place of water
Mahewalu Point	—
Puu Kolekole	—
Puu Mauu (Puu Mau-USGS map)	grass hill
Kileo	—
Puu Alauawa (perhaps Alauwa)	red-fish hill (?)
Hina-kapo-'ula	name of a goddess
Ka'upulehu Crater	—
Kalulu	the sheltered
Malekule	—
Lua-makani	wind pit
Hai-noa	free will offering
Ki-pahe'e	slippery slide
Na-wahine	the women
Pu'u Ma'au	gad-about hill

(ibid:15-16).

Soehren gives the names of two deep-sea fishing grounds (*ko'a*) in the vicinity of Ka'upulehu:

> Mahewalu, for 'opelu, is said to lie beyond Kalaeokamano [Shark Point]...which is actually in Pu'u Wa'awa'a, although close to the Ka'upulehu boundary. However, Mahewalu is also the name of a promontory formed by the Ka'upulehu lava flow on the northeast side of Kahuwai Bay. The exact location of the other fishing ground, Kaho'owaha, is also unknown, but it may well belong to Ka'upulehu. One of the landmarks of this ko'a is Kanaka-loa, a long stone lying on the side of Muhe'enui. Although this prominent hill is in Kuki'o it is close to the Ka'upulehu boundary. The stone was said to be a man and the hill a woman...(ibid.).

Ka'upulehu is said to have gone by the ancient name of Manuahi. This name translates as fire bird (Pukui et al. 1974:146) when broken into two words, *manu* (bird) and *ahi* (fire). Although Pukui et al. say that Manuahi is the ancient name for Ka'upulehu, according to other sources, Manuahi is a name for a place in Ka'upulehu and not for the entire *ahupua'a*. In fact, Soehren lists Manuahi as a village below Kileo and Akahipu'u, noted in the story of two girls eating breadfruit (see below).

Kaupulehu in Legend

Numerous legends are associated with the Ka'upulehu area. The Hawaiians believed that before men inhabited the islands, the gods came. These gods were responsible for all that was found in Hawaii. Jensen and Rosendahl (1989:3) tell about the presence of two gods in Ka'upulehu:

> ...The most prominent reference is to the God Lono, who is associated with Kona. Lono is said to have introduced the main food plants to Hawaii Island. Another reference is to the god Kane who, in one legend, disguises himself

> as a young man and marries a chief's daughter at Kaupulehu. Eventually he reveals his identity and provides the villagers with a spring for drinking and healing.

This story is described by John Reinecke, who collected information on Ka'upulehu during his survey of Kona sites for the Bishop Museum in 1930:

> A chief of Kaupulehu had a lovely daughter. One day a handsome young man appeared; he was the god Kane in disguise. The chief married his daughter to the young man because of his fine looks, but the stranger turned out to be a worthless husband; he slept day and night; he never worked. This angered the chief. Kane always spoke to the rest of the villagers, even his father-in-law, through his wife; the chief therefore had his daughter pester Kane until he could stand it no longer, to do something useful.
>
> At last Kane told his wife to have the chief command all the people of Kaupulehu to gather wood for one day. The chief hesitated at such a seemingly foolish demand, but finally sent his followers out to obey it. Then Kane ordered them to build a huge *imu*.
>
> He then went *mauka* and gathered all the *kalo* in a great patch. This he bundled all together, pulled up a *lehua* tree by the roots, tied the *kalo* to it, and carried the untrimmed tree down to the village, naturally to the amazement of all. The chief began to suspect that his son-in-law was a god.
>
> Kane made the villagers enlarge the *imu*, into which he put all the *kalo*. He then entered it with the *kalo*, just before sunset, and commanded his wife to cover him, ordering her not to open the *imu* until his return. She reluctantly obeyed.
>
> The *imu* was situated about a mile from the coast. Kane went underground until he reached the spot where the spring now is; here he emerged, the spring flowed forth, fresh water, as from a faucet (at low tide). Then he came and appeared to his wife, who cried out in alarm, thinking him a ghost. But he reassured her, and made her and the villagers follow him to the imu which they opened. And behold it was full of all sorts of food, pigs, fish, yams, *kalo*, and whatever else can be cooked in an oven. The people cried out, He is a god! and Kane revealed his identity.
>
> Then he had them follow him to the spring, which he gave them for drinking and for healing (and no doubt disappeared).
>
> If one will dive in twenty-five times, five times repeated five times, once in the morning and once in the evening until the required number is fulfilled, he will be cured of whatever ails him. Then he should dive once more to give thanks. No woman in her period may approach the spring, which is pure water (Reinecke 1930:93).

Another version of this story is told by Eliza D. Maguire in "The Waters of Kane." In it Maguire states that during the reign of a chiefess of Ka`upulehu, there was a severe drought. In response to her prayers, the god Kane came to help her. Kane ordered a large *imu* (oven) to be prepared, entered the oven, and was sealed in it, only to miraculously reappear in the sea

(1926:10). The place from which he emerged became a spring, known from then on as the waters of Kane. When the *imu* was opened, it was found to be filled with great quantities of cooked food, which relieved the famine caused by the drought. Thus the name Ka`upulehu is a contraction of the name given by Maguire in the opening of this report, Ka-imu-pulehu-a-ke-akua, the oven in which the god was roasted (ibid:39).

The location of the spring mentioned as the Wai o Kane is listed only as being at Ka'upulehu beach; however, it is probably the one indicated on the USGS Kiholo quad map, offshore at Kahuwai Bay (Soehren 1963:11).

Maguire recounts another legend for Ka'upulehu Ahupua'a:

> Pele met two girls, Pahinahina and Kolomuo, in the ancient village of Manuahi. The girls were roasting (pulehu) breadfruit ('ulu). When Pele asked for some it was Pahinahina who gladly shared her food. After Pele had eaten, she told the girl to go home and set up the lepa (kapu stick) around her home. That same night lava flowed from Hualalai, went underground and came up near Huehue, destroying the village of Manuahi and the fish pond of Paaiea. The home of Pahinahina, who shared her breadfruit, was spared.

Maguire (1926) tells a similar tale in the story "Two Girls Roasting Breadfruit."

Samuel Kamakau, another 19th century Hawaiian historian, refers to a similar story about breadfruit, but his tale involves Kamehameha and the Hualalai Flow of 1800-1802:

> The people believed that this earth-consuming flame came because of...his [Kamehameha's] refusing her [Pele] the tabu breadfruit of Kamehaikana which grew in the uplands of Huehue where the flow started (1961:184).

According to Kamakau. Pele may have had other reasons for causing the flow. Besides wanting the breadfruit, she wanted the *aku* of Hale'ohi'u and the *ahi* fish of Kiholo. Lastly, she was angry because Kamehameha was devoting himself to Kaheiheimalie (one of his wives) and neglecting Kaahumanu (another wife); of this Kamakau (1961:186) says:

> It was said that Pele herself was seen in the body of a woman leading a procession composed of a multitude of goddesses in human form dancing the hula and chanting:
>
> *Lilo ka makou kane i ka ha'awe 'olo'olo e*
> *Ha'alele ia ka ha'awe leilei e leilei e.*
>
> Our husband has gone to carry the bigger load [Kaheiheimalie]
> While the lighter load [Kaahumanu] is neglected.

Kamakau also states that at the time of Umialiloa (c. 1450 AD), *kauila* wood from Napu'u, a place near Ka'upulehu Waena, was used to make war clubs to be used when two brothers from Maui, Kiha-a-pi'ilani and Lono-a-pi'ilani, went to war (ibid:28). He writes of several battles in the vicinity of Ka'upulehu and neighboring Pu'uwa'awa'a. During one of these, Kekaulike (chief of Maui), and Alapa'i (chief of Hawaii), waged war, and Kekaulike cut down the trees throughout the land of Kona (ibid.).

Early Historical Accounts

During the reign of Kalani'opu'u in the 18th century, the lands of Kekaha belonged to the twins Kame'eiamoku and Kamanawa, half-brothers of Ke'eaumoku, Kamehameha's uncle (ibid:310). Kame'eiamoku was a very important and powerful chief. In the 1780s and early 1790s, Kame'eiamoku had his home here. When Captain Metcalf visited the area on his ship, *Eleanor,* Kame'eiamoku was subjected to humiliating treatment by Metcalf's crewmen while trading with them. Kame'eiamoku vowed to avenge his humiliation by capturing the next ship that came by (incidentally, the *Eleanor* was the ship responsible for a huge massacre of native people on Maui, the Olowalu Massacre). Ironically, the next ship was the schooner, *Fair American,* commanded by Metcalf's son Thomas. Kame'eiamoku captured the ship near Ka'upulehu and killed the entire crew, with the exception of the mate, Isaac Davis (Kamakau 1961:146-7). Although badly beaten, Davis survived, and Kame'eiamoku's men took pity upon him and nursed him back to health. Kamehameha, seeing an opportunity, enlisted Davis and another Englishman, John Young, as advisors. Young had been prevented from returning to his ship, the *Eleanor.* The two white men instructed the Hawaiians in operating the muskets and cannon (Kelly 1985:100).

