June 2000 DEIS
Oneloa Onsen and sports complex
& APPENDICES

Draft Environmental Impact Statement

ONELOA ONSEN AND SPORTS COMPLEX

Ahalanui, Oneloa, Laepao'o, Puna District, Hawaii
TMK: 3rd 1-4-02:13

ONELOA
Paradise Found

Prepared for:
A&O International Corporation

June 2000

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Ahalanui, Oneloa, Laepao'o, Puna District, Hawaii
TMK: 3rd 1-4-02:13

Prepared for:
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This environmental impact statement and all ancillary documents were prepared under my direction or supervision and the information submitted, to the best of my knowledge, fully addresses the document content requirements set forth in §§11-200-17 and 11-200-18, as appropriate.

Applicant:

David Matsuura, Project Manager
A&O International Corporation

10-14-00
Date

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SUMMARY

PROJECT NAME: Oneloa Onsen and Sports Complex

APPLICANT/OWNER: A&O International Corporation, a Hawaii corporation

ACCEPTING AUTHORITY: Planning Department, County of Hawaii
25 Aupuni Street, Hilo, HI 96720

CLASS OF ACTION: Use of County land (required offsite road improvement)

LOCATION: Ahalanui, Oneloa, Laepao'o, Puna District, Island and County of Hawaii

TAX MAP KEY: 3rd/1-4-02:13 (494 acres)

PROPOSED ACTION: Retreat resort with wellness and sports training facilities consisting of the following components:

- Sports complex designed to meet Olympic and professional standards
- 18-hole championship golf course and clubhouse
- Onsen and other health spa facilities
- Lodge (40-unit)
- Chalets (125 units)
- Beach club (recreation facilities, 30 units)
- Restaurant and retail complex
- Equestrian center, trails, orchards, native forest preserve with awa cultivation

Community benefits package as part of a proposed Development Agreement with the County consisting of the following:

- Ahalanui Park enhancements
  -Dedicate 11.242-acre lot to the County for expansion of parking for Ahalanui Park
- Public access to Project facilities
  -Golf course open to public play
  -Public access to Project's trails
  -Special rates for community groups to use sports facilities
- Offsite improvements
  -Connect the Ahalanui Park restrooms to the Project's wastewater treatment plant
  -Construct reservoir and dedicate to the County
  -Widen Kapoho-Kalapana Road as required by the County

-Reroute the segment of the Kapoho-Kalapana Road inundated by high tides and develop a pedestrian/bikeway along the existing corridor

-Provide civil defense siren in accordance with requirements of the State or County Civil Defense agencies

- Employment and economic development opportunities

-Preferential hiring of qualified residents from the area

-Involve native Hawaiian group in the awa cultivation business

ESTIMATED COST: $82 million

ENVIRONMENTAL SETTING: **Climate.** Median annual rainfall is approximately 78". Tradewinds from the northeast and east are predominant (over 70% of the year).

Topography and Soils. Site gently slopes from elevation 200' at the mauka boundary to 20' at the makai boundary. The Land Study Bureau agricultural suitability ratings for the soils within the Site are D and E.

Natural Hazards. A small portion of the Site is in zones VE and AE. Proposed development in these zones will comply with the County Flood Control Code. The Site is in Lava Flow Hazard Zone 2 (same as Pahoa). The Site's distance from the rift zone provides adequate time to evacuate in the event of a threatening flow. For regional evacuation in the event of lava flow hazards, the Project would increase evacuation time from 15 minutes without the Project to 34 minutes with the Project. For evacuation from coastal areas due to tsunami or high waves, the Project would be available as a civil defense shelter.

Flora/Fauna. Vegetation consists of mixed alien shrubland/grassland in the section formerly used for papaya cultivation, and a native-dominated forest and shrubland. There are no known endangered species, although there have been sightings of the Hawaiian bat and Hawaiian hawk in the vicinity. Anchialine pools are located makai of the Site.

Archaeological Resources. A 100% reconnaissance inventory survey has been conducted for the nondisturbed portion of the Site. Of the 47 sites identified, 10 sites are human burial sites that will be preserved in place and 6 sites are significant that will be preserved and interpreted. Almost all of the sites are within the native forest area that will be preserved.

Water Resources. The groundwater passing through the Site is geothermally heated-- the discharge at shoreline pools near the Site has been measured at 31 degrees Celsius, compared to 18 degrees Celsius near Hilo. The groundwater is brackish. The nearshore coastal waters is exposed to frequent wave action. Water quality sampling indicated a substantial influx of groundwater; however, the high degree of wave action rapidly mixes the freshwater to background ocean levels within 5 to 10 meters of the shoreline. The intertidal and anchia-

line pools had nutrient levels that exceeded the State water quality standards. Because of higher rainfall, anchialine pools on the windward side of the island have lower salinities and temperature than anchialine pools on the leeward side (average salinity of 3.5 ppt for windward pools compared with 7.0 ppt for leeward pools). No rare decapod crustaceans have been found in waters with salinity less than 12 ppt. A statewide inventory of anchialine pools in 1987 (using aerial photography) identified four potential anchialine pools in the vicinity of the Site. Field observation has confirmed one of these as an anchialine pool. The more common native decapod crustaceans (*H. rubra, M. lohena*) were abundant in this pool.

Scenic Resources. The Puna Community Development Plan identifies the Mango Road and Red Road as scenic roads. The trees along the Mango Road are designated by ordinance as exceptional trees.

Cultural Practices. In ancient lore, Puna was known for several things: the rising sun (Kumukahi Point is the easternmost point in the Hawaiian Islands); the association with Pele (volcanic activity); the groves of hala and masterfulness of Puna's hala weavers; cultivation of 'awa; and the association with Kane (god of sunlight, fresh water, verdant forest growth). The region encompassing the Site was sparsely settled. No kuleana claims were made for any of the lands within the Site; the Site consisted entirely of government lands. The Government sold or leased lands within the Site. The Wai'opae Pond in Kapoho and the pond at Keahialaka were used to gather bait (opae ula). No traditional gathering seemed to occur within the Site.

Population. The largest subdivisions within five miles of the Site include Nanawale Estates (4,289 lots), Leilani Estates (2,266), Kalapana Seaview Estates (693), Kapoho Vacationland (489), Kehena beach Estates (199), Kaphoho Beach Lots (185), Waawaa (177), and Lanipuna Gardens (118). Most of the lots are vacant. The 1989 median family income in the Pahoa-Kalapana Census Division was less than 60 percent of the County as a whole. Over 30 percent had income below the poverty level, twice the rate of the County as a whole. The median age of 31.4 years is the youngest in the County.

Economy. In the Pohoiki area, papaya farming and fishing are the major economic activities. Unemployment in Hawaii County has been high, varying between 8 and 11 percent over the past five years.

IMPACTS & MITIGATION MEASURES:

Design Phase (Implementation by Owner's Architect or Engineer):

Water Quality Impacts

- Prepare erosion and sedimentation plans to prevent impacts to the coastal water quality during construction (enforced by Grading and/or NPDES permit).

- Design drainage systems to utilize the golf course as a seepage area and retention ponds.

Construction in Flood Zone

- Provide certifications required by the Flood Control Code (enforced by Building Permit and Certificate of Occupancy).

Historic/Cultural Impacts

- Submit trail and archaeological sites restoration plans to the State Historic Preservation Division for review.
- Consult with family members regarding treatment and long term protection of the pa ilina (burial sites). Preserve the sites in place.
- Consult with Hawaiian groups in developing preservation plans for cultural resources.

Impacts from Pesticides

- Utilize above ground storage tanks rather than underground storage tanks for fueling needs (golf carts, maintenance vehicles, emergency generators, etc.).
- Provide a berm and a waterproof floor for maintenance buildings housing fertilizers and biocides to contain any catastrophic leaks or spills.
- Include trees and shrubs around the perimeter of the target spray areas (golf course and agricultural areas) to intercept drift. An adequate buffer (at least 100 feet) should be maintained between the target spray area and populated areas.

Flora/Fauna Impacts

- Protect the remnant native forest and other trees such as kamani, niu, and 'ulu.

Solid Waste Impacts

- Investigate feasibility of composting sludge for agricultural purposes.

Construction Phase (Implementation by Owner's Contractor):

Noise Impacts

- Comply with noise standards.

Water Quality Impacts

- Implement best management erosion control practices specified in construction documents.

Air Quality Impacts

- Implement dust control and traffic control-rerouting measures specified in construction documents.

Operational Phase (Implementation by Owner's management company):

Golf Course Impacts

- Implement water quality monitoring program and adjust golf course management practices as necessary.
- Prepare a golf course maintenance plan with regards to the use of fertilizers, biocides, and irrigation schedule to minimize or prevent environmental pollution consistent with the practices taught at the certification school of the National Association of Golf Course Superintendents.
- Compost green waste to the extent possible to minimize solid waste, and process on the Site to the extent possible to minimize offsite transport of the raw or processed material.
- Apply pesticides in a manner to prevent offsite drift of spray material (e.g., use coarse nozzle and low pressure spray equipment; use shielded or shrouded sprayers; use thickener additives; use non-volative or low-volatile chemicals; apply at lowest possible height during low wind speed conditions when the wind direction will carry any drift away from populated areas.)

Historic/Cultural Impacts

- Provide interpretive programs to educate people on the historical background of the lands, families, and customs of the area.

Economic Impacts

- Give hiring preferences to qualified native families and residents of Puna.

Flora/Fauna Impacts

- Remove and control noxious alien species from the native forest area.

Wastewater Impacts

- Operate the wastewater treatment plant in compliance with Department of Health requirements; be prepared with emergency standby equipment and procedures.

ALTERNATIVES: To avoid or reduce potentially adverse impacts, alternatives include:

No Project. Papaya farming would probably be reinstated. Pesticides and fertilizers would be comparable or exceed the levels for a golf course. There would be no controls to protect the native forest on the Site.

36-Hole Golf Course. To reduce the scale of the project, the lodge, chalets, and sports complex would be deleted from the site plan. The project would then consist of only the commercial area that would be rezoned to Urban, and the Agricultural portion would be used only for a 36-hole golf course. The ability to attract visitors would be significantly reduced. The opportunity to integrate food and medicinal agricultural activity with onsite market demand uses would be foregone.

Urban Zoning. To avoid any question on the appropriateness of a Special Permit versus district boundary amendment, this alternative would rezone the entire Site to Urban. With this rezoning, there would be less control on the actual uses of the Site since any of the permitted uses in an urban zone would be allowed. Other areas in the vicinity could be encouraged to seek Urban rezoning.

RELATIONSHIP TO LAND USE PLANS, POLICIES, AND CONTROLS:

Existing Designation:

State Land Use Classification. Agriculture.

General Plan: Orchards

Zoning: A-10a, A-1a

Permits Required: Special Permit, Use Permit (for the golf course), Grading, NPDES, Subdivision, DOH wastewater treatment works approval, Plan Approval

UNAVOIDABLE IMPACTS OR UNRESOLVED ISSUES:

An unavoidable impact is the increased time to evacuate the region with the Project in the event of a lava flow hazard. However, given the extent of advance warning for lava flow hazards, the increased time would not jeopardize public safety. For coastal evacuation due to tsunami or high waves, the Site would provide an alternate evacuation route and shelter since it is located above the tsunami evacuation zone.

1

INTRODUCTION

1.1 APPLICANT

The Applicant, A & O International Corporation ("A & O" or "Applicant"), a Hawaii corporation, proposes to construct a sports and wellness retreat.

1.2 PURPOSE OF THIS DOCUMENT

The Applicant's action to improve a portion of a County road to mitigate anticipated project-related traffic impacts triggers the environmental review requirements under *Hawaii Revised Statutes* Chapter 343.[1] The approving agency, which reviews the acceptability of the EIS, is the County of Hawaii Planning Department.

This document has been compiled from published and unpublished studies, field investigations, and input from various agencies and the community. Technical studies conducted specifically for this project are included as appendices to this EIS.

The EIS process consists of the following steps:

1 *EIS Preparation Notice and Consultation Period.* During this initial phase of the EIS process, the EIS consultant prepared a summary document consisting of preliminary information describing the project and environs. Availability of this document, called the EIS Preparation Notice, was published in the May 8, 1998 *OEQC Environmental Notice* and mailed to various organizations to notify interested persons that an EIS was being prepared for this project. Publication in the Bulletin commenced a 30-day Consultation Period to receive comments that ended on June 8, 1998. The Applicant agreed to extend the Consultation Period until August 23, 1998; the extension was published in the July 23, 1998 *OEQC Environmental Notice*. The comments assisted in identifying the major issues to be addressed in the EIS.

---

1. *Hawaii Revised Statutes* §343-5(a)(6). In *Kahana Sunset Owners Association v. County of Maui*, 86 H. 66 (1997), an offsite drainage improvement within a County right-of-way to service a 300-unit residential project triggered Chapter 343. Because the ancillary offsite improvement was part of a larger action and a necessary precedent for the larger action, the scope of the environmental review was the entire proposed project.

2 *Draft EIS.* The Draft EIS compiles pertinent information on the project. It describes the proposed action, existing conditions, issues, and possible solutions (mitigation measures) or alternatives to resolve the issues.

3 *Public Review Period.* The public has 45 days to review and comment on the Draft EIS. The objective during this review period is to clarify, correct inaccuracies, resolve disputes, and/or provide additional pertinent information.

4 *Final EIS.* The Final EIS incorporates the comments and any commitments made during the review period. As a comprehensive record of information and concerns, the EIS serves as an important decisionmaking reference.

2

PROJECT DESCRIPTION

2.1 LOCATION AND OWNERSHIP

The approximately 494-acre project site ("Site") is located in Ahalanui, Oneloa, and Laepao'o, Puna District, island and County of Hawaii (see Figure 1). The Site is *mauka* of the Kapoho-Kalapana Road (Highway 137) and situated between the County's Ahalanui Park and Isaac Hale Park (Pohoiki Boat Landing) (see Figure 2). The TMK is 3rd/1-4-2:13 (see Figure 3).[1] The Applicant owns the Site in fee simple.

2.2 EXISTING USES

Site. The Site is currently vacant.

Surrounding Areas. The surrounding uses are as follows (see Figure 4):

- North: vacant undeveloped land owned by Bishop Estate;
- South: papaya farms or fallow lands;
- East (*makai*): County Ahalanui Park (TMK 1-4-2:5, 6, 61) and vacant shoreline property;
- West (*mauka*): papaya farms or fallow lands.

1. The Site was consolidated in 1995 (Subdivision No. 696) from five separate parcels (previous TMK: 1-4-2:13, 14, 24, 69, 70).

FIGURE 1. Vicinity Map

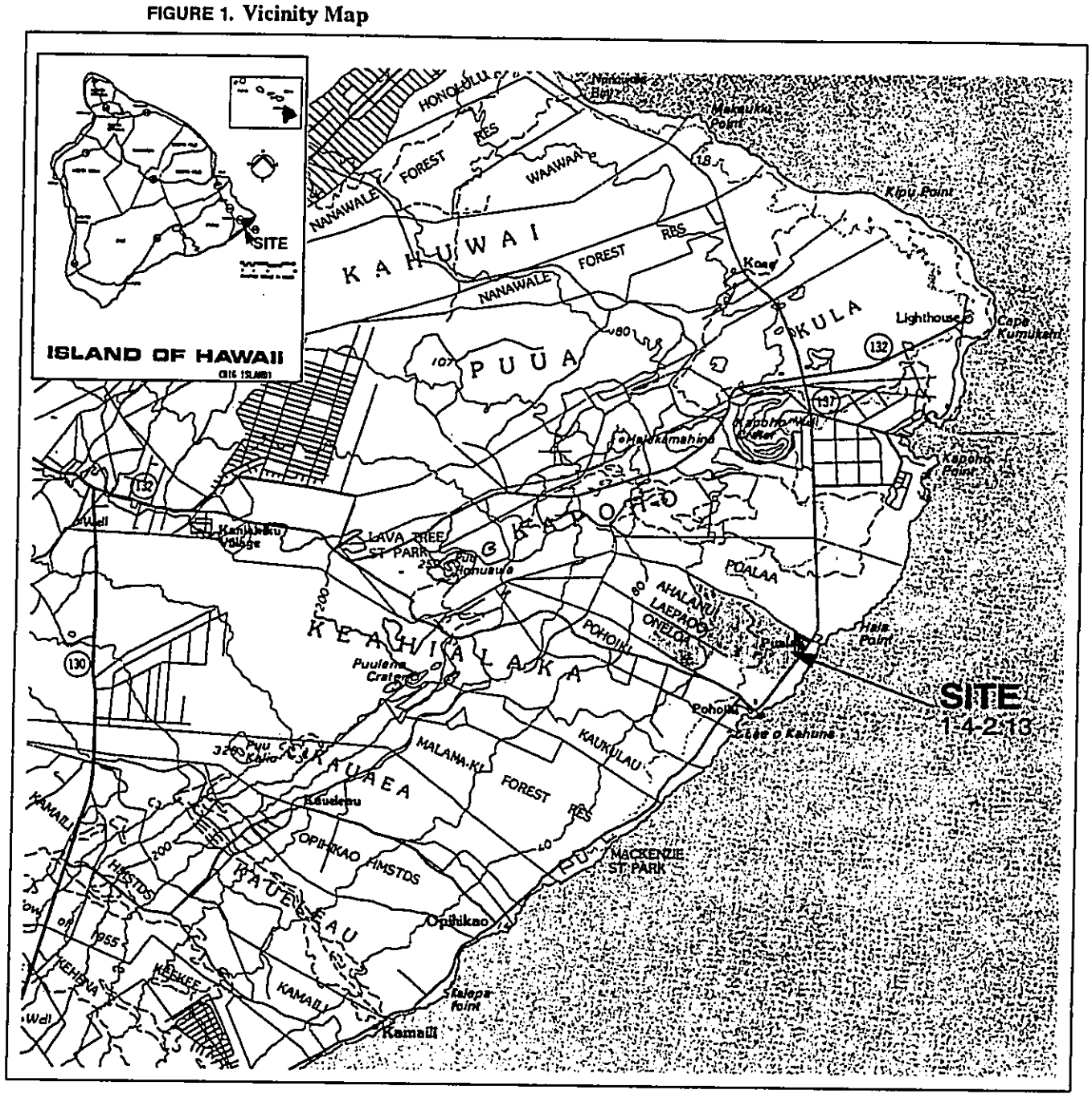


FIGURE 2. Location Map

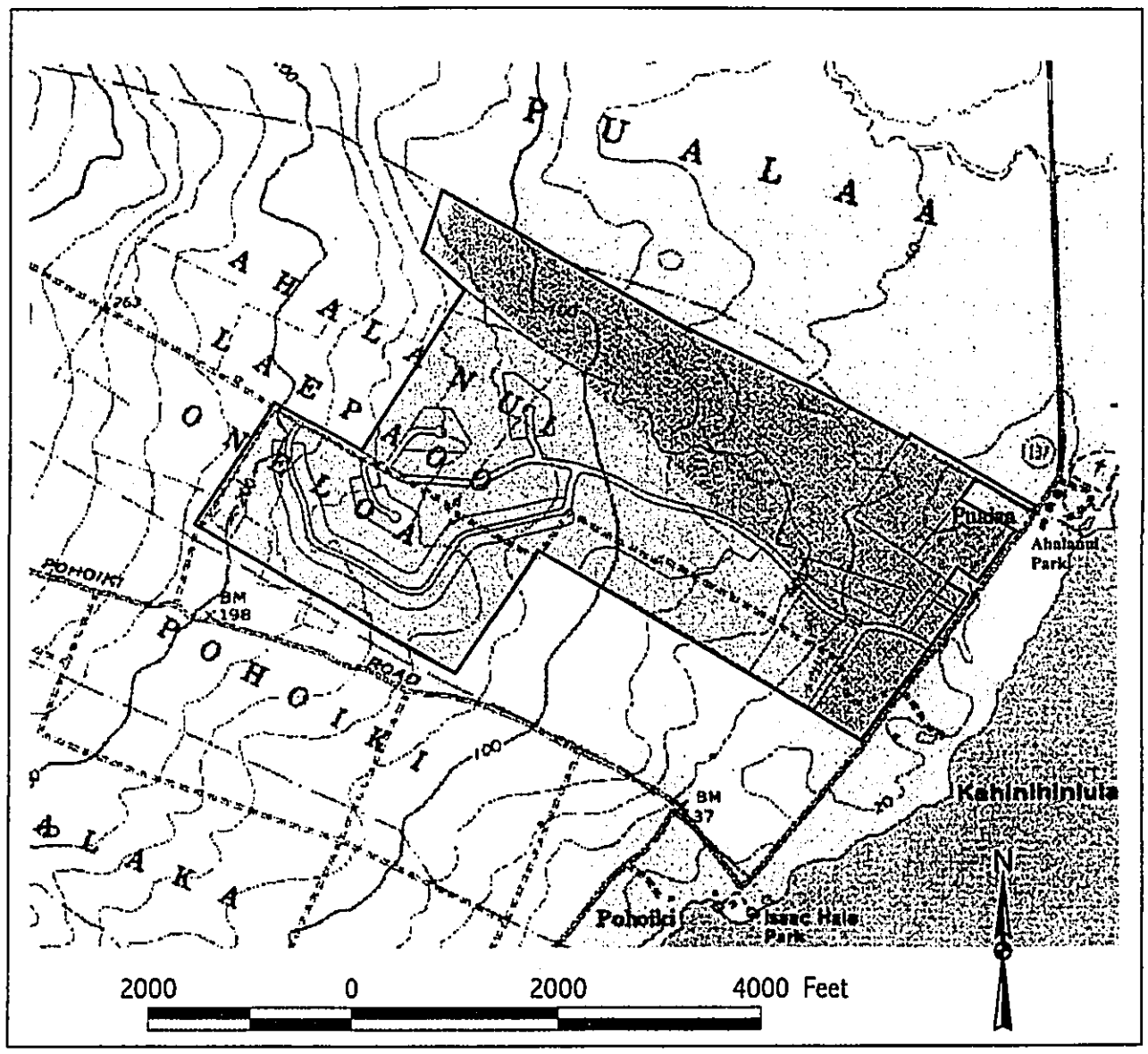


FIGURE 3. Tax Map

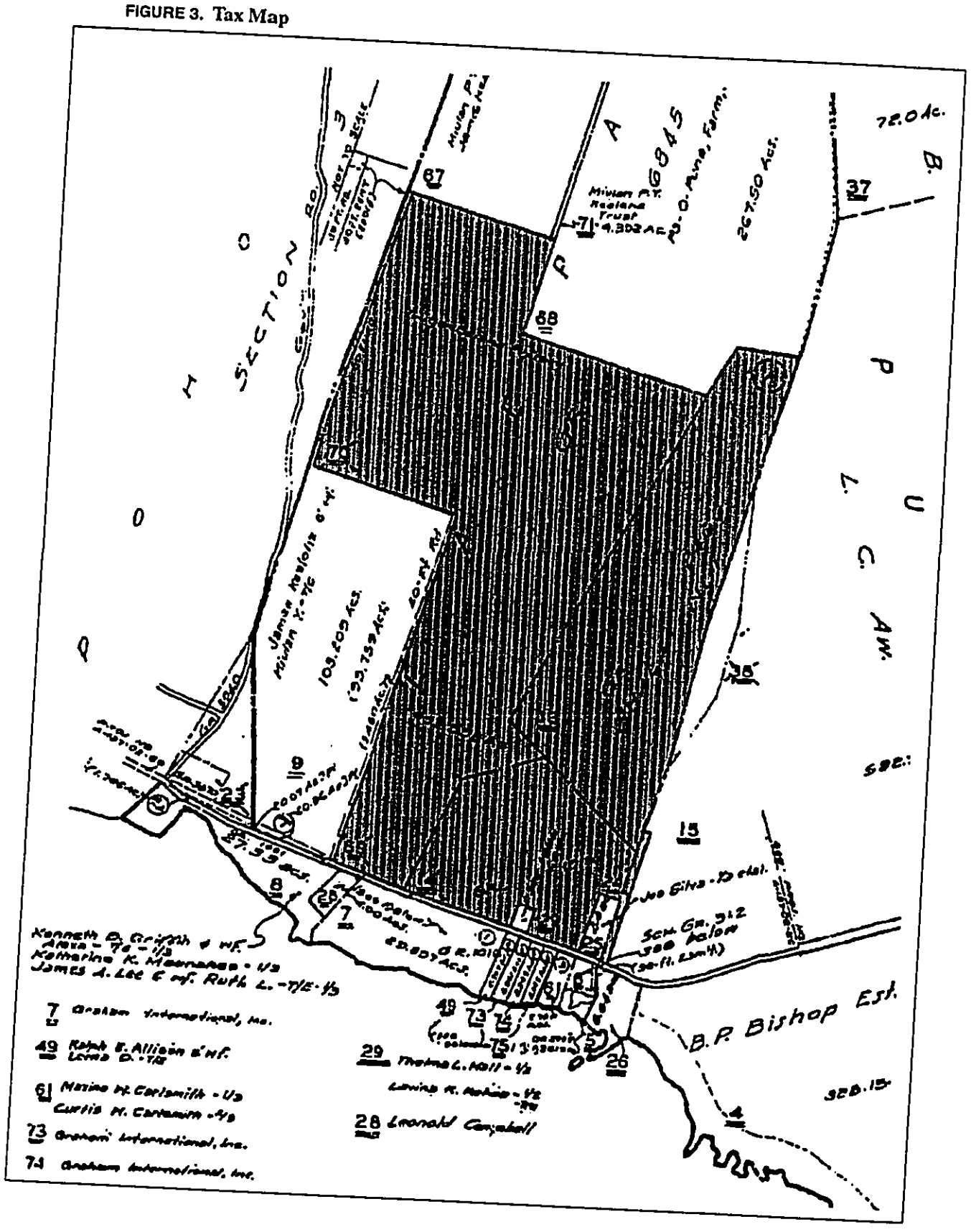
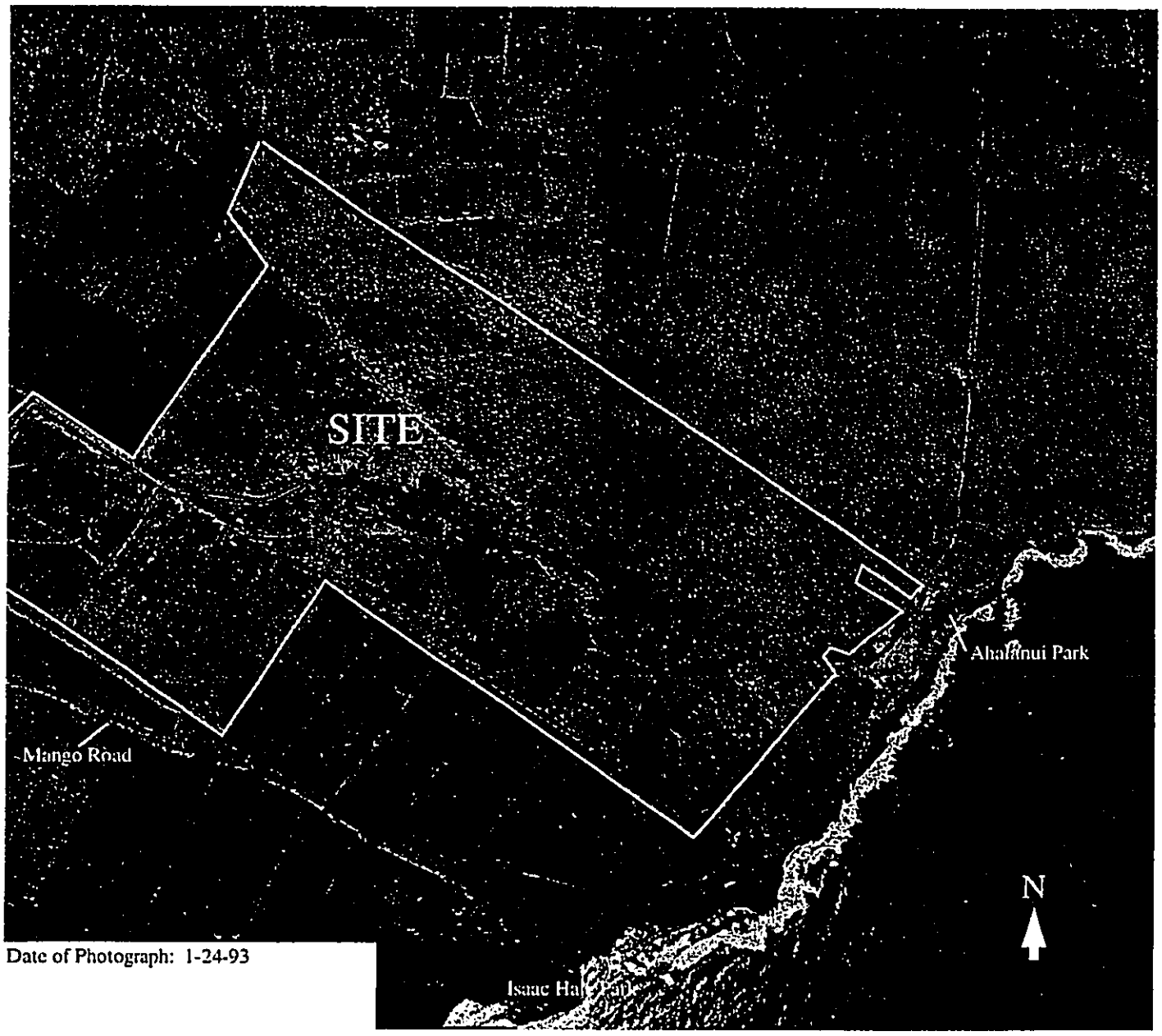


FIGURE 4. Aerial Photograph of Project Site and Vicinity



Date of Photograph: 1-24-93

2.3 PROJECT BACKGROUND

2.3.1 Previous Agricultural Use

Until the early 1990s, most of the Site had been used for growing papaya (see Figure 5). The portion of the Site not used for papaya was rugged lava and ohia forest.

2.3.2 Previous Development Plans

In 1990, the Applicant proposed to develop a 36-hole golf course with a clubhouse. Although golf courses now require a County Use Permit within the agricultural districts, at the time of the application a golf course was a permitted use in the County-zoned agricultural districts and only required a grading permit.[2] The County issued a grading permit for 450 acres of the Site, but restricted grading on 150 acres of the approved 450 acres that were not previously used for papaya until completion of an archaeological report and clearance from the State Historic Preservation Division (SHPD).[3] The County granted extensions to the grading permit to enable completion of the archaeological survey requirements. As designed by the golf course architect, the 450 acres under the grading permit accommodated 30 of the 36 holes; the Applicant had planned to apply for the permits for the balance of the planned golf course together with the proposed clubhouse. Construction started, but stopped before completion.

2.3.3 Previous Archaeological Studies

Several archaeological studies were conducted for the Site to complete a 100% surface inventory of the non-papaya area with selective subsurface testing (Kennedy et al., 1990, revised 1991; Fager and Rosendahl, 1991; Dunn et al, 1994, revised 1995). SHPD approved the final inventory survey report (Dunn et al, 1995) in June 1996.[4] Prior to its approval, SHPD held a public meeting on the findings of the inventory survey report on January 10, 1996 in Pahoa. SHPD still requires a mitigation plan, consisting of a preservation plan and an archaeological data recovery plan, prior to land alteration activities (see further discussion in section 3.1.5 "Historic/Archaeological Resources" on page 3-9).

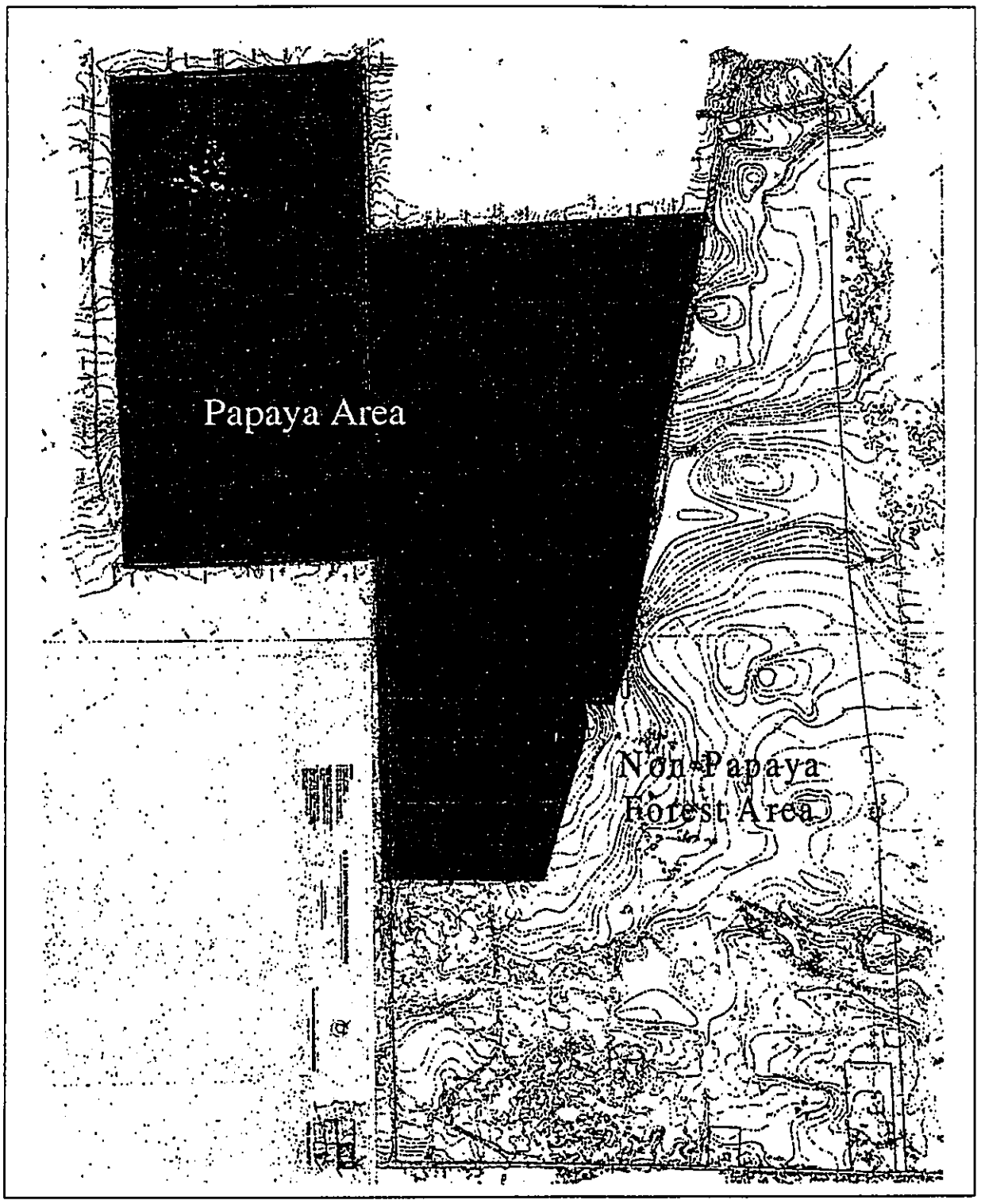
---

2. Ordinance No. 90-105 amended Hawaii County Code Chapter 25 (zoning code) to require a Use Permit for golf courses proposed in the agricultural districts.

3. Grading Permit No. 2551 required the contractor to clearly mark the boundary between the papaya and non-papaya area, and prohibited the construction crews from driving through or parking on the non-papaya area.

4. Letter from SHPD (Don Hibbard, Administrator) to the Planning Department (Virginia Goldstein, Director), dated June 17, 1996.

FIGURE 5. Previous Papaya-Growing Area on the Project Site



2.3.4 Redesign

The Applicant reconsidered the previous project concept, and initially decided to reduce the golf course from 36 to 27 holes and redesign the project to a more distinctive concept that has a better fit with the Site's relatively unique resources such as the geothermal groundwater, archaeological resources, native forest, and rural setting. Based on comments received on the EIS Preparation Notice during the Consultation Period, the Applicant has decided to further reduce the golf course to 18 holes by eliminating all the holes within the native forest area. The preserved native forest area will have trails, and the understory will be used to cultivate *awa* (see section 2.5.7 "Agriculture, Equestrian Center, Open Space, and Trails" on page 2-13 for a more detailed description).

2.4 PROJECT OBJECTIVES

The project objectives are as follows:

- provide a synergistic combination of sports and wellness facilities in a remote rural setting conducive to healthy living, healing, restoration, and recuperation;
- create therapeutic hot baths from the naturally-occurring geothermal groundwater and a respect and appreciation of the volcanic presence;
- provide a diversity of living arrangements from short-term lodge accommodations to longer-term rental units to attract a market spectrum of visitors, retirees, training athletes, or rehabilitating persons or athletes who require physical therapy;
- integrate the existing natural and historic/cultural features as assets in the site planning and landscaping of the facilities and golf courses;
- integrate productive income-producing agricultural activities including orchard, herbal products (medicinal and food), cut flowers, foliage, equestrian facilities, and others to enhance the rural setting, promote the wellness and cultural heritage themes of the project, and provide support to the restaurants and lodge;
- feature traditional healing practices, especially Hawaiian.

2.5 CONCEPTUAL PLAN

The project consists of the following components (see Figure 6 and Table 1):

- Sports and health spa complex with *onsen* ponds
- Boutique lodge
- 18-hole championship golf course, driving range, and clubhouse
- Chalets
- Beach club
- Restaurant and retail complex
- Agriculture, equestrian center, open space, and trails.

Figure 7 on page 2-10 provides a conceptual image of the possible architectural style of these facilities.

FIGURE 6. Site Plan

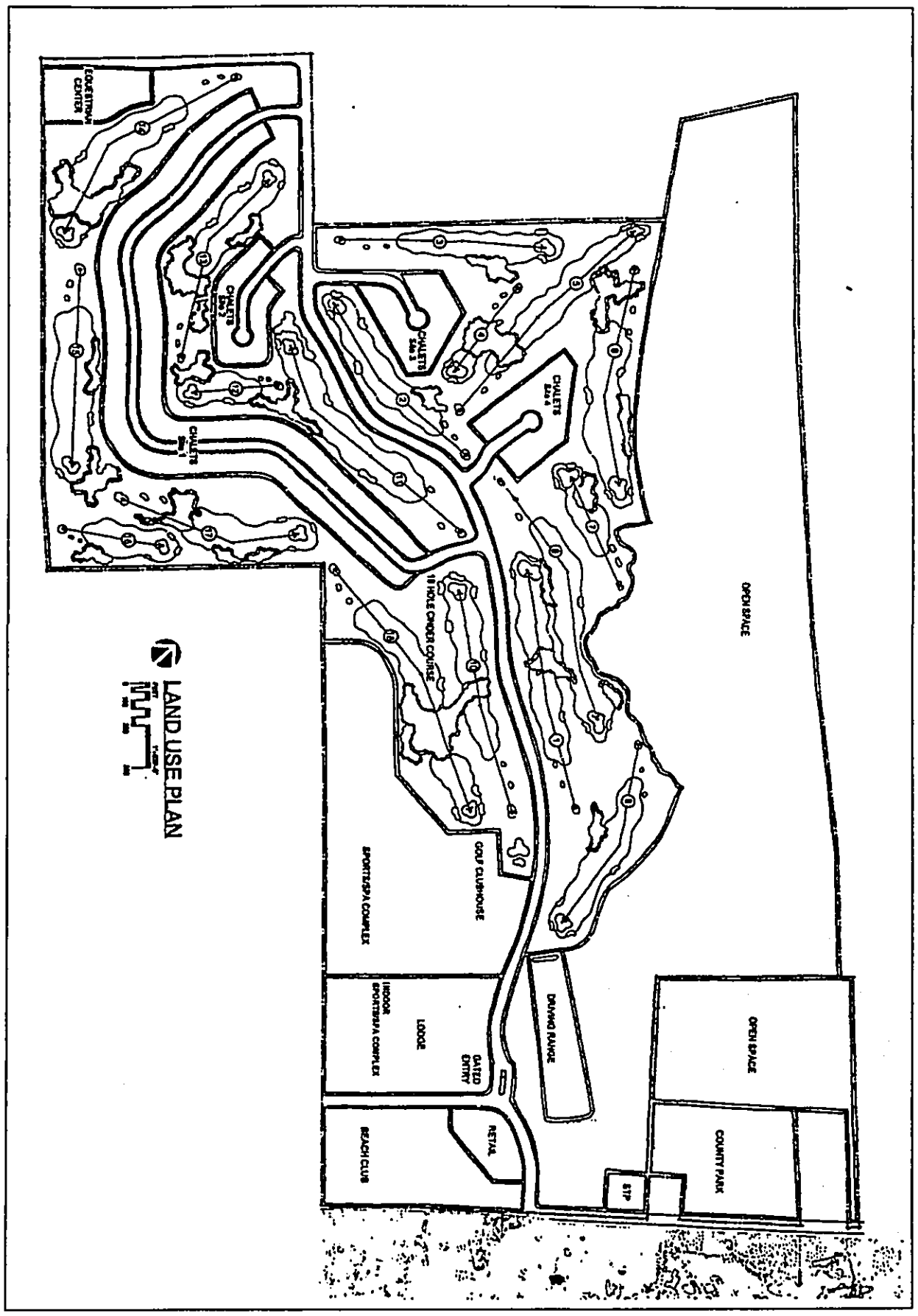
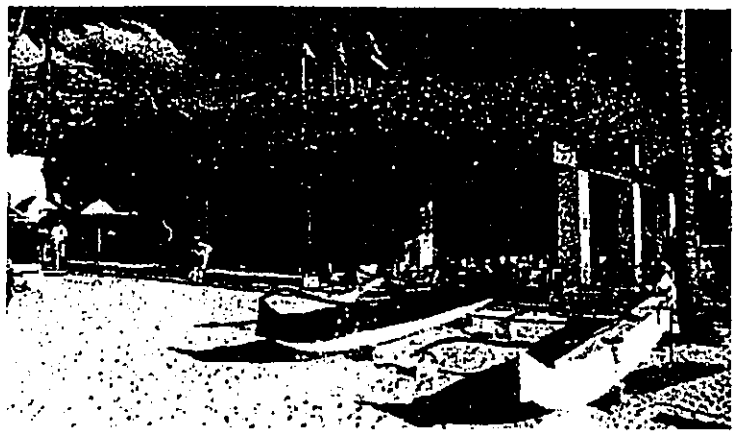


FIGURE 7. Architectural Character Images of Proposed Facilities



Beach Club

Chalets

Lodge

Retail

2-story Sports Complex or Golf Clubhouse

TABLE 1. Proposed Land Uses

Project Component	Units or Gross Floor Area	Land Area (acres)	Developed Use	Undeveloped Open Space	Other Open Space or Permitted Use
Boutique Lodge	40 units	9.9	9.9		
Chalets	125 units	38.5	38.5		
Sports/Spa Complex indoor outdoor	 65,000 s.f. 	27.0 5.0 22.0	27.0		
Restaurant/Retail Complex	15,000 s.f.	3.0	3.0		
Beach Club	30 units	11.9	11.9		
Equestrian Center	8,000 s.f.	3.5			3.5
18-Hole Cinder Golf Course, Driving Range, Clubhouse Clubhouse Golf course, driving range	 50,000 s.f. 	223.0 4.0 219.0	 4.0 		 219.0
Wastewater treatment plant		1.0	1.0		
County Park/Open Space (2 sites)		30.0			30.0
Orchards and Trail System, native forest with *awa* cultivation		141.2		141.2	
Roads		5.0			5.0
TOTAL		494.0	95.3	141.2	257.5
		100%	19%	29%	52%

Total open space (including the golf course and roadways) comprises 81% of the Site (398.7 acres). The native forest area is approximately 141.2 acres or 29% of the Site. The built-up developed area of the Site comprises 19% (95.3 acres). The extensive natural areas and open space establish a rural remote ambience upon which the project concept depends.

2.5.1 Sports and Health Spa Complex

The Sports and Health Spa Complex is a physical training, therapy and wellness facility offering a variety of indoor and outdoor activities. Indoor facilities within this approximately 65,000 square foot, two-level facility, include a weight room, aerobic exercise area, racquetball and handball courts, multi-purpose gymnasium, and men's and women's fully equipped locker rooms. Outdoor facilities include a 50-meter competition swimming pool and diving platforms, 9-court tennis complex, a national and international competition track and field, a baseball complex to accommodate three major league-size fields, and a meandering garden jogging path.

The therapy and wellness facilities include consultation, examination, and treatment rooms, exercise area, men's and women's locker rooms, and a Hydro therapy area equipped with whirlpool tanks and therapeutic pools. A modern spa-type *onsen* will be designed for fitness, massaging, or relaxation. The facility will also provide such services as massages, facials, herbal wraps and baths, sauna and steam baths, hair and beauty care, and holistic healing techniques. Food and beverage amenities will offer a nutritious health-conscious menu. The facility will have a garden of ethnic medicinal plants and encourage a cross-pollination of traditional healing with western practices.

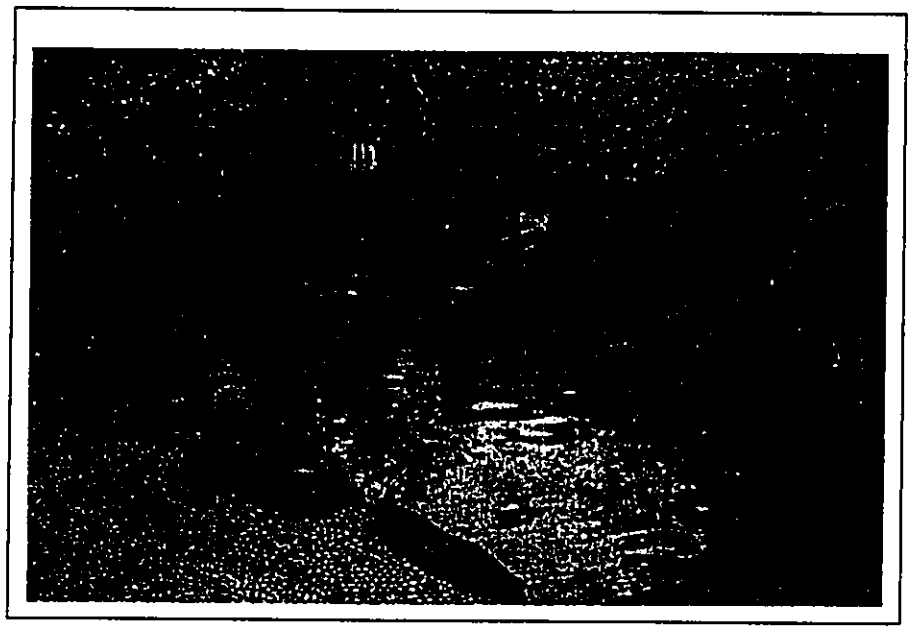
The architecture will reflect the indoor-outdoor Hawaiian-Mediterranean style that will unobtrusively fit into the natural surroundings. Located at the upper elevation of the Site, the facility will have sweeping views of the ocean, sloping hillside, and golf course.

2.5.2 Lodge

This small intimate Lodge will consist of 40 all-suite units. The thatched Hawaiian style single-story bungalow units will be oriented along a meandering lava rock lagoon to take full advantage of the soothing sounds and views of flowing water. Landscaping will ensure an oasis of privacy for each unit.

The lodge will also include meeting facilities, traditional *onsen* baths, a swimming pool, jacuzzi, snack bar, and restaurant. A two-story lobby building will have a restaurant on the upper level that will have a commanding view of the complex and the ocean beyond. Landscaped paths will conveniently connect the lodge to the Sports and Health Spa Complex.

FIGURE 8. Traditional Onsen



2.5.3 Golf Course

The 18-hole, par-72 championship Cinder Golf Course will wrap around volcanic cinder cones and provide scenic vistas of the Puna slopes and coastline. The course will be open to the public and will include a driving range.

The clubhouse will be a two-level 50,000 square foot structure with a pro shop, restaurant, bar, and meeting facilities. The clubhouse will be situated adjacent to the Sports and Health Spa Complex to provide an additional amenity to the sports complex.

2.5.4 Chalets

Nestled between the fairways of the golf course, the 125-unit chalet will provide owner-occupied, time-share, or longer-term rental accommodations. Each detached unit, approximately 2,500 square feet in size, will include a kitchen, living space, dining space, bedrooms, and outdoor recreation area such as a private pool or garden terrace.

2.5.5 Beach Club

With the proposed realignment of the Kapoho-Kalapana Road, the beach club will have open access to the shoreline areas. The beach club will include recreational and exercise facilities (locker rooms, weight lifting, tennis courts, sand volleyball court, swimming pool, jacuzzi), restaurant and pool-side snack bar, and meeting facilities. The beach club will also include 30 thatched-roof bungalow suites and a lobby. The site will be lushly landscaped to provide a colorful tropical ambience, and to buffer the side fronting the realigned Kapoho-Kalapana Road.

2.5.6 Restaurant and Retail Center

The restaurant and retail center, approximately 15,000 square feet in floor area, will be conveniently located along the realigned Kapoho-Kalapana Road. The design will reflect a quaint village style intended to serve the guests, visitors passing through the area, and surrounding residents. The center may include a restaurant, fast food outlet, service station, convenience store, and a variety of retail establishments.

2.5.7 Agriculture, Equestrian Center, Open Space, and Trails

Agricultural areas, open space, and trails are planned to integrate with the sports and health components of the development. The native forest area on the northern portion of the Site will be preserved. *Awa*, a traditional Hawaiian medicinal plant that was historically grown in the area, will be cultivated in the understory of the native forest. Trails through the forest will provide a cool, peaceful, and educational experience. An interpretive program, including signs to identify and explain the native plants and archaeological sites, will be strategically placed within the forest area.

The golf course rough areas will be planted as orchards, which will add a unique identity to the course. The orchard products will be marketed, but will also be open to the golfers to pick as they golf. Herbal products will be cultivated on the Site to complement the wellness and therapy programs to be conducted. A riding academy on the *mauka* end of the Site will provide equestrian facilities complete with stables, feed and equipment areas, tack area, paddock, dressage area, and manager's quarters. A trail system will meander through the native forest area for use by pedestrians, bikers, and horseriders. The trail system will provide access to the cultural and archaeological interpretive features along the northeast portion of the Site, continue through the native forest area to the open space area at the *makai* portion of the Site, and finally connect to the Kapoho-Kalapana Road. The golf course irrigation system will also service the orchard and other agricultural areas.

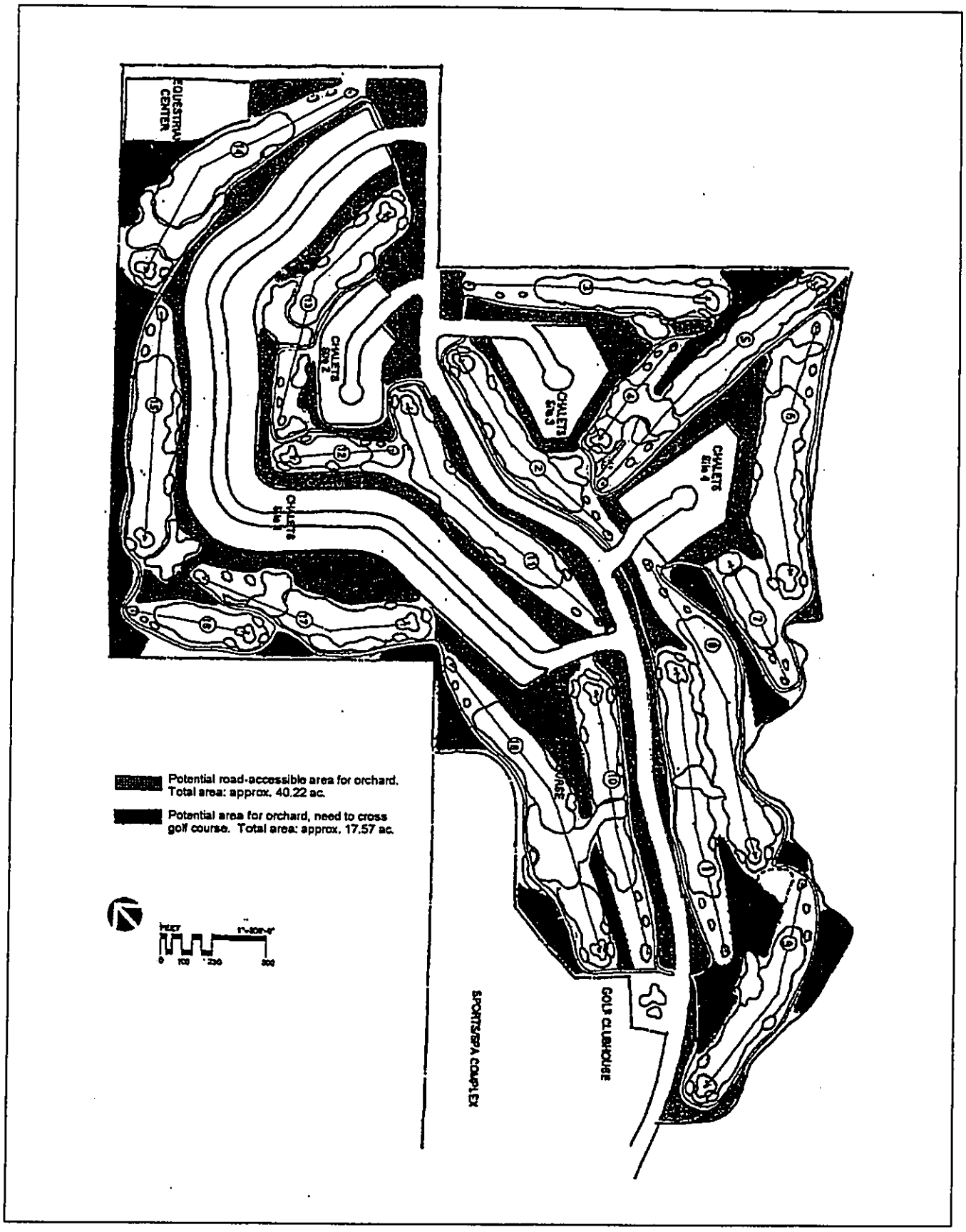
2.6 ECONOMIC VIABILITY OF PROPOSED AGRICULTURAL ACTIVITY

Since the agricultural components are important features of the Project, this section summarizes an economic analysis of the proposed agricultural activity. The study by Agricon Hawaii LLC is included in Appendix C, "Oneloa Development Project: Agricultural Concept". The proposed agricultural activities range from amenities without direct monetary accounting (agricultural landscaping), to commercial operations through a nonprofit entity (*awa*), to typical commercial operations (commercial orchards, equestrian center). For the amenities-type landscaping agricultural activity, the study identified potentially suitable plants. For the commercial operations, including *awa*, the study provided a rough cashflow to demonstrate potential returns.

The findings of the study are summarized as follows:

- Agricultural landscaping of the golf course
  - Tropical fruit trees. Eight to ten trees of a selected variety would be planted at each hole. Each hole would have a different tropical fruit tree variety. Golf course maintenance personnel would maintain and harvest. The harvested fruit would be used within the development (e.g., lodge, sports complex, golf clubhouse, beach club) and/or sold at the retail outlet. The study identified the following trees that are interesting and suitable to the Site conditions: atemoya, avocado, breadfruit, carambola (starfruit), fig, guava, jaboticaba, jackfruit, limes, longan, lychee, mango, mangosteen, pulasan, rambutan, star apple, strawberry guava, and white sapote.
  - Medicinal plants. Selected medicinal plants would be planted at various locations within the golf course. Golf course maintenance personnel would maintain and harvest. The harvested plants would be used within the development (e.g., lodge, sports complex). The study identified the following Hawaiian medicinal plants that could be used for crafts or therapy operations and are suitable to the Site conditions: *awapuhi-huahiwi, hau, kamani, kukui, noni, olena, olona, ti, wauke.*
- Commercial orchards. The orchards would be located as contiguous blocks between the fairways (i.e., the golf course "roughs") and farmed with commercial techniques. There is approximately 40 acres within the golf course that is accessible from the roadways without crossing the golf course (see Figure 9). The fruit would be sold within the development and to other markets. For the given Site conditions, the study identified the following trees that could produce reasonable returns (listed in the order of the quickness of expected positive net returns): carambola (year 3), limes (year 5), breadfruit (year 7), lychee (year 7), avocado (year 10), mangosteen (year 10). In the long term at the end of 20 years, the most profitable crop based on current prices would be the mangosteen, followed by carambola and limes.
- Native forest *awa* planting. Approximately 50 acres of the native forest would be planted with *awa* using the forest as natural cover. Cultivation methods will attempt to replicate the "old style". Community involvement would be encouraged to cultivate and harvest the crop. Any profits would be shared with the community. The study projected potential positive returns from the third year.
- Equestrian center. This 3.5- to 5-acre facility would be leased to an independent experienced organization that will operate the center. The center's functions would include trail rides through the resort and periodic rodeo activity. The facility could hold 20 horses for trail riding. In addition, residents from the area would be able to board horses and participate in the activities at the center. The facility will fulfill a need for more multi-purpose equestrian facilities, especially in East Hawaii.

FIGURE 9. **Potential Orchard Planting Areas within the Golf Course**



2.7 COMMUNITY PROJECTS AND COMMITMENTS

To contribute to the community and mitigate potential impacts, the Applicant has committed to the following:

- To enhance the County's Ahalanui Park:
  - Dedicate to the County 11.242 acres across the street from the existing Ahalanui Park for public parking and interpretation of archaeological sites;
  - Connect the County's wastewater facilities to the Project's wastewater treatment plant;
- To support native Hawaiian education and cultural practices:
  - Commit to the mitigation measures set forth in this EIS related to archaeological and cultural impacts (see section 3.1.5 "Historic/Archaeological Resources" on page 3-9 and section 3.2.1 "Cultural Impact" on page 3-29);
  - Work with an interested native Hawaiian group to cultivate the *awa*;
- To invite community use of the project's sports and health facilities:
  - Open golfing facilities to public play;
  - Allow public access to the project's trails;
  - Offer special rates for community use of the sports complex facilities;
- To provide offsite improvements proportionate to the impact caused by the Project, including:
  - Contribute to the extension of the County water line (already done);
  - Construct a 0.3 MG reservoir and dedicate to the Department of Water Supply;
  - Widen the Kapoho-Kalapana Road as required by the Department of Public Works;
  - Reroute the segment of the Kapoho-Kalapana Road that is inundated by high waves and tides and develop a pedestrian/bikeway within the existing road corridor;
  - Provide civil defense siren in accordance with requirements of the State or County Civil Defense agencies.

The Applicant intends to commit to the above actions, as well appropriate mitigation measures set forth in this EIS, in a Development Agreement with the County.[5]

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5. A Development Agreement is "a written agreement for specified periods of time between the County, any governmental entity or agency made a party thereto, and any person having a legal or equitable interest in real property for the purpose of vesting the right to develop such property in accordance with laws, ordinances, resolutions, rules, and policies of any governmental entity or agency made party to the agreement in effect at the time such agreement is executed, and for the purpose of delineating development requirements that may include, but are not limited to, affordable housing, design standards, water allocations, dedications of real or personal property, on-site and off-site infrastructure and other development related improvements and government services which shall be approved by resolution of the County council and executed by the mayor on behalf of the County." (Hawaii County Code §30-3). The requirements and procedures for a Development Agreement are set forth in Hawaii County Code Chapter 30 (Development Agreements) and County of Hawaii Office of the Mayor Rule 1 regarding Development Agreements.

2.8 TIMETABLE, COST, AND FINANCING

The estimated construction start is in the year 2002, with completion nearly two years later in 2004. The estimated construction cost is $82 million.

The Applicant will consider using the State of Hawaii Immigrant Investor Program as a potential equity funding source. The U.S. Immigration Act of 1990 created the Investor Visa Category allowing qualified applicants to obtain Green Cards (lawful permanent resident status) through investment in a U.S. enterprise.[6] The federal law designated the State of Hawaii in its entirety as a Regional Center to promote increased export sales, with the State Department of Business, Economic Development and Tourism (DBEDT) as the Regional Center Authority.

Ten thousand (10,000) "green cards" are available each year for foreign investors establishing a "new commercial enterprise" in the U.S. The Investor must invest $1,000,000 in the enterprise, or $500,000 in certain "targeted employment areas." The Investor must also create at least 10 full-time jobs for U.S. citizens or permanent residents, excluding the Investor's spouse and children.

A "new commercial enterprise" is any lawful, for-profit business established after November 29, 1990 in which the Investor engages in a managerial or policy-making capacity. "Targeted employment areas" are rural areas and areas where the unemployment rate is at least 1.5 times the national average. DBEDT has designated all the neighbor islands, except for certain parts of Hilo, as targeted employment areas. Since the Site is within the targeted employment areas, Investors for this Project would need to invest $500,000 and create 10 full-time jobs.

"Full-time employment" is defined as a position requiring a minimum of 35 working hours per week. Two or more distinct, part-time positions do not count as a full-time position. As a Regional Center, the 10 full-time jobs in Hawaii include direct and indirect jobs. DBEDT, as the Regional Center Authority, assists in determining the number of indirect jobs based on multipliers derived from econometric models and provides certifications to accompany Investor petitions that the job creation requirements have been met.

When the Investor Visa Application is approved, the Investor, Investor's spouse, and children under 21 years of age receive conditional Permanent Residence (green cards) for a 2-year period. During this conditional 2-year period, the Investor and family members may work and/or attend school in the U.S., and travel at will on temporary visits. At the end of the 2-year period, the Investor and family members may remain Permanent Residents or seek U.S. citizenship, provided that the commercial enterprise, including the 10 full-time jobs, has been maintained during the 2-year period. There is no requirement that the enterprise make a profit. The Investor must have the intent to continue with the enterprise when the Investor is granted full Permanent Resident status; however, it is conceivable that the enterprise could be altered, terminated, or sold due to changes in the business climate, changes in the Investor's plans and circumstances, or other reasons.

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6. *See, generally*, Department of Business, Economic Development and Tourism, State of Hawaii. State of Hawaii Immigrant Investor Program: Information for Foreign Investors Seeking Qualifying Investments in Hawaii, April 1997.

3

ENVIRONMENTAL SETTING, IMPACTS, & MITIGATION MEASURES

This chapter provides background information on the existing conditions, identifies potential impacts, and suggests mitigation measures. The impacts are assessed according to the following categories:

- No impact anticipated;
- Potentially beneficial;
- Potentially adverse;
- Requires mitigation; or
- Requires project modification.

