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GOVERNOR OF HAWAII



Keith W. Ahue, Chairperson
BOARD OF LAND AND NATURAL RESOURCES

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QUALITY CONTROL

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

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HONOLULU, HAWAII 96809

AQUACULTURE DEVELOPMENT
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PROGRAM
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

JUL 27 1993

FILE NO.: HA-4/21/93-2644
DOC. NO.: 3168

MEMORANDUM

TO: Mr. Brian J. J. Choy, Director
Office of Environmental Quality Control

FROM: KEITH W. AHUE, Chairperson *Keith W. Ahue*
Board of Land and Natural Resources

SUBJECT: Document for Publication in the OEQC Bulletin - Final
Environmental Assessment for Conservation District Use
Application No. HA-4/21/93-2644 for a Single Family Residence
and Related Improvements at Puna, Hawaii, TMK: 1-5-10: 29

The above mentioned Chapter 343 document was reviewed and a negative declaration was declared based upon the final environmental assessment provided with the CDUA.

Please feel free to call me or Roy Schaefer of our Office of Conservation and Environmental Affairs, at 587-0377, if you have any questions.

1993-08-08-HF-FAA-Vaughan Single Family Residence?
related improvements

AUG - 8 1993

FINAL

ENVIRONMENTAL ASSESSMENT

PROPOSED VAUGHAN RESIDENCE

TMK 1-5-10:29

MAKUU, HALONA, AND POPOKI AHUPUA'A

PUNA, ISLAND OF HAWAII

Prepared for:
Susan Kay Vaughan
HCR 10045
Keaau, Hawaii 96749

Prepared by:
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P. O. Box 22
Volcano, Hawaii 96785
Phone and Fax: 808-967-7619

July, 1993

CDUA # HA-2644

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CHAPTER ONE INTRODUCTION

1.1 PURPOSE

The intent of this environmental assessment is to provide the State Board of Land and Natural Resources with the information necessary to review a related Conservation District Use permit application request by Ms. Susan Vaughan, a landowner in the Island of Hawaii's Puna District. The Board's review of these requests requires, in part, the consideration of potential environmental consequences of the applicant's proposals, as well as the applicants' submittal of related documentation concerning the existing environment and a more detailed description of their proposal.

In accordance with Chapter 343 of the Hawaii Revised Statutes and Act 241, SLH 1992, the State Department of Land and Natural Resources (DLNR) has the following review and related procedural responsibilities:

1. If DLNR determines that the proposed project will have a significant impact, an environmental impact statement notice is issued; or,
2. If DLNR anticipates the proposed project will not have a significant impact, a summary of the document will be published in the State Office of Environmental Quality Control (OEQC) Bulletin as a draft environmental assessment and undergo a formal 30-day review period beginning on the date of publication in the OEQC Bulletin. Following the end of the 30-day review period, any comments received along with their responses must be incorporated into a final environmental assessment. If appropriate, DLNR should ensure that the text of the environmental assessment is revised by the applicant, Susan Vaughan.
3. After the 30-day review period required by Act 241, SLH 1992, DLNR determines that the action will not have a significant impact, a negative declaration will be issued by DLNR. In essence, the notice of determination or negative declaration will indicate whether or not the preparation of a more detailed environmental impact statement (EIS) is required. The notice of determination and environmental assessment will be submitted by the State Department of Land and Natural Resources to the State Office of Environmental Quality Control (OEQC) which will again publish a summary description of the project in its bi-monthly OEQC Bulletin to provide public notice.

Once a final negative declaration determination has been made and submitted, the environmental assessment stands as a negative declaration unless it is legally challenged. The general public has a 30-day period (from the publication date of the notice of determination) to initiate any litigation contesting the determination (State Office of Environmental Quality Control, 1992).

1.2 SCOPE OF THE ENVIRONMENTAL ASSESSMENT

State of Hawaii environmental impact statement rules (Title 11, Chapter 200 of the Hawaii Revised Statutes) generally outline the content requirements for both environmental assessments, notices of determination and environmental impact statements. In addition, the criteria for determining a significant environmental effect is also identified. This environmental assessment includes information and analyses that conform to the State of Hawaii's content requirements for an environmental assessment which are outlined in Title 11, Chapter 200 of the Hawaii Revised Statutes.

State content requirements for an environmental assessment include the following information:

1. identification of the applicant;
2. identification of the approving agency, if applicable;
3. identification of the agencies consulted in preparing the assessment;
4. general description of the proposed project's technical, economic, social, and environmental characteristics;
5. summary description of the affected environment, including location and site maps;
6. identification and summary of major impacts and alternatives considered, if any;
7. proposed mitigation measures, if any;
8. an approving agency determination and reasons supporting the determination; and
9. agencies that should be consulted if a more detailed environmental impact statement is required.

Information is also provided that addresses the permit application requirements for a conservation district use application which are described in Title 13, Chapter 2, of the Hawaii Revised Statutes.

1.3 REPORT ORGANIZATION

The environmental assessment document is organized in the following manner.

Chapter One describes the purpose of this environmental assessment, the review process and general content requirements for environmental assessments, and the consultation efforts made during the preparation of the environmental assessment.

Chapter Two presents the proposal of the applicant.

Chapter Three evaluates the significant characteristics of the project site and relevant trends influencing the development of the immediate shoreline area and adjacent Hawaiian Paradise Park residential subdivision.

Chapter Four analyzes the anticipated environmental consequences of the proposed construction of a single family residence and related support facilities (TMK: 1-5-10:29).

1.4 METHODOLOGY

A combination of quantitative and qualitative analyses were used in the preparation of this environmental assessment. These evaluations relied primarily upon available information from the present landowner and selected public agencies. Available information consisted primarily of existing technical reports and maps describing physical characteristics of the project site and land use designations.

Onsite reconnaissance surveys of the project site were made by representatives of James Pedersen, Planning Consultant, on September 15, 1992. Video film and field notes of existing conditions were taken by field personnel during these surveys to document existing shoreline characteristics and evaluate ecological relationships.

1.5 AGENCY AND PUBLIC CONSULTATION

The preparation of this environmental assessment involved consultation with the following public and private organizations. The consultation process primarily involved the distribution of a letter from James Pedersen, Planning Consultant, that solicited comments and concerns from the following governmental agencies and community organizations.

State of Hawaii

- Office of the Governor
 - Office of State Planning
 - Office of Hawaiian Affairs
- Department of Land and Natural Resources
 - Office of Conservation and Environmental Affairs
 - State Historic Preservation Division
- Department of Health
 - Environmental Management Division
- University of Hawaii
 - Environmental Center

County of Hawaii

- Planning Department
- Department of Public Works
- Department of Water Supply

Community Organizations

- Paradise Hui Hanalike
- Puna Community Council

A copy of the solicitation letter and documented responses received during the consultation process are included in Appendix A.

CHAPTER TWO PROJECT ALTERNATIVES AND APPLICANT PROPOSAL

2.1 RANGE OF PROJECT ALTERNATIVES

This environmental assessment presents only one alternative for meeting the applicant's specific objectives. This option is presented in section 2.2.

The applicant desires to use the subject parcel (TMK: 1-5-10:29) for the construction and personal use of a single family residence. The only option to this proposal is to not use the subject parcel for this purpose, and to purchase a developed or undeveloped residential houselot within an existing urban district. The "no project" option is not considered viable since it would not address the applicant's objective to obtain a permanent place of residence.

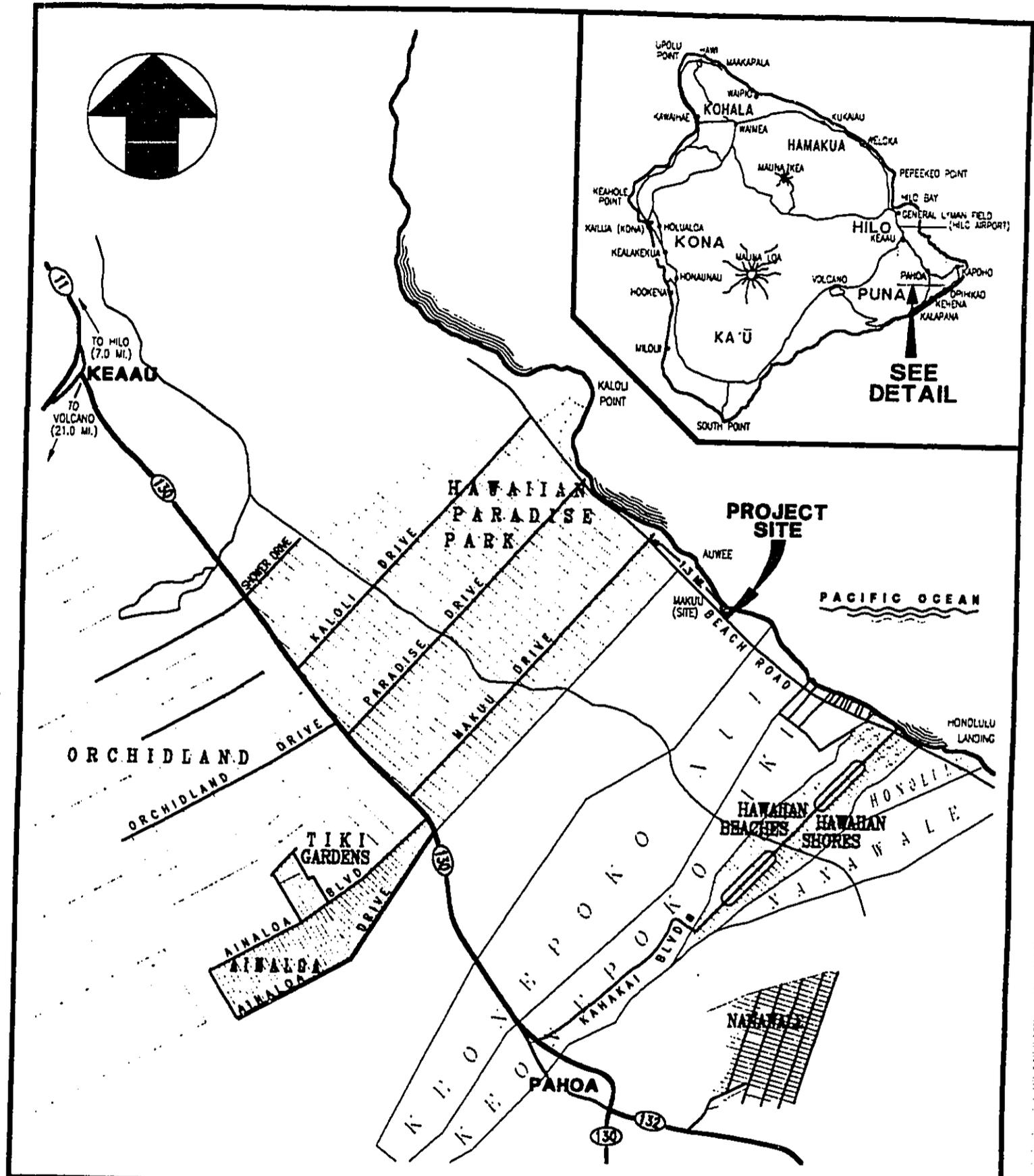
2.2 APPLICANT'S PROPOSAL

2.2.1 General Development Proposal

The applicant proposes to construct a single family dwelling on a 3.6-acre shoreline property that is located about 1.3 miles from the makai end of Makuu Drive in the Hawaiian Paradise Park subdivision (Figure 2-1). The motivation of the landowner is to build a permanent home for her personal use.

The project site would be used to develop and install the following facilities (Figure 2-2):

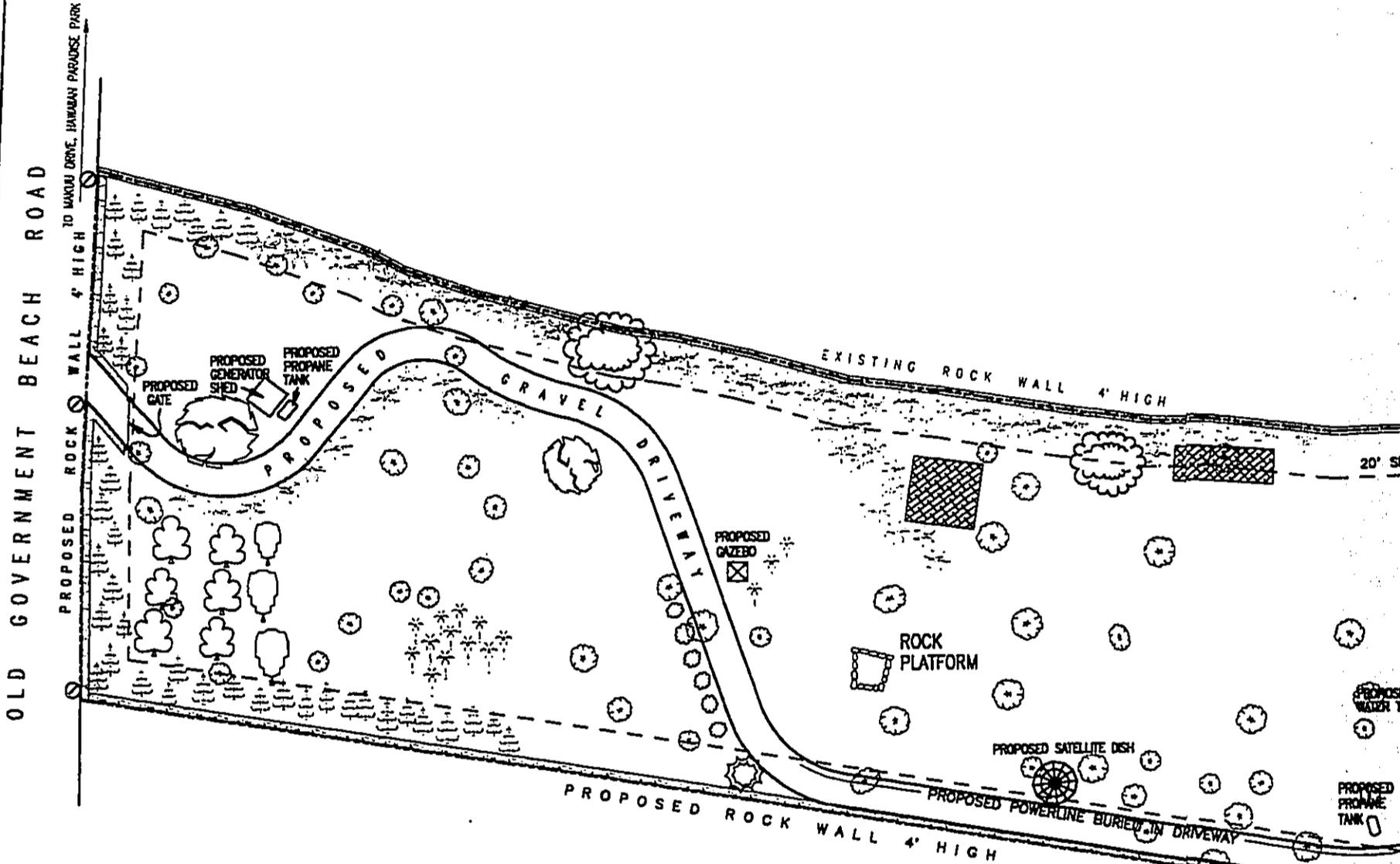
- two-story, single family residence containing about 2,600 square feet of interior floor space and possible 14 x 18-foot addition for a future bedroom and bath (Figures 2-3 and 2-4);
- 14-foot wide cinder driveway;
- an entry gate at the beginning of the driveway adjacent to the government beach road;
- generator shed for a 7-kilowatt propane gas generator and small propane gas storage tank;
- a second propane gas storage tank to provide energy for gas appliances within the proposed residence;
- 1,000-gallon septic tank and absorption bed built to State Department of Health standards (Figures 2-5 and 2-6) for the treatment of domestic wastewater;
- a second subsurface disposal bed for the treatment of swimming pool water;
- 20,000-gallon water storage tank;
- 10 x 10-foot gazebo;
- four-foot high basaltic rock wall along property boundary;
- satellite dish for cable television reception; and
- the landscaping of selected areas for open lawn area, shrubs, ornamental and fruit trees, and small vegetable and flower gardens.



James Pedersen
Planning Consultant
 Post Office Box 22
 Volcano, Hawaii 96785
 (808) 967-7619

REGIONAL LOCATION MAP
VAUGHAN RESIDENCE
 Scale: 1" = 8,000'
 February 15, 1993

FIGURE
2-1



PROPOSED LANDSCAPING

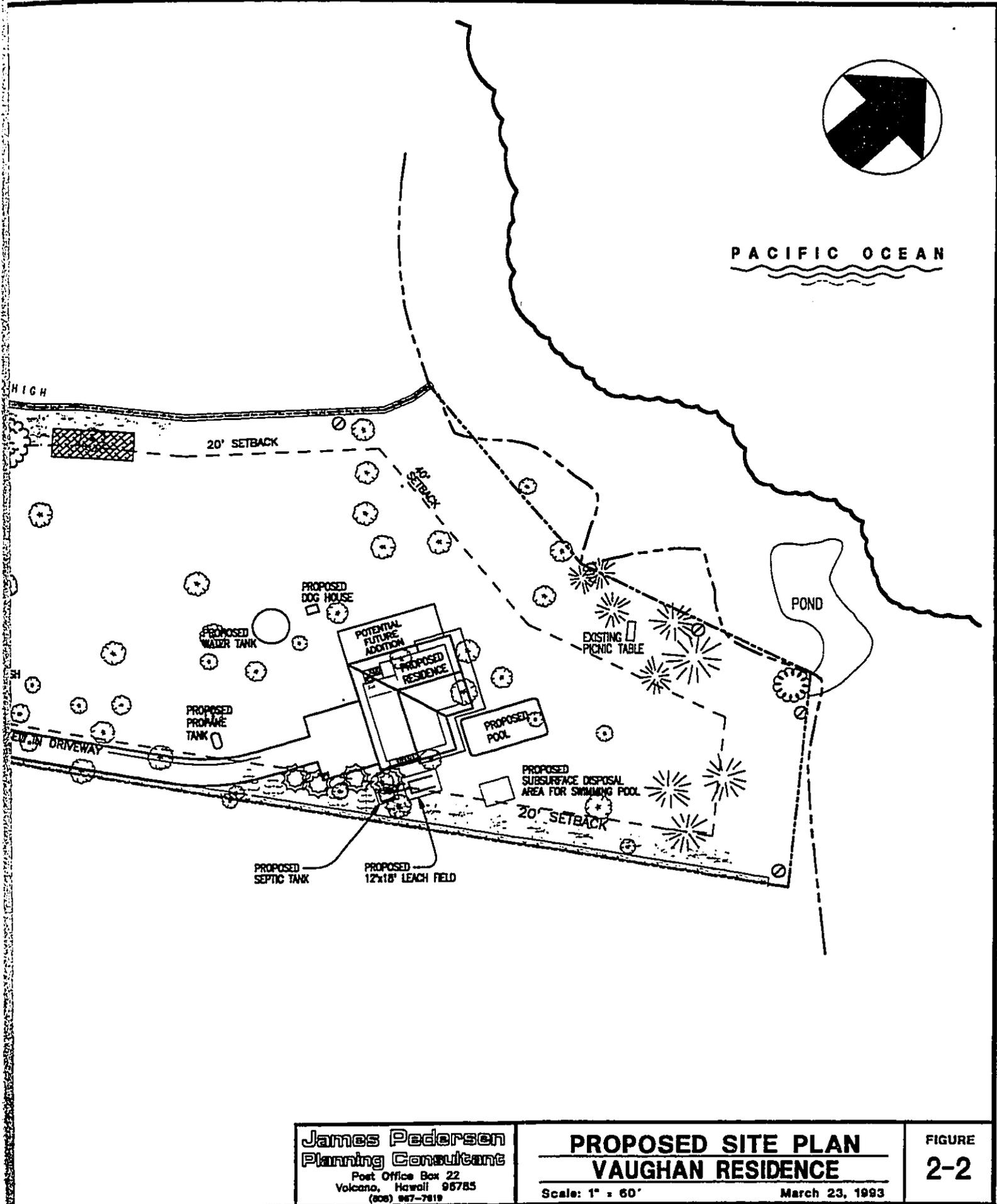
-  NORFOLK PINE TREE
-  PALM TREE
-  AVOCADO TREE
-  GARDENIA BUSHES
-  FRUIT TREE
-  FLOWERING TREE
-  VEGETABLE GARDEN

EXISTING VEGETATION

-  IRONWOOD TREE
-  BANYAN TREE
-  COCONUT TREE
-  MANGO TREE
-  ISCHAEMUM BYRONE
-  PUHALA TREE

MISCELLANEOUS FACILITIES

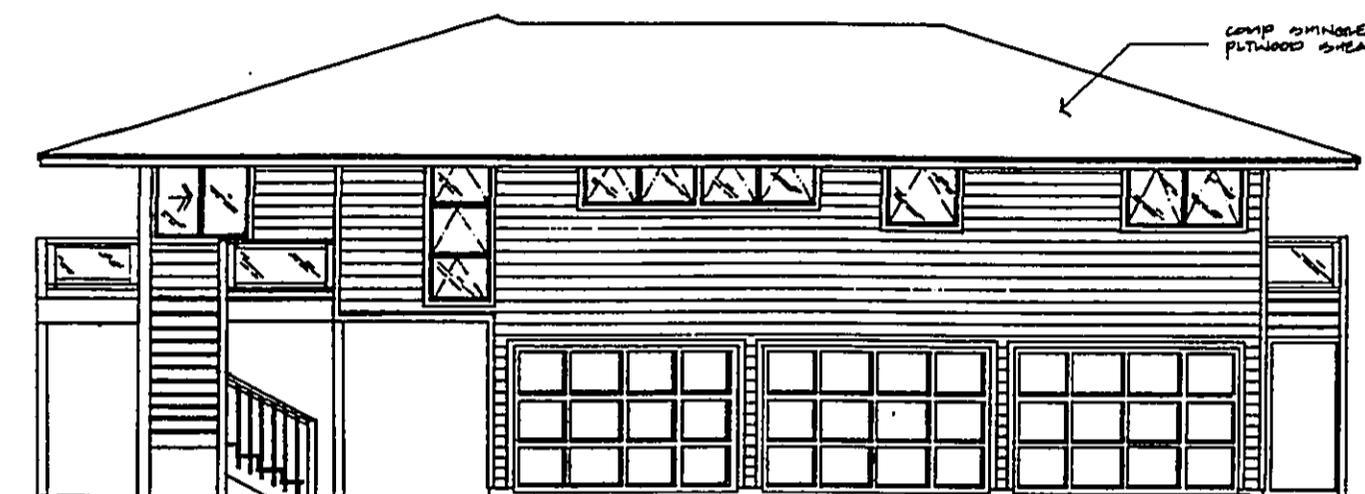
-  NO TRESPASS SIGN



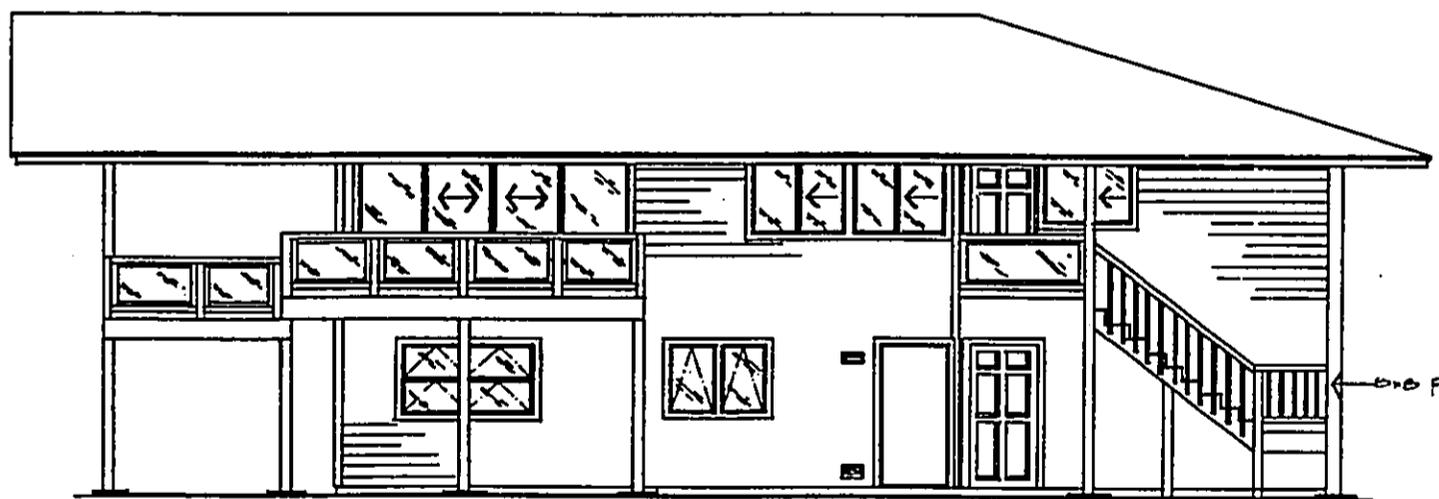
James Pedersen
 Planning Consultants
 Post Office Box 22
 Volcano, Hawaii 96785
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PROPOSED SITE PLAN
VAUGHAN RESIDENCE
 Scale: 1" = 60' March 23, 1993

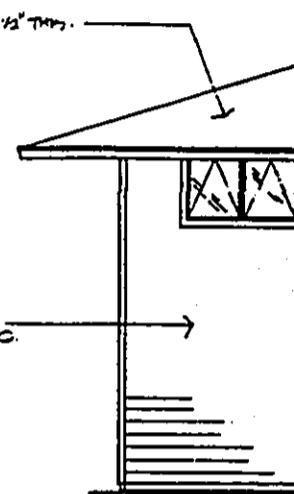
FIGURE
2-2



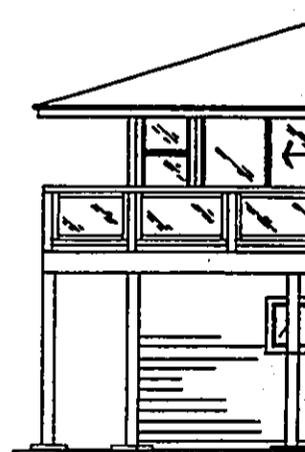
FRONT ELEVATION 14'-1-0"



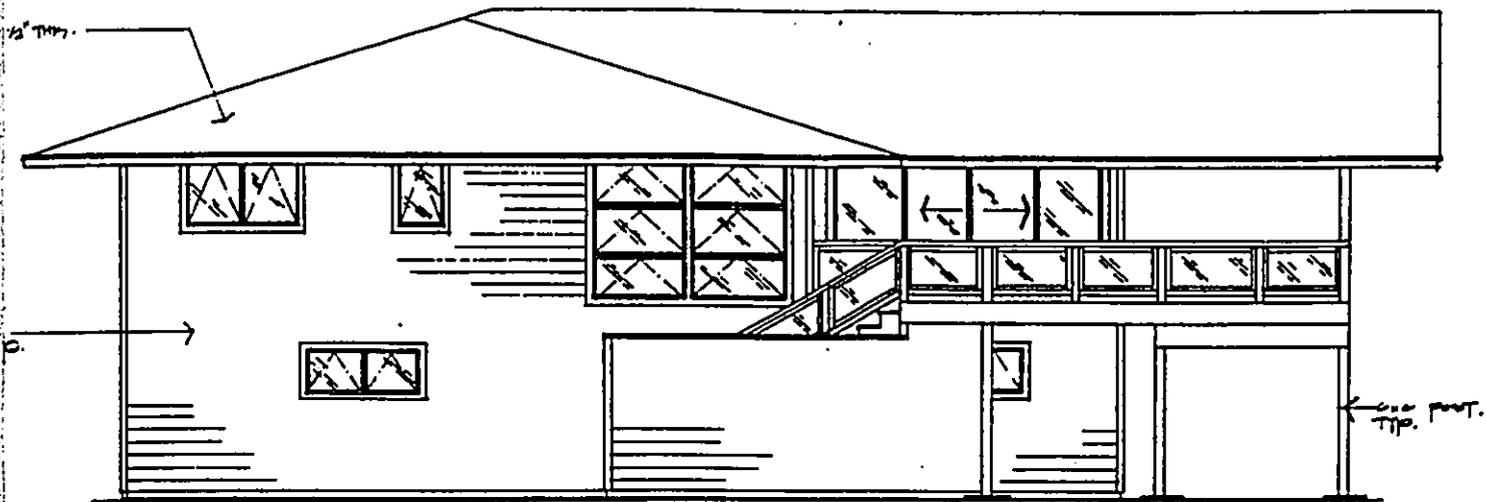
LEFT SIDE ELEVATION 14'-1-0"



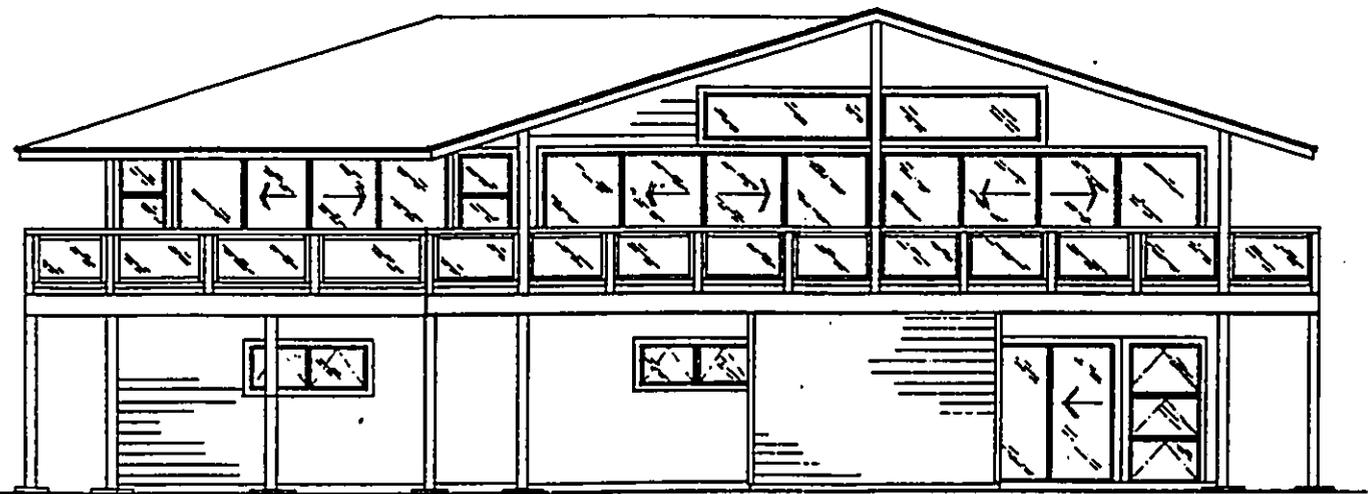
RI



RE



RIGHT SIDE ELEVATION 14'-1-0"

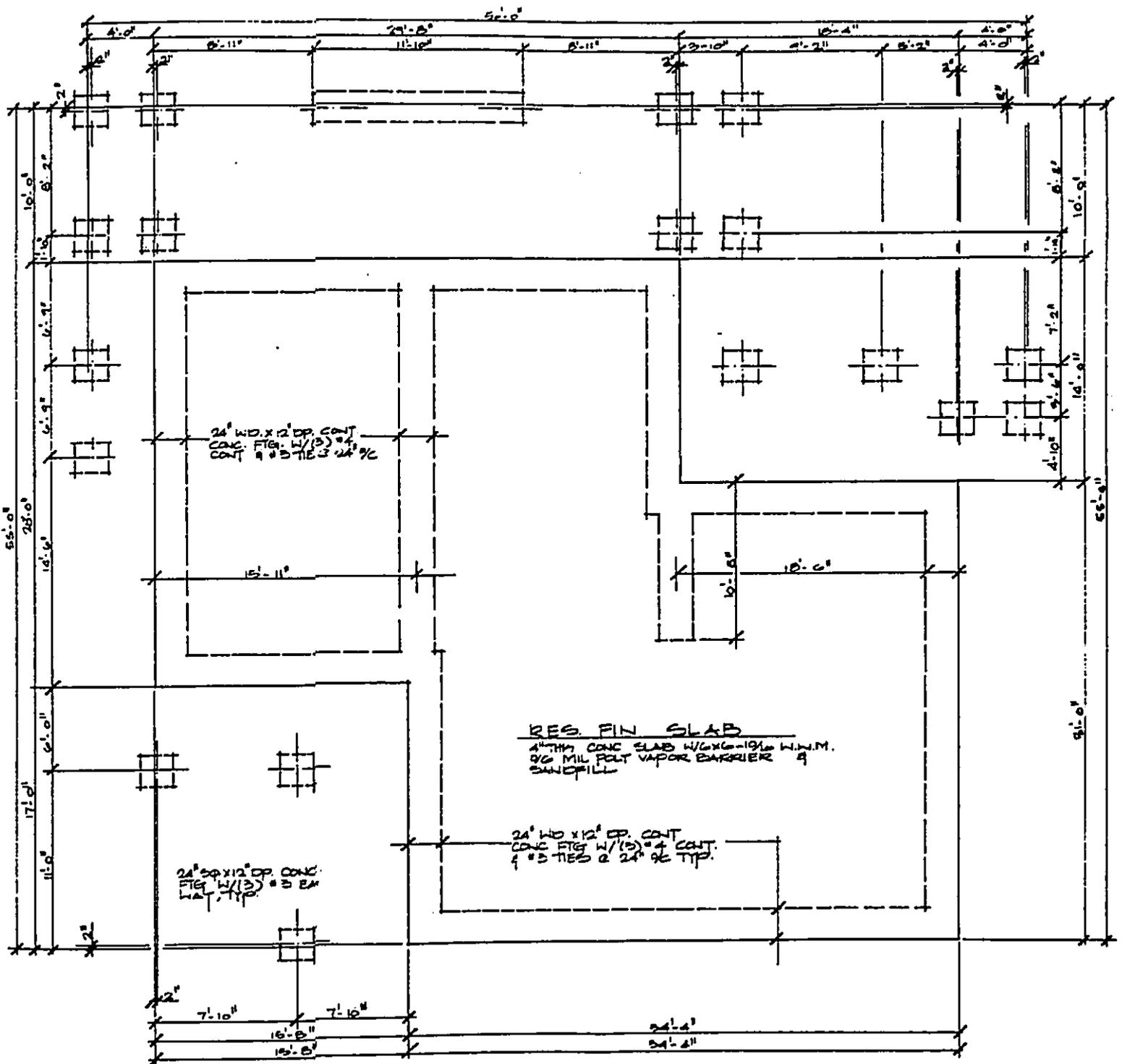


REAR ELEVATION 14'-1-0"

JAMES PEDERSEN
PLANNING CONSULTANT
P. O. Box 22
Volcano, Hawaii 96785

ARCHITECTURAL ELEVATIONS
PROPOSED VAUGHAN RESIDENCE

Figure
2-3

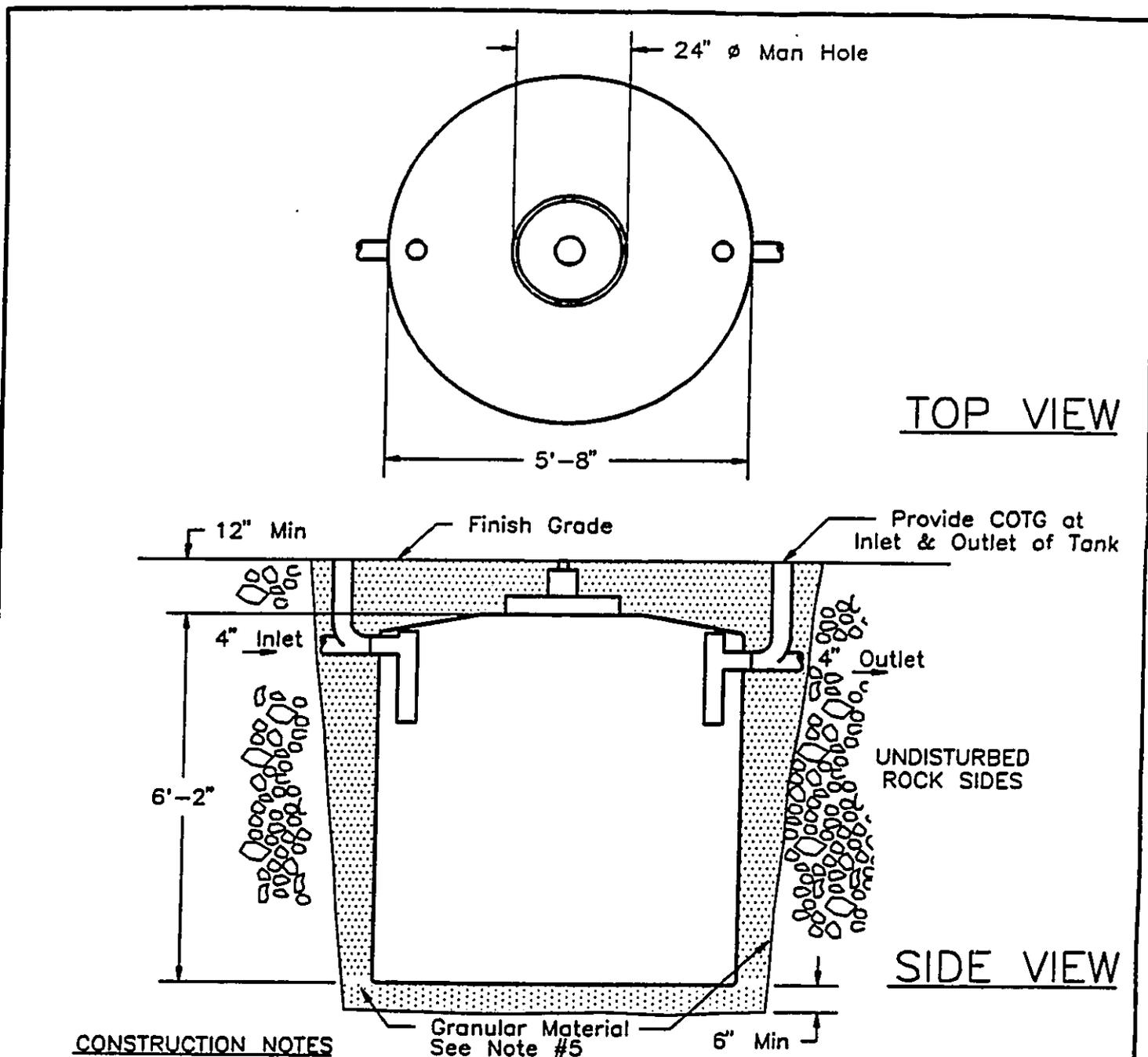


FOUNDATION PLAN 1/4" = 1'-0"

JAMES PEDERSEN
 PLANNING CONSULTANT
 P. O. Box 22
 Volcano, Hawaii 96785

CROSS SECTIONS & FOUNDATION PLAN
 PROPOSED VAUGHAN RESIDENCE

Figure
 2-4



CONSTRUCTION NOTES

1. 1,000 Gallon Fiberglass Septic Tank as provided by Dave Vogt of Industrial Fiberglass Inc., P.O. Box 67, Keaau, HI 96749. Phone (808) 982-5318
2. Substitutions of other tanks are acceptable as long as minimum volume requirements are met and are approved by the Dept. of Health. Contractor shall submit drawing to engineer for approval.
3. Septic tank shall be located in non-vehicular traffic area only.
4. Where not otherwise specified, the construction of the septic tank shall conform to Manual of Septic Tank Practice, U.S. Public Health Service, Publication No. 528.
5. Provide 6" of Granular Bedding Material (#3 Coarse - 3/4" - 1 1/2") around tank.
6. Fill tank with water before backfilling against the tank with granular material. No rocks shall exceed 4" diameter. If water is not available, backfill in lifts not exceeding one foot and compact by hand.
7. The depths to the pipe inverts of the septic tank, distribution box, and absorption system are controlled by topographic features and the invert of the building sewer which may impact the depths shown on the drawings.