During the later years of Kamehameha's life he frequently enjoyed fishing expeditions along the shores of Kekaha (Kamakau 1961:203). The ponds at Kiholo, which he had built in about 1810, were largely destroyed by the 1859 Mauna Loa flow (Soehren 1963:8).

Ka'upulehu was first mentioned by a foreigner in the journal of Archibald Menzies, who visited Hawaii with Captain Vancouver in 1792. He stated that the land was:

> ...barren and rugged with volcanic dregs and fragments of black lava...in consequence of which the inhabitants were obliged to have recourse to fishing for their sustenance (Menzies 1920:99).

Twenty years later, in 1812, John Papa I'i made similar observations: The sustenance of those lands was fish (1973:109). The lands noted by I'i were Kaelehuluhulu, the kaha lands (Kekaha) and Ooma (Ching 1971:33).

In 1823, 11 years after I'i made his observations, Ellis took a canoe trip from Kawaihae to Kailua in North Kona. Along the way he stopped off at Kaparaoa (Kapalaoa). Here he noted "...a small village on the beach, containing twenty-two houses...carved wooden idols..." and an abandoned heiau (1963:306). He also visited the village of Wainanarii (Wainanali'i) and mentioned the name of its chief, Waipo. Later that day his canoe landed at Kihoro (Kiholo), which he described as "...a straggling village, inhabited principally by fishermen" (ibid.). The fishpond of Wainanali'i at Kiholo Bay must have been quite impressive since it is the only one of the 19 fishponds along this coast that he described (Ching 1971:34). This pond was destroyed 36 years later by the Mauna Loa pahoehoe flow of 1859. However, when Ellis saw it, this fishpond was still in operation and "...well stocked with fish..." (ibid:308). Ka'upulehu was his last stop before returning to Kailua, but unfortunately nothing was noted about the village because he arrived so late and the villagers were sleeping (Ching 1971:35).

Fishing was the main occupation of the people who lived in Ka'upulehu Makai in the early 1800s. In 1840 and 1841, C. Wilkes, an explorer with the American Expedition, made a few observations about this area, including the following notes:

> ...a considerable trade is kept up between the south and north end of this district. The inhabitants of the barren portion of the latter are principally occupied in fishing and the manufacture of salt, which articles are bartered with those who live in the more fertile regions of the south, for food and clothing....The natives, during the rainy season, also plant in excavations among the lava rocks, sweet-potatoes, melons, and pine-apples, all of which produce a crop (Wilkes 1845:91).

Evidence of this salt manufacture is still seen along the coast in the numerous basalt and concrete salt pans (ibid:38).

Because of the barren and arid nature of the landscape, most people chose to travel by sea along the coast rather than overland. The earliest description by a western traveler through the inland area was written in 1880 by George Bowser:

> From Kiholo the road southwards is rough and laborious. Perpetual traveling over lava is very hard upon our horses, and it is impossible to travel faster than the slowest walk. On the road we met with some awful chasms of unknown depth and numberless cracks and fissures in the lava (Bowser IN Camara 1989:93).

An anonymous traveler in 1901 stated that:

> The road was bad from start to finish. Between Kiholo and Huehue it has the attractiveness of a stairway making a steep ascent towards the sparsely wooded slopes of Hualalai, with a couple of lava flows to be crossed (The Friend, 1901 IN Camara 1989:93).

Agriculture

Although Ka'upulehu's climate and land are harsh and unforgiving, the area provided a livelihood for hundreds of pre-contact residents. In addition to fishing, residents lived by gathering other seafood and seaweeds, raising fish in ponds, making salt, and growing vegetables in favorable locations (Camara 1989:5). Coastal residents went into the uplands to get wood for fuel, building materials, and tools. They may have tended agricultural plots in the cooler, wetter uplands of Ka'upulehu Waena (ibid.). These people survived in a place so hostile to the eyes of westerners that we can only marvel at and respect their resourcefulness (ibid.).

According to Ellis, Hawaiians living in Kekaha in 1824 were growing some crops in what he called barren rocks (Ellis 1963:30).

Although we may assume that the people of Ka'upulehu were among this group of Hawaiians growing crops in rocks, we cannot assume that the climate of that area was the same then as it is now (Kelly 1985:88). Kelly further adds:

> Previous to the flow of 1800, local conditions at Ka'upulehu may have been more conducive to cultivation. Ka'upulehu, from its history of being the residence of great chiefs, and from the presence of hundreds of petroglyphs, was for generations both a popular oasis with a brackish-water fishpond and a sanctuary for canoe travelers between Kiholo and Kailua. The people living in Kekaha may very well have been able to cultivate, at least seasonally,

> certain crops including: tobacco, sweet potatoes, and perhaps in the shelter of lava-rock pits, even bananas. In addition to seasonal rains as a source of water, heavy dew could have been conserved and evaporation reduced by mulching techniques.
>
> The shoreline dwellers probably received their main vegetable diet from the uplands of their ahupua'a; but, at least seasonally, they would have grown some plants closer to their coastal dwellings than the gardens in the uplands (ibid:89).

Handy and Handy (1972) describe these agricultural practices as well:

> Wherever a little soil could be heaped together along the dry lava coast of North Kona, a few sweet potatoes were planted by fishermen at such places as...Kaupulehu...Doubtless potatoes were planted on the upland of North Kona, on the lower slopes of Hualalai toward Pu'uwa'awa'a (1972:527).

In his book, *The Indigenous Trees of the Hawaiian Islands*, written in 1913, Joseph Rock states:

> The vegetation begins to become interesting at Huehue, near the lava flows on the northern flanks of Hualalai, and reaches its culminating point at Puuwaawaa, the richest floral section of any in the whole territory (Rock 1974:49).

At the turn of the 19th century, sandalwood (*'iliahi*) became an important commodity in Hawaii. According to Kamakau, the chiefs caused a famine by ordering the people to abandon their crops and go into the mountains of Kona to cut sandalwood (1961:204).

We later find that the King had reserved all the sandalwood for his own use, as well as all large trees such as one man cannot clasp (Kingdom of Hawaii, Constitution of 1840).

Land Tenure and Use

In 1848, during the reign of Kamehameha III, the traditional Hawaiian land ownership system was replaced with a more Western-style system. This radical restructuring was called The Great Mahele (division). The Great Mahele separated and defined the undivided land interests of the King and the high-ranking chiefs, and the *konohiki*, who were originally those in charge of tracts of land on behalf of the king or a chief (Chinen 1958:vii and Chinen 1961:13). More than 240 of the highest-ranking chiefs and *konohiki* in the kingdom joined Kamehameha III in this division. The first *mahele* was signed on January 27, 1848 by Kamehameha III and Princess Victoria Kamamalu, and by her guardians Mataio Kekuanaoa and Ione Ii. The last mahele was signed by the King and E. Enoka on March 7, 1848 (Chinen 1958:16).

The Mahele did not convey title to any land. The chiefs and *konohiki* were required to present their claims to The Land Commission to receive awards for lands quitclaimed to them by Kamehameha III. They were also required to pay commutations to the government in order to receive royal patents on their awards. Until an award was issued, title remained with the government. The lands awarded to the chiefs and *konohiki* became known as Konohiki Lands. Because there were few surveyors in Hawaii at the time of the Mahele, the lands were identified by name only, with the understanding that the ancient boundaries would prevail until the land

could be surveyed. This expedited the work of the Land Commission and speeded the transfers (Chinen 1961:13).

During this process all land was placed in one of three categories: Crown Lands (for the occupant of the throne), Government Lands, and Konohiki Lands. These were all subject to the rights of native tenants (Laws of Hawaii, 1848:22). Native tenants were the common Hawaiian people who lived on the land and worked it for their subsistence. Questions concerning the nature of these rights began to arise as the King, the government, and *konohiki* began selling parcels of land. On December 21, 1849 the Privy Council attempted to clarify the situation by adopting four resolutions intended to protect the rights of native tenants referred to in the 1848 law (Chinen 1958:29).

These resolutions authorized the Land Commission to award fee simple title to all native tenants who occupied and improved any portion of Crown, Government, or Konohiki lands. These awards were to be free of commutation except for house lots located in the districts of Honolulu, Lahaina, and Hilo (ibid.).