3.1 PHYSICAL CHARACTERISTICS

3.1.1 Climate

Setting

The median annual rainfall at the Site is approximately 78" (2000 mm). June is the driest average month and November is the wettest, but the driest month on record is a January.[1]

Information on wind conditions is extrapolated from statistical data on offshore winds from the U.S. Naval Weather Service Command at a position of 20.9° north latitude and 156.0° west longitude. This information is representative of conditions at the Site with predominant wind directions from the northeast and east (over 70% of the year) (see Figure 10).[2]

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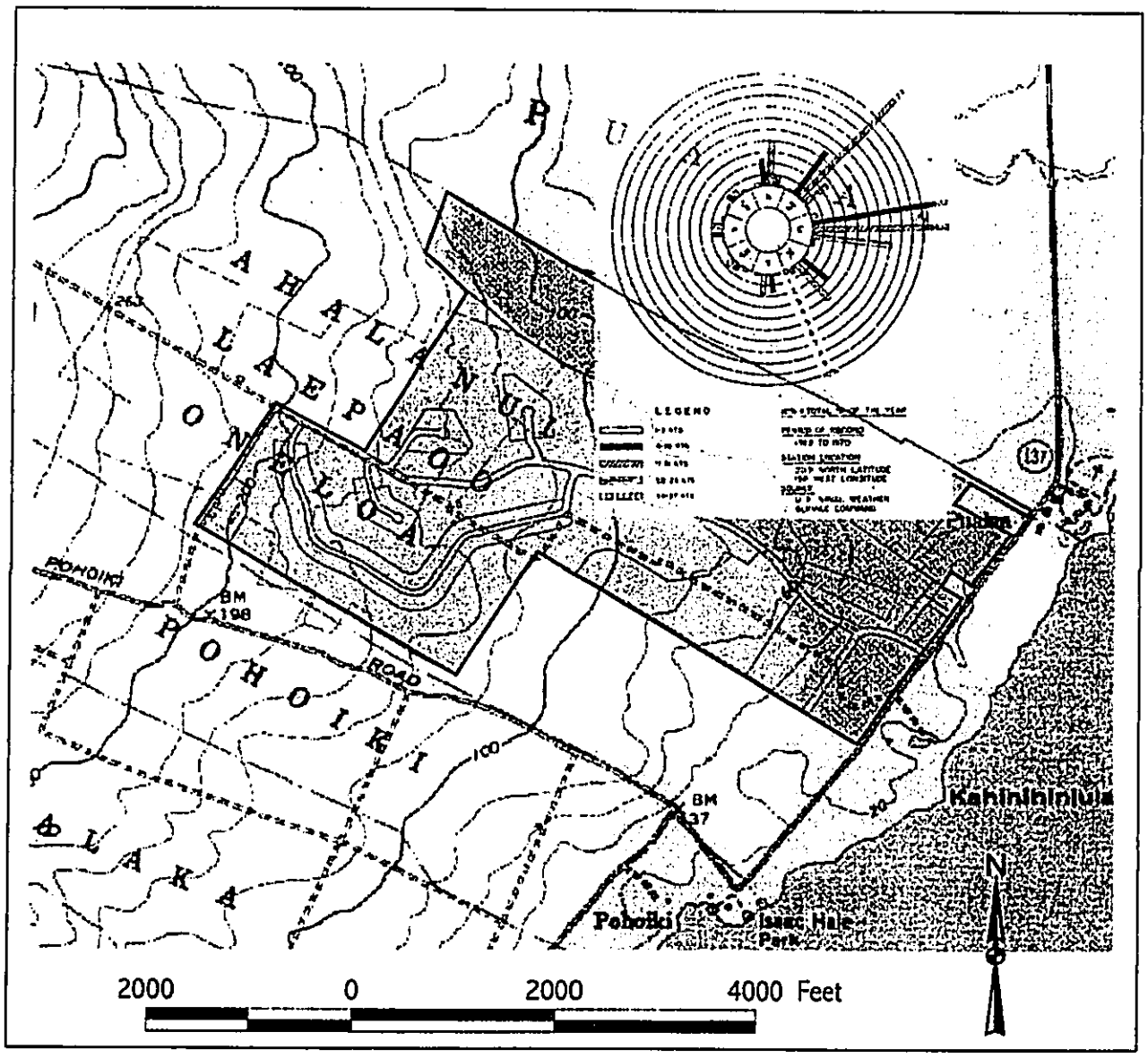
1. State of Hawaii, Department of Land and Natural Resources. *Rainfall Atlas of Hawai'i*. Report R76, 1986 (monthly average rainfall based on gage station State Key No. 67.50).

FIGURE 10. Relationship of Wind Patterns and Site Plan



Impacts and Mitigation

No impact anticipated-- the project will not alter the microclimate.

2. State of Hawaii, Department of Land and Natural Resources, *An Inventory of Basic Water Resources Data: Island of Hawaii*. Report R34, 1970; U.S. Army Engineer District, Honolulu, *Final Detailed Project Report and Environmental Statement: Pohoiki Bay Navigation Improvements*, February 1978.

3.1.2 Topography & Soils

Setting

The Site gently slopes from approximately elevation 20' at the *makai* boundary along the Kapoho-Kalapana Road to approximately elevation 200' at the *mauka* boundary. The Soil Survey Report classifies the soil as Malama extremely stony muck, 3 to 15% slopes (rMAD) and Opihikao extremely rocky muck, 3 to 25% slopes (rOPE).[3] The Malama soils consist of well-drained, thin, extremely stony organic soils over a'a lava. Permeability is rapid, runoff is very slow, and the erosion hazard is slight. The Opihikao soils consists of well-drained, thin, organic soils over pahoehoe lava bedrock. Rock outcrops occupy 30 to 50% of the area. The muck is rapidly permeable. The lava is very slowly permeable, but water moves rapidly through the cracks. Runoff is slow, and erosion hazard is slight.

The Soil Conservation Service rates the suitability of the soils for crops and pasture and other uses on a system of I through VIII, the higher numerals indicating progressively greater limitations. Both the Malama and Opihikao soils have a Land Capability rating of VII ("very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.")[4] The Land Study Bureau's overall productivity rating for the Site is Class D and E (Class A and B are considered prime agricultural lands) (see Figure 11). The State of Hawaii Department of Agriculture's rating is "other" important agricultural lands, probably based on the past use in papaya rather than the physical characteristics of the soil.

Impacts and Mitigation

Agricultural resources. Potentially beneficial. Although not considered prime agricultural lands, a portion of the Site will be committed to orchards and the understory of the native forest will be used for *awa* cultivation. Since the Site is considered marginal agricultural land (i.e., not Land Study Bureau Class A or B), the proposed non-agricultural uses would not impact prime agricultural land resources.

Erodibility. No impact anticipated (long term); mitigation required (during construction). The erosion hazard is slight for the soil types on the Site. Since the limits of grading would exceed five acres, an NPDES permit would likely be required to minimize nonpoint source pollution of coastal waters during construction. The County grading permit would also require best management practices to control erosion and sedimentation.

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3. USDA, Soil Survey of the Island of Hawaii, 1973, sheet 130.

4. Ibid., pp. 37, 43, 55.

FIGURE 11. Land Study Bureau Soil Classification Map

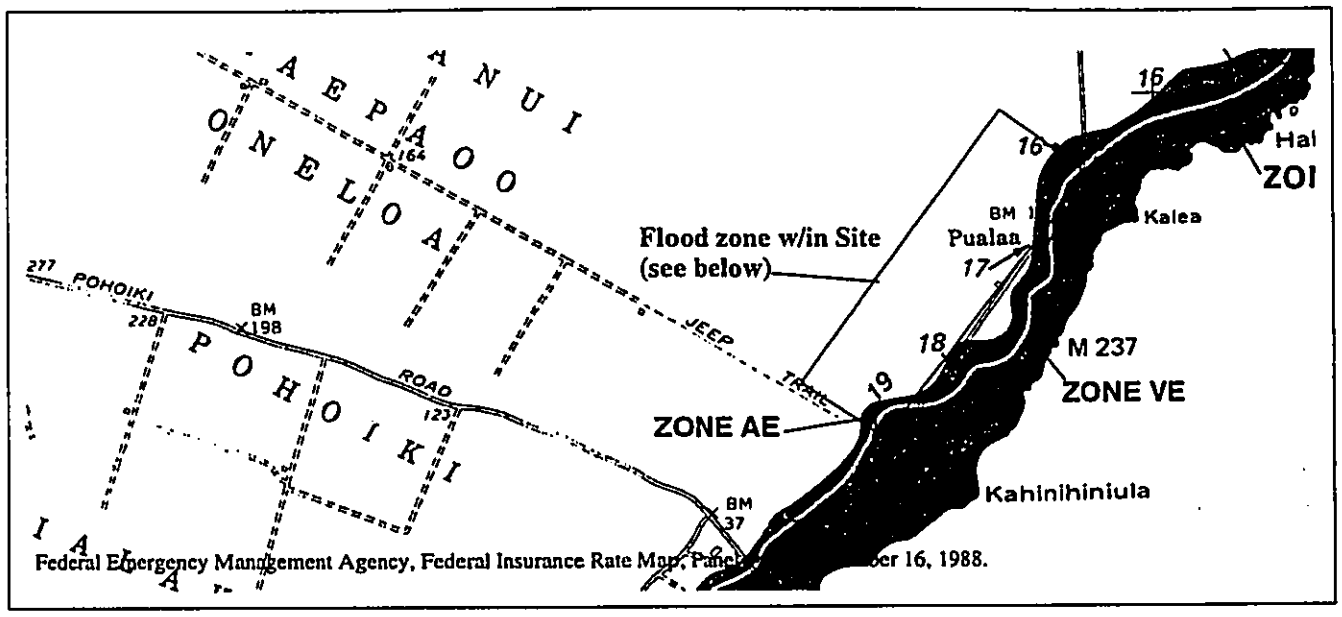
Land Study Bureau, Detailed Land Classification - Island of Hawaii. L.S.B. Bulletin No. 6, November 1965. Maps 694 and 695.

3.1.3 Natural Hazards

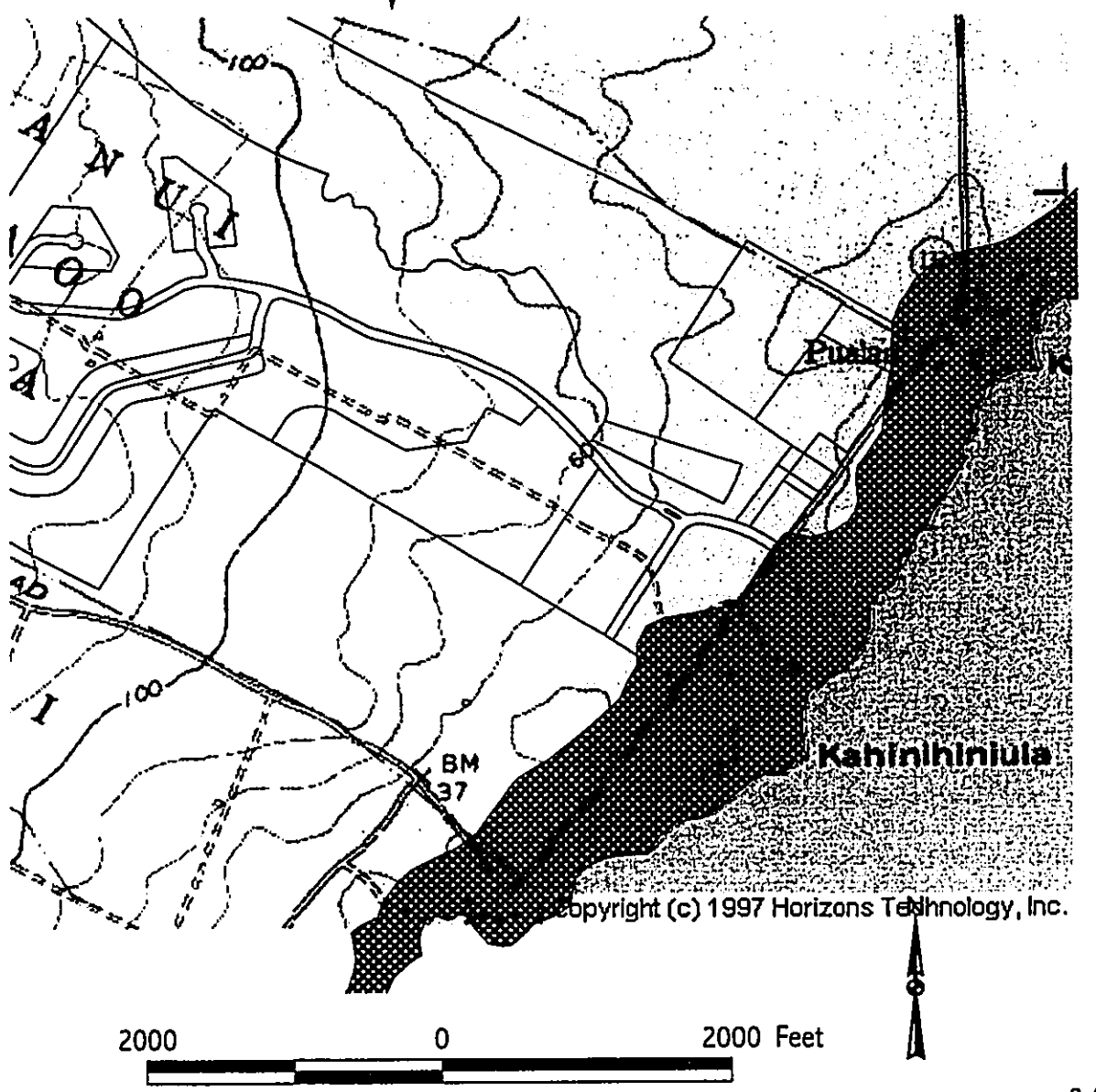
Setting

Flood and Coastal Hazards. The Flood Insurance Rate Map designates a small portion of the *makai* areas of the Site in Zones VE (coastal high hazard) and AE (100-year flood hazard) (see Figure 12). The balance of the Site is not in the special flood hazard zone (Zone X). The base flood elevation within the AE and VE zones on the Site is 19'. The flood hazard zone boundaries were located relative to the conceptual site plan using the digitized Q3 Flood Data produced by the Federal Emergency Management Agency (FEMA).

FIGURE 12. Flood Insurance Rate Map

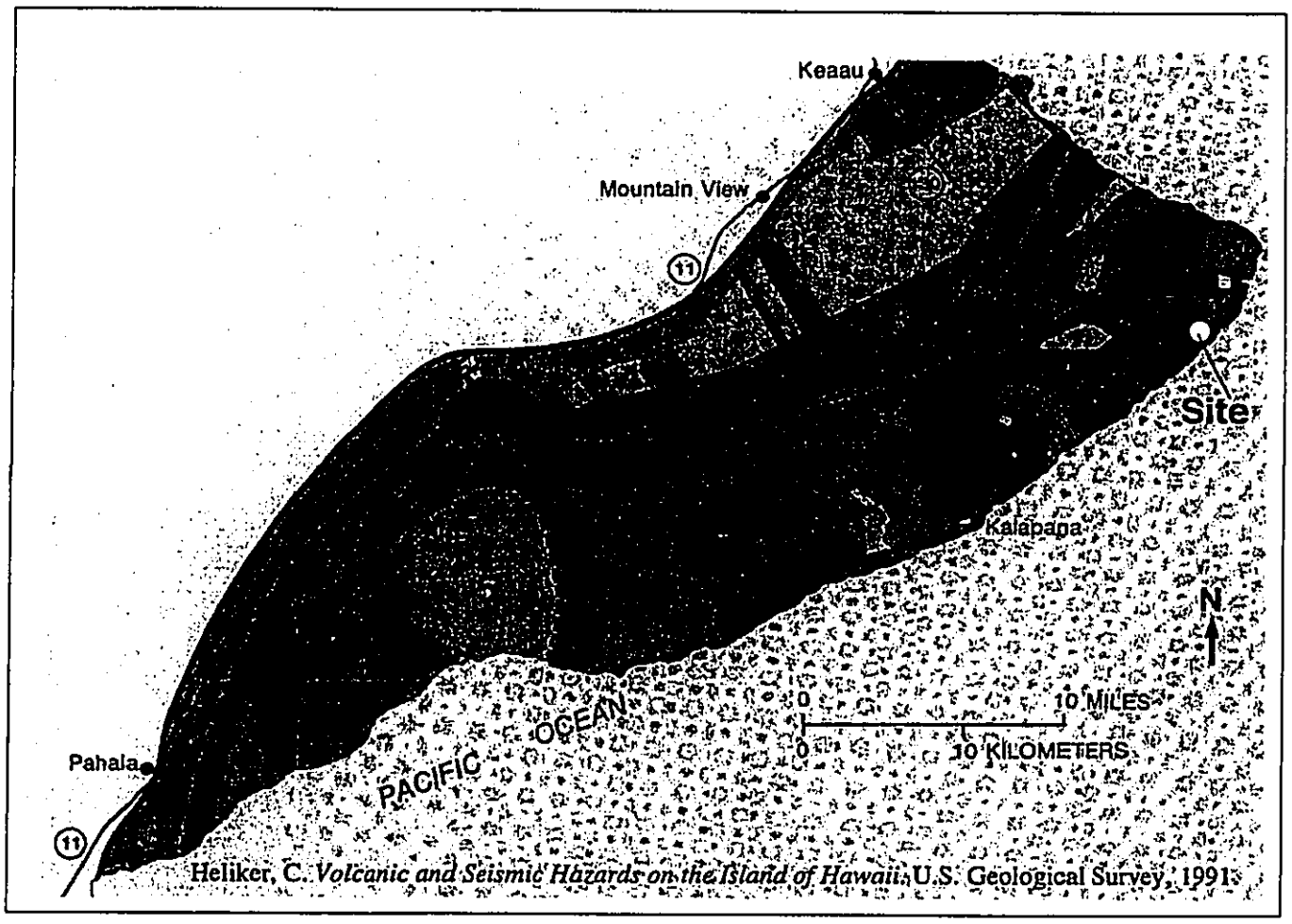


Georeferenced FEMA flood zone map (Q3) overlaid on site plan and USGS quad map



Volcanic and Earthquake Hazards. The United States Geological Survey (USGS) classifies the Site as Lava Flow Hazard Zone 2, on a scale of ascending risk 9 to 1 (see Figure 13). Zone 1 consists of the rift zone of Kilauea. Zone 2, which is downslope from the rift zone, is the area where lava from the rift zone is most likely to flow. Pahoa town is also in Zone 2. The Building Code designates the entire island of Hawaii in Earthquake Zone 3 and contains certain structural requirements to address the relative seismic hazards.

FIGURE 13. **Lava Flow Hazard Zones**



Impacts and Mitigation

Flood Hazard. Mitigation required. No more than five of the proposed thirty beach club units will be located within the AE zone. Since these units within the AE zone would be constructed where the existing elevation is 20', the lowest enclosed floor would be above the base flood elevation of 19'. Tennis courts and a swimming pool are proposed within the VE zone. The Project's architect, engineer, and/or surveyor will certify compliance with the construction standards set forth in the Flood Control Code (Hawaii County Code Chapter 27).[5]

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5. Hawaii County Code §27-28 (standards for construction), §27-23 (standards for coastal high hazard areas), and §27-17 (certification standards).

Volcanic Hazard. No impact anticipated. There are no restrictions to build in lava flow hazard zones. The level of risk is comparable to any development in Pahoa town. Any development within these zones is at the owner's risk. The availability and cost of insurance is a business decision.

Emergency Evacuation. Potentially adverse (for regional evacuation); potentially beneficial (for coastal evacuation). The Project will attract more people to the area, which would be a concern in emergency situations that require evacuation from the entire Pohoiki-Kapoho region. Such emergency situations could arise from lava flows or possibly hurricane. For coastal evacuation due to tsunamis or high waves, the Project would provide additional *mauka* escape routes and shelter since the Site is above the tsunami evacuation zone (for more information on the roadway capacities to accommodate evacuation, see section 3.3.1, "Roads and Traffic" on page 3-45).

3.1.4 Terrestrial Flora/Fauna

Setting

A biological reconnaissance survey of the Site described the vegetation as post-agricultural fallow vegetation (mixed alien shrubland and grassland) and native-dominated forest and shrubland.[6] The native-dominated section included lowland mesic forest dominated by *ohia* (Metrosideros polymorpha) and *hala* (Pandanus tectorius) (see Figure 14). Stands of native *alahe'e* lowland dry shrubland, a vegetation type considered rare and imperiled by the Hawai'i Natural Heritage Program, were observed in the *makai* portion of the 'Ahalanui section, *mauka* of the coastal road. One relatively recent sighting of *'ope'ape'a* (Hawaiian bat, Lasiurus cinereus semotus) along the Pohoiki-Pahoa Road, and a report that *'io* (Hawaiian hawk, Buteo solitarius) has been seen in the area represent the only documentation of rare, threatened, or endangered vertebrates currently in the area. While not in the study area, anchialine pools supporting a red shrimp (*'opae'ula*, Metabetaeus lohena) are present in parcels immediately *makai* of the coastal road. The shrimp is a "species of concern" (SOC) in U.S. Fish and Wildlife Service listings (for more information on anchialine pools, see section 3.1.7, "Coastal Resources" on page 3-19).

Impacts and Mitigation

Ohia/Hala Forest. Potentially beneficial. The proposed development is confined to the alien-dominated mixed shrub and grassland and the alien-dominated forest areas. The resulting preservation of the native forest will protect the existing native vegetation types and habitats for the Hawaiian hawk and Hawaiian bat. The *awa* cultivation in the understory of the native forest will attempt to replicate the practice used by the ancient Hawaiians in this area (see section 3.2.1, "Cultural Impact" on page 3-29). One of the traditional methods placed the *awa* plants up in the crotches of the *ohia* trees, making them epiphytic. The proposed plan also will incorporate as part of the interpretive program the Kipaipai coconut grove and a portion of Kahaleolono agricultural area, both containing remnant cultivated plants descended from past Hawaiian agricultural plantings: *pia* (Tacca leontopetaloides), *pi'a* (Dioscorea pentaphylla), *noni* (Morinda citrifolia), *kī* (Cordyline fruticosa), *kukui* (Aleurites moluccana), etc. As an ongoing managerial practice, the forest stewards need to remove and control noxious alien species in the native vegetation.

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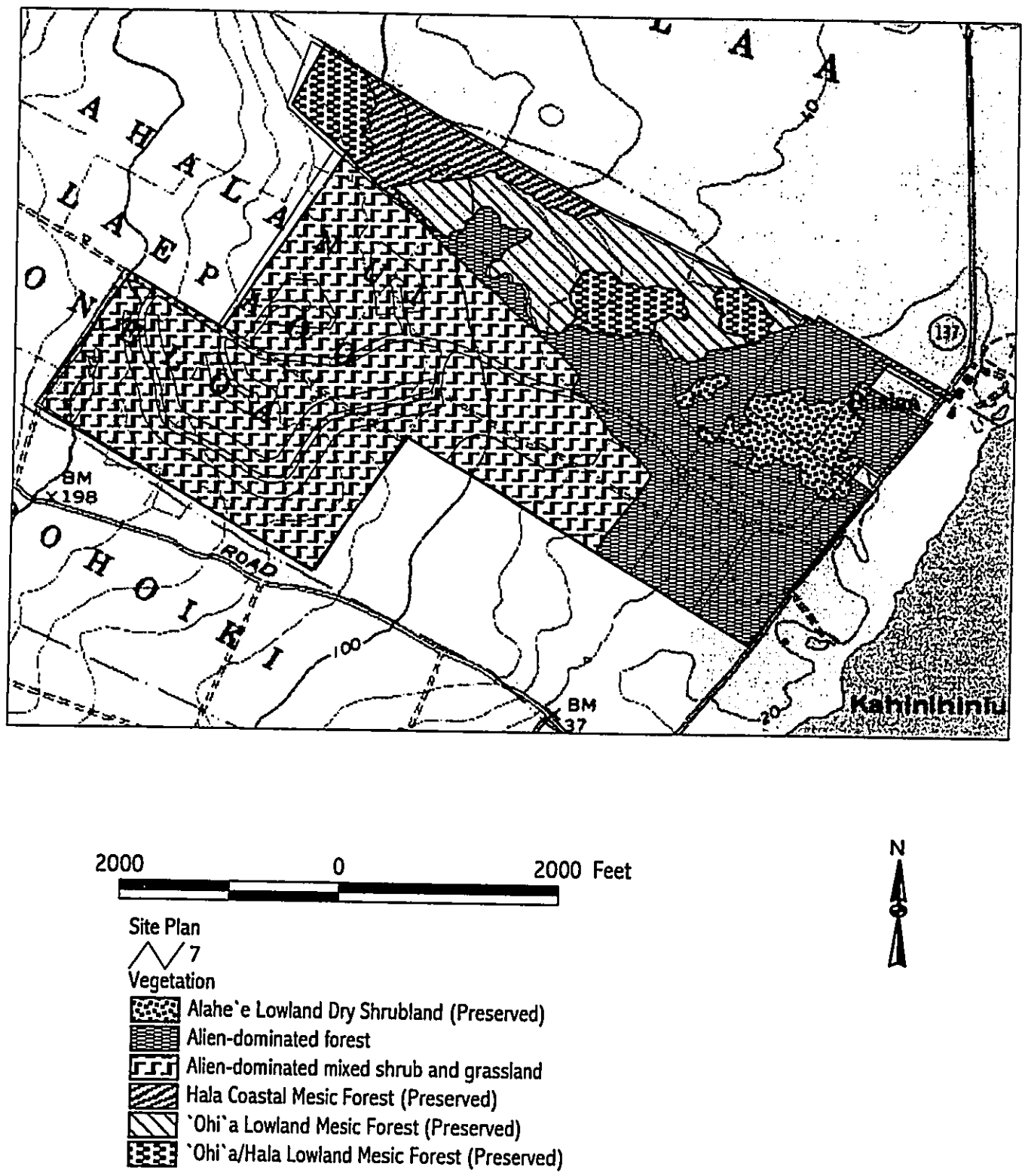
6. The Nature Conservancy of Hawaii. Biological Reconnaissance of Portions of the Laepao'o, Oneloa and Ahalanui Land Sections, Puna, Hawaii. Prepared for A&O International Corporation. February 1998. (See Appendix D).

FIGURE 14. Vegetation Types



Alahe'e Shrubland. No impact anticipated. The *alahe'e* habitat is within the Project's open areas that would be accessible by trails; a portion is within the area that the Applicant will dedicate to the County as a parking lot for the County's Ahalanui Park. Since the *alahe'e* habitat is in the same area of the archaeological sites that will be preserved in place (refer to Figure 17, "Relationship of Vegetation Types and Archaeological Sites," on page 3-14), the *alahe'e* will provide a setting for the interpretation of the natural and cultural values of the *alahe'e* and archaeological features.

3.1.5 Historic/Archaeological Resources

Setting

Archaeologists conducted a 100% reconnaissance survey for the non-papaya portion of the Site.[7] The survey identified 47 sites (see Figure 15). Several of the complexes consist primarily of agricultural features. Other functional categories include habitation, ancillary habitation, temporary habitation, boundary wall, burial, animal husbandry, and transportation. Carbon-based dating suggest initial occupation occurred during the prehistoric period, possibly as early as AD 1250.

The archaeological study recommended the following treatments for the 47 sites (see Figure 16 and Table 2):

- Not significant because their information has been already fully documented; no further work necessary: 7 sites
- Significant for information value; further data collection only: 24 sites
- Contains human burials with cultural value; no further work with preservation "as is": 6 sites
- Contains human burials with significance for information and cultural values; further data collection, followed by preservation "as is": 4 sites
- Significant information value representing an excellent site type example at the regional or islandwide level; further data collection, followed by interpretation: 6 sites.

Impacts and Mitigation

Potentially beneficial (restored sites); no impact anticipated (burials). Since the Project will preserve the native forest, and most of the significant archaeological sites are clustered within the native forest, the significant sites will be preserved in place (see Figure 17). Additionally, the Applicant will comply with all requirements related to burials, and ensure that adequate buffer areas are provided (see Appendix D, "Archaeological Mitigation Plan for Oneloa Onsen & Sports Complex").

In areas outside the native forest, all significant sites will be preserved in place with adequate buffers approved by the State Historic Preservation Division. Where designing around non-significant sites is practically impossible, data recovery will be implemented in accordance with

7. Archaeological Consultants of Hawaii, Inc. conducted the original survey for the Site in three phases between April 4, 1989 and August 10, 1990. PHRI summarized this previous work and completed the study in 1994 (Dunn, A. et al. Archaeological Inventory Survey: A&O Golf Course Project, Lands of Ahalanui, Oneloa, and Laepao'o, Puna District, Island of Hawaii. Prepared for A&O International Corporation. February 1994) (see Appendix E).

the State Historic Preservation Division's requirements. The enforcement of acceptable mitigation measures can occur at Plan Approval at a time when the detailed site planning will be developed.

FIGURE 15. Archaeological Sites

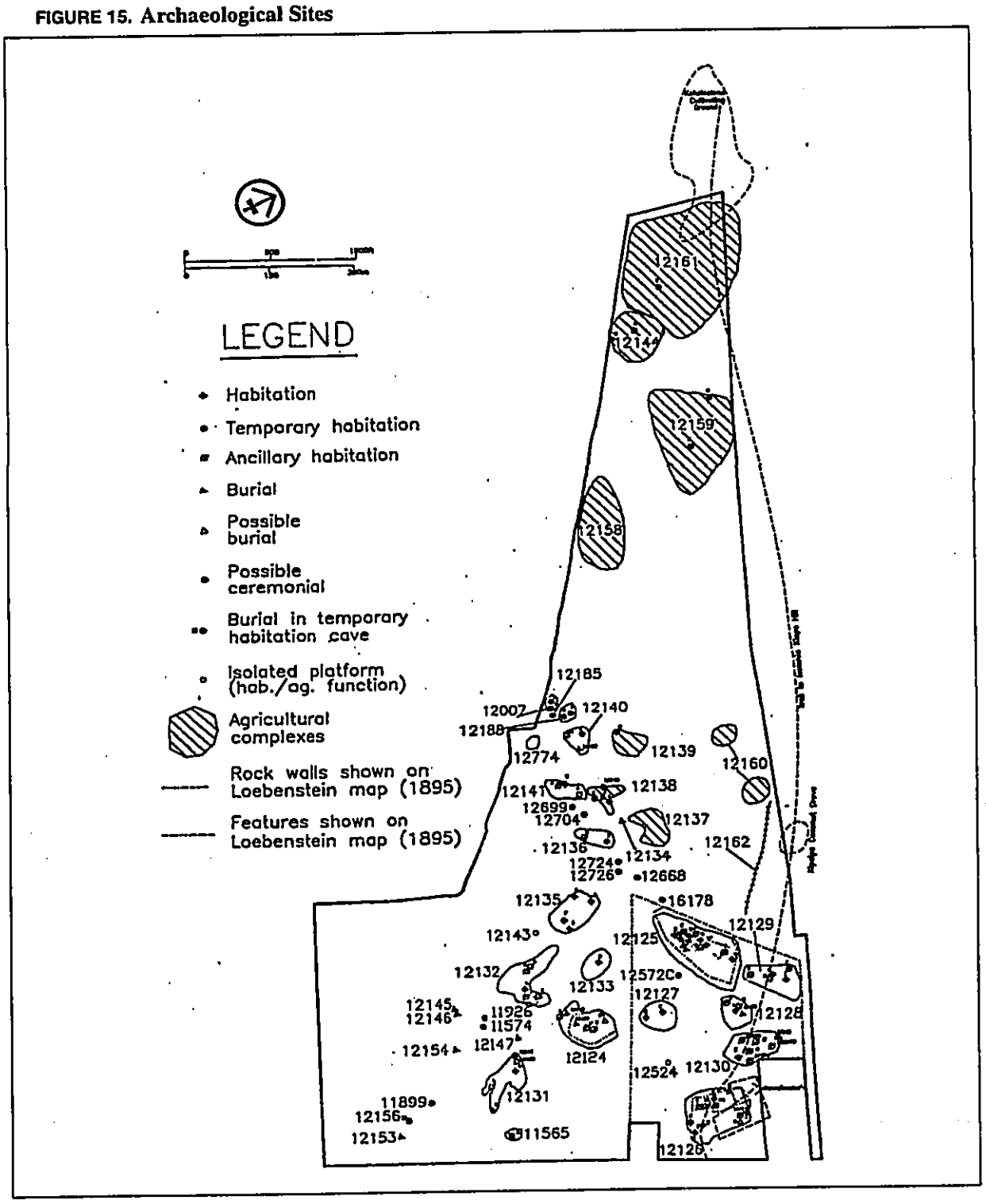
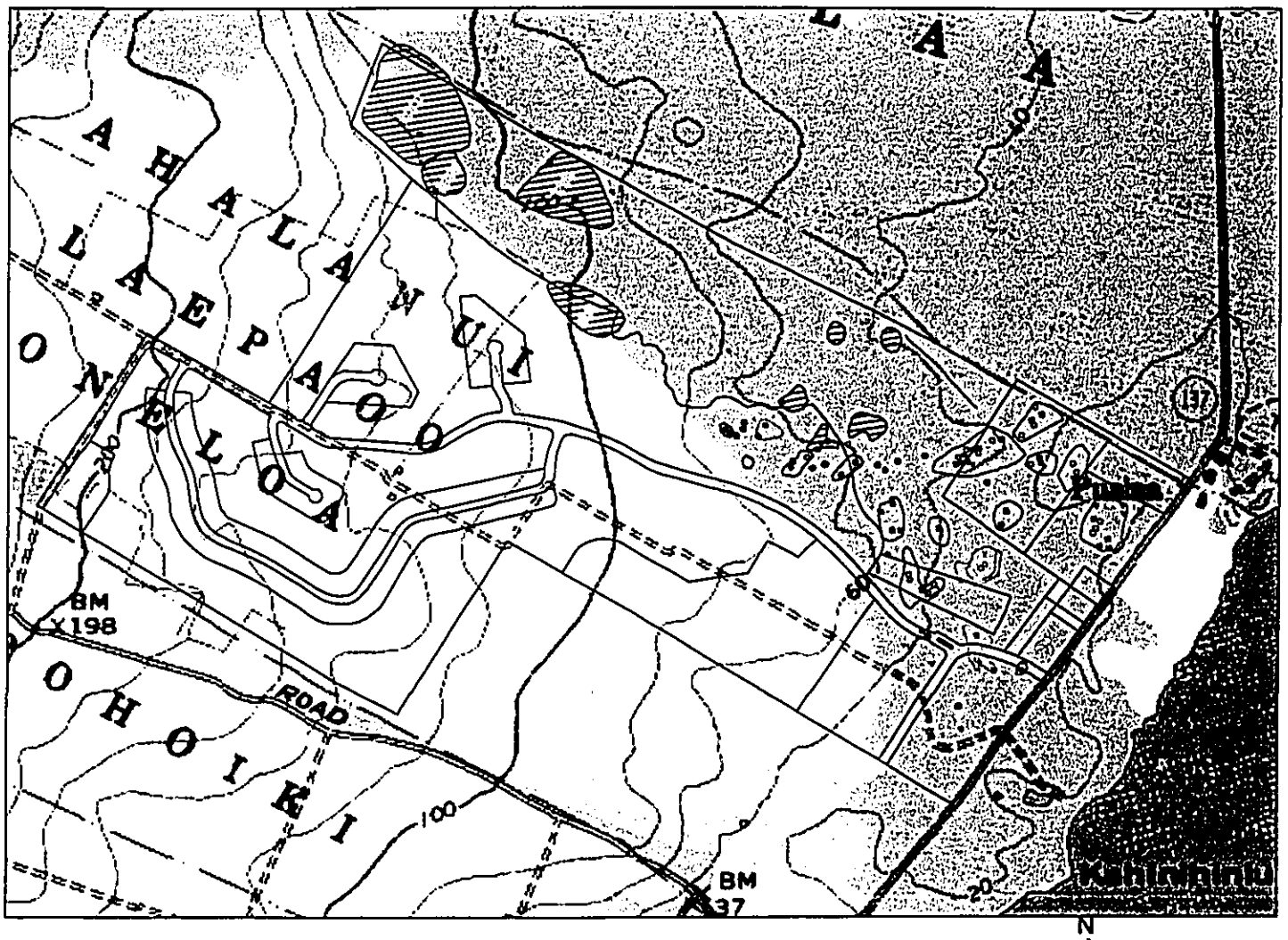


FIGURE 16. Archaeological Sites-- Treatment Recommendations



2000 0 2000 Feet

Archaeological Sites
- No preservation, further data collection
- Preservation with interpretation, further data collection
- Preservation as is, further data collection
- No preservation, no further data collection
- Preservation as is, no further data collection

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TABLE 2. Archaeological Sites-- Treatment Recommendations

SIHP SITE ID	SIGNIFICANCE[1]	TREATMENT[2]	TYPE	FUNCTION
No preservation necessary, further data collection				
11899	A	A0	hearth	temp. habitation
12007	A	A0	complex	temp. habitation
12127	A	A0	complex	residential
12129	A	A0	complex	residential
12132	A	A0	complex	residential
12133	A	A0	complex	residential
12135	A	A0	complex	residential
12136	A	A0	complex	residential
12137	A	A0	complex	multiple
12138	A	A0	complex	ag/temp. habitat
12139	A	A0	complex	ag/temp. habitat
12141	A	A0	complex	residential
12143	A	A0	platform	habitation/ag
12144	A	A0	complex	ag/temp. habitat
12158	A	A0	complex	ag
12159	A	A0	complex	ag/temp. habitat
12160A	A	A0	complex	ag
12160B	A	A0	complex	ag
12185	A	A0	cave	temp. habitation
12188	A	A0	complex	temp. habitation
12572C	A	A0	platform	temp. habitation
12668	A	A0	cave	temp. habitation
12704	A	A0	cave	temp. habitation
12724	A	A0	cave	temp. habitation
12774	A	A0	platform	temp. habitation
Preservation with interpretation, further data collection				
12125	ABC	A1	complex	residential
12126	ABC	A1	complex	residential
12128	ABC	A1	complex	residential
12130	ABC	A1	complex	residential
12161	ABC	A1	complex	ag/temp. habitat
12162	ABC	A1	trail	transportation
Preservation as is, further data collection				
12124	AC	A2	complex	residential
12131	AC	A2	complex	residential
12140	AC	A2	complex	residential
12154	AC	A2	platform	burial
No preservation necessary, no further data collection				
11565	X	B0	complex	ag/temp. habitat
11574	X	B0	cave	temp. habitation
11926	X	B0	cave	temp. habitation
12699	X	B0	cave	temp. habitation

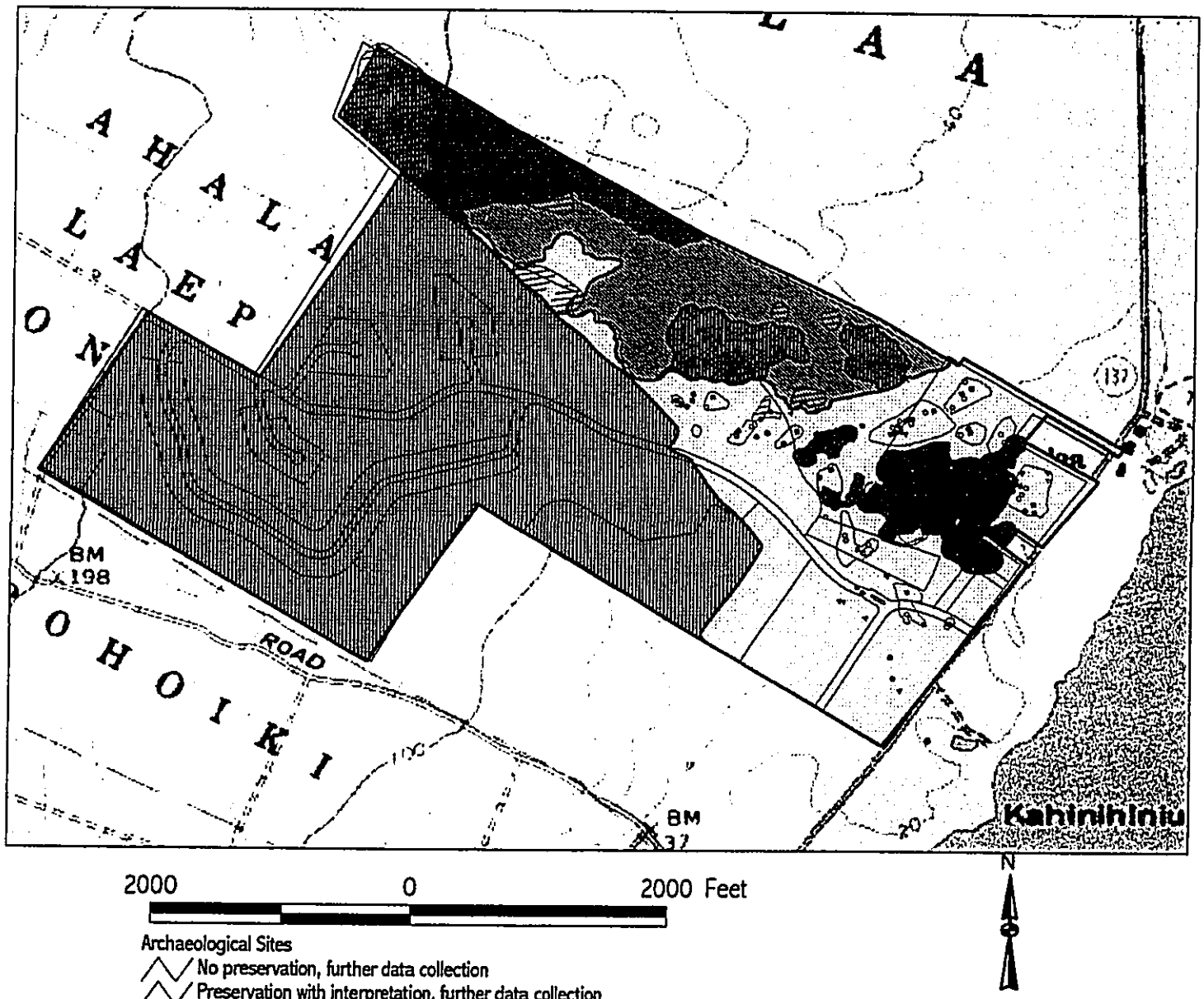
TABLE 2. Archaeological Sites-- Treatment Recommendations

SIHP SITE ID	SIGNIFICANCE[1]	TREATMENT[2]	TYPE	FUNCTION
12726	X	B0	cave	temp. habitation
16178	X	B0	cave	temp. habitation
Preservation as is, no further data collection				
12134	XC	B2	cave	burial
12145	XC	B2	platform	burial
12146	XC	B2	platform	burial
12147	XC	B2	platform	burial
12153	XC	B2	platform	burial
12156	XC	B2	cave	tem. habitat/bur
12148			platform	ceremonial
12149			platform	burial
12150			platform	burial
12151			platform	burial
12152			platform	burial
12155			cave	ancillary habitat
12524			mound	ag
12555			platform	ancillary habitat
12556			cave	ancillary habitat
12740			enclosure	temporary habitat
12899B			cave	ancillary habitat
12901			platform	burial
16179			mod. outcrop	ancillary habitat
Kahaleolono				
Kipaipa				
Trail				

1. SIGNIFICANCE
X Important for information content; no further data collection necessary
A Important for information content; further data collection necessary
B Excellent example of site type at local, regional, island, sate, or national level
C Culturally significant

2. TREATMENT
A Further data collection necessary
B No further work necessary
0No preservation necessary
1Preservation with interpretation
2Preservation as is

Figure 17. Relationship of Vegetation Types and Archaeological Sites



Archaeological Sites
- No preservation, further data collection
- Preservation with interpretation, further data collection
- Preservation as is, further data collection
- No preservation, no further data collection
- Preservation as is, no further data collection

Site Plan
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Vegetation
- Alahe`e Lowland Dry Shrubland (Preserved)
- Alien-dominated forest
- Alien-dominated mixed shrub and grassland
- Hala Coastal Mesic Forest (Preserved)
- `Ohi`a Lowland Mesic Forest (Preserved)
- `Ohi`a/Hala Lowland Mesic Forest (Preserved)

3.1.6 Groundwater Resource

Setting

The Site is situated in an area underlain by lavas extruded from the east rift zone of the Kilauea volcano (see Figure 18). The slope of the water table indicates the general direction of groundwater flow in an aquifer, and its gradient, or steepness, is an indication of either the rate of flow or the permeability of the aquifer. Based on water levels from wells in the vicinity of the Site, the groundwater slopes from the rift zone to the sea at a gradient of approximately 2 feet per mile, which is less than the flow in the Hilo area (see Figure 19). The seaward flow through the Site is estimated at 2 to 4 mgd. The groundwater passing through the Site is geothermally heated. The discharge at shoreline pools near the Site has been measured at 31 degrees Celsius, compared to 18 degrees Celsius near Hilo (see Figure 20).

A well, known as the Allison well (#2881-01), was drilled on the Site in 1973 for agricultural purposes.[8] The pumped water showed a strong influence of geothermal activity. This warm, chemically enriched pumped water, together with warm springs seeping at the shoreline, indicate that the groundwater lens is highly altered everywhere beneath the Site. The Allison well produced very brackish water.

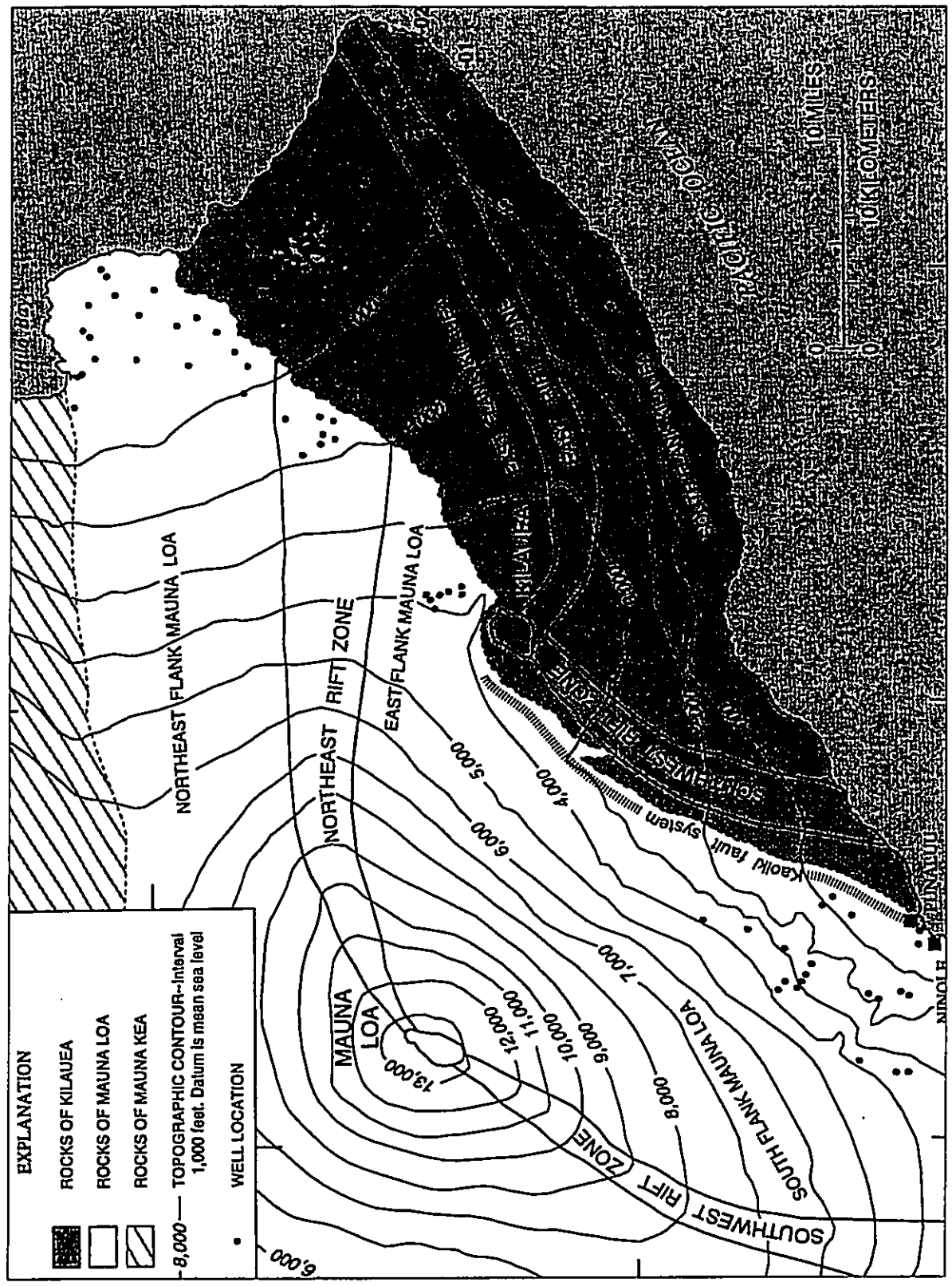
Impacts and Mitigation

Effect on groundwater quantity. No impact anticipated. The high rainfall minimizes the need to irrigate. Groundwater would be supplemented by wastewater reclamation for areas requiring irrigation. The water for the *onsen* pools would be recirculated and flushed periodically; therefore, the water demand will not be excessive.

Effect on groundwater quality. No impact anticipated. The brackish groundwater is not a suitable potable source. Therefore, the use of reclaimed fresh wastewater for irrigation will not have an adverse impact on any drinking water source. The thermal groundwater used for the *onsen* ponds will be treated as necessary to meet health and sanitation requirements.

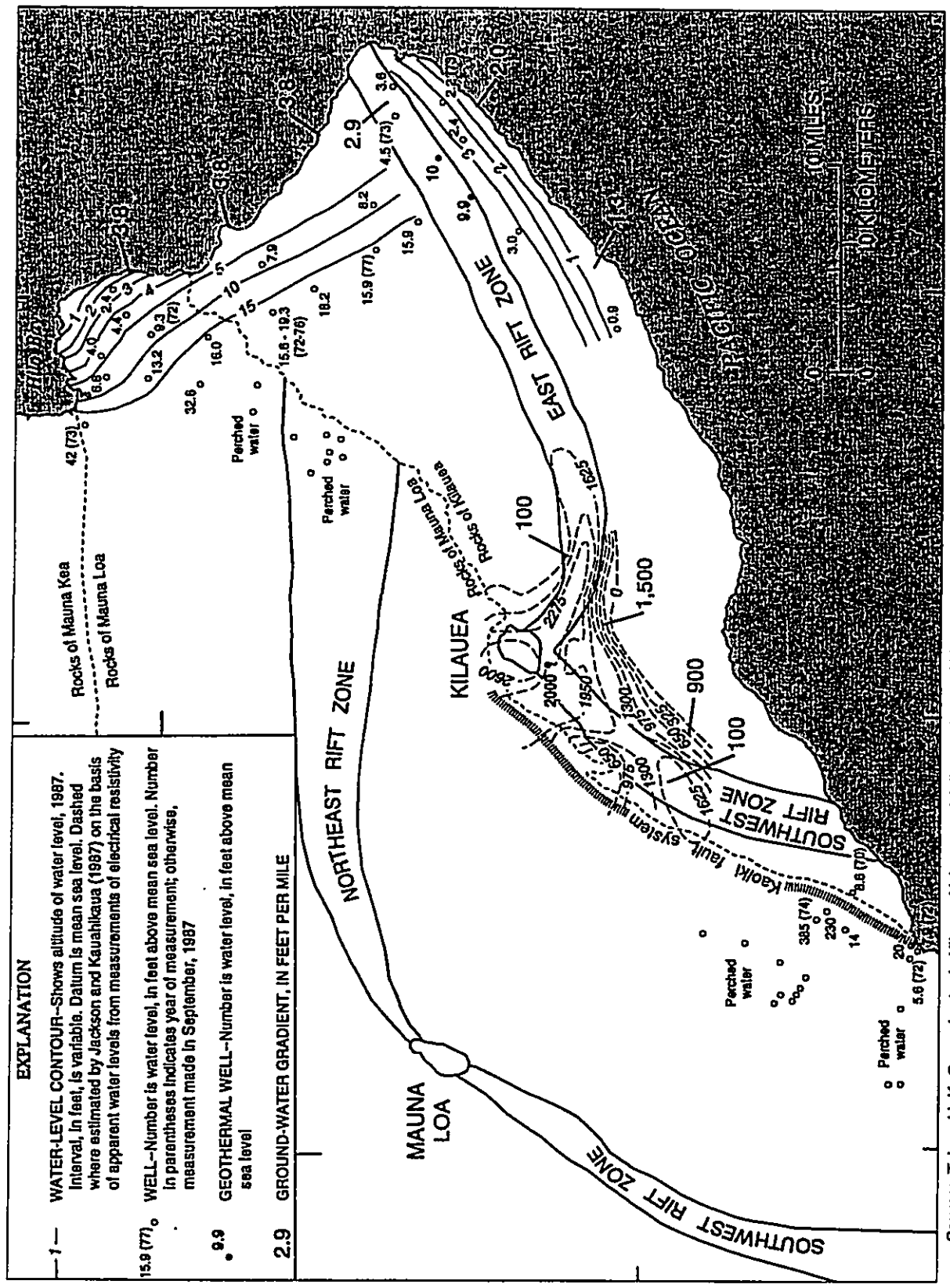
8. See Appendix G, "Hydrogeology of Oneloa, Hawaii".

FIGURE 18. Locations of Rocks and Geologic Structures



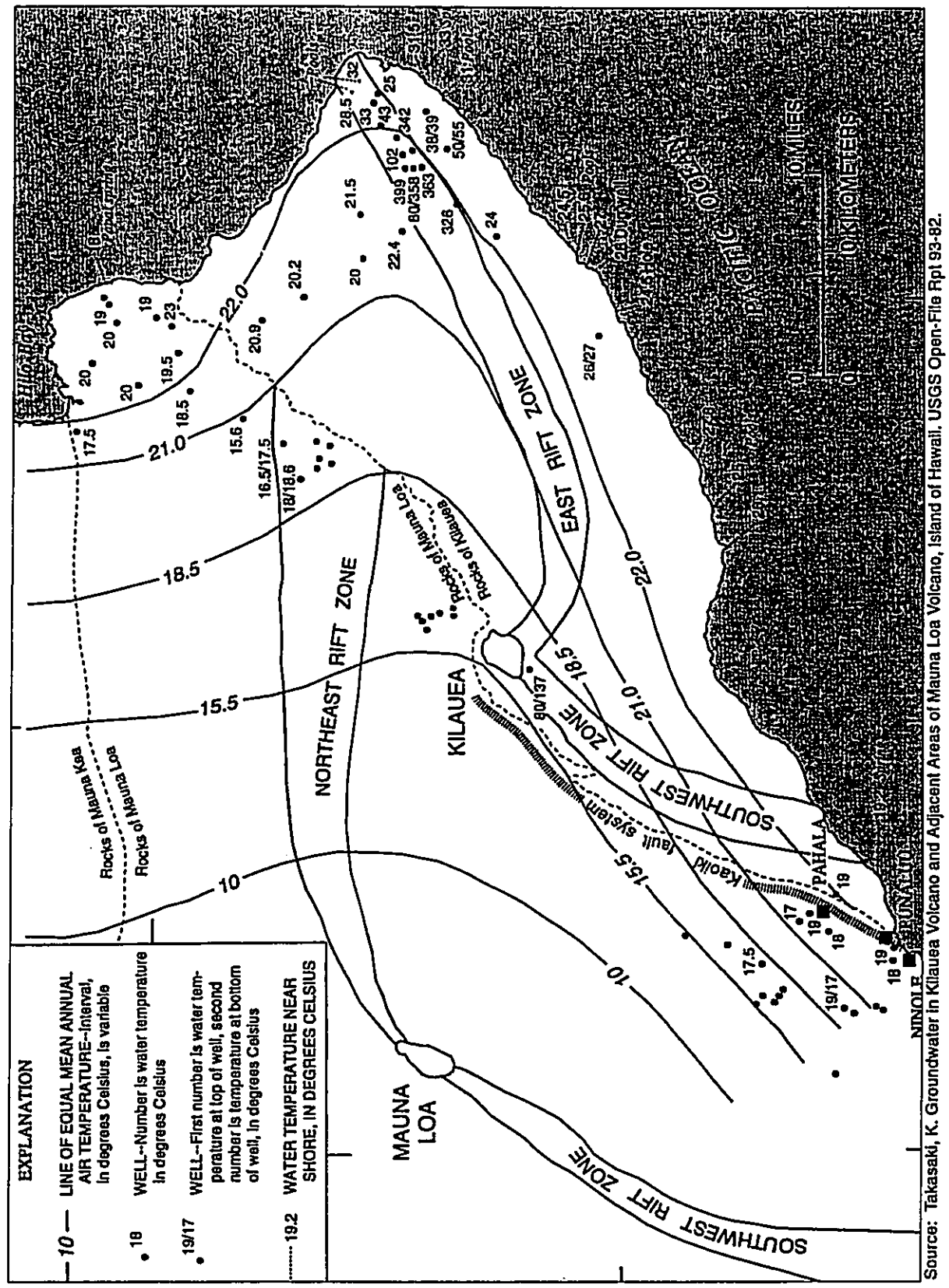
Source: Takasaki, K. Groundwater in Kilauea Volcano and Adjacent Areas of Mauna Loa Volcano, Island of Hawaii. USGS Open-File Rpt 93-82.

FIGURE 19. Groundwater Gradients



Source: Takasaki, K. Groundwater in Kilauea Volcano and Adjacent Areas of Mauna Loa Volcano, Island of Hawaii. USGS Open-File Rpt 93-82.

FIGURE 20. Groundwater Temperatures



3.1.7 Coastal Resources

Setting

Nearshore Physical and Biological Characteristics. The nearshore area fronting the Site is exposed to long-period swells generated by storms in the north Pacific during the winter months and the south Pacific in summer months, as well as northeast tradewind generated swells. Consequently, the nearshore areas are subjected to extreme stress from wave impact and scouring of sediment from wave action. The composition of coral reef communities is structured primarily in response to physical forces of breaking waves.[9]

The nearshore bottom topography consists of three distinct zones:

- *Shallow high wave energy zone (0-5 m).* A solid relatively barren basalt platform slopes gradually from the shoreline downward to a depth of approximately 3 meters, ending abruptly in a small vertical cliff face that extends to a depth of approximately 5 meters. Corals are relatively sparse in this habitat due to the energy of breaking waves. The only commonly occurring corals were Pocillopora meandrina and Palythoa tuberculosa. This habitat provides relatively little shelter for fishes. Fish species in this zone are common to high energy areas (e.g., *po'opa'a* (Cirrhitus pinnulatus), *moano* (Parupeneus mutifasciatus), *nenue* (Kyphosus biggibus), *kikakapu* (Chaetodon lunula and C. ornatissimus), *omilu* (Caranx melampygus), others).
- *Boulder-reef platform (5-20 m).* At the bottom of the cliff, bottom topography consists of large boulders interspersed over a steeply sloping basalt bottom. This boulder-reef platform zone contains substantial cover of living reef corals, and a diverse community of invertebrates and reef fish. The shallower area is predominantly covered by Pocillopora meadrina (up to 25% of the bottom). This species is generally regarded as a "pioneering" species that occurs in areas too harsh for other corals, which appears to be the case in this area due to the turbulence from breaking waves. Other corals that occurred in this shallower area included small, flat encrustations of Porites lobata and Montipora spp. On the outer portions of this zone, corals become more abundant in terms of species diversity and percent coverage. Coral cover ranged from approximately 35-50%, consisting of Porites lobata, Pocillopora meadrina, Montipora patula, M. flabellata, M. verrucosa, Leptastrea purpurea, Pavona varians and Porites (Synararaea) canvexa. The growth forms of virtually all the corals consisted of flat encrustations or low sturdy lobate structures, which are more break-resistant forms typically found in habitats exposed to breaking waves. Because the shelter is well-developed, the standing crops of fishes is greater here than in the other zones. Besides the species in the shallower zone, this zone includes *ala'ihi* (Adioryx diadema and A. xantherythrus), *menpachi* (Myripristes amaenus), *aweoweo* (Priacanthus cruentatus), *upapalu* (Apogon kallopterus), and others. At the outer area of this zone, fish communities are dominated by schooling surgeonfishes, parrotfishes and wrasses. Occasionally, juvenile green sea turtles (Chelonia mydas) were seen either resting under ledges or slowly swimming through the area.
- *Deeper boulder zone (20+ m).* At a depth of approximately 15 meters, a second drop-off occurs extending to a depth of approximately 20 meters. At the bottom of this second drop, the bottom structure consists of large lava boulders and blocks with sand and rubble channels which extend seaward to abyssal depths. Coral cover consists largely of the branching coral Porites

9. The information on the nearshore physical, biological, and water quality characteristics is a summary of a study conducted for this project by Marine Research Consultants (see Appendix F).

compressa, which grows in interconnected thickets generally at depths below damaging wave forces.

Nearshore Water Chemistry. Sampling stations were located along three transects perpendicular to the shoreline fronting the Site, extending from the highest wash of the waves seaward for a distance of approximately 200 meters (see Figure 21). For each transect, samples were collected in tidepools and anchialine ponds landward of the shoreline, and five ocean samples. At each ocean station, a surface sample (within approximately 10 cm of the surface) and bottom sample was collected (except ocean stations within 5 m of the shoreline where no bottom samples were collected). Samples were analyzed for compliance with State Department of Health Water Quality Standards (total nitrogen, nitrate + nitrite nitrogen, ammonium, total phosphorus, chlorophyll a, turbidity, temperature, pH, and salinity), biological activity indicator (orthophosphate phosphorus), and degree of groundwater mixing indicator (silica).

Samples from the intertidal ponds and anchialine pools resulted in low salinity and high nutrient concentrations, indicating a substantial influx of groundwater to the nearshore waters. At the shoreline, however, salinity increases and nutrient concentrations drop radically by several orders of magnitude. From a distance of 5 meters from the shoreline seaward, concentrations of nutrients and salinity are nearly constant for the length of the transect. The results indicate that the substantial wave energy rapidly mixes the freshwater to background ocean levels within 5 to 10 meters of the shoreline. Turbidity was also low on all the ocean samples. The input of freshwater seems to be higher at the southern part of the shoreline fronting the Site.

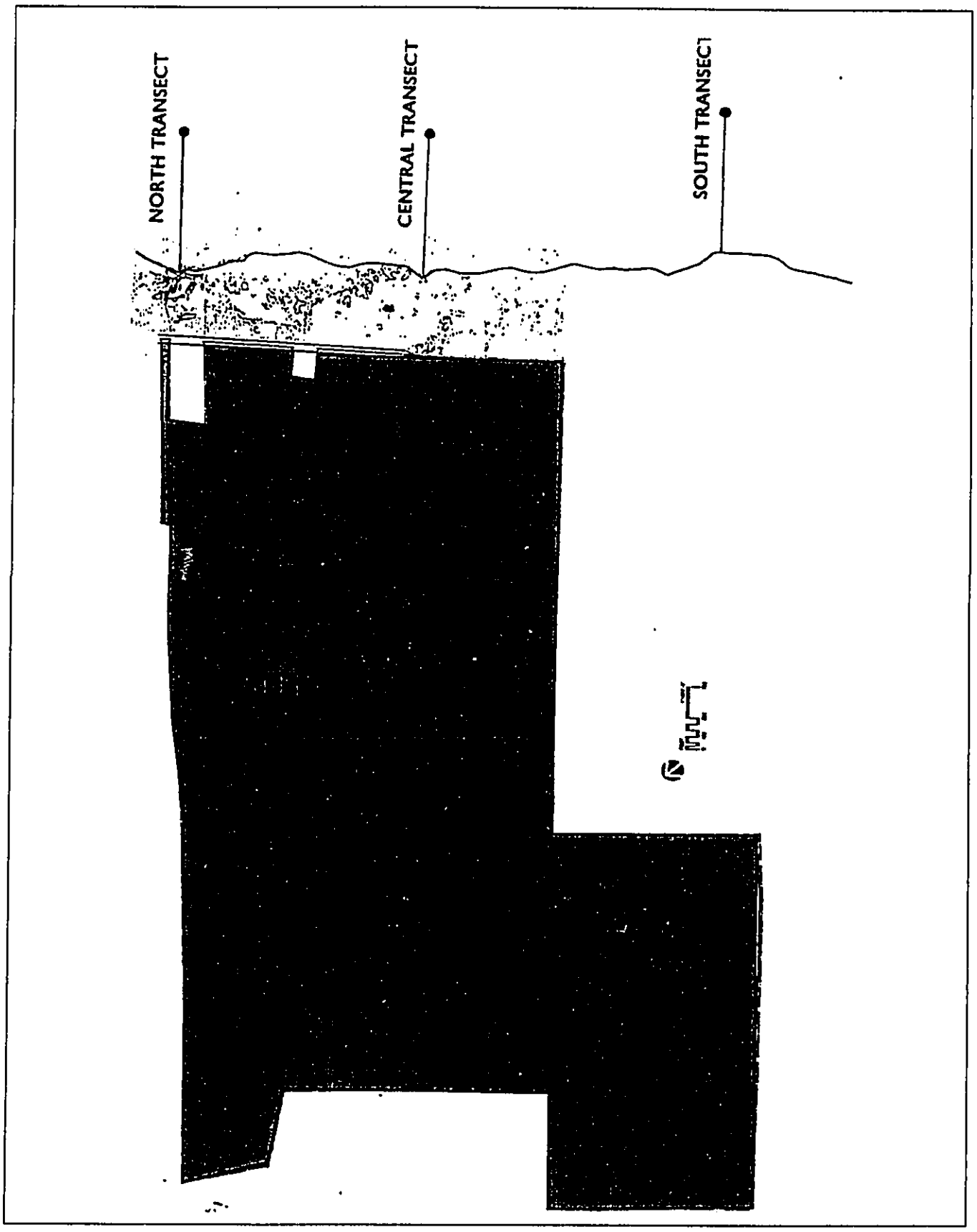
None of the ocean samples exceeded the Water Quality Standards. Samples at the intertidal ponds or anchialine pools along the southern or northern transects did exceed the standards for nutrient indicators (nitrate + nitrite nitrogen, total phosphorous, chlorophyll a). These results indicate that any existing anthropogenic input to the nearshore waters that may be reflected in the high nutrient concentrations in the intertidal ponds are diluted by the turbulent mixing processes to the point that the effect on the nearshore waters are very minimal.