702-5.009



99 AUPUNI STREET

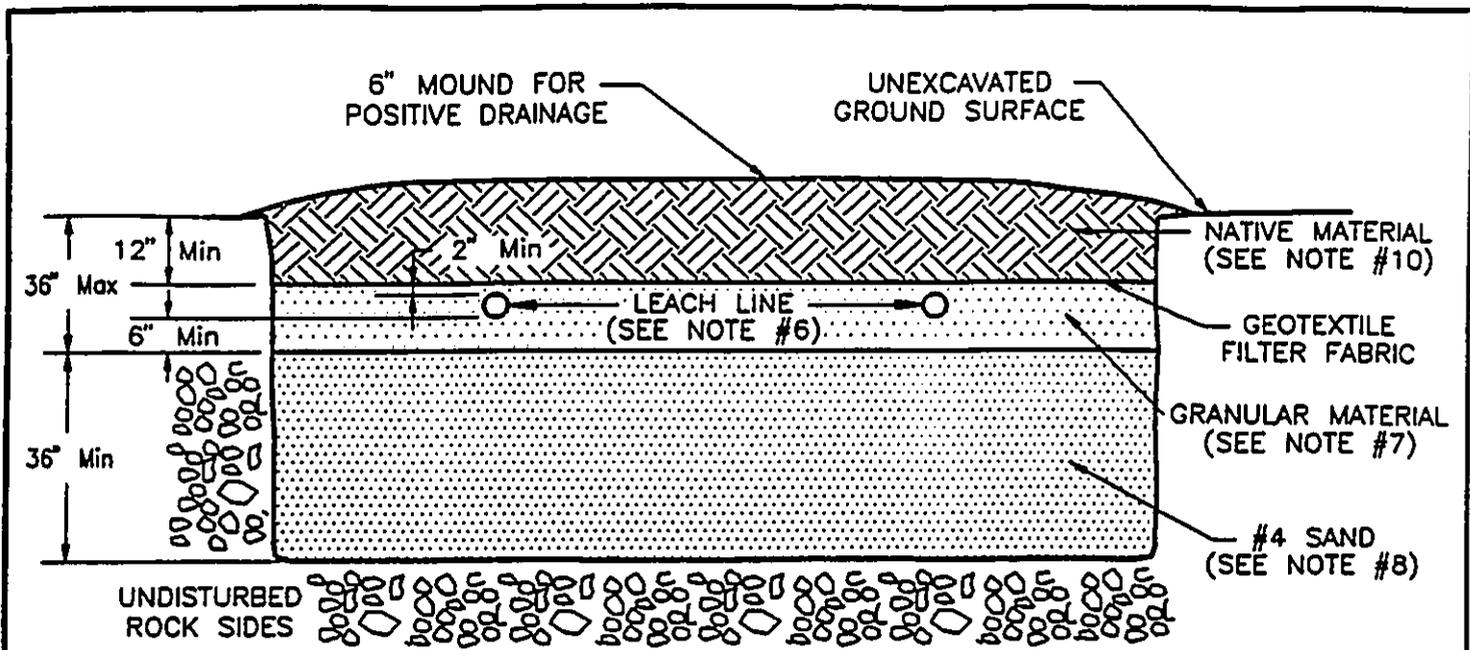
AQUA/WASTE ENGINEERS

SUITE 204, HILO, HI 96720 (808) 969-6700

SEPTIC TANK DETAIL

SCALE: NONE

**FIG
2-5**



CONSTRUCTION NOTES

1. Minimum of two Leach Lines and maximum length of each singular Leach Line shall be 100'.
2. Spacing between Leach Lines shall be 6' center to center maximum, 4' center to center minimum.
3. The bottom of the Bed and Leach Line shall be level.
4. Leach Line shall not be greater than 3' nor less than 18" from Bed side wall.
5. Where not otherwise specified, the construction of the Seepage Bed shall conform to Chapter 62, Wastewater Rules and Regulations, Section 11-62-34, State of Hawaii.
6. 4" diameter perforated PVC pipe, minimum ASTM D-2729 or better.
7. Granular Material shall be Drain Rock (Gravel or Crushed Stone - Washed - Nominal Size 3/4"-1 1/2"). Cannot use #3 road basecourse.
8. Sand having a percolation rate of approximately one minute per inch. Sand shall be #4 (nominal size #4-0). Proof of quantity and origin may be required at the time of inspection by receipts, hauling tickets, etc.
9. The depths to the pipe inverts of the septic tank, distribution box, and absorption system are controlled by topographic features and the invert of the building sewer which may impact the depths shown on the drawings.
10. No rocks in the native fill shall exceed 4" diameter.

NOTE: CONTRACTOR SHALL NOTIFY ENGINEER OF UNUSUAL CONDITIONS FOUND DURING EXCAVATION THAT COULD IMPACT SWS FUNCTION SUCH AS LAVA TUBES, UNDERGROUND HOLES, WATER, EVIDENCE OF INTERMITTENT FLOWING WATER, ETC...

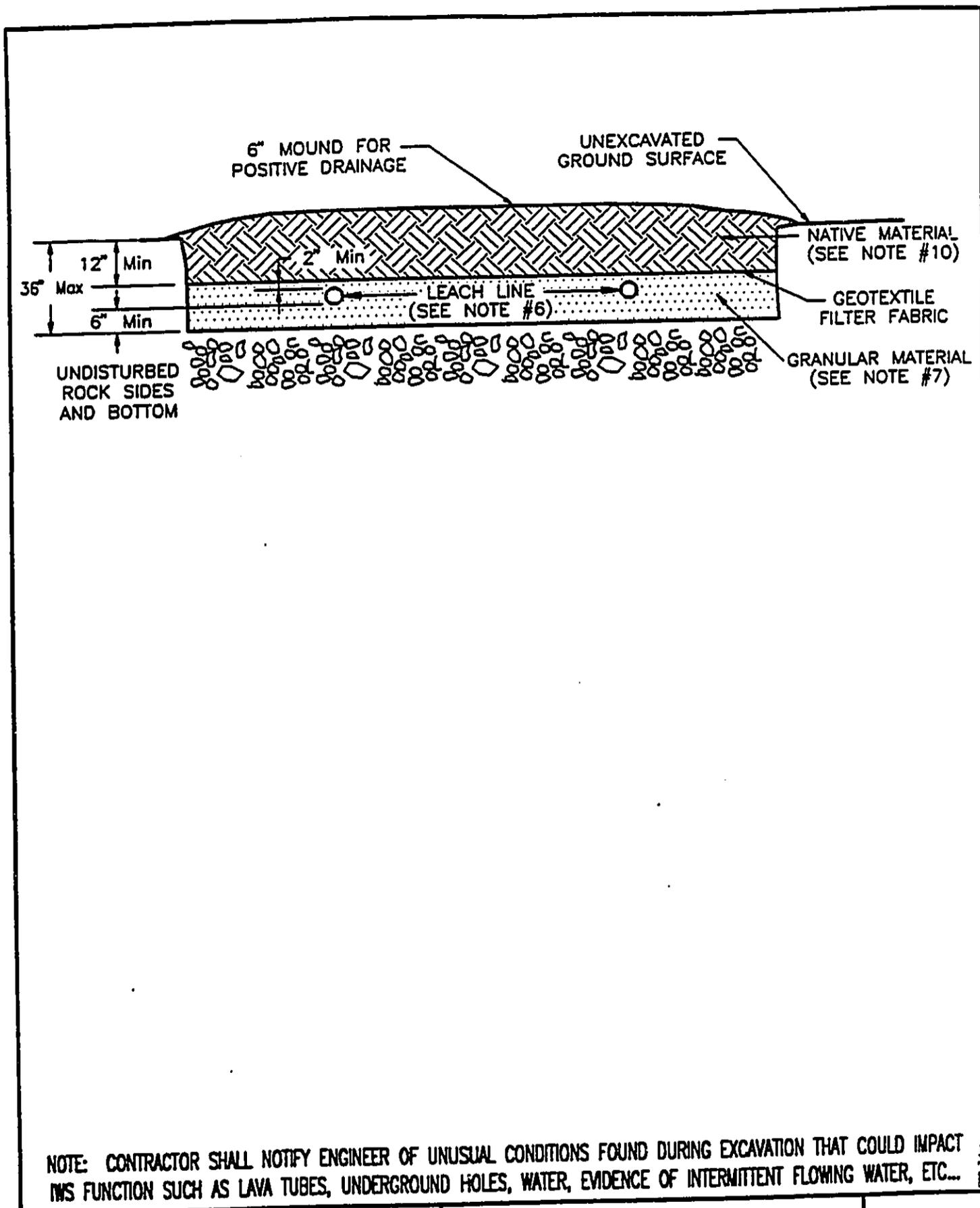


AQUA/WASTE ENGINEERS
 99 AUPUNI STREET SUITE 204, HILLO, HI 96720 (808) 969-6700

**ABSORPTION BED
 FOR SEPTIC TANK**

SCALE: NONE

**FIG
 2-6**



99 AUPUNI STREET

AQUA/WASTE ENGINEERS

SUITE 204, HILO, HI 96720 (808) 969-8700

**SUBSURFACE DISPOSAL BED
FOR SWIMMING POOL**

SCALE: NONE

**FIG
2-7**

With the development of these facilities, the landowner intends to retain the mature trees situated on the project site and preserve in-place the endangered grass specie, Ischaemum byrone. Prior to construction, the building contractor will cordon off the shoreline area that contains the endangered grass specie throughout the construction period to ensure that these botanical resources are not damaged by construction activity.

Similarly, existing archaeological features will be preserved in-place by siting proposed facilities around existing features. Prior to construction, a qualified archaeologist will inspect flagged limits of construction to ensure that proposed facilities will not impact existing archaeological features within the project area.

2.2.2 Utility Systems

Since the project site is not served by any supporting utility systems, use of the proposed residence will depend upon natural rainfall for the supply of potable and irrigation water. Observations of historical water consumption, the use of rainwater collection systems, and rainfall characteristics in the Puna district by James Pedersen, Planning Consultant, indicate that a single family residence can easily be supported by 75 to 90 inches of rainfall per year. The project site receives approximately 95 inches of rainfall per year.

Electrical power will be supplied to the residence via the use of an onsite bank of rechargeable batteries and a back-up propane gas generator. These facilities will be contained within a small generator shed near the entrance of the property (Figure 2-2). The shed will contain a concrete floor to facilitate general maintenance activities and the clean-up of any potential fuel spills. An electrical power distribution line, from the generator shed to the house and satellite dish, will be buried underground along the general alignment of the driveway.

A small above-ground, propane storage tank will be situated adjacent to the enclosed generator shed in order to permit adequate ventilation for the storage tank and a convenient re-supply (via truck delivery) location for the local gas company. A direct supply line connection will be made to the generator unit; consequently, the use of a back-up propane energy supply will minimize the potential for any fuel spill. A second above-ground propane gas storage tank will be installed adjacent to the residence. Propane gas stored in the tank will provide the supply needed to fuel gas home appliances such as a gas oven/range and water heater.

Domestic wastewater that will be generated from the use and maintenance of the proposed residence will be collected via a four-inch collection line. An individual wastewater system, consisting of a 1,000-gallon septic tank and adjacent absorption bed (Figures 2-5 and 2-6), will be used to treat incoming wastewater flows. A separate subsurface disposal bed will also be constructed for the swimming pool which will be approximately 12 feet x 15-feet x 6-feet (Figure 2-7).

No injection wells or drywells will be constructed to dispose of swimming pool water, filter backwash water, or stormwater runoff. The swimming pool will contain a disposal line that will carry occasional flows to the subsurface disposal bed. The permeable basaltic surface of the site and the use of a cinder driveway will accommodate stormwater runoff.

CHAPTER THREE ENVIRONMENTAL SETTING

3.1 PHYSICAL ENVIRONMENT

3.1.1 Location

The project site (TMK: 1-5-10:29) is accessible via the Keaau-Pahoia Road (County Road 130), Makuu Drive, and the government beach road from Hawaiian Paradise Park subdivision (Figure 2-1). The project site is a 3.6-acre shoreline land parcel that is situated along the Island of Hawaii's Puna district coastline. This parcel, approximately 1.3 miles from the makai end of Makuu Drive, is situated within the ahupuaa known as Makuu, Halona and Popoki.

3.1.2 Geology and Soils

The project site has been subjected to pre-historic basaltic lava flows (U.S. Department of Interior, Geological Survey, 1986). Field observations by James Pedersen, Planning Consultant, indicate that the shoreline of this property is characterized by a rocky shoreline bench formed as a result of pre-historic pahoehoe lava flows. The basaltic shoreline bench is virtually void of any organic soil material.

Mauka of the relatively flat shoreline bench, pahoehoe lavas are overlain by an extremely rocky muck material classified by the U.S. Soil Conservation Service as soils from the Opihikao series (rOPE). These soils are typically very permeable and very acidic; they represent a thin surface layer, about two to five inches thick, over a pahoehoe lava bedrock.

The underlying lava has very slow permeability. However, surface runoff can be rapid when surface water moves through fractured lava (U.S. Soil Conservation Service, 1973).

3.1.3 Topography

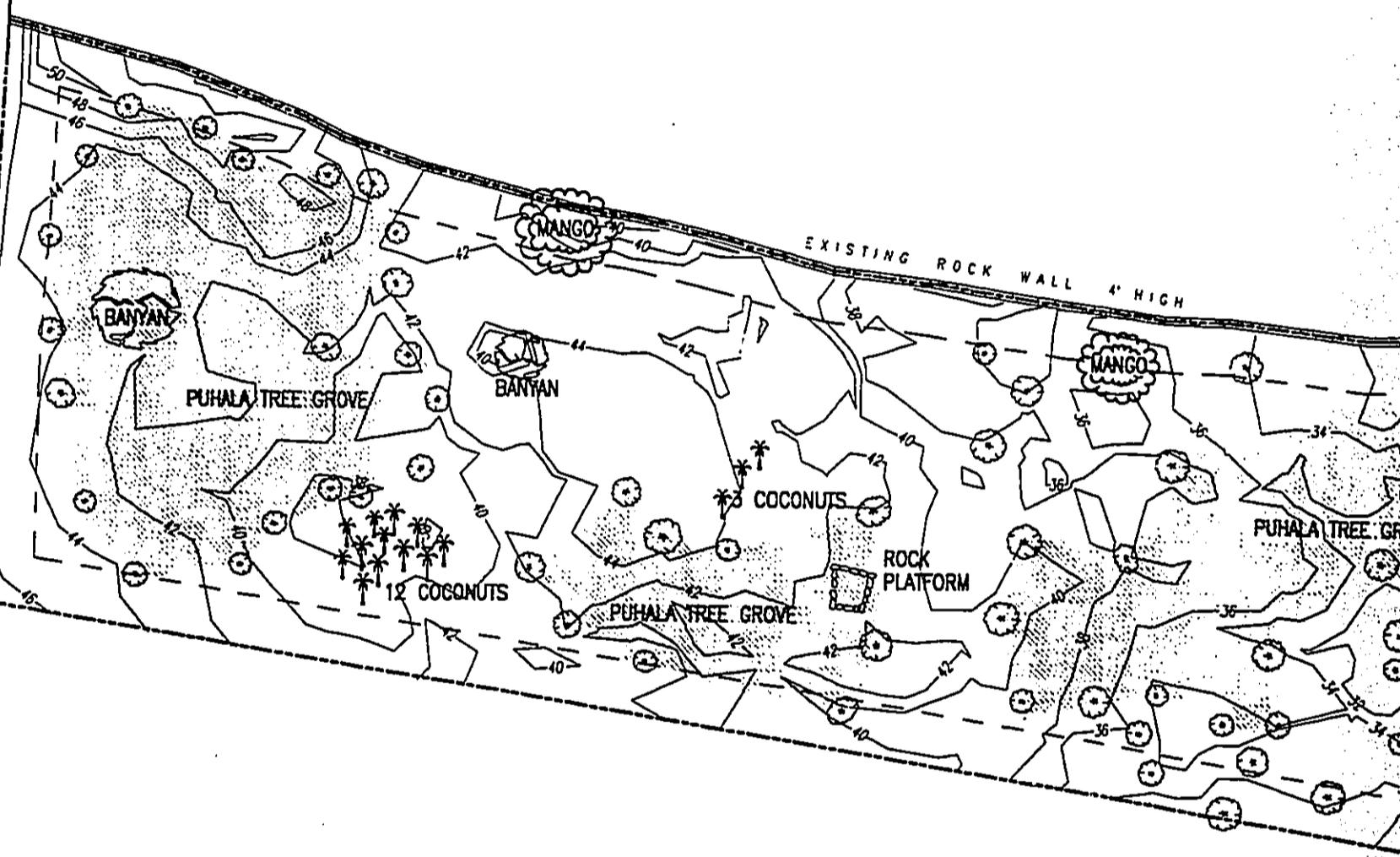
A topographical and certified shoreline survey of the Vaughan property was made by Murray & Associates in January, 1993 (Figure 3-1). Results of the survey indicate that the elevation of the Vaughan property ranges between 25 to 50 feet above mean sea level (MSL). From the relatively flat basaltic shoreline area (about +25 MSL), the topography of the site gradually rises to roughly +40 feet MSL near the center of the property. Elevations from this point continue to gradually rise to 46 feet MSL along the Government Beach Road which is about 820 feet from the certified shoreline. The highest elevations on the property are located on a small ridge located in the western corner of the property (Figure 3-1).

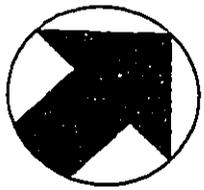
The certified shoreline boundary, proposed by Murray, Smith & Associates, suggests that the certified shoreline area is between 52 and 127 feet mauka of the seaward edge of the basaltic bench that fronts the property.

OLD GOVERNMENT BEACH ROAD

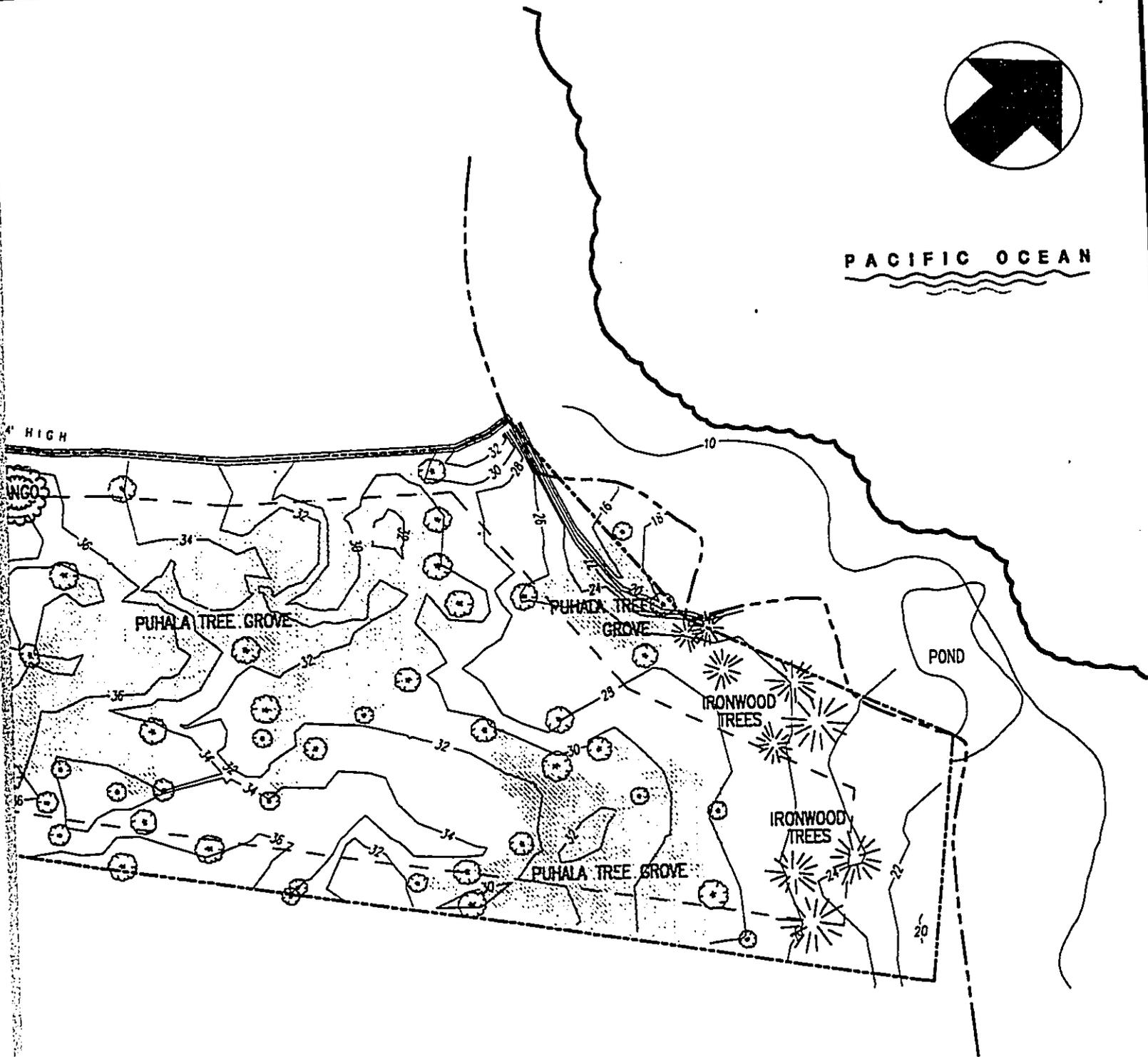
10 HAKOBU DRIVE, HAWAIIAN PARADISE PARK

EXISTING ROCK WALL 4' HIGH





PACIFIC OCEAN



James Pedersen
Planning Consultant
Post Office Box 22
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(808) 967-7219

GENERAL TOPOGRAPHY
VAUGHAN RESIDENCE
Scale: 1" = 80' February 18, 1993

FIGURE
3-1

3.1.4 Climate

The tropical coastal climate of the Hawaiian Paradise Park area and the nearby project site is primarily influenced by north to northeasterly tradewinds and an average annual rainfall (Table 3-1) of roughly 2,400 millimeters (mm), or almost 95 inches per year. Average ambient temperatures vary not more than five degrees throughout the year (University of Hawaii, Department of Geography, 1983) which reflect a limited seasonal variation in local weather. Two climatic seasons occur in the area: the "wet season" occurs between the months of November through March while a "dry season" characterizes the months of April through October. The wet season brings greater rainfall, somewhat cooler temperatures, and more frequent winds from the south.

3.1.5 Storm Wave Exposure and Potential Tsunami Inundation

The project site is directly exposed to northerly and easterly swells. Documented information indicates that the 1946, 1957 and 1960 tsunamis generated wave heights from 12 to 24 feet above mean lower low water (MLLW) about 3.5 miles northwest of the project site. No tsunami wave height data was recorded for the tsunamis of 1952 and 1964 which generated considerably smaller waves along the northerly and easterly-exposed shoreline areas of the Island of Hawaii.

The vertical basaltic cliffs, which characterize the shoreline of the project site, are believed to provide significant protection to occasional storm waves and tsunami-generated waves. The top of these cliffs are believed to be roughly 25 feet above mean lower low water. The lower ground elevations of the project site are generally located along the top of the rocky shoreline immediately behind the vertical basaltic cliffs.

3.2 BIOLOGICAL RESOURCES

3.2.1 Vegetation

An informal reconnaissance of the property's existing vegetation was made by representatives of James Pedersen, Planning Consultant, on September 15, 1992. The general survey was made in conjunction with the investigation of other onsite characteristics. In addition, the Hawaii County Planning Department graciously provided additional information based upon a field survey by one of its staff members in late 1989 or 1990. The combined information was generally mapped (Figure 3-2) to provide an overview of the predominant types of vegetation that are present on the project site.

The project site is primarily characterized by exotic trees and shrubs and scattered clearings of exotic grasses. In 1992, the site was subjected to some hand clearing by the present owner in order to facilitate anticipated archaeological field investigations. This effort involved the clearing of guava, lantana, and other introduced plants. During this effort, several "gro-bags" were discovered which suggests that the project site may have once been used for marijuana production by unauthorized individuals using the property (Paul H. Rosendahl, Inc., 1992).

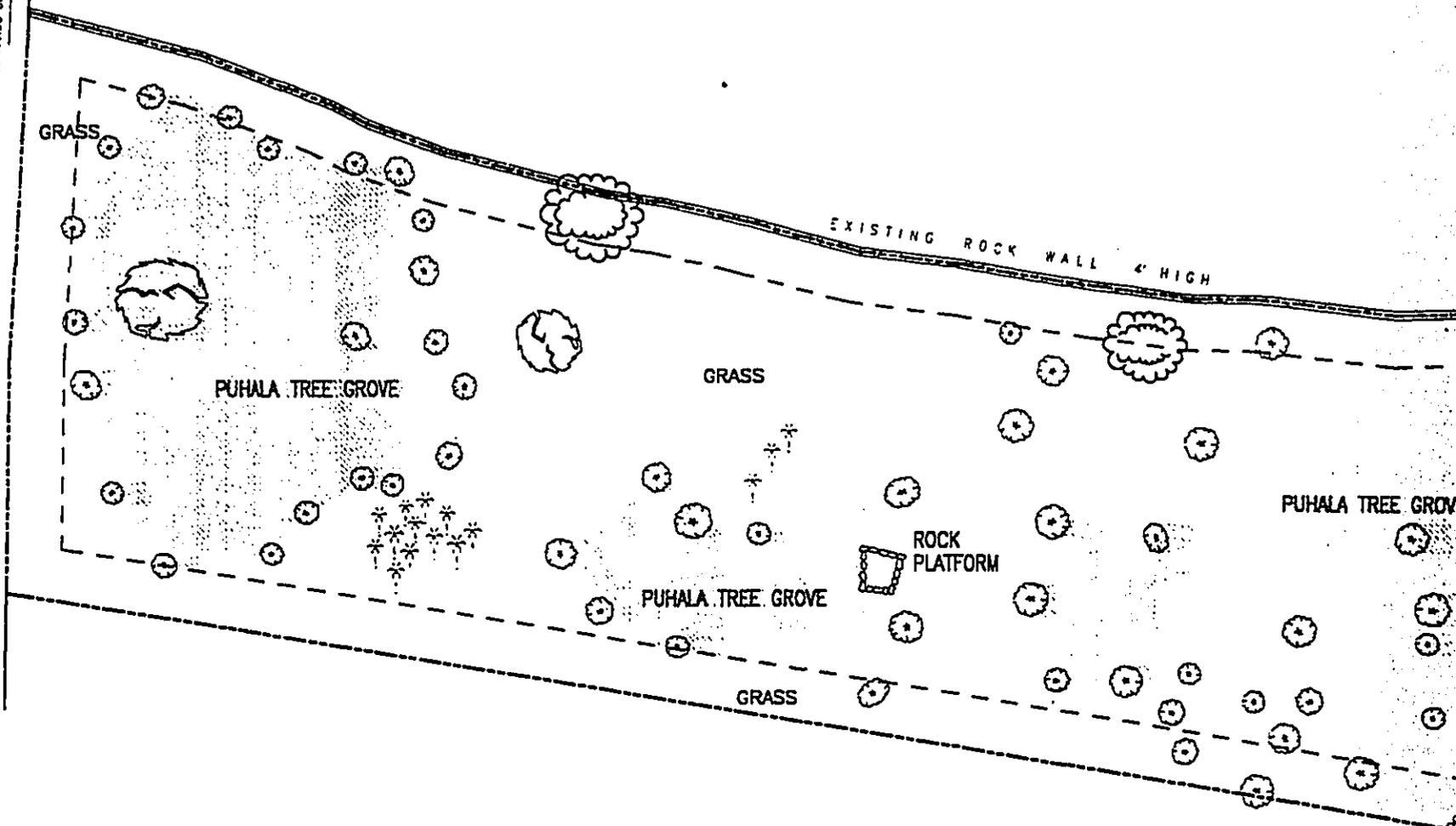
**TABLE 3-1
 MEDIAN ANNUAL RAINFALL
 AHUPUA'A OF MAKU'U, POPOKI, AND HALONA
 PUNA DISTRICT, ISLAND OF HAWAII**

<u>Month</u>	<u>Precipitation (millimeters)</u>
January	250
February	200
March	300
April	200
May	150
June	150
July	150
August	150
September	150
October	175
November	300
December	300
TOTAL	2,375

Source: State Department of Land and Natural Resources,
 Division of Land and Water Development, 1986.

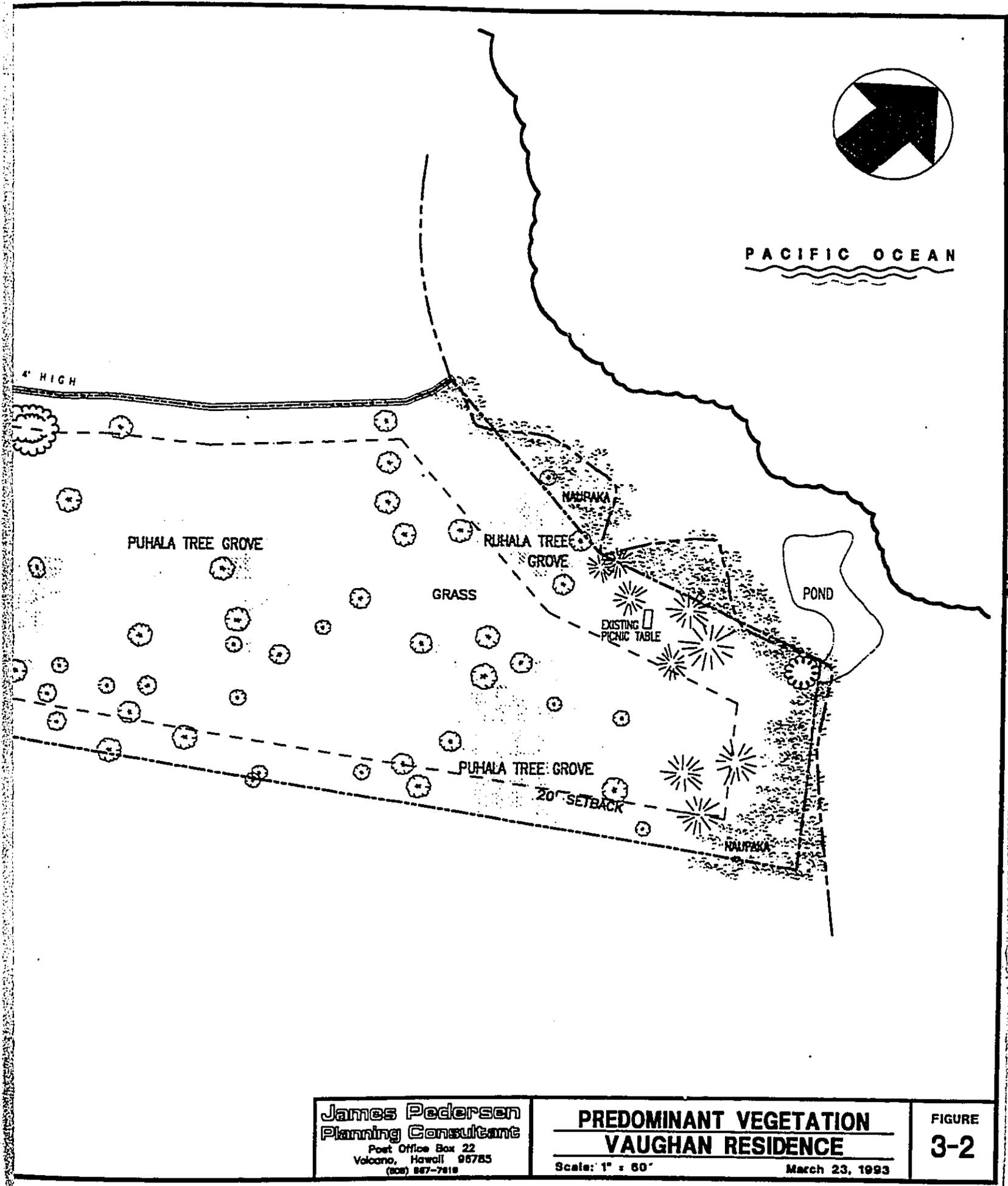
OLD GOVERNMENT BEACH ROAD

TO WARDU DRIVE, HAWAII PARADISE PARK



EXISTING VEGETATION

-  IRONWOOD TREE
-  BANYAN TREE
-  COCONUT TREE
-  MANGO TREE
-  ISCHAEMUM BYRONE



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**PREDOMINANT VEGETATION
 VAUGHAN RESIDENCE**
 Scale: 1" = 60' March 23, 1993

FIGURE
3-2

Existing tree cover primarily includes scattered hala (Pandanus ordoratisissimus) thickets and two coconut (Cocos nucifera) groves throughout the project site. Two mango trees are located along an existing rock wall that extends along most of the site's northwest boundary. Banyan trees (Ficus sp.) are present within 50 feet of the old Government Road and near the center of the project site. Ironwood (Casaurina sp.) are scattered near the seaward end of the property.

Shrubs include beach naupaka (Scaevola sericea) within, but primarily mauka of, the basaltic bench that fronts the Vaughan property. Strawberry guava (Psidium cattleianum) is randomly found throughout the property, but is most abundant near the northwest corner of the property.

Existing ground cover includes scattered exotic grassy areas (Graminae) throughout the property. The most prominent grassy areas are situated adjacent to the existing rock wall, the seaward end of the property, and along the property's southeast boundary. In the vicinity of the proposed residence, perennial nutgrass (Scleria sp.) is commonly found.

One perennial, Ischaemum byrone, was also observed within a 10 to 12-foot diameter area that is located along the property's seaward boundary. This perennial is typically associated with Naupaka kahakai (Scaevola) shrublands that are found on basalt cliffs (Wagner, Herbst, and Sohmer, 1990). In December, 1992, the U.S. Fish and Wildlife Service proposed that this perennial and 21 other plants be given "endangered status" and solicited public comment concerning this proposed designation (Hawaii Tribune Herald, 1993). As of July, 1993, this specie remains as a proposed endangered plant. U.S. Fish and Wildlife Service representatives expect approval in August, 1993.

3.2.2 Marine Ecology

The inshore waters in the vicinity of the project site is a deeper water marine environment that contains a variety of fish and other less mobile marine organisms. While no marine survey was made of the inshore waters adjacent to the project site, available information from the State Division of Aquatic Resources indicates that fish and other marine organisms typically found along this stretch of the Puna district coastline include, at least, the following:

<u>Fish</u>	<u>Other Marine Organisms</u>
Nenui	Crabs
Waaweoaweo	Sea urchins
Papio	Sea turtles
Ulua	
Kala	
Palani	
Surgeonfish	

During the September 15 field investigation, three or four sea turtles were observed in the inshore waters seaward of the project site. Within the inter-tidal zone, a'ama crabs, opihi, sea urchins, and various algae, e.g. Porolithon sp., were observed along the seaward face of the basaltic bench.