Before receiving their awards from the Land Commission, the native tenants were required to prove that they cultivated the land for a living. They were not permitted to acquire wastelands or lands which they cultivated with the seeming intention of enlarging their lots. Once a claim was confirmed, a survey was required before the Land Commission was authorized to issue any award. These lands became known as Kuleana Lands (ibid:30). Until its dissolution on March 31, 1855, the Land Commission issued thousands of awards to the native tenants for their *kuleana*; even so, less than 30,000 acres of land were awarded to the native tenants as Kuleana Lands.

At the time of the Great Mahele, Ka'upulehu, along with Kaloko to the south was awarded to Lot Kamehameha. Lot Kamehameha was the grandson of Kamehameha I, and he had selected these lands for his own. Both of them contained natural fish ponds. Such ponds were highly prized, and at the time of the Mahele, they were usually retained by the *ali'i*. Other North Kona lands were retained for this reason by various other *ali'i*.

The Indices to Land Commission Award titles list the following for LCA 7715, which was the award given to Lot Kamehameha:

> LCA 7715 to Lot Kamehameha Book 10:622 Apana 10, Royal Patent 7843 Book 29:179 for Kaupulehu, Kona, Hawaii.
>
> By action of the Privy Council on Aug. 29, 1850, as recorded on page 423 of Vol. 3 of Privy Council Records, a Resolution was passed for his relief as follows:
>
> Resolved that in consideration of the relinquishment of Kahikinui on East Maui, by Lot Kamehameha to the Government in former division of lands, the Minister of the Interior is hereby authorized to grant Royal Patents to Lot for his lands, said to be eighteen in number, without further division or commutation (p.64-65).

No kuleana awards were listed in the Indices for land in Ka'upulehu, meaning that no one except *ali'i* had put in a claim for any lands there.

Boundary descriptions for LCA 7715, as recorded in the Royal Patent File, are kept at the State Archives:

> CERTIFICATE OF BOUNDARIES OF THE LAND of Kaupulehu...having been filed the 13th day of May, 1886 by J.M. Alexander for and in behalf of Mrs. Bernice Pauahi Bishop's Estate.
>
> Beginning at the SW corner of Puu Waawaa at the seaward extremity of the ledge called Pohakuokahae, whence the Govt. trig. station on Akahipuu is S 2 degree, 31 ft. 43 inches W (true) 36137 feet; thence the boundaries run by the true meridian to corners marked by ahus over rectangles cut in rock with crosses cut on surrounding rocks as follows...area 2345 acres (as surveyed by J.M. Alexander 1885)

Information in the Native Testimony as well as the Native Register indicates only that this land was awarded to Lot; no other data was given.

Land Index Records *contained various records on* Ka'upulehu Ahupua'a, which are listed here:

> INT. DEPT. Aug 27, 1850
> Set apart for Lot Kapuaiwa in Land Division. See list of lands attached to letter from Miriam Kekuanaoa to the Minister of the Interior (John Young).
>
> INT. DEPT. May 28, 1861
> In letter from P.H. Kapaiki, to Minister of the Interior, entering complaint against the action of a person who had under his control the remnant of the Government lands in slaughtering goats belonging to him & others running on the above land.
>
> INT. DEPT. MATTERS Oct. 10, 1861
> R. Keelikolani to Lot Kamehameha, informing him of the receipt of Birds of Kaupulehu from Maiai (k), his hoaaina, forty in number, that 20 went to his younger brother, 5 to herself, and the remaining 15 are his.
>
> INT DEPT. April 25, 1866
> In report by J. H. Kalaiheana showing that the above ahupuaa is a Crown Land.
>
> INT DEPT. Dec. 18, 1867
> In letter by Charles Wall stating that he has heard that some natives have gone to Honolulu for the purpose of leasing the above land. Desires that the same be leased to him.
>
> INT. DEPT. May 3, 1873
> In letter from John Broad to John Dominis applying to lease the above ahupuaa at $200 a year, for a term of 10 years.

INT. DEPT. May 12, 1873
In letter from R. Keelikolani to John O. Dominis acknowledging the receipt of his favor pertaining to the matter of leasing the above land & Keauhou - Suggest that the lauhala on said Kaupulehu, the fishery, the coconut grove & all the beach land be reserved—Also states that the lands of Kahaluu, Keopu & Kaloko be not included in said lease.

INT. DEPT. Bk.14.p.211 Apr. 30, 1877
In letter from Minister of the Interior to the Commissioner of Boundaries that Dr. G. Trousseau had informed him under date of Apr. 12, that Mr. Lyman can not give his decision until advised by His Excellency respecting the boundaries of Kaupulehu & Honuaula.

INT. DEPT. Feb. 9, 1910
Comm of Public Lands-to-Governor. Enclosing papers concerning the above land, the lands of Kau and Haleohiu, in Kona, Hawaii. It appearing that the Territory had deed to Allan S. Wall, under Grant 5067, 112 acres of the above land, that through some error in the survey, it developed that the Govt had granted 7.2 acres of the land of Kau belonging to Mrs. Egan. That an understanding was had at the adjustment of boundaries that Mrs. Egan be given 7.2 acres of the land of Haleohiu in exchange for the area taken from her land.

Kona Village Resort

Although fishing had been the main occupation in Ka'upulehu, by about 1860 ranching began to dominate the economy. During this time the population in this area dwindled, and by the early 1900s most of the native population had moved elsewhere (Ching 1971:38). During the twentieth century, a few Hawaiian families lived at Ka'upulehu, until the tsunami of 1946 swept the whole area. From that time on, the area was home only to pigs and wild goats, and occasionally was visited by fishermen and boaters (Clark 1985:120). In 1956, a wealthy yachtsman, Johnno Jackson, and his wife Helen, sailed past Ka'upulehu during a visit to the islands. They put in at Kahuwai Bay and soon decided that they had found an ideal location for a small, secluded luxury resort village (ibid.).

In 1961, Bishop Estate leased 18,228 acres of Ka'upulehu Ahupuaa to Hualalai Development for 65 years. Later that same year, Hualalai Development subleased 62 acres of the land, the site of the Kona Village, to John M. Jackson, and in 1962 the company subleased 7,000 acres of the land *mauka* of the Mamalahoa Highway to Garner Anthony (Kelly 1985:93).

Clark elaborates on the birth of the Kona Village Resort:

> During the early 1960s, construction began on a complex that eventually became the Kona Village Resort. Ka'upulehu at the time was accessible only by aircraft or boat, so Jackson's first priority was the construction of a 2,600-foot landing strip to expedite transportation of the laborers to and from the work site and that could later be used to bring in guests. He purchased an LCVP, a military landing craft capable of carrying vehicles and personnel, and used it to transport much of the lumber, materials, and equipment that his project demanded. He built a power generating plant, and he sank a 550-foot well shaft for water. While construction was in progress, Jackson lived

> aboard his schooner, anchored in Kahuwai Bay. During a particularly bad storm, high winds and heavy surf forced the boat into the shallow reef and rocks bordering the bay, destroying the craft beyond repair, but Jackson salvaged as much of the wreck as he could and converted it into the Shipwreck Bar, still a popular attraction in the resort village. The original complex, completed in June 1964, was named Jackson Village (ibid.).

In 1963, Jackson assigned the 62-acre sublease to his family-owned corporation, Island Copra and Trading Company, Inc., which later merged with Kona Village Property, Inc. (the merged companies retained the name Island Copra and Trading Company, Inc.). Later, the 62 acres were taken over by a subsidiary of Cambridge Pacific, Inc. In 1963, the same parcel, reduced to c. 60 acres, was leased by Bishop Estate to Kona Village partnership (Kelly 1985:93).

Because the project required a large amount of capital, Jackson brought in Signal Oil Company as a partner and as a result, in 1968, the lease on the bulk of Ka'upulehu Ahupua'a was transferred from Hualalai Development Corp. to Signal Oil Corp. The resort's name was changed to Kona Village Resort, and Signal Oil eventually bought Jackson out. Since the purchase by Signal Oil, ownership of the resort has changed several times. It was transferred to Cambridge Pacific (Canada) in 1979. In 1984 Barnwell Hawaiian Properties joined in a partnership with Cambridge Pacific, Inc., and the lease was assigned to Ka'upulehu Developments, a subsidiary of the partnership Barnwell Hawaiian Properties and Cambridge Pacific (Kelly 1985:94). Despite the many turnovers, the Kona Village Resort continues to be a first-class luxury resort in a secluded tropical setting, providing a variety of amenities and recreational activities. The resort has also preserved and incorporated the rich historical background of Ka'upulehu in its contemporary activities (ibid.).

Today, besides the hotels, there are summer homes along this coast as well as huts of squatters, who are primarily fishermen. Large areas of the land in the North Kona District are still devoted to ranching (Ching 1971:38).