Waves and currents. The shoreline fronting the Site faces the southeast and generally is subject to a wave spectrum from the northeast clockwise to the southwest.[10] The waves can be classified into a few predominant wave types, distinguished by a range of wave heights, periods, and directions of approach. Several wave types may occur simultaneously producing a very complex wave climate. The three primary wave types are as follows:

- Northeast trade waves. These waves result from the strong tradewinds blowing from the northeast over long fetches of open ocean.
  - Typical periods: 6 to 12 seconds
  - Typical heights: 4 to 12 feet
  - Typical occurrence: April through November, 90 to 95% of the time; remainder of the year, 55 to 65% of the time.

10. The information on waves and currents is from U.S. Army Engineer District, Final Detailed Project Report and Environmental Statement: Pohoiki Bay Navigation Improvements, Pohoiki Bay, Hawaii, February 1978.

FIGURE 21. Coastal Water Quality Transect Locations



- Southern swell. These waves are generated during the Antarctic winter months by strong winds blowing over long fetches of the southern Pacific and Indian Oceans. After traveling thousands of miles of open ocean, these waves arrive at the southern shores of the Hawaiian Islands as long period swells.
  - Typical periods: 14 to 22 seconds
  - Typical heights: 1 to 4 feet
  - Typical occurrence: 53% during the year, usually during the summer months from April to October
- "Kona" storm waves. These waves are generated by local storms and fronts which generally cause winds and waves from the south through the west. Although neither frequent nor consistent, these winds may generate large destructive waves.
  - Typical periods: 8 to 10 seconds
  - Typical heights: 10 to 15 feet
  - Typical occurrence: In any year, Kona storms may occur several times or not at all; they occur most often in the winter months.

The net permanent drift from Cape Kumukahi to Keauhou Point is believed to be southwest, with tidal currents that may flow northeast during low tides or any time in the presence of current eddies.

Anchialine Pools. Anchialine pools lack surface connections to the sea, yet have measurable salinities and dampened tidal fluctuations.[11] These pools are topographic depressions that intersect the groundwater. Anchialine pools should be distinguished from "open" coastal ponds that have restricted or occasional surface connection to the sea.

In the open pond ecosystems, the faunal assemblage resembles marine and estuarine ecosystems. In the anchialine pools, the faunal assemblages resemble estuarine ecosystems, but include a distinctive assemblage of organisms. This distinct group of organisms have been classified into epigeal organisms (those that require the sunlit part of the anchialine system) and hypogeal organisms (those that occur in the illuminated part of the system but also spend extended periods of time in the subterranean water table). Biota that may be considered rare and known only from the anchialine habitat include hypogeal shrimp (Calliasmata pholidota, Procaris hawaiana, Antecaridina lauensis), an epigeal shrimp (Palaemnella burnsi), a mollusc (Neritilia hawaiiensis), and a moray eel (Gymnothorax hilonis). Most motile hypogeal anchialine fauna exhibit tidal and/or nocturnal migration, emerging from the subterranean interstices to feed at night or high tide, and retreating with daybreak or the falling tide.[12]

Factors that influence the quality of the anchialine pool as a habitat for the distinctive hypogeal and epigeal biota include: temperature and salinity; type and amount of terrestrial vegetation surrounding the pool; and susceptibility to ocean storms that can sweep in marine species that alter the anchialine ecosystem. These factors differ between the wetter windward side of the island and

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11. Maciolek, J.A. and R.E. Brock. Aquatic Survey of the Kona Coast Ponds, Hawaii Island. Sea grant Advisory Report UNIHI-SEAGRANT-AR-74-04, April 1974.

12. Brock, R.E. An Assessment of the Conditions and Future of the Anchialine Pond Resources of the Hawaiian Islands. Prepared for Transcontinental Development Co., August 1985.

the drier leeward side. Because of the higher rainfall, anchialine pools on the windward side have lower salinities and temperature (average 3.5 ppt for windward pools compared with 7.0 ppt for leeward pools). Vertical stratification (temperature differences between the top layers and bottom layers of water in the pool) in leeward pools average 12.6 ppt compared with 1.4 ppt for windward pools. Temperatures positively correlate with salinity since both variables are influenced by the movement and mixing of seawater into the groundwater lens-- i.e., the greater the mixing with the cooler groundwater, the cooler the temperature and the lower the salinity. Because of the low salinity of the windward pools, rare hypogean crustaceans were not observed and are not likely. In fact, no rare decapod crustaceans have been found in waters with a salinity level less than 12 ppt. Other more common native decopod crustaceans have been observed in the low salinity pools (Macrobrachium grandimanus, Halocaridina rubra, Palaemon debilis, Metabetaeus lohena, Metapograpsus thukuhar), as well as the rare eel (Gymnothorax hilonis).[13]

The introduction of alien fish species have significant impacts on anchialine systems. Topminnows (Poecilia reticulata) and mosquito fish (Gambusia affinis) directly prey on native anchialine biota, as evidenced by examining the stomach contents of these fish. These fish also indirectly initiate a change in the ecological succession of ponds by removing detrital feeders and primary consumers such as Halocaridina, adding nutrients through defecation, and accelerating sedimentation and senescence with the resulting increased algal and emergent vegetation biomass. Indices of degraded pools in the presence of these alien fish species include overabundance of macro and micro algae, deep biogenic sediments, and higher turbidity.[14]

A statewide inventory of anchialine ponds in 1987 by The Nature Conservancy of Hawaii identified four potential ponds along the coastal areas *makai* of the Site.[15] The identification of these ponds were done by aerial photographs and required field inspections (which was not part of the study) to confirm the characteristics of these ponds. A field observation in 1992 by The Nature Conservancy confirmed that one of these four ponds was an anchialine pool consisting of 3-5 small pools separated from the ocean by a boulder berm (see Figure 22). Probably because of the exposure to storm surf, the salinity (based on taste) seemed to be high (>10 ppt). These cluster of pools were surrounded by alien-dominated vegetation that contributed abundant organic material (falling leaves) to the pool. The Halocaridina rubra were abundant. The Metabetaeus lohena were also abundant and preying on H. rubra and other small animals.There were also some snails (probably native).

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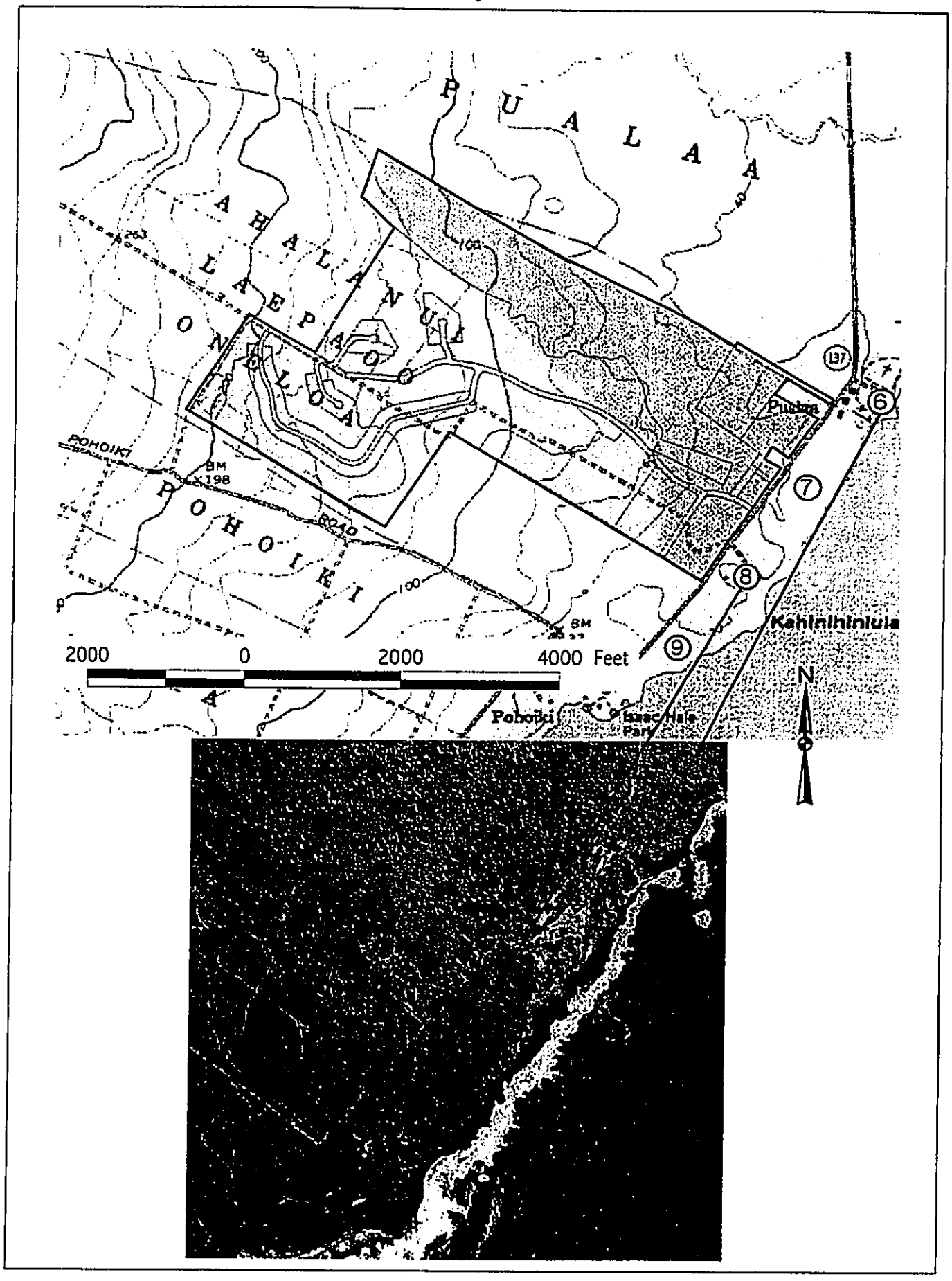
13. Chai, D. A Biophysical Inventory and Assessment of Anchialine Pools Along the Waiakea Coast, Hilo, Hawaii. M.S. Thesis, University of Hawaii, August 1993.

14. Ibid.

15. The Nature Conservancy of Hawaii. Biological Database of Rare Species and Natural Communities in Anchialine Ponds of the State of Hawaii. Prepared for the County of Hawaii. June 1987.

FIGURE 22. Anchialine Pools in the Vicinity of the Site



Impacts and Mitigation

Since the Project is located away from the shoreline, the Project will not directly alter any shoreline or nearshore resources. However, potential impacts to the marine environment and anchialine pools could occur from the transport of contaminants through surface runoff (sedimentation) or infiltration to the groundwater (fertilizer and pesticides).

Sedimentation. No impact anticipated. Grubbing and grading activities during construction are potential sources of sedimentation. However, the County grading ordinance and the Department of Health NPDES permit require the contractor to use best management practices to control erosion. Should some erosion occur, the extremely high rates of mixing in the nearshore coastal waters would rapidly flush the sediment from the area. A study of the effects of a resort development on the nearshore waters compared the reef environments of a pristine area with an area off a resort. The results of the survey showed the reef located off the resort in better condition than the pristine area indicating that even if construction may temporarily increase suspended sediment, this increase is insignificant compared with natural sediment loads to which reef communities are naturally exposed.[16]

Golf Irrigation and Fertilization. No impact anticipated. Golf course irrigation with treated wastewater effluent supplemented with fertilization could increase nutrient loading of the nearshore waters. When subjected to substantial increases in nutrients, eutrophication could result (increased phytoplankton growth which results in increased turbidity and other effects). However, such impacts are not likely to occur from the Project for several reasons (see Appendix F). The nutrient uptake by the vegetation and soil on the golf course is substantial. A study of a golf course that used wastewater effluent for irrigation reported that 98% of the total nitrogen and 100% of the total phosphorous was taken up by the soil plant surface layer.[17] Chemical processes that account for the uptake include incorporation into plant biomass, cation exchange, fixation and adsorption on the soil, biological oxidation and denitrification. Even if some nutrients should leach to the groundwater and be transported to the nearshore waters, the extremely high rates of mixing in the nearshore waters promotes rapid dilution and water exchange. Residence time is probably on the order of minutes to hours, so buildup of any nutrients is unlikely. Studies at ocean outfalls discharging volumes of secondary treated effluent report beneficial impacts in terms of increased fish populations resulting from increased particulate food.

Pest Control. No impact anticipated. A survey of 37 golf courses in 1990-91 reported that 30 different pesticides were being routinely used consisting of herbicides (78.4% of total use), fungicides (15.9%), insecticides (3.7%), and algicides (1.9%).[18] The herbicides were used primarily for selective control of weeds on fairways and roughs. The fungicides and insecticides were applied primarily to greens with spot treatments on fairways and tees. Algicides were used primarily to control algal blooms in ponds, small drainage catchments, and other water elements of golf courses. On average, the greater the amount of pesticides used, the better quality the turf.

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16. Grigg, R.W. and S.J. Dollar. Environmental impact assessment of nearshore marine life at Princeville, Kauai, Hawaii, 1980, cited in Appendix F.

17. Chang, Sy.K. and R.H.G. Young. An investigation into environmental effects of sewage effluent reuse at the Kaneohe Marine Corps Air Station Klipper golf course. Tech. Mem Rep. No. 53, Water Resources Research Center, University of Hawaii, 1977, cited in Appendix F.

18. Brennan, B.M., A.K. Higashi, C.L. Murdoch. Estimated pesticide Use on Golf Courses in Hawaii. College of Tropical Agriculture and Human Resources, University of Hawaii, Research Extension Series 137, October 1992.

However, there were exceptions where a couple "excellent" courses used less pesticides per acre than some "fair" courses. The correlation between rainfall and pesticide use was not strong. Golf courses in medium rainfall areas (26-50 inches average annual rainfall) used slightly more pesticides than courses in high rainfall areas (>50 inches average annual rainfall) and double the amount of pesticides in dry areas (<26 inches average annual rainfall). Resort courses tended to use more pesticides than municipal, military, and other private courses, probably due to the higher maintenance budget at their disposal. All of the pesticides used on golf courses are registered for use on food crops. Most are also available to homeowners. Of the 30 pesticides, only two have been determined by EPA to be potentially hazardous enough to be registered as restricted-use pesticides, i.e., they are not available to homeowners and may only be used by certified applicators. The combined use of the restricted pesticides account for less than 2% of the total pesticide use on golf courses, with no reported adverse effects. With the exception of simazine (used on 18% of the surveyed courses), none of the other pesticides in use has been detected in potable or nonpotable wells. None of the courses in Hawaii use Dacthal (DCPA) which a recent EPA study reported as being present in wells on the mainland and shown to be directly correlated with heavy use on golf courses and commercially maintained landscaping in urban areas. The low amount of insecticide use is due to the use of biological agents, including parasites and predators. Researchers studying the Waikoloa Anchialine Pond Preserve on the Kona coast have monitored for pesticides from the golf course and have detected none.[19]

A study compared the pesticide use for golf courses with the pesticide use for sugarcane, pineapple, and residential use, and reported that golf courses used less pesticides per acre than *pineapple and residences.*[20] The types of pesticides varied: sugarcane primarily used herbicides; pineapple primarily used nematocides, with lesser amounts of herbicides, insecticides, and fungicides; residences used primarily insecticides and herbicides; and golf courses used primarily herbicides and fungicides, with a lesser amount of insecticides.

Although significant adverse impacts caused by the Project in terms of potential sedimentation, nutrient loading, and pesticide leaching are not likely, compliance with the Department of Health's "Guidelines Applicable to Golf Courses in Hawaii" (August 1995, version 5) would mitigate unforeseen impacts.[21] To comply with the Guidelines, permit conditions can require the Applicant to perform the following:

- Design Phase:
  1 Establish baseline groundwater and coastal water quality.
  2 Establish a groundwater and coastal water quality monitoring plan
  3 Above ground storage tanks for fueling golf carts, maintenance vehicles, emergency power generators, or other needs shall be used rather than underground storage tanks.

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19. Brock, R.E. The impact of resort and golf course development on hawaii's agriculture and environment. Testimony for the Committee on Agriculture and Environmental Protection, March 5, 1992 (cited in Brennan, et al, 1992).

20. State of Hawaii, Department of Agriculture, Pesticides Branch. Comparison of the Use of Pesticides: Golf Course, Sugar Cane, Pineapples, and Urban Applications, Appendix G in State of Hawaii, Office of State Planning, Golf course Development in Hawaii: Impacts and Policy Recommendations, January 1992.

21. For a copy of the guidelines, see the Department of Health's comment letter in Appendix B, "Comments and Responses to the EIS Preparation Notice".

4 Buildings to house fertilizers and biocides shall have a waterproof floor and be bermed to a height sufficient to contain catastrophic leak of all fluid containers.

- Construction Phase:

5 Utilize locally-produced compost and soil amendments if available.

6 Use best management practices to minimize soil runoff.

- Operational Phase:

7 Comply with the Department of Health's "Guidelines for the Treatment and Use of Reclaimed Water", November 2, 1993, as may be amended.

8 A golf course maintenance plan shall be prepared with regards to the use of fertilizers, biocides, and irrigation schedule to minimize or prevent environmental pollution consistent with the practices taught at the certification school of the National Association of Golf Course Superintendents.

9 Green waste shall be composted to the extent possible to minimize solid waste, and shall be processed on the Site to the extent possible to minimize offsite transport of the raw or processed material.

10 Apply pesticides in a manner to prevent offsite drift of spray material.

3.1.8 Air Quality

Setting

Existing sources of emissions in the vicinity primarily consist of vehicular emissions and possibly pesticide drift from existing agricultural activities. No Department of Health air quality monitoring data exists for the area, but it is expected that State and National ambient air quality standards are currently being met due to the absence of significant emission sources.

Impacts and Mitigation

Construction Activity. No impact anticipated. Short-term impacts from fugitive dust could occur during construction. Increased vehicular traffic during the construction and operational phases will increase vehicular emissions. However, the increased levels should not exceed State or National standards for carbon monoxide.

Pesticide Drift. Mitigation required. The primary concern in terms of air quality is the potential increase of pesticide drift from the proposed agricultural activities and golf course maintenance. The prevailing northeasterly trade winds during the day blow roughly mauka-makai across the Site. Downwind from the pesticide application areas (i.e., golf course and agricultural areas) would be the proposed chalets, lodge, and sports complex (refer to Figure 10 on page 3-2). It would be in the operator's best interest, therefore, to ensure that pesticide drift is avoided to the extent possible.

Golf course and agricultural pesticides are typically applied by tractor-mounted spray bars or portable sprayer units. The mixed solutions are applied under 20 to 40 pounds per square inch pressure to the target area by flat-fan type nozzles at about 1 to 3 feet above ground.

Drift from spray equipment can occur by two means: vapor drift and physical droplet drift. Vapor drift occurs when a chemical vaporizes after being applied to the target area. The vapors may then

be carried downwind. The amount of vaporization depends mostly on the ambient temperature and volatility of the pesticide. Higher ambient temperature promote more vaporization. The chemicals typically used have a low volatility within the temperature range at the Site. Thus, vapor drift should not be a problem.

Physical droplet drift occurs when the wind carries spray particles away from the target area. Smaller droplets are carried farther away by the wind. Spray equipment produce varying droplet size, from large raindrop size droplets to small fog-sized mists. For the typical flat-fan nozzle sprayer, 85% of the spray volume consists of droplets larger than 100 microns at 20 psi, and 70% at 40 psi.[22] Droplets smaller than 100 microns can drift several hundred to several thousand feet downwind from a spray height of 10 feet in a 3 mph wind.[23] Lower spray heights, lower application pressures, use of thickeners, and use of nozzles producing larger droplets all reduce the drift distance.

Mitigation measures include:

Design Phase. The landscape plan should include trees and shrubs around the perimeter of the target spray areas (golf course and agricultural areas) to intercept drift. An adequate buffer (at least 100 feet) should be maintained between the target spray area and populated areas.

Operational Phase. When spraying pesticides, the golf course operator and agricultural manager should control drift by employing the following measures:

- use coarse nozzle and low pressure spray equipment;
- use shielded or shrouded sprayers;
- use thickener additives;
- use non-volative or low-volatile chemicals;
- apply at lowest possible height during low wind speed conditions when the wind direction will carry any drift away from populated areas.

3.1.9 Noise

Setting

Existing ambient noise levels are typical of remote rural areas (less than 39 dBA).

Impacts and Mitigation

Operational Phase. No impact anticipated. Because of the relatively remote location of the Site, there are no existing noise-sensitive areas in proximity to the Site.

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22. Hofman, V, et al., "Spray Equipment and Calibration". Cooperative Extension Service, North Dakota State University, Fargo, North Dakota, Report No. AE73, revised, January 1986, cited in B.D. Neal and Associates, Air Quality Study for the Proposed Villages at Hokukano project, North and south Kona, Hawaii, December 1992, an appendix in the EIS for Villages at Hokukano.

23. Ibid.

Construction Phase. Mitigation required. Noise during construction will be mitigated through compliance with the Department of Health Community Noise Control Rules which define maximum permissible noise levels for construction equipment.[24]

3.1.10Scenic Resources

Setting

The County of Hawaii General Plan identified the Mango Groves along the Pahoa-Pohoiki Road as an example of natural beauty in the Puna District.[25] The Puna Community Development Plan identifies the Mango Road and the Red Road as scenic roads.[26] The trees along the Mango Road have been designated as exceptional trees.[27]

Impacts and Mitigation

Mitigation required (Red Road). The widening of Red Road is an unavoidable impact. However, the extent of the widening will be limited by the existing 30'-wide right-of-way (see section 3.3.1 "Roads and Traffic" on page 3-45 for more information). Landscaping along the Project's frontage will screen the views of the Project from the roadway.

No impact anticipated (Mango Road). The proposed conversion of Mango Road to one-way in the mauka direction will accommodate the projected traffic increase without requiring any physical changes to the Mango Road (see section 3.3.1 "Roads and Traffic" *on page* 3-45 for more information).

3.2 SOCIOECONOMIC CHARACTERISTICS

3.2.1 Cultural Impact

The assessment of cultural impacts is pertinent to this project since the Site is not "fully developed". In *Public Access Shoreline Hawaii v. Hawaii County Planning Comm'n*, 79 Haw. 425 (Haw. 1995) ("PASH"), the Hawaii Supreme Court determined that areas that were not "fully developed" could be subject to cultural, traditional or religious rights of native Hawaiians. This section summarizes the findings of the cultural impact study by Kepa Maly (see Appendix H) ("Cultural Impact Study"). The contents of this section and the Cultural Impact Study conform with the Environmental Council's "Guidelines for Assessing Cultural Impacts".[28]

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24. *Hawaii Administrative Rules* Chapter 11-46.

25. County of Hawaii General Plan, Supporting Document, November 1989, p. 32.

26. Community Management Associates, Inc. Puna Community Development Plan. May 1995, p. 2-43.

27. Hawaii County Code §14-65.

28. State of Hawaii, Environmental Council. Guidelines for Assessing Cultural Impacts. Adopted November 19, 1997.

Methodology

The author of the Cultural Impact Study consulted the following sources of information:

- *Historical documentary research.* The archival resources included land documents (e.g., Hawaiian Land Commission Award records from the Mahele of 1848; Boundary Commission Testimonies and Survey records of the Kingdom and Territory of Hawaii (c. 1874-76)), survey and cartographic records, historic literature and journals (e.g., by D. Malo, S. Kamakau, A. Fornander, Thrum, Stokes and Dye, J.W. Coulter, M. Beckwith, Hudson, Barrere, Handy and Handy with Pukui, Bevaqua and Dye, McEldowney, and other references as cited in the Cultural Impact Study), native Hawaiian texts from Hawaiian language newspapers (translated by the author of the Cultural Impact Study), and selected archaeological studies. Archival resources were located in the collections of the Hawaii State Archives, Department of Land and Natural Resources (Land Management Division, Survey Division, and Bureau of Conveyances), Bishop Museum, University of Hawaii-Hilo Mookini Library, and private collections. The archival historical documentary research was conducted primarily between November 1997 to February 1998.
- *Oral history interviews.* Interviews were conducted with Hawaiian kupuna (elders) and representatives of native families with generational residency ties to the lands of eastern Puna. The interviews were conducted between November 1997 to July 1998. The primary focus of the interviews was to elicit information from knowledgeable individuals regarding traditional Hawaiian lore and practices (past and presently ongoing), spiritual beliefs, presence of traditional sites, land and resource use, and ongoing subsistence practices within the Site. The oral histories document the continuation of cultural practices and attachment to the area, handed down through time from generation to generation. Interviewees were also encouraged to offer recommendations for long term protection and interpretation of the cultural and natural resources of the area. The interview records are the result of both formal tape-recorded interviews and informal interviews for which hand-written notes were taken and later expanded. All interview narratives (recorded and written) were reviewed by the interviewees for accuracy and context, and released only with the interviewees' consent. In the process of identifying potential interviewees, the author of the Cultural Impact Study sought out individuals who: had genealogical ties to the area (descended from families recorded as having early- to mid-1800s residency ties to the land, or individuals descended from recipients of Land Grants); were old enough to have heard first-hand from their elders some of the traditions, customs, practices, and beliefs of the native residents of the land (generally born prior to 1930); were identified by community members as possessing specific knowledge of lore or historical wisdom pertaining to the lands, families, practices, and land use activities in the area; or were currently involved in cultural and/or natural resource stewardship activities.

Because of the limited historical research resources for the particular ahupa'as in the vicinity of the Site (i.e., Ahalanui, Laepa'o, and Oneloa), the scope of the Cultural Impact Study included documentation from neighboring ahupua'a and larger Puna district in order to formulate a better understanding of the general practices and customs of the native residents of the area.

Findings

Cultural Practices and Beliefs

In the ancient lore of the people of Hawaii, there are several things for which Puna is most famed: rising of the sun; Pele and the geologic phenomena; the groves of *hala* (pandanus) with their fragrant clusters of *hua hala* (pandanus fruit borne on the female trees) and *hinano* (blossoms of the male pandanus); growth of *'awa* (Piper methysticum); and Puna's association with Kane, a Hawaiian god and ancestor of the chiefs and commoners, a god of sunlight, fresh water, verdant

growth, and forests. The relationship between Kane, the sun and Puna was significant throughout the Hawaiian Islands. The people of Puna were known as master weavers of hala.

The god Kane, in his attributes as giver of light and life, plays an important role as healer, and many native customs and practices of healing are associated with the sun rising from the east in Puna. Cape Kumukahi is the extreme eastern point of the whole island group.

Settlement Patterns

While the Puna study area generally receives ample rainfall (nearly 100 inches annually) and is graced by mature forests which could shelter cultivated crops and provide natural resources necessary to life, it was (and remains) also subject to the effects of volcanic and other geologic phenomena. Thus, even with the pressures of growing populations, the ahupua'a of 'Ahalanui-Laepa'o-Oneloa and neighboring lands, may not have been actively sought out for long-term residency and investment of labor resources until such time as population demands made it absolutely necessary.

By the 12th-13th centuries, the lands of 'Ahalanui-Laepao'o-Oneloa were being settled primarily along the coast. The earliest archaeological site within the Site are c. AD 1250. By the 14th-16th centuries, the population increased, requiring agricultural systems to expand upland. The *ohana* (extended family) system of social, religious, political, and economic values linked coastal and upland inhabitants. The stringent political and religious system introduced during the Pa'ao-Pili migration gained increasing control in the islands. By the 16th-18th centuries, there evolved a greater separation between the *ali'i* (chiefly class) and the *maka'ainana* (commoners). Also in the early 16th century, the entire island of Hawai'i came under the rule of one chief, 'Umi-a-Liloa, and the native system of land management by district (*moku-o-loko*), smaller land divisions (*ahupua'a*), and still smaller land units (e.g., *ili*, *ko'ele*, *mala*, and *kihapai*) was formalized. By the time 'Umi-a-Liloa came to rule the island ca. 1525, the island was divided into six districts (*moku-o-loko*). Puna, the easternmost of the districts, was the only district that did not include a mountain peak.

The *ahupua'a* extended from the mountain peaks, or in the case of Puna some other geologically significant feature (e.g., rift zone or crater), to the ocean fisheries fronting the land unit. As long as sufficient tribute was offered and kapu (restrictions) observed, the common people who lived in a given *ahupua'a* had access to most of the resources within the *ahupua'a* from mountain slopes to the ocean. These access rights were almost uniformly tied to residency on a particular land, and earned as a result of taking responsibility for stewardship of the natural environment, and supplying the needs of one's *ali'i*.

The Mahele of 1848 divided all land in the Kingdom of Hawai'i into one of three categories: Crown Lands (for the occupant of the throne), Government Lands, and Konohiki Lands. Ownership rights to these lands were subject to the rights of the native tenants, i.e., those individuals who lived on the land and worked it for their subsistence and the welfare of the chiefs. The Land Commission was authorized to award fee simple title to all native tenants who could prove their claim. The lands awarded to the *hoa'aina* became known as "Kuleana Lands" and were numbered as Land Commission Awards (LCA). No *kuleana* claims were made for any of the lands within the Site. The Site was entirely in Government Lands.

From time to time, portions of the Government Lands were sold to raise revenue to meet the increasing costs of the Government. Purchasers of these lands were issued "Grants" or "Royal Patent Grants." These Grants differed from the Royal Patents issued upon Land Commission Awards to *konohikis*. The grantees of Government Lands did not require an award from the Land Commission.

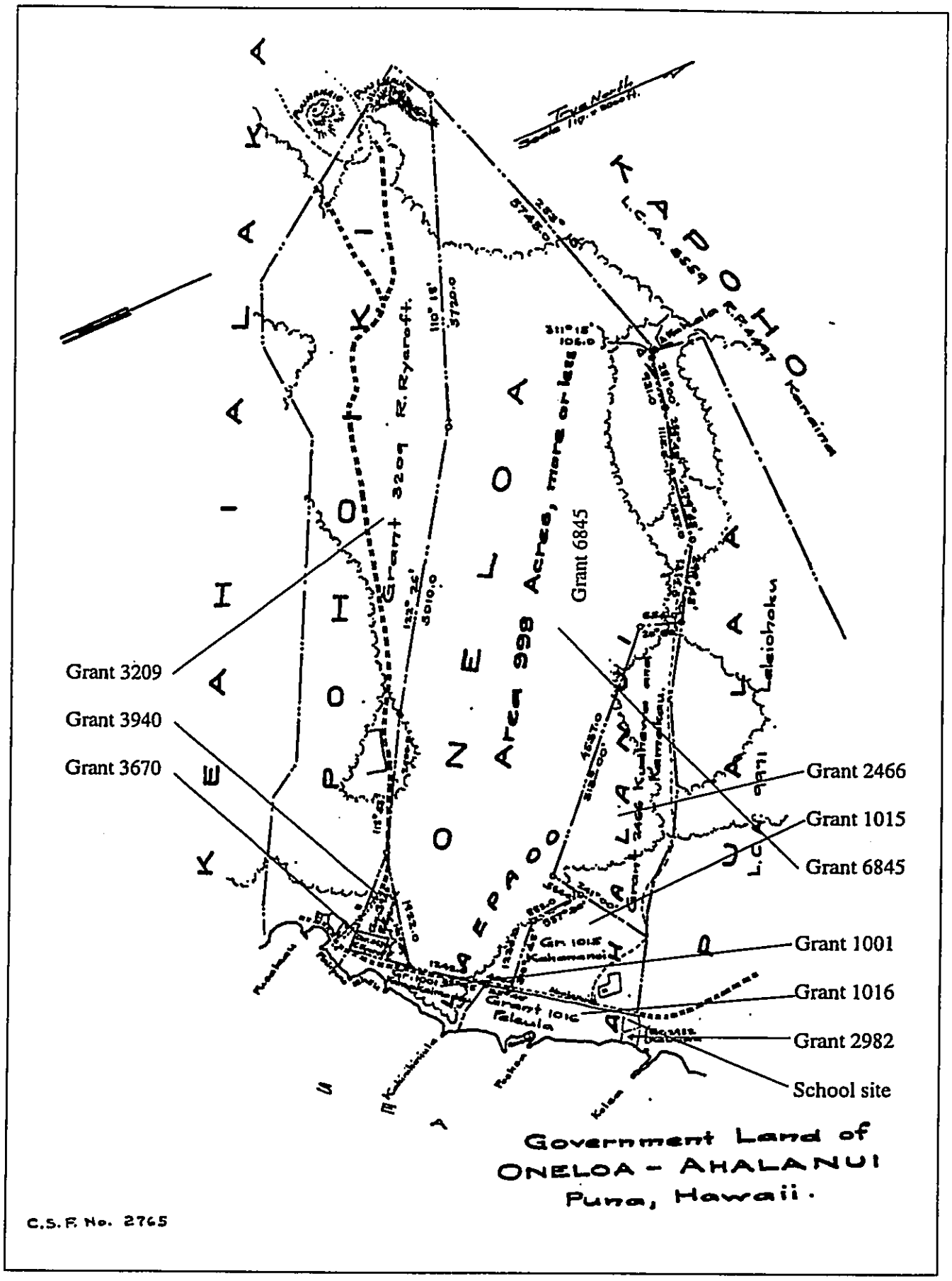
Within the Site, the Government sold or leased the following lands (see Figure 23):

- Grant 2466 to Kuahewa and Kamakau
- Grant 1015 to Kahananui. A.D. Kanaaukahi, son of Kahananui, sold his interest (34 1/2 acres) to Mele Hale. Mele Hale sold 4 acres to Maunakea. David Kapuaaloha Makuakane, grandfather of Kahu John Kumukahi Makuakane, married twice. His first wife, Emily Kalaiwa'a Kahananui-Makuakane (who passed away at a young age), descended from both the Kahananui and Kalaiwa'a (see Grant 2982 below) lines.
- Grant 6845 (Right of Purchase Lease No. 424) to R. Napalapalai. Government granted a 999-acre pastoral lease to Napalapalai under the Homestead Right of Purchase system of 1895. The Government later repossessed the lands due to Napalapai's non-compliance with the conditions of the lease. Napalapai was a cowboy for Parker Ranch. He lived on the Oneloa land from 1903 to 1906, then moved to Waimea. Upon appeal, the Government reinstated the lease to Napalapai. Napalapai's descendants sold the land to Jimmy Kealoha, who planted papayas.
- Remainder of unoccupied Government Lands rented to R. Rycroft in 1882 with the condition that no trees to be cut down; rent disputed by J.E. Elderts who claimed to have entered into a lease with the Government in 1871 with rent paid through 1883; Elderts later relinquished any rights to the land for the sake of avoiding further conflicts with Rycroft.

Within the vicinity of the Site, the Government sold or leased the following lands:

- Makai of Site
  - Grant 2982 to Kalauwaa (reserving the public place where canoes land). The Makuakane family are descendents of Kalauwaa (generally written as Kalaiwa'a) (see Grant 1015 above).
  - Grant 1016 to Peleula. Kaluhiwaha (residing at Ponahawai), widow and sole heir of Peleula, granted the deed to the land to her grandchild, Ainaike; Ainaike and her parents sold the land to R. Rycroft
  - Grant 1001 to Kamakaimoku. Maunakea, son of Makaimoku, conveyed 4 acres to Mele Hale. Mele Hale conveyed this 4-acre parcel to her nephew, Laurence Rowe (of Honolulu).
  - School site (mauka of Kalauwa's Grant). While it appears that a lot was confirmed, a school never opened there. Prior to the Mahele of 1848, the school for the area was at Puuala'a, but by 1853 it had been moved to Pohoiki. In later years, the children walked to Kapoho.

FIGURE 23. Government Land Grants



- South of Site (towards Kalapana)
  - Grant 3670 to Rycroft. J. Kapukini had applied for a 4-acre purchase off the embayment of Niehu. Although surveyed (see Fig. 10 in the Cultural Impact Study), the parcel was not patented and later absorbed into Rycroft's Grant No. 3670. J. Kapukini's daughter, Mele Kapukini-Hale, lived in Rycroft's house on that lot until her passing away in c. 1928. She was John Hale's grandmother.
  - Grant 3209 to Rycroft
  - Grant 3940 to Rycroft
- North of Site (towards Kapoho)
  - Dickman. Although there is no record of a grant to A. Dickman, Lobenstein's Reg. Map 1777 places Dickman's house in Pu'ala'a just outside the Site boundaries. The map also shows Dickman's coffee patch situated *mauka* of the Site.

From the period of western contact throughout the 19th century, the population of Puna was in continuous decline. In 1860, the population of Puna totaled 2,156, but by 1890 there were only 834 people. The Hawaiian families worked at trying to maintain their community.

In the late 1800s, Robert Rycroft moved to the Pohoiki area. He first went into the *'awa* shipping business and built a landing at Pohoiki. He did well and bought land for a cattle business. He then went into coffee and planted three hundred acres. The coffee venture was not a great success and he sold his Puna holdings to a sugar syndicate. He moved to Honolulu in 1899.

Some native families in the Pohoiki vicinity tried to enter into coffee cultivation, and worked at gaining a livelihood from the land. The closure of Rycroft's business probably had a significant impact on the remaining native residents. While families maintained attachments and short-term residences on the land, for the most part, by the 1920s, only a few full time residents remained in the 'Ahalanui-Oneloa area. The names associated with this area include Hale (Grant 3670, Grant 1015, Grant 1001), Makuakane (Grant 1015 and Grant 2982), and Kuamo'o.

Cultural Resources

The records of surveyors, Boundary Commission proceedings, and other documentation indicate that the lands in the vicinity of the Site were valued for groves of coconuts and breadfruit trees, grew some of the best *'awa*, and that portions were used for pasture from at least the 1870s to the 1950s.

Regarding *'awa*, Hawaiian historian S.M. Kamakau wrote in the mid 1800s:

> 'Awa was one of the choice foods of the planter. 'Awa is a handsome plant, with nicely rounded leaves and stems and shiny jointed sections. . . 'Awa grows well on lands with plenty of rain, and on warm lands. . . From of old there are places made famous by the intoxicating quality of their 'awa, such as . . . Puna on Hawaii. In places where wauke and dry taro are planted, 'awa may also be planted. These plantings together with those of bananas and sugar canes, were the pride of the farmer [Kamakau 1976:41].

The *'awa* was important as an offering in rituals, used in ceremonies, and in general use among the people of the land. One of the varieties of *'awa* which grew in this region was also famous because it reportedly grew in the branches of trees.

Past archaeological surveys have identified features in the vicinity of the Site:

- *Holua* slides. The region around Kapoho was well known for its *holua* slides for which the steep slopes of the numerous cone craters were well adapted.

- Agricultural patches. In the vicinity of the *holua* slide are former agricultural patches marked by piles of stones cleared from the small plots. One agricultural field, called Hale-o-Lono, is of particular significance. The name literally translated means "House-of-Lono", a name associated with the Hawaiian god Lono. These *heiau* were of the kind known as *hoouluulu* (*hoouluulu ai*, to make food grow) and were to bring rain from heaven and the crops abundant, bringing wealth to the people, blessing to the government, prosperity to the land.
- Kuaokala Heiau. No other information is known about this *heiau* other than the identification of this site in Ahalanui recorded in a 1929 article of Ka Hoku o Hawai'i. The name may be literally translated as "Back-of-the-sun", and as such, one might expect that it has some function with the sun's travels, and possibly the god Kane. The archaeological survey for this Project did not identify any *heiau* within the Site. None of the oral history interviewees in the Cultural Impact Study could recall any mention by *kupunas* of a *heiau* of that name or any *heiau* within the Site.
- *Ilina* (graves). It was the general practice of those individuals who lived upon the land to bury their departed family members near their place of residence; hence, many *kuleana* awards have *ilina* associated with them. The burial rights of families survived the changing rule of kings and chiefs. "With this right of the common people to the land is connected an inherent love of the land of one's birth inherited from one's ancestors, so that men do not wander from place to place but remain on the land of their ancestors. . ." (Kamakau 1961:376 cited in Appendix H).

The Cultural Impact Study identified the following cultural resources based on the archival research and oral histories:

- *Ala loa* and *ala hele* (regional and inner *ahupua'a* trail systems);
- Sites associated with permanent and temporary habitation activities;
- Sites associated with resource collection and stewardship practices. Fishing was an important occupation. There are several *ko'a 'opelu* (dedicated *opelu* fishing stations which were fed and cared for) between 'Ahalanui and Keahialaka. One *ko'a* is in line with the "Maunakea Pond" near the Oneloa-Laepao'o boundary fronting Kahinihini'ula Point. Each *ko'a* was cared for by a particular family, and associated with the particular *ahupua'a* which it fronted. Traditionally, no one from other lands would fish those *ko'a*, or at least asked permission and shared their catch. The Hale family to this day fishes at the various *ko'a*. The bait used was *'opae 'ula*, which was gathered in the anchialine ponds of Wai'opae in Kapoho and in the pond at Keahialaka. Salt for drying fish and other purposes was purchased rather than gathered. There were no good salt making areas in the vicinity because of the wet climate. Unlike the *ko'a*, the rights to gather the *opae ula* at the Wai'opae and Keahialaka Ponds seemed to be common to all; no permission was required. The same type of common rights seem to apply to the canoe landing at Grant 2982 (the site of today's County Ahalanui Park). No traditional gathering seemed to occur within the Site. Any growing or gathering of *'awa, lau hala*, breadfruit, coconut, or cattle were commercial endeavors under lease or purchase from the Government.

Impacts and Mitigation

Since most of the significant archaeological and cultural resources within the Site are located in the remnant native forest portion of the Site, the Applicant's commitment to preserve this area avoids impacting these resources and provides a beneficial opportunity to restore and interpret these resources.

The Cultural Impact Study recommended the following mitigation measures as suggested by the oral history interviewees:

Design Phase:

- Protection of resources
  - Burial sites. Consult with family members regarding treatment and long term protection of the pa ilina (burial sites). To the extent possible, preserve the sites in place.
  - Other cultural resources. Consult with families of the land in developing preservation plans for cultural resources.
  - Native forest and trees. Protect the remnant native forest and other trees such as kamani, niu, and 'ulu.
  - Ponds and fisheries. Protect the quality of the water, ponds, and fisheries.

Operational Phase:

- Interpretive programs. Provide opportunities to educate people on the historical background of the lands, families, and customs of the area.
- Job opportunities. Provide work opportunities for native families and residents of Puna.

3.2.2 Social Impact

This section summarizes the findings of a socioeconomic impact study prepared for this Project by Ron Terry, Ph.D. (see Appendix I) ("Socioeconomic Impact Study"). The development of resort facilities in rural areas often results in a range of adverse and beneficial social impacts. Potential impacts include losses of farmland, pressure on formerly uncrowded recreational or resource areas, increase in traffic and noise, and unwelcome changes in the character of a community. However, these impacts may not occur, or they may be offset by economic benefits, including: growth in jobs, income, government revenues; larger and more accessible markets for local products; and economic diversification, which in turn spin off positive social impacts. Other social benefits such as improved recreational facilities and community diversification may also result. This section focuses on the following potential impacts:

- Population growth and distribution;
- Community cohesion and sense of community;
- Effects on local businesses, agriculture, churches, and community activities;
- Recreational activities;
- Highway safety for bicyclists and pedestrians.

Population Impacts

Setting

Population in Puna is mainly widely dispersed in the so-called "substandard subdivisions," not clustered within towns or villages. The only true town in the study area is Pahoa, which has about 1,000 inhabitants, but over three dozen stores and service establishments, by far the majority of storefront businesses in lower Puna. There was formerly a small village at Kapoho, but this was destroyed in the 1960 eruption of Kilauea volcano. Major subdivisions are Hawaiian Paradise Park (the most populous subdivision with over 4,000 residents but virtually no commercial or industrial land use), Orchidland, Ainaloa, Hawaiian Beaches- Hawaiian Shores, Leilani Estates, and Nanawale Estates. Several smaller residential/agricultural or agricultural subdivisions are also present.

The Site contains no homes, nor indeed any active land use, and there are only a few homes and a park directly bordering the Site. The most prominent subdivisions (where most residents live) within five miles of the proposed project, and the number of lots in each, are as follows: Nanawale Estates (4,289), Leilani Estates (2,266), Kalapana Seaview Estates (693), Kapoho Vacationland (489), Kehena Beach Estates (199), Kapoho Beach Lots (185), Waawaa (177), and Lanipuna Gardens (118 lots). Most lots in these subdivisions are vacant; residential occupancy rates vary from less than 5 percent to over 50 percent. Various residential and agricultural lots are also scattered throughout other parts of lower Puna. Most germane to the Project is the small settlement at Opihikao, 5 miles west along the coastal road, and other individual homes along or near the coastal road near Pohoiki and Ahalanui.

The study area displays many of the characteristics of a disadvantaged region in its census statistics (see Table 3). The median family income in 1989 in the Pahoa-Kalapana Division was less than 60 percent of that of the County as a whole. Over 30 percent of individuals had income below the poverty level, a rate over a twice as great as Hawaii County.

TABLE 3. Selected Socioeconomic Characteristics, by Districts[1]

	GEOGRAPHIC AREAS			
CHARACTERISTIC	Hawaii Island	South Hilo	North Kona	Pahoa-Kalapana
Total Population	120,317	39,737	22,284	6,745
Pct. Caucasian	39.9	26.7	58.9	45.0
Pct. Asian	37.8	59.4	21.9	27.7
Pct. Hawaiian	19.2	12.6	16.4	22.0
Pct. Under 18 Years	28.7	27.2	26.4	33.4
Median Age	34.3	35.2	34.7	32.0
Pct. Over 65 Years	12.6	13.5	10.1	11.1
Pct. 10-64 Years With Work				
Disability/Mobility/Self Care Limit.	13.0	19.9	9.5	22.6
Pct. Do Not Speak English Well	7.7	12.9	12.1	8.5
Pct. Over 25 Years With High School Diploma	77.7	78.4	86.0	75.1
Pct. Over 16 Years in Labor Force	64.2	62.1	70.7	57.3
Median Household Income	$33,186	$29,967	$35,364	$18,360
Pct. in Poverty	14.2	14.3	9.4	32.1
Pct. Lived in Hawaii 1985 & 1990	35.1	91.4	73.1	85.8
Pct. Owner Occupied Housing	61.1	62.6	55.1	71.3
Median Contract Rent Value	$428	$371	$644	$419
Median Home Price	$113,000	$110,700	$211,900	$68,300

1. Source: U.S. Bureau of the Census: "1990 Census of Population. General Population Characteristics," 1990 CP-1-13 and "1990 Census of Population. Housing, Summary Population and Housing Characteristics," 1990 CPH-1-13. Note: Asian percentage includes non-Hawaiian Pacific Islanders.

About 25 percent of those age 25 years or over have less than a high school education, and 16 percent have a work disability, compared to 22.3 percent and 9.6 percent, respectively, for the County as a whole.

Many of Puna's problems are related to the rudimentary infrastructure of its sprawling subdivisions, which was well-suited for speculation but inadequate to serve the needs of the low and middle income families who have come to occupy the district. Other problems often cited by Puna residents are typical of disadvantaged communities: crime, unemployment, and lack of public amenities such as recreational facilities.

The population of lower Puna has certain characteristics that would suggest a greater than average demand for recreational facilities. The median age for the Kalapana-to-Hawaiian Beaches area is 31.4, as compared to 34.3 for Hawaii County and 35.2 for the Hilo District. Contributing to this low median age (the lowest of all areas in the county) is the proportion of the population under 16, which is at 30.9% as compared to 25.9% for Hawaii County as a whole.

Impacts and Mitigation

The total increase in resident population would be the sum of three components: new residents of the Chalets; employees of the resort who choose to relocate to Lower Puna as a direct result of job availability at the Project; and those who choose to relocate to Lower Puna as an indirect result of the resort. This last category could include, for example, relatives of Chalet residents, retired people who were drawn to settle in the area because of the ambience and amenities of the resort, and those whose jobs are indirectly dependent upon income generated by the resort.

Chalet "Residents". It is recognized that the Chalets would probably house a mixture of occupants: persons who could be classified as hotel guests; second or vacation home owners who visit seasonally or occasionally; short-term vacation renters; corporate guests; and more or less permanent residents. The precise mix of occupants is difficult to predict. For the purposes of analyzing the maximum possible population increase, these distinctions will not be employed, and all occupants will be treated as "permanent". Although it is likely that many if not most occupants will be short-term, this assumption accounts for all of the additional "bodies" that will be added to Puna's population, an important fact for the experience of everyday life of Puna residents.

If all 125 Chalet units are built, and County average of 3.15 residents per household obtained (calculation based on data from the 1990 U.S. Census of Population), approximately 400 new "residents" could be added to this area of Lower Puna. This figure assumes full build-out and 100 percent occupancy of the units, and may be considered an "extreme-case" scenario.

New Residents Drawn to Puna for Employment. The permanent operation of the Project could offer full-time employment to as many as 410 people. Another more than 700 indirect and induced jobs would also be produced. Indirect and induced jobs - e.g., wholesaler employees, travel agents, schoolteachers, government workers - may be distributed throughout the region, state, and even nation. For purposes of this analysis, it is assumed that no more than 300 of these positions would represent employment in the Lower Puna area. The total number of new, permanent jobs would be roughly 700.

The workforce of the Pahoa-Kalapana Division - which is just a portion of Lower Puna - is approximately 2,000, based on an adult population of about 4,000, and a workforce participation of something over 50 percent (see Table 3 on page 3-37). Assuming 10 percent unemployment, there are at least 200 active job seekers in the area. However, not all of these individuals would desire and/or be qualified for the type of jobs offered at the resort. There is an even larger pool of

candidates for Project jobs among Puna residents who work in Hilo but would prefer a closer job, residents from other areas of Lower Puna (e.g., Ainaloa, Hawaiian Paradise Park and Orchid Land subdivision), and even residents from other areas of East Hawaii, where unemployment is also high. Considering the large, underemployed labor force at and near the study area, there is little doubt that jobs could easily be filled by "local" residents, although a certain number of project employees, particularly managers and those with unusual skills (e.g., a golf professional) would come from outside the region.

Some employees who did not already live in Lower Puna might choose to relocate to Lower Puna for convenience of commuting, as those traveling from outside the area would face a one-way commute of at least 20 miles. It is this fraction of the total workforce generated by the workforce that could add to the number of households, and thus the population, of Lower Puna. There is sufficient uncertainty in all the variables that would influence this figure that no reliable estimate can really be given. However, given the chronic unemployment of the region and the large workforce within easy commuting distance, it seems unlikely that any substantial population increase would occur as a result of in-migration to Puna by job-seekers and their families. A figure of 100 new residents is offered here.

Indirect Residents. The number of new residents drawn to the area for indirect reasons related to the increased quality of life offered by the Project (as occurs at Disney World, for example) is expected to be negligible. For the purposes of calculating an extreme-case scenario, a figure of 20 new residents attributable to indirect reasons is used.

Total Population Increase. Summing these three components yields a figure of just over 500 new residents, most of whom would most likely be short-term occupants of the Chalets. It is this additional population component that will require local services, add traffic to roadways, and represent a market for local businesses. In the context of a region that had more than 6,700 residents in 1990 and is expected to contain at least twice that number by the year 2005, the addition of approximately 500 people would not cause any substantial extra demand for general public services, such as schools, fire and police protection, or parks in the general Lower Puna region. It should again be emphasized that the large majority of this extra component will be composed of short-term visitors.

Community Identity and Cohesion

Setting

Puna is a juxtaposition of three historical influences: it is an area important area of Hawaiian settlement and land use, played an important role in 19th and 20th century agriculture, and is surrounded by typical "modern" Puna subdivisions:

- Hawaiian community. Certain out-of-the-way locations in Lower Puna, particularly Kalapana and Opihikao, retained Hawaiian settlement patterns, majority Hawaiian populations, and a picturesque landscape that evoked the 19th century. The core of this area - Kalapana - was devastated by the eruption of Kilauea from 1983 to the present.
- Plantation community. The Olaa Sugar Company centered in Keaau and the Puna Sugar Company in Kapoho both began in 1899. Thousands of immigrants laborers built Keaau, Pahoa and Kapoho into typical plantation communities with a distinctive early 20th century streetscape reminiscent of earlier Old West boomtowns, which has been well preserved in Pahoa.
- Substandard subdivisions. The final influence in Puna was the development of dozens of subdivisions that eventually comprised over 50,000 residential lots. At first simply thought of

as vehicles for land speculation and technically classed within the Agricultural District, they slowly began to attract a distinct assortment of residents: mainland retirees, recluses and eccentrics; guava, papaya, and flower farmers; local families seeking an inexpensive homestead; and "guerilla farmers" who took advantage of the dense cover of forest and ferns, the warm, humid climate, and utter lack of law enforcement to cultivate marijuana; and finally, commuters with jobs in Hilo. Unlike the residents of wealthy resort areas, many of these mainland immigrants in this group are low- income, an example of a relatively recent phenomenon in mainland immigrants to Hawaii (Crane 1992: 38). The subdivisions nearest to Hilo are becoming bedroom communities for Hilo commuters who increasingly demand upgraded services, including roads and utilities, which has to some extent integrated the district with Hilo. Substantial portions of subdivisions such as Hawaiian Paradise Park now have at least the rudiments of urban infrastructure: paved roads, electricity, cable television, and County water lines. Residents, the utility companies and the County are developing orderly plans to complete this. More remote subdivisions retain the backwoods atmosphere of the early subdivision era. Residents often have divided opinions concerning the benefits of infrastructure "improvements."

The multi-ethnic history has helped to create a strong sense of community identity evinced in both the people and the landscape. Many native Hawaiian traditions, including cuisine, *luau* and *pa`ina* (ceremonial feasts), music and dance have been enthusiastically embraced by later arrivals. In addition, many traditions of the Japanese, Chinese, Filipino, Portuguese and Korean immigrant plantation workers have also been perpetuated. Such enduring phenomena as burial societies, lending organizations, religious groups and labor movements evolved from the everyday life of such ethnic groups in the plantation camps. Most long-time Hawaii (*kama`aina*) families trace their roots to such beginnings and share many deep and wide-ranging bonds. Newer residents of the area, particularly those from the mainland, do not share such links. Nevertheless, the celebration of this heritage in such events as *hula* festivals, plantation days and rodeos is enthusiastically supported by old-timer and newcomer alike.

The sense of community is experiencing ever-more rapid change as new residents (and their values) from outside the Big Island are gradually incorporated. *Kama`aina* residents often express a longing for the old days and a fear of being disenfranchised. Many towns and villages (particularly in West Hawaii) have been transformed from charming local settlements into bustling visitor and residential communities with numerous wealthy, transplanted mainlanders whose influence in community affairs is not related to their family connection to the land.

Impacts and Mitigation

The Project will unavoidably change the character of the area. Whether this change is considered adverse or beneficial differs among the Puna residents. Some look forward to the employment opportunities, the recreation facilities, and traditional healing plants and practices that the Project hopes to incorporate. Others believe the golf course will degrade the ponds and coastal waters, will change the laid-back ambience of the area, or increase traffic.

3.2.3 Economic Impact

Setting

Economic Contributions of Tourism and Foreign Investment. Hawaii's economy is based on tourism, construction, services, military expenditures and agriculture. The Gross State Product increased at an annual rate of 3.9 percent during the 1970s and at 3.2 percent during the 1980s in real terms (adjusted for inflation). Largely responsible was the related growth in tourism and

foreign investment. Direct visitor-related spending increased at an average rate of 14 percent per year during this period. Foreign investment grew from less than $150 million in 1985 to more than $2.7 billion in 1989. However, there has been little or no growth in tourism during the 1990s, and a sharp decline in foreign investment. In 1995, direct visitor spending contributed about $11.4 billion to the Gross State Product, nearly the same as 1991. The collapse of Japan's "bubble" economy in the early 1990s ushered in an era of stagnant foreign investment averaging less than $1 billion per year between 1992 and 1994. Not surprisingly, the rate of growth in the Gross State Product after 1990 has been only 0.38 percent annually in real terms.

Per capita income followed suit. It increased at an average rate of 1.6 percent per year during the 1970s and at an average annual rate of 1.9 percent during the 1980s, then it fell as the GSP growth rate declined. During 1990-96, the average annual rate of per capita income was minus 0.65 percent in real terms. This means that in 1996, people in Hawaii were worse-off compared with 1990.

Economic Conditions of Hawaii County. The economy of the Big Island, historically based on agriculture but now more dependent on tourism, has not yet recovered from the statewide slump that began in 1991. In addition to drops in tourism and foreign investment, the sugar industry began its rapid collapse after a century of dominating the islands's economy. Growth rates declined from double digits in the late 1980s to 2.6 percent in the period from 1990-1994.

Since 1991, visitor number increases in West Hawaii have contributed to a small degree of recovery, although investors leery of the hotel/condo glut of the last five years have been slow to implement further ventures. The Four Seasons, which opened in 1997, was the first major new hotel to open in nearly five years. Direct flights from Japan to Kona began in 1996, and have subsequently increased in number. Economic diversification in West Hawaii is evidenced by technology industries centered on the Natural Energy Laboratory-Hawaii and astronomical base facilities in Waimea, diversified agriculture, and services.

East Hawaii's economy presents a different picture. With the domino-like failure of the sugar plantations, roughly a thousand former workers were left with few economic options. Almost 60,000 acres were taken out of production. The closing of Ka`u Sugar in 1996 marked the end of the sugar plantation era on the Big Island.

Today, County and State government, the University of Hawaii at Hilo, several astronomy bases, and diversified agriculture anchor the economy. Timber operations, particularly those using fiber trees, are being developed on former sugar lands. Ranching continues to be a major industry, with over $20 million in annual sales. East Hawaii is noted for its lush tropical agriculture: anthurium, papaya, orchid, foliage, banana, and ginger, among others. While such farms may sometimes be lucrative, the constant battle against invading pests has sapped much of the profit from these ventures.

Economic Conditions of Puna. The economic structure of the Puna District has changed greatly since the era when sugar cane plantations dominated the landscape. The Technical Reference Report, Puna Community Development Plan (Community Management Associates, Inc. 1992) showed that in 1980, 36.3 percent of the Puna population were in the labor force. Of the total, 15.4 percent were managerial, 21.6 percent were involved in technical, sales, or administrative work, 13.0 percent were in service occupations, 15.8 percent in farming, forestry, or fishing, 15.1 percent in precision production, crafts, or repair work, and 6.2 percent were operators, fabricators, or laborers. Government workers made up 19.0 percent of the total, self-employed workers were 14.6 percent, and the remainder, 65.9 percent, were private wage and salary workers. Puna had

and continues to have a diverse economy, even if many of the jobs are actually situated in Hilo. In contrast with former years, small businesses employ more workers than any large company.

In the direct study area (Pohoiki), papaya farming and fishing are the major economic activities. Between 1988 and 1997, papaya on Big Island has consistently yielded approximately $13 million annually in economic returns from about 250 farms harvesting more than 2,000 acres (Source: Hawaii County Data Book, var. years, Hawaii County Research and Development Department).

Fishermen from Puna and to some extent from around the island make frequent use of the Pohoiki Small Boat Launch, as it is the only launching facility in the district. In 1996, 82 commercial fishing licenses were held by fishermen using this landing - an increase of more than 30 percent since 1994. In the fiscal years 1994-1996, the value of the catch has consistently exceeded $1.0 million/year. The major component of the catch is tuna on handline, with trolling, bottom handline, dive and other catch types accounting for less than 10 percent of the value. During the 1980s and 1990s, the Puna catch accounted for between 15 and 20 percent by weight of various commercial pelagic fish (especially ahi, ono, and swordfish) caught in the entire state of Hawaii. (Sources: Puna Community Development Plan Technical Report [PCDP-Tech] Community Management Associates 1992; Commercial Fish Landings by Island, State of Hawaii, var. years [Hawaii State Department of Land and Natural Resources, Division of Aquatic Resources]; Hawaii County Data Book, var. years [Hawaii County Research and Development Department]; State of Hawaii Data Book, var. years [Hawaii State Department of Business, Tourism and Economic Development]).

Unemployment. Unemployment rates in the last five years in Hawaii County have been high, varying between 8 and 11 percent for most of the period. Each month between April and August 1997 (inclusive), the unemployment rate was above 10 percent. As of March 1998, the rate for Hawaii County was 8.3 percent, and that for the state of the whole is 5.5 percent (Source: Hawaii Department of Labor and Industrial Relations monthly reports). In East Hawaii, the situation is worse than these statistics reveal, since West Hawaii accounts for many of the jobs and has a tighter labor market than East Hawaii. In addition, many Puna residents are not eligible for unemployment compensation and/or are discouraged and not actively seeking work. It is generally agreed by residents and agency officials that the lack of employment is a severe problem in Puna, a district with many residents and few sources of employment.

Impacts and Mitigation

Employment and Income. The Project will generate direct, indirect, and induced employment opportunities during the construction and operational phases. Indirect jobs are those created by the local companies as a result of the project activities in the local economy. For example, the resort will purchase construction materials and services from local businesses, that will in turn require workers to fill this demand. Induced jobs, which occur because of the consumption expenditures of project workers, will also be created. The tendency of new investments to cause a large, rippling effect through the economy is known as the multiplier effect, and it typically ends up generating two to three times as many jobs as those produced directly.

The construction cost of the $81 million Project will require approximately 1,089 workers averaged over the two-year construction period. According to the State's latest input-output model, every new full-time job in the construction industry generates 2.07 additional full-time jobs. Hence, during construction, the direct employment of 1,089 workers would create an additional 2,253 indirect jobs. The total direct payroll during the construction phase will be approximately $32.6 million. The direct and indirect employment would generate an additional $27.1 million of employment income.

During the operational phase, the estimated number of jobs for the proposed Project-related resort, commercial, and agricultural activities is 410 full time, permanent direct jobs. Multiplier effects would generate an additional 704 indirect and induced jobs, for a total of 1,114 jobs. These direct, indirect, and induced jobs during the operational phase would contribute to an additional income of $14.8 million annually during the lifetime of the resort.