Seaward of the Vaughan property on State land, an 80 x 25-foot depression is located near the center of the existing basaltic bench. About 10 to 15 feet below the top elevation of the basaltic bench, a ponded basaltic area was observed at the base of the depression during field surveys made on September 15, 1992 and February 2, 1993. Seawater enters the base of the depression and forms a ponded area when occasional storm surges break over the seaward face of the basaltic bench and drain seawater into the depression. A direct connection to the ocean is present on the northern end of the ponded area which is only several feet above mean sea level. The elevation of the pond, and its location behind the seaward face of the basaltic bench, apparently shelter the pond from regular tidal exchange except during periods of higher surf and/or stormwave conditions. During both field surveys, no fauna was observed within the pond.

Consequently, the pond represents an open pond rather than an anchialine pond.

An anchialine pond *"...is a land-locked body of water with measurable salinity, lacking surface connections to the sea, and showing damped tidal fluctuations of water level....Hawaiian anchialine ponds include at least seven aquatic species that are currently believed to be rare worldwide, and new species undoubtedly await discovery."* (Nature Conservancy of Hawaii, 1987). In contrast, ponds with a surface connection to the ocean, during a mean high water condition are considered tidepools or open ponds.

Anchialine ponds are not uncommon to the Puna coastline. Several sites have been identified along this coastline by the Nature Conservancy. Approximately one-half mile of the property, an anchialine pond is located in the vicinity of Opihi Rock.

3.3 CULTURAL RESOURCES

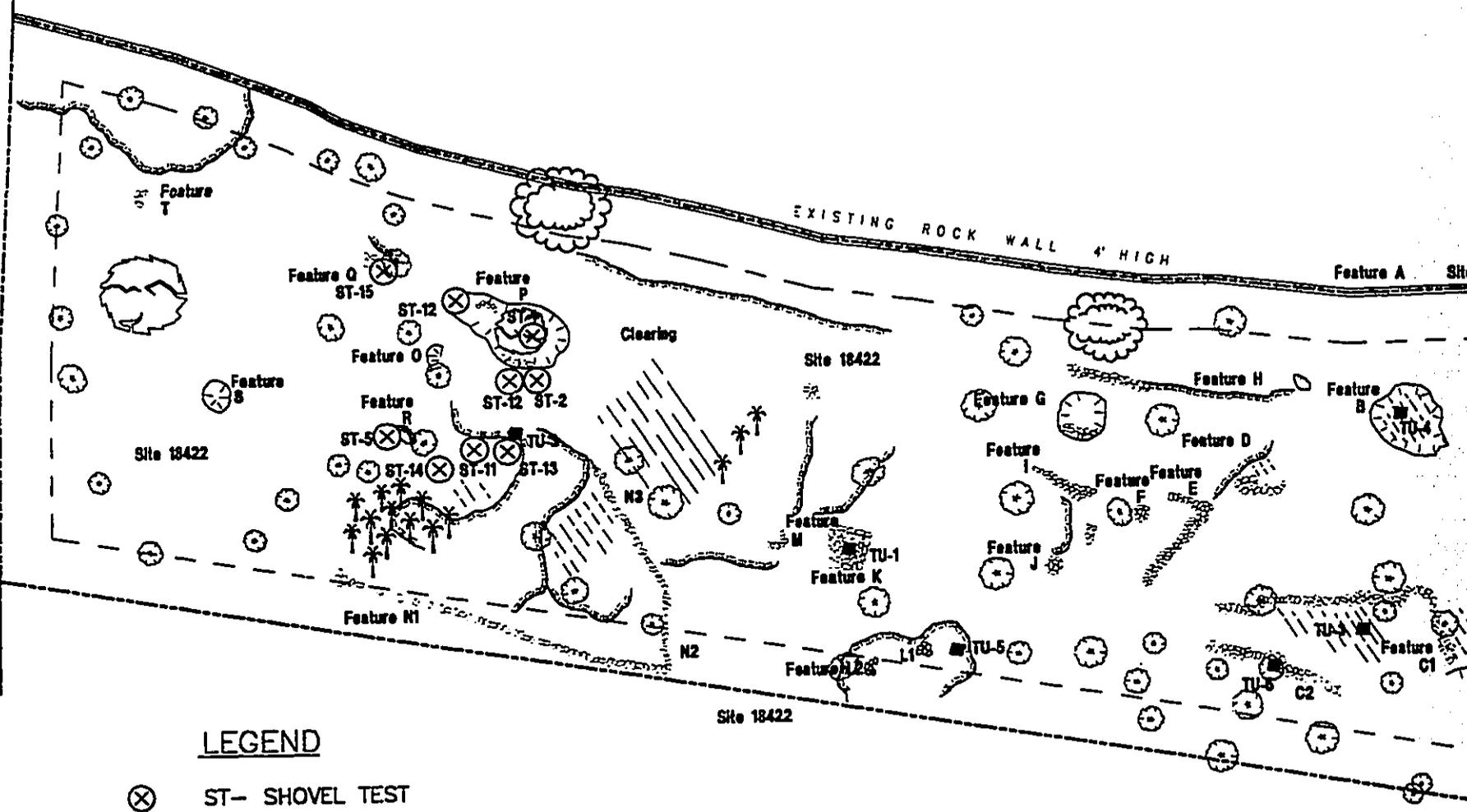
3.3.1 Archaeological and Historical Resources

An archaeological inventory survey of the project site was made by Paul Rosendahl, Ph.D., Inc. on August 19, 1992. The scope of the survey was intended to: 1) identify all sites and features of potential archaeological significance; 2) evaluate the potential general significance of all identified remains; 3) determine the effects of proposed development; and 4) define the scope of any further data collection or mitigation efforts that may be deemed necessary. A copy of the related archaeological inventory survey report is provided in Appendix B.

Five sites were identified on the Vaughan property (Figure 3-3). Site 18418 represents a prehistoric trail. Two historic cattle walls comprise site 18419. Site 18420 includes a coastline terrace complex. Two bait cups upon the shoreline's basaltic bench make up site 18421. An extensive horticultural site, containing 26 component features, was found in site 18422. In addition the various surface features, the field team encountered 59 volcanic glass artifacts. However, no other materials, e.g., hearths, charcoal, and burials, were discovered that provided indications of human activity.

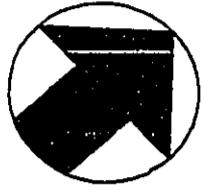
Other unmodified areas of the property, e.g., about 105 feet seaward of the old Government Road, suggest that the property may have sustained the production of various crops. Similar areas, makai of sites 18422-N, O, and P (Figure 3-3) may have formerly been used for pasture.

TO MAOUI DRIVE, HAWAIIAN PARADISE PARK

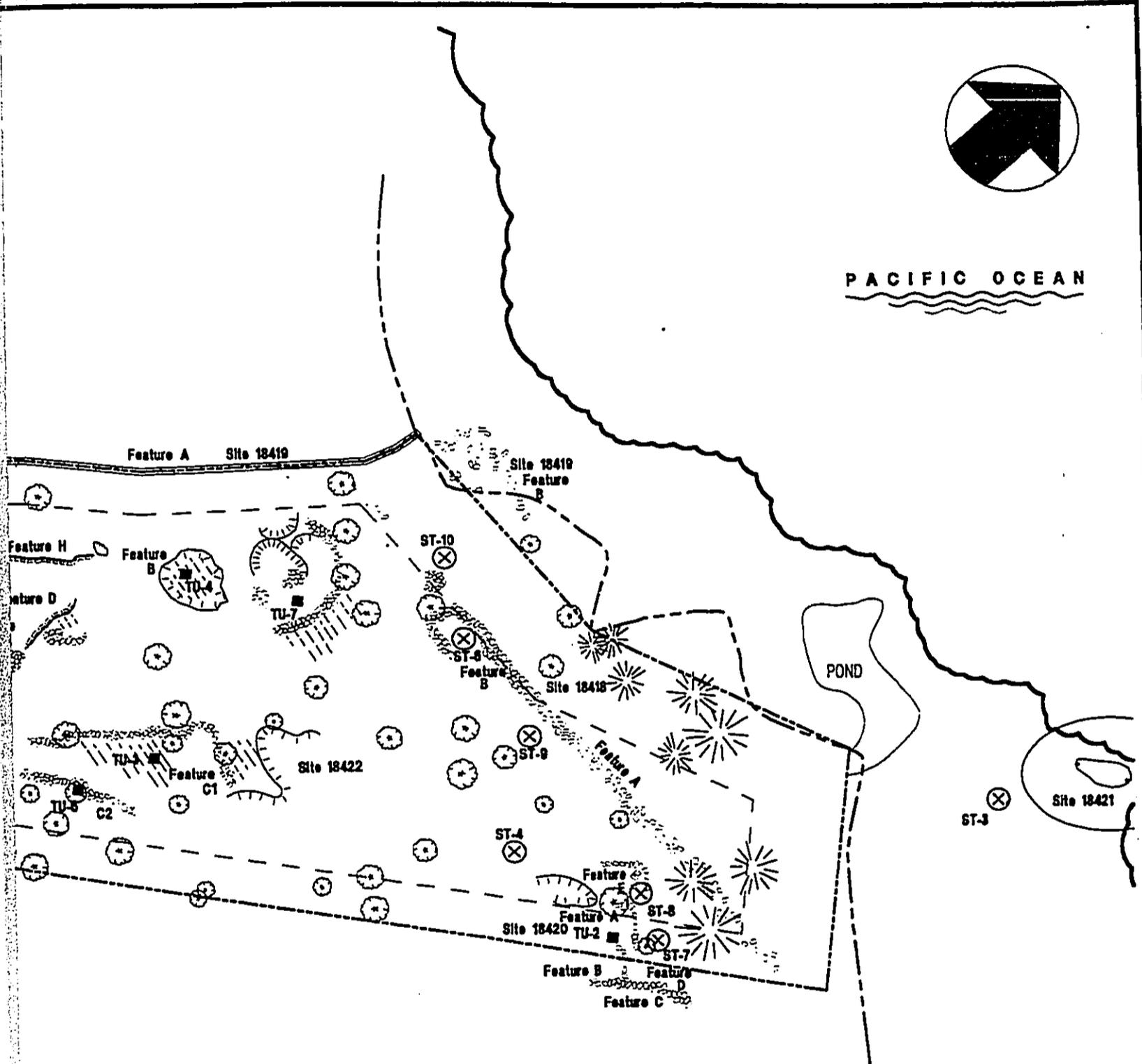


LEGEND

- ⊗ ST- SHOVEL TEST
- TU- TEST UNIT
- ▬ STACKED ROCK
- ▬ BEDROCK OUTCROP
- ⊖ DEPRESSION / COLLAPSED BLISTER
- ▨ LEVEL AREA
- ⊙ PUHALA TREES
- ☼ IRONWOOD TREES
- 🌴 MANGO TREES
- 🌳 BANYON TREES



PACIFIC OCEAN



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ARCHAEOLOGICAL RESOURCES
VAUGHAN RESIDENCE
 Scale: 1" = 60' February 18, 1993

FIGURE
3-3

3.4 BUILT ENVIRONMENT AND GENERAL LAND USES

3.4.1 Adjacent Land Uses

The properties immediately adjacent to the project site remain undeveloped except along the southwest side of the property. Three adjoining land parcels, comprising a total of about 84-acres, are situated mauka of the Government Beach Road. At least one residential dwelling and other unknown land uses have been developed on these properties.

North of the property, an adjoining parcel includes a building foundation that indicates some past intentions to construct a beachfront residence. However, there are no signs of any ongoing or anticipated construction activity. Other nearby parcels along the Government Beach Road include beachfront homes and/or pasture areas.

The future development of the shoreline area between Hawaiian Paradise Park and Hawaiian Beaches subdivisions appears to be destined for limited shoreline residential development and related pasture uses for those residents with horses, cattle or other domesticated animals. The potential market for residential homes in this area is limited due to the lack of public utilities, existing constraints posed by County zoning and State land use designations, and the distance to commercial retail areas.

3.4.2 Shoreline Recreation

No fishing activity or signs of recent use were observed along the shoreline of the project site. The apparent non-use of the site may be due to the presence of more attractive fishing points that are accessible from the Government Beach Road. For example, "High Rock" is located within about one mile north of the Hawaiian Beaches subdivision. This site offers a finger of land that affords a small peninsula of land adjacent to a basaltic bench, as well as an informal shoreline trail to the well-known fishing site.

3.4.3 Public Facilities and Services in the Project Site Vicinity

3.4.3.1 Roads and Vehicular Access

A 10-foot wide unimproved government beach road is adjacent to the mauka boundary of the project site. This government road provides vehicular access to lands that are situated between Hawaiian Paradise Park and the Hawaii Beaches/Hawaiian Shores subdivision.

3.4.3.2 Water, Wastewater and Electrical Power Systems

The project site is not served by any public water distribution, wastewater collection, or electrical power distribution systems.

Private onsite wastewater treatment systems presently serve single family residences situated along the shoreline between the Hawaiian Beaches and the Hawaiian Paradise Park subdivisions. In light of the proximity of the property to the shoreline, State wastewater disposal regulations and policies require that wastewater from shoreline properties in this area will eventually need to be treated and disposed via a septic tank or an alternate onsite wastewater treatment system.

3.5 PLANS, POLICIES AND CONTROLS

3.5.1 Hawaii State Plan, Hawaii Revised Statutes, Chapter 226

The Hawaii State Plan provides a guide for the short and long-term development of Hawaii. These guidelines are presented in the form of regional goals, objectives, policies, and priorities for improving Hawaii's population, economy, environment, and man-made resources (Office of the Governor, Office of State Planning, 1991).

The following paragraphs include selected guidelines that are considered to be relevant to the proposed project.

Section 226-12: Objectives and Policies for the Physical Environment--Historical Resources

This section states, in part, that a policy objective of the State of Hawaii is to promote the preservation of significant historic resources. The Vaughan property contains various archaeological sites and related features. However, the size of the site and the limited amount of proposed residential construction enable the landowner to preserve these resources in their present location by the appropriate siting of proposed residence and support facilities.

Section 226-19: Objectives and Policies for Socio-Cultural Advancement, Housing:

The purpose of this section is to provide greater opportunities for Hawaii's people to secure reasonably-priced, safe, sanitary, and livable homes in a suitable environment that satisfactorily accommodate the needs of families and individuals. This policy is also aimed at increasing home ownership opportunities and choices in terms of quality, location, cost, densities, style, and the size of housing. The proposed project addresses this objective by providing a home for the landowner.

3.5.2 State Coastal Management Objectives: Chapter 205A-2, Hawaii Revised Statutes and Related County Special Management Area Designation

Chapter 205A-2, Hawaii Revised Statutes, outlines seven objectives for the State's recreational resources, historic resources, scenic and open space resources, coastal ecosystems, economic uses, coastal hazards, and the management of development. In addition, Section 205A-2(c) provides specific policies for implementing each of the seven objectives.

One of the more prominent objectives that relates to the proposed project is the protection and preservation of historic resources. The proposed project provides an opportunity to address this objective and its related policies by the preservation of existing archaeological features. This can be accomplished by the careful siting of the proposed residence, support facilities, and proposed landscaping.

The management development objective in Chapter 205A-2 stresses the timely processing of permit applications and related opportunities for public participation. The CDUA application for this project has involved the preparation of this environmental assessment. The related public review process provides an opportunity for public review and a better public understanding of the potential impacts of the project.

One of the objectives cited in Chapter 205-A2 is the preservation, maintenance, improvement and restoration of shoreline open space and scenic resources. An emphasis reflected in the policies for this objective is the mandate to ensure a compatibility between proposed development and the visual quality of the natural shoreline. The dense vegetative cover found in the site provides little to no shoreline vista opportunities from the Government Beach Road. In addition, the location of the certified shoreline, related shoreline setback requirements, and residential height limits for single family residences will ensure that the proposed residence will not be built upon the existing basaltic shoreline bench which represents a scenic open space area.

The State CZM objectives are implemented in Hawaii County primarily by the Hawaii County Planning Commission and the Hawaii County Planning Department. One aspect of their implementation has been the establishment of special management areas and the application of a special review process for development projects or land uses proposed within these geographical areas. The State CZM objectives are reiterated in the administrative rules of the Hawaii County Planning Commission and serve as the Commission's general criteria for project review.

The Vaughan property is located within the special management area that has been defined by the County of Hawaii. For this reason, the applicant will have to comply with the County SMA permitting requirements for the proposed uses on her property.

3.5.3 State Land Use Designations

The project site is situated in an area designated for "conservation" uses (Figure 3-3). Chapter 205-2 of the Hawaii Revised Statutes indicates that conservation districts

"...shall include areas necessary for protecting watersheds and water sources; preserving scenic and historic areas; providing park lands, wilderness, and beach reserves; conserving indigenous or endemic plants, fish and wildlife, including those which are threatened or endangered; preventing floods and soil erosion; forestry; open space areas whose existing openness, natural condition, or present state of use, if retained, would enhance the present or potential value of abutting or surrounding communities, or would maintain or enhance the conservation of natural or scenic resources; areas of value for recreational purposes; other related activities; and other permitted uses not detrimental to a multiple use conservation concept."

Lands located in State conservation districts are administered by the State Department of Land and Natural Resources (DLNR).

3.5.4 State Administrative Rules Governing Land Uses Within Conservation Districts Title 13, Sub-Title 1 Administration, Chapter 2 Conservation Districts

DLNR has established administrative rules for approving or disapproving land uses within State conservation districts. Further, it has more recently defined protective, limited, resource, general, and special subzones that have been mapped by DLNR. The subzone designations are accompanied by defined planning objectives and separate lists of permitted uses.

These administrative rules indicate that all land uses within the conservation district must be approved by the Board of Land and Natural Resources via an application for a conservation district use permit.

The project site is part of larger shoreline area that has been designated as a resource subzone. Within this type of subzone, the planning objective is to develop areas to ensure the sustained use of the natural resources. Further, resource subzones will include:

1. lands necessary for providing future parkland and lands presently used for national, state, county, or private parks;
2. lands suitable for growing and harvesting of commercial timber or other forest products;
3. lands suitable for outdoor recreation;
4. offshore islands of the State of Hawaii;
5. lands and territorial waters below the upper reaches of the wash of waves, usually evidenced by the edge of vegetation, or by the debris left by the wash of waves; and
6. all territorial water not assigned to any subzone.

Permitted uses include aquaculture, artificial reefs, commercial fishing operations, emergency warning or telephone systems; flood, erosion or siltation control projects; the maintenance and protection of desired vegetation, including the removal of dead, deteriorated and noxious plants; marine, plant and wildlife sanctuaries; and other related uses.

The proposed project is consistent with the permitted uses of the resource subzone. The proposed residential use will include the maintenance and protection of desired vegetation such as an endangered grass specie and other mature trees. In addition, the landowner's intent to landscape selected portions of her property will involve a long-term commitment to the removal of dead, deteriorated and noxious plants on the property.

The guidelines and conditions established under the DLNR rules (DLNR Rule 13-2-21) are also addressed by the proposed project. Construction of the residence and support facilities will avoid potential impact of existing archaeological features, an endangered grass specie, and other mature trees on the property. Consequently, these resources will be retained.

The natural beauty and open space quality of the 3.6-acre property will also be retained. The proposed residence will use a limited amount of the property for the construction of the proposed residence and support facilities. Proposed landscaping will further add to the natural beauty of the property without adversely impacting other botanical resources.

The proposed facilities will conform with local building codes and State Department of Health water storage and wastewater disposal requirements. The proposed access road will be approximately 14-foot wide.

3.5.5 Hawaii County General Plan

The Hawaii County General Plan, and related land use pattern allocation guide and facilities maps, recommend a general development pattern for the Island of Hawaii. The plans also outlines recommended policies, objectives for resort, residential, commercial, industrial and agricultural development.

Similar to other shoreline properties between Hawaiian Beaches and Hawaiian Paradise Park subdivisions, the land use pattern map for the Puna district recommends use of the immediate shoreline, e.g., roughly 400 feet inland, as an open area. The remaining portions of the project site, and all surrounding properties, are designated for use as orchards.

3.5.6 Hawaii County Zoning

Hawaii County zoning designates the project site for agricultural use (A-1a). Within agricultural-zoned districts, one single family dwelling is permitted per building site. Consequently, existing zoning would allow a maximum of three residences on the 3.6-acre property.

CHAPTER FOUR ANTICIPATED ENVIRONMENTAL CONSEQUENCES AND PROPOSED MITIGATIVE MEASURES

4.1 PHYSICAL IMPACTS

4.1.1 Site Clearing of Existing Vegetation

4.1.1.1 Removal of Selected Exotic Trees and Shrubs

The proposed construction of a single family residence and various support facilities will involve the limited removal of some exotic grasses, trees and shrubs. Selected hand-clearing will be made through the use of machetes, chain-saw, and other small hand tools.

The proposed residence will be situated in an open grassy area that is about 200 feet inland of the certified shoreline. In contrast, the proposed generator shed (near the old Government Beach Road), driveway, and gazebo will require somewhat more clearing due to their location within more vegetated areas of the property.

The removal of selected vegetation will not alter the present views of the shoreline which is presently not visible from the property's mauka boundary along the old Government Beach Road. Views of the shoreline are available from neighboring properties to the north which have been cleared for pasturage and residences. Dense vegetation within the Vaughan property will continue to block any shoreline views despite the removal of selected exotic trees and shrubs.

4.1.1.2 Recommended Mitigation

Since an endangered perennial or annual, i.e., Ischaemum byrone, is located in an area near the certified shoreline boundary, the building contractor should cordon off this area (about 10 to 12-feet in diameter) to ensure that the perennials are not impacted by any site clearing, equipment mobilization, or other construction related activities. It is recommended that survey flagging material or other construction flagging material be used to advise laborers of this more sensitive area.

The hand clearing and removal of selected grasses, shrubs and trees should be made during periods of limited rainfall in order to reduce the potential for newly-exposed soils to erode and transport sediments to the inshore waters. While soils in the vicinity of the proposed residence are limited, selected site clearing would best be accomplished during the drier months of May through October.

It is also recommended that a portion of the vegetation removed during site clearing be stockpiled seaward of the proposed building site during the course of construction. This precautionary measure will provide a barrier for erosion that might occur via heavier rainfall periods.

4.1.2 Changes in Visual Quality

4.1.2.1 Landscaping

The visual quality of the site will change somewhat with the introduction of additional trees, shrubs and flowers to the Vaughan property. However, this impact is not viewed as adverse; the plants selected for landscaping are believed to be compatible with existing botanical resources.

4.1.2.2 Residential Construction

Inland views from the shoreline to the interior of the property will also be modified. However, the visual character of the adjacent shoreline that primarily contains beach naupaka and ironwood trees will be preserved since the proposed residence and other support facilities will be constructed, at least, 60 feet inland of the certified shoreline.

4.1.2.3 Recommended Mitigation

None required.

4.1.3 Increases in Residential Noise Levels

4.1.3.1 Construction Noise

Temporary increases in noise levels will occur along the old Government Beach Road during and following construction of the proposed residence. Trucks typically generate sound levels ranging from 85 to 95 dB(A) within 50 feet of the source. Results from past noise studies from other Big Island locations suggest that average day-night sound levels (Ldn) along the old Government Beach Road probably range from roughly 40 to 50 Ldn. Limited noise levels is due to the largely undeveloped nature of the area which is influenced primarily by natural sounds, e.g., surf, and the infrequent passing of vehicles.

The temporary increase in noise is expected to slightly increase average day-night sound levels during the initial mobilization of construction materials along the Road to the project site and the transport of a few laborers to the property over a three-month period. However, the average Ldn is not expected to exceed 50 Ldn.

4.1.3.2 Occasional Use of Propane Gas Generator

Following construction of the residence and various support facilities, the occasional operation of the propane gas generator will increase sound levels along the Beach Road. However, this impact will be nominal since the generator will be housed within a small generator shed. In addition, most of the electrical power to the residence will be provided through the use of a bank of DC batteries; consequently, operation of the generator will only occur when adequate power is not available from the DC batteries or the bank of batteries being maintained.

4.1.3.3 Recommended Mitigation

The building contractor should either insulate the proposed generator shed with sound-proofing material or assemble a prefabricated sound enclosure for the propane gas generator housing.

The impact of temporary construction noise will be mitigated somewhat by limiting construction activities during daytime hours.

4.2 CULTURAL IMPACTS

4.2.1 Residential Construction in the Vicinity of Archaeological Resources

4.2.1.1 Potential Damage to Selected Archaeological Features and Subsurface Cultural Deposits

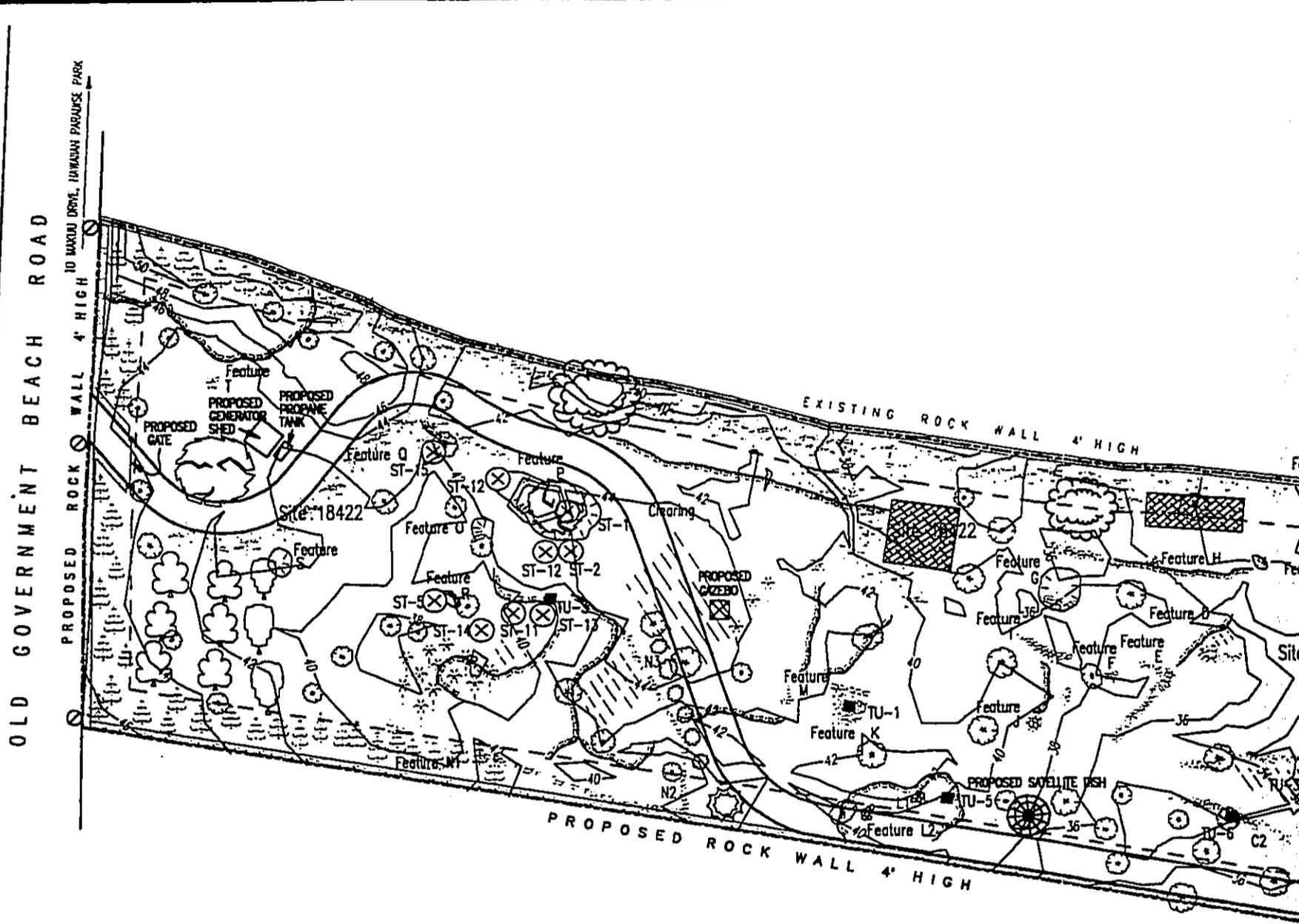
The proposed construction of a new residence and support facilities will not impact any surface archaeological features since all features on the property will be preserved by the landowner (Figure 4-1). This commitment is feasible, in concert with proposed construction, since all surface features have already been identified, mapped, as well as flagged in the field by Paul H. Rosendahl, Ph.D., Inc. (PHRI). The building contractor for the proposed project will be required and advised by the landowner to not construct any facilities or perform any construction related activities within or on existing archaeological features.

4.2.1.2 Recommended Mitigation

Based upon the findings of the archaeological inventory survey by Paul H. Rosendahl, Ph.D., Inc. (PHRI), no further data recovery activities are required at this time. PHRI data collection recommendations are deemed necessary only if specific archaeological features would be affected by the proposed residential development (Appendix B). However, the State Historic Preservation Division has requested the applicant to provide a detailed preservation plan that must include interim and long-term resource management measures.

In terms of short-term mitigation, the building contractor will coordinate his layout of the building site with Paul Rosendahl, Ph.D., Inc. (PHRI). A qualified archaeologist from PHRI will be onsite prior to construction after the contractor has flagged the location of the proposed residence and support facilities. Subsequently, PHRI will document its findings and provide documentation to the State Historic Sites Division and the Hawaii County Planning Department.

Long term resource management measures will be outlined in the detailed preservation plan that will soon be submitted to the State Historic Preservation Division.



PROPOSED LANDSCAPING

-  NORFOLK PINE TREE
-  PALM TREE
-  AVOCADO TREE
-  GARDENIA BUSHES
-  FRUIT TREE
-  FLOWERING TREE
-  VEGETABLE GARDEN

EXISTING VEGETATION

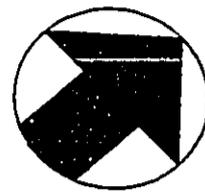
-  IRONWOOD TREE
-  BANYAN TREE
-  COCONUT TREE
-  MANGO TREE
-  ISCHAEMUM BYRONE
-  PUHALA TREE

MISCELLANEOUS FACILITIES

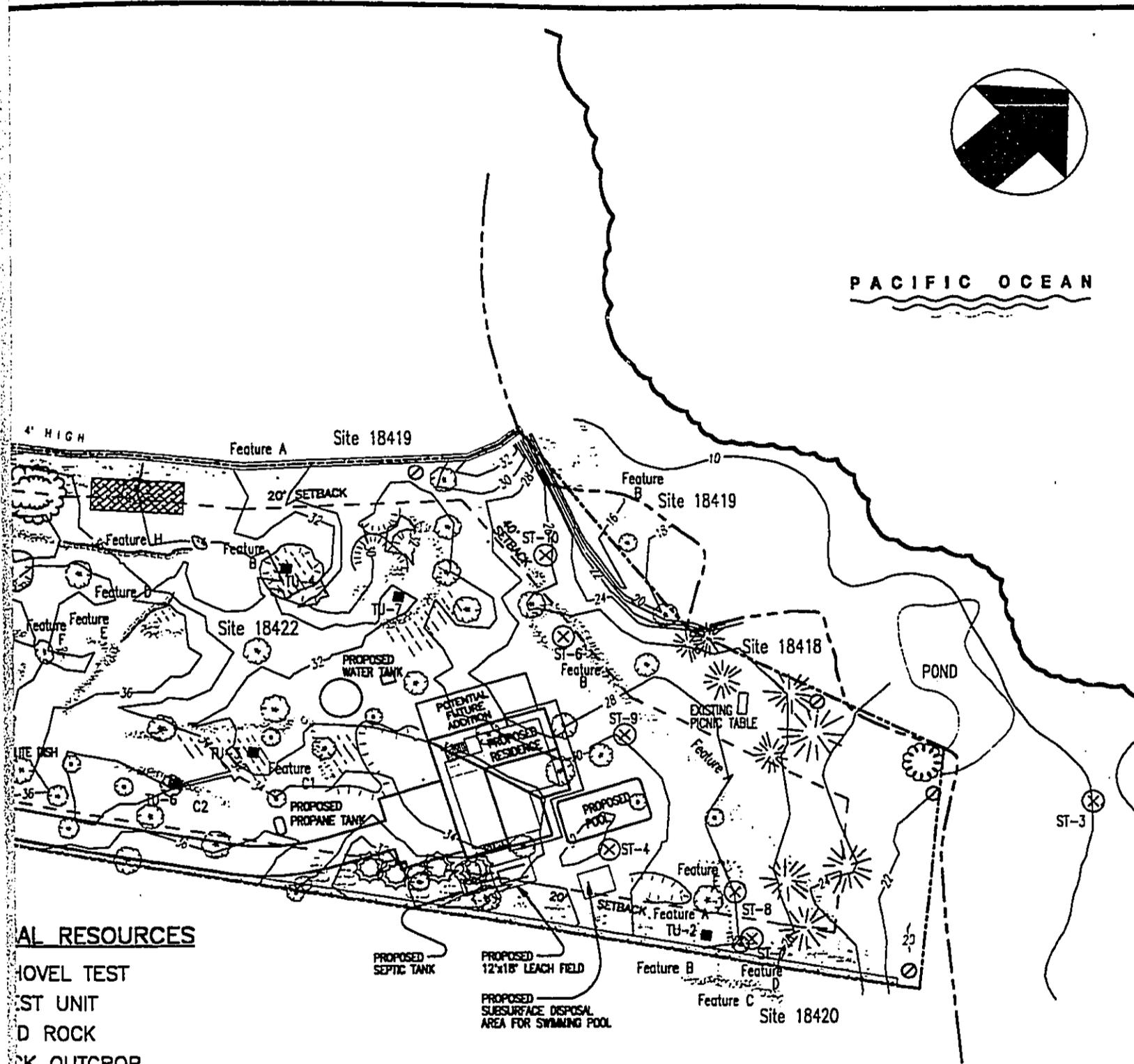
-  NO TRESPASS SIGN

ARCHAEOLOGICAL RESOURCES

-  ST- SHOVEL TEST
-  TU- TEST UNIT
-  STACKED ROCK
-  BEDROCK OUTCROP
-  DEPRESSION / COLLAPSED
-  LEVEL AREA



PACIFIC OCEAN



AL RESOURCES

- NOVEL TEST
- ST UNIT
- D ROCK
- CK OUTCROP
- SION / COLLAPSED BLISTER
- AREA

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ARCHAEOLOGICAL RESOURCES and PROPOSED SITE PLAN
VAUGHAN RESIDENCE

Scale: 1" = 60' March 23, 1993

FIGURE
4-1

4.3 NOTICE OF DETERMINATION

The proposed construction of a single family residence and support facilities on the Vaughan property will not generate any significant impact on the physical, biological and cultural resources of the project site. In addition, the landowner has committed herself to carrying out all recommended mitigative efforts outlined in Chapter Four of this environmental assessment. Consequently, the preparation of an environmental impact statement is not required.

Significant archaeological resources are the primary environmental resource on the property. However, no adverse consequences are anticipated since these resources can effectively be preserved in their present locations. Adequate building sites, that contain no archaeological features, are available on the property. The commitment to preservation of all archaeological features will be ensured prior to construction by a qualified archaeologist who will inspect the proposed building sites, document their location, and provide written confirmation to the State Historic Sites Division and the Hawaii County Planning Department.

The perennial, Ischaemum byrone, is another resource consideration. This plant, which soon may be designated as an "endangered" specie, is located in a small area along the certified shoreline. However, this resource will also not be impacted since no facility construction or mobilization activities will occur in the area. As a precautionary measure, the landowner will require her building contractor to cordon off the area and restrict any construction activities where this plant is located.

Other potential impacts are also viewed as insignificant. Some mitigation will be achieved for limiting construction noise.

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- State of Hawaii. **HAWAII REVISED STATUTES, CHAPTER 205, LAND USE COMMISSION.** State of Hawaii. Honolulu, Hawaii.
- University of Hawaii Department of Geography. 1983. **ATLAS OF HAWAII, SECOND EDITION.** University of Hawaii Press. Honolulu, Hawaii.

REFERENCES (CONTINUED)

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United States Department of Agriculture Soil Conservation Service. December, 1973. **SOIL SURVEY OF ISLAND OF HAWAII, STATE OF HAWAII.** U.S. Government Printing Office. Washington, D.C.

Wagner, Warren; Herbst, Derral; and Sohmer, S.H. 1990. **MANUAL OF THE FLOWERING PLANTS OF HAWAII, VOLUMES 1 AND 2.** University of Hawaii Press and Bishop Museum Press. Honolulu, Hawaii.

APPENDIX A
CONSULTATION
WITH
AGENCIES AND ORGANIZATIONS

JAMES PEDERSEN
PLANNING CONSULTANT
P.O. Box 22
19-3950 Keonelehua Road
Volcano, Hawaii 96785-0022
Tel/Fax: (808) 967 - 7619

September 16, 1992

SAMPLE 2-PAGE CONSULTATION LETTER
MAILING LIST FOLLOWS

Ladies and Gentlemen:

SUBJECT: Proposed Vaughn Residence
Puna, Hawaii
TMK: 1-5-10:29

Ms. Susan Vaughn, a resident of the Island of Hawaii, is in the midst of preparing an environmental assessment that will provide the State Board of Land and Natural Resources with supplemental information necessary to review a related conservation district use application (CDUA) for proposed single family residence on her shoreline property (Figure 1).

During preparation of an environmental assessment, Title 11, Chapter 200, of the Hawaii Administrative Rules requires that applicants should consult with agencies, organizations, citizen groups and individuals having jurisdiction or expertise relating to a proposed project. This letter represents a more formal approach to obtain your concerns and comments prior to preparation of the draft environmental assessment.