Informant Interviews

On August 21, 1990, the author spoke with Mr. Joe Makaai (Uncle Joe), a resident of Ka'upulehu in his youth. Uncle Joe explained that the name Ka'upulehu was not short for Ka'ulupulehu as some people thought. Instead, Ka'ulupulehu was up *mauka*, and the name stood for the man who was "pulehued" (cooked). The following paraphrased story, by Uncle Joe, is similar to the one above by Maguire:

> In the *wa kahiko* (ancient days), Ka'upulehu was a desolate place. There was no food for anyone there, no fish, no water; it was a time of famine. One day a man appeared. He told the people to prepare an *imu*. The people thought this was very strange, because they had nothing to put into it, but they did as he requested. While they prepared the *imu* the man slept, and when he awoke the *imu* was ready. He stood by the side of the *imu* and said to them, "Eia ka'u makana ia'oukou" (this is my gift to you) then he jumped into the *imu* and laid down. He told them to cover him up, and though they were terrified, they did as he asked. After they were done, they all left the area because they were afraid of what had happened. Some hours later though, the man appeared out of nowhere and told them that the *imu* was ready. They uncovered the *imu* and found to their surprise that it was full of food. There was *'ulu*, sweet

potato, fish, pig, and other foods such as they had never seen before. They realized that this man was a *kupua* (a person who could change forms). They were very happy but still they felt this was not enough food to feed all of them. The man set to work dividing the food among the different families. He told them "Don't worry there is enough for all of you many times over." Though they were happy at the food they still were unhappy because they had no water. When the man heard this he told them "go *makai*." They did as he said and at the beach there was a bubbling in the sea, and a well of fresh water came from the ocean. The people took their calabash and got the fresh water and drank it. They were so happy for all this man had done for them. This man was Kane, a god, and from that time on the spring where they had gotten their water from was called Waiokane (waters of Kane), and they never had famine again.

Uncle Joe told a another story similar to Maguire's tale of the two girls roasting breadfruit. The story below is paraphrased from Uncle Joe:

One day Pele, dressed as a poor old lady, went up to two sisters who were cooking *'ulu*. She asked one sister, "When your *'ulu* is cooked, with whom do you intend to share it?" This sister was stingy and told her, "This is my *'ulu* and I'm not going to share it with anyone. If you want *'ulu*, pick your own. There are plenty over there—and cook it yourself." Pele then went to the other sister and asked her the same question. This sister looked at the lady and her *'ulu* and said, "This *'ulu* is too big for me, I will share it with you when it is done." She had just put it on the fire, but Pele told her, "It is cooked already, take it off the fire." The girl said, "No it can't be, I just put it on." But Pele reassured her, and the girl listened to her and took it off. When she cut the *`ulu* open, she was amazed to find that it was cooked, and she halved it and gave half to Pele. She began to wonder if this lady was a *kupua*, since she knew about the *`ulu*. After they were done eating she invited the lady to her home and they rested. When they awoke Pele told the girl, "Go and mark the four corners of your property as soon as I leave." The girl thought this was strange but she sensed the lady was a *kupua*, or spirit, and so she did as she was told. Her sister saw her and laughed at her, saying she was ridiculous to be doing such a thing. But the girl affirmed that she was going to do it and advised her sister to stay on her own side and not enter the marked-off property. That evening a lava flow came down Ka`ulupulehu, covering everything, including the stingy sister, who tried to get away. She was turned into a rock. The generous girl's home, which she had marked as she was told, was spared, and the girl knew that the lady had been Pele.

Uncle Joe said that Puhi-a-Pele is the area where that flow came down, and if you look at it carefully, you will see that it is the body of Pele sleeping with her head to the north. He also said that the area that had not been inundated with lava contained breadfruit and *kukui* trees and one coconut tree that can be found there to this day.

Uncle Joe spoke fondly of his childhood in Ka'upulehu. Donkeys were the only means of transportation from Kiholo to Mahai'ula. He rode his donkey to elementary school in Kalaoa. People also rode donkeys to Kalaoa to trade fish for goods in the Ahuna and Akuna stores. These stores were owned by Chinese families and no longer exist.

He said that all the people who lived on the coast were fishermen and that his grandfather was a great *'opelu* fisherman. His father also fished until he got married, at which time he became a cowboy at Pu'uwa'awa'a Ranch, up *mauka*. Uncle Joe spoke of Waiakuhi Pond, which is where people used to get *'opae* (shrimp) for fishing, and of the many brackish ponds along the coast, which were used for clothes-washing and other domestic chores.

When Uncle Joe was a child, he and the other children made up their own fun. They created a small *holua* (slide), which they covered with grass and slid down on coconut leaves. They also used to explore the many large caves along the coast where he said they found large canoes and *koa* logs. When he asked his grandfather about these things he was told that when people died, families put the objects in the burial caves along with the bodies. These caves have been closed up since the opening of the Kona Village Hotel.

Uncle Joe also mentioned that since there was no grass along the coast they used to feed their donkeys *kiawe* beans, which they picked up from the ground. He said the donkeys loved to eat them (pers. comm. August 21, 1990).

Jean Greenwell, President of the Kona Historical Society, supplied several items of information relevant to the Ka'upulehu area. She mentioned that it was land commissioned to Lot Kamehameha, and consisted of 23,545 acres. She also mentioned that the old name for the area was Manuahi. From the journal of H.M. Greenwell (who was a farmer and rancher in Kona during the late 1800s and early 1900s), she found that sheep were raised in the uplands of Ka'upulehu in 1880 and that a man named George Clark had 200 sheep here. Greenwell's journal also shows that in August of 1884 Clark had leased land from Greenwell for $350 per year, in addition to which he agreed to pay $100 (per year) for raising stock.

Hannah Springer has been a resident on the land *mauka*, at Huehue Ranch, for many years and is familiar with the area. Hannah provided another interpretation of the name Ka'upulehu. She said that she was told that the name stood for the *imu* that puffed (*pu*) with the ashes (*lehu*), because, as in the tale that Uncle Joe told, when the *imu* was opened, the body of Kane was not in it, and the ashes puffed out with the absence of the body. No other source consulted during this research mentioned this explanation of the name. Springer also explained (correctly) that the commonly held belief that Ka'upulehu means the *imu pulehu* involves a contradiction in terms. This is because the type of cooking done in an *imu* is called *kalua* (to bake) and *pulehu* means to cook on hot coals or broil.

Springer also mentioned the story of the two girls eating breadfruit, but like Uncle Joe, she thinks that this incident took place up *mauka* and not on the coast, and so that area is Ka'ulupulehu and *makai* is Ka'upulehu, two different areas. She mentioned the name Manuahi and said that it is a name for a place in Ka'upulehu and not the old name for the whole area.

She stated that her mother and another man of that area, Robert Keakealani, both knew of the area that Uncle Joe mentioned in the Kaulupulehu story, noting that it was an area with one coconut tree. It seemed significant to her and the people who knew of it, and she stated that one day she would find that area.

Springer mentioned Kame'eiamoku at Ka'upulehu and his capture of the *Fair American*, c. 1790. She said that he was one of three brothers who were advisors to the King and that he and his twin are the figures depicted on the seal of the government of Hawaii.

She made reference to Kahuwai Bay, the site of Kona Village, where springs bubble. The people there used to fish for *'opelu*, weave *hala* and *loulu*, and traded with the people at Kalaoa.

Hu'ehu'e Ranch was founded by John Avery McGuire. His first wife was a woman named Luka who had 600 acres at Kukio and 200 acres at Kaulana. McGuire made his living trapping wild *pipi* (cows), and over time he acquired more land. His second wife, Eliza Davis Low, translated the book *Kona Legends*, cited earlier in this report.

CHRONOLOGICAL FRAMEWORK

The establishment of a chronological framework is a primary goal for inventory survey projects, as such a framework provides a context in which to view general settlement patterns. The chronological framework presented below is based on dating results derived from Rosendahl (1973), Sullivan and Goodfellow (1991), Head and Goodfellow (1992), and Goodfellow, Jensen, and Bower (1992) (Table 2). Correlation of these results with important cultural developments follows the chronologies for South Kohala-North Kona area presented in Donham (1987:142-145) and Jensen (1989, 1990). These chronologies include data collected by Cordy (1981, 1985, 1986), Hommon (1976), and Kirch (1980, 1985).

Initial occupation of West Hawaii appears to have occurred between AD 600-800, with occupation being restricted to the southern end of South Kohala around Anaehoomalu Bay. Jensen characterized the early occupation of this area as follows:

> For the earlier time periods, it is possible to envision sporadic exploitation of the coastal and upland resources of West Hawaii by small groups who resided elsewhere during most of the year, probably along the windward coast (Jensen 1978).