Fiscal Impact. State revenues from the construction phase of the project will be derived from general excise tax, materials tax, conveyance tax, and income tax. During construction, about $6.8 million per year in total state revenues would be produced from taxes on construction materials, income tax, general excise tax, and conveyance tax. Very little state expenditure will occur because of construction itself, and therefore these tax revenues can essentially be considered a one-time gain.

During the operational phase, State revenue would be derived from general excise tax, hotel room tax, and income tax. It is expected that approximately $2.58 million annually would be generated annually. State expenditures would occur during operation because visitors would require services supplied by State government; e.g., State parks, airports, etc. The State estimates that it spends $936 annually per visitor-year (the total number of visitor years in any specific area is the total of the daily visitor counts for a year divided by the number of days in a year). With an expected daily visitor count of 366, the State would expend about $342,000. Comparing revenues to expenditures yields a benefit/cost ratio of about 7.6.

The County will also derive revenue from the operation of the resort, in the form of real property taxes, its percentage share of the T.A.T. (Transient Accommodation Tax or room tax), and to a lesser extent, state/federal grants and other taxes. Total expected annual revenues would be approximately $1.16 million. The County estimates that it expends about $591 per visitor-year, for a total expenditure of $216,000. Comparing revenues to expenditures yields a benefit/cost ratio of about 5.4.

TABLE 4. Annual Economic Impacts

	JOBS[1]	INCOME	FISCAL			
			STATE		COUNTY	
			Expenditures	Revenue	Expenditures	Revenue
Temporary (Construction)	3,342	$29.9 M	$0	$3.4 M	$0	$0
Permanent (Operation)	1,114	$14.8 M	$0.342 M	$2.58 M	$0.22 M	$1.16 M
Benefit/Cost Ratio:			7.6		5.4	

1. Jobs include direct, indirect, and induced jobs.

3.2.4 Cumulative Impacts

"Cumulative impact" is the impact on the environment which results from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions.[29] Of particular concern is the impact of the proposed actions-- together with similar past, present, and reasonably foreseeable future actions-- on the following resources:

29. Council on Environmental Quality. Considering Cumulative Effects Under the National Environmental Policy Act, January 1997.

- Past, present, and future urban growth and the potential change to the rural character.
- Past, present, and future nutrient and pesticide leaching to the groundwater, anchialine pools, and coastal waters.
- Past, present, and future demand on public services and infrastructure.

Urban Growth and Rural Character. The only past larger scale urban-type development in the Kapoho-Pohoiki area is the Vacationlands subdivision created in the 1960s. Since then, there has been very little urban development in this area due to the lack of employment centers, the lack of safe swimming beaches, and the lava hazard zone. The proposed project will provide employment opportunities; however, the Applicant will commit to give preference to qualified area residents. New development that may be stimulated by the proposed project would need to overcome two major deterrents to urban growth in the area: the lava hazard zones and zoning. The proposed project is unique from other urban projects in that the geothermal groundwater is an asset to the project that offsets the lava hazard risk.

The zoning is controlled by the government and community. The Special Use Permit tailors and restricts the permitted uses to those set forth in the application. If the Applicant sought Urban zoning for the entire Project, a broad range of urban uses set forth in the zoning code would be permitted. This large rezoning would create a greater stimulus for future urban growth. Currently, there are no known proposed urban-type developments in the near future within the Kapoho-Pohoiki area.

Groundwater and Coastal Water Quality. The Vacationlands subdivision impacts the coastal waters by its concentrated discharge of cesspool seepage. By installing a centralized wastewater collection and treatment system, the proposed Project will not add to the problems caused by cesspool seepage. Agricultural activity is also a source of potential impact to the groundwater and/or coastal water quality. Past agricultural activity within the Kapoho-Pohoiki area, especially papaya growing, has not caused any known impacts to the groundwater or coastal water quality. The proposed golf course will use less pesticides and fertilizer than the previously planted papaya on the Site. Monitoring of the groundwater, anchialine pools, and coastal waters would provide further assurance that any impacts, if detected, would be mitigated (see section 3.1.6, "Groundwater Resource" on page 3-15 and section 3.1.7, "Coastal Resources" on page 3-19).

Public Facilities and Infrastructure Capacity. The project will not create oversized County infrastructure in terms of road or water improvements that would encourage future development. Road improvements have been minimized to address safety and emergency evacuation concerns, while maintaining the rural character. Red Road is of particular concern in terms of maintaining a rural character. The proposed improvements, which are less than the existing County standards, include limited widening of Red Road to allow two-way traffic and improved emergency response (see section 3.3.1, "Roads and Traffic" on page 3-45). As for park facilities, the Applicant will dedicate additional parking area for the popular Ahalanui Beach Park to accommodate any increased demand by the Project's visitors (see section 3.3.7, "Recreation" on page 3-55; see also section 2.7, "Community Projects and Commitments" on page 2-16).

3.3 PUBLIC FACILITIES, UTILITIES, AND SERVICES

3.3.1 Roads and Traffic

Setting

Access to the Site is from the Pahoa-Kapoho Road (Highway 132) and the Pahoa-Pohoiki (Mango Grove) Road. Both roads connect to the coastal road known as the Kapoho-Kalapana Road (Highway 137), also known as the Red Cinder Road. All non-local traffic enters this general region through the Pahoa Bypass (Highway 130) and Pahoa-Kapoho Road junction near Pahoa Town (see Figure 24).

Impacts and Mitigation

Offsite Traffic Impacts. No impact anticipated. The projected increase in traffic from the Project is about 160 vehicles during the morning peak hour and 135 vehicles during the afternoon peak hour for eastbound traffic (towards the Project) with a comparable increase for westbound traffic (from the Project).[30] This increase would lower the level of service (LOS) for both the Pahoa Bypass and Pahoa-Kapoho Highway from LOS B without the Project to LOS C with the Project. For the junction of these two roads, the LOS of this unsignalized intersection is as follows:

	from Pahoa	from Kapoho
AM Peak Hour		
2005 traffic assignment (without Project)	B	B
2005 traffic assignment (with Project)	B	C
PM Peak Hour		
2005 traffic assignment (without Project)	C	C
2005 traffic assignment (with Project)	D	D

Since LOS C and D are still within the acceptable capacity of these highways and intersection, the Project will not require improvements to these highways or the intersection.

Red Cinder Road Improvements. Mitigation required. Improvements to the County's Red Cinder Road are required even without the Project. The Kapoho portion of the road is an improved 80-foot right-of-way with a 22-foot pavement (two 11-foot lanes). The road then narrows. This narrow portion (approximately 3,860') is a substandard County road with a cinder pavement that varies in width (approximately 12' wide) within a 30' right-of-way.

In order to minimize impact to the rural character of this road, the Applicant proposes to improve this segment of the road to a degree less than County standard but sufficient to allow unimpeded two-way traffic albeit at a slower speed than a County standard collector road. The proposed improvement consists of repaving this segment and widening to two 10' lanes with 2' shoulders (see Figure 25). If improved to County standards, this road would have two 12' lanes with 8' shoulders and 10' swales within a 60' right-of-way (see Figure 26).

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30. Okahara & Associates, Inc. Preliminary Engineering Report for Roadway and Drainage for the Oneloa Onsen and Sports Retreat, March 1999 (see Appendix J).

FIGURE 24. Overall Roadway Network

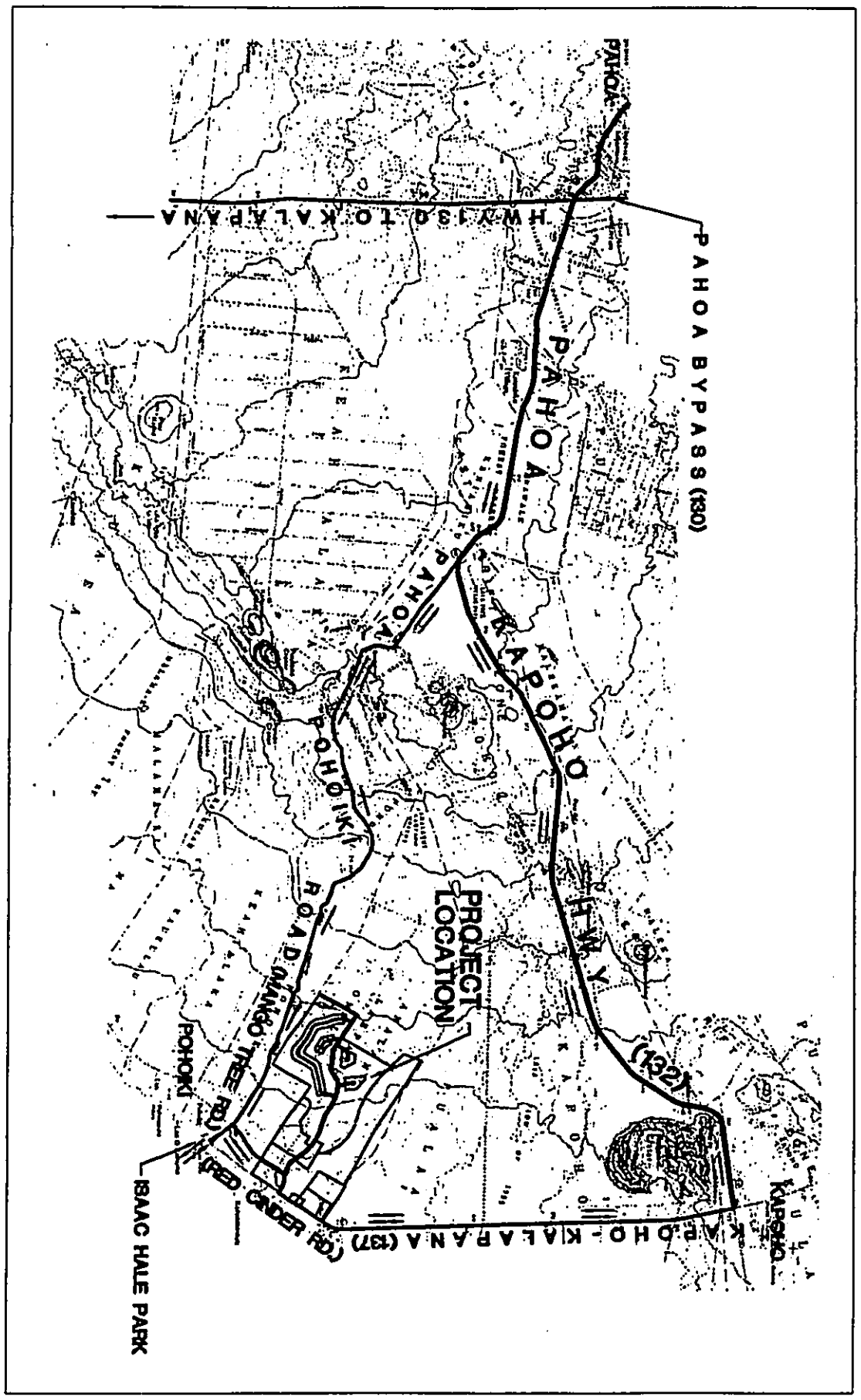


FIGURE 25. Red Cinder Road Typical Section

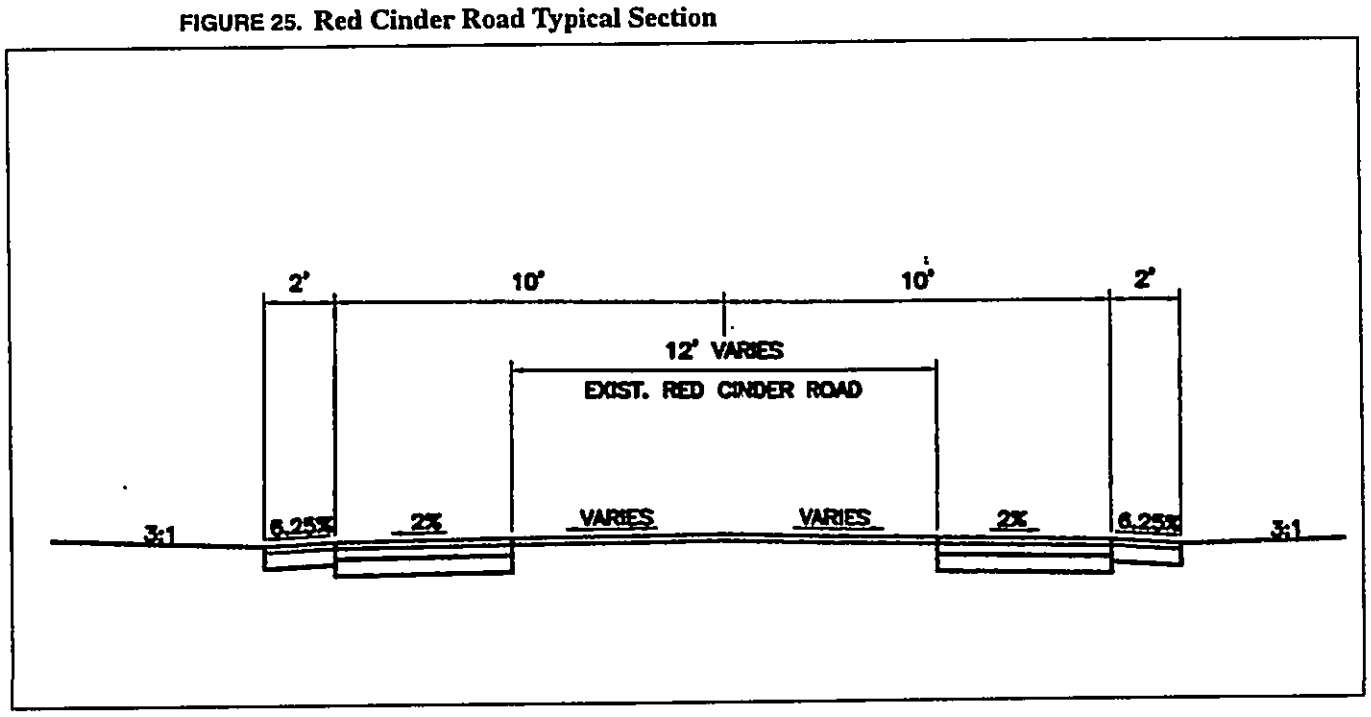
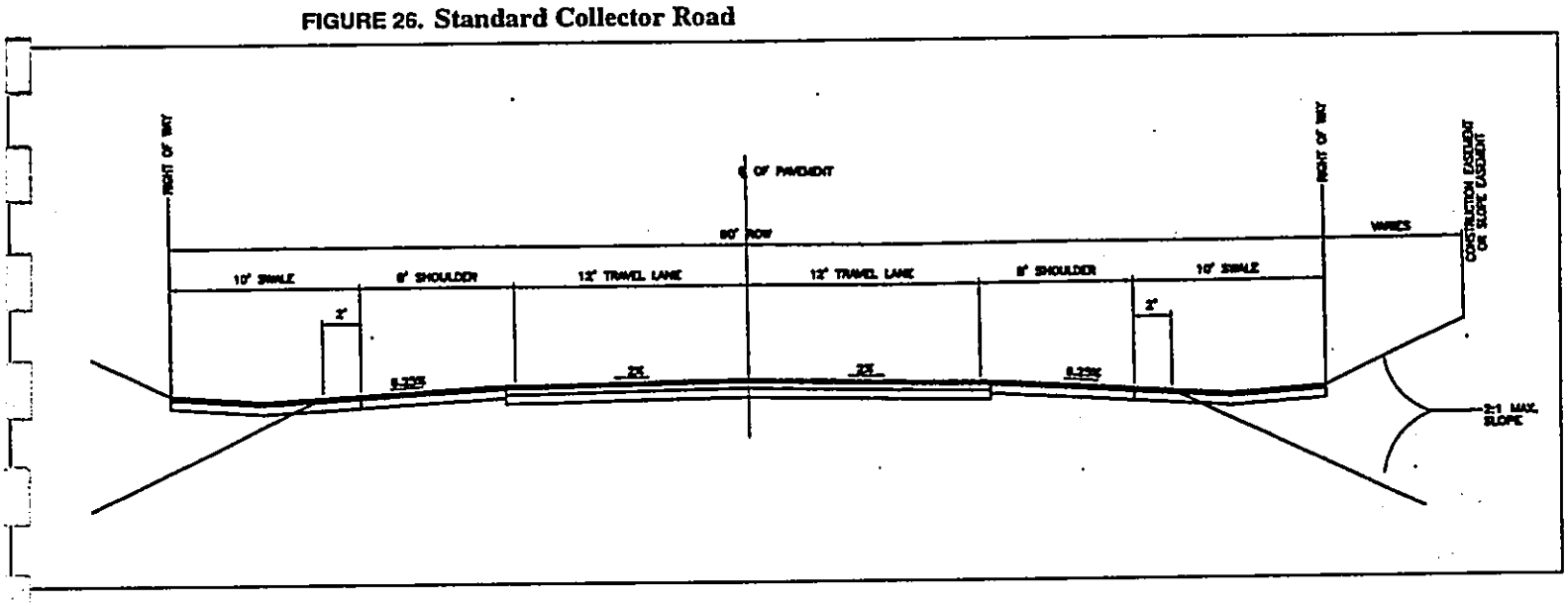


FIGURE 26. Standard Collector Road



Another existing problem with the Red Cinder Road is the tidal inundation of portions of the road fronting the Site. The Applicant proposes to reroute this portion to a higher elevation, and to keep the existing road as a pedestrian/bikeway (see Figure 27). The Applicant would construct the re-routed new road to County standards (60' collector right-of-way) and dedicate it to the County.

Mango Grove Road Traffic Flow. Mitigation required. In preliminary discussions with the County Department of Public Works, the Applicant has suggested converting the Mango Grove Road to a one-way road in the *mauka* direction (refer to Figure 24 on page 3-46). This change in traffic flow direction would require an amendment to the County Traffic Code.[31] The alternative would be to straighten the dangerous curves, which would require eliminating many of the scenic mango trees. The rationale for the uphill one-way traffic include:

- safer evacuation route;
- wider travelway;
- lower speeds going uphill;
- more control of vehicle going uphill.

Emergency Response and Evacuation Capacity. Potentially beneficial (coastal evacuation), potentially adverse (regional evacuation). Although the proposed road and traffic improvements would enhance the emergency response and evacuation roadway network out of the area, the increased traffic generated by the Project will double the evacuation time out of the area from 15 minutes to 34 minutes. Such regional evacuation would be necessary for lava flow inundation. Because of the distance of the Site from the rift zone, there would be sufficient time to enable a systematic evacuation of the Project and adjacent areas. For coastal evacuation due to tsunami or hurricane where time is of the essence, the Project would be available as an evacuation site since it is *mauka* of the tsunami evacuation zone. Approximately 410 vehicles would have to evacuate to the upper areas with the Project, compared to approximately 255 vehicles without the Project. The added traffic would increase the evacuation time from 15 minutes without the Project to 20 minutes with the Project. Currently, there are no accessible *mauka* settlements in the vicinity of the Project that could provide upland evacuation shelters.

Internal Roads. No impact anticipated. The internal roads within the Project would be constructed and maintained as private roads. The major *mauka-makai* private road follows the alignment of an existing County waterline and paved service road. Construction would add an additional 10' lane, 2' shoulders in fill conditions, and 6' swales in cut conditions within a 32' right-of-way. The minor private roads serving the proposed chalets would have 20' pavement width within a 30' right-of-way.

3.3.2 Wastewater System

Setting

The Applicant proposes to construct a private tertiary wastewater treatment plant. The treatment facilities would be located underground. The treated effluent would be pumped to the ponds within the golf course and used to irrigate the golf course. The proposed location of the treatment plant is adjacent to the lot that the Applicant would dedicate to the County to expand the public parking for Ahalanui Beach Park (refer to Figure 6, "Site Plan," on page 2-9). This location would enable gravity flow from the Project to the treatment plant and also enable the County park to connect.

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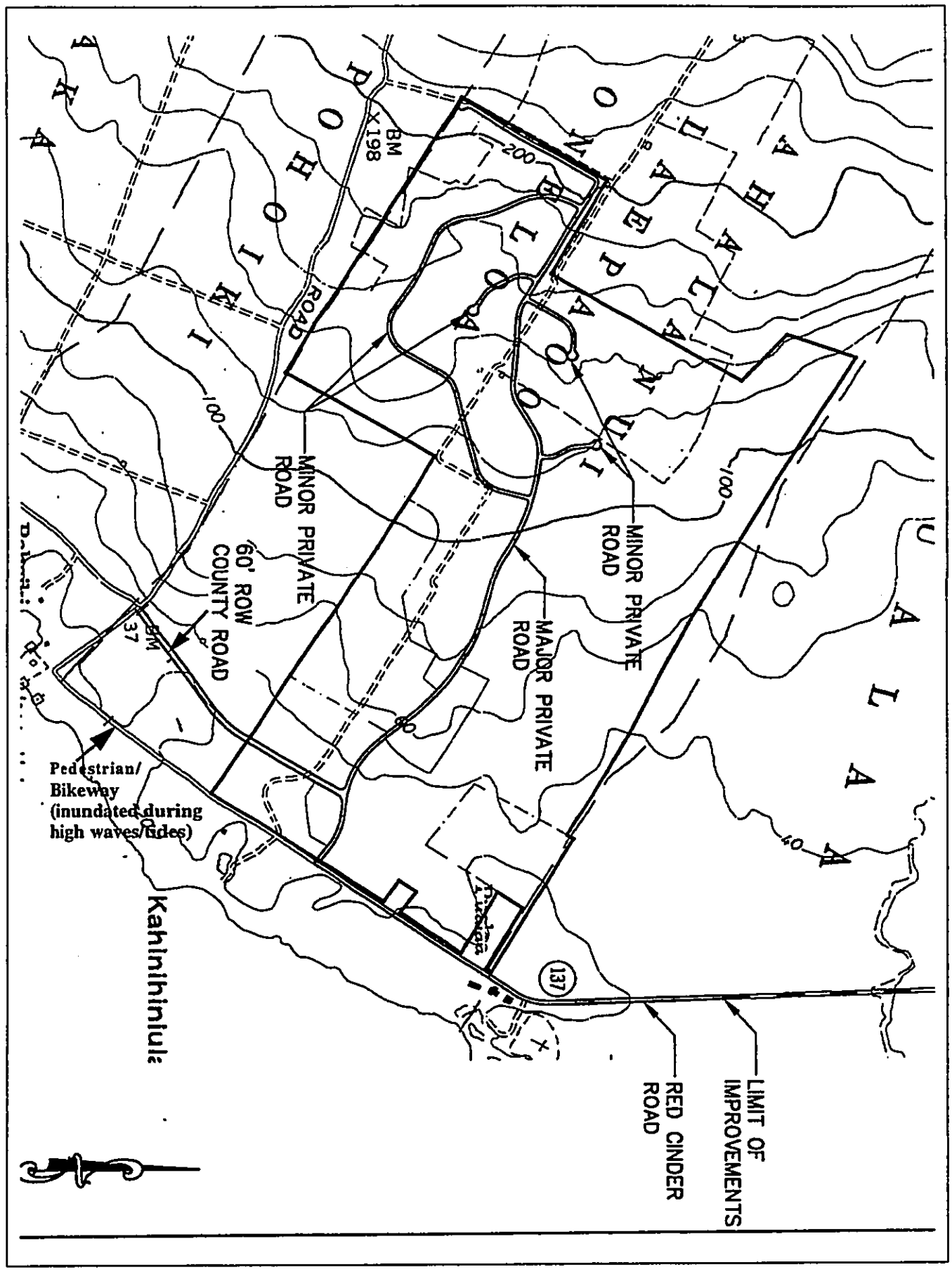
31. Hawaii County Code §24-267 (one way streets).

FIGURE 27. Proposed Road Improvements



Impacts and Mitigation

Odor Control. Mitigation required. An odor problem indicates a malfunctioning of the wastewater treatment system. Because the prevailing northeast tradewinds would blow the odor directly towards the Project, the Project owner has a definite incentive to operate the plant at the highest standards in compliance with Department of Health requirements,[32] as well as to be prepared with adequate emergency standby equipment and procedures such as standby generators, programmed preventive maintenance, onsite storage of critical spare parts, and bypass systems into the golf course ponds that do not have direct drainage to the coastal waters. The Department of Health regulations require that the plant be operated by a certified operator.

Water Quality. Mitigation required. To protect the public health of those who come into contact with the reclaimed irrigation water, the effluent should meet the Class A standard set forth in Department of Health guidelines.[33] The proposed tertiary treatment should meet these standards.

Solid Waste. Mitigation required. The wastewater sludge must be disposed in accordance with Department of Health requirements.[34] During the design phase, the Applicant will investigate the feasibility of composting the sludge for agricultural purposes.

3.3.3 Water System

Setting

The County Department of Water Supply connected the Pahoa water system to the Kapoho water system with an 8" transmission line that traversed the Site (see Figure 28). The Applicant conveyed an access and maintenance easement to the County for that portion of the Site where the water line is located. The Applicant contributed one-half of the construction costs amounting to $500,000. In return, the County granted a water commitment of 160,000 gpd based on average daily demand. The source for the Pahoa-Kapoho water system are the deep wells at the Keonepoko and Pahoa well sites. Since, the Site is situated between the Lanipuna Gardens reservoir and the Kapoho reservoir, water demand for the Project will draw from these existing reservoirs first.

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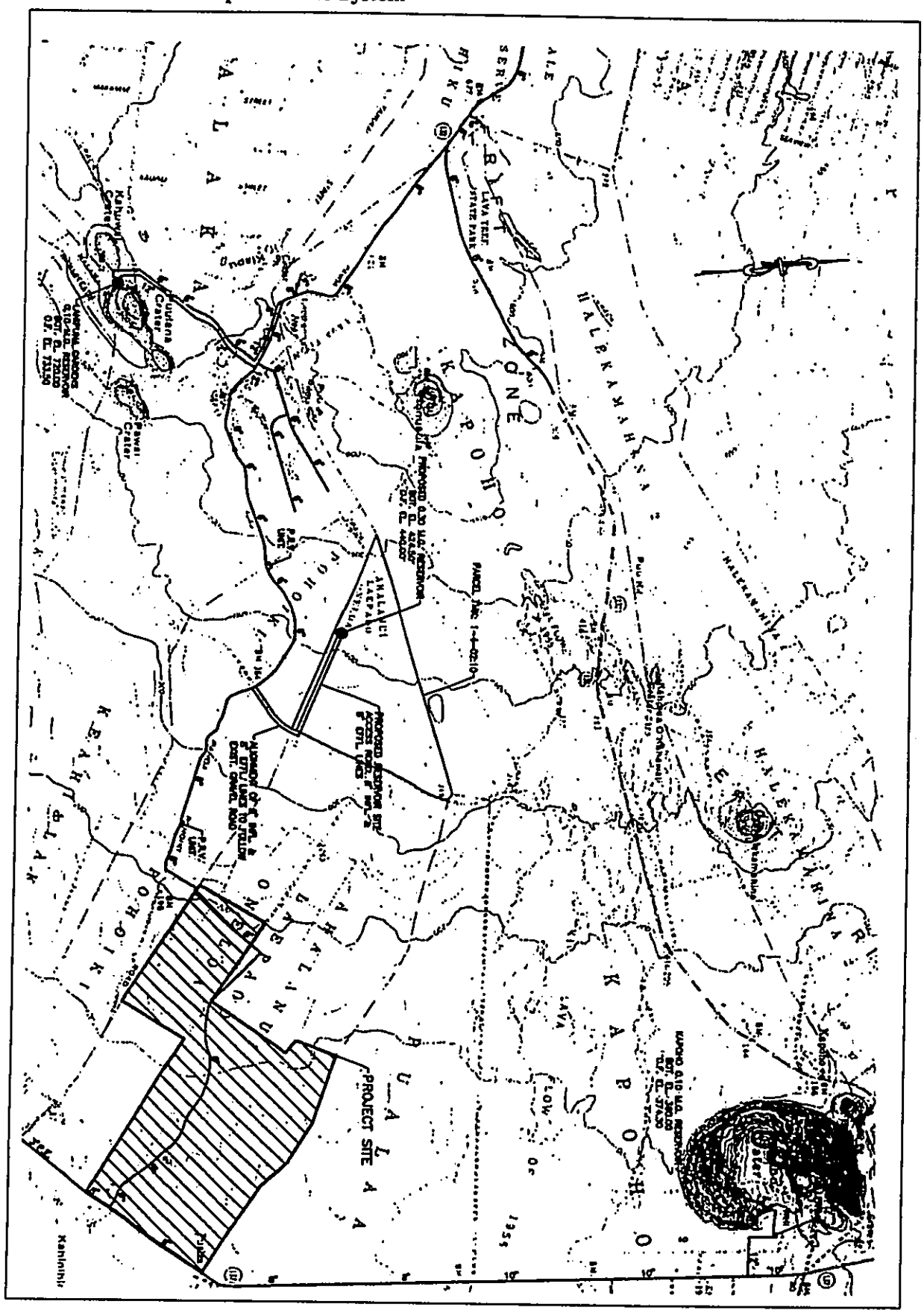
32. Hawaii Administrative Rules Chapter 11-62 (Department of Health, Wastewater Systems).

33. State of Hawaii, Department of Health. Guidelines for the Treatment and Use of Reclaimed Water, November 22, 1993.

34. Hawaii Administrative Rules §11-62-07 (wastewater sludge disposal) requires the director to approve a wastewater sludge disposal plan covering the treatment and transportation of the sludge. The sludge can only be disposed in one of the following methods: at a disposal facility that has been permitted to accept sludge; by reclamation for agricultural purposes as set forth by EPA regulations; by incineration; or by a wastewater system authorized to accept and dispose sludge.

FIGURE 28. Pahoa-Kapoho Water System



Impacts and Mitigation

Water Demand. No impact anticipated. A preliminary engineering report for the Project estimated the total average day water consumption to be 159,770 gallons.[35] This estimate is based on the following uses:

- Chalet, beach club, and lodge units (195 units @ 400 gpd):78,000 gpd
- Employees (410 onsite @ 45 gpd):18,450 gpd
- Other transient guests on any particular day (100 @ 13.2 gpd):1,320 gpd
- Water-related amenities (onsen, restaurants, saunas, etc.) (58 acres @ 1,000 g/acre):58,000 gpd

The estimated average day total demand of 159,770 gallons is less than DWS' allotted water commitment of 160,000 gallons, which commitment is based on adequate capacity of the Pahoa-Kapoho system.

The maximum daily demand is 239,655 gallons per day (1.5 times the average daily demand), and the peak hour demand is 33,285 gallons per hour (5 times the hourly rate of the average daily demand).

Fire Flow Requirements. Mitigation required. The Department of Water Supply Standards require a fire flow of 2,000 gpm for the land uses proposed. There must be adequate storage capacity to accommodate a two-hour fire event, which means a fire flow storage requirement of 0.24 MG for the Project (2,000 gpm x 60 min/hr x 2 hr duration). Although the existing 0.1 MG Lanipuna Gardens Reservoir and the 0.1 MG Kapoho Reservoir together nearly meet the 0.24 MG storage requirement, a 5,000 linear feet section 6" ductile iron pipe along the Mango Grove Road causes a pressure drop that would be too great to meet the required fire flow. Therefore, the preliminary engineering report recommended a new 0.3 MG offsite reservoir with an overflow elevation of 254' to hydraulically match an existing pressure reducing valve (PRV) along the Mango Grove Road. During a fire event at the Site, the fire flow would come from the proposed reservoir and the Kapoho reservoir. Besides the construction cost for the reservoir, other costs include land acquisition, access road, approximately 3,750 linear feet of 8" influent line, and approximately 3,750 linear feet of 8" effluent line.

Onsite Water Distribution. No impact anticipated. Onsite water mains will be sized to accommodate the required fire flow. The water main alignment will follow the onsite road pattern and will be looped where possible. Fire hydrants will be provided in accordance with DWS standards.

3.3.4 Drainage System

Setting

The offsite drainage area affecting the Project encompasses approximately 1.3 square miles *mauka* of the Site (see Figure 29). The Project drainage facilities must be able to convey this offsite flow through the Site. Any increase in runoff generated onsite from buildings, paved roads, parking areas and other impervious surfaces, must be disposed by on-site drainage facilities as mandated by the County's Storm Drainage Standards.

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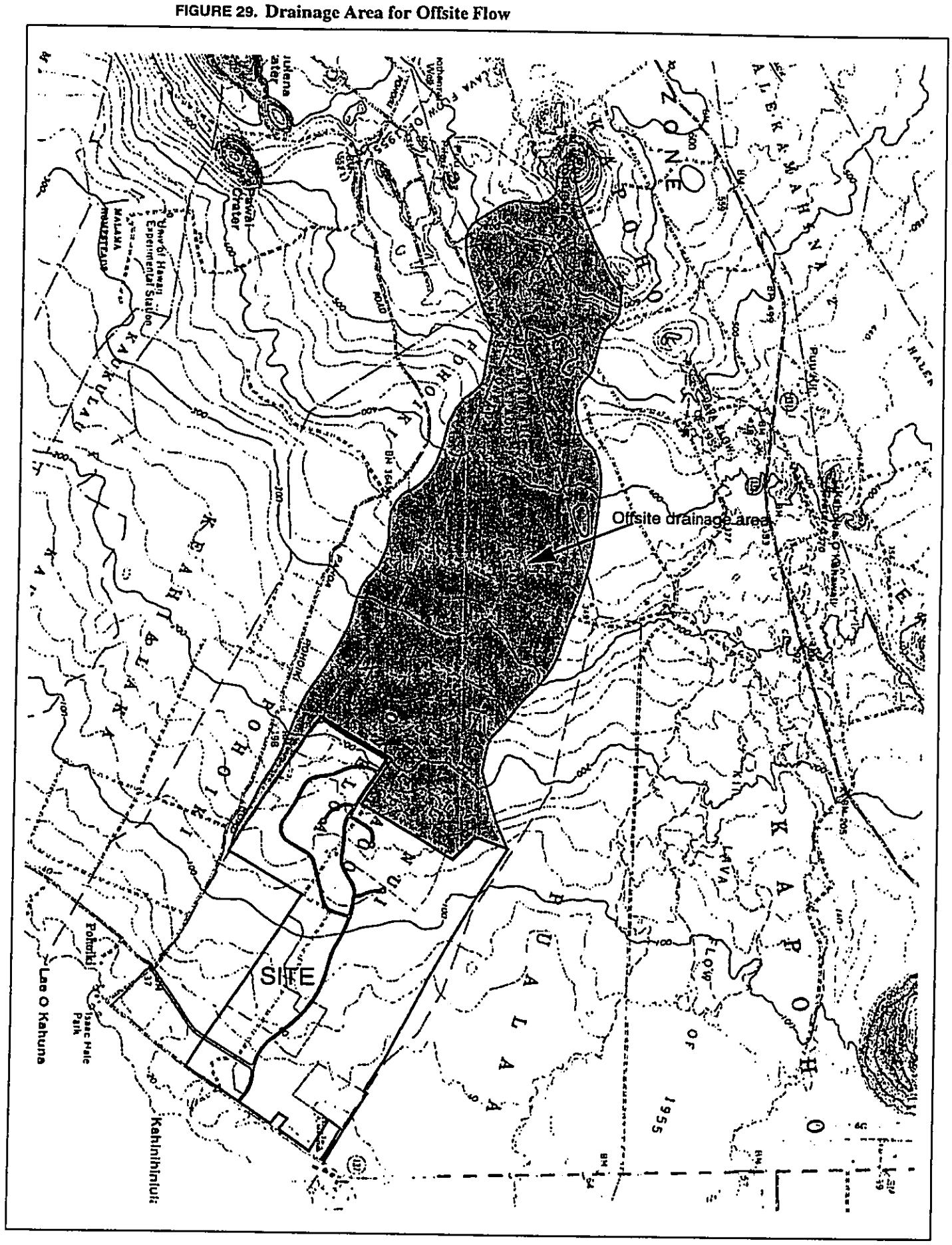
35. See Appendix K, "Preliminary Engineering Report for Water System for the Oneloa Onsen and Sports Retreat".

FIGURE 29. Drainage Area for Offsite Flow



Impacts and Mitigation

Offsite Drainage Flow. Potentially beneficial. According to preliminary calculations,[36] the computed 100-year storm peak runoff from the 1.3 square mile drainage area is 962 cfs. A drainage channel would likely be constructed to route this flow through the golf course. The use of the golf course to retain the drainage flow as much as possible would allow sediments transported by the drainage flow to settle and thereby reduce coastal sedimentation.

3.3.5 Electrical/Telephone

Setting

Electricity and telephone lines are available via overhead lines along the Kapoho-Kalapana Road.

Impacts and Mitigation

No impact anticipated. The existing electrical system serving the area will be able to accommodate the Project.

3.3.6 Police & Fire Protection

Setting

The Keaau police station is the headquarters for police officers serving the Puna district. Pahoa has a substation used as a stopover or typing reports.[37]

Pahoa has a 15-man full time fire operation with a crew of firefighters and Mobile Intensive Care Technicians (MICT). This operation serves the Pahoa-Paradise Park and Kalapana-Kapoho areas. Thirteen miles away in Keaau is a 24-hour, 15-man facility.[38] In Hawaii County, about 80 percent of calls are related to emergency medical services, and 20 percent or less for building, brush, and vehicle fires.

Impacts and Mitigation

No impact anticipated. The project will hire security guards to supplement the County protective services.

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36. See Appendix J, "Preliminary Engineering Report for Roadway and Drainage for the Oneloa Onsen and Sports Retreat".

37. General Plan, p. 55; Puna CDP Technical Report, p. 121.

38. Ibid.

3.3.7 Recreation

Setting[39]

About a dozen County parks in Puna feature ballfields, an Olympic-size swimming pool, basketball courts, playgrounds, and other activities. State and federal parks offer hiking and camping. However, outdoor recreation in the study area itself is mostly confined to coastal activities, since few parks or other public areas offering other activities exist outside Pahoa. Important activities include shore fishing, snorkeling and spear fishing, boat fishing, shellfish and limu (seaweed) gathering, sunbathing, picnicking, surfing and body boarding. Swimming offshore is too dangerous for most people and is usually undertaken instead in sheltered tidepools and anchialine ponds - some of which are geothermally heated.

Before 1990, the Puna coastline was well endowed with parks, mostly in the vicinity of Kalapana. But between 1989 and May 1990, lava flows covered an area of approximately 30 square miles, destroying nearly 200 residences and other structures. The flows also filled in the Kalapana oceanfront area, and moved the shoreline as much as 0.75 mile *makai*. Lava flows inundated three Hawaii County parks in the vicinity of Kalapana- Kaimu: Harry K. Brown Park, Kalapana Beach Park, and Kalapana Black Sands Beach. All of these parks were located near Kalapana in the vicinity of Kaimu Bay. These three parks were buried under 50 to 75 feet of lava. Approximately 50 acres of County land were destroyed, including nearly 28 acres of beachfront property with 1.35 miles of shoreline. The area was renowned for scenic beauty and provided recreation, relaxation, and meeting-places for thousands of island residents and tourists annually. All of the parks were directly accessible by County road and had electricity, telephones, and potable water. Adequate parking was available at each park, and all were supported, maintained, and patrolled by the County of Hawaii Department of Parks and Recreation (DPR).

The disaster left only one County beach park in Puna - Isaac Hale Beach Park at Pohoiki. The harbor there was soon inundated with beachgoers who were in conflict with the main function as a boat launching area for commercial fishermen. Subsequently, the County has obtained several million dollars from the Federal Emergency Management Agency (FEMA) to improve and expand Isaac Hale Beach Park and to develop an additional park centered around a lawn and half-acre swimming pond at Ahalanui. Both these parks are located in the vicinity of the Project. Ahalanui County Park borders the northeast edge of the Project, and Isaac Hale is located less than 0.3 miles away from the southwest border of the Project.

Impacts and Mitigation

Potentially beneficial. The Project will provide increased recreational opportunities for residents and visitors. The Applicant will dedicate land for the expansion of the County's Ahalanui Beach Park to offset any increased usage of the County facilities by the Project's guests.

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39. This section summarizes information presented in Appendix I, "Socioeconomic Impact Assessment: Oneloa Onsen and Sports Retreat".

4

RELATIONSHIP TO PLANS, POLICIES, AND CONTROLS

This chapter evaluates the Project's conformance with the following applicable State and County land use plans, policies, and controls:

- State
  - State Plan
  - State Land Use Law
- County of Hawaii
  - General Plan
  - Zoning and Subdivision Codes
  - Puna Community Development Plan
  - Special Management Area (Coastal Zone Management)
- Other Permits and Approvals

4.1 STATE PLAN

The Hawaii State Plan (*Hawaii Revised Statutes* Chapter 226) serves as a guide for the future long-range development of the State. The following discussion confirms the Project's conformance with the State Plan, particularly the objectives and policies relating to the economy and leisure.[1]

1. The State Plan defines "conform" as "the weighing of the overall theme, goals, objectives and policies of this chapter and a determination that an action, decision, rule or state program is consistent with the overall theme, and fulfills one or more of the goals, objectives, or policies of this chapter." *Hawaii Revised Statutes* §226-2.

[HRS §226-3] Overall Theme. Hawaii's people, as both individuals and groups, generally accept and live by a number of principles or values which are an integral part of society. This concept is the unifying theme of the state plan. The following principles or values are established as the overall theme of the Hawaii state plan:

(1) Individual and family self-sufficiency refers to the rights of people to maintain as much self-reliance as possible. It is an expression of the value of independence, in other words, being able to freely pursue personal interests and goals. Self-sufficiency means that individuals and families can express and maintain their own self-interest so long as that self-interest does not adversely affect the general welfare. Individual freedom and individual achievement are possible only by reason of other people in society, the institutions, arrangements and customs that they maintain, and the rights and responsibilities that they sanction.

(2) Social and economic mobility refers to the right of individuals to choose and to have the opportunities for choice available to them. It is a corollary to self-sufficiency. Social and economic mobility means that opportunities and incentives are available for people to seek out their own levels of social and economic fulfillment.

(3) Community or social well-being is a value that encompasses many things. In essence, it refers to healthy social, economic, and physical environments that benefit the community as a whole. A sense of social responsibility, of caring for others and for the well-being of our community and of participating in social and political life, are important aspects of this concept. It further implies the aloha spirit-- attributes of tolerance, respect, cooperation and unselfish giving, within which Hawaii's society can progress.

Discussion. The theme of self-sufficiency expresses the freedom of an individual or group, in this case the Applicant, to pursue their own self-interest "so long as the self-interest does not adversely affect the general welfare." The Project will not have significant adverse impacts. The Project will provide direct and indirect economic opportunities to the local community, the region, and the County that will enable individuals to realize social and economic mobility. The Project includes a community benefits package in the spirit of providing benefits to the community as a whole. The Project will expose the area to international attention and influences which will present a challenge to the community to live up to its aloha spirit of tolerance, respect, and acceptance as individuals.

[HRS §226-4] State Goals. In order to guarantee, for present and future generations, those elements of choice and mobility that insure that individuals and groups may approach their desired levels of self-reliance and self-determination, it shall be the goal of the State to achieve:

(1)A strong, viable economy, characterized by stability, diversity, and growth, that enables the fulfillment of the needs and expectations of Hawaii's present and future generations.

(2)A desired physical environment, characterized by beauty, cleanliness, quiet, stable natural systems, and uniqueness, that enhances the mental and physical well-being of the people.

(3)Physical, social, and economic well-being, for individuals and families in Hawaii, that nourishes a sense of community responsibility, of caring, and of participation in community life.

Discussion. The proposed Project, as a retreat resort focused on sports and wellness, attempts to meet all of the above goals. The Project features the natural hot springs and native forest as settings to enhance the mental and physical well-being of its guests. The Project operator will nurture a sense of responsibility and caring in their relationship to the community. This Project would bolster the area's economy with new jobs and opportunity.

[HRS §226-6] Objectives and policies for the economy-- in general:

Objectives:

(1)Increased and diversified employment opportunities to achieve full employment, increased income and job choice, and improved living standards for Hawaii's people.

(2)A steadily growing and diversified economic base that is not overly dependent on a few industries.

Policies:

(2)Promote Hawaii as an attractive market for environmentally and socially sound investment activities that benefit Hawaii's people.

(7)Encourage the formation of cooperatives and other favorable marketing arrangements at the local or regional level to assist Hawaii's small scale producers, manufacturers, and distributors.

(9)Foster greater cooperation and coordination between the government and private sectors in developing Hawaii's employment and economic growth opportunities.

(10)Stimulate the development and expansion of economic activities which will benefit areas with substantial or expected employment problems.

(13)Encourage businesses that have favorable financial multiplier effects within Hawaii's economy.

(14)Promote and protect intangible resources in Hawaii, such as scenic beauty and the aloha spirit, which are vital to a healthy economy.

(16)Foster a business climate in Hawaii-- including attitudes, tax and regulatory policies, and financial and technical assistance programs-- that is conducive to the expansion of existing enterprises and the creation and attraction of new business and industry.

[HRS §226-103(a)] Economic priority guidelines. Priority guidelines to stimulate economic growth and encourage business expansion and development to provide needed jobs for Hawaii's people and achieve a stable and diversified economy:

(1)Seek a variety of means to increase the availability of investment capital for new and expanding enterprises.

(A)Encourage investments which:

(i)Reflect long term commitments to the State;

(ii)Rely on economic linkages within the local economy;

(iii)Diversify the economy;

(iv)Reinvest in the local economy;

(v)Are sensitive to community needs and priorities; and

(vi)Demonstrate a commitment to provide management opportunities to Hawaii residents;

(10)Enhance the quality of Hawaii's labor force and develop and maintain career opportunities for Hawaii's people through the following actions:

(D)Promote career opportunities in all industries for Hawaii's people by encourage firms doing business in the State to hire residents.

(F)Provide retraining programs and other support services to assist entry of displaced workers into alternative employment.

Discussion. In a region where agriculture has predominated, the proposed resort/sports/wellness/agricultural/commercial facilities would add an element of diversification. The Project would provide employment choice for an area where most of the residents have had to commute to Hilo or other areas for jobs. The Project will provide a market for diversified agricultural products. The Applicant will commit to preferentially hire and train local residents. The Project will have substantial multiplier effects that will stimulate the regional economy. For the foregoing reasons, the proposed Project fulfills the general economic objectives and policies of the State Plan in terms of its diversification of the regional economy, employment opportunities, multiplier effects, commitment to retrain and hire local residents, and marketing opportunity for agricultural products.

[HRS §226-7] Objectives and policies for the economy-- agriculture:

Objectives:

(1)Continued viability in Hawaii's sugar and pineapple industries.

(2)Continued growth and development of diversified agriculture throughout the State.

Policies:

(3)Strengthen diversified agriculture by developing an effective promotion, marketing, and distribution system between Hawaii's producers and consumer markets locally, on the continental United States, and internationally.

(5)Enhance agricultural growth by providing public incentives and encouraging private initiatives.

(6)Assure the availability of agriculturally suitable lands with adequate water to accommodate present and future needs.

(8)Expand Hawaii's agricultural base by promoting growth and development of flowers, tropical fruits and plants, livestock, feed grains, forestry, food crops, aquaculture, and other potential enterprises.

(10)Promote and assist in the establishment of sound financial programs for diversified agriculture.

(11)Institute and support programs and activities to assist the entry of displaced agricultural workers into alternative agricultural or other employment.

[HRS §226-103(d)] Economic priority guidelines-- diversified agriculture:

(1)Identify, conserve, and protect agricultural and aquacultural lands of importance and initiate affirmative and comprehensive programs to promote economically productive agricultural and aquacultural uses of such lands.

[HRS §226-104] Population growth and land resources priority guidelines:

(2)Make available marginal or nonessential agricultural lands for appropriate urban uses while maintaining agricultural lands of importance in the agricultural district.

Discussion. The priority guidelines urge the protection of "important" agricultural lands. There are three classification systems that rate agricultural suitability: the State Department of Agriculture's Agricultural Lands of Importance to the State of Hawaii (ALISH), the U.S. Soil Conservation Service's Land Capability ratings, and the Land Study Bureau's overall productivity rating. According to the Soil Conservation Service and Land Study Bureau classifications, the Project Site has marginal agricultural soils (see section 3.1.2 "Topography & Soils" on page 3-3). The ALISH classification rates the soils as "other important" agricultural land. The Land Use Commission uses the Land Study Bureau's system to determine prime agricultural land.

The proposed project innovatively landscapes with agricultural crops, such as the orchards as part of the golf course roughs. The proposed awa cultivation in the forest area serves as a cultural restoration of historic practices, a commercial venture with a crop with potential high demand, and a source for onsite uses in the health and wellness facilities.

[HRS §226-8] Objective and policies for the economy-- visitor industry:

Objective: Planning for the State's economy with regard to the visitor industry shall be directed towards the achievement of the objective of a visitor industry that constitutes a major component of steady growth for Hawaii's economy.

Policies:

(2)Ensure that visitor industry activities are in keeping with the social, economic, and physical needs and aspirations of Hawaii's people.

(4)Encourage cooperation and coordination between the government and private sectors in developing and maintaining well-designed, adequately serviced visitor industry and related developments which are sensitive to neighboring communities and activities.

(5)Develop the industry in a manner that will continue to provide new job opportunities and steady employment for Hawaii's people.

(6)Provide opportunities for Hawaii's people to obtain job training and education that will allow for upward mobility within the visitor industry.

(7)Foster a recognition of the contribution of the visitor industry to Hawaii's economy and the need to perpetuate the aloha spirit.

(8)Foster an understanding by visitors of the aloha spirit and of the unique and sensitive character of Hawaii's cultures and values.

[HRS §226-103(b)] Economic priority guidelines-- visitor industry:

(2)Encourage the development and maintenance of well-designed, adequately serviced hotels and resort destination areas which are sensitive to neighboring communities and activities and which provide for adequate shoreline setbacks and beach access.

(4)Encourage visitor industry practices and activities which respect, preserve, and enhance Hawaii's significant natural, scenic, historic, and cultural resources.

(7)Maintain and encourage a more favorable resort investment climate consistent with the objectives of this chapter.

Discussion. The policy to encourage a favorable investment climate is timely. Because of the recessionary condition of Hawaii's economy, a catalyst is needed to energize a recovery. The scale and diversity of this project provides an impetus for direct and indirect economic opportunities, while attempting to sensitively respond to community needs (see section 2.7 "Community Projects and Commitments" on page 2-16). The low-rise resort will be designed with earth-tone colors and indigenous materials to blend with the surroundings. The Project operators will work with the State in developing job training programs. The Applicant has attempted to fulfill the objectives and policies above relating to the visitor industry by designing with sensitivity to the community and environment, and providing various community benefits.

HRS §226-11 Objectives and policies for the physical environment—land-based, shoreline, and marine resources.

Objectives:

(1)Prudent use of Hawaii's land-based, shoreline, and marine resources.

(2)Effective protection of Hawaii's unique and fragile environmental resources.

Policies:

(1)Exercise an overall conservation ethic in the use of Hawaii's natural resources.

(2)Ensure compatibility between land-based and water-based activities and natural resources and ecological systems.

(3)Take into account the physical attributes of areas when planning and designing activities and facilities.

(4)Manage natural resources and environs to encourage their beneficial and multiple use without generating costly or irreparable environmental damage.

(5)Consider multiple uses in watershed areas, provided such uses do not detrimentally affect water quality and recharge functions.

(6)Encourage the protection of rare or endangered plant and animal species and habitats native to Hawaii.

(7)Provide public incentives that encourage private actions to protect significant natural resources from degradation or unnecessary depletion.

(8)Pursue compatible relationships among activities, facilities, and natural resources.

(9)Promote increased accessibility and prudent use of inland and shoreline areas for public recreational, educational, and scientific purposes.

Discussion: The proposed development activities will occur on the portion of the Site that has been previously disturbed by prior papaya cultivation. The undisturbed native forest will be preserved. The management of the golf course and agricultural activities will ensure minimal use of pesticides. The Applicant will conduct water quality monitoring of the receiving coastal waters and anchialine pools to ensure that the management controls are achieving their intended objective of not adversely impacting these receiving waters. The preservation of the native forest will protect rare species and cultural resources that will be made accessible to the public for their enjoyment and education.

[HRS §226-12] Objective and policies for the physical environment-- scenic, natural beauty, and historic resources:

Objective: Planning for the State's physical environment shall be directed towards achievement of the objective of enhancement of Hawaii's scenic assets, natural beauty, and multi-cultural/historical resources.

Policies:

(1)Promote the preservation and restoration of significant natural and historic resources.

(2)Provide incentives to maintain and enhance historic, cultural, and scenic amenities.

(3)Promote the preservation of views and vistas to enhance the visual and aesthetic enjoyment of mountains, ocean vistas, scenic landscapes, and other natural features.

(4)Protect those special areas, structures, and elements that are an integral and functional part of Hawaii's ethnic and cultural heritage.

(5)Encourage the design of developments and activities that complement the natural beauty of the islands.

Discussion: The proposed project will not impact upon significant archaeological features (see section 3.1.5 "Historic/Archaeological Resources" on page 3-9). The proposed project will not impact any views or vistas to any scenic landscapes, and instead will enable the public to enjoy a view of the mountains and ocean from the Site (see section 3.1.10 "Scenic Resources" on page 3-29). The project will preserve and restore the forest area and the complex of archaeological resources within the forest area. In short, the proposed project fulfills the objectives and policies for scenic, natural beauty, and historic resources by minimizing impacts on historic and scenic resources, restoring historic and cultural resources, and designing the project to complement the natural beauty of the area.

§226-13 Objectives and policies for the physical environment—Land, air,and water quality.

Objectives:

(1)Maintenance and pursuit of improved quality in Hawaii's land, air, and water resources.

(2)Greater public awareness and appreciation of Hawaii's environmental resources.

Policies:

(1)Foster educational activities that promote a better understanding of Hawaii's limited environmental resources.

(2)Promote the proper management of Hawaii's land and water resources.

(3)Promote effective measures to achieve desired quality in Hawaii's surface, ground, and coastal waters.

(4)Encourage actions to maintain or improve aural and air quality levels to enhance the health and well-being of Hawaii's people.

*(5)*Reduce the threat to life and property from erosion, flooding, tsunamis. hurricanes, earthquakes, volcanic eruptions. and other natural or man-induced hazards and disasters

(6)Encourage design and construction practices that enhance the physical qualities of Hawaii's communities.

(7)Encourage urban developments in close proximity to existing services and facilities.

(8)Foster recognition of the importance and value of the land, air, and water resources to Hawaii's people, their cultures and visitors.

Discussion: One of the Project's mitigation measures is a water quality monitoring program to ensure that construction and operational practices are not impacting the receiving waters. Best management practices will be employed during construction to minimize nonpoint source pollution in compliance with the NPDES and grading permit requirements. Water and electrical services are or can be easily made available to the Project. A feature of the Project is the geothermal onsen ponds, which take advantage of the physical characteristics of an area located in a lava flow hazard zone. The Applicant has assumed the risks associated with this location. As part of the project, evacuation plans will be developed which will assure timely evacuation of not only the Project's residents and visitors, but will improve evacuation routes for the benefit of all residents and visitors of the Pohoiki area.

HRS §226- 15 Objectives and policies for facility systems—solid and liquid wastes.

Objectives:

(1)Maintenance of basic public health and sanitation standards relating to treatment and disposal of solid and liquid wastes.

(2)Provision of adequate sewerage facilities for physical and economic activities that alleviate problems in housing, employment, mobility, and other areas.

Policies:

(I)Encourage the adequate development of sewerage facilities that complement planned growth.

(2)Promote re-use and recycling to reduce solid and liquid wastes and employ a conservation ethic.

(3)Promote research to develop more efficient and economical treatment and disposal of solid and liquid wastes.

Discussion: The Project includes a private wastewater treatment facility. The treated effluent will be reclaimed for irrigation of the proposed golf course and agricultural areas. The Applicant will allow the County park to hookup to the facility to reduce potential water pollution from the County's restrooms. The Applicant will develop a solid waste management plan to reduce solid wastes in accordance with the County's requirements.

HRS §226-23 Objective and policies for socio-cultural advancement—leisure.

Objective: Planning for the State's socio-cultural advancement with regard to leisure shall be directed towards the achievement of the objective of the adequate provision of resources to accommodate diverse cultural, artistic, and recreational needs for present and future generations.

Policies:

(I)Foster and preserve Hawaii's multi-cultural heritage through supportive cultural, artistic, recreational, and humanities-oriented programs and activities.

(2)Provide a wide range of activities and facilities to fulfill the cultural, artistic, and recreational needs of all diverse and special groups effectively and efficiently.

(3)Enhance the enjoyment of recreational experiences through safety and security measures, educational opportunities, and improved facility design and maintenance.

(4)Promote the recreational and educational potential of natural resources having scenic, open space, cultural, historical, geological, or biological values while ensuring that their inherent values are preserved.

(5)Ensure opportunities for everyone to use and enjoy Hawaii's recreational resources.

(6)Assure the availability of sufficient resources to provide for future cultural, artistic, and recreational needs.

(7)Provide adequate and accessible physical fitness programs to promote the physical and mental well-being of Hawaii's people.

(8)Increase opportunities for appreciation and participation in the creative arts, including the literary, theatrical, visual, musical, folk, and traditional art forms.

(9)Encourage the development of creative expression in the artistic disciplines to enable all segments of Hawaii's population to participate in the creative arts.

(10)Assure adequate access to significant natural and cultural resources in public ownership.

Discussion: The Project will provide a diversity of recreational opportunities-- golf, outdoor field activities (e.g., soccer, baseball, track & field), indoor activities (e.g., swimming, gymnastics, weight training), equestrian activities, hiking, biking, and others. The onsen ponds and native forest will promote the recreational and educational values of the unique geological and biological resources of the Site. The facilities will be made available to the public.

HRS §226-25 Objective and policies for socio-cultural advancement—culture.

Objective: Planning for the State's socio-cultural advancement with regard to culture shall be directed toward the achievement of the objective of enhancement of cultural identities, traditions, values, customs, and arts of Hawaii's people.

Policies:

(1)Foster increased knowledge and understanding of Hawaii's ethnic and cultural heritages and the history of Hawaii.

(2)Support activities and conditions that promote cultural values, customs, and arts that enrich the lifestyles of Hawaii's people and which are sensitive and responsive to family and community needs.

(3)Encourage increased awareness of the effects of proposed public and private actions on the integrity and quality of cultural and community lifestyles in Hawaii.

(4Encourage the essence of the aloha spirit in people's daily activities to promote harmonious relationships among Hawaii's people and visitors.

Discussion: The burial sites on the Site will be preserved in place; families with ties to these sites will be consulted in the development of the preservation plan. These families will also be consulted, as well as the broader community, in the development of the interpretive programs for the archaeological features on the Site. The cultivation of 'awa and the restoration of the Hale-o-Lono site will promote an understanding of the native agricultural practices. The cultivation and use of various medicinal herbs will promote an understanding of multi-cultural healing practices. The onsen will attract and foster an appreciation of the customs of other cultures.

HRS §226-26 Objectives and policies for socio-cultural advancement—public safety.

Objectives:

(I)Assurance of public safety and adequate protection of life and property for all people.

(2)Optimum organizational readiness and capability in all phases of emergency management to maintain the strength, resources, and social and economic well-being of the community in the event of civil disruptions, wars, natural disasters, and other major disturbances.

(3)Promotion of a sense of community responsibility for the welfare and safety of Hawaii's people.

Policies:

(I)Ensure that public safety programs are effective and responsive to community needs.

(2)Encourage increased community awareness and participation in public safety programs.

Discussion: The Project will improve emergency evacuation routes and provide additional civil defense sirens. Other hot springs throughout the world are located in active volcanic areas to access the geothermal groundwater resources. This Project will assume similar risks as these other establishments while improving the emergency response for the whole community in recognition of the natural hazard risks.

4.2 STATE LAND USE LAW

State Land Use District Classification. The State Land Use Law (Hawaii Revised Statutes chapter 205) classifies all lands in the State into one of four districts: Urban, Agriculture, Rural, or Conservation. The classification for the Site is Agriculture.

Permitted Uses in the Agricultural District. Permitted uses within the Agricultural district differ depending on whether the land is prime or marginal agricultural land. The State Land Use Law uses the Land Study Bureau's rating of Class A or B to determine prime agricultural land. For lands classified as A or B, the permitted uses are those set forth in Hawaii Revised Statutes §205-4.5; for lands classified other than A or B, the permitted uses are those set forth in §205-4.5 and also those uses set forth in §205-2.[2] Since the Site is on lands classified as D and E (refer to Figure 11 on page 3-4), the following proposed uses are permitted:

- Equestrian riding stables;[3]
- Open area recreational sports complex;[4]
- Golf course and driving range;[5]
- Orchards and other plant nursery activities;[6]
- Utility lines and roadways;[7]

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2. Hawaii Administrative Rules §15-15-25 (Land Use Commission).
3. Hawaii Revised Statutes sec. 205-4.5(a)(6).
4. Hawaii Revised Statutes sec. 205-2(d).
5. Hawaii Revised Statutes sec. 205-2(d).
6. Hawaii Revised Statutes sec. 2-5-4.5(a)(1).
7. Hawaii Revised Statutes sec. 2-5-4.5(a)(7).

- Trails through Site;[8]
- Native forest restoration and archaeological preservation.[9]

Proposed Uses Requiring Special Permit. For uses not specifically permitted by Hawaii Revised Statutes chapter 205, the Planning Commission may permit certain unusual and reasonable uses within the agricultural district.[10] The following proposed uses require a Special Permit:

- commercial uses;
- overnight transient accommodations (beach club, lodge);
- residential units (chalets);
- golf clubhouse and maintenance building(s);
- wastewater treatment plant;
- indoor sports recreation complex.

For Special Permits involving lands less than 15 acres, the county is the decisionmaker.[11] For permits involving lands greater than 15 acres, the county's approval is subject to approval by the State Land Use Commission.[12] The entire Project will be included in one Special Permit application in order to review the Project as a whole. Therefore, both the Planning Commission and the Land Use Commission must approve the application for this Project.

In determining an "unusual and reasonable use," the Planning Commission has adopted the guidelines listed below,[13] with a discussion applicable to the Project following each guideline:

- Such use shall not be contrary to the objectives to be sought by the Land Use Law and Regulations, which, for the Agricultural and Rural Districts, seeks to preserve or keep lands of high agricultural potential in agricultural use.

  In Neighborhood Board v. State Land Use Commission, 64 Haw. 265 (1982), the Hawaii Supreme Court ruled that the use of special permit procedures to effectuate what amounts to a district boundary amendment frustrates the effectiveness and objectives of the Land Use Law.

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8. Hawaii Revised Statutes sec. 2-5-4.5(a)(6).

9. Hawaii Revised Statutes sec. 2-5-4.5(a)(8).

10. Hawaii Revised Statutes §205-6.

11. Hawaii Revised Statutes sec. 205 -6.

12. For a Special Permit involving more than 15 acres, the Planning Commission must deny or recommend approval to the Land Use Commission within 30 days after the close of the hearing or within a longer period as may be agreed to by the petitioner (County of Hawaii Planning Commission Rules of Practice and Procedure §6-7). The Planning Commission must transmit the complete record of the proceeding to the Land Use Commission within 60 days after the decision is rendered; the Land Use Commission must render a decision within 45 days of receipt of the complete record (Hawaii Revised Statutes §205-6(e)). The Land Use Commission may impose additional restrictions as may be necessary or appropriate in granting approval (Hawaii Revised Statutes §205-6(d)).