Ms. Vaughn intends to construct a new two-story residence for her personal use that will contain approximately 2,600 square feet of floor area. Various site improvements (Figure 2) that would support the proposed residential use include the following:

- a ferro cement water storage tank;
- a septic tank;
- generator shed;
- propane gas tank;
- swimming pool;
- a three-foot high rock wall;
- satellite dish; and
- landscaping of selected areas.

The present 3.6+ acre site is presently undeveloped. Hala (pandanus) trees represent the predominant overstory. However, naupaka, ironwood trees, and scattered coconut trees characterize the area mauka of a wide basaltic shoreline.

Archaeological sites have been located on the site. These resources have already been surveyed by Paul Rosendahl, Ph.D., Inc. This information will be presented in the environmental assessment. No improvements would damage or remove any of these sites.

County Planning Department
September 16, 1992
Page 2

The project site is not served by any public or private utilities. The beach road that adjoins the mauka boundary of the project is an unimproved dirt and cinder road.

Adjacent lands are presently undeveloped; however, residential and pasture uses are in the vicinity of the project site.

With this preliminary information, we invite you to provide written comments concerning any planning issues or concerns that you have regarding the proposed project. Your input will be reviewed and evaluated by the owner and her consultants during the preparation of the environmental assessment. In addition, your written comments will be incorporated into the draft environmental assessment document. Please send any correspondence to:

Ms. Sandra P. Schutte, Attorney-at-Law
Roehrig, Roehrig, Wilson, Hara, Schutte & De Silva
101 Aupuni Street, Suite 124
Hilo, Hawaii 96720

We thank you for insights and comments. Should you have any questions, feel free to contact me at your convenience.

Regards,

Jim Pedersen
Principal Planner

cc: Ms. Susan Vaughn, Keaau, Hawaii
Ms. Sandra Schutte, Attorney-at-Law, Hilo, Hawaii

VAUGHAN CONSULTATION LETTERS
MAILING LIST

County of Hawaii
Planning Department
25 Aupuni Street
Hilo, Hawaii 96720

University of Hawaii
Environmental Center
2550 Campus Road, Crawford 317
Honolulu, HI 96822

County of Hawaii
Department of Public Works
25 Aupuni Street
Hilo, Hawaii 96720

Paradise Hui Hanalike
SR 11,007
Keaau, HI 96749

County of Hawaii
Dept. of Water Supply
25 Aupuni Street
Hilo, Hawaii 96720

Puna Community Council
P. O. Box 1294
Pahoa, HI 96778

State of Hawaii
Dept. of Land & Natural Resources
1151 Punchbowl Street
Honolulu, HI 96813

Sandra Schutte, Attorney
Roehrig, Roehrig, et al
101 Aupuni St., Ste 124
Hilo, HI 96720

State Historic Preservation Div.
Dept. of Land & Natural Resources
33 South King St., 6th Floor
Honolulu, HI 96813

Susan Vaughn
SR 10045
Keaau, HI 96749-9203

State Dept. of Health
1251 Punchbowl Street
Honolulu, HI 96813

State DOH Environmental Mgt Div
500 Ala Moana Blvd.
Five Waterfront Plaza, Suite 250
Honolulu, HI 96813

Office of State Planning
250 South Hotel St., 4th Floor
Honolulu, HI 96813

Office of Hawaiian Affairs
711 Kapiolani Blvd., Suite 500
Honolulu, HI 96813

Paradise Hui Hanalike

1/28/92

SR 11000
Keaau, Hawaii 96749

24-September-1992

Sandra P Schutte, Attorney
Roehrig, Roehrig, Wilson, Hara,
Schutte & De Silva
101 Aupuni St., Ste 124
Hilo, HI 96720

Re: Pedersen Letter Concerning TMK: 3-1-5-10-29
Proposed Vaughn Residence

Dear Ms Schutte:

In response to Mr. Pedersen's letter of 16-September-1992, regarding the proposed Vaughn residence adjacent to our subdivision, Hawaiian Paradise Park. Paradise Hui Hanalike has no authority over land outside of our subdivision. However, the only access to this property is over Kaku'u Drive which is a private roadway owned by Paradise Hui Hanalike and maintained by all property owners in Paradise Park. The road fees for using this private roadways per property owner is currently \$39.60 for 1992. The current owner of this property, Mr. Charles L. Lizama, Jr, thus far as failed to pay the 1992 assessment. Billing is from February to February.

We have asked adjacent property owners to our borders that only have access to our roadways to pay the current road maintenance that is charged each lot owner in Paradise Park. This fair share assessment helps with the upkeep of the roadways and a share in the liability exposure lot owners have. Non-payment can lead to denial of access from our roadways to adjacent properties and other access routes not involving Paradise Park roads would have to be used. Considering the small amount of money in question, it would be to Ms. Vaughn's advantage to contribute to the road maintenance fund.

In the case of her wishing to avail herself of our roadways, we would need the 1992 maintenance paid, her current address for billing purposes and her assurance that she will keep us informed of any change in address or ownership in the future.

If you have any questions please call our office between 7:00am and 3:30pm, Monday through Friday, 966-4500. Thank you for your inquiry.

Sincerely,


Gordon McKay, President

GMCK/gb

JAMES PEDERSEN
PLANNING CONSULTANT
P.O. Box 22
Volcano, Hawaii 96785-0022
Tel/Fax: (808) 967 - 7619

July 12, 1993

Mr. Gordon McKay, President
Paradise Hui Hanalike
SR 11000
Keaau, Hawaii 96749

Dear Mr. McKay:

SUBJECT: CDUA Application and Related Draft Environmental Assessment
Proposed Vaughn Residence (TMK: 1-5-10:29)

Thank you for your response to our letter September 16, 1992 that requested your comments concerning the subject project.

We appreciate your request for the collection of road assessment fees from Ms. Susan Vaughn and other adjacent property owners even though her property is not located within Hawaiian Paradise Park.

It is our understanding that she has already paid the 1992 assessment of approximately \$40 that was never paid by the previous landowner. In addition, she has also paid a 1993 assessment fee for about \$45 and provided you with her current mailing address.

Your comments will be incorporated into the final environmental assessment for this project.

Regards,


Jim Petersen
Principal Planner

cc: Sandra Pechter Schutte, Attorney-at-Law



OFFICE OF STATE PLANNING

Office of the Governor

MAILING ADDRESS: P.O. BOX 2441 HONOLULU HAWAII 96824-2441
STREET ADDRESS: 200 SOUTH HOTEL STREET, 7TH FLOOR
HONOLULU, HAWAII 96813-3600
TELEPHONE: (808) 587-3244, 587-3600

FAX: (808) 587-3649
FACSIMILE: (808) 587-3641

November 20, 1992

Ms. Sandra P. Schutte, Esq.
Roehrig, Roehrig, Wilson, Iara, Schutte & DeSilva
101 Aupuni Street, Suite 124
Hilo, Hawaii 96720

Dear Ms. Schutte:

Subject: Proposed Vaughn Residence
Puna, Hawaii
TMK: 1-5-10: 29

It is our understanding that Ms. Susan Vaughn intends to construct a two-story residential structure with approximately 2,600 square feet of floor area on a 3.6-acre shoreline site within the State Conservation District.

The project site, as well as adjacent properties, are not served by public or private utilities. The beach to access the property is an unimproved dirt and cinder road.

The Office of State Planning is concerned about the proliferation of residential structures within the Conservation District. The land ownership pattern in the area suggests that there may be many more residential units contemplated for the future. Eventually, the demand for public services and facilities will be very difficult, if not impossible to satisfy, given other areas with much higher priority on the Big Island.

Thank you for the opportunity to comment.

Sincerely,

Norma Wong
Norma Wong
Acting Director

cc: William W. Paty
Norman K. Hayashi
Susan Vaughn
James Pedersen

JAMES PEDERSEN
PLANNING CONSULTANT
P.O. Box 22
Volcano, Hawaii 96785-0022
Tel/Fax: (808) 967 - 7619

July 12, 1993

Ms. Norma Wong, Acting Director
Office of State Planning
Office of the Governor
P.O. Box 3540
Honolulu, Hawaii 96811-3540

Dear Ms. Wong:

SUBJECT: CDUA Application and Related Draft Environmental Assessment
Proposed Vaughn Residence (TMK: 1-5-10:29)

Our thanks for your providing comments to our initial consultation letter concerning this project. Your letter of November 20, 1992 indicates your general concern for the proliferation of residential structures within the Conservation District, potential increased residential development along the Puna coastline, and the related demand for public services.

Increased residential development along the Puna coast is gradually occurring. This demand reflects public demand for more affordable shoreline properties which are considerably more expensive on other islands throughout the State.

The applicant, Ms. Susan Vaughn, is very aware of the lack of public services along the Puna coast. The more remote nature of this area is attractive to the applicant. In addition, she has prepared design and construction plans that assume her responsibility for installing onsite systems for rainwater water collection and storage, electrical power generation and distribution, propane gas storage, and a septic tank and related absorption bed for wastewater treatment. Consequently, the applicant will not be generating any demand for the extension of public services, such as utilities, to her property. She understands that her use of other public facilities, e.g., library, will require her travel to nearby community areas such as Kenau and Hilo.

We will incorporate your comments into the final environmental assessment for this project.

Regards,

Jim Pedersen
Jim Pedersen
Principal Planner

cc: Sandra Pechter Schutte, Attorney-at-Law



DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAII
 25 AUPUNI STREET • HILO, HAWAII 96720
 TELEPHONE (808) 969-1421 • FAX (808) 969-6396

RECEIVED

DEPARTMENT OF WATER SUPPLY
 STATE OF HAWAII

RS

May 11, 1993

Mr. Keith W. Ahue
 State of Hawaii
 Conservation and Environmental Affairs
 P.O. Box 621
 Honolulu, HI 96809

CONSERVATION DISTRICT USE APPLICATION
 APPLICANT - SUSAN VAUGHAN # HA-2644
 TAX MAP KEY 1-5-10:29

Please be informed that the proposed subdivision is not within the service limits of the Department's existing water system facilities.

William Sewake
 Manager

WA

RECEIVED
 1993 MAY 11 11 0:31

CDUA

011. 1.

24/10

JAMES PEDERSEN
 PLANNING CONSULTANT
 P.O. Box 22
 Volcano, Hawaii 96785-0022
 Tel/Fax: (808) 967 - 7619

July 9, 1993

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

Dear Mr. Sewake:

SUBJECT: CDUA Application and Related Draft Environmental Assessment
 Proposed Vaughan Residence (TMK: 1-5-10:29)

We appreciate your taking the time to provide comments to the CDUA application and related draft environmental assessment for this project. While your comments raised no issues or recommendations regarding the proposed project, we will include a copy of your May 11, 1993 letter within the final environmental assessment.

Regards,

Jim Pedersen
 Jim Pedersen
 Principal Planner

cc: Sandra Pechter Schutte, Attorney-at-Law

2330

JAMES PEDERSEN
PLANNING CONSULTANT
P.O. Box 22
Volcano, Hawaii 96785-0022
Tel/Fax: (808) 967 - 7619

July 9, 1993

Mr. Brian J.J. Choy, Director
State Office of Environmental Quality Control
220 South King Street
Fourth Floor
Honolulu, Hawaii 96813

Dear Mr. Choy:

SUBJECT: Draft Environmental Assessment
Proposed Vaughan Residence (TMK: 1-5-10:29)

Thank you for taking the time to review the draft environmental assessment for this project. Your letter of May 12, 1993 advised us to consult with the U.S. Fish and Wildlife Service and the State Division of Forestry and Wildlife.

Subsequently, I contacted Mr. Loyal Mehrhoff, Listing Coordinator for Endangered Species, of the USFW Pacific Islands Office in Honolulu. Mr. Mehrhoff indicates that the perennial, *Jaschmum byrson*, remains as a proposed endangered plant specie which may be approved by late August, 1993.

We also contacted the State Division of Forestry and Wildlife in Hilo. Mr. Rod Oshiro recommended that we provide some field markings in the vicinity of the 12-foot diameter area along the shoreline prior to construction. A similar mitigative measure is recommended on page 4-1 of the draft environmental assessment for the project. We have also sent a letter (copy attached) to Mr. Charles Wakida, DOFAW manger in Hilo, in the event that other staff members wish to provide additional recommendations for mitigation.

Regards,

Jim Pedersen
Jim Pedersen
Principal Planner

cc: Sandra Pechter Schulte, Attorney-at-Law



STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
220 SOUTH KING STREET
FOURTH FLOOR
HONOLULU, HAWAII 96813
TELEPHONE 595-1118
FAX 595-1119
May 12, 1993

The Honorable Keith W. Ahue, Chairperson
Board of Land and Natural Resources
P. O. Box 621
Honolulu, Hawaii 96809

Attention: Roy Schaefer, OCEA (HA-2644)

Dear Mr. Ahue:

Subject: Draft Environmental Assessment for the Vaughn Single Family Residence and Related Improvements, Puna, Hawaii

Thank you for the opportunity to review the subject document. We have the following comment.

Please consult with the agencies listed below regarding the endangered plant located within the subject property:

- 1) U.S. Fish and Wildlife Service; and
- 2) Division of Forestry and Wildlife.

If you have any questions, please call Jeyan Thirugnanam at 586-4185.

Sincerely,

Brian J. Choy
Brian J. J. Choy
Director

c: Susan Vaughn
Sandra Pechter Schutte

RS

C/C EA

JAMES PEDERSEN
PLANNING CONSULTANT
P.O. Box 22
Volcano, Hawaii 96785-0022
Tel/Fax: (808) 967 - 7619

July 9, 1993

Mr. Charles Wakida, Manager
Division of Forestry and Wildlife
State Department of Land and Natural Resources
P.O. Box 4849
Hilo, Hawaii 96720

Dear Mr. Wakida:

SUBJECT: CDUA Application and Draft Environmental Assessment
Proposed Vaughan Residence (TMK: 1-5-10:29)

Thank you for taking the time to review the application and environmental assessment for this project. We have noted your concurrence to preserve the coastal trail complex "as is". Your comments and conclusions outlined in your May 19, 1993 memorandum to Mr. Wayne Ching will be incorporated into the final environmental assessment for the project.

The recent review of the draft environmental assessment for this project by the State Office of Environmental Quality Control generated OEQC's recommendation that we consult with the State Division of Forestry and Wildlife concerning an endangered plant within the subject property.

The draft environmental assessment for this project, dated March, 1993, notes the presence of a perennial or annual, Ischaemum byrson, near the certified shoreline boundary of this property. In the spirit of this commitment, the owner of the property has already contoured off a 12-foot diameter area where the proposed endangered plant is located. It should be noted that the U.S. Fish and Wildlife Service proposed this plant for endangered specie status in late 1992. However, approval is expected in late August, 1993.

The draft environmental assessment recommends mitigation that includes the flagging of this area during construction to advise laborers of this more sensitive area. Should you have any other comments or other recommendations, please advise us at your earliest convenience.

Regards,

Jim Pedersen
Principal Planner

cc: Sandra Pechter Schulte, Attorney-at-Law
Biran J. J. Choy, Director, State OEQC

93 MAY 21 11:11 AM
FBI

May 19, 1993

RS

MEMORANDUM:

TO: Wayne Ching, Resource Management Forester *Wayne Ching*
THRU: Michael G. Buck, Administrator
FROM: *Charles K. Wakida* Charles K. Wakida, Hawaii Forestry & Wildlife Manager
SUBJECT: File No. HA-4/21/93-2644, TWK 1-5-10:29 Single Family Residence and Related Improvements Halona and Popokai Puna, Hawaii. Applicant: Susan Vaughan

DOFAW has no objections to the proposed residential construction and improvements. Na Ala Hale concurs with the preservation of the coastal trail complex "as is."

Evidence:

I concur.

M. G. Buck
Michael G. Buck



CDUA 14(3)

DOC. NO. 7419E

Date: May 12, 1993

File No.: HA-4/21/93-2644

Comment and Recommendation
The proposed project will not adversely impact our State Highway System.

339

REX D. JOHNSON
DIRECTOR
DEPT. DIRECTORS
JOYCE T. O'NEIL
AL PANG
JEANNE K. SCHULTZ
CALVIN M. TSUDA
IN REPLY REFER TO:

HHV-PS
2.6835



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
100 FRENCHBOVA STREET
HONOLULU, HAWAII 96813-5007
MAY 20 1993

RS

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

FROM: Rex D. Johnson, Director
Department of Transportation

SUBJECT: CONSERVATION DISTRICT USE APPLICATION, # HA-2644
SINGLE FAMILY RESIDENCE AND RELATED IMPROVEMENTS
HALONA AND POPOKI, PUNA, HAWAII
THK: 1-5-10: 29

Thank you for your memorandum of April 29, 1993, requesting our review of the subject application.

Our response is noted on the attached page 3 of your three-page form.

Enclosure

Signature: _____

JAMES PEDERSEN
PLANNING CONSULTANT

P.O. Box 22
Volcano, Hawaii 96785-0022
Tel/Fax: (808) 967 - 7619

July 9, 1993

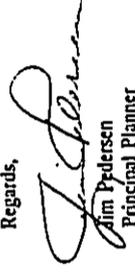
Mr. Rex Johnson, Director
State Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

Dear Mr. Johnson:

SUBJECT: CDUA Application and Related Draft Environmental Assessment
Proposed Vaughan Residence (TMK: 1-5-10:29)

We appreciate your taking the time to provide comments to the CDUA application and related draft environmental assessment for this project. While your comments raised no issues or recommendations regarding the proposed project, we will include a copy of your May 20, 1993 letter within the final environmental assessment.

Regards,



Jim Pedersen
Principal Planner

cc: Sandra Pechter Schutte, Attorney-at-Law

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

FILE NO.: HA-4/21/93-2644
 180-Day Exp. Date: 10/18/93
 SUSPENSE DATE: 21 Days
 DOC. NO.: 2672

APR 29 1993

DIVISION OF AQUATIC RESOURCES	
Planning	<input checked="" type="checkbox"/>
Regulatory	<input checked="" type="checkbox"/>
Research	<input type="checkbox"/>
Public Affairs	<input type="checkbox"/>
Permitting	<input checked="" type="checkbox"/>
Monitoring	<input type="checkbox"/>
Education	<input type="checkbox"/>
Enforcement	<input type="checkbox"/>
Technical Support	<input type="checkbox"/>
Administrative	<input type="checkbox"/>

State of Hawaii
 Department of Land and Natural Resources
 DIVISION OF AQUATIC RESOURCES

Date: May 20, 1993

TO: Paul Kawamoto, Aquatic Resources & Environmental Protection
 FROM: Richard Sixberry, Aquatic Biologist
 SUBJECT: Comments on Conservation District Use Application, HA-2644

Comment Requested by: Edward E. Henry, Acting Administrator
 Date of Request: 04/29/93 Rec'd. 04/29/93

Summary of Proposed Project

Title: Single Family Residence
 Project by: Ms. Susan Vaughn
 Location: Halona & Popoki, [Puna] Hawaii

Brief Description:
 The applicant proposes to construct a single family dwelling with accessory structures and improvements on a 3.6 acre oceanfront parcel located about 1.3 miles from the makai end of Hakuu Drive in the Hawaiian Paradise Park subdivision.

The shoreline consists of vertical basaltic cliffs extending 25 feet above low water line. No fishing or recreational activities have been noted at the site. However, more attractive and accessible fishing areas are located about one mile north of the applicant's property.

Comments:

The proposal as described should not significantly impact aquatic resource values provided construction activities are restricted to periods of minimal rainfall and low runoff, and the areas denuded of vegetation or susceptible to erosion are appropriately stabilized. Further, precautionary measures should include preventing construction materials, petroleum products, wastes, debris, and eroded soil from entering the coastal waters.

MEMORANDUM

TO: Aquatic Resources; Conservation & Resources Enforcement; Forestry & Wildlife; Historic Preservation; Land Management; Natural Area Reserves System; State Parks; Water and Land Development; Water Commission; Boating and Ocean Recreation

FROM: Edward E. Henry, Acting Administrator
 Office of Conservation and Environmental Affairs
 Div. of Aquatic Resources

SUBJECT: REQUEST FOR COMMENTS
 Conservation District Use Application

APPLICANT: Susan Vaughn

FILE NO.: HA-4/21/93-2644

REQUEST: Single Family Residence and Related Improvements

LOCATION: Halona and Popoki, Puna, Hawaii

TRK(s): 1-5-10: 29

PUBLIC HEARING: YES ___ NO X

DO CARE: Please conduct a field inspection on this project. Should you require additional information, please call Roy Schaefer at 7-0383. Please note this is a three-page form. Page 2 is to be limited to your factual responses. Page 3 is to be used for comment and recommendation. Page 3 is not available for public review.* (*Refer to OIP Memorandum dated July 18, 1991 to Board of Land and Natural Resources.)

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

Attachment(s)

Edward E. Henry
 5/21/93

RS

APR 29 1993

RECEIVED

JAMES PEDERSEN
PLANNING CONSULTANT
P.O. Box 22
Volcano, Hawaii 96785-0022
Tel/Fax: (808) 967 - 7619

July 9, 1993

Mr. Paul Kawamoto
Aquatic Resources & Environmental Protection
State Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Kawamoto:

SUBJECT: CDUA Application and Related Draft Environmental Assessment
Proposed Vaughan Residence (TMK: 1-5-10:29)

We appreciate the time that you and Mr. Richard Sixberry have taken to provide comments to the CDUA application and related draft environmental assessment for this project. We also thank you for providing recommendations for project mitigation.

We concur with your precautionary measures relating to erosion and the disposal of wastes into the nearshore coastal waters, as well as your conclusion that the project will not significantly impact aquatic resource values. The geological and soil characteristics of the project site and proposed construction plans do not suggest any significant potential for these impacts. However, we believe that it is prudent to incorporate these mitigative measures to ensure compliance by the applicant and her building contractor. The recommendations outlined in Mr. Sixberry's May 20, 1993 memorandum to you will be incorporated into the final environmental assessment.

Regards,


Jim Pedersen
Principal Planner

cc: Sandra Pechter Schulte, Attorney-at-Law

Stephen K. Yamashiro
Mayor



County of Hawaii
DEPARTMENT OF PUBLIC WORKS
25 Arapaho Street, Room 201 - Hilo, Hawaii 96720-4151
(808) 961-3311 • Fax: (808) 969-1134

Donna Ely K. Niyoshi
Chief Engineer
Riley W. Smith
Deputy Chief Engineer

June 3, 1993

RS

MR. KEITH W. AHUE
DEPARTMENT OF LAND AND NATURAL RESOURCES
P O BOX 621
HONOLULU HI 96809

SUBJECT: CONSERVATION DISTRICT USE APPLICATION FOR A SINGLE FAMILY
RESIDENCE AND RELATED IMPROVEMENTS
Application No.: HA-4/21/93-2644
Location: Halona and Papoiki, Puna, Hawaii
TMK: 3rd Div./1-5-10: 29

We have reviewed the subject application and have the following comment:
1. Building shall conform to all requirements of code and statutes pertaining to building construction.

GALEN M. KUBA, Acting Division Chief
Engineering Division

STT:byf

JAMES PEDERSEN
PLANNING CONSULTANT
P.O. Box 22
Volcano, Hawaii 96785-0022
Tel/Fax: (808) 967 - 7619

July 9, 1993
Mr. Galen Kuba
Acting Division Chief
Engineering Division
Department of Public Works
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Kuba:
SUBJECT: CDUA Application and Related Draft Environmental Assessment
Proposed Vaughan Residence (TMK: 1-5-10:29)

We appreciate your taking the time to provide comments to the CDUA application and related draft environmental assessment for this project. We also thank you for your reminder that the proposed residential building will need to conform to all code requirements and statutes relating to building construction.

We will include a copy of your June 3, 1993 letter within the final environmental assessment.

Regards,

Jim Pedersen
Principal Planner

cc: Sandra Pechter Schutte, Attorney-at-Law

1993 JUL 13 10 51 AM
COUNTY OF HAWAII

Mr. Ed Henry
page 2

1. A detailed preservation plan (scope of work) shall be developed by the applicant and must be approved by the State Historic Preservation Division. This plan must include interim protection measures during construction and include long-term management measures.

We do have a few minor comments, summarized in Attachment 1, on the report. Replacement pages should be submitted to correct these points, to complete the inventory survey report on file. If your office should have any further questions, please contact Kanalei Shum at 587-0007.

KSmkh

c: Paul H. Rosendahl, PHRI
Virginia Goldstein, Planning Dept.

REC

JUN 10 1993

OCEA

June 3, 1993

LOG NO: 8214
DOC NO: 9303ks27

MEMORANDUM

TO: Ed Henry, OCEA

FROM: DON HIBBARD, Administrator
State Historic Preservation Division

SUBJECT: CDVA HA-2644—Single Family Residence and Related Improvements,
Susan Vaughan
Halona (Popoki), Puna, Island of Hawaii
TMK: 1-5-10-019

RS

Our office has reviewed the report (PHRI Ms Report 1240-112992: "Archaeological Inventory Survey, Vaughan Residential Parcel (TMK: 1-5-10-29), Lands of Maku'u, Popoki, and Halona, Puna District, Island of Hawaii" Charvet-Pond and Rosendahl 1992), received February 10, 1993, documenting the results of an archaeological inventory survey conducted in the subject property.

We believe that the parcel was adequately covered during the survey, with a total of 5 historic sites 18418 (coastal trail), 18419 (walls), 18420 (habitation/possible Hawaiian burial complex), 18421 (2 bait cups), and 18422 (a complex of agricultural features and a possible Hawaiian burial platform). We agree that sufficient information has been recorded to evaluate the significance of these sites, and we agree that sites 18418, 18420, and 18422 are significant for their information content (criterion D) and may also be culturally significant (criterion E). We also agree that sites 18419 and 18421 have been sufficiently recorded and can now be considered to be "no longer significant" if we receive photographs of these two sites. Thus, 3 significant historic sites are present.

The applicant agrees to preserve all the significant historic sites, and we find that this form of mitigation will have "no adverse effect" on the 3 sites. However, because one of the possible sites may be a burial, the Hawaii Island Burial Council may have to vote on the proposal at some point should any action other than preservation be proposed. To ensure the commitment to a "no adverse effect" is carried out, we recommend the following condition be attached to any approved permit:

ATTACHMENT I

NEEDED REVISION OF

PHRM Report 1240-112992

*"Archaeological Inventory Survey
Vaughan Residential Parcel (TMK: 3-1-5-10: 29)
Lands of Makua, Popoia, and Halona, Puna District
Island of Hawaii"*

Charvet-Pond and Rosendahl (December 1992)

1. Figure 2 on page 6 shows that there are 2 ST-12, one located in feature P and one in feature O of site 18422. This needs correction.

2. On page 15, a minor editorial correction: there is no site 18518.

3. Page 26, second column, sites 18418-B and 19422-C1 are listed in Appendix A as prehistoric in age and not as historic period features. If these are indeed historic features, then the Appendix A age designation should be changed. Site 18418-C, however, is listed as historic in Appendix A and this feature is described as an agricultural clearing mound, a function that is more suited to prehistoric than historic age.

4. We think that the complex of features in site 18420 is more likely a coastal permanent habitation site than an agricultural heiau or ritual site. Only basaltic glass and no basalt artifacts were recovered from the project area. These findings would suggest activities related to habitation rather than any large scale truly agricultural ones that would require a heiau association. This point does not require a response but should be incorporated as a possible research design in the data recovery program.

JAMES PEDERSEN
PLANNING CONSULTANT
P.O. Box 22
Volcano, Hawaii 96785-0022
Tel/Fax: (808) 967 - 7619

July 15, 1993

Mr. Don Hibbard, Administrator
State Historic Preservation Division
State Department of Land and Natural Resources
1151 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Hibbard:

SUBJECT: CDUA Application and Related Draft Environmental Assessment
Proposed Vaughan Residence (TMK: 1-5-10:29)

We are receipt of your inter-departmental memorandum dated June 3, 1993 to Mr. Ed Henry (DOC NO.9305ks27) concerning this CDUA application and related draft environmental assessment. We thank you for taking the time to review the related archaeological inventory survey report, that was prepared by Paul H. Rosendahl, Inc. in December, 1992, and for taking the time to provide your comments and recommendations.

We concur with your recommendations for the preparation of a detailed preservation plan that would outline interim and long-term management measures. The applicant, Ms. Susan Vaughan, has agreed to provide this information as a condition to any approved CDUA permit.

Regards,


Jim Pedersen
Principal Planner

cc: Sandra Pechter Schulte, Attorney-at-Law

92-350
Mr. James Pedersen
October 23, 1992
Page 2

JOHN G. LEWIS, M.D.
DIRECTOR OF HEALTH



STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3279
HONOLULU, HAWAII 96811

In reply, please refer to:
92-350/epo

October 23, 1992

Mr. James Pedersen
Planning Consultant
P.O. Box 22
19-3950 Keonelehua Road
Volcano, Hawaii 96785-0022

Dear Mr. Pedersen:
Subject: Proposed Vaughn Residence
Puna, Hawaii
THK: 1-5-10: 29

Thank you for allowing us to review and comment on the subject project. We have the following comments to offer:

Wastewater

Ms. Susan Vaughn intends to construct a new two-story residence for her personal use that will contain approximately 2,600 square feet of floor area. Various site improvements that would support the proposed residential use include the following: a ferro cement water storage tank; a septic tank; generator shed; propane gas tank; swimming pool; a three-foot high rock wall; satellite dish; and landscaping of selected areas. The subject project is located in the critical wastewater disposal area as determined by the Hawaii County Wastewater Advisory Committee. Consequently, no new cesspools are allowed in the subject area.

As there is no existing sewer service system in the area and none will be constructed in the near future, the Department of Health (DOH) recommends the use of a treatment individual wastewater system meeting the requirements of the DOH Administrative Rules, Chapter 11-62, "Wastewater Systems."

All wastewater plans must conform to applicable provisions of the DOH Administrative Rules, Chapter 11-62, "Wastewater Systems." We reserve the right to review the detailed wastewater plans.

If you should have any questions on this matter, please contact Ms. Lori Kajiwara of the Wastewater Branch at 586-4290.

Drinking Water

1. The proposed residence is located above the Underground Injection Control (UIC) line which means that there is an underground source of drinking water beneath the property.
2. According to our records, there are no water wells within 1/4 of the site.
3. The source of potable water and irrigation water should be identified.
4. Will sewage effluent be used for irrigation?
5. The designed maximum wastewater flows should be identified.
6. The location of the recommended septic tank and the sewage effluent disposal area(s) should be depicted on the proposed site plan.
7. The disposal method of the swimming pool water and filter backwash water should be identified.
8. The draft environmental assessment should address installing a concrete slab floor in the proposed generator shed to facilitate the clean-up of accidental spills of fuel or oil.
9. Any plans for the construction of underground storage tanks should be disclosed.
10. Any plans for future dwellings at the site or to subdivide the existing parcel should be addressed.
11. Environmentally-sensitive ecosystems, such as anchialine ponds or tidal pools within or near the proposed site, should be identified and examined for possible effects the development will have on them.
12. Erosion control measures for the grading operations should be identified.
13. Plans for the disposal of any increase in storm water runoff due to the development of the project should be identified.

Please be advised that injection wells will not be allowed for the disposal of sewage effluent if the design flow exceeds 1000 gallons per day (gpd). Also, if injection wells or drywells are planned to be constructed to dispose of swimming pool water, filter backwash water, storm water runoff or any other type of



2222

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



RECEIVED

Mr. James Pedersen
October 23, 1992
Page 3

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

93 JUN 1 11:57

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 2770
HONOLULU, HAWAII 96820
SPECIAL SERVICES
STATE OF HAWAII

In reply, please refer to:
92-350/epo

June 23, 1993

fluid, the owner will be required to obtain an UIC permit to authorize the construction and the operation of the injection well.

For more information regarding the UIC permitting process, please contact Morris Uehara of the Safe Drinking Water Branch at 586-4258.

Due to the fact that preliminary plans are the sole basis of our comments, we reserve the right to impose future environmental restrictions on the project at the time final plans are submitted to the Department for review.

Very truly yours,

John C. Lewin
JOHN C. LEWIN, M.D.
Director of Health

c: Wastewater Branch
Safe Drinking Water Branch

To: The Honorable Keith W. Ahue, Chairperson
Department of Land & Natural Resources
From: John C. Lewin, M.D. *John C. Lewin*
Director of Health
Subject: Conservation District Use Application
Applicant: Susan Vaughan
File No.: HA-4/21/93-2644
Request: Single Family Residence
Location: Halona and Popoki, Puna, Hawaii
TKK: 1-S-10: 29

Thank you for allowing us to review and comment on the subject request. We have the following comments to offer in addition to the comments that we made in our letter dated October 23, 1992, addressed to Mr. James Pedersen (copy attached).

Wastewater

As there is no existing sewer service system in the area, the Department of Health (DOH) concurs with the planned use of a 1,000 gallon septic tank with an absorption bed to be constructed on-site.

All wastewater plans must conform to applicable provisions of the DOH's Administrative Rules, Chapter 11-62, "Wastewater Systems," and we reserve the right to review the detailed plans.

If you should have any questions on this matter, please contact Ms. Lori Kajiwara of the Wastewater Branch at 586-4280.

Attachment

Facsimile Transmittal memo 7071 of page 4			
To	From	Date	
Winnie	Roy Schickel	11/23/92	
By	DLHR/COE	587-0389	
Phone	587-0389	587-0390	

JAMES PEDERSEN
PLANNING CONSULTANT
P.O. Box 22
Volcano, Hawaii 96785-0022
Tel/Fax: (808) 967 - 7619

July 12, 1993

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

Dear Dr. Lewin:

SUBJECT: CDUA Application and Related Draft Environmental Assessment
Proposed Vaughan Residence (TMK: 1-5-10-29)

Thank you for your correspondence of June 23, 1993 (92-350/epo) and earlier letter dated October 23, 1992. These letters provided a useful supplement to our internal check-list for environmental issues and data requirements for this project. In response, we believe that each of the relevant issues has been addressed in both the CDUA application and related draft environmental assessment.

The applicant and her sanitary engineer, Aqua/Waste Engineers, will continue to coordinate more detailed plans and specifications with your Department's Wastewater Branch. In addition, we will incorporate your comments to this project within the final environmental assessment.

Regards,


Jim Pedersen
Principal Planner

cc: Sandra Pechter Schutte, Attorney-at-Law

APPENDIX B

**PHRI
ARCHAEOLOGICAL INVENTORY
SURVEY REPORT**

**Archaeological Inventory Survey
Vaughan Residential Parcel
(TMK: 3-1-5-10:29)**

**Lands of Maku'u, Popoki, and Halona
Puna District, Island of Hawaii**

PHRI

Paul H. Rosendahl, Ph.D., Inc.

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**Archaeological Inventory Survey
Vaughan Residential Parcel
(TMK: 3-1-5-10:29)**

**Lands of Maku'u, Popoki, and Halona
Puna District, Island of Hawaii**

by

Ann Charvet-Pond, M.A.
Project Supervisor

and

Paul H. Rosendahl, Ph.D.
Principal Archaeologist

Prepared for

Susan Kay Vaughan
HCR 10045
Keaau, Hawaii 96749

December 1992

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PHRI

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P.O. Box 23305 • G. M. F., Guam 96921 • (671) 472-3117 • FAX (671) 472-3131

SUMMARY

At the request of Susan Kay Vaughan, Paul H. Rosendahl, Ph.D., Inc. (PHRI) recently conducted an archaeological inventory survey within the 3.6-acre Vaughan Residential Parcel (TMK:3-1-5-10:29) site, located in the Lands of Maku'u, Popoki, and Halona, Puna District, Island of Hawaii. The site is on the shoreline, within a Special Management Area (SMA) (cultural and natural resources in SMA areas are administered by the State of Hawaii). The archaeological investigation was conducted in connection with the proposed construction of a personal dwelling and ancillary structures.

The current work included (a) a review of archaeological and historical documentary background research; (b) 100%-coverage, variable-intensity surface survey of the entire project area; (c) limited subsurface testing; and (d) analysis of field and historical research data and preparation of appropriate reports. The overall objective of the survey was to provide information sufficient to meet the inventory-level survey requirements of the Department of Land and Natural Resources - State Historic Preservation Division (DLNR-SHPD).

During the current field work, five sites were identified: Site 18418, a prehistoric coastal trail; Site 18419, two historic cattle walls; Site 18420, a coastline terrace complex; Site 18421, two "bait cups" on a basalt bench; and Site 18422, a horticultural complex of 26 features. Portable remains identified in the project area comprised 59 volcanic glass artifacts. No hearths, charcoal, burials, or midden were encountered in the study area.

All identified sites and features were assessed in terms of federal and state evaluation criteria (cultural significance, research value, and value as a site type). Site 18418, a coastal trail, is assessed as significant for research value and as a relic of past Hawaiian lifeways (cultural value) and is recommended for further data collection and preservation "as is." Site 18420 (a complex with multiple functions) and Site 18422 (horticultural complex) were assessed as potentially significant for cultural value and significant for research value and were recommended for further data collection and provisional preservation "as is." The further data collection would be necessary only if the particular features that require such work are to be affected by the planned development. The remaining two sites, 18419 (rock walls) and 18421 ("bait cups" for fishing), were assessed as significant solely for information content and were recommended for no further work.

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INTRODUCTION

At the request of Susan Kay Vaughan, Paul H. Rosendahl, Ph.D., Inc. (PHRI) recently conducted an archaeological inventory survey within the 3.6-acre Vaughan Residential Parcel (TMK:3-1-5-10:29) site, located in the Lands of Maku'u, Popoki, and Halona, Puna District, Island of Hawaii. The overall purpose of the survey was to provide information sufficient to satisfy the historic preservation requirements of the County of Hawaii and Department of Land and Natural Resources - State Historic Preservation Division (DLNR-SHPD).