Shortly after this period of initial occupation, beginning perhaps as early as AD 900 in some areas, population increases in the more favorable windward zones led to more frequent exploitation of agriculturally marginal lands in West Hawaii (Barrera 1971, Kirch 1985). Areas in the northern end of North Kona and the southern end of South Kohala appear to have been utilized first, followed by more general exploitation of West Hawaii lands by AD 1000. Increased use of these areas was generally marked by the establishment of small, relatively isolated pockets of semi-permanent to permanent occupations at certain favorable coastal locations. Evidence for the spread of this pattern into Ka'upulehu derives from Kahuwai Bay, where a cave shelter (Site 10959, Feature A) yielded a calendric range of AD 1040-1425. The population throughout this period of expansion (AD 900-1200) into West Hawaii appears to have been relatively low (Kirch 1985).

According to Kirch, the population remained fairly stable until AD 1200, at which time there was a pronounced increase (Kirch 1985:288). Data from the Kekaha region suggests, however, that dispersion of the population would have been restricted by the barren conditions and the lack of fresh water, which characterizes much of the region, and that population growth would have been limited to coastal areas such as Anaehoomalu, Kiholo, Kaupulehu and Kukio (Jensen 1989). Age determination data from Kaupulehu indicate, however, that sites dating between AD 1200-1400 are fairly rare and provide little support for a population increase prior to AD 1400. Similarly, although initial occupation appears to have occurred primarily on the coast, sites established after AD 1200 occur in the barren and upland zones as well, suggesting that settlement of Kaupulehu was not substantially restricted by the barren conditions in the upland and barren zones. Coastal resources continued to be exploited sporadically by non-resident populations, while habitation sites appear to have been selected based on proximity to available water and established coastal residential areas.

Table 2.
Summary of Dating Results for Kaupulehu Ahupua'a

Site/Feat.	Formal Type	Function	Dating Results (AD)
Coastal Zone			
10954 A	Midden deposit	Habitation	1390-1665 (C14)
			1665-1940 (C14)
			1673-1764 (VG)
10955 C	Cave shelter	Habitation	1654-1702 (VG)
10956 A	Cave shelter	Habitation	1582-1749 (VG)
10956 B	Cave shelter	Habitation	1644-1712 (VG)
10958 A	Modified outcrop	Habitation	1780-1820 (VG)
10959 A	Cave shelter	Habitation	1040-1425 (C14)
			1523-1785 (VG)
10959 C	Terrace	Habitation/ceremonial	1380-1650 (C14)
			1417-1477 (VG)
			1650-1955 (C14)
10959 D	Pavement	Habitation/ceremonial	1410-1640 (C14)
Barren Zone			
1160	Cave	Habitation	1645-1763 (VG)
10968 A	Cave shelter	Habitation	1533-1769 (VG)
10969 A	Enclosure	Habitation/ceremonial	1620-1890 (C14)
			1722-1750 (VG)
10974 A	Cave shelter	Habitation	1688-1772 (VG)
10976	Cave shelter	Habitation	1620-1890 (C14)
10978	Cave shelter	Habitation	1659-1755 (VG)
10979	Cave shelter	Habitation	1653-1736 (VG)
10985 A	Cave shelter	Habitation	1410-1635 (C14)
			1671-1699 (VG)
10986 A	Terrace	Habitation/ceremonial	1630-1718 (VG)
10986 K	Cave	Ceremonial	1440-1650 (C14)
10986 G	Platform	Habitation/ceremonial	1743-1787 (VG)
10987 A	Terrace	Habitation/ceremonial	1707-1919 (C14)
			1680-1728 (VG)
10987 C	Slab paved area	Habitation/ceremonial	1282-1390 (VG)
10989 A	Cave shelter	Temporary habitation	1790-1940 (C14)
			1555-1741 (VG)
10990 A	Cave shelter	Habitation	1508-1588 (VG)
10993 A	Cave shelter	Habitation	1387-1567 (VG)
10993 B	Cave shelter	Habitation	1569-1605 (VG)
10995 B	Cave shelter	Habitation	1595-1714 (VG)
10995 C	Terrace	Habitation	1687-1727 (VG)
Upland Zone			
14579 A	Lava tube cave	Temporary habitation	1429-1667 (C14)
			1790-1955 (C14)
14579 B	Enclosure	Temporary habitation	1423-1635 (C14)
			modern
14768 E	Hearth	Temporary habitation	1638-1955 (C14)
14802	Hearth	Temporary habitation	1433-1639 (C14)
			1792-1950 (C14)
14821 B	Hearth	Temporary habitation	1446-1701 (C14)
14824	Lava tube cave	Temporary habitation	1664-1891 (C14)
17931	Lava tube	Temporary habitation	1482-1681 (C14)
			1634-1949 (C14)
17932 B	Lava tube	Temporary habitation	1390-1680 (C14)
17932 D	Lava tube	Temporary habitation	1213-1423 (C14)
17934	Lava tube	Temporary habitation	1651-1955 (C14)
17938 A2	Lava tube	Temporary habitation	1458-1660 (C14)
			1795-1946 (C14)
17940 B	Lava tube	Temporary habitation	1798-1944 (C14)

Cordy's work suggests that as the population increased in certain parts of North Kona, substantial uninhabited zones remained between established residential areas (Cordy 1981:173). These zones may have served as a means of delimiting specific resource catchment zones along the coast, as well as to provide room for further growth. As noted above, spread of settlement into less favorable portions of Kaupulehu appears to have started between AD 1200-1400 (Table 2), and was accompanied by increased use of temporary features throughout the region. Kirch argues that these expansions were representative of large-scale population growth occurring throughout West Hawaii and posits that the population nearly doubled each century between AD 1200 and 1600 (Kirch 1985:288). It was during this expansion period that the *ahupua'a* territorial system is thought to have combined with pre-existing social stratification systems to form the Hawaiian socio-political structure documented from the historic period (Kirch 1985, Donham 1987:142).

Initial occupation of upland areas also appears to have begun during Kirch's Expansion Period, starting around AD 1400 at Lapakahi (Rosendahl 1972:495) and varying between AD 1300-1500 in the *ahupua'a* between North Kohala and South Kona. Initial movement into the uplands most likely involved small populations living in temporary shelters associated with marginal agriculture and use of upland trail systems. Larger scale expansion and settlement of the upland regions was predicated on developments in agricultural technology, however, and would have occurred somewhat later. In his study of prehistoric sites in O'oma and Kalaoa Ahupua'a, Cordy (1985:38) proposed that upland populations were small until AD 1500-1600 and that intensive agriculture was not developed in the area until AD 1500. As part of his argument, Cordy reviewed dates from 24 sites in Kalaoa and O'oma and listed the earliest date recovered from each *ahupua'a*. The earliest dates for Kalaoa 5 at that time were AD 1400 (for a temporary habitation feature) and AD 1510 (for a permanent habitation feature). The earliest known date for Kalaoa 4 was AD 1610 for a temporary habitation feature, and AD 1680 for a permanent habitation feature. All of these dates were obtained from coastal sites.

While research since 1985 has provided additional early dates for Hamanamana, Kalaoa, O'oma and Kohana-iki, Cordy's chronology for gradual settlement and agricultural intensification is generally consistent with the data for Kaupulehu presented in Table 2. Of the six sites dated prior to AD 1400, the majority are temporary to semi-permanent habitations located on the coast or at the interface of the coast with the barren zone, suggesting that population growth was initially restricted to the lower elevations where fresh water and coastal resources were more readily available. Spread of settlement to the barren and upland zones started between AD 1200-1400, becoming gradually more frequent after AD 1400. While the majority of sites in the barren and upland zones have been interpreted as agricultural sites (Walker and Rosendahl 1990, Goodfellow and Head 1992), supporting the argument that upland settlement was agriculturally motivated, all of the dated sites in these zones are habitations. Based on the presence of agricultural sites in Kealakehe that date to c. AD 1511-1638 (Walker and Rosendahl 1988b), however, it seems likely that intensification of agriculture in Kaupulehu and the rest of North Kona may have occurred by AD 1550-1650.

Rosendahl argues that expansion of occupation into upland areas and the concurrent intensification of agriculture in West Hawaii was followed by specialization of production in coastal and upland areas, culminating in significantly altered economic and social patterns sometime around AD 1500 (Rosendahl 1972:499). Hommon, following Rosendahl, argues that increased specialization in coastal and upland production led to the establishment of a variety of reciprocal ties between the two areas, and to exchange of specialized commodities (Hommon 1976:258). Concurrent settlement of upland and coastal areas is not documented for the historic period, however, and may have ended shortly after the Expansion Period.

The dating results from Kaupulehu generally support this pattern, although the association of the proposed population increase with specialization and coastal-inland trade has yet to be established. Occupation of Kaupulehu between AD 1500-1700 appears to have been characterized by high population and an increased range of activities. Of the 39 sites and features listed in Table 2, 12 yielded dates between AD 1500-1750, while over 26 yielded date ranges between AD 1650-1955. That population growth was accompanied by increased activities is evidenced by the appearance of sites with ceremonial functions, a greater number of permanent habitations, and an increased range of formal feature types associated with habitation and agriculture.