13. County of Hawaii Planning Commission Rules of Practice and Procedure §6-3(b)(5).

That case involved a proposed 103-acre recreational theme park at Kahe Point. Several criteria can be distilled from that case to determine the appropriateness of the special permit in lieu of a district boundary amendment:

*1) **Agricultural suitability.** The proposed Site is marginal agricultural land (Land Study Bureau Class D). The Neighborhood Board case also involved marginal agricultural land (Land Study Bureau Class E). A recent Special Permit for the East Hawaii Campus of Kamehameha Schools was approved even if a portion involved prime agricultural land.*

*2) **Project size.** Although the Site consists of 494 acres, the actual developed portion will comprise approximately 95.3 acres, or less than one-fifth of the Site. Of this 95.3 acres, if the outdoor recreational facilities are considered a permitted use in the Agricultural district, then the actual uses that require a Special Permit comprise approximately 73.3 acres. The balance of the Site will be perpetually left in open space as a native forest, golf course, and other landscaped open space. The Neighborhood Board case involved 103 acres, most of it planned for full development. Project size is an important criterion, but not dispositive as noted by a recent decision by the State Land Use Commission in approving a special permit for a school (Kamehameha Schools' East Hawaii campus) on 300 acres. The intensity of use proposed for the school is indicated by the estimated cost of $260 million for the full build-out of the school. In comparison, the full build-out of the proposed Project is estimated at $82 million.*

*3) **Proposed use.** The Neighborhood Board case involved a concentration of built uses-- cultural theme rides, restaurants, fast food shops, retail stores, exhibits, theaters, an amphitheater, bank, nurseries, parking, sewage treatment plant, and other support services. The proposed built uses for the Project are clustered within a 95-acre portion of the Site in a landscaped setting. Unlike other uses that have been permitted by Special Permit and which have a strong relationship and preferential proximity to urban uses (e.g., schools), the proposed use thrives best in a remote rural setting. Although the Project may host some spectator events that draw crowds, these types of events are not the staple uses for these facilities as they may be for county-owned sports complexes (e.g., proposed Kapolei Sports Complex). The primary users of the sports facilities for the Project will be the visitors residing within the Project accommodations. The frequency of major spectator events is comparable to the sports events at the East Hawaii Kamehameha Schools. Residential uses have been permitted by Special Permit (e.g., dormitories for the East Hawaii Kamehameha Schools).*

*4) **Surrounding uses.** In the Neighborhood Board case, the surrounding areas were urban uses (e.g., Hawaiian Electric Kahe Power Plant) or transitioning to urban uses (lands further south of the site, although under sugar cultivation at the time of the application, were reclassified from Agricultural to Urban in June 1977 to permit construction of a residential, commercial and resort development). In comparison, the uses surrounding the Site are agricultural, County park, or undeveloped. To redistrict the Site to Urban would invite urbanization of the surrounding areas. By issuing a special permit, the underlying Agricultural zoning remains unchanged, and specific conditions can be tailored to the Project to ensure that the character and impacts of the Project do not encourage district boundary amendment requests to urbanize the surrounding lands.*

*5) **Opportunities to comment and cross-examine.** A special permit application does not in and of itself trigger the environmental review requirements under Hawaii Revised Statutes chapter 343. This Project does trigger chapter 343, and the EIS process will provide comprehensive information and opportunity to comment to any interested parties regardless of standing. In quasi-judicial contested case proceedings, such as district boundary amendment procedures, standing must first be established. Once established, the formal contested case*

procedures do provide for cross-examination. If parties feel they need the additional protections or powers offered by contested case procedures, they may request such procedures from the Planning Commission. In short, unlike the Neighborhood Board case, an EIS is being prepared for the Project. Contested case procedures similar to district boundary amendment procedures are available if requested.

- The desired use shall not adversely affect surrounding properties.
  The surrounding areas to the north, west, and east of the site are agricultural or undeveloped; nevertheless, these lands will be buffered by the preserved native forest, open space, or the golf course. Where proposed development borders another landowner to the south, landscape buffers would be established.
- Such use shall not unreasonably burden public agencies to provide roads and streets, sewers, water, drainage, school improvements and police and fire protection.
  The Applicant will provide the necessary roads, sewers, and drainage improvements to support the Project. The Applicant has already contributed towards the extension of water improvements to service the vicinity. The Applicant will also provide an additional reservoir to support the Project. The Project will not create a need for school improvements. Onsite security will minimize the impact on police protection. The Project design will conform with the Fire Code and other requirements of the Fire Department to ensure adequate water supply and pressure, fire truck access, and appropriate building design (fire rating of materials, sprinkler system as required).
- Unusual conditions, trends and needs have arisen since the district boundaries and regulations were established:
  A recent trend is ecotourism, with its emphasis on low-impact resort development in a natural setting, cultural learning, and health. The natural and cultural amenities of the site (geothermally warmed groundwater, native forest, archaeological sites) are an integral part of the overall Project.
- The land on which the proposed use is sought is unsuited for uses permitted within the district.
  The land is marginal agricultural land. Papaya is one of the few crops that can be grown. However, the papaya farms in this area were hit by disease. Papaya cultivation has expanded to other parts of the island, especially with the closing of the sugar plantations.
- The proposed use will not substantially alter or change the essential character of the land and the present use.
  The land is presently vacant. The low-scale design and extensive landscaping will preserve the rural character of the area.
- The proposed use will not be contrary to the goals, policies and standards of the General Plan and other applicable documents such as community development plans and design plans.
  The Project is consistent with General Plan and Puna Community Development Plan (see Section 4.3 and Section 4.5). The General Plan supports a retreat resort in the Puna area. To ensure that resort projects are low-scale and rural in character, the Puna Community Development Plan favors the controls of the Special Permit over wholesale resort zoning.
- The proposed use is an unusual and reasonable use of land, which would not be contrary to the objectives sought to be accomplished by the Land Use Law Rules and Regulations.

The proposed Project uses the geothermal groundwater and the native forest as unusual features for a resort in Hawaii. The Project is a unique blend of natural resource preservation, resort, sports complex, wellness facilities, and agriculture that does not readily fit into a permissible use category because it is a product of emerging trends (e.g., ecotourism and wellness) and unique site conditions.

In summary, the flexibility of the special permit was intended for these types of uses that could not possibly be foreseen. The Project differs from the Neighborhood Board case in its limited built-up scale, its rural remote character, the non-urban surrounding uses, and the procedural opportunities to comment through the EIS process and options for contested case hearings.

4.3 HAWAII COUNTY GENERAL PLAN

The General Plan Land Use Pattern Allocation Guide (LUPAG) Map designation for the Site is Orchards. Since the underlying zoning will remain Agriculture, no General Plan Amendment will be required.

The Project conforms with the following General Plan goals, objectives, standards, and courses of action:

ECONOMIC

GOALS

oProvide residents with opportunities to improve their quality of life.

oEconomic development and improvement shall be in balance with the physical and social environments of the island of Hawaii.

oThe County of Hawaii shall strive for diversity and stability in its economic system.

oThe County shall provide an economic environment which allows new, expanded, or improved economic opportunities that are compatible with the County's natural and social environment.

POLICIES

oThe County of Hawaii shall assist the expansion of the agricultural industry, especially diversified agriculture, through the protection of important agricultural lands, capital improvements and other programs, and continued cooperation with appropriate State and Federal agencies.

oThe County of Hawaii shall strive for an economic climate which provides its residents an opportunity for choice of occupation.

oThe County of Hawaii shall encourage the development of a visitor industry which is consistent with the social, physical, and economic goals of the residents of the County.

oThe County shall require a study of the significant social and physical impact of large developments prior to approval.

oThe County of Hawaii shall strive for diversification of its economy by strengthening existing industries and attracting new endeavors.

oThe County of Hawaii's land, water, air, sea, and people shall be considered as essential economic resources for present and future generations and should be protected and enhanced through the use of economic incentives.

oThe County shall strive for full employment.

oThe County shall conduct a re-evaluation of all economic goals and policies, particularly in the area of tourism, coincident with any County-initiated overall land use acreage allocation and General Plan review.

oThe County shall identify and encourage primary industries that are consistent with the social, physical, and economic goals of the residents of the County.

oAn active liaison between the County and the private sector should be encouraged with respect to the County's requirements for establishing business on the island.

oThe County of Hawaii shall encourage the continuing development of the retirement industry.

oThe County shall promote a distinctive identity for the island of Hawaii to enable government, business and travel industries to promote the County of Hawaii as an entity separate and unique within the State of Hawaii.

STANDARDS

oThe island of Hawaii should be developed into a unique scientific and cultural model. The island should become a model of living where economic gains are in balance with social and physical amenities. Development should be reviewed on the basis of total impact on the residents of the County, not only in terms of immediate short run economic benefits.

oNew industries which provide favorable benefit-cost relationships to the people of the County should be encouraged. Benefit-cost relationships as used here include more than fiscal considerations.

COURSES OF ACTION FOR PUNA

oThe County shall assist the further development of the agricultural industry by providing support services, such as co-operation with other agencies in developing manpower training programs, protecting important agricultural lands, and requesting and providing necessary capital improvements.

oThere is potential for limited visitor facilities in the form of small accommodations and support facilities, such as natural areas, botanical gardens, and limited commercial facilities. Resort growth should enhance and be in keeping with this area's rural character.

oThe fishing industry in Puna should be assisted by the County through a cooperative effort with State and Federal agencies.

oThe County shall support the development and utilization of geothermal resources and by-products consistent with the environmental, social, economic and other goals expressed elsewhere in the General Plan.

Discussion: The Project is an innovative mix of resort and agriculture. Besides an additional source of income, the agricultural component provides fresh produce, landscaping (e.g., orchards serving as golf course roughs), medicinal herbs, rural character, and cultural education (e.g., 'awa). The resort component provides a ready market for the various products grown on the Site, as well as agricultural and fishery products from the vicinity. The EB-5 immigration program that will finance the Project ensures that substantial direct and indirect jobs will be generated from the Project. If successful, the Project could serve as a unique model to balance the social and physical amenities. The Project's onsen facilities will also serve as a model in Hawaii for the utilization of geothermal resources.

ENVIRONMENTAL QUALITY

GOAL

oMaintain and, if feasible, improve the existing environmental quality of the island.

POLICIES

oThe County of Hawaii shall take positive action to further maintain the quality of the environment for residents both in the present and in the future.

oMinimum controls are established by the Federal and State governments; through its powers the County shall reinforce and strengthen established standards where it is necessary, principally by initiating, recommending, and adopting ordinances pertaining to the control of pollutants which affect the environment.

oThe County should keep apprised of and advise the public of environmental conditions and research undertaken about the island's environment.

oEncourage the concept of recycling agricultural and municipal waste material.

oThe County shall encourage the State to establish air and water quality monitoring stations in areas of existing and potential urban growth.

STANDARDS

oPollution shall be prevented, abated, and controlled at levels which will protect and preserve the public health and well-being, through the enforcement of appropriate Federal, State and County standards.

oEnvironmental quality controls are to be incorporated either as standards in appropriate ordinances or as conditions of approval.

oFederal and State environmental regulations shall be adhered to.

Discussion: The construction and operation of the Project will adhere to applicable Federal, State, and County environmental controls (see summary of controls in Table 5 on page 4-33). As a condition of approval, the Applicant will establish a water quality monitoring program to monitor potential impacts on the coastal, anchialine, and groundwater resources.

HISTORIC SITES

GOALS

oProtect and enhance the sites, buildings and objects of significant historical and cultural importance to Hawaii.

oAccess to significant historic sites, buildings and objects of public interest should be made available.

POLICIES

oAgencies and organizations, either public or private, pursuing knowledge about historic sites should keep the public apprised of projects.

oThe County of Hawaii shall incorporate sections to evaluate, manage, or protect historic sites, buildings and objects into appropriate ordinances.

oThe County of Hawaii shall require both public and private developers of land to provide a historical survey prior to the clearing or development of land when there are indications that the land under consideration has historical significance.

oPublic access to significant historic sites and objects shall be acquired.

oThe County of Hawaii shall embark on a program of restoring significant historic sites on County lands. Through a joint effort with the State, the County can assure the protection and restoration of sites on other public lands.

oThe County of Hawaii shall encourage the restoration of significant sites on private lands.

oThe County of Hawaii shall collect and distribute historic sites information of public interest and in conjunction with the State, keep a current inventory of sites.

oThe County shall also aid in the development of a program of public education concerning historic sites.

oSigns explaining historic sites, buildings and objects shall be in keeping with the character of the area or the cultural aspects of the feature.

oThe County of Hawaii shall develop a continuing program to evaluate the significance of historic sites.

STANDARDS

The evaluation of the importance of specific historic sites is necessary for future action. The following standards establish a framework for evaluating sites.

oImportance in the life or activities of a major historic person.

oAssociated with a major group or organization in the history of the island or community.

oAssociated with a major historic event (cultural, economic, military, social, or political).

oAssociated with a major recurring event in the history of the community (such as annual celebrations).

oAssociated with a past or continuing institution which has contributed substantially to the life of the community.

oUnique example of a particular style or period.

oOne of the few of its age remaining.

oOriginal materials and/or workmanship which can be valued in themselves.

oSites with a preponderance of original materials in context and complexes rather than single isolated sites unless they are of great significance.

oSites of traditional and cultural significance.

Discussion: The Applicant has conducted comprehensive archaeological inventory surveys that have been reviewed and approved by the State Historic Preservation Division. Since the significant sites are clustered within the native forest area, the preservation of this area will ensure the protection of these sites *in situ* (refer to Figure 17, "Relationship of Vegetation Types and Archaeological Sites," on page 3-14). The Applicant will also dedicate an area that contains significant archaeological sites to the County. The Project will include a restoration and interpretive program, developed with input from the community, that will enable public access to these resources and opportunities for cultural education.

NATURAL BEAUTY

GOALS

oProtect, preserve and enhance the quality of areas endowed with natural beauty, including the quality of coastal scenic resources.

oProtect scenic vistas and view planes from becoming obstructed.

oMaximize opportunities for present and future generations to appreciate and enjoy natural and scenic beauty.

POLICIES

oIncrease public pedestrian access opportunities to scenic places and vistas.

oThe County of Hawaii shall establish view plane regulations to preserve and enhance views of scenic or prominent landscapes from specific locations, and coastal aesthetic values.

oThe County of Hawaii shall maintain a continuing program to identify, acquire and develop viewing sites on the island.

oAccess easement to public or private lands which have natural or scenic value shall be provided or acquired for the public.

oStandard criteria for natural and scenic beauty shall be developed as part of design plans.

oThe County shall consider structural setback from major thoroughfares and highways and shall establish development and design guidelines to protect important viewplanes.

oThe County of Hawaii shall maintain a continuing program to identify exceptional trees or tree masses.

STANDARDS

The following standards provide guidelines for designating sites and vistas of extraordinary natural beauty which shall be protected.

oDistinctive and identifiable landforms distinguished as landmarks, e.g. Mauna Kea, Waipio Valley.

oCoastline areas of striking contrast, e.g. Laupahoehoe Point.

oVistas of distinctive features.

oNatural or native vegetation which makes a particular area attractive.

oAreas which are harmoniously developed and enhanced by man so as to appear natural.

Discussion: The native forest area on the Site, one of the last vestiges of a native forest of this size in the vicinity, is a scenic resource that will be preserved. Trails through the forest will provide pedestrian access to the area. As part of the Project, the existing coastal road fronting the Site will be re-routed inland because of the frequent inundation of the road by high waves or tides. The existing road corridor will then be developed as a pedestrian and bikeway to enjoy the coastal vistas.

NATURAL RESOURCES AND SHORELINE

GOALS

oProtect and conserve the natural resources of the County of Hawaii from undue exploitation, encroachment and damage.

oProvide opportunities for the public to fulfill recreational, economic, and educational needs without despoiling or endangering natural resources.

oProtect and promote the prudent use of Hawaii's unique, fragile, and significant environmental and natural resources.

oProtect rare or endangered species and habitats native to Hawaii.

oProtect and effectively manage Hawaii's open space, watersheds, and natural areas.

oEnsure that alterations to existing land forms and vegetation, except crops, and construction of structures cause minimum adverse effect to water resources, and scenic and recreational amenities and minimum danger of floods, landslides, erosion, siltation, or failure in the event of earthquake.

POLICIES

oThe County of Hawaii should require users of natural resources to conduct their activities in a manner that avoids or minimizes adverse effects on the environment.

oThe County shall encourage a program of collection and dissemination of basic data concerning natural resources.

oThe shoreline of the island of Hawaii shall be maintained for recreational, educational, and/or scientific uses in a manner that is protective of resources and is of the maximum benefit to the general public.

oThe shoreline shall be protected from the encroachment of man-made improvements and structures.

oThe County shall coordinate programs to protect natural resources with other government agencies.

oThe County shall promote sound management and development of Hawaii's land and marine resources for potential economic benefit.

oThe County shall encourage public and private agencies to manage the natural resources in a manner that avoids or minimizes adverse effects on the environment and depletion of energy and natural resources to the fullest extent.

oThe County shall encourage an overall conservation ethic in the use of Hawaii's resources by protecting, preserving, and conserving the critical and significant natural resources of the County of Hawaii.

oEncourage the use of native plants for screening and landscaping.

STANDARDS

The following shall be considered for the protection and conservation of natural resources.

oAreas necessary for the protection and propagation of specified endangered native wildlife, and conservation for natural ecosystems of endemic plants, fish and wildlife.

oLands necessary for the preservation of forests, park lands, wilderness and beach areas.

oLands with a general slope of 20% or more which provide open space amenities or possess unusual scenic qualities.

oLands necessary for the protection of watersheds, water sources and water supplies.

oLands with topographic, locational, soils, climate or other environmental factors that may not be normally adaptable or required for urban, rural, agricultural or public use.

oThe Coastal Zone and Special Management Area as defined by statute and in accordance with the adopted objectives and guidelines.

Discussion: The Project is located entirely away from the shoreline and out of the Special Management Area. Other shoreline parcels owned by the Applicant but not part of the Project will be dedicated to the County to expand the County's Ahalanui Beach Park. The native forest area on the Site is a natural ecosystem of endemic plants that will be preserved.

PUBLIC UTILITIES

GOALS

oEnsure that adequate, efficient and dependable public utility services will be available to users.

oMaximize efficiency and economy in the provision of public utility services.

oTo have public utility facilities which are designed to fit into their surroundings or concealed from public view.

POLICIES

oPublic utility facilities shall be designed so as to complement adjacent land uses and shall be operated so as to minimize pollution or disturbance.

oThe County shall encourage the use of properties or easements owned by public or private utility companies or agencies as supplemental open space and recreational areas whenever practical.

oProvide utilities and service facilities which minimize total cost to the public and effectively service the needs of the community.

oUtility facilities shall be designed to minimize conflict with the natural environment and natural resources.

oImprovement of existing utility services shall be encouraged to meet the needs of users.

oEncourage the clustering of developments in order to reduce the cost of providing utilities.

oThe County shall develop short and long range capital improvement programs and plans for public utilities within its jurisdiction and which are consistent with the County General Plan.

(1)*WATER*

POLICIES

oWater system improvements and extensions shall promote the County's desired land use development pattern.

oAll water systems shall be designed and built to Department of Water Supply standards.

oImprove and replace inadequate systems.

oWater sources shall be adequately protected to prevent depletion and contamination from natural and man-made occurrences or events.

oWater system improvements should be first installed in areas which have established needs and characteristics, such as occupied dwellings and other uses, or in areas adjacent to them if there is need for urban expansion, or to further the expansion of the agricultural industry.

oA systematic program by the County, State and private interest shall identify sources of additional water supply to ensure the development of sufficient quantities of water for future needs of high growth areas.

oThe fire prevention systems shall be coordinated with water distribution systems in order to ensure water supplies for fire protection purposes.

STANDARD

oWater systems shall meet the requirements of the Department of Water Supply and the Subdivision Control Code.

COURSES OF ACTION FOR PUNA

oImprove inadequate water system facilities.

oWater source investigation and exploration should be continued in order to provide service for anticipated needs.

(2)*TELEPHONE*

POLICIES

oThe County shall encourage underground telephone lines where they are economically and technically feasible.

oThe County shall work closely with the telephone company to provide all users with efficient service.

STANDARD

oIn the development and placement of telephone facilities, such as lines, poles and substations, the design of the facilities shall consider the existing environment, and scenic view and vistas shall be considered and preserved where possible.

(3)*ELECTRICITY*

POLICIES

oPower distribution shall be placed underground when and where feasible. The County shall encourage developers of new urban areas to place utilities underground.

oRoute selection for high voltage transmission lines should include consideration for setbacks from major thoroughfares and residential areas.

oThe County should encourage electrical utility companies to develop a comprehensive plan for the generation, transmission, and distribution of electrical power to the various parts of the island.

oSafety standards for power systems shall conform to safety standards as established by appropriate regulatory authority.

STANDARDS

oThere shall be a minimization of obstruction of scenic views and vistas by electrical facilities.

oFacilities such as substations shall be aesthetically pleasing.

(5)*SEWER*

POLICIES

oThe "Sewerage Study for All Urban and Urbanizing Areas of the County of Hawaii, State of Hawaii," December 1970, and the "Water Quality Management Plan for the County of Hawaii," December 1980, shall be used as guides for the general planning of sewerage disposal systems.

oPrivate systems shall be installed by land developers for major resort and other developments along shorelines and sensitive higher inland areas, except where connection to nearby treatment facilities is feasible and compatible with the County's long-range plans, and in conformance with state and county requirements.

oDisposal of raw sewage directly into waterways and the ocean shall be discontinued as soon as possible.

oSchemes for wastewater reclamation and reuse for irrigation shall be utilized where feasible and needed.

STANDARDS

oIncorporate sewage works standards proposed in the "Sewerage Study for All Urban and Urbanizing Areas of the County of Hawaii" and the "Water Quality Management Plan for the County of Hawaii."

oSewerage systems shall be designed for the particular area, depending on topography, geology, density of population, costs, and other considerations of the specific area.

oThere shall be a minimum of visual and odor pollution emanating from sewerage treatment facilities.

oApplicable standards and regulations of the State Department of Health, Chapter 23 "Underground Injection Control."

oApplicable standards and regulations of the State Department of Health, Chapter 54 "Water Quality Standards."

oApplicable standards and regulations of the State Department of Health, Chapter 55 "Water Pollution Control."

oApplicable standards and regulations of Chapter 342, HRS; Act 282, Session Laws of Hawaii 1985; and Act 302, Session Laws of Hawaii 1986, Relating to Environmental Quality.

COURSE OF ACTION FOR PUNA

oThe use of cesspools shall be discontinued in the coastal areas where cesspools do not function satisfactorily to meet water quality standards. Individual household aerobic treatment units approved by the State Health Department and the County of Hawaii could be utilized in these areas. Future sewerage systems for the Puna area would then naturally commence with service to the lower coastal areas.

Discussion: The Project has assisted to finance the extension of water service to the area, which has enabled servicing the County park facilities. All water improvements have been and will be constructed to County standards and dedicated to the County. The Project includes a private wastewater treatment plant. The wastewater effluent will be reclaimed for irrigation; there will be no ocean disposal of wastes. Since the package treatment plant will be underground, there will be no visual impacts emanating from the treatment facilities.

RECREATION

GOALS

oProvide a wide variety of recreational opportunities for the residents and visitors of the County.

oMaintain the natural beauty of recreation areas.

oProvide a diversity of environments for active and passive pursuits.

POLICIES

oThe County of Hawaii shall improve existing public facilities for optimum usage.

oRecreational facilities in the County shall reflect the natural, historic, and cultural character of the area.

oThe use of land adjoining recreation areas shall be compatible with community values, physical resources and recreation potential.

oFacilities for compatible multiple uses shall be provided.

oThe County shall provide facilities and a broad recreational program for all age groups, with special considerations for the handicapped, the elderly, and young children.

oThe County shall coordinate recreational programs and facilities with governmental and private agencies and organizations. Innovative ideas for improving recreational facilities and opportunities shall be considered.

oThe County of Hawaii shall adopt an on-going program of identification, designation, and acquisition of areas with recreational resources, such as land with sandy beaches and other prime areas for shoreline recreation.

oPublic access to the shoreline shall be provided in accordance with an adopted program of the County of Hawaii.

oThe County shall establish a system of pedestrian access trails to places of scenic, historic, natural or recreational values.

oThe County in coordination with appropriate State agencies shall establish a program to inventory ancient trails, cart roads and old government roads on the island.

oThe County shall develop facilities and safe pathway systems for walking, jogging and biking activities.

oThe County shall review and, if appropriate, revise its ordinance requiring subdivisions to provide land area for park and recreational use or pay a fee in lieu thereof.

STANDARDS

Regional Parks:

Major recreation area serving several districts and providing indoor and outdoor activities. A major center for spectator sports and cultural activities. May include features of historic, geological, and horticultural interests.

Vicinity of major populated areas.

Facilities include: multi-purpose building, auditorium, gymnasium, swimming pool, adequate and defined parking area, and facilities for spectator sports: football, baseball, softball, track field, tennis, basketball and volleyball.

District Parks:

Offer diversified types of recreational activities which include indoor and outdoor sports during the day as well as nights.

Within a district consisting of several populated communities and good topography.

Facilities include: gymnasium with office, storage, restrooms, showers; a center for community and recreational programs; swimming pool (if justifiable); play area and equipment for young children; courts for basketball, tennis, and volleyball; ballfields for soccer, baseball, softball and football; night lights; and adequate parking area.

Community Parks:

Community recreation area serving a 1 mile radius in urban areas, and entire community in rural areas. Provide active and passive activities.

Between 4 and 8 acres, within the center of the community or several neighborhoods.

Facilities include: recreation building with multi-purpose room, office, storage, restrooms and parkkeeper's room; swimming pool; gymnasium (where not serviceable from a district park); courts for basketball, volleyball and tennis; ballfields for softball/baseball, soccer, football; play area and equipment for young children; walking and jogging paths; picnic and passive area; night lights and adequate defined parking area.

Neighborhood Parks:

Provide open space in urbanizing areas for the general aesthetic enjoyment of the outdoors, play areas for young children, and a social gathering place for the neighborhood.

Up to 4 acres, within the center of the neighborhood and preferably adjacent to a school.

Minimum facilities include: restrooms; drinking water; parkkeeper's storage; walking and jogging paths (bike and skating paths); courts for basketball, volleyball and tennis; ballfields for tetherball, baseball/softball and soccer; play area and equipment for young children; and an adequate and defined parking area.

Community Centers:

Major center for spectator sports and for cultural and social activities.

Size depends on facilities proposed and accessory uses.

Facilities include: multipurpose building; auditorium; gymnasium; facilities for spectator sports; swimming facility; and adequate and defined parking.

Parks for General Use:

Centered around a major natural asset, such as a sandy beach, a prime forest, or a volcanic feature and including historic sites whenever feasible.

Designed to accommodate users from throughout the County.

Beach parks provide opportunities for swimming/sunbathing, surfing, camping, fishing, boating, nature study, and other pastimes. Every section of the island should be adequately served. Facilities depend on size and intensity of use but should include: restrooms with showers and changing area; picnic area with tables and cooking facilities; a defined tent camping area when allowed; drinking water; defined and adequate parking; pavilions of various sizes; lifeguard facilities; and storage for groundskeeper and lifeguard equipment.

Wilderness and wildland areas are remote from population centers and have limited access by jeep, hiking, biking, or horseback.

Facilities include: trails and unimproved roads; designated hunting and fishing areas; designated conservation areas for nature study and other passive activities; wilderness camp sites with simple shelters where needed; outhouse facilities; and drinking water.

COURSES OF ACTION FOR PUNA

None applicable to the Project.

Discussion: The Project will provide professional- or Olympic-standard indoor and outdoor recreational facilities. The overnight facilities will enable residents from all parts of the County to use the facilities. There may be opportunities to observe or participate in training sessions of visiting professional athletes. Trails will provide access to the native forest area. Since the Project is not located along the shoreline, the requirement for public shoreline access is not applicable. The Applicant will dedicate land adjacent to the existing County Ahalanui Beach Park for the expansion of this park. The Applicant will also dedicate land across the park for parking and preservation of historic sites.

LAND USE

Through the careful analysis and examination of past and present situations, the following goals, policies, and standards are set forth to physically plan the lands in the County in the best interest of the island's residents.

GOALS

oDesignate and allocate land uses in appropriate proportions and mix and in keeping with the social, cultural, and physical environments of the County.

oProtect and encourage the intensive utilization of the County's important agricultural lands.

oProtect and preserve forest, water, natural and scientific reserves and open areas.

POLICIES

oZone urban- and rural- types of uses in areas with ease of access to community services and employment centers and with adequate public utilities and facilities.

oPromote and encourage the rehabilitation and use of urban and rural areas which are serviced by basic community facilities and utilities.

oAllocate appropriate requested zoning in accordance with the existing or projected needs of neighborhood, community, region and County.

oMaintain the "land zoning bank" from which land use zoning may be allocated to specified urban and rural centers and districts.

oConduct a review and re-evaluation of the real property tax structure to assure compatibility with land use goals and policies.

oIncorporate innovations such as the "zone of mix" and "mixed use zones" into the Zoning Code.

oIncorporate the concept of a "floating zone" for future industrial and retreat resort areas, to allow flexibility in locating future needed developments which cannot be pinpointed at this time, especially in the more rural and/or remote areas.

oThe county shall encourage the development and maintenance of communities meeting the needs of its residents in balance with the physical and social environment.

oConduct a review and re-evaluation of the Zoning Code in light of emerging new industries and technologies and incorporate revisions to land use regulations as necessary.

oThe County shall develop, in cooperation with community residents, community development or regional plans for all of the districts or combinations of districts and shall periodically review and amend these documents as necessary or as mandated.

STANDARDS

oThe designated land uses will be delineated on the General Plan Land Use Pattern Allocation Guide Map. The broad-brush boundaries indicated are graphic expressions of the General Plan policies, particularly those relating to land uses. They are long-range guides to general location and will be subject to: a) existing zoning; b) State Land Use District; and c) zone guide map and interpretation. Similarly, the acreages allocated represent alternatives for the various levels of economic activity and supporting functions, such as resort, residential, commercial and industrial activities. Land required for community and governmental services and programs as well as new towns and resort centers may be accommodated within the allocated acreages.

oZoning requests shall be reviewed with respect to General Plan designation, district goals, regional plans, State Land Use District, compatibility with adjacent zoned uses, availability of public services and utilities, access, and public need.

oZoning may be recommended on an incremental basis depending upon construction schedule, development of supporting services and facilities, and other pertinent factors bearing upon the performance of the petitioner.

oZoning may be reallocated as to location within districts according to need with or without change in total zoned acreage.

oZoning of areas for industrial and retreat resort uses under the "floating zone" concept shall be required to meet all pertinent elements of the General Plan.

Discussion: The Project will use marginal agricultural lands, and will provide or improve the necessary public utilities. The forest area on the Site will be preserved as open space. To ensure the long-term preservation of the forest area and take advantage of tax incentives, the Applicant will dedicate the area as a native forest to qualify for real property tax. The Project will create an employment center for the region. The Project is a nonconventional type of rural resort use that must use the flexibility of the Special Permit to accommodate the unique mix of sports/resort/ wellness/agriculture/cultural uses.

(1)*AGRICULTURE*

The following goals and policies are intended to address some of the land related problems of agriculture and are to be consistent with and supportive of the overall land use element.

GOAL

oIdentify, protect and maintain important agriculture lands on the island of Hawaii.

POLICIES

oZoning shall protect and maintain important agricultural lands from urban encroachment. New approaches to preserve important agricultural land shall be implemented by the County.

oThe County shall assist in the development of basic resources such as water, roads, transportation and distribution facilities for the agricultural industry.

oAgricultural land shall be used as one form of open space or as green belt.

oThe County shall coordinate and encourage efforts to solve the problems of the agricultural industry in the County of Hawaii.

oThe compatibility of agricultural and non-agricultural uses should be carefully reviewed and where appropriate, buffers required.

oRural-style residential-agricultural developments, such as new small-scale rural communities or extensions of existing rural communities, shall be encouraged in appropriate locations.

oThe County shall develop subdivision standards which make a distinction between agricultural and urban land uses.

oDesignate, protect and maintain important agricultural lands from urban encroachment. New approaches to preserve important agricultural land shall be implemented by the County.

oThe County shall ensure that development of important agricultural land shall be primarily for commercial agricultural use purposes.

COURSES OF ACTION FOR PUNA

oAssist in the provision of water in agricultural areas.

oAssist in the further development of diversified agriculture in the district.

Discussion: The Project proposes a rural-style resort-agricultural use on marginal agricultural land. The Project attempts to create a market for the agricultural products grown on the premises. The Project also attempts to grow a commercially valuable product, 'awa, in a manner that recreates past cultural practices.

(2)COMMERCIAL DEVELOPMENT

Following an examination and analysis of present and past situations concerning commercial development, the following goals, policies, and standards have been set forth.

GOALS

oProvide for commercial developments that maximize convenience to users.

oProvide commercial developments that complement the overall pattern of transportation and land usage within the island's regions, communities, and neighborhoods.

POLICIES

oCommercial facilities shall be developed in areas adequately served by necessary services, such as water, utilities, sewers, and transportation systems. Should such services not be available, the development of more intensive uses should be in concert with a localized program of public and private capital improvements to meet the expected increased needs.

oDistribution of commercial areas shall be such as to best meet the demands of neighborhood, community and regional needs.

oThe development of commercial facilities should be designed to fit into the locale with minimal intrusion while providing the desired services. Appropriate infrastructure and design concerns shall be incorporated into the review of such developments.

oApplicable ordinances shall be reviewed and amended as necessary to include considerations for urban design, aesthetic quality and the protection of amenities in adjacent areas through landscaping, open space and buffer areas.

STANDARDS

There are three basic types of shopping centers:

o1)Neighborhood Centers

Provide: Convenience goods, e.g., foods, drugs, and personal services.

Major Shops: Supermarket and/or drug store.

Number of Shops: 5 to 15.

Acreage: 5 to 10 acres.

Approximate Market: 3,000 people.

o2)Community Centers

Provide: Convenience goods, plus "soft line" items, such as clothing, and "hard line" items, such as hardware and small appliances.

Major Shops: Variety or junior department store.

Number of Shops: 20 to 40.

Acreage: 10 to 30 acres.

Approximate Market: 15,000 people.

o3)Regional Centers

Provide: Full range of merchandise and services.

Major Shops: Full size department store.

Number of Shops: 40.

Approximate Market: 50,000 people.

oCommercial development shall be located in areas adequately served by transportation, utilities, and other amenities. Commercial developments shall provide for adequate internal circulation amongst commercial facilities in the area.

oOff-street parking and loading facilities shall be provided.

oCommercial development shall maintain or improve the quality of the present environment through the consideration of visual, access, landscaping, and other design elements in their development.

oPreference shall be given to commercial lands with a reasonably level topography.

COURSES OF ACTION FOR PUNA

oCentralization of commercial activities in Pahoa shall be encouraged.

oExpanded commercial services to meet the needs of population growth in the Puna district shall be encouraged in the area of Keaau.

oRehabilitation of existing commercial development in appropriate locations shall be encouraged.

oAppropriately zoned lands shall be allocated as the need arises.

Discussion: The proposed commercial area meets the standards for a neighborhood center. It will be a small-scale retail area for the convenience of the visitors and residents of the area. The Project will provide or improve the necessary services-- the road system will be improved, the private wastewater treatment plant will serve the area, water will be provided, and utilities will be provided. Adequate onsite parking and loading will be provided. The commercial facilities will be designed to fit the rural character with adequate landscaping.

(6)*RESORT*

GOALS

oMaintain an orderly development of the visitor industry.

oProvide for resort development that maximizes conveniences to its users and optimizes the benefits derived by the residents of the County.

oEnsure that resort developments maintain the social, economic, and physical environments of Hawaii and its people.

POLICIES

oThe County may impose incremental and conditional zoning which would be based on performance requirements.

oPromote and encourage the rehabilitation and the optimum utilization of resort areas which are presently serviced by basic facilities and utilities.

oZoning of resort areas shall be granted when the proposed development is consistent with and incorporates the stated goals, policies and standards of the General Plan.

oThe County shall continue to seek funds from the State Capital Improvement Program to help develop visitor destination areas in accordance with the County's General Plan.

oThe County shall designate and allocate future resort areas in appropriate proportions and in keeping with the social, economic, and physical environments of the County.

oThe County shall evaluate resort areas and the areas surrounding existing resorts to insure that viable quality resorts are developed and that the surrounding area contributes to the quality, ambience and character of the existing resorts.

oThe County shall encourage the visitor industry to provide resort facilities which offer an educational experience of Hawaii as well as recreational activities.

oCoastal resort developments shall provide public access to and parking for beach and shoreline areas.

oThe County shall re-evaluate existing undeveloped resort designated and/or zoned areas and reallocate resort designated and/or zoned lands in appropriate locations.

oThe concept of a "floating zone" shall be used to allow for the future development of retreat resort areas.

STANDARDS

The following established standards shall guide the development of resort areas.

Destination Resort Community

A destination resort is a self-contained resort destination area which provides basic and support facilities for both the needs of the entire development and the surrounding regional area. Such facilities shall include employee housing, recreational facilities, regional civic center facilities, other community facilities serving the region. Basic infrastructure needs such as water, sewer and roads for the entire development shall be provided.

The designation of any destination resort community shall be established through a formal General Plan Amendment accompanied by an Environmental Impact Statement.

Maximum hotel and condominium-hotel units: to be determined in conjunction with the adoption of a master plan for the destination resort community's zoning.

Resort Acreage: to be determined in conjunction with the adoption of a master plan for the destination resort community's zoning.

Active and passive recreation area: to be determined in conjunction with the adoption of a master plan for the *destination resort community's zoning.*

Residential acreage: acreage shall include areas for employee housing and/or affordable housing and shall be determined in conjunction with the adoption of a master plan for the destination resort community's zoning.

The required employee housing ratio and method of provision shall be determined by an analysis of housing needs of each district or relative area and with the adoption of the resort zoning; provided that the ratio shall not exceed one employee unit for every two hotel units built.

Major Resort Area

A major resort area is a self-contained resort destination area which provides basic and support facilities for the needs of the entire development. Such facilities shall include sewer, water, roads, employee housing and recreational facilities, etc..

Maximum hotel and condominium-hotel units: 3,000 rooms.

Resort acreage: 90 acres minimum.

Active and passive recreation areas: 50 acres minimum.

Either participate in an off-site housing program or a maximum of 640 acres for residential use when other zoned lands are not available in close proximity for support use.

The required employee housing ratio and method of provision shall be determined by an analysis of housing needs of each district or relative area and with the adoption of the resort zoning; provided that the ratio shall not exceed one employee unit for every two hotel units built.

Intermediate Resort Area

An intermediate resort area is a self-contained resort destination area which provides basic and support facilities for the needs of the entire development on a smaller scale than a major resort area. Such facilities shall include sewer, water, roads, employee housing and recreational facilities, etc..

Maximum hotel and condominium-hotel units: 1,500 rooms.

Resort acreage: 45 acres minimum.

Active and passive recreation area: 25 acres minimum.

Either participate in an off-site housing program or a maximum of 320 acres for residential use when other zoned lands are not available in close proximity for support use.

The required employee housing ratio and method of provision shall be determined by an analysis of housing needs of each district or relative area and with the adoption of the resort zoning; provided that the ratio shall not exceed one employee unit for every two hotel units built.

Minor Resort

A minor resort area shall not exceed the density of an intermediate resort area and is generally an area with many small property owners or an isolated resort development without sufficient land area to develop into a self-contained destination area.

Maximum hotel and condominium-hotel units: 500 Rooms.

Resort acreage: 35 acres minimum.

Provide active and passive recreation area commensurate with the scale of development.

The required employee housing ratio and method of provision shall be determined by an analysis of housing needs of each district or relative area and with the adoption of the resort zoning; provided that the ratio shall not exceed one employee unit for every two hotel units built.

Retreat Resort Area

A retreat resort area is generally an area which provides the user with rest, quiet, and isolation for an environmental experience. It shall have sewer, water, roads, employee housing, and recreational facilities, etc..

Maximum hotel and condominium-hotel units: up to 100 rooms to be determined in conjunction with retreat resort area's zoning.

Resort acreage: 15 acres minimum.

Provide active and passive recreation area commensurate with the scale of development.

The required employee housing ratio and method of provision shall be determined by an analysis of housing needs of each district or relative area and with the adoption of the resort zoning; provided that the ratio shall not exceed one employee unit for every two hotel units built.

COURSES OF ACTION FOR PUNA

oThe development of visitor accommodations and any resort development in the district shall complement the character of the area and be consistent with the General Plan.

oConsider the development of small family or 'bed and breakfast' type visitor accommodations and small-scale retreat resort development.

Discussion: The Project falls into the category of a retreat resort. The short-term overnight accommodations consist of the 40 lodge units and 30 beach club units for a total of 70 units. The natural features of the Site are integrally designed into the Project-- the native forest, the historic sites, the geothermal groundwater for onsens. The agricultural components (e.g., orchards, equestrian facilities) create a rural setting that distinguishes this project from other typical resorts. The Project will create job opportunities in a region that needs it, with preference given to qualified existing residents for available jobs.

(7)OPEN SPACE

The following goals, policies, and standards are set forth to insure the protection and wise use of open space in the County of Hawaii.

GOALS

oProvide and protect open space for the social, environmental, and economic well-being of the County of Hawaii and its residents.

oProtect designated natural areas.

POLICIES

oOpen space in the County of Hawaii shall reflect and be in keeping with the goals, policies, and standards set forth in the other elements of the General Plan.

oOpen space in urban areas shall be established and provided through zoning and subdivision regulations.

oThe County of Hawaii shall encourage the identification, evaluation, and designation of natural areas.

oZoning, subdivision and other applicable ordinances of the County of Hawaii shall provide for and protect open space areas.

STANDARDS

oOpen Space designations shall include:

Forest Reserves

Water Areas

Potential Natural Hazard Areas

Natural Areas and Reserves

Open Space Recreation Areas

Scenic Vistas and Viewplanes

General Use Conservation Sub-zones with Compatible Uses

Scientific Areas, including Habitats of Endemic Species

Discussion: The native forest area on the Site will be preserved in open space. Any development within the flood hazard zone along the makai portion of the Site will comply with the County's Flood Control Code. The proposed golf course will also create a landscaped open space recreation area that will also function as a drainage retention area.

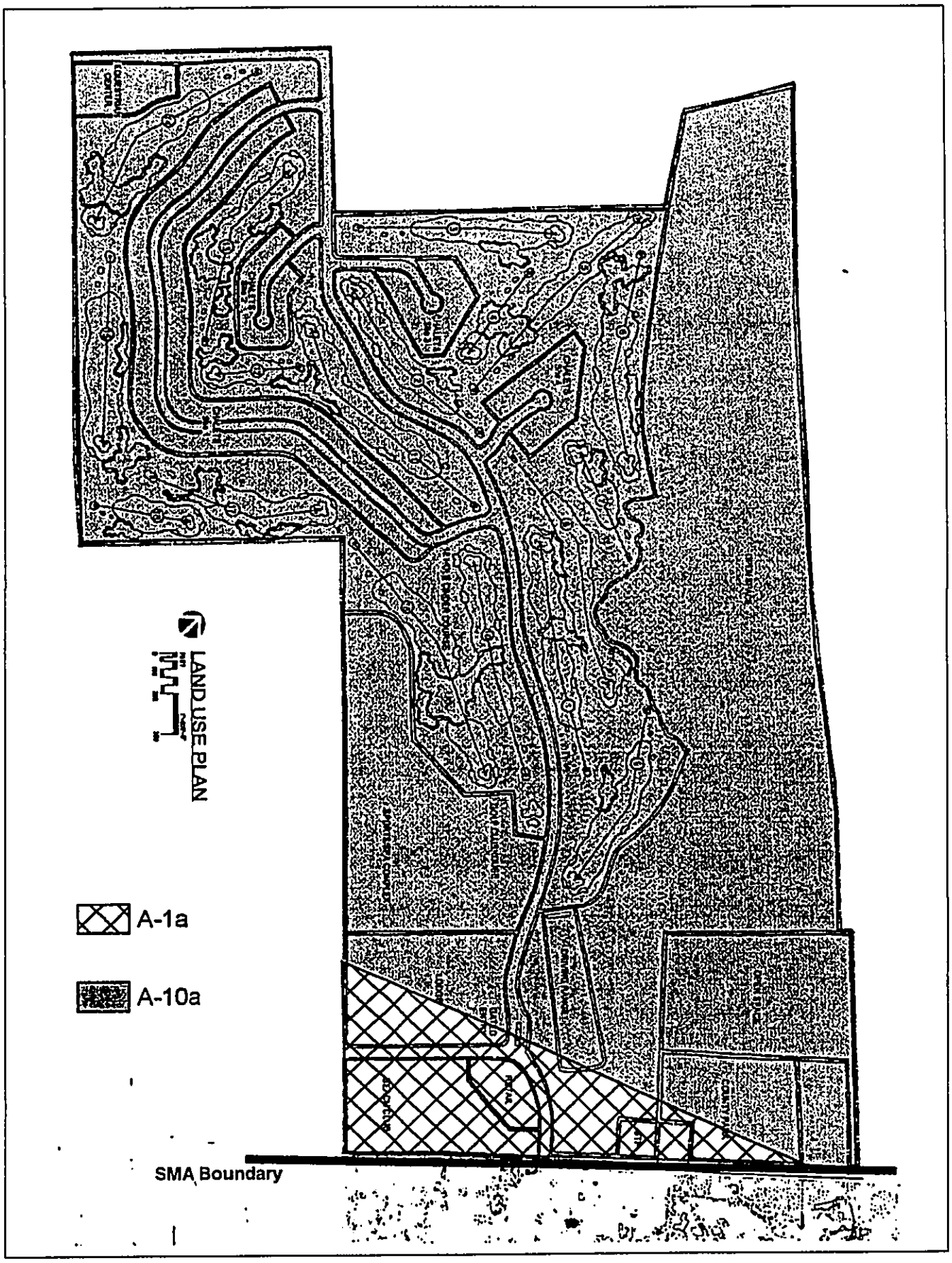
4.4 HAWAII COUNTY ZONING AND SUBDIVISION CODES

A portion of the *makai* area of the Site is zoned A-1a, and the balance of the Site is zoned A-10a (see Figure 30). The existing zoning will remain unchanged. Within the agricultural zoning district, the zoning code requires a Use Permit for golf courses and related uses (e.g., driving ranges, club houses, maintenance buildings) even if the State Land Use Law permits golf courses and driving ranges (but not clubhouses and maintenance buildings) within the State Agricultural District.[14] Although the Applicant received a grading permit for the golf course, this permit expired in 1998.[15]

14. Hawaii County Code §25-5-72(b)(1).

15. Grading Permit No. 004441.

FIGURE 30. Existing Zoning



The Applicant intends to apply for subdivision approval to create 4 separate lots and a roadway lot (see Figure 31). The lots will be for the commercial area (14.9 acre lot), the lodge area (14.9 acre lot), the lot to be dedicated to the County for the park (11.242 acre lot), and one large lot, traversed by a roadway easement, for the golf course and related facilities, sports complex, equestrian facilities, native forest area, and chalets. The roadway on the roadway lot will be constructed to the County's standards and dedicated to the County. The roadway easement will be a private road. The orchards may be established as agricultural easements to ensure a long-term commitment to agriculture and to define the area that could benefit from agricultural property tax rates.

4.5 PUNA COMMUNITY DEVELOPMENT PLAN

Although approved by the Planning Commission, the Puna Community Development Plan has not yet been adopted by the County Council. The plan designates the Site as agricultural in a lava hazard zone.[16] Permitting the Project in an agricultural land use district (i.e., State Land Use Agricultural, General Plan Orchards, and County Agricultural zoning) would be consistent with the Puna Community Development Plan's goals to encourage diversified agriculture, maintain the rural character, promote smaller scale resort development by special permit rather than wholesale resort zoning, and encourage collaboration among interrelated commercial, resort, and agricultural uses.[17] The proposed limited improvements to the Kapoho-Kalapana road, coupled with the routing of the proposed electrical lines away from the Kapoho-Kalapana right-of-way, would preserve the road's scenic qualities consistent with the recommendations of the Community Development Plan.[18] Other proposed road and traffic improvements consistent with the Plan include the rerouting of the Kapoho-Kalapana Road in the vicinity of Pohoiki and the suggestion to turn the Mango Road into a one-way road.

4.6 COASTAL ZONE MANAGEMENT AND SPECIAL MANAGEMENT AREA

The Project is located outside the Special Management Area (SMA). The SMA boundary follows the *makai* boundary of the Kapoho-Kalapana Road. Although the Project does not require a SMA Permit, because the "coastal zone management area" includes all lands, whether within or outside the SMA, the Project must still conform with the objectives and policies of the Coastal Zone Management Act.[19] The Project is consistent with the CZM objectives and policies (see Appendix A, "Hawaii CZM Program Assessment Form").

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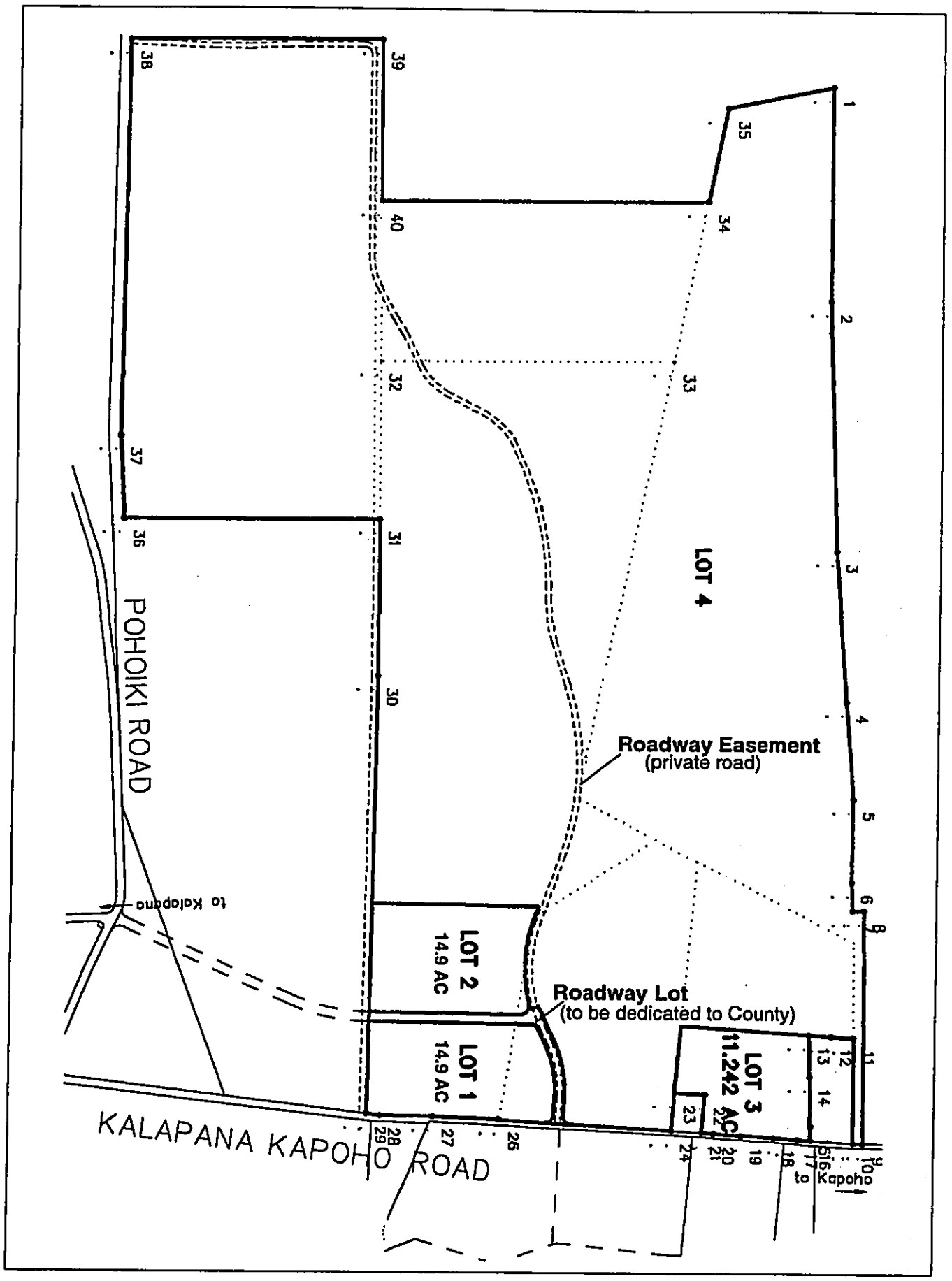
16. Community Management Associates, Inc. Puna Community Development Plan. Prepared for the County of Hawaii Planning Department. May 1995 (second draft).

17. Ibid., p. 2-7 and -8 (recommendations for Agriculture and Resort policies).

18. Ibid., p. 2-13.

19. Hawaii Revised Statutes sec. 205A-1 (definition of coastal zone management area); sec. 205A-4(b) (objectives and policies binding upon actions within coastal zone management area).

FIGURE 31. Proposed Subdivision



4.7 OTHER PERMITS AND APPROVALS

The Project will require grading and building permits. If drywells are required, the drywells may require an Underground Injection Control (UIC) Permit from the Department of Health (DOH). Since the limits of grading for the improvements will involve more than 5 acres, the non-point source controls under the NPDES Permit administered by DOH will likely apply to the Project. A project identification sign will require a sign permit. The lodge, restaurant, sports complex, and other facilities that qualify as public accommodations or commercial facilities must comply with the requirements of the Americans with Disabilities Act.

TABLE 5. List of Permits

Permit or Approval	Authority[1]	Approving Agency
FEDERAL		
Americans with Disabilities Act Design Guidelines	Americans with Disabilities Act (P.L. 101-336)	judiciary (enforcement by litigation)
STATE OF HAWAII		
Underground Injection Control (possibly)	HAR Chap. 11-23	Department of Health
NPDES	HAR Chap. 11-55	Department of Health
Historic Preservation written concurrence	?	State Historic Preservation Division
Conformance with burial site requirements	HRS sec. 6E-43	State Historic Preservation Division, Burial Council, OHA, others
Well Drilling Permit (possibly)	HAR Chap. 13-168	Department of Land and Natural Resources
Wastewater systems approval	HAR Chap. 11-62	Department of Health
Endangered species propagation	HAR ??	Department of Land and Natural Resources
COUNTY OF HAWAII		
Special Permit	HRS §205-6; PC Rule 6; HAR Chap. 15-15	Planning Commission; Land Use Commission
Use Permit	HCC §25-5-72; PC Rule 7	Planning Commission
Flood zone certification	HCC Chap. 27	Department of Public Works
Plan Approval	HCC sec. 25-2-70, *et seq.*	Planning Department
Grading Permit	HCC Chap. 10	Department of Public Works
Subdivision Approval	HCC Chap. 23	Planning Department
Building Permit	HCC Chap. 5	Department of Public Works
Sign Permit	HCC Chap. 3	Department of Public Works

1. PC Rule= Rules of Practice & Procedure, Planning Commission, County of Hawaii; HCC= Hawaii County Code; HAR= Hawaii Administrative Rules

5

ALTERNATIVES

This chapter explores and evaluates reasonable alternatives to the proposed Project that could enhance environmental quality or avoid/reduce adverse environmental impacts.

5.1 No Project

If the Project is not approved, the Applicant could use the Site for uses permitted under the current agricultural land use designations. The likely use would be to reinstate the leases to papaya growers.

Advantages
The adverse impacts that would be reduced or avoided include:

- no loss of agricultural land;
- no change to the rural character of the area;
- no increase in traffic as generated by the Project;
- no new development within a higher risk lava hazard zone.

Disadvantages
The potential impacts of this alternative include:

- greater non-point source pollution impact on the coastal waters and anchialine pools due to the more concentrated amounts of pesticides and fertilizers used to grow papaya compared to golf course operations;
- no coastal water quality monitoring program;
- no preservation, restoration, and public access to the archaeological sites;
- no controls to prevent clearing the native forest area and archaeological sites for additional agricultural acreage;
- foregone opportunites:
  - increased jobs (direct and indirect) generated by the Project;
  - increased annual tax revenues generated by the Project;

- Infusion of foreign capital;
- Privately-funded improvements to public roads including the limited widening of the Kapoho-Kalapana Road and rerouting of the segment frequently inundated by waves and high tides;
- Expansion of parking area for Ahalanui Park on land donated by the Applicant to the County;

5.2 36-HOLE GOLF COURSE

To reduce the intensity of the project, this alternative would delete the lodge, chalets, and sports complex and just develop a 36-hole golf course similar to a previous plan for the Site (see section 2.3.2 "Previous Development Plans" on page 2-6). The 36-hole golf course had previously been approved. The approval restricted the golf course to the portion of the Site previously used for papaya cultivation. Because the market feasibility for golf courses has deteriorated, the Applicant reduced the size of the golf course to 18 holes and added other components besides golf. This alternative could be revived if the Project is not approved and the economics of golf courses improves in the future.

Advantages
The adverse impacts reduced or avoided include:

- There would be less traffic and less population increase without the proposed sports complex, chalets, and lodge components;
- Agriculturally-zoned land would be available for agricultural activities;
- There would be less change to the rural character of the area;
- There would be less development within a higher risk lava hazard zone.

Disadvantages
The potential impacts of this alternative include:

- The 36-hole course is double the size of the current Project's 18-hole course and would increase the potential for fertilizers and pesticides to leach into the coastal waters and anchialine pools;
- The diversity of recreational opportunities provided by the sports complex would be foregone;
- The opportunity to increase the market demand for agricultural products would be foregone;
- The opportunity to integrate health-based agricultural products with wellness facilities would be foregone;
- The opportunity to attract world-class athletes as models to local residents, and to have Olympic-standard facilities available for training, would be foregone.

5.3 URBAN ZONING

Under this alternative, the Project remains exactly as proposed with only one difference-- the Applicant petitions for a State Land Use District Boundary Amendment from Agriculture to Urban for the entire Site (except the native forest area).

Advantages
The adverse impacts reduced or avoided include:

- The issue of whether the proposed non-agricultural uses (e.g., lodge, chalets, sports complex) in the Agricultural district require a Special Permit or a district boundary amendment would be avoided;

Disadvantages

The potential impacts of this alternative include:

- Once zoned Urban, the Site becomes easier to more intensely develop compared to the control on the specific uses and intensity available through the Special Permit;
- The requirements for income-producing agricultural activity would become discretionary rather than conditional;
- The cumulative impact of Urban zoning could be potentially greater since it could encourage other petitions for Urban zoning of the surrouding area.

6

IMPACT SIGNIFICANCE ANALYSIS

6.1 Relationship Between Short-Term Uses and Long-Term Productivity

The Site is considered marginal agricultural land. The types of crops that can be feasibly grown on the Site is very limited. For the crop grown on the Site in the past (papaya), there are many other areas on the island suitable to grow that particular crop.

The Project offsets some of the loss of agricultural land with a commitment to alternative agricultural activity in concentrated areas that complement the proposed uses, such as herb gardens and orchards to support the wellness theme of the Project, the awa in the native forest as an income-producing crop that also has cultural value, and the equestrian center. The long-term natural productivity of the native forest will be protected in perpetuity through the land use controls imposed as a result of the Project approvals. Without the Project, a private landower would be able to clear the native forest area for agriculture.

6.2 Irreversible and Irretrievable Commitment of Resources

The Project will not irreversibly commit natural resources. The Project will preserve the native forest and archaeological resources. The water quality of the offsite anchialine pools and coastal water quality will be monitored to ensure that Project operations are not impacting these resources.

6.3 Unavoidable Adverse Impacts

The Site is located in a high-risk lava hazard zone (Zone 2). An unavoidable impact is the increased time to evacuate the region with the Project in the event of a lava flow hazard. However, given the extent of advance warning for lava flow hazards, the increased time would not jeopar-

dize public safety. For coastal evacuation due to tsunami or high waves, the Site would provide an alternate evacuation route and shelter since it is located above the tsunami evacuation zone.

6.4 UNRESOLVED ISSUES

None.

7

EIS PREPARERS, CONSULTED PARTIES, AND REVIEWERS

7.1 PREPARERS OF THE EIS

The following persons contributed to the preparation of this EIS:

Consultant	Role
Roy R. Takemoto	Principal author
Alan Okamoto, Esq.	Legal counsel
KY International (Robert Yoneoka, Tracy Nagata)	Architects (site planning)
The Nature Conservancy of Hawaii (Sam Gon)	Flora and fauna analysis
Kumu Pono Associates (Kepa Maly)	Cultural impact analysis
Okahara and Associates, Inc. (Terry Nago, Bruce Meyers) with Julian Ng, Inc.	Preliminary engineering report (water, roads, traffic impact analysis)
Ron Terry, Ph.D. with Gholam H. Khaleghi, Ph.D.	Socio-economic analysis
Marine Research Consultants (Steve Dollar, Ph.D.)	Coastal waters impact
Waimea Water Services, Inc. (Steve Bowles)	Groundwater analysis
Agricon, Inc. (David Rietow, Sally Rice)	Agricultural feasibility analysis

7.2 CONSULTED PARTIES AND REVIEWERS OF THE EIS PREPARATION NOTICE

The EIS Preparation Notice (EISPN) was sent to various agencies, organizations, and individuals who may have had a potential stake or interest in the project. Those marked with an asterik sent comments, which are reproduced along with the respective responses in Appendix B.

- Federal
  - U.S. Army Corps of Engineers

  - U.S. Department of the Interior, Fish and Wildlife Service*
- State
  - Department of Accounting and General Services
  - Department of Business & Economic Development, Office of Planning*
  - Department of Health*
  - Department of Land and Natural Resources*
  - Department of Transportation*
  - Land Use Commission*
  - Office of Hawaiian Affairs*
  - Office of Environmental Quality Control*
- County
  - Planning Department
  - Department of Public Works
  - Department of Water Supply*
  - Fire Department
  - Police Department
  - Department of Parks & Recreation
  - Civil Defense
- Organizations and Individuals
  - Community Organizations
  - Legislators and Councilpersons
  - Adjacent landowners

7.3 CONSULTED PARTIES AND REVIEWERS OF THE DRAFT EIS

To be added in the Final EIS.

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APPENDIX A

HAWAII CZM PROGRAM ASSESSMENT FORM

HAWAII CZM PROGRAM
ASSESSMENT FORM

RECREATIONAL RESOURCES

Objective: Provide coastal recreational opportunities accessible to the public.

Policies

1) Improve coordination and funding of coastal recreation planning and management.

2) Provide adequate, accessible, and diverse recreational opportunities in the coastal zone management area by:

   a) Protecting coastal resources uniquely suited for recreational activities that cannot be provided in other areas;

   b) Requiring replacement of coastal resources having significant recreational value, including but not limited to surfing sites and sandy beaches, when such resources will be unavoidably damaged by development; or requiring reasonable monetary compensation to the State for recreation when replacement is not feasible or desirable;

   c) Providing and managing adequate public access, consistent with conservation of natural resources, to and along shorelines with recreational value;

   d) Providing an adequate supply of shoreline parks and other recreational facilities suitable for public recreation;

   e) Encouraging expanded public recreational use of County, State, and Federally owned or controlled shoreline lands and waters having recreational value;

   f) Adopting water quality standards and regulating point and non-point sources of pollution to protect and where feasible, restore the recreational value of coastal waters;

   g) Developing new shoreline recreational opportunities, where appropriate, such as artificial reefs for surfing and fishing; and

   h) Encouraging reasonable dedication of shoreline areas with recreational value for public use as part of discretionary approvals or permits by the land use commission, board of land and natural resources, County planning commissions; and crediting such dedication against the requirements of section 46-6.