The project site is private property, and its owners have proposed constructing a personal dwelling and ancillary structures on the property. Ordinarily, a development plan for a personal residence on private property is not subject to archaeological review; however, the subject parcel is shoreline property in a Special Management Area (SMA), and thus requires such a review. Cultural and natural resources in SMA areas are administered by the State of Hawaii. SMA rules and requirements are adapted from federal and state guidelines and coastal regulations.

The field work for the current project was conducted 10-19 August 1992 under the supervision of Project Supervisor Ann Charvet-Pond, M.A. Assisting on the project were Project Supervisors Jim Head, B.A., and Martin Boudreau, B.A., and Field Archaeologists Sheryl Dowden, B.A., and Mike Fager, B.A. PHRI Cultural Resources Specialist Kepa Maly, an authority on native Hawaiian culture and ethnobotany, visited the project area for a few hours on the last day of field work. The field work required 200 labor-hours to complete.

SCOPE OF WORK

The basic purpose of the inventory survey was to identify all sites and features of potential archaeological significance present within the project area. An inventory survey comprises an initial level of archaeological investigation. Basically, it determines the presence or absence of archaeological resources and, if present, indicates their general nature and variety, and their general distribution and density. 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. 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 current survey were: (a) to identify all archaeological sites and site complexes present in the project area; (b) to evaluate the potential general significance of all identified archaeological remains; (c) to determine the possible effects of proposed development upon the identified remains; and (d) to define the general scope of any subsequent further data collection or other mitigation work that might be necessary.

Based on a review of available background literature, familiarity with both the region and specific project area, and the current requirements of review authorities; and based on discussions with Ms. Susan Kay Vaughan, the following specific tasks were determined to constitute an adequate scope of work for the inventory survey:

1. Review archaeological and historical documentary background research involving assessment and evaluation of readily available archaeological and historical literature relevant to the immediate project area;
2. Conduct a 100%-coverage, variable-intensity surface survey of the entire project area, with emphasis upon (a) relocation and evaluation of any previously identified sites, and (b) identification, recording, and evaluation of all newly identified sites;
3. Limited subsurface testing of selected sites and features in order to recover (a) samples of portable remains (artifacts and ecofacts), and (b) samples suitable for age determination analyses;
4. Analysis of field and background data, and preparation of appropriate reports.

The inventory survey was carried out in accordance with the standards for inventory-level surveys recommended by the DLNR-SHPD. These standards are currently used by the Hawaii County Planning Department as guidelines for review and evaluation of archaeological survey reports submitted in conjunction with various development permit

applications. The significance of all archaeological remains identified in the project area were assessed in terms of (a) the National Register criteria outlined 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. These criteria are used by DLNR-SHPD to evaluate eligibility for both the Hawaii State and National Registers of Historic Places. All sites were also assessed in terms of PHRI CRM (Cultural Resource Management) value modes, which are derived from the federal evaluation criteria. These modes are discussed in detail in the Conclusion section of this report.

PROJECT AREA DESCRIPTION

The project area is in the *ahupua'a* Maku'u, Popoki and Halona, on the east flank of Kilauea Volcano, approximately 1.4 miles southeast of the Makuu Street/Beach Road intersection in Paradise Park Subdivision (Figure 1). Specifically, the area is *makai* (seaward) of the Beach/Government Road, which bounds the project area on the southwest. The parcel is bounded on the northeast by the sea, on the northwest by Parcel 28 (Lot 4), and on the southeast by Parcel 29 (Lot 6). These parcels are part of a cluster of residential/farm lots; the lots are surrounded by Hawaiian Home Lands, and State of Hawaii lands. Prominent landmarks in the vicinity of the project area include Auwae Point, about 1.5 km northwest of the property, and Mokuopihi (Opihi Rock), an offshore rock about 0.75 km east of the project area. The Makuu Petroglyph Field (Site 50-10-45-4222) is about 0.5 km from the project area, on the other side of Government Road, toward Paradise Park Subdivision (USGS, Pahoa North Quad, 1981).

During the past year, in anticipation of the proposed construction of the dwelling and ancillary facilities, the project area was cleared of dense vegetation. During the clearing, several "gro-bags" were found. This may indicate

the area was once used (by non-owners of the property) to grow a few marijuana plants. The vegetation clearing was done by hand, using machetes, cane knives, and chain saws. Guava, lantana, and a few other introduced plants were removed. The clearing did not disturb the subsurface of the property, and it greatly facilitated locating and delineating surface archaeological features during the current survey. The clearing resulted in several huge refuse piles and at least 10-20 cm of ground litter. Many of the refuse piles were burned, resulting in perhaps half-a-dozen scorched areas scattered throughout the property. The client made every effort to locate the piles in open areas, away from archaeological structures. The burning did, however, affect a few archaeological structures. Specific structures affected are noted in Appendix A - Site Descriptions.

Certain areas of the parcel appear to have been disturbed by other activities. The area from the Government/Beach Road to about 32 meters seaward (105 feet) may have been disturbed in connection with road construction. Introduced vegetation is more abundant in this area, and there are scattered, geologically anomalous surface boulders in the area. In addition, only two amorphous archaeological features were identified in this area, even though the land is even, low-lying, and generally has deeper soil than elsewhere on the property. Other sections of the property have probably been cleared and minimally grubbed to create pasturage. Such clearing was suggested by a large grassy open area (site of the proposed housepad) and another smaller open area, both of which lacked trees or shrubs. The topsoil in both areas appeared disturbed, and soils were mixed with decomposing bedrock. Since there was no bulldozed pathway from Beach/Government Road to the open areas, and since the areas were not levelled and appeared only minimally grubbed, it is possible they were cleared using something other than a bulldozer; perhaps the area was cleared by chain-dragging, a technique that allows more selective clearing. Similar clearing appears to have occurred on the neighboring parcel to the northwest, which is separated from the project area by a historic cattle wall.

BACKGROUND

ENVIRONMENTAL SETTING

For more than two decades much scientific research in Hawaii and elsewhere has been increasingly directed toward investigating the complex interactions that occur between humans and their environment. The environment is seen as both influencing and constraining patterns of human settlement and social adaptation. In Puna, lava flows are fundamental features of the landscape, and surely affected human settlement in the region. The nature of the flows, their age, distribution, geology and soil patterns are summarized briefly below. Other environmental factors that would affect human settlement in the region are coastal access and the nature of the shoreline, availability of potable water, proximity of springs, streams, and bays, and amount of rainfall.

Geology

The most notable feature of Hawaii Island is its extremely active volcanism. Hawaii is the second largest volcanic island in the world. It consists of five coalesced volcanos—Kilauea, Mauna Loa, Mauna Kea, Hualalai, and Kohala. Mauna Kea is the highest, and the most central, while Mauna Loa is slightly lower but the largest by volume. Hualalai is the most western and Kohala the most northern. Kohala and Mauna Kea have not erupted for many hundreds of years, however, Hualalai last erupted about 1800, and Mauna Loa was very active in the 19th century and last erupted in 1984. Kilauea has been especially active in the 20th century, and its most recent eruptive phase has been almost continuous since the early 1980s, during which time lavas have been pouring out of various vents and fissures along the east rift zone—a linear swathe of tectonically disrupted terrain consisting of eruptive fissures, spatter cones, and open cracks. The axis of the east rift zone of Kilauea extends almost due east from Kilauea caldera to Cape Kumukahi at Kapoho and continues onto the Puna Ridge, a submarine ridge that extends for over 60 km out to sea. Nearly all of the Puna district is covered by Kilauea surficial lavas.

In recent years geologists associated with the Hawaii Volcano Observatory have been able to tentatively date the various lava flows on Hawaii. The dating was accomplished using a combination of techniques that included radiocarbon dating of woody residues along the margins of the various flows and paleomagnetic dating based on curves derived from the radiocarbon dates. It has been tentatively established that most of the surficial lavas of Puna are 700 years old or less, with the youngest lavas on the south side of the east rift axis

(south Puna). In south Puna much of Kilauea's surface lavas are geologically very recent; they date from the 18th century to present, and include the lavas from the ongoing eruption of Kilauea—which destroyed Kalapana and Kaimu in 1990. North of the east rift axis, the surface lavas of Puna are somewhat older. Aside from the 1840 flow, which inundated the lands of Kahuwai and Nanawale, most of the surface lavas in north Puna (the Ai-laau and Keauhou flows) have been dated to 350-500 BP (approximately AD 1450-1600). However, there are also several patches of even older surface lavas—areas that were not covered by the 1450-1600 flows—and some of these are quite extensive. These older lavas or *kipuka*, include the Kilauea Volcano flows (dated to 750-1,000 years BP [approximately AD 950-1200]) and lavas that probably emanated from Mauna Loa; the latter have been dated to 1,500-10,000 BP (8050 BC to AD 450). The older *kipuka* may be predominantly pahoehoe, aa, or ash, and are of particular interest to researchers because of their more well-developed soils and vegetation. The subject parcel is on one of the older *kipuka*—on a flow that has been tentatively dated to 1,500-10,000 BP. It is on the approximate interface of the old flow and the more recent Kilauea lavas dated to 350-500 BP (Holcomb 1987).

Elevation and Topography

Although Mauna Loa is over 13,000 feet in elevation (above mean sea level), the Puna District, on the southeast flank of Kilauea/Mauna Loa, extends from sea level to only to about 4,000 feet. The topography in the district consists of undissected uplands that rise gradually from sea level; there are no permanent streams. The basal aquifer for most of Puna consists of a freshwater lens floating on salt water, however some groundwater near the east rift is confined by dikes, and does not float on salt water. The district was once noted for its natural springs (Puna = spring). The shoreline is generally rugged, especially in north Puna where basalt cliffs drop sharply to the sea. South Puna generally has a more accessible shoreline that includes tidal pools areas and some gravelly beaches. Offshore of the east coast, in the area of the current study, there is a steeply sloping, deep, submarine valley. The east flank of the valley is the Puna Ridge, which extends some 60 km out to sea from Cape Kumukahi at Kapoho. From about Kaloli Point southeast through the project area, the steep offshore region is prone to massive submarine landslides (Mark and Moore 1987). The offshore coast of south Puna is also subject to submarine slides, and the shoreline has also been significantly altered by subsidence—especially that associated with the earthquake(s) of 1868.

Elevation in the current project area ranges from sea level to about 50 ft AMSL at the Government/Beach road. Lava deposits are successive swathes of ropy pahoehoe covering a gently sloping, but irregular terrain. Lava formations include natural elevated terraces, low-lying swales, pressure ridges, collapsed domes (blisters), fissures, buckled outcrops, and small rock overhangs. On the *mauka* end of the parcel by the Government/Beach road, the terrain is a gently sloping low-lying swale with generally deeper soils than found elsewhere on the property. On the seaward edge on the southeast side of the parcel, ropy pahoehoe slopes to a rocky outcrop, then levels off to a bare flat pahoehoe bench before dropping to the sea. On the northwest seaward edge of the property, the level terrain ends in a basalt cliff that drops precipitously to collapsed boulders about 5-8 m below; on the cliff face, remnant vegetation is clearly visible sandwiched between successive deposits of lava. For the most part, the pahoehoe is thinly covered with a layer of rich organic soil, deeper in the fissures, blisters, and cracks, and the *mauka* swale noted above, and sufficient to support a dense, varied vegetation.

Soils

The ropy pahoehoe outcrops are covered with about 10-20 cm of dark-brown to black silt loam; they are only occasionally completely bare and exposed. The soils are deeper in the swales, fissures and cracks, and in the collapsed blisters, and inside one or two small rock overhangs. The United States Department of Agriculture (USDA) has classified soil types in the region as Pahoehoe flow (rLW) or Opihikao Series (rOPE). The latter is described as well-drained, thin organic soils over pahoehoe bedrock. In a representative profile for Opihikao Series, the soil is very dark brown (7.5YR 2/2) muck about three inches (7.62 cm) thick; moderate, medium, and fine subangular blocky structure; friable, slightly sticky and slightly plastic, with matted roots and many fine pores; strongly acid, with an abrupt smooth boundary to the pahoehoe beneath (Sato et al. 1973). Deposits encountered in the study area conform well to the standard profile for Opihikao soils, the only exception being the somewhat greater thickness (depth) of the soils generally (about 10-20 cm), and in the cracks, fissures, and swales (as noted above). Standard (USDA) descriptions of soils encountered in test excavations are included in Appendix B.

Rainfall, Temperature

Annual rainfall in Puna ranges from 50-75 inches on the south coast to as much as 150-200 inches above Mountain View. In the project area, on the east coast, it ranges from 100-150 inches a year, with showers more frequent during the night and early morning, and during the winter months. Most

of this is orographic (mountain-caused) rainfall that results when moist currents move inland from the sea on the prevailing northeast tradewinds. The average maximum temperature for Puna, taken at Mountain View, is about 80 degrees Fahrenheit; however, at lower elevations average temperatures may be somewhat higher (Armstrong 1983).

Flora, Fauna

For the most part, elevation, temperature, rainfall, and substrate determine the distribution and density of vegetation. Over the years several different schemes for defining the vegetation zones of the Hawaiian Islands have been proposed (Ripperton and Hosaka 1942; Selling 1948; Carlquist 1970; Fosberg 1972; Knapp 1975; Lamoureux 1976). Three major vegetation zones were defined for Windward Hawaii by Knapp (1975): the submontane rainforest ranging from sea level to 2,000 feet elevation, the montane rainforest from 2,000 to 5,000 feet, and the subalpine from 5,000 feet. The submontane zone, or coastal-lowland forest is characterized by mixed native and introduced trees including *ohia* (*Metrosideros collina*), *hala* (*Pandanus ordoratisissimus*), *kukui* (*Aleurites moluccana*), and guava (*Psidium* sp.), as well as various native and introduced grasses, ferns, and shrubs. Armstrong (1983) described a four-stage lowland forest succession for Kilauea, which progressed from rockland (fresh lava) to fernland (*uluhe* [*Dicranopteris linearis*]) to treeland (*ohia-uluhe*) to climax *ohia* forest.

In the project area vegetation is extremely dense, and includes thick strawberry guava (*Psidium cattleianum*), especially on the *mauka* end of the property near the road and near the historic wall. There are *hala* throughout the parcel with an especially dense thicket in the northwest quadrant. There are also two groves of coconut (*Cocos nucifera*), two mango trees adjacent to a historic wall, one large banyan (*Ficus* sp.) near the road, and ironwood (*Casaurina* sp.) at the shoreline. There were no 'ulu (breadfruit [*Artocarpus communis*]) or *kukui* on the property, although they were observed on neighboring parcels, as was the *ipu-haole*, the "white-man's" gourd (watermelon [*Citrullus vulgaris*]). In general, trees and shrubs were dense throughout the property, except in one large clearing on the east side of the parcel near the shoreline, and a smaller clearing on the west side of the parcel, which sustained only grasses (see Figure 2). Ground cover included abundant shampoo (wild) ginger (*Zingiber zerumbet*), *uluhe*, swordfern (*Nephrolepis* sp.), grasses (Graminae), and abundant *naupaka* (*Scaevola sericea*) at the basalt cliffs. Fauna in the project area includes *io* (Hawaiian hawk [*Buteo solitarius*]), owls of undetermined species, and feral pigs (*Sus scrofa*). 'A'ama crabs (*Grapsus tenuicrustatus*) were abundant on the basalt benches.

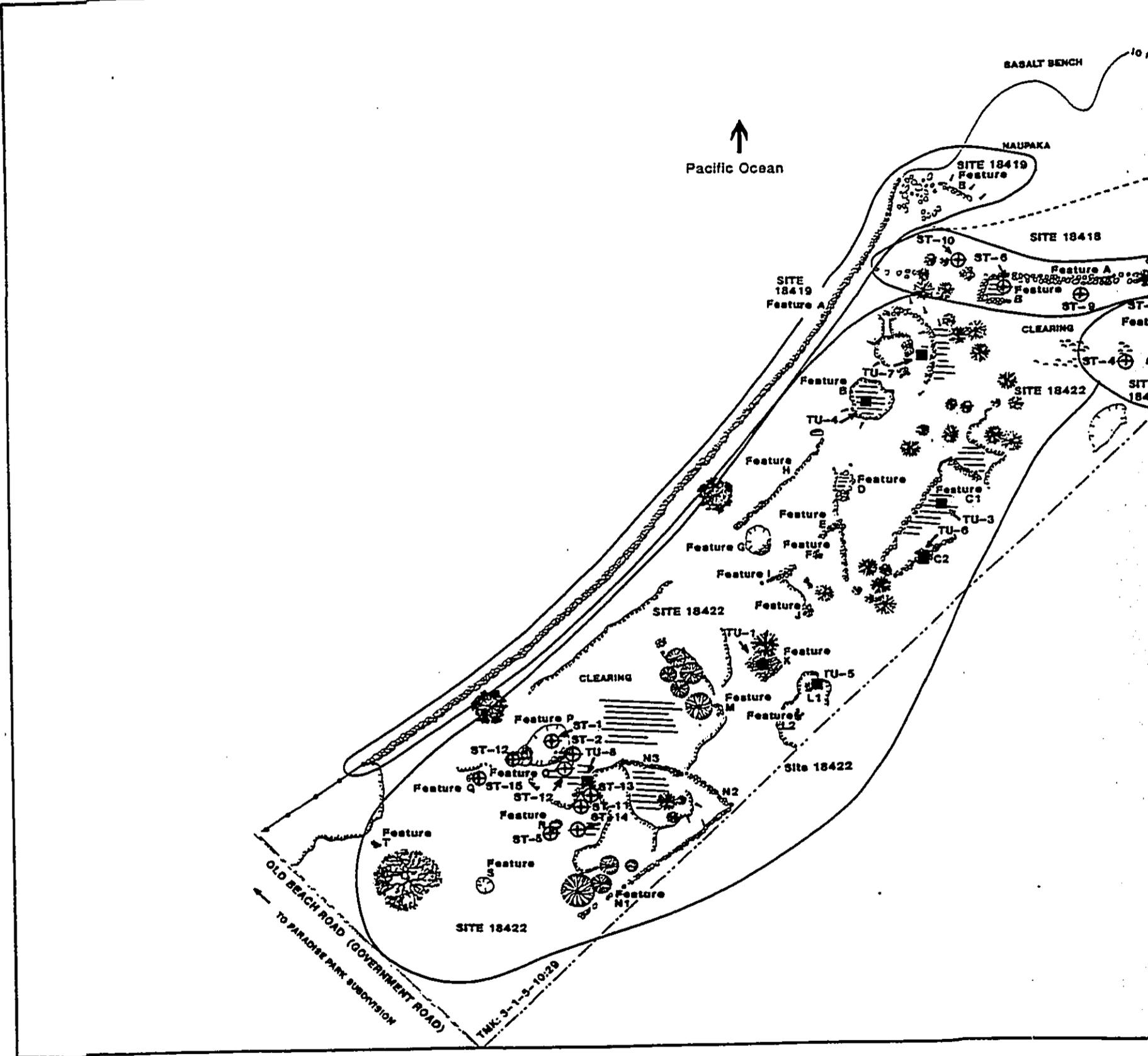
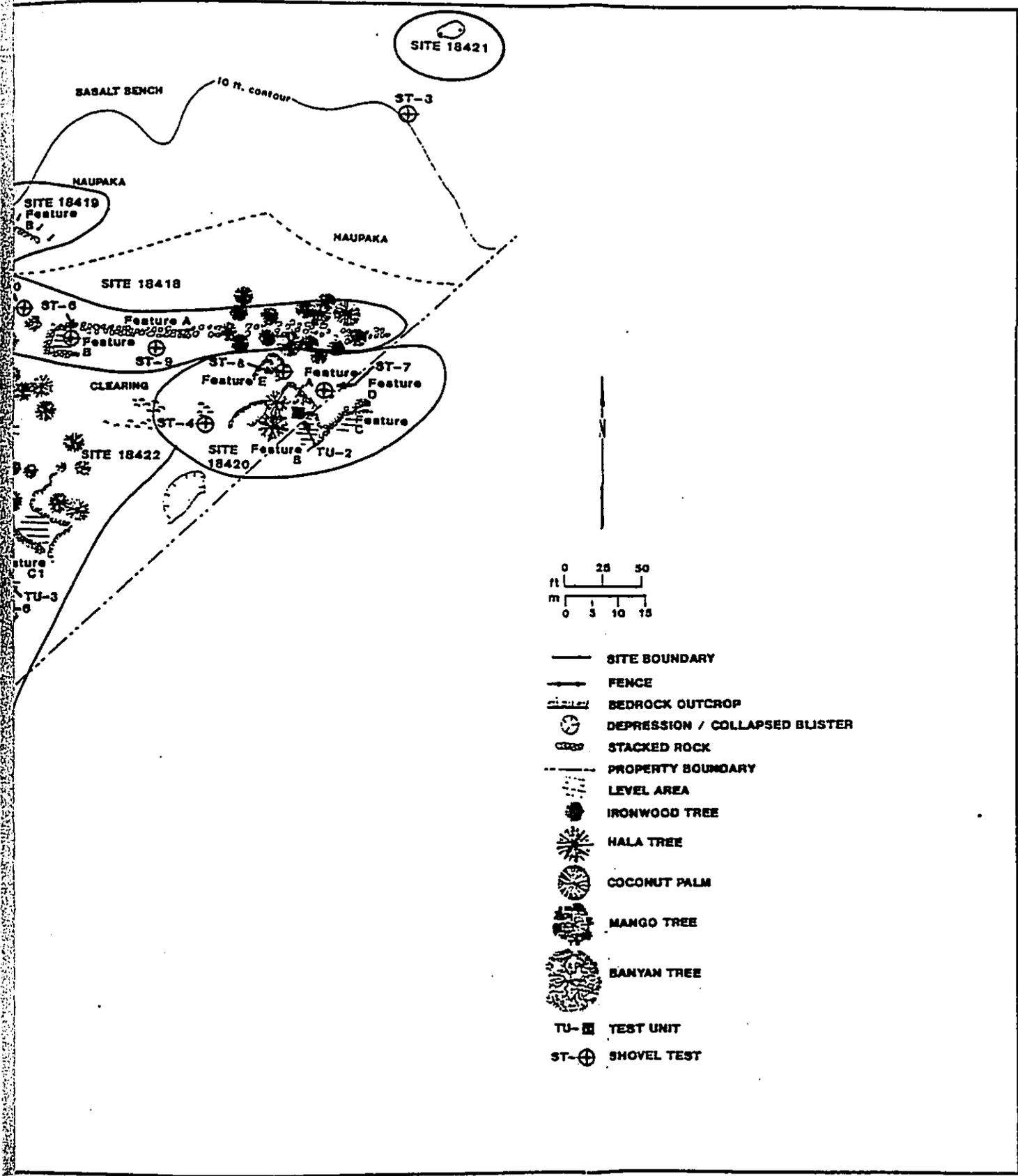


Figure 2. Locations and Plan Views of Sites

nd



Plan Views of Sites

CULTURAL SETTING

The Puna district is the easternmost ancient political land division of Hawaii Island. It is flanked by the Hilo district to the north, with its bay, well-developed soils, permanent streams, and comparatively large population, and Ka'u district to the south, with its extremely arid environment and its social history of rugged independence. Historic documentation and legends for both these districts are abundant. By comparison there is a dearth of historic documentation for Puna, and the little that is known of its past must be inferred from the brief accounts available.

Traditional information indicates that Puna was "once Hawaii's richest agricultural region and that it is only in relatively recent times that volcanic eruption has destroyed much of its best land" (Handy and Handy 1972:542). Legend tells of a chief of Puna, Keli'ikuku, who [was] very proud of his homeland:

While on Oahu, he boasted to a prophet of Pele, Kaneakalau, of the abundance and flourishing green vegetation of Puna. The prophet ridiculed him and told him that Pele had deserted the area. Keli'ikuku headed home and climbed the highest point for a view of Puna. He saw lava covering its fertile plains, and the forest burning as clouds of smoke poured out of the volcano. Pele had heard of his boasts and demonstrated they the land around her fire pit was dependent upon her will (Westervelt 1916:31-32).

Five indigenous land-use areas that are thought to reflect patterns of settlement in the early 19th century, have been identified for Hilo and Puna (McEldowney 1979); these are a coastal zone and four upland zones. Inland of the coast, in the "upland agricultural zone" an unbroken expanse of open parkland was dotted with dispersed dwellings and gardens, with groves of *hala* and breadfruit. Above this area, exploitation of the "lower forest zone" involved the gathering of forest resources, including wood, various fibers, and feathers, and the harvesting of supplemental food crops grown in clearings and along streams. Small temporary dwellings and shrines, and numerous paths were associated with these activities. At greater elevations, in the "rainforest zone," exploitation was largely limited to bird catching, with clusters of small temporary shelters associated with access trails, while at the highest elevations, in the "subalpine zone," a major trail system was present.

In the coastal zone, the area of the current study, indigenous land use involved habitation, gardening,

aquaculture, and various forms of marine exploitation. Settlements were isolated, or occurred as small widely spaced clusters, or as aggregates of households, the latter being typical of Hilo Bay and the six villages to the east along the Puna coast. These six villages were Kea'au or Haena, Maku'u, Wai'akahiula, Honolulu, Kahuwai, and Kula or Koa'e, and each consisted of dwellings and gardens of varying sizes and complexity. Marine resource exploitation, including fishing, shellfish gathering, and crabbing, would presumably have been a significant component of village life. Major cultigens included 'uala (sweet potato [*Ipomea batatas*]), *ki* (*Cordyline terminalis*), *noni* (*Morinda citrifolia*), and *ipu*. There were also extensive 'ulu, mountain apple (*Eugenia malaccensis*), and *hala* groves.

Platforms and walls were built to include and abut outcrops, crevices were filled and paved for burials, and the large numbers of loose surface stones were arranged into terraces. Most accounts mention the lack of readily available fresh water and discuss the presence of underground water in caves, the use of brackish water from coastal springs, and catchment schemes involving the use of ti leaves and calabashes to gather cave drips and rainfall (Ibid:17).

In the vicinity of the project area, in the Land of Waikahaheke to the north, are at least three complexes, suggesting a probable settlement, and one site, Ha-A2-3, a probable *heiau* (Ewart and Luscomb 1974). These sites are about one-half mile south of the Maku'u Street/Government Beach Road intersection on the *makai* side of the road (about one mile northwest of the project area). Similar complexes, also probable settlements, are noted for Maku'u Ahupua'a (not distinguished from Popoki and Halona in Ewart and Luscomb's survey). Other site types recorded for Maku'u were petroglyphs (including Site 10-45-4222, located about one quarter mile northwest of the project area, on the other side of Government Road, a coastal trail, historic burials, and other historic features.

One notable pattern of indigenous settlement is reflected in the utilization of lava tubes and caverns by Hawaiians for temporary shelters and permanent dwellings, as work areas for the making of tapa and canoes, canoe shelters, goatfolds, pigsties, gardens (Douglas 1914), shrines (Pickering 1840), and for burial and refuge (McEldowney and Stone 1991, and others). Extensive "cultural" cave complexes have been noted for Puna, most notably the Shipman Cave complex in Keaau (50-Ha-A1-11) and the Pahoa cave complex (50-10-55-14899 to 14903), and there are other smaller tubes or caverns scattered across the extensive pahoehoe flows. These features reflect a unique aspect of indigenous cultural adaptation; however, they also present certain difficulties in

terms of resource management, some of which will be addressed below.

Historic activity for the region centered around Hilo Bay. Four major historic periods of shifting economic and social patterns have been distinguished. The earliest was 1824-1848, and it was characterized by a still predominately Hawaiian population and culture, both of which were being modified through alien influences (missionary influences, western agricultural practices, disease). The next period, from 1848-1865, saw a reduction and dislocation of the Hawaiian people, the economic dominance of the whaling industry in Hilo, and concomitant alterations in agricultural practices that were associated with the provision of sweet potatoes, beef, sugar, and other agricultural products to the whaling ships. The period 1865-1895 saw an influx of immigrant labor, with economic activity centered around large-scale sugar production and cattle ranches. This period witnessed a reduction in diversified subsistence agriculture in Hilo, although in the Puna area small-scale farming still predominated within the context of a reduced numbers of villages and village inhabitants. After 1895, major economic, technological (railway, breakwater, electricity), and social developments, including the annexation of Hawaiian Islands, were in support of the sugar industry (McEldowney 1979).

In Puna, in the 20th century, in addition to sugar, other industries included ranching, quarrying, and the milling of lumber at Paho. In the 1950s several massive residential subdivisions were created from empty, unused lands; however, these have been only sparsely occupied until recently. These subdivisions currently function as "bedroom" communities for Hilo workers. Also in recent years, small-scale agriculture has made a resurgence in Puna, and there are now many flower farms that grow a variety of exotic blooms for export. Probably the most controversial current land use in Puna is for geothermal energy, and the proposed (and ongoing) development of plant facilities is a major political issue—the resolution of which is expected to have long-term impacts on the economic and social development of the district.

PREVIOUS ARCHAEOLOGY

Compared to other regions of the Hawaiian Islands, there have been few archaeological investigations in East Hawaii. Among them are various comprehensive surveys, none of them recent, that have been extensive in area but limited in scope. In the Puna District in particular, most recent studies have been conducted in connection with geothermal development in south Puna, on the rift zone, and these projects were largely limited to surveys of varying

levels of intensity. There have been even fewer formal investigations in north Puna, and these are of uneven quality and scope. In addition to these more formal surveys non-professionals and interested lay persons over the years have amassed a significant body of historical and archaeological data for Puna, most of which exists as field notes or unpublished manuscripts, and much of which is not easily accessible. The following are summaries of the published studies most relevant to the current investigation; they are in order of date of publication.

Hudson (1932)

In the early 1930s Alfred E. Hudson surveyed and inventoried archaeological sites on the east coast of Hawaii Island, from Waipio to Ka'u. A wide variety of structural remains were recorded, including *heiau*, platforms, caves, trails, and agricultural features. Hudson's data is available only in a draft typescript. Descriptions of the sites are very brief and lack detail; however, in spite of this limitation certain features were so distinctive that it was possible to tentatively identify some of Hudson's sites in subsequent surveys.

Ewart and Luscomb (1974)

In late 1973 Bishop Museum conducted a pedestrian survey of a proposed Kalapana-Keaukaha highway corridor; the corridor was 16 miles long, 2,000 feet wide, and extended from the Hilo-Puna district boundary through upper Puna to the Waiakahiula-Honolulu *ahupua'a* boundary. One hundred-eighteen sites were located within the corridor. Unfortunately, the scope of the project was limited, and the survey report includes only brief site descriptions and preliminary significance assessments. The accompanying site maps lacked the detail necessary to make locational correlations based on known landmarks; moreover, not all the sites encountered during the survey were plotted on the maps. Despite this, the authors made several interesting observations. It was suggested that prehistoric settlement patterns may have varied among the several *ahupua'a* in the survey corridor, and that settlement-pattern differences may have been due to variations of local topography, in particular the availability of canoe-landings, ground water from springs, natural wells, and low-lying areas. The authors concluded that the study area offered excellent research potential in terms of addressing Hawaiian economic patterns. As the reasons for the high research potential were not always made explicit in the survey report, they are enumerated below:

1. There has been comparatively little destruction of archaeological sites in the survey area [such

that the archaeological record may be presumed to be intact];

2. Sites within the survey area appeared to include both prehistoric and historic indigenous features, thus offering a unique opportunity to study the effects of western impact and the processes of cultural change;
3. The variations observed among the *ahupua'a* suggest that comparative studies would greatly enhance our understanding of the relationships between the natural environment, patterns of aboriginal settlement and resource exploitation, and economic practices.

McEldowney (1979)

In 1979 Bishop Museum conducted an archaeological and historical literature review in order to define and evaluate potential cultural resources in the Hilo region (resources that would be affected by proposed lava diversion alternatives). The scope of work included (1) a literature and data review, (2) an inventory of identified historic and prehistoric sites, (3) formulation of a predictive model for unidentified cultural resources, and (4) a research design and methodology for future archaeological work. McEldowney's regional settlement model was fundamental to the current research, and various aspects of the study are elaborated elsewhere in this report.

Komori (1987)

In February of 1987 Bishop Museum conducted a pedestrian survey of alternate routes for a proposed Pohoiki-Keaau transmission line corridor in Puna. The scope of work included the identification and evaluation of archaeological resources found in the proposed corridors. In keeping with the research design developed for the east Hawaii region, prehistoric sites encountered during survey were referenced to the predictive model for aboriginal settlement proposed by McEldowney (1979). All of the proposed transmission-line routes were within the area defined by McEldowney as Zone II, Upland Agriculture (approximately 50-1,000 ft AMSL).

In all, five agricultural sites, including walls, terraces, clearings, ditches, and modified outcrops, were encountered, and all were on or adjacent to ash or aa deposits dated to 1500+ BP. Other sites, including burial and refuge caves, petroglyphs and platforms, were on the more recent pahoehoe flows that have been dated to 350-500 BP. The author concluded that the settlement pattern model proposed by McEldowney was generally supported by the results of the survey, in that the predicted occurrence of extensive agricultural fields and

adaptation patterns were found to be closely related to physiographic features. In concluding remarks, Komori suggested that period of occupation of the sites was circa AD 1450 to the present, spanning the latter part of the Expansion Period (AD 1100-1650) and the Proto-historic period (AD 1650-1795), as defined by Kirch (1985). The establishment of agricultural complexes distant from primary areas of settlement on the coast sometime after AD 1450 was found to be consistent with Kirch's model for the evolution of Hawaiian culture.

Franklin et al (1992)

In February 1992 PHRI conducted an intensive survey, including aerial reconnaissance, surface survey, recording, and subsurface testing, of a 200-acre parcel in the *ahupua'a* of Waikahekahe and Waikahekahe Nui, North Puna District, in connection with proposed golf course development. The project area was entirely within the land-use region defined as Zone II, Upland Agriculture, by McEldowney (1979). Although there was evidently an extensive lava-tube system associated with the relatively recent bare pahoehoe lavas surrounding the project area, no lava tube openings were located on property. Two sites were recorded for the parcel; both were agricultural features located on Keaukaha soils, rather than bare pahoehoe. They were estimated to be 150-350 years old. The authors suggested that the proximity of several lava tube entrances to the agricultural sites suggested these features were used, and concluded that forested sections of the surrounding area would have provided an important part of the subsistence base for Hawaiians using the caves.

RESEARCH ORIENTATION

For the past twenty years or more, much of archaeological research in Hawaii has been directed toward an elucidation of the settlement patterns of ancient Hawaiian communities. As a research approach, settlement-pattern analysis has evolved from modern theoretical and methodological developments in American archaeology in general, and involves systematic investigation into the nature and development of human settlement over an entire landscape. Settlement theory is premised on the concept that human groups disperse themselves over the landscape in response to various environmental conditions and constraints, and according to various perceived social (cultural) distinctions.

Settlement Pattern Model

As part of a lava control study for Hilo and surrounding environs, Hawaii archaeologist Holly McEldowney developed a predictive model and research design for future archaeological

studies in East Hawaii. The model and the design was explicitly oriented toward investigating the relationships between human settlement and adaptation to Hawaii's unique environments (McEldowney 1979). Using 19th-century ethnographic data and a compilation of various vegetation-zone schemes defined for Hawaii, five land-use zones were proposed as a basis for a predictive model for the distribution of indigenous and historic cultural resources within Hilo and Puna. The study included the formulation of a research design and sampling methodology that addressed each zone in terms of its known and anticipated site types and distributions. The zones are:

- Zone I - Coastal settlement (0 to about 50 ft elevation)
- Zone II - Upland agriculture (50 to 1,500 ft)
- Zone III - Lower forest (1,500 to 2,500 ft)
- Zone IV - Rainforest (2,500 to 5,500 ft)
- Zone V - Subalpine (5,500 to 9,500 ft)

Indigenous adaptations and patterns of resource exploitation in the various zones have been described elsewhere (see Cultural Setting). In terms of predicting site frequency and distribution, it was anticipated that sites would be fewer in the three higher-elevation zones (III, IV, V) as historic documents research indicated that indigenous exploitation of upland resources probably did not involve significant or numerous modifications to the landscape. The upland zones were expected to have scattered shelters and access trails. In the upper zones, elevation, rainfall, and temperature, and the consequent distributions of vegetation and fauna, were seen as the most salient features affecting prehistoric land use. In the two lower-elevation zones, Zone I (coastal settlement) and Zone II (upland agriculture) it was expected that archaeological resources would be far more numerous—especially in the coastal area where settlement was associated with more-or-less immediate access to marine resources. It was also suggested that aboriginal dwellings, gardens, and other features would more likely be encountered in areas of deeper soils and more well-developed vegetation, and that deeper soils would be associated with older aa or ash substrates—areas that exist in north Puna largely as *kipuka* (see Environment). It is of interest to note that McEldowney did not consider the relocation of Puna coast villages listed by Hudson to be a high priority in terms of future work, as the presence of a "less favorable substrate (i.e., younger pahoehoe)" reduced the probability that a major site complex such as Kahuwai would be found (48-49).

Research Goals

Data addressed by the current study are referenced to the settlement-pattern model proposed by McEldowney (1979). Regional models are particularly necessary to contract

archaeological projects, as study areas are defined by the requirements of development rather than archaeological research considerations. The advancement of archaeological research dictates that data be meaningfully incorporated to a common body of reference, and a regional research model facilitates the integration of spatially diverse data sets into a common research framework, and permits assessment of localized settlement patterns and adaptations in terms of their larger implications—in this case, with respect to Puna as a whole, Hawaii Island, and settlement in the Hawaiian Island in general.