According to Kirch, population growth levelled off by AD 1600, and was followed by a regional population decline after c. AD 1700 (Kirch 1985). Data from Awakee (Donham 1987a) support this model, documenting that population began to decline between AD 1700-1800. Jensen notes a decrease in utilization of non-permanent features at Anaehoomalu after AD 1700, and argues that the hypothesized changes in settlement patterns, induced by the evolution of upland agriculture and initiation of trade, could easily account for a population decline such as that modelled by Kirch (Jensen 1989: 112). Additional explanations for the purported population decline have been advanced by Kirch and others, including the appearance of major economic and political centers such as Kawaihae, Waimea and Kailua, and the development of major prehistoric transportation routes which linked population centers with one another, both of which may have contributed to reduce dependence on the coastal areas between Kailua and Kawaihae (Jensen 1989: 112). By the mid-1800s, permanent coastal sites were generally abandoned.

In his recent archaeological investigations near Pauoa Bay, Welch (1989) re-evaluated existing cultural chronologies for Anaehoomalu and Kalahuipuaa, based primarily on a re-evaluation of volcanic glass dating results obtained from various sources. The accepted chronologies, particularly those advocated by Kirch (1985) and Hommon (1976), were generated in large part on the basis of volcanic glass dates which were in turn based on an age formula developed in the 1970s by Morgenstein. Welch's research involved recalculating the volcanic glass age estimates using the range of alteration formulas available in the literature: (a) Michel's exponential formula, based on induced hydration experiments involving Puuwaawaa glass, (b) the Mohlab formula which assumes that patina develops at 51.10 microns-squared/ 1,000 years under certain conditions of temperature and humidity (Kona airport mean values are used for these variables), and (c) Morgenstein's linear formula. The results obtained with all three formulas were then compared.

The results of Welch's comparison appear to document that significantly different dates can be achieved for individual samples of volcanic glass, depending on the formula selected for calculation (Welch 1989:97):

> Relative to the linear formula, the exponential formula reduces the age of recent specimens and increases the age of earlier specimens. As a result, longer spans of occupation are indicated than previously reported on the basis of Morgenstein's dates. Hawaiian occupation of these areas... [may thus date] both earlier and later than previously estimated.

Based on this observation, Welch suggested that use of the Morgenstein formula may have artificially created the population "decline" which was first suggested by Hommon (1976) and later supported by data from Anaehoomalu (Barrera 1971) and Kalahuipuaa (Kirch 1979). Several shortcomings in these arguments were previously noted by Clark (1987), not the least of which was the fact that the dating results obtained using Morgenstein's formula for volcanic

glass hydration rates could not be easily reconciled with the available radiocarbon dates. Use of the more recent formulas used by Mohlab and Michels significantly increases the number of post-1750 dates on datable samples, and leads one inevitably to Welch's conclusion that for much of West Hawaii:

> "..abandonment of many of the sites does not seem to have occurred until at least 1800, while Anaehoomalu [and some other areas] appears to have been occupied until 1900..." (Welch 1989:97).

Use of these same formulas may push estimates of initial occupation back in time as well, thus extending the occupational sequence for the entire region. While there are currently no artifact seriations which can be used to substantiate this model for the earlier end of the sequence, extension of the sequence into the 19th and 20th centuries should be supported by the recovery of historic-era artifact types and/or artifacts manufactured from historically introduced materials.

Evidence from Kaupulehu supports Welch's contention. Over 26 of the sites in the project area yielded date ranges between AD 1650-1955 (Table 2), seven of which were clearly post-contact. Perhaps more compelling, however, is the evidence provided by the historic documentary research for this report. Journals written by early western explorers such as Menzies and Metcalf indicate that there was frequent contact between ships and the native people in the Kaupulehu area. There is evidence that the early historic inhabitants of Kaupelehu manufactured salt, harvested seaweed, and practiced some agriculture, in addition to their exploitation of marine resources.

By the end of the 1800s, land use in North Kona-South Kohala had undergone significant alterations from the dryland cultivation and fishing practiced during prehistoric and proto-historic times. Maly summarizes the gradual replacement of Hawaiian lifestyle in this area as the result of two major factors: the 1801 eruption of Hualalai and changing land use patterns over the last 150 years. The lava flows from Hualalai reclaimed much of the land used for settlement, agriculture and fishponds, reducing the land to a shadow of its former condition. Introduction of foreign plants and animals brought about additional changes, as once-barren lava fields became overgrown with *kiawe* and other weedy shrubs, and goat and cattle raising became a mainstay of local industry. The 1850s saw the development of large-scale commercial ranching and agriculture as a result of the shift to private land-ownership brought about by the Mahele and an 1850 law permitting foreigners to own land. Coffee, grazing land, tobacco and sugar cane gradually replaced traditional subsistence crops such as taro and *uala*, stripped the land of forests, and caused disruptions in the water catchment systems. As the water resources dried up and Western land use practices replaced traditional methods, Hawaiian communities gradually disappeared (Maly, this report). After 1890, coffee became the leading agricultural crop in western Hawaii, while eastern Hawaii shifted to large-scale sugar cane and macadamia nut production (Schilt 1984: 24-25).

The tsunami of 1949 swept the coastal portion of the *ahupua'a*, and the few native families that had been living there never moved back. In 1956, while sailing off Kaupulehu, an investor named Johnno Jackson and his wife were impressed enough with the area to believe that it could be developed into a small, secluded, luxury resort. The original Kona Village Resort complex was completed in June 1964, and the concept proved successful. The rest of the *ahupua'a* remains largely undeveloped.

SETTLEMENT PATTERN MODELS

A second goal of the current projects was the refinement of a settlement pattern for Kaupulehu Ahupua'a. In order to accomplish this task, however, it was first necessary to review and evaluate previous settlement pattern models for West Hawaii and synthesize the pertinent concepts with the observations of site patterning observed in previous studies of Kaupulehu. Once these tasks have been completed, the implications of this synthesis for predicting site distribution patterns in the current project area will be discussed.

Review of Previous Models

Apart from the general chronological models for Hawaiian settlement proposed by Kirch (1979) and Hommon (1976), settlement pattern models for West Hawaii are primarily based on the interrelationship of environment and cultural adaptation. Land use and site distribution patterns are viewed as direct outgrowths of environmental conditions within the region, such that rich environments would support larger, permanent populations and poor environments would support smaller, more transitory populations. These models generally separate West Hawaii into environmental zones and make predictions concerning the type of land use and site distribution patterns that would develop in response to the terrain and resources present within each zone. Five such models are outlined below.

Rosendahl (1973:60-61, 65-66) proposed general patterns of aboriginal settlement for the North Kona area, based on ethnohistoric and ethnographic sources. From these sources, Rosendahl divided the area of occupation into three principal environmental zones: a narrow and arid coastal zone associated with the exploitation of marine resources; a sloping, rocky, barren, midland zone; and an upland habitation- agricultural zone. He notes that the forest zone, further inland, was used, but rarely inhabited. Rosendahl summarized these occupational zones as follows:

> **Coastal Occupation** - Housing appeared as small clusters or fishing hamlets, along the shore and frequently found near fishponds and small bays. The inhabitants were principally engaged in marine exploitation (including in-shore and deep-water fishing, gathering shellfish, production of salt and aqua-culture). Very limited agriculture including coconut, sweet potatoes, and possibly bananas raised in small beach areas and tiny pockets of sand and gravel in barren flows. These may have provided supplies for travellers going by canoe between Kailua and Kawaihae.
>
> **Barren Zone Occupation** - Temporary shelter and the mauka-makai foot trails evidence the movement of people and goods between the coast and uplands. Both terrestrial and marine resources midden remains from habitation evidence access to both upland and coastal zones. Artifacts and structural remains are indicative of recurrent use of temporary occupation features.
>
> **Upland Occupation** - This appears to be a major occupation area, with scattered, small residential hamlets (probably above 2,000 ft and 25 inches-per-year rainfall). Extensive agriculture exploitation is indicated and composed of dryland swidden cultivation. The principal crops were dryland taro and sweet potato, with other crops including breadfruit, bananas, paper mulberry, ti, and sugar cane.

Although Rosendahl's model lacks clear geographic definition of the environmental zones, and doesn't describe potential changes in the land use patterns associated with each zone through time, it does provide information concerning expected site distribution and land use patterns within each zone. Further, the overall generality of the model removes it from the restricted context of Rosendahl's original study area, and improves its utility for examining areas to the south.