Check either "Yes" or "No" for each of the following questions.

	Yes	No
1. Will the proposed action involve or be near a dedicated public right-of-way?	x	
2. Does the project site abut the shoreline?		x
3. Is the project site near a State or County park?	x	
4. Is the project site near a perennial stream?		x
5. Will the proposed action occur in or affect a surf site?		x
6. Will the proposed action occur in or affect a popular fishing area?		x
7. Will the proposed action occur in or affect a recreational or boating area?		x
8. Is the project site near a sandy beach?		x
9. Are there swimming or other recreational uses in the area?	x	

Discussion

The Project Site does not abut the shoreline; a County road separates the site from the shoreline area. The Site is near the County's Ahalanui Park and Isaac Hale Park. The Applicant proposes to dedicate land to the County to expand the parking for the Ahalanui Park. The Applicant also proposes to improve access to the shoreline by re-routing further inland a segment of the Kapoho-Kalapana Road that is frequently inundated by high waves and tides, and to convert the existing corridor to a pedestrian and bikeway.

HISTORIC RESOURCES

Objective: Protect, preserve, and where desirable, restore those natural and man-made historic and pre-historic resources in the coastal zone management area that are significant in Hawaiian and American history and culture.

Policies

1) Identify and analyze significant archaeological resources;

2) Maximize information retention through preservation of remains and artifacts or salvage operations; and

3) Support State goals for protection, restoration, interpretation, and display of historic resources.

Check either "Yes" or "No" for each of the following questions.

	Yes	No
1. Is the project site within a historic/cultural district?		x
2. Is the project site listed on or nominated to the Hawaii or National register of historic places?		x
3. Does the project site include undeveloped land which has not been surveyed by an archaeologist?		x
4. Has a site survey revealed any information on historic or archaeological resources?	x	
5. Is the project site within or near a Hawaiian fishpond or historic settlement area?		x

Discussion

The site includes previously disturbed (papaya cultivation) and undeveloped lands. An archaeological inventory survey was conducted on the undeveloped lands. Although the Site is not currently within a historic/cultural district nor listed on the Hawaii or National registers of historic places, the inventory survey identified several significant sites. All significant sites will be preserved in place. The significant sites are clustered in the undeveloped native forest area. This native forest area will be preserved. The Applicant proposes to restore the archaeological sites as appropriate, and to incorporate these sites into an interpretive trail. The native Hawaiian community will be consulted in the development of the interpretive program. The Applicant will also comply with all requirements related to burials. The archaeological inventory survey is included as an appendix to the EIS for the Project.

SCENIC AND OPEN SPACE RESOURCES

Objective: Protect, preserve and, where desirable, restore or improve the quality of coastal scenic and open space resources.

Policies

1) Identify valued scenic resources in the coastal zone management area;

2) Insure that new developments are compatible with their visual environment by designing and locating such developments to minimize the alteration of natural landforms and existing public views to and along the shoreline;

3) Preserve, maintain and, where desirable, improve and restore shoreline open space and scenic resources; and

4) Encourage those developments which are not coastal dependent to locate in inland areas.

Check either "Yes" or "No" for each of the following questions.

	Yes	No
1. Does the project site abut a scenic landmark?		x
2. Does the proposed action involve the construction of a multi-story structure or structures?	x	
3. Is the project site adjacent to undeveloped parcels?	x	
4. Does the proposed action involve the construction of structures visible between the nearest coastal roadway and the shoreline?	x	
5. Will the proposed action involve construction in or on waters seaward of the shoreline? On or near a beach?		x

Discussion

The County's Puna Community Development Plan identifies the Red Road as a scenic road. Since the Project is inland of this road, the Project will not impact the makai views from this road. The Project proposes 2-story structures for the golf clubhouse and sports complex; however, these structures will not be visible from the coastal roadway or the shoreline. The proposed re-routing of a segment of the Kapoho-Kalapana Road will result in a portion of the Project being located between the shoreline and the re-routed roadway. Public views to and along the shoreline will be preserved by reconstructing the existing road corridor into a public pedestrian and bikeway. Over 80% of the site will remain in open space as golf course or preserved native forest.

COASTAL ECOSYSTEMS

Objective: Protect valuable coastal ecosystems from disruption and minimize adverse impacts on all coastal ecosystems.

Policies

1) Improve the technical basis for natural resource management;

2) Preserve valuable coastal ecosystems of significant biological or economic importance;

3) Minimize disruption or degradation of coastal water ecosystems by effective regulation of stream diversions, channelization, and similar land water uses, recognizing competing water needs; and

4) Promote water quantity and quality planning and management practices which reflect the tolerance of fresh water and marine ecosystems and prohibit land and water uses which violate State water quality standards.

Check either "Yes" or "No" for each of the following questions.

	Yes	No
1. Does the proposed action involve dredge or fill activities?	___	x
2. Is the project site within the Shoreline Setback Area (20 to 40 feet inland of the shoreline)?	___	x
3. Will the proposed action require some form of effluent discharge into a body of water?	___	x
4. Will the proposed action require earthwork beyond clearing and grubbing?	x	___
5. Will the proposed action include the construction of special waste treatment facilities, such as injection wells, discharge pipes, or cesspools?	x	___
6. Is an intermittent or perennial stream located on or near the project site?	___	x
7. Does the project site provide habitat for endangered species of plants, birds, or mammals?	x	___
8. Is any such habitat located nearby?	x	___
9. Is there a wetland on the project site?	___	x
10. Is the project site situated in or abutting a Natural Area Reserve?	___	x

11. Is the project site situated in or abutting a Marine Life Conservation District?	___	*x*
12. Is the project site situated in or abutting an estuary?	___	*x*

Discussion

The Project will not involve any dredging or filling of wetlands or coastal waters, nor will the Project involve any point source discharge to coastal waters. The Project will involve grading, and will use best management practices to minimize nonpoint source pollution in accordance with the County's grading permit requirements and the NPDES permit requirements. The Project includes a private wastewater treatment plant, which will avoid cesspool seepage to the coastal waters. There may be drainage injection wells that would be constructed in accordance with the Department of Health's UIC requirements. The Applicant has agreed to conduct a water quality monitoring program to detect any effects of the golf course operations on the coastal water quality. A study of the marine environment is included in an appendix to the EIS for the Project. The study describes the substantial mixing of the nearshore waters due to the exposure to waves. This mixing rapidly dilutes any effluent that may seep to the coastal waters. The monitoring program will also include the anchialine pools in the vicinity of the Project. These pools were not inhabited by the rare species that have been surveyed in the anchialine pools in the drier climate on the leeward side of the Big Island.

ECONOMIC USES

Objective: Provide public or private facilities and improvements important to the State's economy in suitable locations.

Policies

1) Concentrate in appropriate areas the location of coastal dependent development necessary to the State's economy;

2) Insure that coastal dependent development such as harbors and ports, visitor industry facilities, and energy generating facilities are located, designed, and constructed to minimize adverse social, visual, and environmental impacts in the coastal zone management area; and

3) Direct the location and expansion of coastal dependent developments to areas presently designated and used for such development and permit reasonable long-term growth at such areas, and permit coastal dependent development outside of presently designated areas when:

   a) Utilization of presently designated locations is not feasible;

   b) Adverse environmental effects are minimized; and

   c) Important to the State's economy.

Check either "Yes" or "No" for each of the following questions.

	Yes	No
1. Does the project involve a harbor or port?		x
2. Is the project site within a designated tourist destination area?		x
3. Does the project site include agricultu: . lands or lands designated for such use?	x	
4. Does the proposed activity relate to commercial fishing or seafood production?		x
5. Does the proposed activity relate to energy production?		x
6. Does the proposed activity relate to seabed mining?		x

Discussion

The Project is located outside the SMA. Since the Project is located on agricultural lands, the Project includes income-producing agricultural activity such as equestrian facilities, orchards, and 'awa cultivation. The Project will produce substantial jobs and tax revenues to further the island's economic development in a manner that respects and is sensitive to the physical and social environment.

COASTAL HAZARDS

Objective: Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, and subsidence.

Policies

1) Develop and communicate adequate information on storm wave, tsunami, flood erosion, and subsidence hazard;

2) Control development in areas subject to storm wave, tsunami, flood, erosion, and subsidence hazard;

3) Ensure that developments comply with requirements of the Federal Flood Insurance Program; and

4) Prevent coastal flooding from inland projects.

Check either "Yes" or "No" for each of the following questions.

	Yes	No
1. Is the project site on or abutting a sandy beach?		x
2. Is the project site within a potential tsunami inundation area as depicted on the National Flood Insurance Program flood hazard map?	x	
3. Is the project site within a potential flood inundation area according to a flood hazard map?	x	
4. Is the project site within a potential subsidence hazard area according to a subsidence hazard map?		x
5. Has the project site or nearby shoreline areas experienced shoreline erosion?		x

Discussion

A portion of the Site is within the flood hazard (AE and VE zones) as depicted in the National Flood Insurance Program flood hazard maps. Any development within these areas will conform with the requirements set forth in the County's Flood Control Code (Hawaii County Code Chapter 27).

MANAGING DEVELOPMENT

Objective: Improve the development review process, communication, and public participation in the management of coastal resources and hazards.

Policies

1) Effectively utilize and implement existing law to the maximum extent possible in managing present and future coastal zone development;

2) Facilitate timely processing of application for development permits and resolve overlapping or conflicting permit requirements; and

3) Communicate the potential short- and long-term impacts of proposed significant coastal developments early in their life cycle and in terms understandable to the general public to facilitate public participation in the planning and review process.

Check either "Yes" or "No" for each of the following questions.

	Yes	No
1. Will the proposed activity require more than two (2) permits or approvals?	x	
2. Does the proposed activity conform with the State and County land use designations for the site?	x	
3. Has or will the public be notified of the proposed activity?	x	
4. Has a draft or final environmental impact statement or an environmental assessment been prepared?	x	

Discussion

The public will have opportunities to participate in the review process for this Project through the EIS and Special Permit/Use Permit procedures. The EIS discusses the Project's conformance with the State Plan and County General Plan. The public will be notified through OEQC's Environmental Notice and the public hearing notification required for the permit applications to surrouding landowners.

PUBLIC PARTICIPATION

Objective Stimulate public awareness, education, and participation in coastal management

Policies

1) Maintain a public advisory body to identify coastal management problems and to provide policy advice and assistance to the coastal zone management program,
2) Disseminate information on coastal management issues by means of educational materials, published reports, staff contact, and public workshops for persons and organizations concerned with coastal-related issues, developments, and government activities, and
3) Organize workshops, policy dialogues, and site-specific mediations to respond to coastal issues and conflicts

Discussion

Not applicable to the Project since the objectives and policies seem directed to public agencies involved with overall coastal zone management responsibilities.

BEACH PROTECTION

Objective: Protect beaches for public use and recreation

Policies

1) Locate new structures inland from the shoreline setback to conserve open space and to minimize loss of improvements due to erosion,
2) Prohibit construction of private erosion-protection structures seaward of the shoreline, except when they result in improved aesthetic and engineering solutions to erosion at the sites and do not interfere with existing recreational and waterline activities, and
3) Minimize the construction of public erosion-protection structures seaward of the shoreline

Discussion

The Project is located inland of the shoreline setback area. The Project does not involve any shoreline construction or erosion-protection structures.

MARINE RESOURCES

Objective Implement the State's ocean resources management plan

Policies

1) Exercise an overall conservation ethic, and practice stewardship in the protection, use, and development of marine and coastal resources,
2) Assure that the use and development of marine and coastal resources are ecologically and environmentally sound and economically beneficial,
3) Coordinate the management of marine and coastal resources and activities management to improve effectiveness and efficiency,
4) Assert and articulate the interests of the State as a partner with federal agencies in the sound management of ocean resources within the United States exclusive economic zone,
5) Promote research, study, and understanding of ocean processes, marine life, and other ocean resources in order to acquire and inventory information necessary to understand how ocean development activities relate to and impact upon ocean and coastal resources, and
6) Encourage research and development of new, innovative technologies for exploring, using, or protecting marine and coastal resources

Discussion

The Project does not propose to use any marine resources.

APPENDIX B

COMMENTS AND RESPONSES TO THE EIS PREPARATION NOTICE

COMMENTS AND RESPONSES TO THE EIS PREPARATION NOTICE

The EIS Preparation Notice (EISPN) was published in the May 8, 1998 OEQC Environmental Notice. This publication date triggered the start of the thirty-day Consultation Period, which officially ended on June 8, 1998. The applicant agreed to extend the Consultation Period until August 23, 1998; the extension was published in the July 23, 1998 OEQC Environmental Notice.

The EIS Consultant sent the EISPN to the agencies listed below. Additional letters were received from individuals and organizations. The written comments and respective responses are reproduced in this Appendix.

Agency/Organization	Commented; Response Sent	Commented; No Response Necessary	Did not send written comments
Federal			
U.S. Department of the Interior, Fish & Wildlife Service	X		
U.S. Army Corps of Engineers			X
State			
Department of Land & Natural Resources	X		
Department of Business & Economic Development Office of Planning	X		
Department of Health	X		
Department of Transportation	X		
Land Use Commission	X		
Office of Hawaiian Affairs	X		
Office of Environmental Quality Control	X		
Department of Accounting & General Services		X	
Big Island Legislators			X
County			
Department of Water Supply	X		
Department of Public Works			X
Civil Defense			X
Fire Department			X

Agency/Organization	Comments Response Sent	Comments No Response Necessary	Did not send written comments
Police Department			X
Hawaii County Council			X
Department of Parks & Recreation			X
Organizations and Individuals			
Michele Sheehan	X		
Friends of the Red Road	X		
Puna Outdoor Circle	X		
Keikialoha Kekipi	X		

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Ecoregion
300 Ala Moana Boulevard, Room 3-122
Box 50088
Honolulu, Hawaii 96850

'98 JUN 8 PM 2 29
COUNTY OF HAWAII

In Reply Refer To: MR

JUN - 5 1998

Virgina Goldstein,
Planning Director
Planning Department
County of Hawaii
25 Aupuni Street
Hilo, HI 96720-4252

Re: Environmental Impact Statement Preparation Notice (EISPN), Oneloa Onsen and Sports Retreat, Puna District, Hawaii.

Dear Ms. Goldstein:

The U.S. Fish and Wildlife Service (Service) has reviewed the referenced Environmental Impact Statement Preparation Notice (EISPN) for the proposed Oneloa Onsen and Sports Retreat in the Puna District, Hawaii. The purpose of the project is to develop currently vacant, privately owned land located in the Puna district of the island of Hawaii into a facility which is to include two golf courses, short and long-term rental accommodations, sports and health spas, restaurants, and some retail arrangements. The project sponsor is A & O International Corporation. The Service offers the following comments for your consideration.

Approximately one half of the project site has been previously disturbed, having been used for papaya cultivation. The remainder of the site consists of native dominated forests and shrubland. This native dominated section includes lowland mesic forest dominated by ohia *(Metrosideros polymorpha)* and hala (*Pandanus tectorius*). Additionally, stands of native alahee lowland dry shrubland, a vegetation type considered rare and imperiled by the Hawaii Natural Heritage Program, persist in parts of the project area.

The EISPN states that there has been one recent sighting of the federally endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*) and a recent report of the federally endangered Hawaiian hawk (*Buteo solitarus)* in the project site. The Service would like to point out that it is still quite likely that one or both species use the forested land on the project site for habitat. The Service did note and appreciates the intent of A & O International Corporation as mentioned in the EISPN to incorporate as much of the natural, native forest land into the setting for the 18 hole forest golf course. However, we believe that the proposal to include an area of open space at both the Northeast and Northwest corners of the golf course may provide only a frogmented natural setting too small to be utilized by the Hawaiian hoary bat, the Hawaiian hawk, or other wildlife. Additionally, we are concerned that the parcels designated as open space may be smaller than necessary in order to retain the functional integrity of the rare alahee lowland dry shrubland and recommend leaving as much of the native forest land as intact and unfragmented as possible. We would appreciate the above concerns being discussed in more detail in the Environmental Impact Statement (EIS). Furthermore, augmenting the EIS with detailed maps showing the location of the native forest, and in particular, the rare alahee lowland dry shrubland, will assist us in providing recommendations on how to avoid adverse impacts to these native elements.

Another important matter that the Service wishes to bring to your attention concerns the several anchialine pools which lie along the coastal border of the proposed project land. Several aspects of the proposed project may detrimentally affect water quality in the anchialine ponds, which are an important natural resource unique to the Hawaiian Islands and also home to the rare anchialine pond shrimp (*Metabetaeus lohena*). Project components that may adversely affect the ponds include increased nutrient runoff from fertilizers applied to the golf course and surrounding grounds in addition to use of treated sewage effluent to water the golf course, increased nutrient runoff from the equestrian stable area, and lastly, potential pesticide runoff from the golf course and grounds. We feel that the proposed mitigation measure of monitoring water quality in the anchialine ponds will not serve to mitigate potential impacts to the pools because it fails to include specific, preventative plans for protecting water quality in the ponds. Furthermore, it lacks plans for correcting problems should they arise. We suggest developing additional measures for minimizing and mitigating potential impacts to the anchialine pools at the project site; these measures may include, but not be limited to, off-site mitigation at other anchialine pools (i.e., removal of alien species).

The Service appreciates the opportunity to provide comments and asks that you take the aforementioned concerns into consideration when preparing the EIS. If you have questions regarding these comments, please contact Fish and Wildlife Biologist Mike Richardson at (808) 541-3441.

Sincerely,

Brooks Harper

Brooks Harper,
Field Supervisor
Ecological Services

A & B INTERNATIONAL CORPORATION
458 PONAHAWAI STREET • HILO, HAWAII 96720
TELEPHONE (808) 935-1011 • FAX (808) 961-6727

August 20, 1998

Mr. Brooks Harper, Field Supervisor
U.S. Fish & Wildlife Service
Box 50088
Honolulu, HI 96850

RE: Oneloa Onsen and Sports Retreat EIS Preparation Notice

Thank you for your comments, dated June 5, on the subject EIS Preparation Notice. The Draft EIS will address your comments as follows:

1. **Native forest habitat.** In response to concerns regarding the native forest, we have deleted the golf course proposed within the native forest area. The Draft EIS will describe the revised site plan that will show the preservation of the native forest and the use of the understory for compatible cultivation of *awa*.

2. **Anchialine pools.** The Draft EIS will include your suggestions to supplement the proposed monitoring with identified preventive measures to minimize impact, and a response plan to correct problems detected by the monitoring program.

Please call me if you have any questions. We will send you a copy of the Draft EIS for your review.

Yours truly,

David Matsuura
Project Manager

cc: Planning Department, County of Hawaii

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

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND DIVISION
STATE PARKS
WATER RESOURCE MANAGEMENT

June 12, 1998

LD:NAV

Ref.:OOSRPUNA.RCM

Mr. Roy R. Takemoto
Land Use Consultant
Post Office Box 10217
Hilo, Hawaii 96721

Dear Mr. Takemoto:

SUBJECT: Review : EIS Preparation Notice
Applicant: A & O International Corporation
Project : Oneloa Onsen and Sport Retreat
Location : Ahalanui, Oneloa & Laepao'o, Puna, Hawaii
TAX MAP : 3rd/ 1-4-02: Parcel 13

Thank you for the opportunity to review and comment on the EIS Preparation Notice.

Attached herewith is a copy of our Division of Aquatic Resources' comments.

Please provide this office with five (5) copies of the Draft Environmental Impact Statement.

The Department of Land and Natural Resources has no other comments to offer at this time.

Should you have any question, please feel free to contact Nicholas Vaccaro of our Land Division's Support Services Branch at 1-808-587-0438.

Very truly yours,

DEAN Y. UCHIDA
Administrator

c: At Large Land Board Member
Hawaii Land Board Member
Hawaii District Land Office

Suspense Date: Tuesday, June 9, 1998

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Aquatic Resources
Honolulu, Hawaii

MEMORANDUM

To: William Devick, Acting Administrator,
From: Richard Sixberry, Aquatic Biologist
Subject: Comments on EIS Preparation Notice

Comments Requested By: Dean Uchida, Land Management

Date of Request: 5/26/98 Date Received: 5/29/98

Summary of Project

Title: Oneloa Onsen and Sjport Retreat

Proj. By: A & OP International Corporation

Location: Puna, Hawaii

Brief Description:

The applicant proposes to develop approximately 494-acres, located in Ahalanui, Oneloa, and Laepaoo (Puna) into a project consisting of a sports and health spa complex, boutique lodge, chalets, beach club, 18-hole & 9-hole golf course, restaurant and retail complex, agricultural, open space and trails.

Comments:

We will review the DEIS when it is completed and comment on any significant impacts adverse to aquatic resource values,including the nearby anchialine pond, at a later date.

Although the EIS Preparation Notice describes briefly the proposed project, we suggest the forthcoming EIS discuss in detail potential short term impacts and propose specific means for averting or minimizing adverse effects, and provide possible mitigation for unavoidable damage to natural resource values.

Any shoreline improvements or modifications should be adequately described in the DEIS and the Department should have the opportunity to review all activities that may limit, restrict or discourage the public use of State shoreline land in this vicinity.

JOHN J. CAYETANO
GOVERNOR OF HAWAII

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

MICHAEL D. WILSON
CHAIRPERSON

ROBERT G. GIRALD
DAVID A. NOBRIGA
LAWRENCE H. MIKE
RICHARD H. COX
HERBERT M. RICHARDS, JR.

TIMOTHY E. JOHNS
DEPUTY DIRECTOR

June 18, 1998

TO: Mr. Dean Uchida, Administrator
Land Division

FROM: Timothy E. Johns, Deputy Director
Commission on Water Resource Management (CWRM)

SUBJECT: EIS Preparation Notice for Oneloa Onsen and Sports Retreat

FILE NO.: OOSRPUNA.COM

Thank you for the opportunity to review the subject document. Our comments related to water resources are marked below.

In general, the CWRM strongly promotes the efficient use of our water resources through conservation measures and use of alternative non-potable water resources whenever available, feasible, and there are no harmful effects to the ecosystem. Also, the CWRM encourages the protection of water recharge areas which are important for the maintenance of streams and the replenishment of aquifers.

[x] We recommend coordination with the county government to incorporate this project into the county's Water Use and Development Plan.

[x] We are concerned about the potential for ground or surface water degradation/contamination and recommend that approvals for this project be conditioned upon a review by the State Department of Health and the developer's acceptance of any resulting requirements related to water quality.

[x] A Well Construction Permit and/or a Pump Installation Permit from the CWRM would be required before ground water is developed as a source of supply for the project.

[ ] The proposed water supply source for the project is located in a designated water management area, and a Water Use Permit from the CWRM would be required prior to use of this source.

[ ] Groundwater withdrawals from this project may affect streamflows. This may require an instream flow standard amendment.

[ ] If the proposed project diverts additional water from streams or if new or modified stream diversions are planned, the project may need to obtain a stream diversion works permit and petition to amend the interim instream flow standard for the affected stream(s).

[ ] If the proposed project performs any work within the bed and banks of a stream channel, the project may need to obtain a stream channel alteration permit and a petition to amend the interim instream flow standard for the affected stream(s).

[ ] We recommend that no development take place affecting highly erodible slopes which drain into streams within or adjacent to the project.

[ ] OTHER:

If there are any questions, please contact Mr. Ryan Imata at 587-0255.

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

June 30, 1998

LD:NAV

Ref.:OOSRPUNA.3RC

Mr. Roy R. Takemoto
Land Use Consultant
Post Office Box 10217
Hilo, Hawaii 96721

Dear Mr. Takemoto:

SUBJECT: Review : EIS Preparation Notice
Applicant: A & O International Corporation
Project : Oneloa Onsen and Sport Retreat
Location : Ahalanui, Oneloa & Laepao'o, Puna, Hawaii
TAX MAP : 3rd/ 1-4-02: Parcel 13

This is a follow-up to our letters dated June 12, and June 26, 1998, regarding the subject matter.

Our Engineering Branch has recently submitted to us the following comments:

1) There are no future plans for exploratory wells within 1,000 feet from the proposed improvements, however it is recommended that mitigative measures be implemented to prevent groundwater contamination;

2) A small portion of the makai areas of the project site is located in Zone VE and Zone AE. Zone VE is an area within the 100-year flood plain with velocity hazards (wave action) and base flood elevations determined. Zone AE is an area within the 100-year flood plain with base elevations determined. The highest base flood elevation within Zone VE and AE is 19 feet; and

3) The remainder of the site is located in Zone X, an area determined to be outside of the 500-year flood plain.

The Department of Land and Natural Resources has no other comments to offer on the subject matter at this time. Should you have any questions, please feel free to contact Nicholas Vaccaro of our Land Division's Support Services Branch at 1-808-587-0438.

Very truly yours,

DEAN Y. UCHIDA
Administrator

c: Hawaii Land Board Member
Hawaii District Land Office

A & B INTERNATIONAL CORPORATION
458 PONAHAWAI STREET • HILO, HAWAII 96720
TELEPHONE (808) 935-1011 • FAX (808) 961-8727

August 20, 1998

Mr. Dean Uchida, Administrator
Land Division
Department of Land & Natural Resources
P.O. Box 621
Honolulu, HI 96809

RE: Oneloa Onsen and Sports Retreat EIS Preparation Notice

Thank you for your comments, dated June 12, June 26, and June 30, on the subject EIS Preparation Notice. The Draft EIS will address your comments as follows:

Comments from Engineering Branch

1. **Groundwater quality.** We acknowledge the information you provided that there are no known existing or proposed wells within 1,000 feet of the project site. The Draft EIS will include mitigation measures to prevent groundwater contamination.

2. **Flood hazard zones.** The Draft EIS will include a map to delineate the special flood hazard zones. If at all possible, we will avoid this area. If any filling or construction is unavoidable within the flood hazard zone, the Draft EIS will identify mitigation measures including compliance with the County's Flood Control Code.

Comments from Division of Aquatic Resources

1. **Shoreline improvements.** The project does not propose any shoreline improvements. The site is not oceanfront property and not located within the SMA.

Commission on Water Resources Management

1. **County Water Use Plans.** The Draft EIS will discuss the relationship of the proposed project to the County's Water Use and Development Plan.

2. **Groundwater quality.** The Draft EIS will discuss the potential impacts to the groundwater quality including use of treated wastewater effluent for irrigation, groundwater withdrawal for the onsen facilities, and golf course management practices (fertilizer and pesticides). The Department of Health has been included as a consulted

agency and will also be sent the Draft EIS for review.

3. **Well permits.** The Draft EIS will identify the applicability of the Well Construction and Pump Installation Permits to the project.

Please call me if you have any questions. We will send you a copy of the Draft EIS for your review.

Yours truly,

David Matsuura
Project Manager

cc: Planning Department, County of Hawaii

DEPARTMENT OF BUSINESS,
ECONOMIC DEVELOPMENT & TOURISM

BENJAMIN J. CAYETANO
GOVERNOR
SEIJI F. NAYA
DIRECTOR
BRADLEY J. MOSSMAN
DEPUTY DIRECTOR
RICK EGGED
DIRECTOR, OFFICE OF PLANNING

OFFICE OF PLANNING
235 South Beretania Street, 6th Flr., Honolulu, Hawaii 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804

Tel.: (808) 587-2846
Fax: (808) 587-2824

Ref. No. P-7482

June 8, 1998

Ms. Virginia Goldstein
Planning Director
Planning Department
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Ms. Goldstein:

Subject: Environmental Impact Statement Preparation Notice (EISPN) for Oneloa Onsen and Sports Retreat, Puna District, Hawaii, TMK: 1-4-2:13

We have the following comment on the proposed Oneloa Onsen and Sports Retreat project.

According to the EISPN, a portion of the proposed project is situated in a flood hazard zone. In addition, given the project's proximity to the shore, there are questions about whether coastal water quality will be degraded by polluted runoff from the 494-acre project and whether appropriate mitigation measures can be implemented. A primary objective of the Coastal Zone Management (CZM) law, Chapter 205A, Hawaii Revised Statutes, is to protect coastal ecosystems and minimize adverse impacts to water quality. Therefore, we recommend that a thorough discussion of this issue and the project's conformance with the CZM objectives and policies be incorporated into the EIS.

If there are any questions, please contact Charles Carole of our CZM Program at 587-2804.

Sincerely,

Rick Egged
Director
Office of Planning

cc: Roy Takemoto, Land Use Consultant
Gary Gill, OEQC

A & B INTERNATIONAL CORPORATION
458 PONAHAWAI STREET • HILO, HAWAII 96720
TELEPHONE (808) 935-1011 • FAX (808) 961-6727

August 20, 1998

Mr. Rich Egged, Director
Office of Planning
P.O. Box 2359
Honolulu, HI 96804

RE: Oneloa Onsen and Sports Retreat EIS Preparation Notice

Thank you for your comments, dated June 8, on the subject EIS Preparation Notice. The Draft EIS will address your comments as follows:

1. Flood hazard zones. The Draft EIS will include a map to delineate the special flood hazard zones and identify appropriate mitigation measures. We would appreciate your checking the map and proposed mitigation measures to ensure that your concerns are addressed.

2. Coastal water quality. The Draft EIS will include a study assessing the potential impact of the project on the coastal water quality and marine biota.

3. CZM Objectives and Policies. The Draft EIS will discuss the relationship of the project to the CZM objectives and policies.

Please call me if you have any questions. We will send you a copy of the Draft EIS for your review.

Yours truly,

David Matsuura
Project Manager

cc: Planning Department, County of Hawaii

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

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

LAWRENCE MIIKE
DIRECTOR OF HEALTH

In reply, please refer to:

June 9, 1998 98-110/epo

Mr. Roy R. Takemoto
Land Use Consultant
P.O. Box 10217
Hilo, Hawaii 96721

Dear Mr. Takemoto:

Subject: Environmental Impact Statement Preparation Notice (EISPN)
Oneloa Onsen and Sports Retreat
Puna District, Hawaii
TMK: 1-4-02:13

Thank you for allowing us to review and comment on the subject document. It appears from the EISPN that most of our concerns will be addressed in the Draft Environmental Impact Statement (DEIS). However, we would like to list some of our standard comments which apply to a project of this type and size. These comments should be useful in the preparation of the DEIS.

Polluted Runoff Control

The State has developed *Hawaii's Coastal Nonpoint Pollution Control Program Management Plan*. This management plan addresses proper planning, design, and use of Best Management Practices to substantially reduce polluted runoff (nonpoint source pollution) generated by golf course development and management. Please refer to the management plan (pages III-148 to III-154) for golf course management measures. The management plan can be obtained from the State Planning Office, Coastal Zone Management Program at 587-2877.

The following are suggested management measures to consider:

1. Develop and implement grading and site preparation plans to:

   a) Design and install a combination of management and physical practices to settle solids and associated pollutants in runoff from heavy rains and/or wind. For example, parts of the golf course should be designed as

sediment basins which would retain and prevent polluted runoff from entering coastal waters;

   b) Prevent erosion and retain sediment, to the extent practicable, on-site during and after construction;

   c) Protect areas that provide important water quality benefits and/or are environmentally sensitive ecosystems;

   d) Avoid construction, to the extent practicable, in areas that are susceptible to erosion and sediment loss;

   e) Protect the natural integrity of water bodies and natural drainage systems by establishing streamside buffers; and

   f) Follow, to the extent practicable, the amended U.S. Golfing Association (USGA) guidelines for the construction of greens.

2. Develop nutrient management guidelines appropriate to Hawaii for qualified superintendents to implement so that nutrients are applied at rates necessary to establish and maintain vegetation without causing leaching into ground and surface waters.

3. Develop and implement an integrated pest management plan. Follow Environmental Protection Agency (EPA) guidelines for the proper storage and disposal of pesticides.

4. Develop and implement irrigation management practices to match the water needs of the turf.

Any questions on these matters should be directed to the Polluted Runoff Control Program in the Clean Water Branch at 586-4309.

Solid Waste

1. The developer should develop an overview of the solid waste impacts resulting from the proposed project, including a conceptual plan for minimizing the generation and disposal of waste during construction and operations, based on the State's waste management hierarchy and goals and any applicable County goals or conditions.

2. At the time of local zoning approval, a detailed Integrated Waste Management Plan for the development, which would address specific waste diversion programs necessary to

assist in meeting the State and County reduction goals, should be submitted to the County's Department of Public Works.

3. The developer should investigate the use of secondary resources (recycled materials) whenever possible in the construction of the project, including but not limited to, the use of crushed glass as an aggregate substitute in road paving and the use of locally-produced greenwaste compost as a soil amendment in landscaping.

Any questions regarding this matter should be directed to Mr. John Harder of the Office of Solid Waste Management at 586-4240.

Water Pollution

1. The applicant should contact the Army Corps of Engineers to identify whether a federal permit (including a Department of Army permit) is required for this project. If a federal permit is required, then a Section 401 Water Quality Certification is required from the State Department of Health, Clean Water Branch.

2. A National Pollutant Discharge Elimination System (NPDES) general permit is required for the following discharges to waters of the State:

   a. Storm water discharges relating to construction activities, such as clearing, grading, and excavation, for projects equal to or greater than five acres;

   b. Storm water discharges from industrial activities;

   c. Construction dewatering activities;

   d. Noncontact cooling water discharges less than one million gallons per day;

   e. Treated groundwater from underground storage tank remedial activities;

   f. Hydrotesting water;

   g. Treated effluent from petroleum bulk stations and terminals; and

   h. Treated effluent from well drilling activities.

Any person requesting to be covered by a NPDES general permit for any of the above activities should file a Notice of Intent with the Department's Clean Water Branch at least 30 days prior to commencement of any discharge to waters of the State.

3. After construction of the proposed facility is completed, an NPDES individual permit will be required if the operation of the facility involves any wastewater discharge into State waters.

Any questions regarding these comments should be directed to Mr. Denis Lau, Branch Chief, Clean Water Branch at 586-4309.

Golf Course Guidelines

We are inclosing a copy of the Department of Health's "Guidelines Applicable To Golf Courses in Hawaii", Version 5, dated August, 1994.

Sincerely,

BRUCE S. ANDERSON, Ph.D.
Deputy Director for Environmental Health

Attachment

c: County of Hawaii, Planning Department
CWB
OSWM

ATTACHMENT

STATE OF HAWAII
DEPARTMENT OF HEALTH

August, 1994 (Version 5)

GUIDELINES APPLICABLE TO GOLF COURSES IN HAWAII

In order to assure that environmental quality is promoted, protected and enhanced, the State Department of Health (DOH) recommends the following for all golf courses in Hawaii. The owner/operator must also comply with all applicable DOH rules.

1. Baseline groundwater quality and, if appropriate, coastal water quality should be established.

2. The owner/operator should establish a groundwater and, if appropriate, a coastal water monitoring plan. The groundwater and coastal water monitoring plans should minimally describe the following components:

   a. A routine monitoring schedule of at least once every six (6) months for the first three (3) years of operation and once a year thereafter, or more frequently in the event that the monitoring data indicates a need for more frequent monitoring.

   b. Compounds which should be tested for include compounds associated with fertilizers, biocides, and effluent irrigation. These data should be permanently retained by the golf course and submitted periodically to the State DOH and the Planning Department of the county in which the golf course is being proposed. These data should be provided both in detail and in summary format and should relate to the baseline data and to adverse impact levels.

   c. If the monitoring data indicate increased levels of a contaminate associated with golf course maintence activities that poses, or may pose, a threat to public health or the environment, the owner should immediately inform the State Department of Health and the County Planning Department. Subsequently, the owner must mitigate any adverse effects caused by the contamination.

3. If a wastewater treatment works with effluent reuse becomes the choice of wastewater disposal, then the owner/developer and all subsequent owners should develop and adhere to a wastewater reuse plan which should incorporate the provisions of the Department of Health's Guidelines for the Treatment and Use of Reclaimed Water, developed by the Wastewater Branch and dated November 22, 1993. A copy of the guidelines may be obtained by contacting the Wastewater Branch at 586-4294.

4. Above ground storage tanks for storing petroleum products for fueling golf carts, maintenance vehicles, and emergency power generators should be used rather than underground storage tanks (USTs). USTs may pose a potential risk to the groundwater and should not be encouraged.

5. Buildings designed to house fertilizers and biocides should be bermed to a height sufficient to contain a catastrophic leak of all fluid containers. It is also recommended that the floor of this room be made waterproof so that all leaks can be contained within the structure in order to facilitate a cleanup.

6. A golf course maintenance plan should be prepared and implemented with regards to the use of fertilizers and biocides as well as an irrigation schedule. This maintenance plan should be based on operational practices that would minimize or prevent environmental pollution, including, but not limited to, pratices that are taught at the certification school of the National Association of Golf Course Superintendants.

7. Every effort should be made to minimize the amount of noise from golf course maintenance activities. Essential maintenance activities (e.g., mowing of greens and fairways) should be conducted at times that do not disturb nearby residents.

8. Solid waste should be managed in a manner that does not create a nuisance. Whenever possible, composting of green wastes for subsequent use as a soil conditioner or mulching material is encouraged. The composting and reuse should be confined to the golf course property to eliminate the necessity for offsite transport of the raw or processed material. In addition, during construction the developer should utilize locally-produced compost and soil amendments whenever available.

9. Pesticides and other agricultural chemicals should be applied in a manner that prevents the offsite drift of spray material. The State Department of Agriculture should be consulted in this regard.

10. To avoid soil runoff during construction, the developer should consult with the U.S. Department of Agriculture, Soil Conservation Service to assure that best management practices are utilized.

If there are any questions regarding the guidelines recommended above, please contact the Environmental Planning Office at 586-4337. We appreciate your cooperation in preserving and protecting environmental quality in Hawaii.

Contact People at the Department of Health for Information Regarding the Guidelines for Golf Course Development in Hawaii

Subject	Contact Person/Phone No.
1. Groundwater Quality & Management Plans	Chauncey Hew--Safe Drinking Water Branch 586-4258
2. Drainage Drywells	Chauncey Hew--Safe Drinking Water Branch 586-4258
3. Coastal Water Quality & Monitoring Plans	Denis Lau--Clean Water Branch 586-4309
4. NPDES Permit	Denis Lau--Clean Water Brnach 586-4309
5. Maintenance Plan	Chauncey Hew--Safe Drinking Water Branch 586-4258
6. Wastewater Reuse Plan	Harold Yee--Wastewater Branch 586-4294
7. Composting Green Waste	John Harder--Office of Solid Waste Management 586-4240
8. Noise from Maintenance Activities	Jerry Haruno-- Noise & Radiation Branch 586-4700
9. Underground Storage Tanks	Steven Chang--Solid Hazardous Waste Branch 586-4226

Other Contact People

Subject	Contact Person/Phone No.
1. Runoff During Construction	U.S. Department of Agriculture, ~~Soil~~ Natural Resources Conservation Service 541-2600
1. The Application Pesticides & other Agricultural Chemicals	State Department of Agriculture 973-9403

A & B INTERNATIONAL CORPORATION
458 PONAHAWAI STREET • HILO, HAWAII 96720
TELEPHONE (808) 935-1011 • FAX (808) 961-6727

August 20, 1998

Mr. Bruce Anderson, Deputy Director
Department of Health
P.O. Box 3378
Honolulu, HI 96801

RE: Oneloa Onsen and Sports Retreat EIS Preparation Notice

Thank you for your comments, dated June 9, on the subject EIS Preparation Notice. The Draft EIS will address your comments as follows:

1. **Polluted Runoff Control.** We have obtained a copy of Hawaii's Coastal Nonpoint Pollution Control Program Management Plan. The Draft EIS will discuss how the proposed mitigation measures for golf course management relate to the recommendations in the plan. The mitigation measures will also incorporate the suggestions that you listed. Thank you for the information.

2. **Solid Waste.** The Draft EIS will include an analysis of the project's solid waste impacts and how these impacts would be mitigated as part of an Integrated Waste Management Plan. The Draft EIS will discuss the potential to use recycled materials during construction, such as crushed glass and greenwaste compost.

3. **Water Pollution.**
   a. *Corps of Engineers Permit.* The Corps is on our list as a consulted party. We acknowledge that should a Corps permit be required, this will trigger a Section 401 Water Quality Certification from your department.
   b. *NPDES Permit.* We will review the project activities to determine if there are any potential point or nonpoint source discharges on the list you provided. If there are, the Draft EIS will discuss the applicability of the NPDES Permit to the project.
   c. *Golf Course Guidelines.* Thank you for enclosing a copy of the guidelines. The Draft EIS will address how the project will implement these guidelines.

Please call me if you have any questions. We will send you a copy of the Draft EIS for your review.

Yours truly,

David Matsuura
Project Manager

cc: Planning Department, County of Hawaii

BENJAMIN J. CAYETANO
GOVERNOR

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

JUN 23 1998

KAZU HAYASHIDA
DIRECTOR

DEPUTY DIRECTORS
BRIAN K. MINAAI
GLENN M. OKIMOTO

IN REPLY REFER TO:
HWY-PS
2.9804

Ms. Virginia Goldstein
Director
Planning Department
County of Hawaii
25 Aupuni Street, Room 109
Hilo, Hawaii 96720

Dear Ms. Goldstein:

Subject: Environmental Impact Statement Preparation Notice (EISPN),
Oneloa Onsen and Sports Retreat, Ahalanui, Oneloa, Laepao'o, Puna
TMK: 1-4-2: 13

We have the following comments:

1. A Traffic Impact Analysis Report (TIAR) must be prepared for our review and approval.

   a. The TIAR must evaluate roads adjacent to the development including the Kapoho-Kalapana Road, Pahoa-Pohoiki Road, Keaau-Pahoa Road and Pahoa-Kalapana Road.

   b. Intersection and roadway improvements to mitigate any traffic impacts caused by the project must be provided to maintain highway capacity and public safety. These required improvements must be provided by the applicant at no cost to the State.

   c. The TIAR should also include an analysis regarding the use of the 18-hole championship golf course or other facilities in special events which may generate unusual levels of traffic. Contingency plans to accommodate these kinds of events should be prepared and coordinated with appropriate State and County agencies.

2. Work to be done within our highway rights-of-way requires the submittal of construction plans for our review and approval. We recommend that the applicant coordinate this project with our Highways Hawaii District Engineer.

If there are any questions regarding these comments, please contact Ronald Tsuzuki, Head Planning Engineer, at (808) 587-1830.

Very truly yours,

KAZU HAYASHIDA
Director of Transportation

c: Mr. Roy Takemoto, Land Use Consultant

A & O INTERNATIONAL CORPORATION
458 PONAHAWAI STREET • HILO, HAWAII 96720
TELEPHONE (808) 935-1011 • FAX (808) 961-6727

August 20, 1998

Mr. Kazu Hayashida, Director
Department of Transportation
869 Punchbowl Street
Honolulu, HI 96813-5097

RE: Oneloa Onsen and Sports Retreat EIS Preparation Notice

Thank you for your comments, dated June 23, on the subject EIS Preparation Notice. The Draft EIS will address your comments as follows:

1. **Traffic Impact Analysis Report (TIAR).** The Draft EIS will include a TIAR to address the concerns listed in your letter (i.e., capacity of roads adjacent to the project, intersection and roadway improvements, special events contingency plans).

2. **Coordination with Hawaii District Engineer.** Since the Hawaii District Engineer will have to review and approve any work within the State highway rights-of-way, the engineering consultant for the EIS will consult and work closely with the Hawaii District Engineer in the process of preparing any reports or plans for the EIS as well as construction plans in later phases of the project.

Please call me if you have any questions. We will send you a copy of the Draft EIS for your review.

Yours truly,

David Matsuura
Project Manager

cc: Planning Department, County of Hawaii

BENJAMIN J. CAYETANO
GOVERNOR

ESTHER UEDA
EXECUTIVE OFFICER

STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
LAND USE COMMISSION
P.O. Box 2359
Honolulu, HI 96804-2359
Telephone: 808-587-3822
Fax: 808-587-3827

June 8, 1998

Ms. Virginia Goldstein, Director
Planning Department
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Ms. Goldstein:

Subject: Oneloa Onsen and Sports Retreat - Environmental Impact Statement Preparation Notice

We have reviewed the subject Environmental Impact Statement Preparation Notice (EISPN), and have the following comments to offer:

1) We confirm that the project area, as shown on Figures 1 and 2 of the EISPN, and identified as TMK: 1-4-2: 13, is within the State Land Use Agricultural District.

2) It is noted in §4.2 of the EISPN (pp. 19-20) that the proposed project will require a land use district boundary amendment for the proposed commercial area (15 acres). It is our understanding, after reading The Environmental Notice that the commercial area includes the Restaurant/Retail Complex (3.0 acres) and the Proposed Beach Club (12.0 acres).

   With the exception that the Beach Club will include 30 units, the EISPN does not provide a description of what the Beach Club will include, and whether it will be for commercial purposes or for additional units for guests.

3) Section 4.2 of the EISPN also states that Special Permits will be obtained for the lodge and indoor sports complex. It is our understanding that separate Special Permits will be applied for these uses.

   The proposed project would include 125 chalets. The EISPN does not mention whether a district boundary

amendment or a Special Permit will be sought for the chalet units.

We have concerns that separate approvals are being sought for the lodge, indoor sports complex and chalet uses. It appears that the applicant is parcelling components of the total project. We feel that inasmuch as these components are part of a total development proposal, it should be consolidated into one petition for review and approval.

We have no further comments to offer at this time.

We request that upon publication and notification in The Environmental Notice, that the subsequent Draft Environmental Impact Statement be forwarded to our office for review and comment.

If you have any questions in regards to this matter, please feel free to contact me or Leo Asuncion of my staff at 587-3822.

Sincerely,

ESTHER UEDA
Executive Officer

EU:th

cc: Mr. David Matsuura
Mr. Roy Takemoto
OEQC
OP

A & B INTERNATIONAL CORPORATION
458 PONAHAWAI STREET • HILO, HAWAII 96720
TELEPHONE (808) 935-1011 • FAX (808) 961-8727

August 20, 1998

Ms. Esther Ueda, Executive Officer
Land Use Commission
P.O. Box 2359
Honolulu, Hawaii 96804-2359

RE: Onelua Onsen and Sports Retreat EIS Preparation Notice

Thank you for your comments, dated June 8, on the subject EIS Preparation Notice. The Draft EIS will address your comments as follows:

1. **Project Description (Beach Club).** The Draft EIS will include a description of the beach club. The additional 30 units at the beach club are intended for guests.

2. **Special Permits for Lodge and Indoor Recreation Complex.** The lodge will be on a separate 15-acre lot from the indoor recreation complex. A significant portion of the lodge site will be landscaped. The portion of the site actually occupied by the lodge structures would be conservatively 10 acres. The proposed land area for the indoor recreation complex is 5 acres. We would need to discuss with you whether the total area for the lodge and indoor recreation complex subject to the Special Permit is 15 acres (defined by building footprints) or 20 acres (defined by parcel boundaries).

3. **Approvals for Chalets.** The owners of the chalets will own the agricultural operations located on the same site as the chalets. The agricultural operations will consist of orchards and possibly *taro* cultivation. We intended the chalets to qualify as farm dwellings, which would be a permitted use within the Agricultural District. We would need to discuss with you whether our interpretation of farm dwellings conforms with the LUC's Declaratory Order on farm dwellings (Docket No. DR94-17).

We will call you to arrange a meeting. We will incorporate our discussions at this meeting in the Draft EIS and send you a copy for your review.

Yours truly,

David Matsubara
Project Manager

cc: Planning Department, County of Hawaii

STATE OF HAWAI'I
OFFICE OF HAWAIIAN AFFAIRS
711 KAPI'OLANI BOULEVARD, SUITE 500
HONOLULU, HAWAI'I 96813-5249
PHONE (808) 594-1888
FAX (808) 594-1865

May 29, 1998

Mr. Roy K. Takemoto
Land Use Consultant
P.O. Box 10217
Hilo, HI 96721

Subject: Environmental Impact Statement (EIS) Preparation Notice for Oneloa Onsen and Sports Retreat, Ahalanui, Oneloa, and Laepao'o, Puna District, Island of Hawaii

Dear Mr. Takemoto:

Thank you for the opportunity to review the Environmental Impact Statement (EIS) Preparation Notice for Oneloa Onsen and Sports Retreat, Ahalanui, Oneloa, and Laepao'o, Puna District, Island of Hawaii. The applicant proposes to develop a complex of sports and health facilities including golf courses and other accessory outlets on approximately 494 acres of private land located in the Puna District.

The Office of Hawaiian Affairs (OHA) has no objections at this time to the EIS Preparation Notice. But OHA intends to thoroughly review the EIS once the document is available for public review. Because of the size and scope of the development, OHA expects the applicant to fully address several potential adverse impacts on (i) inland and shoreline habitats, (ii) coastal resources, (iii) flora and fauna, (iii) archaeological resources, (iii) air quality and noise (iv) scenic resources, (v) public access to shoreline, and (vi) traditional and customary gathering practices.

Please contact Colin Kippen (594-1938), LNR Officer, or Luis Manrique (594-1758), should you have any questions on this matter.

Sincerely yours,

Randall Ogata
Administrator

Colin Kippen
Officer,
Land and Natural
Resources Division

cc: Board of Trustees
OEQC
CAC, Island of Hawaii

A & B INTERNATIONAL CORPORATION
458 PONAHAWAI STREET • HILO, HAWAII 96720
TELEPHONE (808) 935-1011 • FAX (808) 961-6727

August 20, 1998

Mr. Randall Ogata, Administrator
Office of Hawaiian Affairs
711 Kapiolani Boulevard, Suite 500
Honolulu, HI 96813-5249

RE: Oneloa Onsen and Sports Retreat EIS Preparation Notice

Thank you for your comments, dated May 29, on the subject EIS Preparation Notice. The Draft EIS will address the items of concern listed in your letter (i.e., coastal resources, flora and fauna habitats, archaeological resources, air quality and noise, scenic resources, public shoreline access, and cultural impact (including customary and traditional gathering practices)).

Please call me if you have any questions. We will send you a copy of the Draft EIS for your review.

Yours truly,

David Matsuura
Project Manager

cc: Planning Department, County of Hawaii

BENJAMIN J. CAYETANO
GOVERNOR

BY GAIL
LECTOR

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY C
235 SOUTH BERETANIA STREET
SUITE 702
HONOLULU, HAWAII 96813
TELEPHONE (808) 586-4185
FACSIMILE (808) 586-4186

June 8, 1998

Mr. David Matsuura
A&O International Corporation
c/o 458 Ponahawai Street
Hilo, Hawai'i 96720

Dear Mr. Matsuura:

We submit for your response the following comments on a final environmental assessment - environmental impact statement preparation notice (FEA-EISPN) for the *Oneloa Onsen and Sports Retreat*, Ahalanui, Oneloa and Laepao'o, Puna District, Hawai'i, TMK: 3rd 1-4-2:13.

A. ONSEN AND SPA COMPLEX

Please consult with the District Health Office in Hilo regarding the proposed spa complex. Also, please provide the following information: discussion on whether the *onsen* will make use of existing geothermal hot spring pools, or whether such existing pools will be modified in any way, or whether the geothermal water will be drawn from a well and pumped into a man-made pool; the location of the geothermal water source(s); discussion of physico-chemical analyses undertaken to determine the suitability of the water source for bathing or drinking; and drawings and renderings detailing the size, dimensions, and plumbing for the *onsen* ponds.

B. BIOLOGICAL RESOURCES

A number of biological resources may be impacted by the proposed project. Discuss the presence, the biology, the range/distribution and habitat of the following organisms: the red shrimp, opae 'ula, *Halocaridina rubra* and other hypogeal caridian shrimp species; the ope'ape'a or Hawaiian bat, *Lasiurus cinereus semonus*; the alahe'e, *Plectronia odorata*; various other biota contained within geothermal, tidal and/or anchialine ponds; and, various other biota surrounding these ponds. Discuss direct, indirect and cumulative impacts of the proposed project on any of the above biological resources. Discuss any active monitoring or management of pond ecosystems that is being practiced or proposed. Please refer to the following enclosures: *West Hawai'i Coastal Monitoring Program, Monitoring Protocol Guidelines*, [1] and *An Assessment of the Conditions and Future of the Anchialine Pond Resources of the Hawaiian Islands*. [2]

[1] West Hawai'i Coastal Monitoring Task Force, *West Hawai'i Coastal Monitoring Program - Monitoring Protocol Guidelines*, May 1992.

[2] Brock, Dr. Richard E., *An Assessment of the Conditions and Future of the Anchialine Pond Resources of the Hawaiian Islands*, prepared for Transcontinental Development Co., Inc., 1001 Bishop Street, Pauahi Tower 2610, Honolulu, Hawaii 96813, August 2, 1985. This study was originally included as an Appendix to the Final Environmental Impact Statement entitled *U.S. Department of the Army Permit Application (File No. PODCO-O 1812-SD), Waikoloa Beach Resort, Waikoloa, South Kohala District, Island of Hawai'i, State of Hawai'i*, prepared by the U.S. Army Engineer District, Honolulu, September 1985.

[3] Macdonald, Gordon A., Abbott, Agatin T., and, Peterson, Frank L., *Volcanoes in the Sea, the Geology of Hawaii*, Second Edition, University of Hawai'i Press, Honolulu, 1983, p. 238.

C. GROUND AND SURFACE WATER RESOURCES

Geologists have also described the occurrence of thermal water resources in the Puna district. Professors Macdonald, Abbott and Peterson noted that "[o]n the east rift zone of Kilauea volcano, warm basal springs issue along the beaches between Cape Kumukahi and Opihikao Village." [3] Please study the location of these basal springs, the nature and extent of geothermal ponds, tidal ponds, and anchialine ponds hydrologically downgradient of the project site. Discuss what direct, indirect, and/or cumulative effects the project may have on these resources, along with proposed mitigative measures to minimize these impacts.

D. VISUAL RESOURCES

Please provide: photographs of the project site, showing views from north, south, east and west; renderings of what the completed complex will look like from various view planes; discussion of what direct, indirect, and cumulative effects the project may have on visual resources, along with appropriate mitigative measures.

E. DISCUSSION OF SIGNIFICANCE CRITERIA AS APPLIED TO THE PROJECT

Page 24 of the FEA-EISPN provides the determination with supporting findings and reasons. Please include in the DEIS a detailed discussion of the the thirteen significance criteria as they related to the project.

Please include discussion of the above concerns in the draft environmental impact statement (DEIS). Also, include a copy of this letter and your response in the DEIS. If there are any questions, please call my environmental health specialist, Leslie Segundo at 586-4185. Thank you for the opportunity to comment.

Sincerely,

GARY GILL
Director

Enclosures

c: Roy R. Takemoto, Land Use Consultant (with enclosures)
County of Hawai'i Planning Department (with enclosures)

WEST HAWAII

COASTAL MONITORING PROGRAM

MONITORING PROTOCOL

GUIDELINES

FORMULATED AND PREPARED BY:

WEST HAWAII COASTAL
MONITORING TASK FORCE

MAY 1992

AN ASSESSMENT OF THE CONDITIONS AND FUTURE OF THE ANCHIALINE POND RESOURCES OF THE HAWAIIAN ISLANDS

Prepared For:

Transcontinental Development Co.
1001 Bishop Street
Pauahi Tower 2610
Honolulu, Hawaii 96813

Prepared By:

Dr. Richard E. Brock
Environmental Assessment Co.
1804 Paula Drive
Honolulu, Hawaii 96816

August 2, 1985

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M & O INTERNATIONAL CORPORATION
458 PONAHAWAI STREET • HILO, HAWAII 96720
TELEPHONE (808) 935-1011 • FAX (808) 961-6727

October 7, 1998

Mr. Gary Gill, Director
Office of Environmental Quality Control
236 Beretania Street, Suite 702
Honolulu, HI 96813

RE: Oneloa Onsen and Sports Retreat EIS Preparation Notice

Thank you for your comments, dated June 8, on the subject EIS Preparation Notice. The Draft EIS will address your comments as follows:

1. **Project Description (*Onsen*).** The Draft EIS will include a more detailed description of the onsen operations, particularly the geothermal groundwater source, groundwater quality, and prototypical designs. We will also consult with the Hilo District Health Office to determine whether any special approvals apply to the proposed spa operations.

2. **Biological Resources.**
   a. *Anchialine Ponds.* Thank you for a copy of the reference on anchialine ponds by Dr. Richard Brock. The Draft EIS will assess the impacts of the project on the offsite anchialine ponds (there are no anchialine ponds present within the project site).
   b. *Coastal waters.* Thank you for a copy of the reference on coastal monitoring. The Draft EIS will assess the impacts of the project on the nearshore coastal waters.
   c. *Terrestrial habitats.* The Draft EIS will assess the impacts of the project on the terrestrial flora and fauna habitats within the project site.

3. **Ground and Surface Water Resources.** The Draft EIS will discuss the groundwater resource— its occurrence, movement, quality, and discharge as springs or other means.

4. **Visual Resources.** The Draft EIS will include photos of the project site. The view of the project, if any, will be assessed from significant public vantage points.

5. **Significance Criteria.** We find your comment to discuss the significance criteria in the Draft EIS perplexing. It was our understanding that the significance criteria determines whether an EA or an EIS will be prepared. A determination has already been made to prepare an EIS. The EIS content requirements address the concerns covered by the significance criteria. The Consultation Period provides further opportunity to identify pertinent issues of significance. If our interpretation is mistaken, please advise how and where in the EIS should the significance criteria be discussed.

Please call me if you have any questions. We will send you a copy of the Draft EIS for your review.

Yours truly,

David Matsuura
Project Manager

cc: Planning Department, County of Hawaii

(P)1349.8

JUN 10 1998

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

Gentlemen:

Subject: Environmental Impact Statement Preparation Notice
Oneloa Onsen and Sports Retreat
Ahalanui, Oneloa, and Laepao'o, Puna District,
Hawaii, TMK 3rd 1-4-22:13

We appreciate the opportunity to review the subject Environmental Impact Statement Preparation Notice dated April 6, 1998 which we received on May 22, 1998.

The planned retreat does not impact any Department of Accounting and General Services projects or existing facilities. Thus, we have no comments to offer.

If there are any questions, please have your staff contact Mr. Ronald Ching of the Planning Branch at 586-0490.

Sincerely,

GORDON MATSUOKA
Public Works Administrator

RC:jy
c: Mr. Roy R. Takemoto, Land Use Consultant

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAII
25 AUPUNI STREET • HILO, HAWAII 96720
TELEPHONE (808) 961-8660 • FAX (808) 961-8657

June 12, 1998

Mr. Roy R. Takemoto
Land Use Consultant
P.O. Box 10217
Hilo, HI 96721

ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE FOR
ONELOA ONSEN AND SPORTS RETREAT
APPLICANT - A&O INTERNATIONAL CORPORATION
TAX MAP KEY 1-4-002:013

We have reviewed the subject document and have the following comments.

Please be informed that the applicant, through involvement in the Pohoiki eight (8)-inch waterline improvements, has secured a water commitment for 160,000 gallons of water per day or 267 equivelant units.

For your information, the applicant has installed four (4) 2-inch service laterals; each will accommodate a 1½-inch meter. The total maximum flow allowed for all four (4) meters is 60,000 gallons of water or 100 equivalent units per day. Additional water system improvements are required to provide adequate flow for the remaining 167 units of water.

Therefore, during the design stage, plans and calculations prepared by a professional engineer, registered in the State of Hawaii, are to be submitted for our review and approval.

Further, should water be required beyond the 267 units, the applicant will be responsible for the construction for offsite improvements and additions, including source, storage, transmission, booster pumps, and distribution facilities as necessary.

Should there be any questions, please contact our Water Resources and Planning Branch at 961-8660.

Milton D. Pavao, P.E.
Manager

WA:gms

copy - Customer Service Sections (Hilo, Waimea, Kona and Ka'u)

A & O INTERNATIONAL CORPORATION
458 PONAHAWAI STREET • HILO, HAWAII 96720
TELEPHONE (808) 935-1011 • FAX (808) 961-6727

August 20, 1998

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

RE: Oneloa Onsen and Sports Retreat EIS Preparation Notice

Thank you for your comments, dated June 12, on the subject EIS Preparation Notice. The Draft EIS will include a preliminary engineering report that will estimate the water demand requirements relative to the existing water commitment of 160,000 gpd (or 267 equivalent units). Should the estimated water requirements exceed 160,000 gpd, the Draft EIS will discuss the additional offsite improvements that would be necessary.

Please call me if you have any questions. We will send you a copy of the Draft EIS for your review.

Yours truly,

David Matsuura
Project Manager

cc: Planning Department, County of Hawaii

June 5, 1998

'98 JUN 8 PM 3 26

Dr. Michele Sheehan
P.O. Box 10
Hilo, Hawaii 96721-5572
(808) 933-1334

Planning Department
County of Hawaii
25 Aupuni Street
Hilo, Hawaii

Re: Comments on Oneloa Onsen and Sports Retreat EISPN

Dear Planning Staff and Mr. Takemoto, Consultant;

After reading the EISPN on the above named project, I concur with the stated planning department reasons for requesting an EIS on this project. While this is a venture proposed for a privately owned land area, the project is of a magnitude to potentially effect a whole community.

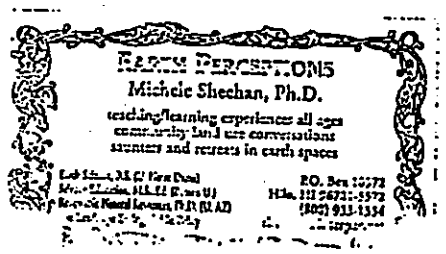
Social welfare of the surrounding community
Here there is a question of socio-cultural "fit". Is an upper-class sports complex compatible with a rural, subsistence farming, largely native Hawaiian community?

JOBS (3.2.3)
Are the jobs of a type that will result in local self respect and community building?

How many of the jobs are to be filled by the Immigrant Investor Act strategy as described in the Hawaiian Tribune Herald(5/21/98)?

RECREATION FACILITY USE (3.1.9)
Will sports facilities be affordable to the local public?

PUBLIC ACCESS SHORELINE HAWAII(3.2.1)
Important consideration.



Archeological resources and Natural habitats

Landscaping Hawaiian cultural/archeological sites into golf course attractions does not sound respectful of our host culture(3.1.5).

Natural habitats as a rule require a connectedness with the surrounding natural landscape to survive intact. Further, suggestion to have applicant monitor anchialine ponds for possible degradation from golf course run-off places the applicant in a conflicting position(3.1.4).

Economic Viability of Proposed Agriculture Activity
The suggestion that the Chalets be zoned as "farm dwellings" requires great care to be taken seriously.

Once again, I am thankful for your efforts to seriously study the viability of this proposed venture. Please inform me when the EIS is available for public review.

Mahalo,

Dr. Michele Sheehan

A & B INTERNATIONAL CORPORATION
458 PONAHAWAI STREET • HILO, HAWAII 96720
TELEPHONE (808) 935-1011 • FAX (808) 961-6727

August 20, 1998

Ms. Michele Sheehan, Ph.D.
P.O. Box 10572
Hilo, HI 96721-5572

RE: Oneloa Onsen and Sports Retreat EIS Preparation Notice

Thank you for your comments, dated June 5, on the subject EIS Preparation Notice. The Draft EIS will address your comments as follows:

1. **Social Impact.** The Draft EIS will include a social impact analysis that will address social well-being and community cohesion. Since this type of analysis is inherently subjective, we would appreciate your review and comments. More importantly, we would appreciate any suggestions you may have to better "fit" the project with the community.

2. **Jobs.** The types of jobs would be similar to other resort projects. If it is your assertion that resort-type jobs do not foster self-respect, then we need the benefit of your evidence to support that finding, and what suggestions you may have to improve working conditions. All the jobs created by the project will be credited to the Immigrant Investor Act requirements. The local residents will have priority to fill the jobs created.