Although the research model proposed by McEldowney is largely directed toward an elucidation of prehistoric or early-historic aboriginal settlement, historic (post-1778) adaptations will be integrated into the analysis as appropriate. Research questions that may be addressed include:

1. What kinds of indigenous activities are indicated by the archaeological sites. What kinds of historic activities? How old are the sites, and how do they relate temporally? How are the sites distributed and what kinds of adaptive patterns are revealed.
2. Does the local pattern of aboriginal settlement indicated by the archaeology of the study area conform to the McEldowney's predictive model for Zone I coastal zone? If not, how does it differ? What do the differences mean in terms of revising the regional model for future research?
3. How has volcanic activity affected the nature, distribution, and density of prehistoric sites types in the study area? Historic site types? Given that the study area appears to be on an ancient lava flow, is there any empirical evidence to suggest that prehistoric settlement was continuous, or recurring, over many centuries? Or conversely, is there any evidence that would indicate that indigenous settlement was initiated late in prehistory, perhaps after Kilauea pahoehoe flows inundated more desirable agricultural lands inland?

METHODS AND SAMPLING

Survey

Extensive 100% ground-surface survey was accomplished with pedestrian sweeps. The sweep-lines

were oriented parallel to the long axis of the parcel beginning at the surveyor's stake at the south corner of the property on the Government/Beach Road and proceeding *makai* (seaward) to the basalt cliffs. Sweep transects were spaced at 10 m, which permitted rapid and thorough coverage of the property. All sites encountered were numbered sequentially beginning with PHRI temporary number 1240-1, and were marked with metal tags to facilitate relocation. Following Kirch (1985) sites were initially identified at the most basic level of organization, that of the independent structural element; elements were subsequently aggregated to features, features to complexes (if indicated), with the highest level of organization being that of the site. Sites were defined on the basis of perceived spatial, architectural and sometimes functional relationships. All archaeological resources were subsequently assigned permanent site numbers (State Inventory of Historic Places; SIHP). Temporary numbers, SIHP numbers, and any other identifying labels that may have been given to archaeological resources over the years are cross-referenced in Table 1 and Appendix A.

Recording

As noted elsewhere, the subject property had been recently staked by professional surveyors, and survey pins and all property boundaries were clearly evident. Using the survey pin on the south corner of the parcel on Government/Beach Road as a primary reference point (this pin is referenced to the Olaa benchmark), a dozen arbitrary map stations were set along the rock wall forming the west boundary of the property and three map stations were established down the mid-point of the property, from *mauka* (inland) to *makai* (seaward). Using a meter-tape and compasses (Brunton and Sunto) the location of all sites on the property were areally located by triangulating off three or more of the map stations; the various sites and other features of archaeological interest were then plotted and sketched relative to the parcel boundaries (see Figure 2 parcel plan). In addition, Site 18420, part of which is not on the subject parcel, was mapped in detail (see Figure 3). Site data were recorded on standard PHRI site and feature forms, and all features were photographed using 35-mm black-and-white film.

Subsurface Testing

Eight controlled test units and 15 shovel tests were excavated at various features throughout the parcel (Figure 2).

The primary purpose of the excavations was to determine the presence/absence of cultural remains. Placement of the units was discretionary, that is, subsurface tests were located at those site or feature-types that previous experience has suggested would yield artifacts or ecofacts, including datable materials. Controlled test units, formally gridded units that were excavated by 10 cm levels within natural layers, were excavated at those feature-types where stratification of cultural remains were anticipated (terraces and other level surfaces that may have been temporary habitations), and the shovel tests were located mostly at the agricultural site and adjacent to the coastal trail. The controlled test units were generally small (usually 50 cm by 50 cm), with the exception of a one-meter wide sectioning of a facing to determine the presence/absence of a cave entrance, the excavation of a platform, and the sectioning of a mound. Detailed excavation notes and photos were recorded for all test units, and profiles and stratigraphic descriptions accompanied all excavations including shovel tests. All deposits were sieved through 1/4" wire mesh to recover any ecofact and artifact remains.

Age Determinations

In the absence of datable samples from field work, estimates of the ages of features and sites were based largely on formal type; that is, on similarities of structure and relationships to known prehistoric sites. Additionally, to establish an approximate sequence of events or an estimation of the period of site occupation, the age of lava flows (Holcomb 1987) was utilized as a baseline. However, the dates of the lava flows were reported in terms of years BP (Before Present = 1950). For ease of reference, ranges expressed in terms of years BP were converted to conventional format (350-500 BP > AD 1450-1600), but without statistical correction. Thus the converted calendar ranges must be considered only a rough approximation of when the lavas may actually have been deposited.

Artifact Analysis

Recovered artifacts, which were limited to volcanic glass flakes and cores, were sent to the PHRI laboratory for cleaning, processing, and analysis. Susan T. Goodfellow, Ph.D., analyzed the artifact material and her discussion is included in this report. No ecofacts, including midden, charcoal, or other cultural materials, were encountered during field work.

Table 1.

SITE CORRELATION SUMMARY

SIHP No. (50-10-45-)	PHRI Temp. No.	Other
18418		
Fea. A	17	BPBM A3-10, A3-16, A4-13?
Fea. B	17	—
Fea. C	17	—
18419	5	
Fea. A	12	Fea. B-46
18420		
Fea. A	16	—
Fea. B	16	—
Fea. C	16	—
Fea. D	16	—
Fea. E	16	—
18421		
Fea. A	21	BPBM A3-15, Hudson's Site 80
Fea. B	21	BPBM A3-15, Hudson's Site 80
18422		
Fea. A1	44	—
Fea. A2	43	—
Fea. A3	45	—
Fea. B	26	—
Fea. C1	9	—
Fea. C2		9
Fea. D	28	—
Fea. E	29	—
Fea. F	31	—
Fea. G	30	—
Fea. H	33	—
Fea. I	32	—
Fea. J	7	—
Fea. K	5	—
Fea. L1	6	—
Fea. L2	4	—
Fea. M	34	—
Fea. N1	2	—
Fea. N2	3	—
Fea. N3	3	—
Fea. O	36	—
Fea. P	35	—
Fea. Q	39	—
Fea. R	48	—
Fea. S	40	—
Fea. T	41	—

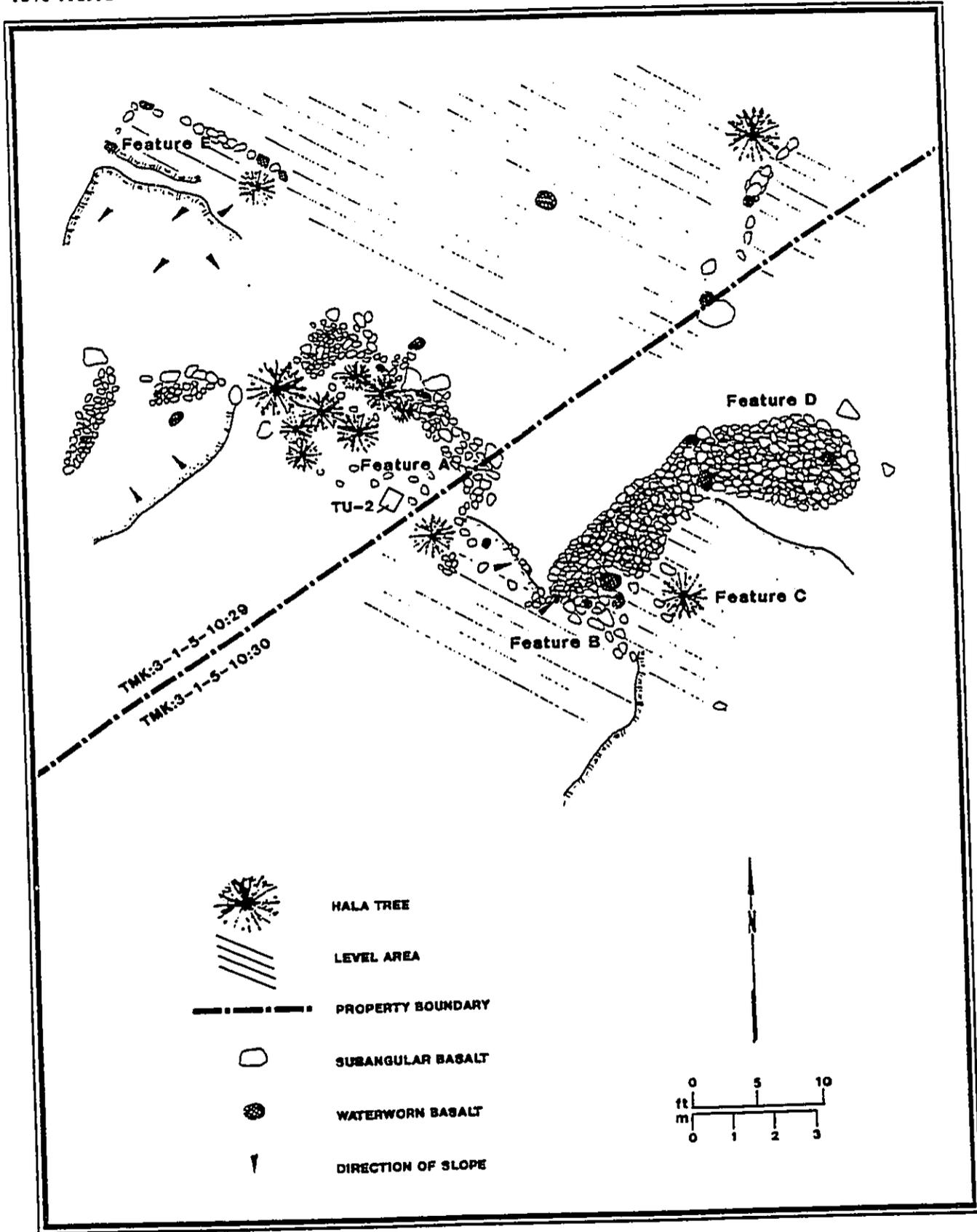


Figure 3. Detailed Plan, Site 18420

FINDINGS

Five sites were identified in the project area (*Figure 2*). These are: Site 18418, a prehistoric coastal trail; Site 18419, which includes two historic cattle walls; Site 18420, a coastline terrace complex; Site 18421, two "bait cups" on the basalt bench; and Site 18422, an extensive horticultural site with 26 component features. Aside from the extensive structural remains, cultural resources included 59 volcanic glass artifacts. No other material indications of human activity (hearths, charcoal, burials, middens) were encountered in the study area.

In addition to formally identified cultural features, there were several structurally unmodified areas of the property that were relevant to analysis of settlement patterns. From the Government/Beach Road to about 32 meters (105 feet) seaward the terrain was generally even, low-lying and with deeper soils than elsewhere. The depth of the soils suggested that prehistorically this area may have sustained various crops, although currently it appears disturbed. Proceeding *maukaimakai*, other features include a stand of coconut (Coconut Grove 1) on the east boundary, a grassy clearing on the west side of the property *makai* of 18422-N, O, and P, that may have been used for pasture, another stand of coconut (Coconut Grove 2) that consists of a line of trees planted in a natural linear depression in the lava, and a large grassy clearing on the east side of the property—near the coastline—that is probably also a former pasture. On the east side of the latter clearing, near the property line, is a large, collapsed blister (about 10 m diameter, 1.5 m deep) that shows no evidence of modification.

FORMAL SITE/FEATURE TYPES

A formal typology consists of classification of features and sites at the most basic level of structural organization. Such a typology facilitates an accurate, unbiased physical and spatial description of sites and features without reference to any possible functional interpretation(s). Ideally formal classifications are an independent body of objective data; these data are eventually integrated with other types of information (e.g., documents research, excavation data, laboratory analyses) in order to formulate functional interpretations that are inferential, integrative and knowledgeable. From these data, inferences regarding the origins, purpose, and use of sites through time may be made. The following are brief descriptions of formal types identified in the project area.

Complex An aggregate of formal/structural

types, sometimes organized to feature complexes, but most often to site complexes; there are two feature complexes and three site complexes in the project area.

- Depression* An excavation or modified natural depression, sometimes consisting entirely of packed earth, but often lined or rimmed with rock; there is one depression in the project area.
- Enclosures* C-shape or L-shape structures that enclose a level interior floor space; they may be free-standing or contiguous with other structures or outcrops; there is one L-shape and one C-shape in the project area.
- Linear rock mounds* Conspicuously elongated rock mounds (cf. rock alignments and rock mounds); there are two in the project area.
- Modified outcrop* Includes various types of structural modifications to natural outcrops that are not otherwise assignable to a formal type; there are 13 modified outcrops in the project area.
- Platforms* Free-standing structures with an elevated floor of packed earth or stone paving; there is one in the project area.
- Rock alignment* A line of rocks only one rock high and one rock wide (cf. rock mound); there is one in the project area.
- Rock mounds* Rock piles (cf. rock alignment) are usually wider than they are high; construction may range from informal, amorphous rock heaps to more carefully constructed features; there are eight in the project area.
- Rock walls* Free-standing structures of piled or stacked and faced rock; there are five in the project area.
- Terraces* Dependent structures, nearly always associated with modified natural

outcrops; terraces have two or more "faced" embankments, a level surface, and a discernible length and width; there are five in the project area.

Table 2 is a summary of sites and features identified in the project area. It is organized by formal type, and includes tentative functional interpretations, and recommended field work tasks. At this level of inquiry, functional interpretations are considered tentative and preliminary; they are essentially planning devices, and are subject to revision pending additional data. Table 1 is a site correlation summary. This table is organized by the permanent SIHP site number and is cross-referenced to PHRI temporary site numbers; the latter were recorded on metal tags placed at sites during field work. The table also includes correlations (or possible correlations) with site numbers from earlier surveys. Table 3 is an excavation summary; it is organized by provenience (site/feature) and unit number (unit numbers were assigned sequentially as testing progressed throughout the project area). These various data are addressed in the site discussions below and in Appendix A.

Site 18518

This was site complex of dissimilar formal types located near the *makai* edge of the property. It consisted of a linear rock mound, Feature A, which paralleled the coastline and extended across the property onto the neighboring parcels on both sides. Contiguous with the linear mound were two other structures, Feature B, an L-shaped enclosure, and Feature C, a rock mound. There were three shovel tests placed at the site (ST-6, ST-9, ST-10) Excavations revealed unstratified deposits of dark brown silt loam, and no cultural materials were encountered.

Feature A was a linear mound of variable construction. In some sections it exhibited a paving of flat waterworn basalt boulders placed into the surface side-by-side near the edges, about one meter or a footstep apart. This feature is very similar to inferred prehistoric coastal-trail segments in the vicinity described by Hudson (1932) and Ewart and Luscomb (1974). Hudson reported remnants of an old trail between Mokuopihi and Waikahiula (Opihi Rock and Hawaiian Beaches/Shores). The trail consisted of several sections of "flat stones from the beach laid about a pace apart" (Hudson 1932:309). Further down the coast to the east, Hudson also noted trail segments for about a half mile along the shore of Nanawale Bay, just north of Kahuwai, which he described as consisting of:

Smooth beach boulders, round or flat, laid end to end or side by side. That the trail is indisputably fairly old

is shown by the fact that sections of it have been covered by the lava flow of 1840 and that other parts have been destroyed by the erosion of the coastline (311).

In the more recent survey of a proposed Kapoho-Keaukaha highway corridor (Ewart and Luscomb 1974) several segments of a shoreline trail were encountered in Maku'u (Site A3-10, A3-16) and in Keonepoko (A4-13). Site A3-16 was described as constructed of "large waterworn boulders placed side by side to form a smooth-surfaced trail, c. 1 to 2 m wide in places" (Ewart and Luscomb 1974:28). Unfortunately Site A3-16 was not located on the map included in Ewart and Luscomb's published survey report, and it is very likely that the trail encountered on the subject property during the current survey, and now identified as State Site 18418, is Site A3-16. Another trail segment (A4-13) in Keonepoko, just south of Makuu/Popoki/Halona, was described similarly by Ewart and Luscomb with the additional information that it was "one rock high" (33) and kerbed with rough stones.

Even farther down the coast, at Kahuwai, McEldowney notes a "raised trail" (Site A6-20). The trail at Kahuwai is elevated, about 1.0-1.5 m high, and is fully faced on both sides with fitted basalt cobbles. It is about the same width as the trail on the subject property (about 1-2 meters), but the surface is packed earth; there are no steppingstones (personal observation). At present there is no information on how, or if, the Kahuwai trail connected with the "steppingstone" trail segments to the northwest. However, the consistencies in the descriptions of trail construction and the similarity of location close to the shoreline indicate that trail segments encountered in the various surveys are almost certainly part of a formerly continuous prehistoric trail that may have paralleled the shoreline from Hilo to Ka'u and beyond.

Feature B was an L-shaped enclosure contiguous with Feature A on the *mauka* side; it was joined with the Feature A to form a U-shaped structure that was open to the east (and open to the prevailing winds and rains). Enclosures are commonly interpreted as foundation structures of indigenous dwellings, however the lack of cultural material revealed by the shovel test (ST-6) suggests that occupation, if it occurred, was low-intensity. It is possible that Feature B functioned as a temporary shelter or rest area for wayfarers. The rock mound, Feature C, is an amorphous heap of stone located west of Feature B enclosure and on the Feature A trail alignment, such that the current trail/footpath diverges from the alignment to circumvent both Feature C and a stand of *hala* that also impacts the trail on the west end. The rock mound is adjacent to a large (probable historic) clearing, and as it does not appear to function with the trail or enclosure, it is very likely a clearing mound associated with historic agriculture.

Table 2.

SUMMARY OF IDENTIFIED SITES AND FEATURES

*SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	#CRM Value Mode Assess.			+Field Work Tasks Recommended		
			R	I	C	DR	SC	EX
18418	Complex (3)++	Multiple	M	M	H	+	-	-
A	Elevated trail	Transportation	M	M	H	+	-	-
B	L-shaped enclosure	Temp. habitation	L	L	L	-	-	-
C	Rock mound	Agriculture	L	L	L	-	-	-
18419	Complex (2)	Livestock management	L	L	L	-	-	-
A	Rock wall	Livestock management	L	L	L	-	-	-
B	Rock wall	Livestock management	L	L	L	-	-	-
18420	Complex (5)	Multiple	H	M	H	+	+	+
A	Terrace	Temp. habitation	M	M	H	-	-	-
B	Terrace	Temp. habitation	M	M	H	+	+	+
C	Terrace	Possible burial	M/H	L/M	M/H	+	+	+
D	Rock mound	Possible burial	M/H	L/M	M/H	+	+	+
E	Terrace	Temp. habitation	L	L	L	-	-	-
18421	Complex (2)	Fishing; bait cup	L	L	L	-	-	-
A	Modified outcrop	Fishing; bait cup	L	L	L	-	-	-
B	Modified outcrop	Fishing; bait cup	L	L	L	-	-	-

* State Inventory of Historic Places (SIHP) numbers. SIHP numbers are five-digit numbers prefixed by 50-10-45 (50=State of Hawaii; 10=Island of Hawaii; 45=Pahoa North Quad [USGS 7.5' series, 1981]).

Cultural Resource Management

Value Mode Assessment —Nature: R = scientific research
I = interpretive
C = cultural
—Degree: H = high
M = moderate
L = low

+Field Work Tasks Recommended:

DR = detailed recording (scaled drawings, photographs, and written descriptions)
SC = surface collections
EX = test excavations

++ = Number of component features within complex.

Table 2. (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess.			Field Work Tasks Recommended		
			R	I	C	DR	SC	EX
18422	Complex (26)	Multiple	M	L	L	+	-	+
A	Feature complex	Agriculture	H	L	L	+	-	+
A1	Modified outcrop	Agriculture	M	L	L	+	-	+
A2	Modified outcrop	Agriculture	M	L	L	+	-	+
A3	Modified outcrop	Agriculture	M	L	L	+	-	+
B	Modified outcrop	Temp. habitation	H	M	M	+	-	-
C1	Terrace	Agriculture	L	L	L	-	-	-
C2	Rock mound	Agriculture	L	L	L	-	-	-
D	Rock wall	Agriculture	L	L	L	-	-	-
E	Rock wall	Agriculture	M	L	L	-	-	-
F	Rock mound	Indeterminate	L	L	L	-	-	-
G	Modified outcrop	Agriculture	M	L	L	-	-	-
H	Modified outcrop	Agriculture	L	L	L	-	-	-
I	Rock wall	Agriculture	M	L	L	-	-	-
J	Rock mound	Indeterminate	L	L	L	-	-	-
K	Platform	Activity area; poss. burial	M/H	L	L/H	+	-	+
L1	Rock mound	Indeterminate	L	L	L	-	-	-
L2	Rock mound	Indeterminate	L	L	L	-	-	-
M	Modified outcrop	Agriculture	L	L	L	-	-	-
N	Feature complex	Multiple	M	L	L	-	-	-
N1	Modified outcrop	Agriculture	M	L	L	-	-	-
N2	Modified outcrop	Agriculture	M	L	L	-	-	-
N3	Linear rock mound	Agri.; boundary	M	L	L	-	-	-
O	Modified outcrop	Agriculture	L	L	L	-	-	-
P	Modified outcrop	Agriculture	M	L	L	-	-	+
Q	Rock alignment	Agriculture	L	L	L	-	-	-
R	C-shape enclosure	Temp. habitation	L	L	L	-	-	-
S	Depression	Agriculture	L	L	L	-	-	-
T	Rock mound	Indeterminate	L	L	L	-	-	-

Table 3.

EXCAVATION SUMMARY

Unit	Length	Width	Depth	Location	Remarks
SITE 18418-A					
ST-9	0.35	0.35	0.18	15 m east of Fea. B	No cultural material
ST-10	0.35	0.35	0.00	Seaward of trail at west end	No cultural material
SITE 18418-B					
ST-6	0.35	0.35	0.26	In Fea. B enclosure	No cultural material; enclosure interior burned
SITE 18420-A					
ST-4	0.35	0.35	0.43	Clearing W of Fea. A	No cultural material
ST-7	0.35	0.35	0.15	2 m seaward of Fea. A	No cultural material
TU-2	0.50	0.50	0.18	Surface of Fea. A	No cultural material
SITE 18420-E					
ST-8	0.35	0.35	0.20	Surface of Fea. E	No cultural material
SITE 18421-A					
ST-3	0.35	0.35	0.43	Sand "pond" at basalt bench	No cultural material
SITE 18422-A					
TU-7	0.50	0.50	0.33	In ditch at corner	Volcanic glass artifacts; 2 cores and 6 flakes
SITE 18422-B					
TU-4	1.00	0.50	0.29	Surface of outcrop	Volcanic glass artifacts; 3 cores and 42 flakes
SITE 18422-C1					
TU-3	1.00	0.50	0.10	Surface of Fea. C1	No cultural material
SITE 18422-C2					
TU-6	3.00	0.50	1.10	Fea. C2 (section)	One (1) volcanic glass core

Table 3. (cont.)

Unit	Length	Width	Depth	Location	Remarks
SITE 18422-K					
TU-1	2.00	0.50	2.20	Fea K (through depression)	No cultural material
SITE 18422-L1					
TU-5	1.00	0.50	0.10	Fea L1 (section)	Four (4) volcanic glass flakes
SITE 18422-0					
ST-2	0.35	0.35	0.23	Between Fea. 0 and Fea. P	No cultural material
ST-11	0.35	0.35	0.20	East of Fea. 02 facing	No cultural material
ST-13	0.35	0.35	0.22	Base of Fea. 02 facing	No cultural material
ST-14	0.35	0.35	0.28	East of Fea. 02 facing	No cultural material; area burned
TU-8	1.00	0.50	1.40	Sectioned Fea. 02 facing	No cave; no cultural material
SITE 18422-P					
ST-1	0.35	0.35	0.30	Interior of large pit	No cultural material
ST-12	0.35	0.35	0.41	Interior of small pit	No cultural material
SITE 18422-Q					
ST-15	0.35	0.35	0.21	South of Fea. Q	No cultural material
SITE 18422-R					
ST-5	0.35	0.35	0.16	Inside Fea. R	One (1) volcanic glass core

Site 18419

This site includes two features, both free-standing rock walls. Their height, type of construction, and location, are typical of historic walls that almost certainly functioned as livestock barriers. Feature A is also the west boundary of the parcel, and runs from a fencepost near the Government/Beach Road *makai* to the seaward end of the parcel and ends at the cliff drop-off. On the east side of the endpoint of Feature A is a large basalt outcrop that may have been modified with piled rocks. Abutting this outcrop on the east side, and perpendicular to Feature A, is a second wall, about 8 m long (Feature B), which is positioned at the very edge of basalt cliff drop-off. It appears to be a barrier wall, placed to prevent grazing animals from plunging over the cliff to the rocks below. These features may be contemporaneous with the clearings and the apparently secondary rock mounds (18418-C and 18422-C2). In age they are probably late-19th or early-20th century.

Site 18420

This is a site complex that includes four terraces (Features A, B, C, E) and one rock mound (Feature D) located on the seaward edge of the parcel (see Figure 3). Features A-D are contiguous, and Feature E is an isolated structure positioned between the contiguous structures and the adjacent coastal trail (Site 18418). The site is intersected by the east boundary line of the parcel, and Features B, C, and D are not located on the subject property. However, in order to assess the nature of the site as a whole, the latter were mapped and recorded during project field work, but were only minimally cleared and were not tested. The complex is located under ironwood and *hala*, and is positioned between the large clearing and the coastal trail.

Detailed descriptions of all five features and four test excavations at the site are given in Appendix A. Briefly, Features A and B are both low terraces, side by side, but Feature B is set somewhat lower and *mauka* (inland) of Feature A. Feature C was a comparatively high (1.0+ m) two-tiered terrace with waterworn cobbles on the surface. Feature D was a large formally-constructed rock mound, contiguous with the west facing of Feature C, but *makai* of it and structurally distinct. Feature E was a small, low terrace located west of the contiguous structures. No artifacts or ecofacts, upright stones, or pieces of coral were noted on the surface of any of the features. The four test excavations (TU-2, ST-4, ST-7, ST-8, all on the subject property) revealed unstratified deposits of dark brown silt loam with no cultural remains.

Because three of the five features could not be assessed, any interpretation of site function must be considered

provisional; however, certain characteristics of the complex suggest a ritual function. The position of the complex directly on the parcel boundary, as well as its proximity to the trail and the coastline, suggest a ritual-use that may have been related to land boundaries and transportation/communication. That is, the current property boundary may reflect an ancient land boundary, which may in turn, have been based on perceived differences in land utility and desirability (the ancient and recent lava flows interface somewhere near this boundary (see Environment above). Moreover, the level of effort indicated by the complex construction of the site suggests a possible ritual function, as do certain stylistic features, such as tiering or faced construction. Tiering (Feature C) has often been associated with ritual structures (*heiau*). *Heiau* typically exhibit more formal constructions, and moreover, when burials have been found to be associated with these ritual structures, they are often recovered from faced mounds (or platforms) such as Feature D. Lastly, the absence of cultural materials suggest low-intensity use, which may be cited as negative evidence for ritual use, since ceremonial structures normally were not utilized for cooking or other practical activities that would be expected to leave cultural remains.

Although located on the coastline and overlooking the sea, the absence of coral, often associated with *ko'a* (fishing shrines), suggests that if the site did have a ritual function, it may not have been related to fishing. (Another factor to be considered, however, is the absence of coral reef, which would mean that coral would have to be imported from distant shores.) Given the evidence for intensive horticulture in the area, it is more likely that rituals were associated with agriculture; that is, it is possible that the complex functioned as a small agricultural *heiau*, an interpretation that is consistent with the apparent absence of ecofact or artifact remains (vegetal offerings rarely survive in the archaeological record), with its position adjacent to a possible "around-the-island" trail (cf. *makahiki* celebrations), and with its location on land boundary that was possibly prehistorically significant.

Aside from ritual use, alternate functional interpretations include use as a possible temporary shelter associated with fishing or shellfishing (the area is renowned for *opihi*). However, these alternatives are considered somewhat unlikely in view of the structural complexity of the site and the proximity of a probable temporary shelter (Site 18418-B) only a few meters to the west. A third, more remote, possibility is that the site was a household complex that was occupied for a very short time, leaving no evidence of use, or was not occupied at all. In terms of age, the site may be late-prehistoric (17th or 18th century) or possibly early historic (late 18th-early 19th). It is typical of prehistoric architecture; however, its relatively good condition (despite its proximity to areas traversed by *opihi* pickers for

generations) suggests it may have been constructed late in the Hawaiian cultural sequence.

Site 18421

This sites includes two features. Formally classified as modified outcrop, Features A and B are a pair of perfectly round, cup-shaped holes in the basalt bench at the shoreline. They are four meters apart, and one slightly larger than the other. Their description correlates with Hudson's Site 80:

By the edge of the cliff near Makuu are two small cup-shaped holes in the lava....The larger of these holes is 8 inches across and 6 deep; the other 4 inches across and 4 deep. Frank Kamahole of Pahoa says they were used to collect salt, pound ava, and pound crabs (Hudson 1932:308).

The latter function (crab pounding) appears quite likely in view of the abundance of 'a'ama crabs, which were observed crawling all over the basalt bench. Since smashed 'a'ama was (and is) used for bait, a functional interpretation as fishing "bait cups" appears indicated; however, the two *puka* (holes) may also have functioned in various household capacities as specific needs dictated. In terms of age, these features are typical prehistoric-type structures; however, they could have been created as recently as the 20th century, or a thousand years ago—there is no way of making a determination. And although they may have been fashioned and utilized prehistorically, it is very likely that they have also been in recent use—as plastic lines, metal hooks, leaders, and lures, were noted on the basalt bench.

Site 18422

This is a site complex of 26 formal components, including 11 modified outcrops (mostly faced lava terraces or collapsed blisters), six rock mounds, three rock walls, one terrace, one platform, one linear rock mound, one rock alignment, one C-shape and one depression. The site extends from just *mauka* of the coastal trail to Beach/Government road, although feature density diminishes considerably *mauka*. Features A through J are in a dense *hala* thicket on the *makai* end of the site. Feature K, an isolated platform, is about central and is relatively out in the open. Features L through R are on the *mauka* side of the site and are associated with two coconut groves, while Features S and T are closest to Beach/Government Road (see Figure 2). There were 15 test excavations placed at the site—seven controlled test units and eight shovel tests.

The excavations exposed unstratified deposits of dark brown silt loam, and five units yielded volcanic glass artifacts.

No other artifact types, ecofacts, or datable materials were encountered. Detailed descriptions of all features and their associated excavations are included in Appendix A. The following is a brief overview of the site.

The site is a horticultural complex. Natural features of the lava terrain (fissures, collapsed blisters, buckled outcrops, natural terraces, swales) have been variously modified to form a dense network of interrelated garden features, some of which have shallow soils and some with deeper deposits. Low lying areas have been modified for gardens, and form natural catchments for soils and moisture. There are retaining walls, probably for trellises and lattice supports and for spatial definition. There are broad flat structures with shallow soils, ideal for certain kinds of crops such as *ipu* (gourds). There are structures that function as work stations, windbreaks, or animal pens, and various walls that may delimit specialized garden areas. In the aggregate, the multiplicity of econiches created by the modifications suggest intensive horticulture, and probable presence of a variety of cultigens.

Some of the more notable structures include Features A and N, which are somewhat similar in that natural lava terraces and opposing outcrops have been faced to delimit trench-like low lying areas (at Feature A, a "moat" with deeper soils. Because of dense vegetation Feature N was not tested, but Feature A was excavated to more than 30 cm without encountering bedrock, and eight volcanic glass artifacts (two cores and six flakes) were recovered from deeper levels of excavation (20-30 cmbs). Both Features A and N would have provided ideal conditions for a number of crops, including dryland taro (*Colocasia esculenta*), sugarcane (*Saccharum officinarum*, *awa* (*Piper methysticum*), or other plantings.

Other notable features include two collapsed blisters (Features G and P), which have been faced with rock; Feature P also is bifurcated by a substantial rock wall, which separates it into a small pit (*mauka*), and a much larger one (*makai*). These may have been used as animal pens, or specialized planting areas. PHRI Cultural Resources Specialist Kepa Maly suggested that *ipu* may have been planted inside the blisters, and that poles may have been placed across the tops of the pits and the gourds suspended from the poles by their vines, so that the *ipu* would develop without pressure marks or other blemishes (personal communication). It is very likely the *ipu* were grown on other features of the site as well, as the lack of soil depth would not have been a limiting factor and other conditions were ideal. Feature C was a large terrace faced on three sides, with very shallow soils; it would have provided an excellent environment for gourds. The "white-man's" gourd, watermelon, is currently being grown on a property about two or three lots to the north.

Site 18422 also had work (staging) areas, that is, structures where activities associated with gardening occurred. One of these was Feature B, a small, modified, flat elevated outcrop adjacent to Feature A. Test excavation (TU-4) yielded 45 volcanic glass artifacts (three cores and 42 flakes and one intact *kukui* nut), embedded in dark brown silt loam; this was the largest single cultural deposit encountered in the project area. The frequency of cores and the number of flakes suggest that feature function was related to tool manufacture—"for cutting and scraping plant materials" (Kirch 1973). Feature R, a small C-shape enclosure located *mauka* on the site, was probably a small field shelter or windbreak (it also contained one volcanic glass flake), and Feature K, a comparatively exposed platform located centrally on the site, was possibly a drying area for *hala* fronds (abundant in the area) or other vegetal materials. Feature K was unique to the site and the project area.

Feature K was a nearly square platform about 0.6 m high, comparatively isolated from the other features, with a conspicuous depression or indentation on the rock surface that suggested the presence of a possible burial pit (a feature very similar to this was described by Ewart and Luscomb [1974], but according to their map it was located across Government Road and to the south). Excavation (TU-1) revealed that the platform fill extended through a "skylight" in the bedrock to a subterranean cavern; the rocks were piled to a depth of about 1.8 m, to the top of a layer of dark brown silt loam (see profile, Figure 4). The soil deposit did not quite fill the cavern, which appeared to extend in all directions, but more prominently to the north (*makai*). No cultural materials of any kind were noted in the rock fill or the 0.3 m of soil that was excavated. The soil was extremely friable and appeared to be typical cave colluvium; however, it exhibited no lensing or horizons, it was completely homogenous in color, and lacked any indication of floral or fauna remains. Some variation would be expected from a natural deposit; therefore, despite the complete absence of cultural remains, the possibility that the soil is fill (placed by human agency) cannot as yet be entirely eliminated. As the limited scope of the project precluded definitive excavation, feature function(s) remain provisional pending additional data.

ANALYSIS OF PORTABLE ARTIFACTS by Susan T. Goodfellow, Ph.D.

Fifty-nine flaked stone artifacts were encountered in the project area during the current investigation (Table 4). The inventory, which consists entirely of items manufactured from surface chill (a poor quality mixture of volcanic glass and pahoehoe), derives from Features A, B, C2, K1 and R of Site 18422. The artifacts are discussed in detail below.

All flaked stone material is evaluated with respect to flake/core type. Following established procedures for evaluating flaked stone material, diagnostic flakes are defined here as those flakes having a complete or partial striking platform and a bulb of percussion. Non-diagnostic flakes are fragments which lack the platform and/or bulb. Cores tend toward multi-faceted polyhedral shapes dominated by one or more platforms, and typically show little evidence of subsequent use as tools. Primary cores exhibit only flake scars, while secondary cores are actually flakes with a bulb from which other flakes have been removed. Based on these criteria, the 59 specimens can be distinguished as follows: five primary and two secondary cores, 39 diagnostic flakes and 13 non-diagnostic flakes.

Cores

The primary cores are primarily polyhedral in shape and range from 2.05-5.55 cm in length, 1.60-1.70 cm in width and 0.80-1.00 cm in thickness. All of the primary cores have single intact platforms, each of which is associated with 1-3 flake scars. The secondary cores are generally parallel-sided in plan view, and measure 1.0 by 1.6 by 0.5 cm and 3.70 by 2.30 by 0.8 cm, respectively. Both have single intact platforms, one with two flake scars and one with a single flake scar. Based on the lack of specimens with multiple platforms, the small number of flake scars noted in the assemblage, and the presence of cortex on the bodies of most of the cores, it was determined the cores were only minimally utilized prior to discard. Minimal use of cores implies a lack of core preparation prior to flaking, and should correspond to a high percentage of debitage and non-diagnostic flakes in the assemblage. This pattern is generally consistent with the generally expedient nature of the Hawaiian flaked stone industry noted elsewhere, and suggests that flaked stone manufacture, while undertaken in the project area, was not oriented towards the production of specialized tools.