Davis' work in the Keahole Agricultural Park also resulted in the identification of three terrestrial or environmental zones applicable to the current study area (Davis 1977:19-21). A summary of these zones is as follows:

> **Coastal Zone** - Consists of barren, rocky shorelines, isolated bays with coralline beach formations, inland ponds, brackish basal water, fresh water springs, and strand vegetation occurring in limited soil deposits. It originates at the coastline and extends to approximately 300 meters inland, or from the 0-9 meter contour (0-30 feet).
>
> **Transitional or Barren Zone** - Consists of bare, non-disintegrated lavas, arid conditions, limited dry scrub vegetation (fountain grass, lantana and *noni*), which increases east the of highway. Little or no soil development is in evidence. This zone originates at the 9-12 meter contour (30-39 feet), or 300-600 meters inland from coast (984-1969 feet), and extends to the 130 meter contour (425 feet).
>
> **The Upland Forest Zone** - Consists of moderate soil development and adequate rainfall. This zone begins with the appearance of *koa-haole* and Christmas-berry, and continues to a mixed, broadleaf forest vegetation. It originates at 130 meter contour (425 feet), continuing east.

Although Davis included little information concerning the types of sites expected in the lower two zones, he made the following observations about site types in the upland forest zone:

> Here also begins the lower margin of the upland agricultural systems with extensive prehistoric site remains including house enclosures, stone platforms, high stacked ahu (cairns), stone walls and the numerous stone mounds suggesting that the local crop was largely sweet potato (Davis 1977:21).

The primary utility of Davis' model is the combination of clear geographical criteria with vegetation data to define the three environmental zones. With the exception of the comments on upland site patterns, however, Davis fails to take the next step and describe the site distribution and land use patterns expected within each zone. Chronological associations are also neglected, making Davis' model little more than a study in ecological zonation in North Kona rather than a model of adaptation to the environment through time.

Cordy summarized archaeological findings in the Lands of 'O'oma and Kalaoa (1985). Like Rosendahl (1973) and Davis (1977) he divided the study area into three environmental zones and examined site locations and types within each land unit. The zones are described in the following.

The Coastal Zone extends from the shoreline to 164 ft (50 meters), with a maximum elevation of 20 ft (six meters). It is composed of low pahoehoe with some sand beaches. Features here include trails, caves, enclosures, platforms, pools, cairns, C-shapes, and pavings.

Cordy suggests that there are at least 22 permanent house sites located right along the shore. The permanent structures at the sites included platforms, enclosures, and pavings with relatively shallow fill.

Also located in the Coastal Zone, according to Cordy, are sites interpreted as temporary dwelling areas, with feature types such as caves and C-shaped shelters. These are located just inland of the Coastal Zone, at the interface with the Barren Zone, or along the shore in areas not used as permanent housing. Two very large structures interpreted as *heiau* were found in ʻOʻoma 1, in the Coastal Zone.

The Barren Zone is a band from the 20 ft contour (six meters) to c. 0.8-1.4 kilometers inland, with sites that appeared to consist mostly of a few *mauka-makai* trails, the early historic Mamalahoa Trail (which parallels the shore), a few C-shaped structures and caves near the trails, and cairns that may have been associated with the trails. With some exceptions, habitation sites contained only shallow deposits and appeared to be temporary, with shallow deposits.

At the 200-400 ft level (61-122 meters) of Kalaoa 5 and ʻOʻoma 1, site density increased, according to Cordy, and he reported large numbers of cave shelters in tubes branching off of sinks and on the floors of the sinks. These were marked by extensive features that Cordy felt may have been indicative of recurrent, short-term usage. A number of surface cairns in the vicinity might have marked trail locations and associated caves. A single historic, walled, permanent structure (with associated features) was found near the upper end of the Barren Zone (ibid.:32).

The Upland Zone consisted of rough aa and soil terrain, and extended from the 426-ft elevation to 3,379 ft (130-1,030 meters), and up to six kilometers from shore. Only three archaeological investigations had been conducted at the time of Cordy's work in this zone, but indications of upland agricultural features, platforms, mounds, and walls were noted. Cordy reported virtually continuous sites beginning at the c. 450 ft elevation extending up to at least the 800 ft contour (and perhaps beyond). There were indications that this was the lower margin of an upland agricultural system. Present were house enclosures, stone platforms, high-stacked *ahu*, and stone walls. there were also numerous stone mounds, suggesting that the local crop was largely sweet potato (Davis IN Cordy 1985).

By including both well-defined geographical data for each zone and clear descriptions of the formal and functional site types encountered to date in each area, Cordy's model has considerably greater utility for predicting site distribution in unsurveyed areas than those proposed by either Davis or Rosendahl. The model has the further advantage of tying site distribution patterns to the regional chronology, if only in general terms, and lays the groundwork for future research in North Kona.

Hammatt followed the same basic zonation proposed by Cordy, but did not discuss the definition of his zones in any detail (Hammatt 1987:69-71). His model, which was formulated for an intermediate elevation parcel in Kealakehe, was intended to provide a picture of upland settlement to contrast with the more frequently studied coast. Hammatt argued that the lack of trails connecting the uplands with coastal settlements suggested less formalized integration of the uplands with the coast. This was in contrast to the models posited by Rosendahl (1973) and Hommon (1976). That some level of interaction between the uplands and coast existed was indicated by the presence of marine midden in upland sites, but the lack of artifacts associated with marine exploitation and the small quantity of marine midden suggest a fairly irregular or tentative network. Based on his survey data, Hammatt observed that upland Kealakehe was

characterized by scattered house lots associated with cultivation of sweet potato and taro in small garden plots. Cultivation was extended into arable microenvironments at lower elevations, conforming to the "belt of residence" about half a mile wide at the lower edge of the forest boundary where taro and breadfruit could be easily cultivated. This main *mauka* agricultural vegetation zone is closely related to the 50" isohyet rainfall line which veers inland north of Kailua town (Hammatt 1987:70). This inland shift of the upland-intermediate zone boundary would have resulted in greater expenditures of time and labor on the part of coastal residents commuting to upland agricultural areas, as compared to their neighbors to the south. Hammatt argues that the twelve kilometer round trip from the coast to his study area would have promoted greater specialization toward either fishing or farming rather than the practice of both occupations, which was certainly common in the lands to the south. This occupational specialization is supported by the artifact assemblage which includes only four artifacts, small amounts of marine material, and no artifacts with a clear marine related purpose.

Hammatt's model differs from the models presented above in several ways. First, it is clearly restricted to the upland zone, and consequently provides little information concerning site distribution patterns in the region as a whole. Second, the model places a greater emphasis on coastal-upland interaction, perhaps due to the apparent negative evidence for the type of interaction posited for the population centers in North Kona-South Kohala. It should be noted, however, that Hammatt's study area was located in the intermediate zone, not the uplands, and lacked habitation structures. His arguments on the nature of the artifact and ecofact assemblages within the uplands are thus somewhat suspect, and should be reevaluated in the context of actual upland sites. Finally, Hammatt's model is limited by the absence of a chronological framework to refine site distribution data through time.

Barrera, like Hammatt, adopted the three environment zones described by Cordy (1985). The project area upon which his model is based corresponds to that of his 1985 Keahole Point study (1985a) in coastal and intermediate Kalaoa. Based on data from survey and excavations within the parcel, Barrera posited the following model of settlement and land use within North Kona:

> Certain especially favorable locations (small protected bays such as Kaloko, North Kona, Anaehoomalu, South Kohala, for example) were being exploited by the tenth and eleventh centuries. A permanent inland agriculturally-oriented population developed by the 15th century, preceding most of the permanent coastal habitation. This is supported by recent excavation data in sites four miles from the ocean in the ahupuaa of Kohanaiki. Here several permanent habitation structures and a large, well-built Men's House situated in the midst of agricultural fields were being utilized by the late 15th century. There was indirect access to ocean products through trade, and possibly temporary or intermittent direct access (Barrera 1987). Lateral expansion from the early exploitation centers along the relatively less productive coastlines did not occur until the 16th century. This is followed in the late 17th and early 18th centuries by a period during which temporary coastal habitation evolves into more permanent occupation with full time exploitation of marine and agricultural resources. The end of the sequence is marked by an abandonment of the agricultural fields in the early 18th century, with a concentration on marine resources and a tendency towards nucleation of coastal settlements that was interrupted by historic contact (Barrera 1987:231).

Despite the clear focus of subsistence activities on exploitation of locally available marine and avian resources, and the later addition of animal husbandry, Barrera notes that some form of coastal-upland interaction was also present during the occupation sequence.

> It is difficult to ascertain the degree of interaction with the uplands, either directly or through trade or gift exchange with residents of that area, but clear evidence that this took place is present in the form of kukui shells in many of the coastal sites. The main problem in this regard is the differential preservation of the various remains in the archaeological record. We have lots of mollusc shells and a fair amount of fish, mammal and bird bone but virtually no highly perishable vegetal remains (Barrera 1987:226).