3. **Recreation Facility Use.** The facilities will be open to public use. Although the cost to use the facilities cannot be determined at this time, the Applicant recognizes the value to the community and will commit to a minimum percentage of affordable use to qualified community groups. The Draft EIS will discuss the nature of this commitment.

4. **Cultural Impacts (*PASH* rights).** The Draft EIS will include a cultural impact analysis with particular focus on the gathering rights established by the *PASH* case.

5. **Archaeological Resources and Natural Habitats.** Most of the archaeological resources are within the native forest habitat. In response to comments received on the EIS Preparation Notice, we have modified the project to preserve the native forest by eliminating the golf course in that portion of the project site. The archaeological resources in this area will be interpreted within the setting of the native forest. The Draft EIS will incorporate your suggestion to have the monitoring of anchialine ponds be done by a neutral party agreeable to the State and community groups but financed by the

project.

6. **Economic Viability of Proposed Agricultural Activity.** We will meet with the Land Use Commission to confirm whether they concur with our interpretation of the farm dwelling requirement. The Draft EIS will include a market feasibility analysis of the proposed agricultural activity.

Please call me if you have any questions. We will send you a copy of the Draft EIS for your review.

Yours truly,

David Matsuura
Project Manager

cc: Planning Department, County of Hawaii

FRIENDS OF THE RED ROAD
P.O. Box 1610, Pahoa, Hawaii 96778
Phone: (808) 965-8183 Fax: (808) 965-1220 (phone first)
kehena@aloha.net

June 8, 1998

DAVID MATSUURA
A & G International Corp.
458 Ponohawai'i Street
Hilo, Hi 96720

Hawai'i County Planning Department – V. GOLDSTEIN
County Building
25 Aupuni Street
Hilo, Hawai'i 96720
Attention: Alice Kawaha OR SUSAN GREGORIK

Roy Takemoto
Land Use Consultant
P.O. Box 10217
Hilo. Hawai'i 96721

OEQC – GARY GILL, Dr.
231 So. Berentania
State Office Building, Suite 702
Honolulu, Hawaii 96813

Re: Commentary, due June 8, 1998,
EISPN: Oneloa Onsen and Sports Retreat

Friends of the Red Road is a grassroots, 501(c) (3) corporation, organized to protect the natural beauty and pristine environment of the lower Puna coast along the Red Road, State Highway No. 137 aka the Kalapana/Kapoho Road. Although our area of concern has been focused several miles south of the proposed project in the past, this project, if implemented, would have a major impact on our lives and the lives of all who live in east Hawai'i. For the aforementioned reason, we have reviewed the above-referenced EISPN and submit the following comments:

Coastal Resources

1. Isaac Hale park, also known as the Pohoiki Boat Ramp, situated next to the proposed site on the Red Road is the state's second largest commercial fishery as well as a major subsistence and sports fishery. This priceless resource provides most of the fish consumed on this island as well as supplying Oahu. There 260,000 recreational anglers in this state, many of them are frequent visitors to the Red Road for family camping and fishing. On weekends and holidays, Hawaiian families have always informally camped and fished along the Red Road. The Red Road has been the place where Hawaiian families come from all over the island, and as far away as Oahu, to informally gather, celebrate and spend a precious day living the traditional coastal lifestyle of old Hawai'i.

2. How does this project propose to accomplish what no other shoreline golf course/resort complex has been able to --- guarantee maintenance of pristine water quality? Project Manager David Matsuura was quoted "Golf courses are big losers anyway" in the Hilo Tribune-Herald, 5/21/98. Then why are unacceptable risks being proposed that threaten priceless fisheries, anchialine pools and the aquifer IF golf courses are big losers as well as big polluters?

3. A few months ago, Mike Wilson, Director of the Hawai'i Department of Land and Natural Resources (DLNR), publicly and rightly stated that "killing fish is genocide." Genocide is defined by Webster's dictionary as "the deliberate and systematic destruction of a racial, political or cultural group." The most important issue this EIS must address if the worst case scenario of ocean reef and fisheries pollution. The consequence of destroying the second largest fisheries in the state is genocide. We, therefore, request that Running Grass, Director, Environmental Justice, U.S. Environmental Protective Agency but added to the list of consulted government agencies as will as Mike Wilson, DLNR.

4. Recreational fishing alone contributes $238 million a year to the state economy. The lower Puna coastline is the second largest commercial fishery in the state and contributes hundreds of million dollars a year to the state economy besides feeding the uncounted subsistence fishing families. Kona side used to be favorite fishing grounds but no more. The fish are poisoned because they inhabit poisoned waters.Hilo waters are sewage and lead contaminated. Golf course/resort/commercial development equals ocean/reef/fishery death. Is this worth 625 minimum wage jobs?

5. Applicant water quality monitoring of the fishery and anchialine ponds is not acceptable. There are no non polluting golf courses in this state, therefore, applicant monitoring has only been proven to be the means to measure the decline of water quality and NOT to ensure preservation of water quality. Testing would also need to extend to the aquifer as well. Because there is no acceptable level of killing the fisheries or polluting the aquifer, testing of this sensitive nature and all baseline water quality and anchialine pool studies would have to be conducted by the University of Hawai'i or a federal agency, and NOT delegated to a state or county agency, to ensure objectivity,

6. What are the risks to the pristine water quality of our county community park, 'Ahalanui, just makai of the proposed development? The EISPN correctly identifies the area as "a remote rural setting conducive to healthy living, healing, restoration and recuperation", EISPN, Project Objectives, p. 7, but must also disclose if this project will be conducive to retaining the rural and remote nature of this land. Is it the intention of the project developers to sacrifice the remote rural setting conducive to healthy living, healing restoration and recuperation enjoyed by the present residents so that tourists may have a taste of what used to be? For many residents, this water is a healing spa. Hawaiians come from all over the island as well as Oahu and Maui to bathe in the healing thermal anchialine pond. How will

the chemicals used in the creation and maintenance of a golf course and the proposed agricultural projects affect the anchialine pools? How will the creation and maintenance of the proposed onsen pools affect 'Ahalanui? How will the pools be maintained and sanitized? What chemicals, disinfectants, enhancers will be used? What lotions, oils, etc. will be on the bodies of the bathers? The waters in the mauka anchialine ponds will wind up in the waters of the makai anchialine ponds. What effect will this development have on the rare red shrimp, 'opae'ula, makai of the coastal road? Why has this species been omitted from the EIS study? Please include the red shrimp, 'opae'ula, in this study and the risk to this animal designated a species of concern by the U.S. Fish & Wildlife Service.

7. The EIS must reveal the socioeconomic impact this project will have on a poor, rural remote community's wellness, culture and resources. Puna has the lowest income in the state yet there are many low-income property owners living in the east rift zone of Kilauea, both native Hawaiian and haole. What will be the sociological impact on the native Hawaiian population living on the lower Puna coast? Because of the well documented relationship between golf course/resort development and death of the ocean reef and fisheries, the EIS must address the worst case scenario impact to traditional native Hawaiians living in this last large, rural and remote coastal region?

8. What will be the impact of rapidly escalating land values to senior, disabled and fixed income residents who cannot apply for one of the project's minimum wage jobs? The EIS must disclose how changing the nature of this last corner of old Hawai'i by building a whole town catering to wealthy aliens and fast lane, fast food, bars, tourist healing and a sports mecca will affect the present culture and the future cultural history of this rich and sacred land? Can this be mitigated by the development's proposed 625 minimum wage jobs?

9. There is another cultural group living on the Red Road. The kama'aina who generally can be identified as haoles/main landers/lovers of nature preferring simple coastal lifestyles. Friends of the Red Road represents many of these residents and many of the island's residents who frequently visit the lower Puna coast. What will be the impact on this subculture if the project is implemented?

10. The people of Puna were surveyed for years in a recent study the Puna Community Development Plan (PCDP), FUNDED and ACCEPTED by the County. The EISPN dismisses this study as "not having been adopted by the County Council". This is only a political technicality resorted to by the present County administration who is displeased with their own consultants' findings. Regardless, the PCDP's findings are generally quite valid and are the ONLY documentation of cultures, lifestyle preferences, values and disagreements of this coastal region. The EIS should incorporate the findings of the PCDP into this EIS.

11. Infrastructure

a. Roads - What will be the impact on roads? On the Red Road from Four Corners to Kalapana? Will the proposed sports complex with professional facilities host professional and competitive sports events? The narrow, winding Red Road will never be able to accommodate this kind of traffic. The PCDP documents the community's historical opposition to the creation of a coastal highway. How will the additional traffic affect the peace and safety of a quiet rural community? How many vehicles will be added to the local traffic? Please include vehicle count of employees, delivery of services and supplies for residents, visitors, recreational and sports complex users, boutique lodge, restaurants and bars, golf course and trail systems customers of the fast food, convenience store, gas station, etc. What will the traffic be in daytime, at night and how late in the night? Please include the additional traffic that will be generated in the town of Pahoa as a consequence of the development. Please include the cumulative impact on the present road system and the $ cost to the state and federal government for meeting the consequent infrastructure demands. Is the federal government willing to fund road expansion in Lava Hazard Inundation Zones I and II? If not, who will pay for the roads?

b. Electricity - There has never been electricity in this area before. . There is no question that water plus electricity induce development. What will be the cumulative impacts of induced population density on this geologically sensitive area? The project is in the East Rift Zone, Lava Hazard Zone 2 as well as high risk tsunami, seismic and tropical storm sectors . FEMA's recommendations (1993), after the Kalapana lava flow, specifically discourages any development that will promote or encourage population density in Lava Hazard Zone 2. FEMA further identifies the highest risk area as being makai of the East Rift, Zone I, on the coast, which is exactly where the development site is. Please include U.S. Federal Management Agency (FEMA) in list of agencies to be consulted.

c. The community is aware that many development plans are just waiting for the electrical overhead extension line to be extended along the portion of the Red Road now served by county water thanks to A&O International Corp. The developer's denial of this truth will not be accepted by the community. The EIS must address the cumulative infrastructure impact of electricity coupled with county water. The EIS must also address the multiple geologic and storm risks such as seismic activity, tsunami and tropical storms and lava inundation.

d. Emergency Evacuation Plan - We would like the EIS to address how the proposed population density of 625 daily employees, visitors, local customers and residents of 195 dwellings will impact on the safe evacuation of present residents. The Kapoho lava flow was noted for fast moving lava. Besides lava, there is always the possibility of a multiple hazard civil defense emergency. The proposed project will employ more people than the town of Pahoa presently employs. What impact will the development's thousands of people and private vehicles have on Pahoa residents' safe evacuation? What financial burden will be imposed on the

state and county resources for public safety and road infrastructure? The community would need to have all emergency evacuation plans approved by Harry Kim of Hawai'i Civil Defense.

12. Secondary Impacts

a. What will be the impact to the picturesque village of Pahoa if this project is implemented? Is Pahoa's fate to be the same as old Kea'au? Will the Pahoa's popular restaurants have the same fate as Kea'au's Tanya's Cafe: i.e., be bulldozed for the next Macdonald's? Who is going to "feed" this complex? Where will supplies and groceries be purchased? How will the trash be disposed of? What development plans and permits are now sitting in the Planning Department regarding Pahoa? The community needs to have this information revealed by the EIS. What will be the economic and social costs of secondary development in Pahoa to "feed" the project and the cumulative impacts of subsequent Pahoa development? Please include the cost of police, fire, water, road maintenance, civil defense, solid waste disposal,emergency services, etc. to taxpayers to service the project? Will there be recycling of reusable materials throughout the entire project?

b. What other subdivisions, resort, tourist and commercial development have already been planned for the Red Road area? This information was promised to the community last year by Planning Director Virginia Goldstein in two SMA hearings with the Planning Commission, This information has never been provided. We request full disclosure on all such pending matters in this EISPN. There is a rumor on the coconut wireless that a 16-mansion subdivision is planned on the Kalapana side of Pohoiki. The statement "It is unlikely that the project will induce growth" is not true and therefore not acceptable to the community. We have heard this statement too many times.

13. Recreation Resources - The golf course proposed to be built integrating rain forest and archaeological sites is extremely offensive as well as destructive to the environment. The EIS needs to address the classic golf course scenario of creating open spaces in an established ohia rain forest which creates invasion by opportunistic weeds creating further reliance on herbicides and pesticides creating toxic runoff into anchialine ponds, the aquifer and the ocean fisheries. The EIS must address the consequences of the destruction of the second largest commercial and largest subsistence fishery in the state and solicit commentary from the EPA, Clean Water Division, the Western Fisheries Council, OHA, State Department of Economic Development, Pohoiki fishermen, native Hawaiian elders, environmental groups, community associations and residents along the Red Road. These parties must be asked if public access to a golf course, school access to a sports complex for competition and 625 minimum-wage jobs balance loss of the island's most important food source, the fishing industry, a pure aquifer, county park 'Ahalanui healing thermal waters, endangered species and the native Hawaiian traditional coastal camping, fishing and gathering area?

14. Scenic Resources - The Red Road is one of the most beautiful coastal roads in the world. Up until the recent electrification at Kehena, the ride from Kalapana past the project area was an unforgettable experience for residents and visitors alike. The EIS must address the impact on Red Road residents and travelers who are being presented with the depressing prospect of a realigned Red Road passing through a retail, commercial strip and more uglification of the Red Road by overhead electrical transmission lines. The EISPN must address this scenic sacrifice.

15. Historic/Archaeological Resources - It is our understanding that this project is built by and for Japanese nationals. The Japanese culture is well known for devout reverence of ancestors and religious artifacts. What is the justification of a project built to serve foreign visitors with a culture noted for strong ancestor consciousness playing golf among the sacred burial sites of the host country? The EISPN leaves us with the idea that all the developer has to do is to acknowledge the sites, see that sites are properly cataloged with the proper agencies and that is where all responsibility ends. Is this true? The EIS must solicit commentary from traditional native Hawaiian lineage holders and kupunas (elders) as well as the Burial Council and EPA Environmental Justice on this plan to incorporate burial and sacred sites with golf links.

16. Air Quality and Noise

a. The EISPN reveals a commercial strip on the realigned road with fast foods, service station, convenience store and a variety of retail establishments as well as restaurants, bars, meeting facilities, pro shop, golf course and driving range as well as agricultural and orchard components. The developer states that "The project will not emit noise or air pollutants other than from vehicular sources." The volume of the vehicular traffic generated by the development will have a stunning effect on the local residents, on the fauna and flora and must be presented in detail in the EIS. Coastal traffic passing through barren lava flows at night sounds like the roar of enraged goliaths and can be heard for miles by sleeping residents that are accustomed only to the sound of surf, swaying palms and bird song.

b. Is the developer claiming that herbicides, pesticides and other toxic commercial toxic chemicals will not be used during construction or maintenance of any component of this project? Please clarify this statement. Due to the sensitive geologic nature of the project site, the EISPN must address air quality in terms of the pesticide, herbicide and all toxic chemicals and products used on the project site. The EISPN must also address the cumulative impacts of secondary development on noise and air quality. And what kind of sewage treatment plant is planned for this project? All known sewage treatment plants to date are known to smell offensive and to leak. What is so different about this project's sewage treatment plant?

17. Wind Studies - To adequately disclose the risks of pollution to the ocean reef and fisheries, the EIS needs to include wind patterns and velocities. The area is

noted for brisk trade winds. Agricultural, trail and golf course maintenance normally entail regular schedules for spraying of toxic chemical products. All toxic chemical products have instructions NOT to spray while winds are blowing but this important safety warning is always ignored. Commercial management of agricultural, trail and golf course sites require cost efficent maintenance schedules and there is little if any allowance for the whims of the wind, particularly when brisk trade winds are the norm. One of the most important tasks required by this EIS is to show the extent to which the anchialine pools, reservoir and coastal waters will be subject to over spray of toxic chemicals and the resultant effect on the fisheries and endangered species.

18. The EISPN only describes the developer as a Hawai'i corporation. Is the developer a foreign held corporation? Please identify the nationality of the developer. The Hilo Herald-Tribune, 5/21/98, mentioned the faltering Asian economies and people desperate to obtain citizenship in stable economies. The news article relates the plan to lure investors with green cards, residency and citizenship. We wish the EIS to fully disclose details concerning capitalization of this project and the sale of citizenship and anything else pertinent to the financial structuring of this project. Where do the profits go? Who gets what and when? The community wants full disclosure of the names of Hawai'i residents, such as realtors, county and state employees, who have financial interests in this venture including the ancillary commercial development that accompanies this project.

19. The EISPN must clearly delineate the legal process which would permit the creation of a town complex (larger than the town of Pahoa) within a remote, rural agricultural zone district, sited on an extremely geologically sensitive, site. The creation of 3-acre orchard chalets in a portion of the parcel to conform to the ag zone for lease or sale to wealthy Asian investors with the lure of U.S. residency, green cards and citizenship reminds us of the developer/county scams that created the many substandard Puna subdivisions in sixties. What will these orchards grow? Where will the products be marketed? Is this a latch-key gentleman farmer package for sale replete with orchards, worker crews, maintenance contracts, residency, green card and citizenship package?

Friends of the Red Road questions the propriety and ethics of such a business venture. What assurance do we have that the high-density complex development proposed, larger than the town of Pahoa, which appears to be a resort, a sport complex and golf course, a healing spa, a retail center, an opportunistic legal immigration gimmick (with special Hawai'i exemptions), 195 exclusive gentleman chalet/orchards for Asian millionaires, a possible money laundry and haven for yakuza is in the best interest of the community at large and the environment? Why are there special exemptions and cut rates for Hawai'i in the first place? It stands to reason that because of Hawaii's unique status of tropical paradise, state with the most endangered species and highest cost of living that the tariff would be twice the mainland rate of $1 million instead of the bargain basement price of $500,000. Who

is being served by the special exemptions --- wealthy Asians in political exile or Hawaiians? Why is not Hawai'i entitled to the same protection and afforded the other 49 states of the U.S.?

20. The maps in the EISPN are illegible and do not clearly show the project or its relationship to the makai coastal road and 'Ahalanui county park or the surrounding communities. Please provide better maps in the EIS.

21. It is very disturbing to this community that copies of this EISPN were not routinely distributed to the public libraries as required by OEQC and had to be supplied to our local Pahoa library by a private citizen. The librarians at the Hilo library initially informed us there were no copies available because the publication in the OEQC Bulletin was in fact the EISPN in its entirety. Obviously this was not true. Because the EISPN was inaccessible to many interested parties during a large portion of the commentary period, we formally request that the commentary period be officially extended to accommodate the many individuals and organizations that were unable to meet the June 8, 1998 deadline.

The proposed project is not without some merit and has some charming and worthwhile features plus the potential for hundreds of minimum wage jobs. A & O does own other properties on the Big Island. The EIS should also explore the possibility of creating this development in a less sensitive environment and present alternative sites.

Thank you for your time and kind consideration in providing the the opportunity to express our concerns.

At one with the Earth,

Athena Peanut

Athena Peanut, President

List of contact individuals, organizations and government agencies

Running Grass, Director, Environmental Justice, U.S. EPA
Shannon Fitzgerald, Director, Region IX, U.S. E.P.A.
Mike Wilson, Director, Hawaii State Department of Land and Natural Resources
Burial Council
Harry Kim, Administrator, Hawai'i Civil Defense
Kupunas
Keklaloha Kekipi, Director Pu'ula'a Hawaiian School
Luana Jones
Friends of the Park
Friends of the Red Road
Puna Outdoor Circle
Sandy Misaka, Pohoiki fishermen
Starsha Cindy Bryan, surfers' organization

A & B INTERNATIONAL CORPORATION
458 PONAHAWAI STREET • HILO, HAWAII 96720
TELEPHONE (808) 935-1011 • FAX (808) 961-6727

August 20, 1998

Ms. Athena Peanut, President
Friends of the Red Road
P.O. Box 1610
Pahoa, HI 96778

RE: Oneloa Onsen and Sports Retreat EIS Preparation Notice

Thank you for your comments, dated June 8, on the subject EIS Preparation Notice. The Draft EIS will address your comments as follows:

1. **Coastal Resources.**
   a. *Impact on fishing and Isaac Hale Park* (response to paragraphs 1 and 4). As part of a community benefits package, we are exploring with the fishing community ways in which the project could benefit the fishing industry. The Draft EIS will discuss three potential benefits that have been identified to date: 1) provide a site for an ice house; 2) participate in the creation of an alternative swimming area to divert swimmers from the boat ramp; and 3) identify potential opportunities to market fish catch directly to the project.
   b. *Golf Course Impact on Anchialine Ponds and Coastal Water Quality* (response to paragraphs #2, 3, 4, 5). The Draft EIS will include a study of the project's impact on anchialine ponds and coastal water quality from the golf course operations. This impact will be compared to the impact of papaya cultivation that previously grew on the project site. The Draft EIS will incorporate your suggestion to have the monitoring of anchialine ponds and coastal water quality be done by a neutral party agreeable to the State and community groups but financed by the project.
2. **Impact on Ahalanui Park** (response to paragraph #6). The Draft EIS will assess the project's impacts on the usage and water quality of Ahalanui Park.
3. **Project Description (onsen)** (response to paragraph #6). The Draft EIS will describe the operation of the geothermal *onsen* ponds (e.g., sanitation, discharge).
4. **Socioeconomic Impacts.**
   a. *Impact on rural setting* (response to paragraphs #6 and 7). The Draft EIS will include a social impact analysis that will discuss the project's impact on the rural community's identity and cohesion.
   b. *Land values* (response to paragraph #8). The Draft EIS will analyze the present tax assessed value of typical lots in the vicinity of the project, and the maximum increase in values that could occur before affecting the taxes of homeowners and

elderly homeowners taking into consideration the homeowner's exemption and double exemption for the elderly.
   c. *Impact on "kamaaina subculture"* (response to paragraph 9). The Draft EIS will attempt to identify the composition of this group and the promixity of this group's settlement pattern to the project site.
5. **Puna CDP** (response to paragraph 10). The Draft EIS will highlight the findings from the Puna CDP that are pertinent to the project, and clarify the implications of the plan not being adopted by the County Council.
6. **Infrastructure.**
   a. *Roads* (response to paragraph 11a). The Draft EIS will include a traffic impact analysis report that will estimate the generation of traffic from the project's typical operations as well as special events, the need for offsite improvements, and proposed mitigation measures.
   b. *Electricity* (response to paragraph 11b and c). The Draft EIS will discuss the cumulative impacts of new electrical service to the project site.
   c. *Emergency evacuation* (response to paragraph 11d). The Draft EIS will discuss the commitments to prepare an emergency evacuation plan, how the plan would be developed, who would participate in its development, and when the plan would have to be prepared.
7. **Secondary Impacts** (response to paragraphs 12a and 12b). The Draft EIS will analyze the secondary and cumulative impacts of the proposed project in the context of known planned projects in the vicinity.
8. **Consulted Parties** (response to paragraphs #3 and 11b). We sent DLNR a copy of the EISPN for their comments. We will send the Draft EIS to DLNR, EPA, and FEMA.
9. **Native Forest** (response to paragraph 13). In response to comments received on the EIS Preparation Notice, we have modified the project to preserve the native forest by eliminating the golf course in that portion of the project site. The Draft EIS will describe the project as modified.
10. **Scenic Resources** (response to paragraph 14). The Draft EIS will identify the Red Road as a scenic resource and assess the project's impact on this resource.
11. **Historic/Archaeological Resources** (response to paragraph 15). The Draft EIS will describe the plans to preserve the archaeological sites in place within the native forest setting. As part of the cultural impact analysis, native Hawaiians connected to the area or knowledgeable of the history will be interviewed.
12. **Air Quality and Noise.**
   a. *Vehicular noise* (response to paragraph 16a). The Draft EIS will assess the vehicular noise impact relative to ambient day and night conditions.
   b. *Pesticide drift* (response to paragraph 16b and 17). The Draft EIS will identify the potential pesticides to be used for landscaping, golf course, and agricultural

operations, and the mitigation measures to minimize drift. As part of this analysis, the Draft EIS will include available wind studies.

c. *Sewage treatment plant odors* (response to paragraph 16b). The Draft EIS will describe the type of package treatment plant, the probability of odor-causing malfunctions, the impact of the odors, and mitigation measures (including alternative siting).

13. **Applicant** (response to paragraph 18). The EIS laws do not require any description of the Applicant recognizing the irrelevance of such a requirement in terms of environmental impacts. There is an Environmental Disclosure Law (Hawaii Revised Statutes 343D) that sets forth when such disclosure is appropriate.
14. **Financing** (response to paragraph 18 and 19). The Draft EIS will explain the proposed financing for this project using the Immigrant Investor program.
15. **Permits** (response to paragraph 19). The Draft EIS will identify the applicable permits with particular focus on the issue of qualifying the chalets as farm dwellings.
16. **Graphics** (response to paragraph 20). The Draft EIS will include clearer maps than the maps in the EISPN.
17. **Distribution of EISPN** (response to paragraph 21). The EIS Rules do not require distribution of the EISPN to public libraries. The EISPN was distributed to various agencies and groups; it was an oversight not to send copies to the libraries. Once the Planning Department made us aware of a request by one of the libraries, we immediately sent copies to the Pahoa and Hilo libraries. We also requested the Planning Department to extend the Consultation Period in response to your letter. The July 23 Environmental Notice publicized the extension to August 23.

Please call me if you have any questions. We will send you a copy of the Draft EIS for your review.

Yours truly,

David Matsuura
Project Manager

cc: Planning Department, County of Hawaii

PUNA OUTDOOR CIRCLE

May 28, 1998

A&O International Corporation
458 Ponohawai Street
Hilo, HI 96720.
Attn: David Matsuura

Hawaii County Planning Dept.
25 Aupuni Street
Hilo, HI 96720
Attn: Alice Kawaha or Susan Gagorik

Roy Takemoto Land Use Consultant
P. O. Box 10217
Hilo, HI 96721

Office of Environmental Quality Control
235 South Beretania Street
State Office Tower, Suite 702
Honolulu, HI 96813
Attn: Gary Gill

RE: EISPN FOR THE ONELOA ONSEN AND SPORTS RETREAT

The Puna Outdoor Circle has studied the EISPN and has the following comments, questions and concerns about this project and its scope which we wish to see addressed in the DEIS:

(1) According to the site plan, the chalets will be located at various places within the present TMK. How can an interior parcel be subdivided out from the center of a larger one, even with road easement?

(2) Page 21 states that "Since the owners of the chalets will be the owners of the income-producing orchard, the chalets are proposed as "farm dwellings"." Will the chalet owners be the farmers? My impression, although this is not stated one way or the other, is that many of the jobs this project proposes to create will be for farm workers to tend the orchards, etc. If this is the case, then the chalets are just a bureaucratic convenience for gentlemen farmers, and are not really farm dwellings. Is this a scam? So many of Puna's substandard subdivisions are having infrastructure and other problems because they are zoned as "orchards", though their actual use is primarily residential. I cannot help but wonder: are we creating another such situation here? The State now says that those land uses and classifications, such as in Hawaiian Paradise Park, are illegal. How can we, and why should we, create another such?

Page 21 says that the applicant intends to apply for subdivision as well as rezoning. This kind of density is totally inappropriate for the area.

(3) What kind of orchard(s) is(are) contemplated? Will this be more papaya? One predominant tree crop? Tutti frutti? The EISPN does not clarify this. The Draft EIS must.

(4) Page 16 states that the Hawaii County General Plan does not identify any scenic sites or vistas for Puna in this area. Yet on page 8, the document refers to "sweeping views of the ocean" and "a commanding view of the complex and the ocean beyond". On page 9 we are told that "The Cinder Golf Course will wrap around volcanic cinder cones and provide scenic vistas of the Puna slopes and coastline." So which is it? Is it possible to have a sweeping ocean view that is not scenic? This is a major contradiction in the document. General Plan not withstanding, this IS a very scenic area AND THERE ARE VIEWPLANES to be considered in the DEIS.

(5) Page 8 says that the architecture will "unobtrusively fit into the natural surroundings". Yet the 65,000 square foot Sports and Health Spa Complex will be a "two-level facility", as will the Boutique Lodge, and the Cinder Golf Course Clubhouse. Multi-levels are not "unobtrusive".

(6) The project plans to "integrate" a golf course into an existing forest area. The Figure 4 Site Plan shows that by "integration" what is meant is that a dozen or so groupings of trees will be left, and the rest of the native forest area will be for the course. This is hardly "integration". Furthermore, as we in Puna have seen over and over again in the past, once there is incursion into native forest, it marks the end of the forest. Opening up the canopy to sun hampers the natural propagation of young plants/trees, which need shade to prosper. Also, the native owl, the Pueo (Asio flammeus sandwichensis), is well-known to the area, and is a ground-nester. Disturbance of native forest for the golf course could very well destroy nests. We have seen (in the Wao Kele O Puna) how a road, or in this case, a fairway, can act as an avenue for the introduction of non-native invasive plants, which will slowly crowd out the natives, which have never developed competitive strategies. Added to the above is the concern about the impact of intensive chemical applications which are usually associated with golf course maintenance. Native species have an extremely low tolerence, not only to herbicides, but even to man-made fertilizers. How will the groundskeepers maintain the fairway without releasing chemicals which will negatively impact the native forest? Does the "mitigation plan" include the option of non-chemical grounds maintenance? How can a health and wellness center justify using poisons on its grounds?

(7) Regarding the use of pesticides (in its inclusive sense) on the golf course, orchards, etc., we are aware that the entire property slopes down toward the ocean on very porous substrate in an area of high rainfall. Monitoring (p. 14) is not good enough. What preventive measures will be taken? What is an "acceptable level", and to whom?

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(8) Page 12 gives the mean annual rainfall at "approximately 75"." This is based on DLNR's "An Inventory of Basic Water Resources Data: Island of Hawaii" Report R34, 1970. This document is almost 30 years old! We need more up-to-date data, if not from DLNR, then from the National Weather Service.

(9) Re Emergency Evacuation Plan: page 13 indicates that the EIS will propose an EEP as a mitigation measure "for the lava flow hazard risk". It should also address the potential other risks which would trigger the need for evacuation, such as tsunami, hurricane and geothermal blowout. Although road-widening is in the plan, it is only for a short distance. With 195 units (about 400 people) plus their guests, visitors, staff (several hundred according to the newspaper), parks-goers (both Pohoiki and Ahalanui) etc. all the evacuation traffic will back up at the bottleneck by Lava Tree Park, where there are only 2 lanes, and one of them would have to be used for emergency vehicles going makai. Residents from Vacationland, Kapoho Beach Lots and Farm Lots, and Waawaa would also be trying to get out of the "Great Puna Cul-de-Sac". The scope of the entire project is too large to be accomodated by the available infrastructure.

(10) The issue of pesticide use for golf course maintenance and orchards also raises the concern about the impacts of these chemicals on opae in the downslope anchialine ponds, as well as the fingerlings that use these ponds as a "nursery". Pohoiki boat ramp is the only launching site for fishermen for at least 60 miles, and this local fishing industry is a major contributor to the Puna economy. We have already seen how the proliferation of golf courses on the Kona side is correlated with increased incidence of ciguatera fish poisoning. We don't have that problem here - but then we don't (so far) have any golf courses. The potential economic impacts of pesticide pollution could be devastating. Also frequenting the near-shore and in-shore coastal waters of the Pohoiki area are the endangered dolphin, whale, green sea turtle and monk seal. The presence of these species has been well documented in this area. The EISPN totally ignores all the above concerns. The DEIS must not or it will be seriously flawed.

(11) Page 13 (3.1.4 Flora/Fauna) claims that "One relatively recent sighting of ope'ape'a (Hawaiian bat, Lasiurus cinereus semotus)... and "a report that 'io (Hawaiian hawk, Buteo solitarius) has been seen in the area represent the only documentation of rare, threatened, or endangered species currently in the area." This is totally incorrect! Ask any local resident.

(12) On page 14, mitigation measures include monitoring by the Applicant. This is a "fox guarding the henhouse situation", which we in Puna are very familiar with. Reading between the lines, the real meaning emerges: no monitoring. And even if the applicant does monitor in good faith, what good is it without stringent preventive measures, such as as total elimination of pesticides.We all know that golf courses are notorious users of these chemicals, and no EIS will be complete if the public is not informed ahead of time what chemicals are planned.

(13) Under Historic/Archaeological Resources (3.1.5 on page 14)is the statement " Not significant because their information has been already fully documented;". This is a very narrow definition of "significant" in that only the intellectual needs of archaeologists are being considered, and not that of the Hawaiian community. The DEIS must also ask whether any of these sites are culturally significant to the native Hawaiians from the area, and their opinions must count equally with those of the archaeologists, if not even more so.

(14) On page 15 (3.1.6 Coastal Resources) the EISPN admits that "The existing County road fronting the Site is flooded during high tides" and refers to resources makai of the present road alignment. Ignored is the adjacent land which is mauka of the road, which also floods and remains flooded even when the tide is out. In other words, it is a wetland. Yet Table 2 on page 23 does not list the Army Corps of Engineers for a federal level approval, although this is clearly within their jurisdiction. Please correct this very serious omission.

(15) On page 15, 3.1.7 Air Quality and Noise: "The project will not emit noise or air pollutants other than from vehicular sources." Does this mean that no pesticides will be sprayed anywhere on the site? If so, I am very happy to know this. If not, however, then this statement is false (or at the very least, grossly misleading). Regarding noise: I assume that all these lawns and fairways will be mowed, and probably with a riding mower, which makes it vehicular. DOH permissible levels for land zoned for agriculture is 70 decibels during the day and 55 at night. However, the levels are set at different rates for the Commercial Village category. Since it is proposed to remove portions of the parcel for up-zoning, how will the higher levels of noise be kept from the areas requiring lower levels? Or will they? Please clarify this in the DEIS.

(16) Page 17, 3.2.5 Secondary andCumulative Impacts: "It is unlikely that the project will induce growth." We take strong exception to this statement. The project will bring electricity to the area, and electricity is one type of infrastructure. Once this is in place, it will be more economical for other developers to run power anywhere along theRed Road and environs.This will encourage more development, which will put additional strain on both County and community resources. To claim that this is "unlikely" is either extremely naive, short-sighted or dishonest.

Furthermore, despite the disclaimer that there are no planned residential projects in the vicinity, we know that Amfac has been selling off all of its extensive land holdings in the area. It is hard to believe that someone would purchase these without having plans to develop eventually. Surely they are not purchasing ocean-view land for the joy of paying County taxes, without a return on their investment. We understand that already such a plan is in the works on the 1,000 acres on the Kalapana side of Pohoiki Road.This project will be for, initially, 16 mansions. Between the Oneloa Onsen Complex and this Barnes project, the real property assessment for the area will go up, and with it the taxes of local residents. since the rates are based on "highest and best use". Indeed, a substantial tax increase may force many residents to lose their homes. This is a major inpact.

(17) 3.3.1 Roads and Traffic (page 17): Where exactly would the realignment of the flooded portion of Kapoho-Kalapana Road be sited? There is a wetlands mauka of the present road where the flooding occurs. How, if at all, will the new alignment affect the wetlands? The site access via Pahoa-Pohoiki (Mango Grove) Road is not clearly described. Will it be above the mango grove or will it cut through it? The grove is protected by County ordinance (this fact is omitted) and no development must encroach on the trees or their extensive root systems. We approve of the developer's plan to add a bikeway to the Kapoho-Kalapana Road corridor, and would like assurances that such widening would not be responsible for destruction of our beloved trees (we do not include "junk" trees such as gunpowder and castor bean, or melastomes in this category). What distance will the bikeway run? This is not given in the EISPN.

(18) We are happy to read that the project will host its own wastewater treatment plant, and that the treated water will be recycled onto the golf course. What about the runoff?

(19) Page 13,3.3.6 Electrical/Telephone: Running utility lines from the nearest available poles (at Vacationland?) will be over a mile. Overhead lines will affect the scenic viewplanes. The DEIS engineering report must include the alternative of undergrounding of these lines. This is done by the big hotels along the Kohala coast, and it should be done here as part of mitigation.

(20) Police & Fire Protection: The Puna police force is badly understaffed, and quite often, between vacations, sick leave, comp time, etc.. is even more so. The Red Road area is not patrolled as a rule. There have been problems at Ahalanui Park with break-ins in the parking lot. Drag racing on Kapoho-Kalapana Road near Vacationland has not been stopped, despite numerous complaints to the police. Police response time from Keaau is about one hour.

The Pahoa Fire Station is the one that is 13 miles away, not Keaau, as stated, Keaau is 24 miles away. This error must be corrected, as it gives an erroneous false sense of security. Because of the great distances and poor roads, our valiant fire fighters have often arrived too late at the scene: an example of this was the fire which destroyed the community center at Kalapana Seaview Estates.

(21) Page 24, Table 2: Why is the Kailua Village Design Commission listed as an approving agency? Their jurisdiction is on the other side of the island, not in Puna.

(22) Since the project will be tapping into the geothermally-heated water which underlies the site, and which also feeds the hot pond at Ahalanui County Park, we would like to see a hydrologist's report with assurances that the onsen will not impact the public (and other private) ponds.

(23) We thank A&O for their generous offer to donate 11 acres to the County for Ahalanui Park, and we sincerely hope that this offer will not influence the Planning Department's decision about this project, and that they will study the plan with an impartial eye, keeping the public weal as their highest priority.

(24) The Applicant is identified as "a Hawaii corporation" on page 1. Is A&O a subsidiary of, or have any other type of relationship with a foreign company? If so, how much, in terms of percentage, of the profits of this venture will be transferred abroad? The company is known to have had financial problems in the past. What assurance do we have that they have the wherewithal to complete this project as described and to comply with all mitigation measures and agreements with the County of Hawaii?

(25) A recent article in the Hawaii Tribune-Herald described a green card scheme which this project will be involved with. Will this project be used as a front to buy U. S. citizenship and protection from prosecution for the immigrants able to pay $500,000? Will we be importing wealthy criminals? Yakuza? If for some reason this part of the plan fails to function as hoped for, will A&O still have enough capital and/or collateral to honor its financial commitments to the County and to local contractors?

(26) Why was the matter of using the project to provide housing and legal income for these immigrants published in the news media but not mentioned in the EISPN? Will this influx of persons (criminal or not) into our community not represent an impact which will put an additional strain on our infrastructure and society?

(27) We applaud the plan for an Equestrian Center, as this is not only a healthy activity for a sports facility, but is also a good fit for an area such as Pohoiki, with its rural flavor. However, it is only referred to briefly in the document. We are not told, for example, the size of the stables or how many horses will be housed there, nor anything about disposal of the manure. Please make sure that the DEIS gives more information about this.

(28) We have some concerns about the fast food outlet, service station and convenience store: although there is a need for these sorts of enterprises in the area, we would not like their presence to be too obtrusive. The "quaint village style" allays our fears about gaudy garish golden arches, but we hope that these will also be set back a bit from the road (including their parking lots) and landscaped so as not to be too inappropriate to the area. We are also aware that as a rule, fast food places and convenience stores generate a lot of garbage. People take the items off premises and the amount of litter in the area increases. We already have a major littering problem at Pohoiki. Will these stores add to it? What does A&O propose as mitigation?

(29) There is also already a problem in the area with large-scale consumption of alcoholic beverages. Presently, people bring these with them from Pahoa. If more are readily available to parkusers we can probably expect an increase, not only in litter, but in drunkenness and fights. This is not a healthy atmosphere for the children using the County parks.

We also have concerns about leakages from a gas station and the possibility of petroleum residues leaching into the ground- and coastal waters. How will this be prevented?

(30) With reference to (24) above, an article, Bishop Estate settles lawsuit by Kevin Dayton published in the 11/27/96 issue of the Hawaii Tribune-Herald, identifies Keiichiro Asaoka as a "Japanese investor who also owns the Pohoiki land slated for the long-stalled Oneloa Golf Course." Is Mr. Asaoka still the land owner, and is he involved with A&O? The article mentioned that Mr.Asaoka was accused of paying kickbacks to William Rosehill, the Estate's land manager on the Big Island. The article also referred to the involvement of Asaoka's attorney, Sen. Richard Matsuura. What, if any, is the relationship between Asaoka and A&O's Michael Matsuura? Was Asaoka cleared of paying kickbacks?

Thank you for the opportunity to comment. Attached is a list of persons, agencies and organizations which we feel should be consulted for the DEIS.

René Siracusa
President

SUGGESTED INDIVIDUALS, AGENCIES AND ORGANIZATIONS TO BE CONTACTED:

Harry Kim, Administrator
Civil Defense

National Marine Fisheries

Army Corps of Engineers

National Biological Survey
U.S. Fish & Wildlife

U.S. E.P.A. Region IX, San Francisco

Keikialoha Kekipi, Burial Council

Hawaiian elders: Robert Keli'iho'omalu
John Hale
Emma Kauhi
Minnie Ka'awaloa

Gail Makuakane, UH-Hilo
Lahenae'e Gay, Pacific Cultural Conservancy

Mayor's Puna Parks Advisory Committee
Arborist Advisory Committee

Friends of the Red Road, Athena Peanut
Sandy Masaoka, Pohoiki fishermen's group
Cindy "Starsha" Bryan (for the surfers)
Puna Outdoor Circle

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August 20, 1998

Ms. Rene Siracusa, President
Puna Outdoor Circle
P.O. Box 1085
Pahoa, HI 96778

RE: Oneloa Onsen and Sports Retreat EIS Preparation Notice

Thank you for your comments, dated May 28, on the subject EIS Preparation Notice. The Draft EIS will address your comments as follows:

1. **Project Description (chalets).**
   a. *Subdivision plans* (response to paragraph 1). The Draft EIS will discuss the subdivision plan for the chalets. The chalets will be part of a large lot. The owners of the chalets will own the entire large lot. Whether the individual chalet units will be owned as condominium units is an alternative that is still being studied.
   b. *Farm dwellings* (response to paragraph 2). The Draft EIS will discuss the interpretation of "farm dwellings" pursuant to the State Land Use Law (Hawaii Revised Statutes chapter 205) and the recent State Land Use Commission Declaratory Order on farm dwellings (Docket No. DR94-17). The Draft EIS will also discuss the alternative of applying for a State Land Use District Boundary amendment to reclassify the chalet area from Agriculture to Urban.
   c. *Density* (response to paragraph 2). The Draft EIS will explain the density of the chalets as 1 unit per 3 acres. This density is clustered to preserve most of the site in open areas.
2. **Agricultural Feasibility** (response to paragraph 3). The Draft EIS will identify feasible orchard crops and medicinal plants that are suitable for the restaurant and spa operations.
3. **Scenic Resources** (response to paragraphs 4 and 5). The Draft EIS will assess the view *of* the project from various public vantage points. The view *from* the project, as mentioned in your letter, is an acknowledged feature of the project and irrelevant for further discussion in the Draft EIS for purposes of analyzing the project's impacts. The view analysis will consider the proposed mass of the buildings.
4. **Native Forest** (response to paragraph 6). In response to comments received on the EIS Preparation Notice, we have modified the project to preserve the native forest by eliminating the golf course in that portion of the project site. The Draft EIS will describe the project as modified.

5. **Monitoring of Anchialine Ponds and Coastal Water Quality** (response to paragraphs #7, 8, and 12). The Draft EIS will address impacts to the anchialine ponds and coastal water quality, and recommend that the monitoring of these resources be done by a neutral party agreeable to the State and community groups but financed by the project. The Draft EIS will also specify preventive mitigation measures.
6. **Rainfall Data** (response to paragraph 8). The Draft EIS will use data from *Rainfall Atlas of Hawaii* (DLNR R76, 1986).
7. **Emergency Evacuation Plan** (response to paragraph 9). The Emergency Evacuation Plan in the Draft EIS will address all types of emergencies requiring evacuation.
8. **Flora/Fauna** (response to paragraph 11). The Draft EIS will rely upon the observations of trained biologists, existing documentation, and input from the U.S. Fish and Wildlife to assess the presence of various flora and fauna species. We would appreciate any documented information that you are willing to share to supplement the information that we will present in the Draft EIS.
9. **Historic/Archaeological Resources** (response to paragraph 13). The Draft EIS will clarify the significance criteria used by archaeologists (which includes cultural value). The Draft EIS will also include a cultural impact analysis based on input from native Hawaiians.
10. **Wetlands** (response to paragraph 14). The Army Corps of Engineers has been included as a consulted party and was sent a copy of the EISPN. We will follow-up with them specifically to determine whether any part of the project site meets the definition of wetlands.
11. **Air Quality and Noise** (response to paragraph 15). The Draft EIS will discuss the potential for pesticide drift. The noise impacts will distinguish the noise standards for the various zoning districts and address the compatibility between adjacent parcels with differing zoning designations.
12. **Secondary and Cumulative Impacts** (response to paragraph 16). The Draft EIS will analyze the secondary and cumulative impacts of the proposed project in the context of known planned projects in the vicinity. The Draft EIS will also analyze the potential impact on land values and relationship to the homeowners exemption.
13. **Roads** (response to paragraph 17). The Draft EIS will include a preliminary engineering report and traffic study that will provide more details on the proposed realignment and bikeway. The Draft EIS will also identify the Grove of Mangoes protected by the Exceptional Trees ordinance and explicitly relate the proposed improvements to these trees to assess whether any impacts could occur.
14. **Wastewater** (response to paragraph 18). The Draft EIS will assess the impacts of using treated wastewater effluent for irrigation.

15. **Electrical/Telephone** (response to paragraph 19). The Draft EIS will identify the offsite alignment of utility lines to service the project, evaluate the feasibility of underground installation, and assess the view impacts of overhead lines.
16. **Police and Fire Protection** (response to paragraph 20). The Draft EIS will provide any updated information from the County on plans to improve staffing of the police force for Puna. The distance and response time information for the Pahoa and Keaau fire stations will be checked.
17. **Permits** (response to paragraph 21). The Draft EIS will omit the mistaken reference to the Kailua Village Design Commission.
18. **Groundwater** (response to paragraph 22). The Draft EIS will include an hydrologist's report on the impact of the *coven* operations on the groundwater flow as related to the offsite anchialine and swimming ponds fed by groundwater.
19. **Park Dedication and Enforcement of Developer's Commitments** (response to paragraphs 23 and 24). The dedication of 11 acres for County park expansion is one part of a community benefits package that will be documented in a Development Agreement and subject to public scrutiny. The Draft EIS will discuss the role, timing, contents, and procedures of the Development Agreement. The Development Agreement will include provisions such as bonding or zoning revertments to ensure compliance with the specified conditions.
20. **Applicant** (response to paragraphs 24 and 30). The EIS laws do not require any description of the Applicant recognizing the irrelevance of such a requirement in terms of environmental impacts. There is an Environmental Disclosure Law (Hawaii Revised Statutes 343D) that sets forth when such disclosure is appropriate.
21. **Financing** (response to paragraphs 25 and 26). The Draft EIS will explain the proposed financing for this project using the Immigrant Investor program.
22. **Project Description (Equestrian Center)** (response to paragraph 27). The Draft EIS will describe the proposed equestrian center with further details on the stable sizes, capacity of horses, and manure disposal.
23. **Retail Center** (response to paragraph 28 and 29). The Draft EIS will include design mitigation measures, such as setbacks (including the parking lots) and landscaping, to maintain a rural ambience. The Draft EIS will also suggest measures to curtail littering resulting from fast food outlets. As for alcoholic beverage consumption, there are already laws prohibiting drinking at the parks. We do not know what more the project could do or not do. Strict underground storage tank laws enforced by the Department of Health are aimed at preventing leakages should the project include a gas station.
24. **List of Parties of Contact.** Thank you for providing the list of contacts. They will all be consulted and/or receive a copy of the Draft EIS.

Please call me if you have any questions. We will send you a copy of the Draft EIS for your review.

Yours truly,

David Matsuura
Project Manager

cc: Planning Department, County of Hawaii

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Mr. David Matsuura
A & O International Corporation
458 Ponahawai Street
Hilo, HI 96720

Dear Mr. Matsuura,

I am writing with regard to the EISPN Oneloa, Onsen and Sport Retreat proposed project at Oneloa, Laepao'o and Ahalanui.

My name is T. Keikialoha Kekipi. I am the director of Ho'oulu Lahui, a not-for-profit organization serving the youth and community of Puna. I have enclosed a fact sheet of our organization for your information. My greatest concern is for the cultural impact on my 'ohana burials within the proposed site. I would like to discuss visual and physical buffers with you as well as environmental concerns that I have.

I would like to meet with you to discuss these concerns. I would appreciate your contacting me at your earliest convenience to arrange a meeting. I thank you in advance for your courtesy and cooperation in this matter.

Respectfully,

KeiKialoha Kekipi
Box 2177
Pahoa HI
phone 965-7433

cc: Mr. Gary Gill, OQEC
Mr. Don Hubbard, SHPD
Mr. George Yoshida, P&R Hawaii County
Mr. Punahele Lerma, Hawaii Island Burial Council
Mr. Roy Takemoto

August 20, 1998

Mr. Keikialoha Kekipi
Box 2177
Pahoa, HI 96778

RE: Oneloa Onsen and Sports Retreat EIS Preparation Notice

Thank you for your comments, faxed on June 8, on the subject EIS Preparation Notice. The Draft EIS will address your comments as follows:

1. Cultural Impact. The Draft EIS will include a cultural impact and archaeological studies. These studies will identify appropriate mitigation measures, such as visual and physical barriers.

2. Meeting. We will gladly meet with you to discuss your concerns. I will call you to arrange a date, time, and place.

Please call me if you have any questions. We will send you a copy of the Draft EIS for your review.

Yours truly,

David Matsuura
Project Manager

cc: Planning Department, County of Hawaii

APPENDICES. Appendices C through K (volumes 2 and 3) are available on the internet at www.oneloa.com. Hard copies are available to view at the Hilo, Pahoa, and Keaau libraries. A CD-ROM is available upon request by calling 935-9060.

APPENDIX A

ONELOA DEVELOPMENT PROJECT: AGRICULTURAL CONCEPT

by:

Agricon Hawaii LLC

Oneloa Development Project

Agricultural Concept

June 1999

Agricon Hawaii LLC
P.O. Box 95
Kamuela, HI 96743

Oneloa Development Project
Agricultural Concept

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SUMMARY

The agricultural concept for the Oneloa Development Project contains the following components.

- Tropical fruit trees for the 18-hole golf course.
- Hawaiian medicinal plants for the areas within the golf course.
- Commercial tropical fruit crops.
- A 50 acre 'awa planting within a native forest.
- An equestrian center.

Tropical fruit trees will be planted within the golf course, each hole having a different group of trees. In addition, Hawaiian medicinal plants will be planted in selected areas of the golf course. These plants will serve as both landscaping and a source of medicinal product.

Commercial crops will be planted in blocks within the development. These commercial plantings will provide product for sale within the development and to local markets.

The 'awa planting will be a cooperative effort between the development and the community.

The equestrian center will provide trail rides for guests and related community activities, such as rodeos, for both guests and the local community.

The development is committed to the principles and practices of sustainable agriculture. These practices are designed to maintain and enhance the economic viability of agricultural production, the natural resource base, and other ecosystems that may be influenced by the agricultural activities at Oneloa.

INTRODUCTION

As an integral part of the development, an agricultural concept is desired, as a method of creating a viable enterprise that is visually acceptable and self-sustaining.

Tropical fruit trees will planted within the golf course. Eight to ten trees of a selected variety will be planted at each hole. Each hole will have a different tropical fruit tree variety. Golf course maintenance personnel will accomplish the maintenance and harvesting. Fruit harvested will be used within the development by the lodge, the sports complex, the beach club, and the retail outlet.

Selected Hawaiian medicinal plants will also be planted at various locations within the golf course. These plants will also be maintained and harvested by golf course maintenance personnel. Product harvested will be used within the development and by the community.

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Economically viable tropical fruit crops will be farmed within the golf course in contiguous blocks between the fairways, using commercial farming techniques. The goal of these operations is profit oriented. Fruit will be sold to enterprises within the development and to other markets.

An 'awa planting of approximately 50 acres will be established in a 250-acre natural forest within the development. The 'awa will be planted in the "old style" using the natural forest as cover and community labor to cultivate and harvest the crop.

An equestrian center, encompassing approximately five acres, will be constructed as part of the development. This center will be leased to an independent organization that will operate the center. The center's functions will include trail rides through the resort and periodic rodeo and horse show activity.

TROPICAL FRUIT – GOLF COURSE

The following tropical fruit varieties are suggested for the golf course. Eight to ten trees will be planted around each hole. Trees should be identified in order to provide an item of interest to golfers. Maintenance and harvesting is to be accomplished by golf course maintenance personnel as part of their normal golf course maintenance program. Fruit harvested will be used within the development by the various entities.

Each crop listed below includes a brief history and a description.

ATEMOYA

Brief History: *Annona squamosa* L. x A. *cherimola* Mill. Family: Annonaceae. Originated as a man-made hybrid between the sugar apple, *annona squamosa* L.,and the cherimoya, A. *cherimola* Mill. developed in Florida. The best varieties of atemoya combine the best qualities of both parent species and are adapted to a wider range of environmental conditions than either of them. The atemoya is well known in Australia, Central America, Florida, India, Israel, New Zealand, Philippines, South Africa, and South America. It is becoming well known in Hawaii as more growers develop commercial plantings

Description: Atemoya is a small tree. Mature specimens can reach a height and spread of 32 feet, but for successful commercial production the tree is kept smaller by periodic pruning. The leaves are alternate, 10 to 20 centimeters long and 4 to 8 centimeters wide. They may be lanceolate, elliptic, or ovate. The fruit is spherical, conical, or ovate, with a weight of 8 ounces to 21 ounces. The shape and surface texture of the fruit are quite variable, even among fruit from the same tree. The fruit surface may be relatively smooth, or the distal ends of the individual carpels may project as rounded protuberances. The fruit has a thin green rind that becomes yellowish green at ripeness. The flesh of good varieties makes up a large proportion of the fruit weight.

It is very sweet, with a pleasant flavor, and is soft when ripe. The hard black seeds are 10 to 15 millimeters long, and there are 15 to 40 seeds per fruit. Fruit production starts in 2 to 3 years from grafted seedlings.

The trees are grown from grafts and begin flowering in the spring with the harvest season in late fall. The trees have one major bloom per year and usually an additional minor bloom. The period from bloom to fruit maturity is 5 to 6 months. The fruit can be harvested when mature but still firm and will ripen to excellent eating quality. This allows it to be shipped to distant markets. Studies show that with good care, hand pollination and favorable weather conditions mature trees can yield 200 to 500 pounds of fruit per year. A spacing of 20 feet between trees in a row and 25 feet between rows is used. Best fruit production occurs when trees have an adequate supply of moisture throughout the year. Irrigation insures proper water distribution. Methods of pollination are either self-fruiting or hand pollination. Some varieties need hand-pollination for good production. Atemoyas do have some pest problems and diseases. Fruit flies and the chalcid wasp are the main fruit pests. Some control can be achieved with approved chemicals but more research needs to be done in this area. Field sanitation is beneficial.

The atemoya is sold in the expanding Asian markets in Hawaii and in Oahu supermarkets. The tropical fruit industry has organized supermarket demonstrations and promotions of the atemoya. Although customers are unfamiliar with the fruit at first they express great interest after tasting the atemoya, enjoying its exotic flavor. The atemoya is a superb fruit for fresh consumption. The pulp can be used in sherbets and ice creams. The fruit is a good source of phosphorus and a fair to good source of thiamine and ascorbic acid.

AVOCADO
See Tropical Fruit - Commercial.

BREADFRUIT
See Tropical Fruit - Commercial.

CARAMBOLA (STARFRUIT)
See Tropical Fruit - Commercial.

FIG

Brief History: *Ficus carica* L. Family: Moraceae. The fig is believed to be indigenous to Western Asia and to have been distributed by man throughout the Mediterranean area. It has been cultivated for thousands of years. Remnants of figs have been found in excavations of Neolithic sites traced to at least 5,000 B.C. As time went on, the fig-growing territory stretched from Afghanistan to southern Germany and the Canary Islands. The first figs in the New World were planted in Mexico in 1560. Figs were introduced into California when the San Diego Mission was established in 1769.

The Smyrna fig was brought to California in 1881-82 but it was not until 1900 that the wasp was introduced to serve as the pollinating agent and make commercial fig culture possible.

Description: The fig is most commonly cultivated in mild-temperate climates; it nevertheless has its place in tropical and subtropical horticulture. It is unique in a genus embracing perhaps over 1,000 species, mostly giant "rubber trees", and mostly tropical. It is almost universally known simply as fig, common fig, or edible fig.

The fig is a tree of small dimensions, 10 to 30 feet high, with numerous spreading branches and a trunk rarely more than 7 inches in diameter. It contains copious milky latex. The root system is typically shallow and spreading, sometimes covering 50 feet of ground, but in permeable soil some of the roots may descend to 20 feet. The deciduous leaves are palmate, deeply divided into 3 to 7 main lobes, these more shallowly lobed and irregularly toothed on the margins. The blade is up to 10 inches in length and width, fairly thick, rough on the upper surface, softly hairy on the underside.

What is commonly accepted as a "fruit" is technically a synconium, that is, a fleshy, hollow receptacle with a small opening at the apex partly closed by small scales. It may be obovoid, turbinate, or pear-shaped, 1 to 4 inches long, and varies in color from yellowish-green to coppery, bronze, or dark-purple.

Tiny flowers are massed on the inside wall. In the case of the common fig discussed here, the flowers are all female and need no pollination. There are 3 other types, the "Caprifig" which has male and female flowers requiring visits by a tiny wasp, *Blastophaga grossorum*; the "Smyrna" fig, needing crosspollination by Caprifigs in order to develop normally; and the "San Pedro" fig which is intermediate, its first crop independent like the common fig, its second crop dependent on pollination. The skin of the fig is thin and tender; the fleshy wall is whitish, pale-yellow, or amber, or more or less pink, rose, red or purple; juicy and sweet when ripe, gummy with latex when unripe. Seeds may be large, medium, small or minute and range in number from 30 to 1,600 per fruit.

There is no commercial market for figs at this time because there is no commercial production. Figs from existing small plantings are sold at the local farmer's markets as both fresh and dried.

GUAVA

Brief History: *Psidium guajava L.* Family: *Myrtaceae.* The guava originates from the American tropics but can now be found naturalized in many parts of the world in both tropical and subtropical climates. The guava is best adapted to the warm climate of Hawaii and Florida, although it can be grown in coastal Southern California.

Description: Guavas are evergreen, shallow-rooted shrubs or small trees to 33 feet, with spreading branches. The bark is smooth, mottled green or reddish brown and peels off in thin flakes to reveal the attractive "bony" aspect of its trunk. The plant branches close to the ground and often produces suckers from roots near the base of the trunk. Guava leaves are opposite, short petioled, oval or oblong-elliptic, somewhat irregular in outline, 2 - 6 inches long and 1 - 2 inches wide. The dull-green, stiff but leathery leaves have pronounced veins, and are slightly downy on the underside.

The flowers are faintly fragrant, white and borne singly or in clusters in the leaf axils, are 1-inch wide, with 4 or 5 white petals. These petals are quickly shed, leaving a prominent tuft of perhaps 250 white stamens tipped with pale-yellow anthers. Guava fruits may be round, ovoid or pear-shaped, 2 - 4 inches long, and have 4 or 5 protruding floral remnants (sepals) at the apex. Varieties differ widely in flavor and seediness. The better varieties are soft when ripe, creamy in texture with a rind that softens to be fully edible. The flesh may be white, pink, yellow, or red. The sweet, musky odor is pungent and penetrating. The seeds are numerous but small and fully edible. Actual seed counts have ranged from 112 to 535.

The guava will tolerate many soil conditions, but will produce better in rich well-drained soil types. Guavas are grown from grafts. They are not easy to graft, but satisfactory techniques have been worked out for patch budding. Guavas can bloom throughout the year in mild-winter areas, but the heaviest bloom occurs with the onset of warm weather in the spring. Guavas can take considerable neglect, withstanding temporary waterlogging and very high temperatures. The adaptability of the guava makes it a serious weed tree in some tropical areas. The smaller guava cultivars can make an excellent container specimen.

Dessert Guava Variety: Hong Kong Pink
Selected at Poamoho Experimental Farm, Oahu, Hawaii from seed obtained from a clone grown in Hong Kong. Medium to large, roundish fruit, weighing 6 - 8 ounces. Flesh is pinkish-red, very thick, and smooth-textured. The flavor is sub-acid to sweet, very pleasant, few seeds. The plant breeding to secure more desirable varieties of dessert guava is continuing.

Guavas can be eaten fresh or processed into juices, jams, jellies and candies. Baked goods, soups, and ketchup may be incorporated into main courses.

JABOTICABA

Brief History: *Myrciaria cauliflora* Berg. Family: Myrtaceae. The jaboticaba is native to the hilly region surrounding Rio de Janeiro, Brazil.

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Description: The jaboticaba is a slow growing large shrub or small, bushy tree. It reaches a height of 10 - 45 feet, depending on the species. The trees are profusely branched, beginning close to the ground and slanting upward and outward so that the dense, rounded crown may attain an ultimate spread as wide as it is tall. The evergreen, opposite leaves are lanceolate to elliptic, 1 - 4 inches in length and 1/2 - 3/4 inch wide. In color they are a glossy dark green with a leathery texture.

The small yellow-white flowers dramatically emerge from the multiple trunks, limbs and large branches in groups of four. It has been reported from Brazil that solitary jaboticaba trees bear poorly compared with those planted in groups, which indicates that cross-pollination enhances productivity.

Jaboticaba fruit is grape-like in appearance and texture but with a thicker, tougher skin. Averages size is one inch in diameter but can run from 3/4 to 1-1/2 inches, depending on species and variety. The gelatinous whitish pulp contains from one to four small seeds and has a pleasant, sub acid flavor markedly similar to certain muscadine grapes. The skin has a slight resinous flavor that is not objectionable. Fruit may be produced singly or in clusters from the ground up all over the trunk and main branches, and the plant may fruit up to five times per year.

Jaboticaba trees are will take full sun or some shade. They are fairly wind tolerant but do not like salty sea air. Small, young trees do best with some protection. Jaboticabas grow and fruit best in rich deep soil with a pH of 5.5 to 6.5. Water should be supplied as needed to maintain good soil moisture and prevent wilting, but constant flooding is undesirable. As the root system is somewhat shallow, irrigation is usually required when the upper inch or two of soil becomes dry. Most seeds are polyembryonic, producing a plant that is true or close to the parent plant. The seeds germinate in about one month. The grafted plant will fruit considerably earlier than a seedling. One may expect a grafted plant to produce fruit within three years. It can take from 8 to 15 years for a seedling to mature into a fruiting tree. It is this very slow growth that has kept this plant from becoming as popular as it deserves to be. Grafting older trees over to a different variety is inadvisable because it is the trunk and inner branches, which produce the fruit. One would have to cut the tree back to a one-inch stump in order to change its fruiting nature.

When planting a jaboticaba, the crown (uppermost) roots should be 2 to 3 inches higher than the surrounding soil levels to provide water runoff. Peat, compost or rotted manure may be mixed with the soil from the planting hole to improve it. The soil should be a well-aerated mixture.

Jaboticaba fruit is grape-like in appearance and texture but with a thicker, tougher skin. The fresh fruit is delicious eaten out-of-hand and can be made into jellies, jams and wine. The skin is high in tannin and should not be consumed in large quantities over a long period of time.

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JACKFRUIT

Brief History: *Artocarpus heterophyllus* Lam. Family: Moraceae. The jackfruit is believed indigenous to the rain forests of the Western Ghats of India. It spread early on to other parts of India, Southeast Asia, the East Indies and ultimately the Philippines. It is often planted in central and eastern Africa and is fairly popular in Brazil and Surinam.