Flakes

The diagnostic flakes range from 1.00-2.95 cm in length and 0.75-1.85 cm in width, while the non-diagnostic flakes range from 0.95-2.55 cm in length and 0.65-1.50 cm in width. The majority are angular or parallel sided in plan-view, and retain cortex on the dorsal face; attributes which are consistent with primary reduction. While attributes indicative of good control (e.g., ventrally-convex cross-sections, positive salient bulbs of percussion and feathered terminations) were noted in approximately 25-30% of the flakes, the majority were manufactured with inadequate or outward-directed force. It should be noted, however, that the poor quality of the volcanic glass would have had an effect on the flaking process. Consistent application of adequate force may not have

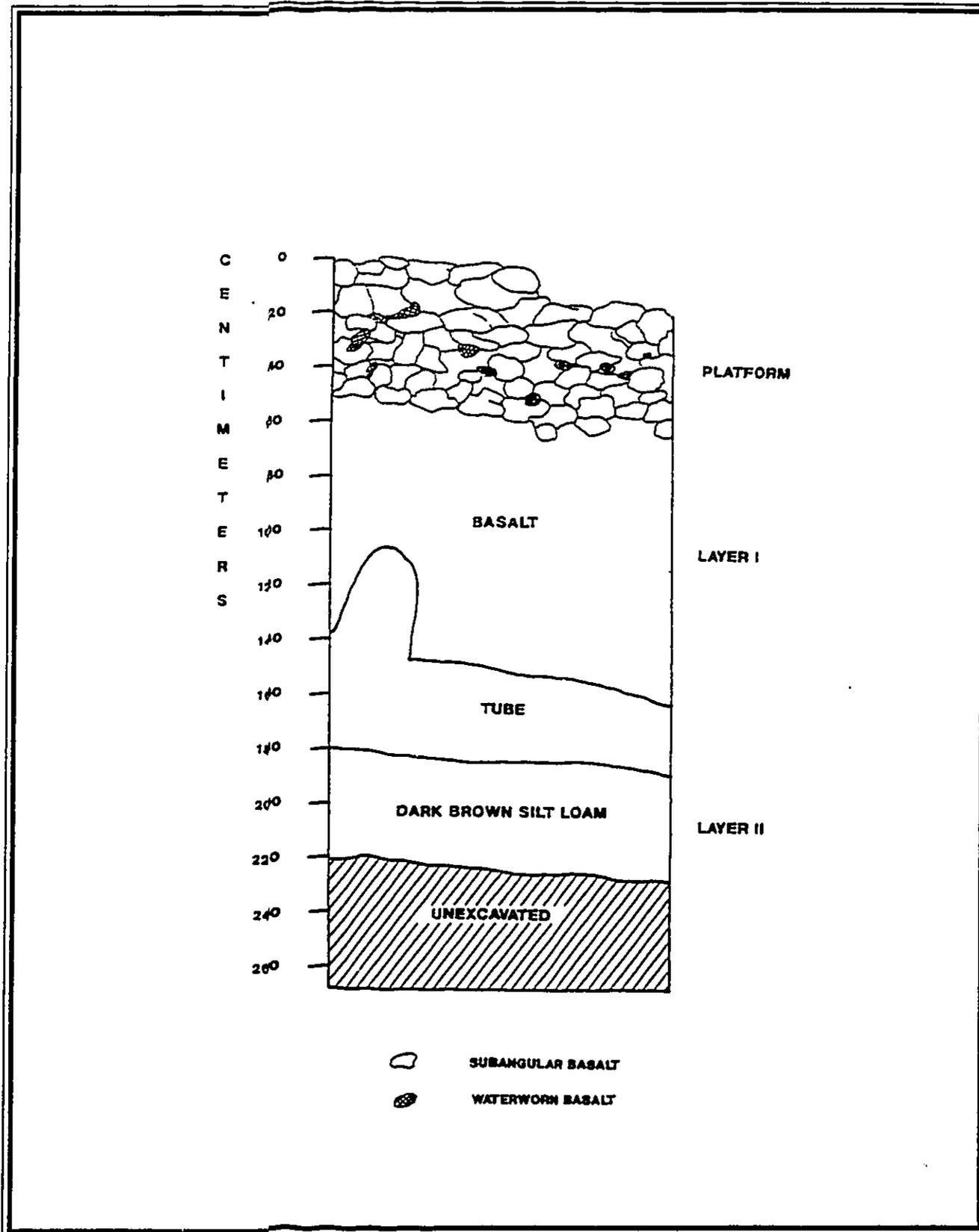


Figure 4. Profile, Site 18422-K, TU-1, North Face

Table 4.

DETAILED DISTRIBUTION OF PORTABLE ARTIFACTS

Material	18422 Fea. A TU-7 I-3	Fea. B TU-4 I-2	Fea. C2 TU-6 II	Fea. K1 TU-5 I-1	Fea. R ST-5 I	Grand Total
INDIGENOUS						
FLAKED STONE						
Volcanic Glass						
Primary Core	1	3	1	—	—	5.00
Secondary Core	1	—	—	—	1	2.00
Diagnostic Flake	4	32	—	3	—	39.00
Non-diagnostic flake	2	10	—	1	—	13.00
TOTAL FLAKED STONE	7	45	1	4	1	59.00
TOTAL	7	45	1	4	1	59.00

produced consistently shaped flakes, thus producing an assemblage with a high proportion of apparently uncontrolled flakes compared to controlled flakes. Similarly, the prevalence of small to medium sized cores in the assemblage suggests that core size may have adversely affected the degree of control exerted during flake manufacture.

Uses for flaked stone artifacts have been suggested by Kirch (1973), who observed:

The possible functions ... are many and varied.
Basaltic glass holds a fine, sharp edge and the tools

make excellent cutting and scraping implements. They may have been used in food preparation, for cutting and scraping plant materials, or for delicate woodworking ... [t]hese artifacts are extremely common, being found in virtually every type of [Hawaiian] site. The suggestion, then, is that the ubiquitous basaltic glass flakes functioned as a prehistoric "pocketknife", to use a modern analogy... (1973:185-6).

CONCLUSION

SETTLEMENT PATTERNS

The data derived during this project indicates that indigenous activities on the subject parcel were primarily concerned with intensive horticulture (Site 18422). The data suggest that prehistoric adaptations to the local environment involved modifications to the natural terrain that enhanced and maximized exploitation of natural terraces, facilitating the cultivation of a variety of cultigens. Rainfall in Puna, even at the coastline, was probably sufficient for almost any type of dryland crop, particularly when natural catchment features were modified and utilized to enhance moisture retention. The pahoehoe blisters, fissures, outcrops, and cracks, with their organic-rich soils, provided an ideal environment for small-scale, but intensive and diversified plantings. The importance of horticulture is underscored by the presence of a site that may be small agricultural *heiau* (Site 18420).

Diversified garden plots would be expected near permanent households, but there were no data that would suggest that aboriginal dwellings were in the study area. However, historic documentation notes that "Maku'u Village" was somewhere nearby. Since the study area was relatively small and restricted by artificial (non-archaeological) constraints, it is very likely that the absence of habitation sites is a function of limited sampling rather than a true indication of the nature of coastal settlement. Permanent habitations (household compounds) associated with the gardening site may have been located on neighboring parcels or across what is now the government/beach road.

In terms of age, site architecture for the most part is typically prehistoric; however, without any absolute means of dating the features the ages of the sites can only be hypothetical—derived by using the radiocarbon dates of the lava flows as a baseline for a proposed sequence of events. Given the massive destruction of arable lands inland in Puna, it is possible the study area, which is on a *kipuka* of ancient lavas, may not have been developed for horticulture until comparatively late in the Hawaiian cultural sequence (the proto-historic period [AD 1650-1795], following Kirch 1985), after prime inland agricultural lands of Puna, attested to by legend, were destroyed.

Most of the surface lavas of north Puna have been dated to approximately AD 1450-1600 (350-500 BP [Holcomb 1987]). If development of intensive horticultural areas on the coast were at least partially in response to the destruction of upland agricultural lands, then the gardens of the project area

may have been built after the eruption was completely over, when the inhabitants could be reasonably certain that their efforts would be safe. This would put development of the gardens at about the 17th or 18th centuries. If subsequent research establishes the age of the sites at about this time frame, then this would suggest that volcanic activity profoundly influenced the nature of exploitation of the area, and may have provided at last part of the impetus for the development of intensive horticulture at the coast.

Abandonment of the sites by Hawaiian inhabitants probably had occurred by the mid-19th century and may have happened much earlier. It is likely that the gardens would have fallen into disuse with the introduction of western-style economic practices, which shifted agricultural emphasis from subsistence plantings to crops for cash-sale, a process that was occurring throughout Hawaii in the 19th century. Decimation of the Hawaiian population due to disease or war was also a probable factor in abandonment. In terms of duration of occupation, the absence of stratification and the paucity of cultural remains suggests the period of settlement may have been relatively short, an inference not inconsistent with the hypothesized time frame.

Historic activity is indicated on the parcel by the presence of the livestock barriers (Site 18419), and the two grassy clearings, which were probably grazing areas for horses, or perhaps goats or sheep. Other historic features are the secondary rock mounds on the trail and the garden terrace (18418-B and 18422-C1), which probably resulted from the clearing of the larger, seaward pasturage. In terms of age, the features probably date to the late-19th or early 20th century. It is of interest to note that despite the apparent shift from Hawaiian to western agricultural practices, the overall pattern of settlement in the coastal region has probably been consistent through time—small scale farming in connection with permanent habitation.

The Predictive Model

With some exceptions, the pattern of aboriginal settlement indicated by the archaeology of the study area conforms well to the model proposed by McEldowney (1979). The predicted occurrence of horticultural systems closely adapted to natural topography was borne out by investigation, in that virtually all topographic variations of the landscape in the subject property were manipulated for horticultural purposes to some degree. However, the predictive model proposed that coastal settlement would consist of garden areas and clusters of

aggregated households, and as previously noted, the preliminary data suggest there were no permanent aboriginal dwellings in the study area. As this was almost certainly a function of the limited area sampled, the absence of dwellings cannot be considered a valid deviation from the anticipated settlement patterns. Of more interest perhaps, in terms of possible revisions to the predictive model, is the expectation of site occurrence vis-a-vis the age and nature of the lava substrate.

McEldowney had proposed that archaeological sites were more likely to be encountered on aa or ash substrates, as soil development would advance more quickly, and the soils would be deeper and the vegetation more dense and varied. Sites on pahoehoe flows were expected to be far fewer, with cultural adaptations limited to modest surface agricultural modifications and utilization of lava tubes. However, the density of horticultural features on the subject parcel suggests that pahoehoe flows, older ones with developed soils (however scant), were probably ideally suited for certain types of plants, and may have provided ecological niches for a variety of crops. This suggests that in predicting the occurrence of sites, the age of the substrate may be at least as important as its nature, and that expectations of site occurrence should not necessarily be lowered if the substrate is pahoehoe. It is hoped that future projects will provide additional insights.

EVALUATIONS AND RECOMMENDATIONS

All sites and features were evaluated in terms of their cultural significance, their potential value to research, and with regard to recreational and educational opportunities for the public. Table 5 is a summary of the assessments and recommended general treatments. Features recommended for some type of additional work are listed by provenience on the first half of the table, while those features requiring no additional work are grouped at the bottom.

Site 18418, Coastal Trail Complex

Although a number of coastal trail segments have been noted for the east coast of Puna, the portion on the subject property is currently the only segment mapped with some degree of certainty. Because the trail (18418-A) is a component of an indigenous communications and transportation system that may have been island-wide, it is considered a significant relic of past Hawaiian lifeways, and significant to the Hawaiian ethnic group. As such it is recommended for preservation "as is." It is also recommended that further work include a detailed plan view and photographs of structurally significant segments of the trail, in order that a record of its construction be preserved for future research. Features B (enclosure) and

C (rock mound) are important for informational content only; no further work is recommended.

Site 18419, Historic Walls

These features were important for information content only; no further work is recommended.

Site 18420, Possible Heiau

Preliminary assessment suggests that Site 18420 may have functioned in a ritual capacity, possibly as a small agricultural *heiau*; it also may contain human burials. As such, the site is potentially valuable to research, and may be of particular significance to the Hawaiian people as a religious site and ancestral burial place. In order to maintain site integrity, assessments and recommendations are made with respect to the site as a whole, and specific recommendations are made for the disposition of each feature, regardless of whether or not it is on the subject property. Features A and E were both in the study area; they were documented and excavated and no further work is recommended. However, it is recommended that Feature A be preserved in place until such time as contiguous Features B, C, and D, which are not on the subject parcel, can be adequately assessed. Whenever survey for Features B, C, and D is initiated, it is recommended that they be thoroughly documented and tested, and that test excavations include sectioning of Features C and D to determine presence/absence of human remains. It also is recommended that historic research include review of land records, in order to assess the likelihood of the site being on a prehistoric boundary. Further mitigative procedures should be implemented as necessary pending informed assessment of site function. Since this site is adjacent to the shoreline, which is routinely traversed by *opih*i pickers and fisherman, the site is probably at risk.

Site 18421, "Bait Cups"

These features were recorded for information content, and no further work is recommended.

Site 18422, Agricultural Complex

Prehistoric Hawaii was primarily an agricultural society. Archaeological structures associated with farming and gardening number in the thousands, and many hundreds have been formally recorded and investigated. The various features of agricultural sites are usually significant in the aggregate, that is, in terms of their spatial relationships to each other, their density, and their construction. They usually do not exhibit an abundance of portable artifacts, and often

Table 5.

**SUMMARY OF GENERAL SIGNIFICANCE ASSESSMENTS
AND RECOMMENDED GENERAL TREATMENTS**

SIHP Site Number	Significance Category				Recommended Treatment			
	A	X	B	C	FDC	NFW	PID	PAI
18419	-	+	-	-	-	+	-	-
A	-	+	-	-	-	+	-	-
B	-	+	-	-	-	+	-	-
18421	-	+	-	-	-	+	-	-
A	-	+	-	-	-	+	-	-
B	-	+	-	-	-	+	-	-
Site Subtotal:	0	2	0	0	0	2	0	0
Fea. Subtotal:	0	4	0	0	0	4	0	0

General Significance Categories:

- A = Important for information content, further data collection necessary (PHRI=research value)*
- X = Important for information content, no further data collection necessary (PHRI=research value, SHPD=not significant)*
- B = Excellent example of site type at local, regional, island, state, or national level (PHRI=interpretive value)*
- C = Culturally significant (PHRI=cultural value)*

Recommended General Treatments:

- FDC = Further data collection necessary (detailed recording, surface collection, and limited excavation and possibly subsequent data recovery/mitigation excavations)*
- NFW = No further work necessary, sufficient data collected, no preservation potential*
- PID = Preservation with some level of interpretive development recommended (including appropriate related data recovery work)*
- PAI = Preservation "as is," with no further work (and possible inclusion into landscaping), or possibly minimal further data collection necessary*

SIHP Site Number = State Inventory of Historic Places (SIHP) site number, prefixed by 50-10-45- (50=State of Hawaii; 10=Island of Hawaii; 45=Pahoa North Quad [USGS 7.5' topographic series]).

- * Provisional assessment; definite assessment pending completion of further data collection*

Table 5. (cont.)

SIHP Site Number	Significance Category				Recommended Treatment			
	A	X	B	C	FDC	NFW	PID	PAI
18420 #	+	-	-	*	+	-	-	*
A	-	-	-	*	-	-	-	*
B	+	-	-	*	+	-	-	*
C	+	-	-	*	+	-	-	*
D	+	-	-	*	+	-	-	*
E	-	+	-	-	-	+	-	-
18422 #	+	-	-	*	+	-	-	*
A	+	-	-	-	+	-	-	-
B	+	-	-	-	+	-	-	-
C	-	+	-	-	-	+	-	-
D	-	+	-	-	-	+	-	-
E	-	+	-	-	-	+	-	-
F	-	+	-	-	-	+	-	-
G	-	+	-	-	-	+	-	-
H	-	+	-	-	-	+	-	-
I	-	+	-	-	-	+	-	-
J	-	+	-	-	-	+	-	-
K	+	-	-	*	+	-	-	*
L1	-	+	-	-	-	+	-	-
L2	-	+	-	-	-	+	-	-
M	-	+	-	-	-	+	-	-
N	-	+	-	-	-	+	-	-
O	-	+	-	-	-	+	-	-
P	+	-	-	-	+	-	-	-
Q	-	+	-	-	-	+	-	-
R	-	+	-	-	-	+	-	-
S	-	+	-	-	-	+	-	-
T	-	+	-	-	-	+	-	-
Site Subtotal:	2	0	0	2	2	0	0	2
Fea. Subtotal:	7	18	0	5	7	18	0	5
18418 #	+	-	-	+	+	-	-	+
A	+	-	-	+	+	-	-	+
B	-	+	-	-	-	+	-	-
C	-	+	-	-	-	+	-	-
Site Subtotal:	1	0	0	1	1	0	0	1
Fea. Subtotal:	1	2	0	1	1	2	0	1
Site Total:	3	2	0	3	3	2	0	3
Fea. Total:	8	24	0	6	8	24	0	6

The recommended further data collection for the features of this site would be appropriate if the features are to be affected by development work. If the features are preserved "as is", then no further work would be necessary.

lack datable materials, so that dating them may be difficult. Site 18422 is somewhat unusual in terms of the localized density of structural remains and the relative abundance of volcanic glass artifacts. No datable materials were recovered, however (volcanic glass is currently not dated in Hawaii, because of methodological problems).

Most of the features of Site 18422 were significant on the basis of their informational content, and no further work is recommended. However, two features (Features A and B) may have the potential to yield datable materials, and on this basis they are assessed as significant and recommended for further work. The further work would be necessary only if the features are to be affected by development work. Feature A, the low lying ditch with deeper soils, should be excavated, and soil samples collected for possible dating. In the test unit placed at the feature, the volcanic glass was sufficiently restricted in the vertical column so that despite the absence

of stratigraphic layering, if soils yield sufficient carbon for dating it may be possible to make cultural correlations. Feature B, the elevated flat knoll *mauka* of Feature A, yielded 45 volcanic glass artifacts and a *lukui* nut—the largest cultural deposit encountered in the project area. It should be excavated more extensively for cultural remains, and soils at the feature should be dated directly if possible. With regard to the cavern that is accessed beneath Feature K, it should be investigated further to determine that origin of the soil fill and the likelihood of the cavern having been utilized for burial or other purposes. In addition, a concerted effort should be made to locate other cavern entrances, which would involve dismantling of the east wall of Feature P (collapsed blister). Finally, as it is evident that a subterranean cavern of unknown dimensions and use does exist on the property, all future subsurface construction activity on the subject parcel should be monitored by a qualified archaeologist.

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APPENDIX A

SITE DESCRIPTIONS

SITE NO.: State: 50-10-45-18418

PHRI: 1240-17

SITE TYPE: Complex (3 features)

DIMENSIONS: Approximately 100 m by 1.0 m

AREA: 100 m²

ORIENTATION: 90 degrees magnetic north

ELEVATION: 20 ft (6.9 m) AMSL

TOPOGRAPHY: Level pahoehoe with thin soil layer adjacent to the basalt cliffs of the shoreline

VEGETATION: Ironwood, *naupaka*, *hala*, grasses.

CONDITION: Fair to poor

INTEGRITY: Altered

PROBABLE AGE: Prehistoric, historic

FUNCTIONAL INTERPRETATION: Multiple

DESCRIPTION: The site is a coastal trail complex that includes Feature A, an elevated trail that transects the property and parallels the shoreline; Feature B, an enclosure that abuts the linear mound at the western end, *mauka* side; and Feature C, a piled rock mound that interrupts the trail alignment at a point a few meters west of the enclosure. The features are adjacent to the rocky basalt drop-off at the shoreline. The trail and enclosure may be components of a prehistoric coastal trail system that is reported to have extended through Puna from Hilo to Ka'u, and beyond.

FEATURE A: Elevated trail

FUNCTION: Coastal trail

DIMENSIONS: 85.0+ m by 2.5 m by 0.6 m

ORIENTATION: 90 degrees magnetic north

PROBABLE AGE: Prehistoric

DESCRIPTION: The elevated trail varies in construction materials, styles and techniques. In some sections the primary building material is subangular basalt cobbles, while other segments are largely waterworn cobbles. On one eastern segment, two parallel alignments of flat waterworn basalt boulders have been placed on the surface at about one meter intervals near the edges; these appear to be steppingstones. There are occasional small rounded basalt pebbles ('*ili 'ili*') between them, suggesting that the interstices between the steppingstones were at one time rock-filled. The trail is moderately elevated, and is generally lower (0.3 m) on the *mauka* side and higher (0.6 m) on the *makai* side; in width it ranges from one to two meters. On the west end of the trail, Feature B enclosure abuts the *mauka* side. West of the enclosure, the trail surface appears to have been altered by the addition of piled rock (Feature C), so that the current footpath is diverted around the blocked portion of the trail.

West of Feature C rock mound, a *hala* grove has eroded the trail to the extent that the alignment is barely visible. The trail appears to extend to adjacent parcels on both sides of the subject property. There were two shovel tests excavated in the vicinity of Feature A: ST-9, 15.0 m east of Feature B enclosure and *mauka* of the trail, and ST-10, *makai* of the trail alignment at the *hala* grove on the west end. Both units exhibited a shallow, unstratified soil deposit of dark brown silt loam that extended to bedrock. No cultural materials were encountered.

FEATURE B: L-shaped enclosure

FUNCTION: Temporary habitation (wayside shelter)

DIMENSIONS: 5.0 m by 4.5 m by 0.6 m

ORIENTATION: 10 degrees magnetic north

PROBABLE AGE: Prehistoric

DESCRIPTION: This feature is contiguous with the *mauka* side of Feature A trail. The west and south walls are natural lava terraces that have been roughly faced with piled subangular basalt cobbles. The elevated trail forms the north wall of the enclosure, and it is open to the east. The interior of the enclosure is a shallow sink, smooth and level, with the tops of the south and west walls level with the surrounding ground surface, and the top of the north wall level with the surface of the trail. The surface of the earthen interior of the feature has been scorched recently by the burning of vegetal refuse. One shovel test, ST-6, was excavated within the enclosure. The unit exposed a shallow, unstratified soil deposit of dark brown silt loam that extended to bedrock. No cultural materials were encountered.

FEATURE C: Rock mound

FUNCTION: Agriculture; clearing mound

DIMENSIONS: 4.0 m diameter by 0.7 m high

ORIENTATION: Not applicable

PROBABLE AGE: Historic

DESCRIPTION: This rock mound is constructed of loosely piled subangular basalt cobbles and small boulders. It is on top of the trail alignment west of Feature B enclosure. The current coastal footpath diverges from the trail alignment to circumvent both the mound and a stand of *hala*, both of which impact the west end of the trail. There appears to be no functional purpose for the mound in relation to the trail, and it is very likely that it is an intrusive construction possibly associated with historic agricultural clearing. The mound has been eroded by *hala*, and is in only fair condition.

SITE No.: State: 50-10-45-18419
PHRI: 1240-12,46
SITE TYPE: Complex (2 features)
DIMENSIONS: Approximately 100 m by 1.0 m
AREA: 100 m²
ELEVATION: 20-45 ft (6.09-13.70 m) AMSL
ORIENTATION: 45 degrees magnetic north
TOPOGRAPHY: Pahoehoe flows form natural terraces with collapsed blisters, fissures, cracks, and small rock overhangs; thin layer of soil on the terraces, thicker soil deposits in the fissures, blisters, and overhangs
VEGETATION: Common guava dominates upslope, *hala* downslope; ground cover is *maile* fern, swordfern, shampoo ginger; two ancient mango trees adjacent to Feature A wall.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Historic
FUNCTIONAL INTERPRETATION: Livestock barriers (cattle walls)
DESCRIPTION: This site includes two rock walls: Feature A, which is oriented parallel to the long axis of the property and forms the west boundary; and Feature B, which is oriented perpendicular to Feature A and parallels the shoreline. Both are livestock barriers, the latter (Feature B) functioning to prevent grazing animals from plunging over the edge of the seacliff.

FEATURE A: Rock wall
PHRI: 1240-12
FUNCTION: Livestock barrier and land boundary
DIMENSIONS: 165.0 m by 0.7 m by 1.2 m
ORIENTATION: 45-50 degrees magnetic north
AGE: Historic
DESCRIPTION: This feature is a double-faced, core-filled rock wall with approximately seven courses of stacked subangular basalt cobbles, small boulders, and occasional waterworn basalt cobbles; the height and thickness of the wall are variable. The sides are vertical, but rocks are not tightly fitted or smoothly faced, and the top of the wall is eroded and somewhat irregular. The wall runs from a boundary-line fencepost near Government/Beach Road to the seaward cliff-face, and forms the west boundary of the property.

FEATURE B: Rock wall
PHRI: 1240-46
FUNCTION: Livestock barrier
DIMENSIONS: 8.0 m by 0.3 m by 0.7 m
ORIENTATION: 100 degrees magnetic north
AGE: Historic
DESCRIPTION: This rock wall is constructed of stacked subangular basalt

cobbles. It is positioned at the edge of a basalt drop-off on the west shoreline of the property, and evidently functioned to prevent animals from falling to the rocks below. Feature B abuts a large rock mound on the west side that separates it from Feature A; however, the mound essentially joins the two walls, which are at right angles to each other. The rock mound appears to be a natural outcrop that may have been slightly modified with loosely piled basalt cobbles. The mound, Feature B wall, and the surrounding ground surface are covered with *naupaka*, making ground visibility poor, and the terrain dangerous.

SITE NO.: State: 50-10-45-18420
PHRI: 1240-16
SITE TYPE: Complex (5 features)
DIMENSIONS: 21.0 m by 11.0 m
AREA: 231 m²
ELEVATION: 20 ft (6.9 m) AMSL
ORIENTATION: 110 degrees magnetic north
TOPOGRAPHY: Exposed low, pahoehoe outcrops, and natural pahoehoe terraces that are thinly covered with soil. The surrounding ground surface is generally level on the subject property, but irregular (gullied and fissured) on the adjacent property.
VEGETATION: Ironwood, *hala*, grasses.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Multiple (ritual)
DESCRIPTION: This site is adjacent to the shoreline about 10-20 m inland of the coastal trail (Site 18418); the complex includes four terraces (Features A, B, C, E) and a rock mound (Feature D). Feature A is a low terrace modified from an upslope pahoehoe outcrop. Feature B terrace is contiguous with Feature A on the east, but is somewhat lower and more inland; it also abuts a pahoehoe outcrop on the upslope side. Feature C is a much higher terrace that abuts Feature B on the *makai* side; its west facing is tiered, and contiguous with Feature D rock mound. Feature D rock mound is *makai* of Feature C, and the features are separated by a deep, small gully or trough except where connected by the facing. Feature E is a small, low terrace modified from natural outcrop. It is not contiguous with the other four features, but is positioned between them and the coastal trail. The east property boundary runs through the contiguous features of the site, so that Features B, C, and D are not within the study area as defined.

FEATURE A: Terrace
FUNCTION: Temporary habitation; possible ritual, ceremonial area
DIMENSIONS: 6.5 m by 3.5 m by 0.5 m

ORIENTATION: 110 degrees magnetic north

AGE: Prehistoric

DESCRIPTION: This feature is a low earth-filled terrace that has been modified from natural pahoehoe outcrop; it is faced on the west and *makai* sides. The facings are two to three courses of piled subangular basalt cobbles to small boulders (approximately 0.05 to 0.60 m diameter). Boulders are placed at the base and sides of the facings and the smaller cobbles/pebbles are on top. The width of the level surface of the terrace is approximately 2.0 m; the surface is earth with a few pebbles, but it may have been paved at one time. Feature A is in poor condition; it is badly damaged by *hala* roots, especially on the west side. Three units were excavated at Feature A: TU-2, a 0.5 by 0.5 test excavation on the east side of the terrace; ST-4, a shovel test in the clearing west of Feature A; and ST-7, a shovel test two meters downslope of the *makai* facing. All excavations exposed a thin unstratified deposit of dark brown silt loam that extended to bedrock. There was no indication of cultural remains interior or exterior of the feature, indicating low-intensity use of the particular locus. A tentative functional interpretation of "temporary habitation" (possible storage, sleeping, ritual or other use) has been assigned pending additional data.

FEATURE B: Terrace

FUNCTION: Temporary habitation; possible ritual, ceremonial area

DIMENSIONS: 6.0 m by 3.0 m by 0.3 m

ORIENTATION: 110 degrees magnetic north

AGE: Prehistoric

DESCRIPTION: Feature B is contiguous with the east side of Feature A. It is a natural pahoehoe terrace that has been faced on the *makai* edge with piled subangular basalt cobbles, and the surface has been made level with packed earth. The feature is slightly lower in elevation than Feature A, and the *makai* facing is set back approximately 0.7 m upslope from the *makai* facing of Feature A. On the east seaward side, Feature B is contiguous with Feature C. Feature B was not within the study area as defined, and therefore was only minimally cleared and not tested. It is unaltered and in fair condition. No surface remains were noted. A tentative functional interpretation of "temporary habitation" (possible storage, sleeping, ritual or other use) has been assigned pending additional data.

FEATURE C: Terrace

FUNCTION: Possible burial; possible ritual, ceremonial feature

DIMENSIONS: 6.50 m by 6.00 m by 1.14 m

ORIENTATION: 90 degrees magnetic north

AGE: Prehistoric

DESCRIPTION: This terrace was built up from ground

surface on the west side to meet the level of outcrop on the east. The west side was faced with stacked, small (0.20-0.50 m) subangular basalt boulders. No courses were evident, but the facing exhibited stepped levels; it had two tiers. The lower tier was 0.50 m wide, but the height could not be determined because of the vegetation. The upper tier was approximately 0.70 m high to the surface of the terrace. The facing, which was oriented north/south, curved to the east on seaward end and was contiguous with Feature D rock mound. The surface of the terrace was packed earth with a few waterworn basalt cobbles. Although surface soils appeared shallow, the feature requires closer investigation to eliminate the possibility of burial of human remains. However, like Feature B, Feature C was not within the project area, so clearing was minimal and it was not tested. No upright stones, coral, or other cultural indicators were noted. It was unaltered and in good condition. A tentative functional interpretation of "possible burial" or "ritual structure" has been assigned pending additional data.

FEATURE D: Rock mound

FUNCTION: Possible burial; ritual, ceremonial

DIMENSIONS: 4.3 m by 2.6 m by 1.1 m

AGE: Prehistoric

ORIENTATION: 90 degrees magnetic north

DESCRIPTION: This feature was a linear mound of 0.20-0.35 m subangular basalt cobbles, stacked and piled in about five to nine courses. Waterworn stones were on the top of the mound. Feature D was contiguous with the facing of Feature C on the western edge. Like Features B and C, it was outside of the project area as defined, so it was cleared only minimally and not tested. No cultural materials were noted on the surface. This feature was unaltered and in good condition. The type of construction and its association with a possible ceremonial structure suggest the possibility of a human burial. A tentative functional interpretation of "possible human burial" or "ritual structure" has been assigned pending additional data.

FEATURE E: Terrace

FUNCTION: Temporary habitation

DIMENSIONS: 4.70 m by 1.70 m by 0.32 m

ORIENTATION: 90 degrees magnetic north

AGE: Prehistoric

DESCRIPTION: This feature was a pahoehoe outcrop with a thin soil cover that was modified on the seaward side with packed earth and 13 subangular basalt cobbles (0.20-0.30 m) placed upright to form a facing; the facing is one to two courses high. One shovel test, ST-8, was excavated on the *makai* end of the terrace; the profile revealed a thin (20.00 cm) unstratified deposit of dark brown silt loam on bedrock. No cultural remains were encountered. The terrace was unaltered,

but in only fair condition due to erosion and the impact of *hala*. The feature probably functioned as a temporary shelter, or storage shed, in connection with contiguous Features A-D.

SITE NO.: State: 50-10-45-18421
PHRI: 1240-21
SITE TYPE: Complex (2 features)
DIMENSIONS: 4.0 m by 4.0 m
ORIENTATION: 90 degrees magnetic north
AREA: 16 m²
ELEVATION: 6.1 ft (2.0 m) AMSL
TOPOGRAPHY: Basalt bench at shoreline
VEGETATION: None
CONDITION: Excellent
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Fishing (bait cups)
DESCRIPTION: This site includes two circular, smoothly abraded and incised holes in the basalt bench immediately adjacent to the shoreline drop-off to the sea; the site is *makai* and northwest of Site 18420 complex. The smaller hole is Feature A and the larger hole, approximately 3.0 m south, is Feature B. Until recently this area of the basalt bench was included in tax maps as part of the subject parcel, however, the property boundaries have been redefined and currently the site is outside the project area.

FEATURE A: Modified outcrop
FUNCTION: Fishing; bait cup
DIMENSIONS: 0.15 m diameter by 0.10 m deep
ORIENTATION: Not applicable
AGE: Prehistoric?
DESCRIPTION: This feature is an almost perfectly round hole in the pahoehoe bench, with smoothly curved sides and base. The basalt is dense enough to hold water for several hours. It is unaltered and in excellent condition.

FEATURE B: Modified outcrop
FUNCTION: Fishing; bait cup
DIMENSIONS: 0.20 m diameter by 0.15 m deep
ORIENTATION: Not applicable
AGE: Prehistoric?
DESCRIPTION: This feature is an almost perfectly round hole in the pahoehoe bench, with smoothly curved sides and base. The basalt is dense enough to hold water for several hours. It is unaltered and in excellent condition.

SITE NO.: State: 50-10-45-18422
PHRI: 1240-2, 3, 4, 5, 6, 7, 9, 26, 28, 29, 30, 31, 32, 33, 34, 35, 36, 39, 40, 41, 43, 44, 45, 48

SITE TYPE: Complex (26 feature-components)
DIMENSIONS: 170 m by 55+ m
AREA: 9350 m²
ELEVATION: 25-40 ft AMSL
TOPOGRAPHY: Undulating pahoehoe with natural terraces sustaining a thin layer of soil; sinks, collapsed blisters, fissures, cracks, and small overhangs with thicker soil deposits.
VEGETATION: Abundant guava *mauka*; *hala* throughout, but extensive grove *makai*; two coconut groves, two mangoes, a banyan, and ti; shampoo (wild) ginger, *maile* fern, and swordfern are common ground cover.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Multiple (agriculture)
DESCRIPTION: This site is a complex consisting of 26 formal components, including 11 modified outcrops (mostly faced lava terraces or collapsed blisters), six rock mounds, three rock walls, one terrace, one platform, one linear rock mound, one rock alignment, one C-shape, and one depression. The site extends from just *mauka* of the coastal trail to Beach/Government Road. Features A through J are in a dense *hala* thicket on the *makai* end of the site. Feature K, an isolated platform, is about central and relatively out in the open. Features L through R are *mauka* on the site and associated with two coconut groves. Features S and T are closest to Beach/Government Road. There were 15 test excavations at the site, seven controlled test units, and eight shovel tests. Excavations exposed unstratified deposits of dark brown silt loam, and five units yielded volcanic glass artifacts. No other artifact types, ecofacts, or datable materials were encountered.

FEATURE A: Feature complex
PHRI: 1240-43, 44, 45
FUNCTION: Agriculture
DIMENSIONS: 15.0 m by 2.0 m by 1.2 m deep
ORIENTATION: 130 degrees magnetic north
AGE: Prehistoric
DESCRIPTION: This feature includes three discontinuous sections of modified outcrop (feature components). There are two faced areas (A1, A2) on a small elevated outcrop or "island" and these are positioned opposite a third modified natural feature, an extensively faced L-shaped fissure (A3) oriented north/south (*mauka/makai*) on its long axis. Taken together, the modifications form a walled ditch or "moat-like" trough approximately 1.5-2.0 m wide and 15.0 m long. The ditch is closed off on the west end by a low packed-earth/rock berm. It did not function in irrigation, but appears to have been a planting area of deeper soils and enhanced moisture retention (a natural catchment feature modified to retain soils and rainwater). Structurally Feature A resembles a similar compound feature at the *mauka* end of the site (Feature N).

The ditch contained deeper soils than were commonly found in the project area, and one test unit, TU-7, was excavated in the center of the ditch just *mauka* of the "corner." TU-7 (50 by 50 cm) was excavated to 33 cm below surface without encountering bedrock. The profile exposed an unstratified deposit of dark brown to black silt loam; eight volcanic glass flakes were recovered from 20-30 cm below surface.

FEATURE A1: Modified outcrop

PHRI: 1240-45

FUNCTION: Agriculture

DIMENSIONS: 0.6 m wide by 0.6 m

ORIENTATION: Not applicable

DESCRIPTION: The elevated outcrop or "island" has two areas of modification (feature components). On the southwest (*mauka*) side there is a piled rock facing of subangular basalt cobbles (10-30 cm). The rocks are loosely piled on the side of the outcrop. The feature is unaltered, but in poor condition due to damage from *hala* roots.

FEATURE A2: Modified outcrop

PHRI: 1240-43

FUNCTION: Agriculture

DIMENSIONS: 2.5 m by 1.1 m by 1.2 m

ORIENTATION: 160 degrees magnetic north

DESCRIPTION: This feature component is on the northwest (*makai*) side of the elevated outcrop or "island," near the "corner" where the ditch angles to the west; here the outcrop is faced with stacked subangular basalt cobbles (10-20 cm). This facing is unaltered and in good condition. The two rock facings on the "island" (A1 and A2) are not contiguous, and there is no tumbled rock in the ditch that would indicate they were once connected.

FEATURE A3: Modified outcrop

PHRI: 1240-44

FUNCTION: Agriculture

DIMENSIONS: About 15.0 m by 1.2 m deep

ORIENTATION: 130 degrees magnetic north

DESCRIPTION: The third feature component is the faced L-shaped fissure. The long axis of the fissure itself is about 40 degrees magnetic north (*mauka/makai*), and it runs along the base of Feature B (elevated outcrop) and the "island" (Features A1, A2) before turning west around the base of A2 for a distance of about 8-9 m, where it ends in a berm. The fissure is not "faced" for its entire length; there are three to four courses of stacked subangular basalt cobbles (10-30 cm) at the "corner" where the fissure changes direction, and piled rock facing on the length of fissure that runs east/west. The fissure facing is on the side opposite the "island." Feature component A3 is unaltered, and only slightly eroded.