Habitation sites in the project area ranged from temporary to permanent, depending on the occupation period, and included a category of "crude" shelters which Barrera interpreted as hunting blinds and/or storage areas. He notes that coastal populations were generally small in all phases, not because of the arid conditions in this area, but because of the limits of the marine environment.

It should be noted that the widely held view that the availability of water was a prime element limiting population size along the coast does not stand up to scrutiny. The limiting factor was in fact the relatively poor capacity of the marine environment to provide subsistence (Barrera 1987:231).

Barrera's model, like Cordy's, combines site distribution and land use patterns with elements of a regional chronology. His model provides specific data on patterns within his study area, and notes the probability of interaction between the coast and uplands without making it the entire focus of his model, in the manner of Hammatt's discussion. Once the study area findings are extrapolated to the larger region, however, Barrera emphasizes broad patterns at the expense of more utilitarian information on site distribution and land use patterns within the various ecozones. The end result is a general framework rather than a predictive model.

Synthesis of Models with Site Distribution Data

The preceding models, though varying in detail, have several common elements. First, there is general agreement on separation of the region into three basic environmental zones: the coastal zone, the barren or intermediate zone, and the upland zone. Second, all five models associate the coastal zone with marine exploitation and the upland zone with dryland cultivation. Depending on their locations, sites within the barren zone are interpreted as extensions of either coastal or upland settlement, or related to travel between the coastal and upland zones (e.g, trails, shelters, etc.). Third and finally, all of the models posit some level of interaction between the coast and uplands, although there is little agreement concerning the nature and intensity of this interaction. Of the three models that actually define geographic boundaries for the environmental zones, Davis' stands out as offering the greatest detail, especially in terms of biotic distinctions between zones. Rosendahl provides more analysis of the types of subsistence activities associated with each zone, while Cordy provides information concerning site functions beyond subsistence. Only two of the models, those proposed by Cordy and Barrera, present their hypotheses in the context of a regional chronology. As was stated above, however, Barrera's model becomes too generalized at this point and offers little more than a restatement of the chronological framework outlined in the beginning of this section. Cordy's model, in contrast, provides sufficient detail to differentiate site distribution patterns through time.

Synthesizing the best elements of the five models with the data on site patterning derived from previous archaeological and historic documentary research, the following settlement pattern model is posited for Kaupulehu *ahupua'a*:

> **Coastal Zone**: Consists of barren, rocky shorelines, isolated bays with coralline beach formations, inland ponds, brackish basal water, fresh water springs, and strand vegetation occurring in limited soil deposits. It originates at the coastline and extends to approximately 300 meters inland, or from the 0-9 meter contour (0-30 feet). Formal feature types include caves, cairns, c-shapes, enclosures, footpaths and trails, midden scatters, overhangs, pahoehoe excavations, *papamu*, petroglyphs, platforms, pools, salt pans, terraces, walled shelters, and wall fragments. Functional types consist primarily of habitations (both temporary and permanent), quarry, transportation, burial or shrine, art/communication and marker.
>
> The majority of sites are prehistoric, with habitation sites providing evidence of greater permanence and increasing nucleation through time. Permanent habitation sites are located along the shore and are frequently found near small bays; while temporary habitations (caves and C-shaped shelters) are located just inland of the Coastal Zone, at the interface with the Barren Zone, or along the shore in areas not used for permanent habitation. Ceremonial structures are rare, but appear to be positively correlated with permanent habitations.
>
> The inhabitants were principally engaged in marine exploitation (including in-shore and deep-water fishing, gathering shellfish, production of salt and aquaculture). Agriculture was limited to cultivation of coconut, sweet potatoes, and possibly bananas in small beach areas or in tiny pockets of sand and gravel in barren flows; and may have provided supplies for travellers going by canoe between Kailua and Kawaihae.
>
> **Barren Zone** - Consists of bare, non-disintegrated lavas, arid conditions, limited dry scrub vegetation (fountain grass, lantana and *noni*), which increases east of the highway. Little or no soil development is in evidence. This zone originates at the 9-12 meter contour (30-39 feet), or 300-600 meters inland from the coast (984-1,969 feet), and extends to the 130 meter contour (425 feet). Sites consist mostly of a few *mauka-makai* trails, cairns, caves, C-shapes, enclosures, modified outcrops, pahoehoe quarries, crude platforms and walled structures, terraces and wall alignments.
>
> With some exceptions, habitation sites contain only shallow deposits and appear to be temporary, with shallow deposits. At the 100-400 ft level site density increases and cave shelters in tubes branching off of sinks and on the floors of the sinks become a common site type. These features are generally marked by extensive features indicative of recurrent, short-term use. A number of surface cairns in the vicinity may mark trail locations and associated caves. Apart from boundary walls, trails and some cairns, the majority of features appear to be associated with prehistoric use of the zone. Temporary shelters and the *mauka-makai* foot trails evidence the movement of people and goods between the coast and uplands. The presence of both terrestrial and marine resources in midden remains associated with tempo-

rary habitations evidences access to both upland and coastal zones, while artifact assemblages and structural remains are indicative of recurrent, short-term use.

Upland Forest Zone - Consists of rough aa terrain with moderate soil development and adequate rainfall. Extends from the 426-ft elevation to 3,379 ft (130-1,030 meters), up to six kilometers from shore. This zone begins with the appearance of *koa-haole* and Christmas-berry, and continues to a mixed, broadleaf forest vegetation. This appears to be a major occupation area, with scattered, small residential hamlets (probably above 2,000 ft and 25 inches-per-year rainfall). Feature types consist of the Kiholo-Kaupulehu and Kukio-Huehue Trails (Sites 1319 and 1193), upland agricultural features, platforms, mounds, and walls, with virtually continuous sites beginning at the c. 800 ft elevation extending up to at least the 2,200 ft contour (and perhaps beyond). Features found at the uppermost elevations of the parcel represent the northern extension of the Kona Agricultural System, and include house enclosures, stone platforms, high-stacked *ahu*, stone walls and numerous stone mounds. Although a large number of features are associated with prehistoric land use, subsequent ranching and large-scale agriculture during the historic period have obscured or destroyed much of the earlier patterning, making it difficult to establish the original distribution of prehistoric features. Primary land use during prehistoric times is associated with dryland swidden cultivation. The principal crops were dryland taro and sweet potato, with other crops including breadfruit, bananas, paper mulberry, ti, and sugar cane. Historic period land use is associated with ranching, habitation and large-scale agriculture.

Implications for the Current Project

The current project area does not contain any portion of the Coastal Zone, but does contain portions of the Barren and Upland Zones. Based on factors discussed above, the Barren zone extends from the Queen Ka'ahumanu Highway along the western boundary of the project area (c. 80-120-ft elevation), inland to approximately the 400-foot elevation. Site types within the Barren Zone are expected to reflect transitory occupation and to include types such as C-shapes and cave/sink complexes and transportation routes between the coast and the Upland Zone. The Upland Zone begins at approximately the 450-ft contour and continues inland to the easternmost edge of the project area (c. 800-foot elevation) and beyond. Given the distribution of sites encountered within the *ahupua'a*, however, few sites are expected between 450-800 ft. If any sites are present at these elevation, site types would include pahoehoe excavations, cave/sink complexes, trails and cairns.

FIELD METHODS

The field work for the current project consisted of a 100% pedestrian survey. The survey was conducted on September 16-17, 1993, by PHRI Laboratory Director Susan T. Goodfellow, Ph.D., and Lab Technician Earl Fujishige, B.A. The project area consisted of a 1.9 mile long by 100 ft. wide corridor. The survey was accomplished using transects spaced at intervals of 10 meters or less. The transects were oriented parallel to the centerline of the corridor. Visibility in the project area was good on the barren 'a'a and pahoehoe flows and moderate in the grassland area.

FINDINGS AND CONCLUSION

During the field survey, no archaeological remains of any significance were identified. This was not unexpected, given the predicted scarcity of cultural remains between 400-800 ft AMSL in the general area, and given the narrowness of the survey corridor.

The results of the current investigation generally conformed to the project expectations. The negative findings add support to the argument that the portion of the Barren Zone between 400-800 ft AMSL was largely un-utilized, with the exception of cinder cone areas and lava tubes, and trails that extended from the coast to the uplands In view of the negative results of the inventory survey, it is concluded that the project area requires no further archaeological work.

It should be noted that the recommendation presented here is given with the general qualification that during any development activity involving the extensive modification of the land surface, there is always the possibility, however remote, that previously unknown or unexpected subsurface cultural features, deposits, or burials might be encountered. In such a situation, archaeological consultation should be sought immediately.

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