FEATURE B: Modified outcrop

PHRI: 1240-26

FUNCTION: Temporary habitation

DIMENSIONS: 10.0 m diameter by 2.0 m high

ORIENTATION: Not applicable

AGE: Prehistoric

DESCRIPTION: This feature consists of a levelled knoll with remnants of rock facing on the southeast side. The knoll is *mauka* of Feature A "island" and on the west side of the fissure/ditch that is faced further downslope at Feature A. One side of the knoll exhibits remnants of small subangular basalt cobbles piled approximately 1.5 m high, and vertical against the outcrop. It is about 2+ m from the top of the piled facing to the base of the ditch. The feature appears unaltered and in fair condition. One test unit, TU-4, was excavated on the level surface of the knoll. Excavation revealed an unstratified deposit of very dark grayish brown silt loam, with bedrock encountered at various depths from 6 to 29 cm below surface. Forty-five volcanic glass artifacts, including three primary cores, were recovered from 10-30 cm below surface, as was one intact *kukui* nut. There is no *kukui* tree currently anywhere on the property. Feature B appears to have functioned as an activity area associated with agriculture, probably a tool manufacturing locus. No surface remains were noted.

FEATURE C1: Terrace

PHRI: 1240-9

FUNCTION: Agriculture

DIMENSIONS: 31.0 m by 8.0 m by 1.5 m

ORIENTATION: 30 degrees magnetic north

AGE: Prehistoric

DESCRIPTION: This feature is a triangular-shaped terrace with rock facing on three sides; the east side facing is only partial, so that the surface of the terrace is continuous with the open clearing to the east. The west facing and the east facing meet *mauka* at the apex of the triangle, and the juncture is badly damaged by *hala* roots. The east facing is stacked basalt, about 5-6 courses, 0.75-0.90 m high; the rocks are not flat or fitted. There is an oval rock mound (Feature C2) at about the midpoint of the east facing (described separately below). The west-side facing is loosely piled subangular basalt cobbles, 0.40-0.80 m high, and badly eroded on the *makai* end where it intersects the *makai* facing. The *makai* facing forms the base of the triangle; it is constructed of stacked and faced subangular basalt cobbles and boulders, from 1.25-1.50 m high. One test unit, TU-3, was excavated in the approximate center of the terrace. The profile revealed an unstratified deposit of very dark grayish brown silt loam; bedrock was encountered in part of the unit at 3 cm below surface, and in all of the unit by 10 cm below surface. No

cultural materials were noted on the surface, or encountered in excavation.

FEATURE C2: Rock mound

PHRI: 1240-9

FUNCTION: Agriculture

DIMENSIONS: 3.0 m by 1.5 m by 1.3 m

ORIENTATION: 90 degrees magnetic north

PROBABLE AGE: Historic

DESCRIPTION: This feature is an oval rock mound constructed of piled subangular basalt cobbles and small boulders. It was superimposed on the east-side facing of Feature C1 terrace; its interior height (toward the center of the terrace) was 0.65 m and its exterior height (on the downslope edge of the facing) was 1.30 m. Feature C2 was sectioned (TU-6). The profile revealed three strata: Layer I, the cobble/boulder mound-fill; Layer II, a very dark brown clay loam; and Layer III, a very dark brown cobbly silt loam; it was excavated to bedrock. No cultural remains were encountered. The feature was adjacent to the opening clearing on the east side of the property, and was probably a clearing mound associated with historic clearing for pasturage.

FEATURE D: Rock wall

PHRI: 1240-28

FUNCTION: Agriculture

DIMENSIONS: 3.0 m by 2.0 m by 0.3 m

ORIENTATION: 20 degrees magnetic north

AGE: Prehistoric

PROBABLE AGE: Prehistoric

DESCRIPTION: This feature includes a rock mound of piled basalt boulders about 2.0 m in diameter and 0.7 m high, from which extends (*makai*) a rough basalt cobble alignment that forms a small compartment or enclosure with a level soil interior (dimensions above are for the compartment). The feature abuts an unmodified basalt outcrop. Feature D appears unaltered but its condition is poor. The compartment may delineate a planting area. No cultural materials were noted.

FEATURE E: Rock wall

PHRI: 1240-29

FUNCTION: Agriculture

DIMENSIONS: 12.0 m by 5.0 by 0.8 m

AGE: Prehistoric

ORIENTATION: 175 degrees magnetic north

DESCRIPTION: This feature is an L-shaped wall that has been modified from a natural pahoehoe terrace that was irregular and rocky on the surface but overall, level. Rocks have been piled or stacked on two sides of the outcrop to form a wall, which ranges in height from 0.40 m on the short axis to 0.60 m on the long axis, and about 0.80 m at the corner.

The *makai*-side facing (long axis) is at the edge of a low pahoehoe terrace, which continues unmodified to Feature D compartment. The L-shaped configuration and general orientation of Feature E resembles Feature I, which is *mauka* (southwest). Feature E appears unaltered, but is eroded and in fair-to-poor condition. No cultural materials were noted.

FEATURE F: Rock mound

PHRI: 1240-31

FUNCTION: Indeterminate

DIMENSIONS: 1.7 m by 1.1 m by 0.7 m

ORIENTATION: 170 degrees magnetic north

AGE: Prehistoric

DESCRIPTION: This mound consists of loosely piled subangular basalt cobbles and small boulders (10-30 cm) that are held together by the roots of a *hala*. It is *mauka* of Feature E and *makai* of Feature I, in an area of level but irregular terrain. It is unaltered but in very poor condition. No surface remains were noted.

FEATURE G: Modified outcrop

PHRI: 1240-30

FUNCTION: Agriculture

DIMENSIONS: 5.0 m diameter by 1.0 deep

AGE: Prehistoric

DESCRIPTION: This feature is a nearly circular collapsed blister, the sides of which have been partially faced with piled subangular basalt cobbles (10-20 cm). The facing is most evident on the east side, where it is about 1.0 m long and 0.7 m high. The floor of the blister is generally level, although there are a few rocks scattered about; there is a large basalt boulder (c. 0.65 m in diameter) on the east floor of the sink, and also a small waterworn boulder (about 35 cm). The sink sits in an elevated pahoehoe outcrop that has a high (1.0+ m) vertical edge on the west side. The part of the edge nearest Feature G (about 2.0 m west of it) is faced with stacked rock (see Feature H below). This spatial arrangement of faced sink adjacent to a conspicuous, prominent vertical facing is repeated at Features O and P. Feature G appears unaltered, however, it is eroded and in only fair condition. No surface remains were encountered.

FEATURE H: Modified outcrop

PHRI: 1240-33

FUNCTION: Agriculture

DIMENSIONS: 7.00 m long by 0.40 m thick by 0.85 m high

ORIENTATION: 40 degrees magnetic north

AGE: Prehistoric

DESCRIPTION: This feature consists of an elevated pahoehoe outcrop with a steeply vertical edge more than one meter high on the west side. The vertical edge runs *mauka/makai* and ends *makai* in a small rock overhang. On the *mauka*

end, the vertical edge is faced with four courses of stacked subangular basalt cobbles and small boulders (20-45 cm) that are stacked to about 0.30 m above the level surface of the outcrop. This prominent facing is a few meters west of Feature G. The level surface of the pahoehoe outcrop between Feature H facing and Feature G sink is about 2.00-3.00 m wide. Considered in isolation, Feature H appears to have no discernible utility, however, it may have functioned as a specialized planting area in conjunction with Feature G. A similar arrangement of faced sink and isolated, prominent facing is found at Features O and P. The condition of this feature is good and it appears unaltered. No cultural remains were noted.

FEATURE I: Rock wall

PHRI: 1240-32

FUNCTION: Agriculture

DIMENSIONS: 8.0 m by 5.0 m by 1.2 m

ORIENTATION: 20 degrees magnetic north

AGE: Prehistoric

DESCRIPTION: This feature consists of an L-shaped wall of piled subangular basalt cobbles and boulders (10-45 cm) on the *mauka* edge of the *hala* thicket. The *makai* (seaward) wall is about 0.6 m high and sits atop a natural lava terrace. The west wall ranges from 0.6-1.2 m high. The interior of the L-shape has two distinct ground surfaces, a narrow pahoehoe terrace about 0.7 m high, and *mauka* of this, a sink with a more or less level ground surface. The walls appear to delimit a bi-level planting area. With the exception of the bi-levels, it morphologically resembles Feature E, located *makai*. The condition of this feature is generally good with some *hala* impact at the corner, however, it has been altered; the interior ground surface and some rocks have been recently scorched in connection with the burning of vegetal refuse.

FEATURE J: Rock mound

PHRI: 1240-7

FUNCTION: Indeterminate

DIMENSIONS: 1.50 m by 1.00 m by 0.25

ORIENTATION: 65 degrees magnetic north

AGE: Prehistoric

DESCRIPTION: This feature consists of a roughly piled kidney-shaped rock mound of subangular basalt cobbles and small boulders (10-40 cm) located *mauka* of Feature I on the east side at the edge of the *hala* thicket. It may at one time have been contiguous with Feature I, in which case the features would have delimited a U-shaped bi-level area. Any connection was impossible to determine, however, as the area was badly eroded by *hala* and recently scorched by the burning of huge rubbish piles. No surface remains noted.

FEATURE K: Platform

PHRI: 1240-5

FUNCTION: Agricultural activity area; possible burial

DIMENSIONS: 4.5 m by 4.0 m by 0.6 m

ORIENTATION: 145 degrees magnetic north

AGE: Prehistoric

DESCRIPTION: This formal type was unique to the horticultural site, and spatially somewhat isolated. The feature was a nearly square platform constructed of subangular basalt cobbles and boulders and occasional waterworn stacked two to four courses high; the platform surface was rocky, and in the approximate center was a depression about 1.35 m in diameter and 10-15 cm deep. On the possibility that it was a burial platform, one test unit was excavated through the depression (TU-1). Excavation revealed that the platform covered a hole in the pahoehoe bedrock. The ceiling of an underground tube or cave had partially collapsed, and the hole had been filled with subangular and waterworn basalt cobbles to the top of a soil layer. Removal of the rock fill and about 30 cm of soil (a reddish-brown silt loam) revealed the apparent upper levels of a subterranean chamber that appeared to extend in all directions, but more conspicuously northwest (*makai*); the visible part of this northwest extension was partially blocked with cobbles. No cultural remains were noted in the cobble fill or in the excavated soil deposit. The limited scope of the project prohibited definitive excavation of this feature. The inferred function above refers to its possible surface utility, and any additional information must await additional data. The feature is unaltered and in good condition.

FEATURE L1: Rock mound

PHRI: 1240-6

FUNCTION: Indeterminate

DIMENSIONS: 0.9 m diameter by 0.1 m high

ORIENTATION: Not applicable

AGE: Prehistoric?

DESCRIPTION: This feature was a small, nearly perfectly round flat mound about 10 cm high, constructed of subangular basalt cobbles (10 cm). On the possibility that it was a "packed" hearth, the feature was half-sectioned. Excavation revealed abundant cobbles with scant soil (dark brown silt loam with many roots) and four volcanic glass flakes, but no charcoal. It was only 10 cm thick and was excavated to the exposed pahoehoe beneath. It was not a hearth, and its function remains unknown. It is 6.0-8.0 m east of Feature K platform, and just *makai* of Feature L2, an amorphous rock mound. It may be a dismantled *ahu* (cairn [marker]).

FEATURE L2: Rock mound

PHRI: 1240-4

FUNCTION: Indeterminate

DIMENSIONS: 1.20 m by 0.75 m by 0.60 m high

ORIENTATION: 90 degrees magnetic north

DESCRIPTION: This feature is just *mauka* of L2 on an

exposed pahoehoe outcrop; it is a loose pile of subangular basalt boulders and cobbles about 10.00 m east of Feature K platform. It is unaltered, but it is eroded by *hala* so that its condition is poor. It may be discarded rocks from the dismantling of L1.

FEATURE M: Modified outcrop

PHRI: 1240-34

FUNCTION: Agriculture

DIMENSIONS: 1.50 m by 0.25 m thick by 1.00 m high

ORIENTATION: 120 degrees magnetic north

AGE: Prehistoric

DESCRIPTION: The feature consists of subangular basalt cobbles and small boulders (15-40 cm) roughly stacked and piled to form a facing on the corner of a natural pahoehoe terrace, where it intersects a shallow linear depression or ditch at right angles. The ditch is oriented east/west and extends for about 20.00 meters across the property *mauka* of Feature K platform. Approximately half a dozen mature coconut trees are in the ditch. Feature M is on the east end of the ditch, and there is another amorphous rock pile on the west end. It is likely that they are both remnants of ditch retaining walls. Feature K appears unaltered, but is badly eroded and in poor condition. No cultural materials were noted.

FEATURE N: Feature complex

PHRI: 1240-2, 3

FUNCTION: Multiple (agriculture)

DIMENSIONS:

ORIENTATION:

AGE: Prehistoric

DESCRIPTION: This feature includes three contiguous but distinct structural components: Feature N1, a modified (faced) outcrop that runs *mauka/makai* and is contiguous with Feature N2 on the *makai* end; Feature N2, a modified (faced) outcrop that runs east/west, and is contiguous with N1 on the east and N3 on the west; and Feature N3, a linear rock mound that is contiguous with N2 on the east side and extends across level pahoehoe to end at the edge of outcrop that supports Feature O. All three components are oriented toward a sloping sink area in the middle of which are at least two levels of flat natural terraces and a rocky elevation. Features N1 and N2 face the rocky elevation, which is where N1 and N2 intersect, so that an L-shape corner is formed. Like Feature A (see above), the facings and the elevation form an L-shaped ditch that probably functioned as a planting area. Near the *makai* end of A1, two linear rock/earth berms, about 1.0 m thick, 0.6 m high, and about 2.0-3.0 m apart, connect the rocky elevation to the A1 facing, closing off the ditch into small discrete sections in this area.

FEATURE N1: Modified outcrop

PHRI: 1240-2

FUNCTION: Agriculture

DIMENSIONS: 32.00 m by 0.75 m thick by 1.60 m deep

ORIENTATION: 55 degrees magnetic north

DESCRIPTION: Feature component N1 is a natural pahoehoe elevation that has been faced on its west downslope edge with piled cobbles and boulders. This linear faced outcrop runs parallel to the east parcel boundary, and on the *makai* end it intersects N2 at approximate right angles. The land surface west of N1 facing is a shallow sink with rocky outcrops and natural pahoehoe terracing; east of N1 is the adjacent property, which is elevated. On the *mauka* end, N1 is intermittent through a stand of coconut and is in general badly eroded and difficult to follow because of vegetation. The facing also diminishes as the natural elevation on the adjacent parcel disappears on the *mauka* end and the two properties become level with each other. Feature-component N1 appears unaltered. No surface remains were noted.

FEATURE N2: Modified outcrop

PHRI: 1240-3

FUNCTION: Agriculture

DIMENSIONS: 10.5 by 1.0 m by 0.9 m

ORIENTATION: 130 degrees magnetic north

DESCRIPTION: Feature component N2 consists of an elevated pahoehoe flow that is modified on its downslope (*mauka*) edge with a rock facing of stacked subangular basalt cobbles and small boulders (15-40 cm). The facing rises above the surface of the elevated outcrop, so that its *makai* height ranges from 0.3-0.5 m, while its *mauka* (downslope) height is from 0.6-0.9+ m. Feature N2 intersects N1 at right angles to the east, and forms the *makai* retaining wall of the L-shaped ditch. It is contiguous with N3 on the west. It is unaltered, and only slightly eroded where it intersects with N3. No surface remains were noted.

FEATURE N3: Linear rock mound

PHRI: 1240-3

FUNCTION: Agriculture; possible land boundary

DIMENSIONS: 12.0 m by 1.0 m by 0.3 m

ORIENTATION: 100 degrees magnetic north

DESCRIPTION: The feature is a low linear mound of piled subangular basalt cobbles that is contiguous with Feature N2 to the east, and with the outcrop contour of Feature O to the southwest; it crosses a level, natural pahoehoe terrace. Although the integrity of the mound appears good, there does not appear to be much rock, and it seems unlikely that it was a tumbled wall of any great height. It appears to function in delimiting areal space, and may have been a land boundary of some kind. It is unaltered but somewhat eroded. No surface remains were noted.

FEATURE O: Modified outcrop

PHRI: 1240-36

FUNCTION: Agriculture

DIMENSIONS: 8.0 by 8.0 by 1.5 m

AGE: Prehistoric

ORIENTATION: 130 degrees magnetic north

DESCRIPTION: This feature is a pressure bulge that is level on top, and modified on the sides with two different types of facings. The *mauka* (south) downslope edge and sections of the east edge were modified with piled subangular basalt cobbles, small boulders, and a few waterworns (15-45 cm); part of this section of facing (O1) forms a rough corner about 3.5 m long and 2.0 m high. On the east side, part of the downslope edge is modified with a formal, vertical facing of about seven courses of stacked and fitted subangular basalt boulders (15-40 cm). This section of facing (O2) is approximately 4.0 m long and 1.5 m high, and contiguous on either side with the piled facing. The differences in the facings do not appear to be the result of differential erosion, rather they appear to represent two different phases of construction. Facing O2 was sectioned to determine whether or not it concealed a cave opening (TU-8). It did not; removal of the rock revealed a smooth unblemished dome of solid basalt. Four shovel tests were also excavated in the area to determine presence/absence of cultural remains: ST-2, on top of the surface of the bulge; ST-11 in the level area east of O2; ST-13 at the base of the sectioned portion of O2; and ST-14 in a recently burned, level area east of O2. All excavations exposed an unstratified deposit of dark brown silt loam; no cultural materials were encountered. In terms of possible function, it was noted that the prominent vertical facing (O2) was a few meters across the bulge from the partitioned collapsed blister Feature P, a spatial configuration similar to that of Features G and H. The modified outcrop appears unaltered, but is somewhat eroded. No surface remains were noted.

FEATURE P: Modified outcrop

PHRI: 1240-35

FUNCTION: Agriculture

DIMENSIONS: 17.0 m by 10.0 m by 3.0 m deep

ORIENTATION: 90 degrees magnetic north

AGE: Prehistoric

DESCRIPTION: This feature is a collapsed blister. The sides have been faced with piled subangular basalt cobbles and small boulders (10-40 cm) and some waterworn basalt. The blister has been partitioned with a rock wall, so that there is a large pit on the *makai* side and a very small pit on the *mauka* side. The east sidewall of the large pit, parallel with Facing O2 a few meters across the bulge, has been loosely faced with piled rocks. The rock wall partitioning the blister is constructed of five to six courses of subangular basalt cobbles and small boulders. It is about 2.00 m long, 0.80 m wide or thick, and 1.25 m high. It is faced vertically and flat

on the *makai* side, and faced with piled rock on the *mauka* side. The sides of the small blister are small overhangs. The feature appears unaltered, but the piled facing of the east sidewall of the large pit is badly eroded. Two shovel tests were excavated in the blister, ST-1 in the interior of the large pit, and ST-12 in the interior of the small one. Both excavations revealed an unstratified deposit of dark brown silt loam, shallow in the large pit, much deeper in the small pit; no cultural remains were encountered.

FEATURE Q: Rock alignment

PHRI: 1240-39

FUNCTION: Agriculture

DIMENSIONS: 2.1 m by 1.4 m by 0.5 m

ORIENTATION: 40 degrees magnetic north

AGE: Prehistoric

DESCRIPTION: This feature consists of a rough circular alignment of small basalt boulders with one upright on the southeast wall; it abuts the outcrop of Features O and P. The interior is level, and about 1.0 by 0.5 m in area. One shovel test was excavated just outside the alignment to the south (*mauka*). Excavation revealed an unstratified deposit of dark brown silt loam; no cultural material was encountered. Probable planting area.

FEATURE R: C-shape enclosure

PHRI: 1240-48

FUNCTION: Temporary habitation

DIMENSIONS: 3.00 m by 2.00 m by 0.30 m

ORIENTATION: 45 degrees magnetic north

AGE: Prehistoric

DESCRIPTION: This feature was a small enclosure constructed of two courses of subangular basalt cobbles; there was a waterworn cobble embedded in the east wall. The C-shape was open to the southwest, and the interior was level with about 0.05 m of organic litter. The interior surface and the rocks were scorched by recent burning, and it was also somewhat eroded. One shovel test, ST-5, was excavated inside the C-shape. The profile revealed an unstratified deposit of dark brown silt loam, and one volcanic glass artifact was recovered. The feature is classified as "temporary habitation," and probably functioned as a small field shelter or windbreak associated with agricultural activity.

FEATURE S: Circular depression

PHRI: 1240-40

FUNCTION: Agriculture

DIMENSIONS: 2.50 m diameter by 0.75 m deep

ORIENTATION: Not applicable

AGE: Prehistoric

DESCRIPTION: This feature consists of a nearly circular

earthen depression with smooth sloping sides and base; it is not rock-lined. The interior has been recently burned, but its condition is good; it is not eroded. It was a probable planting area. No surface remains were noted.

FEATURE T: Rock mound
PHRI: 1240-41
FUNCTION: Indeterminate
DIMENSIONS: 3.0 by 1.0 by 0.5 m
ORIENTATION: 90 degrees magnetic north

AGE: Prehistoric/historic

DESCRIPTION: This feature is constructed of loosely piled subangular basalt cobbles. The mound is barely visible through the aerial roots of several *hala*, which appear to be holding the feature together. It is somewhat spatially isolated from the other features in the site, and is adjacent to the proposed driveway and a recent burn pile. It is the most *mauka* feature on the property. It appears unaltered, but it is in poor condition. No surface remains were noted. It may be a relic of historic construction of the adjacent road.

APPENDIX B

DETAILED STRATIGRAPHIES OF EXCAVATIONS

TEST UNITS

<i>Layer</i>	<i>Description</i>	
TU-1 [Site 18422-K]		roots; common very fine to fine interstitial pores; cultural material present; layer terminates on bedrock.
I	5-204 cmbd; basalt subangular cobble (20-30 cm) layer, with occasional basalt waterworn cobbles (platform and cave fill); many micro to coarse vesicular roots; many micro to coarse interstitial pores; abrupt, wavy boundary;	TU-5 [Site 18422-L1]
II	204-244+ cmbd; very dark brown (10YR 2/2 moist); silt loam; dark reddish brown (5YR 3/4 dry); strong, very fine subangular blocky structure; loose, very friable, slightly sticky, non-plastic consistence; no roots or pores noted; culturally sterile; layer continues.	I 0-10 cmbs, ranges from 4-10 cm thick; very dark grayish brown (10YR 3/2 moist); cobbly silt loam; dark brown (10YR 3/3 dry); strong, coarse, subangular blocky structure; soft, very friable, slightly sticky, slightly plastic consistence; many micro to coarse vesicular roots; many micro to fine interstitial pores; cultural material present; layer terminates on bedrock.
TU-2 [Site 18420-A]		TU-6 [Site 18422-C2]
I	0-16 cmbs, ranges from 4-16 cm thick; very dark grayish brown (10YR 3/2 moist); cobbly silt loam; dark brown (10YR 3/3 dry); strong, coarse subangular blocky structure; soft, friable, slightly sticky, slightly plastic consistence; many very fine to coarse tubular roots; common very fine to fine interstitial pores; culturally sterile; layer terminates on bedrock.	I 9-81 cmbd, ranges from 43-72 cm thick; cobble and boulder layer; few coarse tubular roots; cultural material present; clear, irregular boundary;
TU-3 [Site 18422-C1]		II 60-109 cmbd, ranges from 29-49 cm thick; very dark brown (10YR 2/2 moist); clay loam; moderate medium blocky structure; soft, friable, slightly sticky, plastic consistence; many micro to coarse vesicular roots; many micro to fine interstitial pores; culturally sterile;
I	0-10 cmbs, ranges from 3-10 cm thick; very dark grayish brown (10YR 3/2 moist); cobbly silt loam; strong, coarse subangular blocky structure; soft, friable, slightly sticky, slightly plastic consistence; many very fine to coarse tubular roots; common very fine to fine interstitial pores; culturally sterile; layer terminates on bedrock.	III 109-120 cmbd, ranges from 4-15 cm thick; very dark brown (10YR 2/2 moist); cobbly silt loam; moderate medium blocky structure; loose, friable, slightly sticky, slightly plastic consistence; many micro to coarse vesicular roots; common micro to fine interstitial pores; culturally sterile; layer terminates on bedrock.
TU-4 [Site 18422-B]		TU-7 [Site 18422-A]
I	0-29 cmbs, ranges from 8-29 cm thick; very dark grayish brown (10YR 3/2 moist); stoney silt loam; strong, coarse subangular blocky structure; soft, friable, sticky, slightly plastic consistence; many very fine to coarse tubular	I 0-33 cmbs, generally 33 cm thick; very dark grayish brown (10YR 3/2 moist); silt loam; dark brown (10YR 3/3 dry); strong, coarse subangular blocky structure; soft, friable, slightly sticky, slightly plastic consistence; many very fine to coarse tubular roots; common very fine to fine interstitial pores; cultural material present; layer continues.

SHOVEL TESTS

ST-1 [Site 18422-P, interior of large pit]

Layer	Description
I	0-30 cmbs; black (10YR 2/1 moist); clay loam; very fine to fine subangular blocky structure; soft, friable, slightly sticky, slightly plastic consistence; many micro to coarse tubular roots; many micro to fine interstitial pores

ST-2 [Site 18422-O, on the surface of the pressure bulge]

I	0-23 cmbs; black (10YR 2/1 moist); clay loam; very fine to fine subangular blocky structure; soft, friable, slightly sticky, slightly plastic consistence; many micro to coarse tubular roots; many micro to fine interstitial pores
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ST-3 [Site 18421-A, stormwash "pond" on the basalt bench]

I	0-43 cmbs; mottled black and white (10YR 2/1 and 8/1 moist); fine sand; weak, very fine single grain structure; loose, loose, non-sticky, non-plastic consistence; no roots or pores noted
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ST-4 [Site 18420, clearing west of complex]

I	0-43 cmbs; dark brown (7.5YR 3/2 moist); clay loam; strong fine to coarse crumb structure; very hard, friable, slightly sticky, slightly plastic consistence; many micro to coarse tubular roots; many micro to fine interstitial pores
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ST-5 [Site 18422-R]

I	0-16 cmbs; very dark brown (10YR 2/2 moist); clay loam; strong, fine subangular blocky structure; soft, friable, slightly sticky, slightly plastic consistence; many micro to coarse tubular roots; many micro to fine interstitial pores; layer terminates on bedrock
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ST-6 [Site 18418-B]

I	0-26 cmbs; dark brown (7.5YR 3/2 moist); clay loam; strong, fine to coarse crumb structure; soft, friable, slightly sticky, slightly plastic
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consistence; many micro to coarse tubular roots; many micro to fine interstitial pores

ST-7 [Site 18420-A, 2 m seaward of feature]

I	0-15 cmbs; very dark brown (10YR 2/2 moist); clay loam; strong, fine to coarse crumb structure; soft, friable, slightly sticky, slightly plastic consistence; many micro to coarse tubular roots; many micro to fine interstitial pores
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ST-8 [Site 18420-E]

I	0-20 cmbs; very dark brown (10YR 2/2 moist); clay loam; strong, fine to coarse crumb structure; soft, friable, slightly sticky, slightly plastic consistence; many micro to coarse tubular roots; many micro to fine interstitial pores
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ST-9 [Site 18418, 15 m east of Fea B enclosure and mauka of Fea A trail]

I	0-18 cmbs; dark brown (7.5YR 3/2 moist); clay loam; strong, fine to coarse crumb structure; soft, friable, slightly sticky, slightly plastic consistence; many micro to coarse tubular roots; many micro to fine interstitial pores
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ST-10 [Site 18418, makai of Fea A trail at west end]

I	0-18 cmbs; black (10YR 2/1 moist); clay loam; strong, fine to coarse crumb structure; soft, friable, slightly sticky, slightly plastic consistence; many micro to coarse tubular roots; many micro to fine interstitial pores
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ST-11 [Site 18422, level area east of Fea O2 facing]

I	0-20 cmbs; dark brown (7.5YR 3/2 moist); clay loam; strong, fine to coarse crumb structure; soft, friable, slightly sticky, slightly plastic consistence; many micro to coarse tubular roots; many micro to fine interstitial pores
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ST-12 [Site 18422-P, interior of small pit]

I	0-41 cmbs; black (10YR 2/1 moist); clay loam; strong, fine to coarse crumb structure; soft, friable, slightly sticky, slightly plastic
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consistence; many micro to coarse tubular roots;
many micro to fine interstitial pores

**ST-13 [Site 18422, base of sectioned facing
Fea O2]**

- I 0-22 cmbs; black (10YR 2/1 moist); clay loam;
strong, fine to coarse crumb structure; soft,
friable, slightly sticky, slightly plastic
consistence; many micro to coarse tubular roots;
many micro to fine interstitial pores

**ST-14 [Site 18422, burned area east of
Fea O2 facing]**

- I 0-28 cmbs; black (10YR 2/1 moist); clay loam;
dark brown (7.5YR 3/2 dry); strong, fine to
coarse crumb structure; hard, friable, slightly
sticky, slightly plastic consistence; many micro
to coarse tubular roots; many micro to fine
interstitial pores

ST-15 [Site 18422-Q]

- I 0-21 cmbs; dark brown (7.5YR 3/2 moist); clay
loam; strong, fine to coarse crumb structure;
hard, friable, slightly sticky, slightly plastic
consistence; many micro to coarse tubular roots;
many micro to fine interstitial pores

APPENDIX C

HISTORICAL DOCUMENTARY RESEARCH

By Lehua Kalima, B.A.

The project area is in the *ahupua'a* of Halona and Popoki, in the district of Puna, Hawaii. These are small *ahupua'a* adjacent to the *ahupua'a* of Maku'u on the north. While the project area is not in Maku'u *Ahupua'a* itself, Maku'u is often the general term used to mean this entire area. Historical documentation for this entire district is scant compared to other areas on the island. Few of the traditions and legends in this area survive; this may be due to the strong missionary presence in Puna. The Reverend Titus Coan came to the islands in 1835 and was in charge of a mission in Hilo. He served for more than 50 years in this capacity and was known for his highly organized methods of watching over his flock. He would send out male and female converts as disciples (Barrere 1971:11). In 1841 Charles Wilkes, an explorer with the U.S. exploring expedition in the 1830s and 40s noted, "almost all the hills or craters of any note have some tradition connected with them; but I found that the natives were now generally unwilling to narrate these tales, calling them 'foolishness'" (Wilkes 1845 4:186).

Barrere (1959:15), speculating on the lack of traditional political history, states that Puna as a political unit was insignificant in shaping the course of history of Hawaii Island. Unlike the other districts, Puna lacked a great family whose support the chiefs seeking power could depend on for success. Puna lands were sought, but their control rested on the control of the adjacent districts of Ka'u or Hilo. Puna's history is often bound up with the fortunes of the ruling families on either side of her.

PRE-CONTACT HISTORY

The translations of the following *ahupua'a* names are given by Pukui et al. (1974). Halona literally means "peering place;" Popoki translates as "ti leaf bundle;" and Maku'u is listed as "canoe end-pieces." In the legend of Ka-Miki (Maly in prep), a different meaning for Maku'u is given. Maku'u is referred to as the name of a sling which Kaniahiku used to destroy her combatants, as the following excerpt illustrates:

During her battle with Ka-Miki, Kaniahiku used her sling stone Kaueleau to strike at Ka-Miki. This sling stone was eight feet long and weighed several 100 pounds, whatever it hit was completely crushed. Kaueleau had a hole in it, through which cordage of *olona* and *pulu niu* (coconut fiber) was tied in the

technique called *maku'u*, so it could be swung overhead. Because of the stones' great weight, the cordage broke, and the stone went flying to the sea thus the lands of Kaueleau were named. The cordage flew in the opposite direction, and fell in the lands now called Maku'u (444).

In the tale of Halemano, a Hawaiian love story, Laenihi, Halemano's sister, tells Halemano how he may attract Kamalalawalu, a woman he has fallen in love with. She suggests that Halemano make some playthings for Kamalalawalu's brother, Kumukahi, whom Kamalalawalu would not refuse anything. In the following passage, Maku'u and Popoki are mentioned as Halemano and Laenihi sail from Oahu to Puna:

Laenihi then instructed the people from Waialua to Waianae that wooden idols be hewed out and that they be painted red and black. Orders were also issued that wooden chickens be made to ride on the surf, also *koieie* floaters, and kites to fly above; also that a red canoe be prepared and red men be had to paddle the canoe. The men should be provided red paddles and the canoe must be rigged with red cords, and that a large and a small canoe be provided. After these different things were ready they set out for Puna, Hawaii. Upon their arrival off of Makuu and Popoki, two small pieces of land next to Puna, the kite was put up. When the people on the shore saw this flying object they all shouted with joy (Elbert 1971:256).

Other legends refer to the general Puna area. One legend tells of a chief of Puna, Keliikuku, who was very proud of his homeland. While on O'ahu he boasted to a prophet of Pele, Kaneakalau, of the abundance and verdure of Puna. The prophet ridiculed him, and told him that Pele had desolated the area. Keliikuku headed home and climbed the highest point for a view of Puna. He saw its fertile plains covered with lava, and the forests burning as clouds of smoke poured out of the volcano. Pele had heard of his boasts and demonstrated that the land around her fire pit was dependent upon her will (Westervelt 1916:31-32).

Many of the legends of Puna deal with Pele. Numerous legends describe her anger, which caused lava to cover large areas or small sections of the region. It has been implied by

tradition that Puna "was once Hawai'i's richest agricultural region and that it is only in relatively recent time that volcanic eruption has destroyed much of its best land" (Handy and Handy 1972:542). Lava flows in historic times have definitely covered more good gardening land here than in any other district, but Handy and Handy feel the present desolation was largely brought about by the gradual abandonment of the country by Hawaiians after sugar and ranching came in rather than by volcanic activity.

LAND UTILIZATION

The uplands of Puna extend back toward the great heights of Mauna Loa, and in the past its lands have been built, and covered over, and built again by lava flows (Handy and Handy 1972:539). In the long intervals between flows, vegetation took hold, beginning with tiny mosses and lichens, then ferns and hardier shrubs, until the uplands became green and forested and good earth and soil covered much of the lava-strewn terrain, making interior Puna a place of great beauty.

The fern-covered plains between the forest and coast in northeast Puna used to be planted in taro. Hawaiians used the burning-over, digging-up, and planting processes of taro cultivation (Handy and Handy 1972:540). Of sweet potatoes, which were usually grown in drier areas, Handy says "too little sun or too much rain quickly spoils the potato," which infers that they might have been planted only in the dry season. He also mentions that despite the fact that sweet potatoes were planted almost universally and many patches are still maintained, the Puna natives seemed uninterested in this vegetable, probably because they prided themselves on and relished their breadfruit, and also because "potato was nowhere and at no time the staple for this rainswept district" (Handy 1940:165).

The Reverend William Ellis, who toured the island of Hawaii in 1823, gives his impressions of Keaau:

...Soon after five p.m. we reached Kaau (Keaau), the last village in the division of Puna. It was extensive and populous, abounding with well cultivated plantations of taro, sweet potatoes, and sugar-cane; and probably owes its fertility to a fine rapid stream of water, which descending from the mountains, runs through it into the sea. It was the second stream we had seen on the island (Ellis 1963:212).

Ellis' observation regarding sweet potatoes is contrary to Handy's theory that Puna people were not interested in the

vegetable. Perhaps Handy's statement refers to the people of southern Puna rather than the northern Puna area to which Ellis refers.

In 1848, when the Great Mahele took place, only 14 land awards were recorded in the Puna area (Komori 1987:2), and the *ahupua'a* of Halona, Popoki, and Maku'u were set aside as government lands. No *kuleana* were awarded within the *ahupua'a*; thus, no testimony revealing land use of those areas exists for that time period. Cordy, however, predicts a high concentration of permanent habitation sites in the more populated coastal areas of the vicinity (up to 1.75 miles inland), with agricultural areas nearby. Farther inland he predicts few sites, with burials or temporary campsites in lava tube caves or walled shelters (Cordy 1986).

In 1974, Ewart and Luscomb conducted an archaeological study in the vicinity for the proposed Kapoho-Keaukaha Highway. The study noted that within Maku'u, the settlement pattern demonstrated by the archaeological remains seemed directly related to the coastal elevation in the area. Ewart and Luscomb predicted virtually continuous settlement in the low lying coastal fraction, which became more dispersed as the elevation rose (1974:25). Eighteen sites were recorded for the area, most of which represented historic settlement. The sites included petroglyph fields, trails, burials, and walls. An informant, Quentin Gandall, reported that Maku'u had a population of more than 2,000 as recently as 1910. No reference to confirm this population figure was located. According to the maps in this report, none of the sites located by Ewart and Luscomb lie in the present project area.

Historic land use in the general Puna area includes sugar and coffee cultivation. In the 1890s, coffee plantations were established in the Olaa area. In 1899, the incorporation of the Olaa Sugar Plantation marked the beginning of sugar cultivation in the Puna District. In the Olaa area, the company took over land formerly covered with coffee and *ohi'a* forests (Peterson 1987:A-7). By 1900, the plantation consisted of 19,500 acres, one of the largest sugar plantations in the territory. With the advent of sugar came the Railroad Company, which operated in Puna from 1899 to 1946. The railroad ran from Hilo to Olaa and on to Pahoa in the early 1900s. In 1907, Hawaiian Mahogany Lumber Company of Pahoa cleared *ohi'a* forests on Puna Sugar Company land, and in 1909 the cleared land was taken over by Pahoa Lumber Company. By 1910, the railroad was serving Pahoa Lumber Mill. From 1908 to 1925 the railroad also carried rock from quarries in Kapoho to Hilo for the Hilo breakwater (Peterson 1987:A-8).

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