Description: Jackfruit is adapted to humid tropical and near-tropical climates. Young trees are likely to be killed at temperatures below 32°F. The jackfruit tree is handsome and stately. In the tropics it grows to an enormous size, like a large eastern oak. All parts contain sticky, white latex.

The leaves are oblong, oval, or elliptic in form, 4 to 6 inches in length, leathery, glossy, and deep green in color. Juvenile leaves are lobed. Male and female flowers are borne in separate flower heads. The stalks of both male and female flower heads are encircled by a small green ring.

Jackfruit is the largest tree-borne fruit in the world, reaching 80 pounds in weight and up to 36 inches long and 20 inches in diameter. The exterior of the compound fruit is green or yellow when ripe. The interior consists of large edible bulbs of yellow, banana-flavored flesh that encloses a smooth, oval, light-brown seed. The seed is 3/4 to 1-1/2 inches long and 1/2 to 3/4 inches thick and is white and crisp within. There may be 100 or up to 500 seeds in a single fruit, which are viable for no more than three or four days. When fully ripe, the unopened jackfruit emits a strong disagreeable odor, resembling that of decayed onions, while the pulp of the opened fruit smells of pineapple and banana.

The jackfruit tree should have a location that is sunny and warm. The jackfruit flourishes in rich, deep soil of medium or open texture. Planting on top of an old compost heap would be ideal. The tree needs the best drainage and cannot tolerate "wet feet". The jackfruit's nutrient requirements are not known, but frequent, weak solutions of all-purpose fertilizer will speed the plant's growth without causing burn. In the regions where it is commonly grown, it succeeds without much care from man, the sole necessity being abundant moisture. Propagation is usually by seeds, which can be kept no longer than a month before planting. Germination requires 3 to 8 weeks. The seedlings should be moved when no more than 4 leaves have appeared. A more advanced seedling, with its long and delicate taproot is very difficult to transplant successfully. Cutting-grown plants and grafted seedlings are possible. Air layering is common in India.

The flesh and the seeds comprise the edible portion. The flesh contains 23.4% carbohydrate and the seed 38.4 %. The seed contains 6.6 % protein.

The seeds can be boiled or roasted and eaten similar to chestnuts. In Southeast Asia dried slices of unripe jackfruit are sold in the markets. The ripe bulbs, fermented and then distilled, produce potent liquor.

LIMES
See Tropical Fruit - Commercial.

LONGAN

Brief History: .*Euphoria longana*. Family: Sapindaceae. Longan is native to southern China. The USDA introduced the Longan to Florida in 1903 directly from southern China. From Florida it was taken to Bermuda, Cuba, Puerto Rico, Hawaii. The Longan original to the New World was not one of the best varieties and was not a good fruit. In the late 1950's, improved varieties were brought to the US, the 'Fukien' and the 'Kohala', the latter developed in Hawaii.

Description: The longan is member of the Sapindaceae family; it is an erect tree with spreading, slightly drooping, heavily foliaged branches. It is evergreen and has ovate-oblong, blunt-tipped leathery leaves, glossy on the upper surface and minutely hairy beneath. New growth is wine colored, turning grayish green. Pale yellow, hairy stalked flowers are borne upright with male and female mingled.

The fruit droops in clusters of yellow-brown globose with a translucent, sweet flesh that has a musky bouquet. Inside the flesh is a jet black, shiny seed.

Longans perform well in a subtropical to temperate climate, with a temperature range of 32 to 95 degrees. Longan thrives best on rich sandy loam or organic sand. They need adequate water, and can stand flooding but not prolonged drought. Annual rainfall required is 59 to 120 inches. Longan may be grown from sea level to 3,000 feet temperature permitting. Longan trees are grown from grafts and begin to produce fruit in two to four years. Longan trees need 20 feet to properly produce full growth. They are relatively free of pests and diseases but can show signs of mineral deficiency.

Fertilization, including the addition of nitrogen and minor elements, should take place after fruit harvest and during blooming season.

Medical uses of longan include stomachache, insomnia, and as an antidote for poison. Dried leaves and flowers are sold in Chinese herb markets.

Food uses include out-of-hand, canned, dried, used in salads and deserts.

Longan, Papaya, & Pineapple: 2 C seeded, halved longans, 2 C diced papaya, 2 C diced fresh pineapple, 2 T lemon juice, 1/2 C mayonnaise, lettuce. Combine, chill, serve on lettuce.

LYCHEE
See Tropical Fruit - Commercial.

MANGO

Brief History: *Mangifera indica*, Family: Anacardiaceae. The mango is a popular evergreen fruit tree native to southeastern Asia. It has been in cultivation for over 4,000 years, during which time it has spread from Asia to tropical and subtropical countries. According to recent research there are hundreds of different varieties. The first introduction was brought to Hawaii about 1825 by Captain Meek from Manila on the ship Kamehameha. These mango trees were planted by Don Marin in Honolulu and Reverend Joseph Goodrich, a missionary in Wailuku, Maui.

Description: Mango is a large, deep-rooted, symmetrical evergreen tree growing to 90 feet and 80 feet wide. It has simple, alternate, lanceolate leaves 12 to 16 inches long that are yellow-green, purple, or copper colored when young, turning leathery, glossy, and deep green when mature. Fruits weigh about 1/4 pound to 3 pounds. Fruit shape varies according to variety and may be round, ovate, or obovate. The color of immature fruit is green, gradually turning to yellow, orange, purple, red or combinations of these colors as the fruit matures. Internal flesh color of ripe mangos is pale yellow to orange. The single seed usually is large and flattened and adheres to the flesh.

Mangos can be grown on a wide range of soil types, from light sandy loams to red clay soils. Mangos are best adapted to hot tropical lowlands, seasonally dry. Mangos will grow from sea level to an elevation of 2,800 feet in Hawaii, but are most productive below 1,200 feet. The best fruit production occurs when the weather is dry during the flowering period. Mangos are large trees and should be planted 35 to 40 feet apart. Also, good air circulation and exposure to sunlight is better if the trees are not crowded for space. Grafted mangos usually produce fruit in three to five years. The tree will produce for 30 or 40 years or longer with good cultural care. The mango fruit can be picked when it has reached full size, but is not fully colored. The fruit will ripen after harvesting. Green mango is picked for specialty food products.

The fruit bruises easily and must be handled carefully to avoid damage. Fruit is harvested from the tree by hand using long poles and baskets. The industry has numerous modifications of this equipment. Mechanical harvesting equipment (e.g., hydraulic lifts) can be used if the ground is level. Most growers use what is more commonly known as a mango picker (long bamboo or aluminum pole with a net basket attach) to pick the fruit from the ground or in the tree.

Mango are commonly peeled and eaten fresh but are also used in juice preparation and made into preserves, chutney, dried slices, gourmet sauces, ice cream, ices, baked goods and pickles.

MANGOSTEEN

See Tropical Fruit - Commercial.

PULASAN

Brief History: *Nephelium mutabile.* Family: Sapindaceae. The pulasan has its origins in west Malaysia, Borneo and Sumatra. The pulasan is a close relative of the rambutan. The tree form and foliage are similar to the rambutan but are smaller in characteristics.

Description: Under normal conditions the pulasan is a medium size tree, 32 feet to 50 feet in height, with a canopy width approximately two-thirds the height. Leaves are petioled, alternate and pinnate with two to four pairs of leaflets arranged alternately or sub-opposite on the rachis.

The inflorescences are axillary and terminal, erect and widely branched, rusty pubescent and bear numerous small, greenish white flowers. The fruit is attractively colored and varies from green to yellow to pink to dark red to dark purple according to cultivar. The skin is about 1/8 inch thick and is covered with soft spines. Fruit shape is globose to ovoid, 1 ¼ to 2 ¾ inches in length and 1 to 3 ounces in weight. Edible flesh varies from 30 to 60 % of total fruit weight. The aril in preferred varieties is translucent cream white, sweet and juicy with a slight sub-acid tang. The pulasan fruit is a little larger than the rambutan, with fewer fruit per panicle, but appearance and eating quality is very similar.

Pulasan prefers a high humidity and rainfall. They are best suited to a tropical climate where winter temperatures rarely fall below 50 F. or peak above 104 F. Rainfall parameters should be between 60 to 120 inches of rain annually. Deep, rich, well-drained soils are generally preferred but pulasan is tolerant of a wide range of soil types. Grafting is the preferred method of propagation. Grafted trees will begin to fruit in 3 to 5 years. Fruit maturity takes from 100 to 130 days in warm tropical areas. Records show an average of 44 pounds of fruit may be harvested in year 5 and 440 pounds in 15 years.

Pulasan are normally eaten as a fresh fruit. However, pulsan can be frozen or dried, used for flavoring in ice cream, puddings, can be made into preserves, jams, jellies and sauces

The chefs in the gourmet restaurants use pulsan in their entrée dishes and in sauces. Pulasan is also being used more recently in tropical juice blends.

RAMBUTAN

Brief History: *Nephelium lappaceum L.* Family: Sapindaceae. The rambutan originated in the rain forests of Malaysia and is widely cultivated throughout the lowland tropics of Southeast Asia. In Hawaii, rambutans have fruited on Maui, Oahu, and the Big Island (Hilo and Kona).

Description: The tree is evergreen and may reach 32 to 82 feet high and 19 feet wide. Rambutans perform best with 80-120 inches of well-distributed rainfall throughout the year. It requires permanently moist soil, except for a few weeks prior to flowering. Sufficient moisture is essential from antithesis to harvest.

The trunk, which reaches 30 centimeters in diameter, is upright, with rather large branches. The bark is very dark and rugose. The crown is somewhat open. The leaves are pinnately compound and consist of 2 to 4 pairs of leaflets and sometimes a terminal leaflet. The leaflets are oblong or elliptical, shiny dark green above and lighter below. The leaf measures 5 to 10 centimeters in length and 2 to 10 centimeters in width. The fruit is an ovate or ellipsoidal drupe 3 to 8 centimeters long and 2 to 4 centimeters wide, borne in clusters, with a short, thick pedicel. The skin is red or yellow and is covered with smooth appendages that look like curved thorns but that are soft and flexible. The interior aril is smooth, white, translucent, juicy and sweet.

The seeds, usually one to a fruit, are ellipsoidal and 2 to 3 centimeters long. The fruit is attractively colored and varies from yellow to pink to dark red according to cultivar.

Trees are propagated by aerial layering, approach grafting, or by budding, using buds from matured wood and a modified forkert method. Grafted rambutan trees may begin to bear as early as the second year of growth, but they normally begin to bear in 3 to 5 years. If grown from seed, trees bear fruit in 6 to 8 years. Figures show yields of 44 pounds per tree in year 5, 242 pounds per tree in year 10, and 485 pounds per tree in year 17. The harvest season in Hawaii is August through March.

The fruits can be collected when they begin to turn from green to reddish. Fruit should be harvested when full color saturation is reached. Full maturity takes from 100 to 130 days in warm tropical areas and up to 150 days in cooler sub-tropical climates.

Rambutans are predominantly sold as a fresh fruit item in local markets. Rambutan, like its close relatives the lychee and pulasan can be frozen or dried, used for flavoring in ice cream, puddings, can be made into preserves, jam, jellies and sauces. The chefs in the gourmet restaurants use rambutan in their entrée dishes and in sauces.

STAR APPLE

Brief History: *Chrysophyllum Cainito.* Family: Sapotaceae. The star apple or camito is indigenous to the West Indies and Central American regions, where it is grown extensively. Although not common in Hawaii, there are good specimens to be found in many gardens.

Description: It is a very attractive tree growing to the height of 50 feet with dark green leaves 6 inches long, which have a silky golden-brown undersurface. The small purplish white flowers are borne in axillary clusters on mature twigs. Fruits are green, purple or copper colored, round and up to 3 inches in diameter with a smooth skin containing a white sweet pulp arranged in eight segments surrounding 3 to 5 hard, brown, glossy seeds. When halved, these segments give the fruits a star-shaped pattern.

The tree is tropical in its requirements and less tolerant of low temperatures then the sapodilla. The star apple is reported to grow well in a range of soils from sands to clay loams. The reported times of cropping vary from early spring, late spring to midsummer, two crops per year have been reported for some varieties. Trees grown from grafts will begin fruiting in 2 to 3 years.

The purple variety of star apple is an attractive fruit and sells well in all types of markets. The flavor is very pleasant and the color eye-catching. The flesh is tender, mild and sweet in flavor. The fruits are allowed to ripen to full maturity as under ripe fruit contains some latex.

Analyses shows the fruit contains 85.7 gm moisture; 1.2 gm fiber; .130 gm nitrogen; .44 gm ash; 17.3 mg calcium; 16.4 mg phosphorus; .48 mg iron; .027 mg thiamine; .015 mg carotene; .018 mg riboflavin; 1.053 mg niacin; 9.1 mg ascorbic acid.

It is strictly a dessert fruit and not suitable for cooking. The fruits are very popular in Asian countries.

STRAWBERRY GUAVA

Brief History: *Psidium Cattleianum* Sabine. Family: Myrtaceae. Strawberry guava is one of the hardiest of guava varieties. It is said to be a native of Brazil.

Description: A shrubby tree 15 to 20 feet in height. The bark is smooth, mottled green or reddish brown and peels off in thin flakes to reveal the attractive "bony" aspect of its trunk. Strawberry guava leaves are opposite, short petioled, oval or oblong-elliptic, somewhat irregular in outline, 2 - 4 inches long and 1 inch wide. The leaves are leathery, shiny dark green, and are slightly downy on the underside. The flowers are faintly fragrant, white and borne singly or in clusters in the leaf axils, are 1-inch wide, with 4 or 5 white petals. These petals are quickly shed, leaving a prominent tuft of perhaps 250 white stamens tipped with pale-yellow anthers. The fruit is spherical, about 1 inch in diameter and purple-reddish when ripe, the flesh is whitefish pink and is soft and juicy with an agreeable flavor, containing many small white seeds.

The strawberry guava will tolerate many soil conditions, but will produce better in rich well-drained soil types. Strawberry guavas are grown from grafts. They are not easy to graft, but satisfactory techniques have been worked out for patch budding. Strawberry guavas can bloom throughout the year in mild-winter areas, but the heaviest bloom occurs with the onset of warm weather in the spring. Strawberry guavas can take considerable neglect, withstanding temporary water logging and very high temperatures.

The smaller size of the tree and the shape, color of the leaves of the strawberry guava make it a very attractive landscape plant, but the adaptability of the guava makes it a serious weed tree in Hawaii. The strawberry guava makes an excellent container plant.

Strawberry guava can be eaten fresh or processed into juices, jams, jellies, and candies. Baked goods, soups, and ketchup may be incorporated into main courses.

WHITE SAPOTE

Brief History: The white sapote, *Casimiroa edulis* Llave & Lex. Family: Rutaceae. The genus *Casimiroa* of the family Rutaceae was named in honor of Cardinal Casimiro Gomez de Ortega, a Spanish botanist of the 18th Century. It embraces 5 or 6 species of shrubs or trees.

The white sapote originated in Mexico. Its range is broad, extending down into Central America as far as Costa Rica. The white sapote, *C. edulis*, remains the preferred fruit of the genus due to its delicious flavor and wide appeal.

Description: White sapote trees range from 15 to 20 feet up to 30 to 60 feet in height. They have light-gray, thick, warty bark and often develop long, drooping branches. The leaves, mostly evergreen are alternate, palmately compound, with 3 to 7 lanceolate leaflets, smooth or hairy on the underside. The odorless flowers, small and greenish-yellow, are 4- or 5-parted, and borne in terminal and axillary panicles. They are hermaphrodite or occasionally unisexual because of aborted stigmas. The fruit is round, oval or ovoid, symmetrical or irregular, more or less distinctly 5-lobed; 2 1/2 to 4 1/2 inches wide and up to 4 3/4 inches in length; with thin green, yellowish or golden skin coated with a very thin bloom, tender but inedible; and creamy-white or yellow flesh glinting with many tiny, conspicuous, yellow oil glands.

The flavor is sweet with a hint or more of bitterness and sometimes distinctly resinous. There may be 1 to 6 plump, oval, hard, white seeds, 1 to 2 inches long and 1/2 to 1 inches thick, but often some seeds are under-developed (aborted) and very thin. The kernels are bitter and narcotic.*C. edulis* has leaves that are usually composed of 5 leaflets, glabrous to slightly pubescent on the underside, and 5-parted flowers. The fruit is somewhat apple-like externally, generally smooth, fairly symmetrical and 2 1/2 to 3 inches wide. The fruits are usually 4 to 4 1/2 inches wide, ovoid, irregular and knobby, with rough, pitted skin, and there are often gritty particles in the flesh.

The white sapotes can be classed as subtropical rather than tropical. *C. edulis is* usually found growing naturally at elevations between 2,000 and 3,000 feet and occasionally in Guatemala up to a maximum of 9,000 feet in areas not subject to heavy rainfall. As long as there is good drainage, the trees will do very well on sandy loam or even on clay. White sapotes are commonly grown from seeds and seedlings usually begin to bear in 7 or 8 years. Grafting is a common practice. Grafted trees will start bearing in 3 or 4 years.

Within its native range, the white sapote is commonly eaten out-of-hand. The flesh of ripe fruits may be added to fruit cups and salads or served alone as dessert, but it is best cut into sections and served with cream and sugar. Sometimes it is added to ice cream mix or milk shakes, or made into marmalade.

The wood is yellow, fine-grained, compact, moderately dense and heavy, medium strong and resistant, but not durable for long.

The ancient Nahuatl name for the fruits, "cochiztzapotl", is translated "sleepy sapote" or "sleep-producing sapote", and it is widely claimed in Mexico and Central America that consumption of the fruit relieves the pains of arthritis and rheumatism.

TROPICAL FRUIT - COMMERCIAL

Commercial tropical fruit is to be planted in approximately 20-acre blocks located within the development. These crops will be farmed using commercial methods by either qualified farmers or by personnel hired by the development specifically for this purpose. Crops harvested will be sold in both local and out of State markets. The intent of the commercial farming operation is to create a profit.

Included in this section is a list of the suggested commercial crops, a detailed description of each and a cash flow showing the level of profitability that may be expected from each crop. Along with each cash flow is a list of assumptions used to create the cash flow.

AVOCADO

Brief History: *Persea americana* Mill. is a traditional crop of Central America that now grows in most subtropical and tropical countries. There are three distinct races of avocados: Mexican, Guatemalan, and West Indian. Some important commercial cultivars are hybrids of the various races. Don Marin, a horticulturist who lived in Pauoa Valley in Honolulu, is considered to be the person who planted the first avocado trees in Hawaii.

Description: Avocado is a much-branched evergreen tree 40 to 80 feet in height with elliptic leaves 3 to 10 inches long. Fruit: spherical, ovoid, ellipsoid, or pyriform. External color: green, reddish-purple, purple or black. Internal color: greenish yellow to bright yellow when ripe. Fruits have a single large seed making up 10 to 25 percent of the fruit weight.

Basic Cultivation Requirements:
Soil: The avocado may be grown in many soil types as long as the soil is well drained. Good drainage is critical. A soil pH level between 5.7 and 6.5 is preferred.

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Temperature: Optimum temperatures for growth and flowering according to research done in Florida and Australia is moderate day (77 F) and cool nights (68 F).

Elevation: Avocados can be grown from 0-3,500 ft. Microclimates suited to the culture of different cultivars are found throughout Hawaii.

Rainfall: Rainfall of 50 inches of well-distributed rainfall throughout the year is adequate; higher rainfall is tolerated if drainage is good. Rainfall in the Puna district generally ranges 80 to 100 inches per year. Relative humidity of 50% or more is desirable during flowering and fruit set.

Cultural: Trees should be spaced 25 to 35 feet apart. Weeds and grass under the trees can be controlled with the herbicide Roundup or heavy mulching. A combination using Best Management Practices (BMP) is recommended.

Organic mulches are recommended for weed control and maintenance of good soil condition. Early pruning of young trees is done to shape young trees and remove dead branches. Bearing trees are pruned, usually annually, after harvest to control tree height and to open the interior of the tree to light. Areas exposed to high winds should be avoided because branches are easily broken, and flowers and fruits may be damaged. Windbreaks are recommended where there is consistent wind exposure.

Diseases: In general avocados are not susceptible to disease unless their overall tree health is poor or water accumulates around the root system. The list of avocado diseases is dodder (*Cuscuta sandwichiana*), avocado root rot (*Phytohthora cinnamomi*), stem-end rot (*Phomopsis sp., Dothiorella sp.*), fruit rot (*Dothiorella sp.*), anthracnose (*Colletotrichum gloeosporioides*), algal leaf spot (*Cephaleuros virescens*), scab (cause unknown; resistant varieties available), and leaf tip-burn (various causes, not all disease related, including salt accumulation from over fertilizing).

Pests: Pests are generally not a problem in avocado cultivation. However, some control with organic sprays may be required occasionally, especially in young trees. The major pests are red-banded thrips (*Selenothrips rubrocinctus*), armored scales (several species), Chinese rose beetle (*Adoretus sinicus*), fruit fly, mites, black twigborer (*Xylosandrus compactus*), mealybug (*Dysmicoccus neobrevipes, Nipaecoccus nipae*), and plantbugs (*Hyalopeplus pellucidus* and other species).

Nutrients: Important plant nutrients applied as fertilizer to avocado are nitrogen (N), phosphorus (P), potassium (K), and calcium (Ca). Among micronutrients, zinc (Zn) is important to avocado and should be applied whenever deficiency is indicated. Boron can be deficient and is an element needed by the avocado for proper fruit development. If soil is strongly acidic, add calcium carbonate to raise pH. If soil pH is adequate calcium sulfate can be used to provide calcium without increasing pH. A soil analysis is recommended to determine basic nutrient levels in the soil. Even more important is a tissue analysis done at least annually to determine nutrient levels in the tree.

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From observation, production records, and the soil and tissue analysis a fertilizer regime can be designed to suit the orchard. This fertilizer regime must be closely monitored and changed as the indicators dictate.

Fruit Maturity: Fruit is produced in 5-8 years from seed, 3-4 years from grafts, continuing for about 25 years and in some cases even longer. Several approximate methods are used to determine fruit maturity, such as the presence of fallen fruit which ripen when stored, lack of glossy skin, historic picking date, mature fruit size, seed membrane change, stem turns yellowish brown and snaps more easily, and skin color change.

Sources of Nursery Stock: Seedling plants fail to reproduce true to type, and grafting is necessary to maintain desired growth, bearing and fruit characteristics. Grafted trees usually begin to bear fruit three to four years after transplanting.

Various grafting techniques such as side, whip and bark grafting can be employed. The preferred commercial varieties are Hass and Sharwil. Hass is a black-skinned, ovate cultivar whose fruit weighs 5 to 12 oz. It descends primarily from the Guatemalan race. Sharwil is a green-skinned, pyriform cultivar whose fruit weighs 8 to 20 oz. It is a Mexican and Guatemalan cross. The Sharwil, a variety propagated by the University of Hawaii, is considered by many to be the finest quality commercial avocado in the world, considered better tasting than the popular California variety known as Hass.

Nurseries that sell grafted avocado plants are:

1. Plant It Hawaii, Kurtistown, Hawaii
2. Kahili Farms Nursery (Candace Strong), Kilauea, Kauai

Production: Once planted, orchards of grafted varieties will begin producing a harvestable crop in 3 to 4 years. The estimated yield at this point is 20 to 50 pounds per tree per year. Yields will increase each year and peak at 500 to 1,000 pounds per tree per year at between 10 and 15 years. The large yield variation is attributed to varying year-to-year climate conditions and to the specific variety. In Hawaii, the 1997 average yield per acre was 2,300 pounds.

The Hass avocado and the Sharwil are harvested generally from late winter to May. Fruits are picked when mature but still hard and then allowed to ripen. Fruit is harvested from the tree by hand, generally with pruning shears, special clippers, poles and baskets and never pulled from the branch. The pedicel (fruit stem) should remain attached to the fruit. When the stem is pulled out, the fruit often spoils. Fruits are easily bruised, and windfall fruits are not marketable. The industry has numerous modifications of this equipment. Mechanical harvesting equipment (e.g., hydraulic lifts) can be used if the land is level.

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Packing: The ripening and storage vary with the variety. In general avocados will ripen during storage, and the best ripening temperature range is between 55 and 75 F. Ripening avocados generate much heat. In closed packages or containers, fruit can be heat- damaged. Vented and screened boxes and airfreight containers designed for fresh products should be used. Ripe fruit can be refrigerated at 40' to obtain maximum shelf life of the product.

Uses: Avocado is eaten as a fresh fruit worldwide. This is its most important commercial use. The increasing popularity of the Mexican guacamole, which is pureed avocado with seasoning, is a large user of avocados. Fine oil is also made from the avocado. This oil is used in salad dressings and in cosmetics and health food products.

Marketing: The avocado industry in Hawaii at present is comprised of approximately 95 growers farming 340 acres and producing 500,000 pounds. The estimated farm value of the industry's production is $265,000.

The average price per pound paid to the grower was $0.53. Current wholesale prices on the spot market are between $0.65 and $0.90 per pound for Hass and Sharwil. These statistics are from the 1997 Hawaii Agricultural Statistics Service avocado annual report dated September 3, 1998.

Current federal regulations will permit export of fresh Hawaii avocados to the U.S. Mainland. The United States Department of Agriculture regulations require that the avocado fruit use an approved 10 to 14 day cold treatment to kill fruit flies. These regulations apply to all Hawaii grown avocado varieties. Shippers have to determine if the fruit needs a preconditioning heat treatment to maintain quality. Transshipment through U.S. ports is permitted if certain conditions are met. Seattle and Chicago being bonded as transshipment points have opened up more opportunities for the industry.

The existing markets are the state supermarkets, state food service industry, the mainland, and Canada. The price is determined by the mainland fruit supply, and there is at this time no premium for Hawaii grown avocados. Fruit sent to Canada does not require post harvest quarantine treatment.

Local markets have been dominated by the Hass variety of avocado, and are somewhat familiar with the Sharwil. The November-May harvest season for Sharwil avocados enables growers to market some of their crop before California's peak Hass avocado harvest in April-October, during which time Hass are exported to Hawaii' supermarkets in large quantities. The food service industry and supermarkets that are located near middle or upper income residential areas in Hawaii look for the high quality Hawaii grown products and will pay a premium for those. Locally grown Sharwil and Hass compete with the California Hass for markets. The KTA Supermarket chain on Hawaii supports local agricultural products and will purchase those in preference to mainland products if the price is competitive.

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Packaging: Corrugated cardboard box, 2 ply, 200 lb tested, can be used. This is available at Weyerhaeuser Paper Company in Honolulu.

Transport: Barge service or airfreight. Fruits are shipped inter-island to Honolulu either by Young Bros. barge (1-1/2 - 3-1/2 cents/lb) or by air (19-20 cents/lb) or (10 cents/lb for 1,000 lbs or more).

Oneloa Development Project: Cash Flow for Avocado:

28-Jun-99 **Acreage:** **20**

Production & Revenue	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Pounds Harvested	-	-	-	-	58,140	77,520	116,280	155,040	204,000	204,000
Revenue	$0	$0	$0	$0	$37,791	$50,388	$75,582	$100,776	$132,600	$132,600
Average price per lb	$ 0.65									
Operating Costs										
Mowing	$2,448	$2,448	$2,448	$2,448	$2,040	$2,040	$2,040	$2,040	$2,040	$2,040
Herbicide	$1,836	$1,836	$1,836	$1,530	$918	$918	$918	$918	$918	$918
Fertilize	$612	$1,224	$2,448	$3,672	$3,672	$3,672	$3,672	$3,672	$3,672	$3,672
Pest Control	$85	$85	$85	$85	$85	$85	$85	$85	$85	$85
Hand Weeding	$2,550	$816	$0	$0	$0	$0	$0	$0	$0	$0
Replant	$51	$102	$102	$102	$102	$102	$102	$102	$102	$102
Pruning	$255	$255	$255	$510	$510	$510	$510	$510	$510	$510
Crop Log	$17	$17	$17	$17	$17	$17	$17	$17	$17	$17
Other	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing	$0	$0	$0	$0	$15,698	$20,930	$31,396	$41,861	$55,080	$55,080
Post-harvest Treatment	$0	$0	$0	$0	$5,814	$7,752	$11,628	$15,504	$20,400	$20,400
Management Fee	$1,974	$1,706	$1,808	$2,102	$5,073	$6,149	$8,300	$10,451	$13,169	$13,169
General Excise Tax	$411	$355	$377	$438	$1,604	$2,011	$2,824	$3,637	$4,664	$4,664
Total Operating Costs	$9,871	$8,532	$9,042	$10,508	$33,972	$42,218	$58,710	$75,203	$96,035	$96,035
Net Operating Profit (Loss)	($9,871)	($8,532)	($9,042)	($10,508)	$3,819	$8,170	$16,872	$25,573	$36,565	$36,565
Capital Expenditures	$ 35,163	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow	($45,034)	($8,532)	($9,042)	($10,508)	$3,819	$8,170	$16,872	$25,573	$36,565	$36,565
Cumulative Cash Flow		($53,566)	($62,607)	($73,116)	($69,296)	($61,126)	($44,254)	($18,681)	$17,884	$54,449

Oneloa Development Project: Cash Flow for Avocado

28-Jun-99 **Acreage:** **20**

Production & Revenue	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Pounds Harvested	204,000	204,000	204,000	204,000	204,000	204,000	204,000	204,000	204,000	204,000
Revenue	$132,600	$132,600	$132,600	$132,600	$132,600	$132,600	$132,600	$132,600	$132,600	$132,600
Average price per lb	$0.65									
Operating Costs										
Mowing	$1,428	$1,428	$1,428	$1,428	$1,428	$714	$714	$714	$714	$714
Herbicide	$918	$918	$918	$918	$918	$918	$918	$918	$918	$918
Fertilize	$4,896	$4,896	$4,896	$4,896	$4,896	$4,896	$4,896	$4,896	$4,896	$4,896
Pest Control	$85	$85	$85	$85	$85	$85	$85	$85	$85	$85
Hand Weeding	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Replant	$153	$153	$153	$153	$153	$196	$196	$196	$196	$196
Pruning	$510	$510	$510	$510	$510	$510	$510	$510	$510	$510
Crop Log	$17	$17	$17	$17	$17	$17	$17	$17	$17	$17
Other	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing	$55,080	$55,080	$55,080	$55,080	$55,080	$55,080	$55,080	$55,080	$55,080	$55,080
Post-harvest Treatment	$20,400	$20,400	$20,400	$20,400	$20,400	$20,400	$20,400	$20,400	$20,400	$20,400
Management Fee	$13,334	$13,334	$13,334	$13,334	$13,334	$13,167	$13,167	$13,167	$13,167	$13,167
General Excise Tax	$4,698	$4,698	$4,698	$4,698	$4,698	$4,663	$4,663	$4,663	$4,663	$4,663
	$96,864	$96,864	$96,864	$96,864	$96,864	$96,025	$96,025	$96,025	$96,025	$96,025
Net Operating Profit (Loss)	$35,736	$35,736	$35,736	$35,736	$35,736	$36,576	$36,576	$36,576	$36,576	$36,576
Capital Expenditures	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow	$35,736	$35,736	$35,736	$35,736	$35,736	$36,576	$36,576	$36,576	$36,576	$36,576
Cumulative Cash Flow	$90,185	$125,921	$161,657	$197,393	$233,129	$269,705	$306,280	$342,856	$379,431	$416,007

28-Jun-99 **Acreage:** **20**

Acreage and Yield Assumptions

Acreage & Tree Count Assumptions:

Acreage		
Total acres		20.00
Estimated net tree acres	85%	17.00
Tree Data		
Density, trees per acre (30'x30')		48
Theoretical trees on net acres		816

Yield Assumptions:

Category	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Lbs/Tree/Year	-	-	-	-	75.0	100.0	150.0	200.0	300.0	400.0
Lbs Adjusted for Spoilage	-	-	-	-	71.3	95.0	142.5	190.0	285.0	380.0
Lbs per Tree Acre per Year	-	-	-	-	3,420	4,560	6,840	9,120	12,000	12,000

Category	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Lbs/Tree/Year	500.0	500.0	750.0	750.0	750.0	750.0	750.0	750.0	750.0	750.0
Lbs Adjusted for Spoilage	475.0	475.0	712.5	712.5	712.5	712.5	712.5	712.5	712.5	712.5
Lbs per Tree Acre per Year	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000

Key Assumptions	
Estimated Producing Tree Density (tpa)	48
Spoilage	5.0%
Maximum Lbs per Tree Acre per Year	12,000

Average Price Assumptions:

Average Price	$	0.65

28-Jun-99 **Acreage:** **20**

Cost Assumptions

Establishment Cost:

Category	Total Cost	Unit Cost	
Land Clearing	$ 16,000	$ 800	per acre
Planting	$ 14,688	$ 18	per tree
Management fee	$ 3,069	10%	
Sub-Total	$ 33,757		
GET	$ 1,406	4.166%	
Total	$ 35,163		

Planting Cost Detail:

Trees	$ 10.00
Soil	$ 2.00
Dig holes	$ 2.50
Labor	$ 3.00
Fertilizer	$ 0.50
Total	$ 18.00

Operating Costs:

Cost per Acre per Round:

Category	Rds. per Yr.	Year 1	Year 2	Year 3	Year 4	Yr 5 thru 10	r 11 thru 15	r 16 thru 20
Mowing	6	$ 24.00	$ 24.00	$ 24.00	$ 24.00	$ 20.00	$ 14.00	$ 7.00
Herbicide	6	$ 18.00	$ 18.00	$ 18.00	$ 15.00	$ 9.00	$ 9.00	$ 9.00
Fertilize	6	$ 6.00	$ 12.00	$ 24.00	$ 36.00	$ 36.00	$ 48.00	$ 48.00
Pest Control	1	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00
Hand Weeding	6	$ 25.00	$ 8.00	$ -	$ -	$ -	$ -	$ -
Replant	1	$ 3.00	$ 6.00	$ 6.00	$ 6.00	$ 6.00	$ 9.00	$ 11.50
Pruning	1	$ 15.00	$ 15.00	$ 15.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00
Crop Log	1	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00
Other	1	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50

	Unit Cost	
Harvesting	$ 0.10	per pound
Packing	$ 0.10	per pound
Packing Materials	$ 0.05	per pound
Hauling	$ 0.02	per pound
Total Harvest, Pack & Haul	$ 0.27	per pound
Post-harvest Treatment	$ 0.10	per pound
Management - Cultivation	25%	of operating costs
Management - Harvesting	15%	of harvesting, packing & post-harvest treatment costs.
GET on Operating Costs	4.166%	
GET on Revenue	0.500%	

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BREADFRUIT

Brief History: The breadfruit belongs to the Moracceae (fig or mulberry) family. Its scientific name is *Artocarpus altilis* Fosberg. The breadfruit is believed to be native to a vast area extending from New Guinea through the Indo-Malayan Archipelago to Western Micronesia.

It is said to have been widely spread in the Pacific area by migrating Polynesians. Hawaiians believe that it was brought from the Samoan island of Upalu to Oahu in the 12th Century A.D. It is said to have been first seen by Europeans in the Marquesas in 1595, then in Tahiti in 1606.

Description: The breadfruit tree is handsome and fast growing, reaching 85 feet in height, often with a clear trunk to 20 feet becoming 2 to 6 feet in width and often buttressed at the base, though some varieties may never exceed 1/4 or 1/2 of these dimensions. There are many spreading branches, some thick with lateral foliage-bearing branchlets, others long and slender with foliage clustered only at their tips. The leaves, evergreen or deciduous depending on climatic conditions, on thick, yellow petioles to 1 1/2 inches long, are ovate, 9 to 36 inches long, 8 to 20 inches wide, entire at the base, then more or less deeply cut into 5 to 11 pointed lobes. They are bright green and glossy on the upper surface, with conspicuous yellow veins; dull, yellowish and coated with minute, stiff hairs on the underside.

The tree bears a multitude of tiny flowers, the male densely set on a drooping, cylindrical or club-shaped spike 5 to 12 inches long and 1 to 1 1/2 inches thick, yellowish at first and becoming brown. The female are massed in a somewhat rounded or elliptic, green, prickly head, 2 1/2 inches long and 1 1/2 inches across, which develops into the compound fruit (or syncarp), oblong, cylindrical, ovoid, rounded or pearshaped, 3 1/2 to 18 inches in length and 2 to 12 inches in diameter. The thin rind is patterned with irregular, 4- to 6-sided faces, in some "smooth" fruits level with the surface, in others conical; in some, there may rise from the center of each face a sharp, black point, or a green, pliable spine to 1/8 inches long or longer. Some fruits may have a harsh, sandpaper-like rind. Generally the rind is green at first, turning yellowish-green, yellow or yellow-brown when ripe, though one variety is lavender.

In the green stage, the fruit is hard and the interior is white, starchy and somewhat fibrous. When fully ripe, the fruit is somewhat soft, the interior is cream colored or yellow and pasty, also sweetly fragrant.

The seeds are irregularly oval, rounded at one end, pointed at the other, about 3/4 inches long, dull-brown with darker stripes. In the center of seedless fruits there is a cylindrical or oblong core, in some types covered with hairs bearing flat, brown, abortive seeds about 1/8 inches long. The fruit is borne singly or in clusters of 2 or 3 at the branch tips. The fruit stalk (pedicel) varies from 1 to 5 inches long.

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Basic Cultivation Requirements:
Soil: Breadfruit is tolerant of a wide range of soil types. Fertile, well-drained, volcanic soils is recommended.

Temperature: The breadfruit is ultra-tropical, much more sensitive than the mango tree. It has been reported that it requires a temperature range of 60° to 100°F. Young plants do best in partial shade.

Elevation: Breadfruit has been cultivated at sea level and up humid slopes to an altitude of 3,500 feet. In Central America, it is grown only below 2,000 feet. The Hawaiian windward coasts are ideal growing locations.

Rainfall: Requires 60 to 100 inches of rain annually but will tolerant a minimum rainfall of 50 inches and a relative humidity of 70 to 80%.

Cultural: Breadfruit is propagated from shoots growing from the roots or from one inch diameter root cuttings, 9 to 10 inches long. These can be placed in a shaded bed until a 2-3 foot top has grown. Young breadfruit trees are planted in well-enriched holes 15 inches deep and 3 feet wide. The breadfruit plant grows an extensive root system, so it is best to plant it where it will have plenty of room to stretch out and also up. The trees are spaced 25 to 40 feet apart in plantations.

Those grown from root suckers will bear in 5 years and will be productive for 50 years. Some growers recommend pruning of branches that have borne fruit and would normally die back, because this practice stimulates new shoots and also tends to keep the tree from being too tall for convenient harvesting.

Diseases: Young breadfruit trees have been killed by a disease caused by *Rosellinia* sp. In the Pacific Islands *Fusarium* sp. is believed to be the cause of die back, and *Pythium* sp. is suspected in cases of root rot. The fungus, *Phytophthora palmivora*, attacks the fruit and *Phomopsis*, *Dothiorella* and *Phylospora* cause stem-end rot.

Pests: Soft-scales and mealybugs are found on breadfruit trees and ants infest branches that die back after fruiting.

Nutrients: Standard mixtures of NPK are applied seasonally. When the trees reach bearing age, they each receive, in addition, 4.4 pounds superphosphate per year to increase the size and quality of the fruits.

Maturity: Trees begin to bear fruit five to seven years after planting the root shoot. In the South Seas, the tree fruits more or less continuously, fruit in all stages of development being present on the tree the year around, but there are two or three main fruiting periods. Breadfruits are most abundant in Hawaiian markets off and on from July to February. But some fruits may mature at other times during the year.

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Sources of Nursery Stock:

1. Plant It Hawaii, Kurtistown, Hawaii
2. Frankie Sekiya Nursery, Honolulu, Oahu
3. Kahili Farm Nursery, Kilauea, Kauai
4. Lyon Arboretum, Honolulu, Oahu

Production: Breadfruit is usually picked while still firm and will soften in a few days. If not picked before it softens on the tree, it often falls and smashes. Breadfruits are picked when maturity is indicated by the appearance of small drops of latex on the surface. It is recommended to pick breadfruit with the aid of a "picker", as the branches are brittle and can easily break. However, harvesters do climb the trees and break the fruit stalk with a forked stick so that the fruit will fall. Even though this may cause some bruising or splitting, it is considered better than catching the fruits by hand because the broken pedicel leaks much latex.

A mature tree may bear 50 to 150 fruits with two harvestable crops per year. A conservative estimate of 100 fruits weighting 8 to 10 pounds depending on the varieties used will yield 1,600 pounds of fruit per tree per year.

Uses: Breadfruit is a high carbohydrate vegetable, *not a fruit as we generally use the* term. It is a good source of calcium, a wholesome food high in vitamin B, with some ascorbic acid and thiamin. In green breadfruit, the carbohydrates are in the form of starch, turning to sugar as the fruit ripens.

There are recipes throughout the islands indicating many ways to prepare breadfruit. It may be steamed, baked, boiled, dried, fermented, marinated, fried and ground in to a powder for baked goods. It is also made into poi and desserts.

Like the banana and plantain, the breadfruit may be eaten ripe as a fruit or under ripe as a vegetable. For the latter purpose, it is picked while still starchy and is boiled or, in the traditional Pacific Island fashion, roasted in an underground oven on pre-heated rocks.

The breadfruit tree has many uses other than for food. All parts of the plant give off the milky sticky sap. When the sap is used alone or when mixed with other plants, it can be applied to the skin to heal cuts, scratches and various skin diseases. It is also used as a moisturizer for wind-cracked or scaly skin. Mouth sores can be treated with the sap and the leaf buds. The sap can also be used as a chewing gum, and more importantly was used in ancient days as a glue and caulking material, for such as canoe building.

In the old times, a birdlime made from the sap was used to catch nectar-feeding birds for their brightly colored feathers. These were collected for their service as warm and colorful capes for the chiefly ones. The fallen and sun-dried male flowers of the breadfruit can be lit, and the smoke is a nontoxic mosquito repellent.

The wood of the tree's trunk is light in weight. Hawaii's craftsmen used it for making canoes, woodwork for homes, drums, surfboards, and for poi boards. A low-grade tapa cloth was made from the inner bark of young branches. The rough sheath was used as a dry abrasive in the final polishing of bowls and utensils. It was also used to sand candlenut before they were strung into leis.

Marketing: The mainland markets, both the West Coast and East Coast, are importing breadfruit from the South Pacific and the Caribbean for the large Samoan population on the West Coast and Southeast Asians on both coasts. There are pockets of ethnic markets throughout the mainland, in Canada, and in Europe that are receiving small shipments of breadfruit. Breadfruit is also attracting the attention of gourmets. These markets have a good potential for Hawaiian breadfruit. Hawaii has a shelf life advantage as it is closer to these markets than the other exporters from the South Pacific and, therefore, shipping time is less.

The local market in Hawaii has never been developed for breadfruit. There is an opportunity for market expansion if the supermarkets promoted breadfruit and stocked it more consistently. Another opportunity is more use of Hawaiian breadfruit by the local chefs in restaurants and hotels. This would require a concerted effort by the farmers, wholesalers, and retailers.

Breadfruit is not a fruit fly host and may be shipped to the mainland without a post harvest treatment.

Packaging: Breadfruit is packed in cartons in which they are separated individually by dividers. Fully ripe fruits can be wrapped in polyethylene, or put into polyethylene bags, and kept for 10 days in storage at a temperature of 53.6°F. At lower temperatures, the fruit shows chilling injury. Slightly unripe fruits that have been caught by hand when knocked down can be maintained for 15 days under the same conditions. The thickness of the polyethylene is important: 38-or even 50-micrometer bags are beneficial, but not 25-micrometer.

Some Jamaican exporters partly roast the whole fruits to coagulate the latex, let them cool, and then ship them by sea to New York and Europe. In Jamaica, surplus breadfruits are often kept under water until needed.

Transport: Breadfruit can be transported by refrigerated containers either on ships or planes.

Oneloa Development Project: Cash Flow for Breadfruit

28-Jun-99 **Acreage:** 20

Production & Revenue	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Pounds Harvested	-	-	-	-	43,605	65,408	87,210	119,914	152,618	196,223
Revenue	$0	$0	$0	$0	$21,803	$32,704	$43,605	$59,957	$76,309	$98,111
Average price per lb	$ 0.50									
Operating Costs										
Mowing	$2,448	$2,448	$2,448	$2,448	$2,040	$2,040	$2,040	$2,040	$2,040	$2,040
Herbicide	$1,836	$1,836	$1,836	$1,530	$918	$918	$918	$918	$918	$918
Fertilize	$408	$816	$1,632	$2,448	$2,448	$2,448	$2,448	$2,448	$2,448	$2,448
Pest Control	$85	$85	$85	$85	$85	$85	$85	$85	$85	$85
Hand Weeding	$2,550	$816	$0	$0	$0	$0	$0	$0	$0	$0
Replant	$51	$102	$102	$102	$102	$102	$102	$102	$102	$102
Pruning	$170	$170	$170	$170	$170	$170	$170	$170	$170	$170
Crop Log	$17	$17	$17	$17	$17	$17	$17	$17	$17	$17
Other	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing	$0	$0	$0	$0	$6,541	$9,811	$13,082	$17,987	$22,893	$29,433
Post-harvest Treatment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Management Fee	$1,902	$1,583	$1,583	$1,711	$2,437	$2,927	$3,418	$4,154	$4,890	$5,871
General Excise Tax	$396	$330	$330	$356	$726	$937	$1,148	$1,465	$1,782	$2,204
Total Operating Costs	$9,509	$7,916	$7,916	$8,553	$14,800	$18,561	$22,322	$27,963	$33,605	$41,127
Net Operating Profit (Loss)	($9,509)	($7,916)	($7,916)	($8,553)	$7,003	$14,143	$21,283	$31,994	$42,704	$56,985
Capital Expenditures	$ 26,748	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow	($36,258)	($7,916)	($7,916)	($8,553)	$7,003	$14,143	$21,283	$31,994	$42,704	$56,985
Cumulative Cash Flow		($44,173)	($52,089)	($60,642)	($53,639)	($39,497)	($18,213)	$13,780	$56,484	$113,469

Oneloa Development Project: Cash Flow for Breadfruit

28-Jun-99 **Acreage:** 20

Production & Revenue	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Pounds Harvested	239,828	283,433	327,038	370,643	414,248	457,853	479,655	479,655	479,655	479,655
Revenue	$119,914	$141,716	$163,519	$185,321	$207,124	$228,926	$239,828	$239,828	$239,828	$239,828
Average price per lb	$0.50									
Operating Costs										
Mowing	$1,428	$1,428	$1,428	$1,428	$1,428	$714	$714	$714	$714	$714
Herbicide	$918	$918	$918	$918	$918	$918	$918	$918	$918	$918
Fertilize	$2,448	$2,448	$2,448	$2,448	$2,448	$2,448	$2,448	$2,448	$2,448	$2,448
Pest Control	$85	$85	$85	$85	$85	$85	$85	$85	$85	$85
Hand Weeding	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Replant	$153	$153	$153	$153	$153	$196	$196	$196	$196	$196
Pruning	$170	$170	$170	$170	$170	$170	$170	$170	$170	$170
Crop Log	$17	$17	$17	$17	$17	$17	$17	$17	$17	$17
Other	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing	$35,974	$42,515	$49,056	$55,596	$62,137	$68,678	$71,948	$71,948	$71,948	$71,948
Post-harvest Treatment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Management Fee	$6,711	$7,693	$8,674	$9,655	$10,636	$11,449	$11,940	$11,940	$11,940	$11,940
General Excise Tax	$2,597	$3,019	$3,442	$3,864	$4,287	$4,674	$4,885	$4,885	$4,885	$4,885
	$47,947	$55,469	$62,991	$70,513	$78,035	$84,717	$88,478	$88,478	$88,478	$88,478
Net Operating Profit (Loss)	$71,967	$86,247	$100,528	$114,809	$129,089	$144,209	$151,350	$151,350	$151,350	$151,350
Capital Expenditures	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow	$71,967	$86,247	$100,528	$114,809	$129,089	$144,209	$151,350	$151,350	$151,350	$151,350
Cumulative Cash Flow	$185,436	$271,683	$372,211	$487,019	$616,109	$760,318	$911,667	$1,063,017	$1,214,366	$1,365,716

28-Jun-99 **Acreage:** 20

Acreage and Yield Assumptions

Acreage & Tree Count Assumptions:

Acreage		
Total acres		20.00
Estimated net tree acres	85%	17.00
Tree Data		
Density, trees per acre (40'x40')		27
Theoretical trees on net acres		459

Yield Assumptions:

Category	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Lbs/Tree/Year	-	-	-	-	100.0	150.0	200.0	275.0	350.0	450.0
Lbs Adjusted for Spoilage	-	-	-	-	95.0	142.5	190.0	261.3	332.5	427.5
Lbs per Tree Acre per Year	-	-	-	-	2,565	3,848	5,130	7,054	8,978	11,543

Category	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Lbs/Tree/Year	550.0	650.0	750.0	850.0	950.0	1,050.0	1,100.0	1,100.0	1,100.0	1,100.0
Lbs Adjusted for Spoilage	522.5	617.5	712.5	807.5	902.5	997.5	1,045.0	1,045.0	1,045.0	1,045.0
Lbs per Tree Acre per Year	14,108	16,673	19,238	21,803	24,368	26,933	28,215	28,215	28,215	28,215

Key Assumptions	
Estimated Producing Tree Density (tpa)	27
Spoilage	5.0%
Maximum Lbs per Tree Acre per Year	30,000

Average Price Assumptions:

Average Price	$ 0.50

Cost Assumptions

Establishment Cost:

Category		Total Cost	Unit Cost	
Land Clearing		$ 16,000	$ 800	per acre
Planting		$ 7,344	$ 16	per tree
Management fee		$ 2,334	10%	
	Sub-Total	$ 25,678		
	GET	$ 1,070	4.166%	
	Total	$ 26,748		

Planting Cost Detail:

Trees	$	8.00
Soil	$	2.00
Dig holes	$	2.50
Labor	$	3.00
Fertilizer	$	0.50
Total	$	16.00

Operating Costs:

Cost per Acre per Round:

Category	Rds. per Yr.	Year 1	Year 2	Year 3	Year 4	Yr 5 thru 10	r 11 thru 15	r 16 thru 20
Mowing	6	$ 24.00	$ 24.00	$ 24.00	$ 24.00	$ 20.00	$ 14.00	$ 7.00
Herbicide	6	$ 18.00	$ 18.00	$ 18.00	$ 15.00	$ 9.00	$ 9.00	$ 9.00
Fertilize	4	$ 6.00	$ 12.00	$ 24.00	$ 36.00	$ 36.00	$ 36.00	$ 36.00
Pest Control	1	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00
Hand Weeding	6	$ 25.00	$ 8.00	$ -	$ -	$ -	$ -	$ -
Replant	1	$ 3.00	$ 6.00	$ 6.00	$ 6.00	$ 6.00	$ 9.00	$ 11.50
Pruning	1	$ 10.00	$ 10.00	$ 10.00	$ 10.00	$ 10.00	$ 10.00	$ 10.00
Crop Log	1	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00
Other	1	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50

	Unit Cost	
Harvesting	$ 0.05	per pound
Packing	$ 0.05	per pound
Packing Materials	$ 0.03	per pound
Hauling	$ 0.02	per pound
Total Harvest, Pack & Haul	$ 0.15	per pound
Post-harvest Treatment	$ -	per pound
Management - Cultivation	25%	of operating costs
Management - Harvesting	15%	of harvesting, packing & post-harvest treatment costs.
GET on Operating Costs	4.166%	
GET on Revenue	0.500%	

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CARAMBOLA (STARFRUIT)

Brief History: *Averrhoa carambola* L. originated in Southeast Asia but is now grown in tropical and warm subtropical lowland areas of the world.

Description: Carambola is a fast growing evergreen, symmetrical in form, 25-30 feet in height and 20-25 feet in spread. The leaves are light to dark green, alternate and compound with 2 to 11 ovate leaflets, 1-3 inches long. Fruit is ovoid to ellipsoid, 2.5-7 inches in length, with 5 prominent longitudinal ribs, star- shaped in cross section. Skin thin light to dark yellow, smooth, with a waxy cuticle. Flesh is light yellow-to-yellow, translucent, crisp, and very juicy, without fiber. Seeds are usually no more than 10-12 per fruit, sometimes none, 1/4 to 1/2 inch long, thin light brown, enclosed by gelatinous aril.

Basic Cultivation Requirements:
Soil: Carambola is tolerant of a wide range of soil types from sand to heavy clay loam. However, carambola grows best in deep clay loam with good drainage and where soil reaction is moderately acid. In calcareous soils, special care is required to prevent minor element deficiencies, particularly iron and zinc. It is tolerant of a wide range of pH levels, but 5.6 to 6.5 are preferred.

Temperature: Carambola grows best in a tropical or warm subtropical lowland climate. The East Hawaii temperatures, with lows of 60's and 70's and highs in 80's and low 90's are excellent for carambola.

Elevation: Tropical lowlands, sea level to 1500 ft., have the best fruit production.

Rainfall: Best fruit production occurs when trees have an adequate supply of moisture throughout the year, irrigation is advisable in times of drought. Optimum rainfall is 59 inches to 118 inches of rain, well distributed throughout year.

Cultural: In orchard planting, a spacing of 15 to 18 feet within the rows by 22 to 25 feet between rows is recommended. Carambola requires full sunlight and should not be shaded. Pruning is minimal and is done to promote a strong central leader and keep lower branches off the ground. Windbreaks are desirable to reduce limb breakage and in particular, fruit drop and fruit rub damage.

Diseases: Anthracnose caused by (*Colletotrichum gloeosporioides)* may be a problem, and leaf spot may arise from attack by (*Phomopsis sp., Phyllosticta sp.)* or (*Cercospora averrhoae).*

Pests: The carambola is relatively pest-free in Hawaii, except for fruit flies. In Malaya, fruit flies (especially *Dacus dorsalis*) are so troublesome on carambolas that growers have to wrap the fruits on the tree with paper.

In Florida, a small stinkbug causes superficial blemishes and a black beetle attacks overripe fruits. Reniform nematodes may cause tree decline.

Nutrients: At the Research Center in Homestead, trees 8 to 10 ft (2.4-3 m) high respond well to 1 lb (0.5 kg) applications of N, P, K, Mg in the ratio of 6-6-6-3 given 3 to 4 times per year. If chlorosis occurs, it can be corrected by added iron, zinc and manganese. Some advisers recommend minor-element spraying 4 times during the year if the trees are on limestone soils.

Fruit Maturity: Fruit production starts in 5 to 8 years from seedlings and 1 to 2 years from rafts. Fruit develop evenly over a period of 10 to 14 weeks varying with cultivar and climate. Maturity is determined by color change, which is sometimes very slight. It may also depend on the cultivar's acceptable sweetness.

Sources of Nursery Stock: Grafted nursery stock is recommended to insure quality and fruit production, as seedlings are not true to type. Preferred varieties are Sri Kembangan, a bright yellow fruit 5 to 7 inches in length, with wide angled wings, and very sweet flesh; Kary which has flesh sweeter than Sri Kembangan, but identical in most other respects; Kajang, Kyra; and Arkin.

Nurseries that sell grafted carambola plants:
Plant It Hawaii, Kurtistown, Hawaii
Sekiya Nursery, Honolulu, Hawaii

Production: Grafted trees start flowering the first year after planting and yields increase annually. By the third year 50 pounds per tree can be expected. Production usually runs from September through January. Mature trees will yield 200 to 300 pounds of fruit per year starting in their fifth to eighth year. Fruits are picked singly, by hand; care being necessary, as bruised wing edges will discolor rapidly. Mechanical harvesting equipment (e.g., hydraulic lifts) would aid in harvesting but can only be used if the ground is level.

Processing: Pre-cooling and refrigeration (50' to 65' F) (10' to 20'C) together with P.V.C. wrap will give 10 to 20 days shelf life.

Use: The fruit is eaten fresh or made into preserves, jellies, juices, or dried. Its attractive star shape, when cut, is an excellent decorative addition to salads and main dishes.

Marketing: The market of carambola has increased dramatically with the development of cultivars superior in appearance and taste. These new varieties are recognized as a very attractive addition to menus in the gourmet hotels and restaurants. There is also a demand for this fruit in the expanding Asian markets and restaurants.

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Under current regulations, fresh fruit may be exported to the mainland with a cold treatment for 12 days at 1.1'C (34'F) or below. Irradiation at 250 Gy in an approved facility in Hawaii or in non-fruit fly supporting areas of the mainland U.S. is acceptable for export also.

Packaging: Hula Brothers, Inc. in Hilo has had the most experience in growing and selling carambola in Hawaii. Hula Brothers recommends wrapping the fruit individually in foam within specially designed cardboard cells, stem end down, in corrugated cardboard boxes (2 ply, 200 lb tested) of 20 to 25 fruit per box depending on size. Net box weight was 11 pounds.

Transport: Airfreight or refrigerated containers on the freight ships are used to ship the fruit to other islands and to the mainland.

Oneloa Development Project: Cash Flow for Carambola (Starfruit)

28-Jun-99 **Acreage:** 20

Production & Revenue	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Pounds Harvested	-	28,101	93,670	187,340	318,478	430,882	515,185	562,020	562,020	562,020
Revenue	$0	$21,076	$70,253	$140,505	$238,859	$323,162	$386,389	$421,515	$421,515	$421,515
Average price per lb	$ 0.75									
Operating Costs										
Mowing	$2,448	$2,448	$2,040	$2,040	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428
Herbicide	$1,836	$1,836	$1,530	$1,224	$918	$918	$918	$918	$918	$918
Fertilize	$714	$867	$1,020	$1,224	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428
Pest Control	$51	$51	$51	$51	$51	$51	$51	$51	$51	$51
Hand Weeding	$2,550	$816	$0	$0	$0	$0	$0	$0	$0	$0
Replant	$51	$102	$102	$102	$102	$102	$102	$102	$102	$102
Pruning	$0	$85	$85	$85	$85	$85	$85	$85	$85	$85
Crop Log	$17	$17	$17	$17	$17	$17	$17	$17	$17	$17
Other	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing	$0	$7,868	$26,228	$52,455	$89,174	$120,647	$144,252	$157,366	$157,366	$157,366
Post-harvest Treatment	$0	$1,405	$4,684	$9,367	$15,924	$21,544	$25,759	$28,101	$28,101	$28,101
Management Fee	$1,927	$2,957	$5,859	$10,470	$16,783	$22,347	$26,520	$28,838	$28,838	$28,838
General Excise Tax	$401	$876	$2,087	$3,914	$6,441	$8,640	$10,289	$11,205	$11,205	$11,205
Total Operating Costs	$9,637	$18,495	$41,657	$77,077	$125,952	$168,609	$200,602	$218,376	$218,376	$218,376
Net Operating Profit (Loss)	($9,637)	$2,581	$28,595	$63,428	$112,907	$154,552	$185,787	$203,139	$203,139	$203,139
Capital Expenditures	$ 52,227	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow	($61,864)	$2,581	$28,595	$63,428	$112,907	$154,552	$185,787	$203,139	$203,139	$203,139
Cumulative Cash Flow		($59,283)	($30,687)	$32,740	$145,647	$300,199	$485,986	$689,125	$892,264	$1,095,403

Oneloa Development Project: Cash Flow for Carambola (Starfruit)

28-Jun-99 **Acreage:** 20

Production & Revenue	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Pounds Harvested	562,020	562,020	562,020	562,020	562,020	562,020	562,020	562,020	562,020	562,020
Revenue	$421,515	$421,515	$421,515	$421,515	$421,515	$421,515	$421,515	$421,515	$421,515	$421,515
Average price per lb	$0.75									
Operating Costs										
Mowing	$714	$714	$714	$714	$714	$714	$714	$714	$714	$714
Herbicide	$918	$918	$918	$918	$918	$918	$918	$918	$918	$918
Fertilize	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428
Pest Control	$51	$51	$51	$51	$51	$51	$51	$51	$51	$51
Hand Weeding	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Replant	$153	$153	$153	$153	$153	$153	$153	$153	$153	$153
Pruning	$85	$85	$85	$85	$85	$85	$85	$85	$85	$85
Crop Log	$17	$17	$17	$17	$17	$17	$17	$17	$17	$17
Other	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing	$157,366	$157,366	$157,366	$157,366	$157,366	$157,366	$157,366	$157,366	$157,366	$157,366
Post-harvest Treatment	$28,101	$28,101	$28,101	$28,101	$28,101	$28,101	$28,101	$28,101	$28,101	$28,101
Management Fee	$28,672	$28,672	$28,672	$28,672	$28,672	$28,672	$28,672	$28,672	$28,672	$28,672
General Excise Tax	$11,171	$11,171	$11,171	$11,171	$11,171	$11,171	$11,171	$11,171	$11,171	$11,171
Total Operating Costs	$217,547	$217,547	$217,547	$217,547	$217,547	$217,547	$217,547	$217,547	$217,547	$217,547
Net Operating Profit (Loss)	$203,968	$203,968	$203,968	$203,968	$203,968	$203,968	$203,968	$203,968	$203,968	$203,968
Capital Expenditures	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow	$203,968	$203,968	$203,968	$203,968	$203,968	$203,968	$203,968	$203,968	$203,968	$203,968
Cumulative Cash Flow	$1,299,371	$1,503,339	$1,707,306	$1,911,274	$2,115,242	$2,319,210	$2,523,178	$2,727,145	$2,931,113	$3,135,081

28-Jun-99 **Acreage:** **20**

Acreage and Yield Assumptions

Acreage & Tree Count Assumptions:

Acreage		
Total acres		20.00
Estimated net tree acres	85%	17.00
Tree Data		
Density, trees per acre (15'x25')		116
Theoretical trees on net acres		1,972

Yield Assumptions:

Category	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Lbs/Tree/Year	-	15.0	50.0	100.0	170.0	230.0	275.0	300.0	300.0	300.0
Lbs Adjusted for Spoilage	-	14.3	47.5	95.0	161.5	218.5	261.3	285.0	285.0	285.0
Lbs per Tree Acre per Year	-	1,653	5,510	11,020	18,734	25,346	30,305	33,060	33,060	33,060

Category	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Lbs/Tree/Year	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0
Lbs Adjusted for Spoilage	285.0	285.0	285.0	285.0	285.0	285.0	285.0	285.0	285.0	285.0
Lbs per Tree Acre per Year	33,060	33,060	33,060	33,060	33,060	33,060	33,060	33,060	33,060	33,060

Key Assumptions

Estimated Producing Tree Density (tpa)		116
Spoilage		5.0%
Maximum Lbs per Tree Acre per Year		35,000

Average Price Assumptions:

Grade #1	80%	$	1.00
Grade #2	20%	$	0.50
Average Price		$	0.75

28-Jun-99 **Acreage:** **20**

Cost Assumptions

Establishment Cost:

Category		Total Cost	Unit Cost	
Land Clearing		$ 16,000	$ 800	per acre
Planting		$ 29,580	$ 15	per tree
Management fee		$ 4,558	10%	
	Sub-Total	$ 50,138		
	GET	$ 2,089	4.166%	
	Total	$ 52,227		

Planting Cost Detail:

Trees	$	7.00
Soil	$	2.00
Dig holes	$	2.50
Labor	$	3.00
Fertilizer	$	0.50
Total	$	15.00

Operating Costs:

Cost per Acre per Round:

Category	Rds. per Yr.	Year 1	Year 2	Year 3	Year 4	Yr 5 thru 10	Yr 11 thru 15	Yr 16 thru 20
Mowing	6	$ 24.00	$ 24.00	$ 20.00	$ 20.00	$ 14.00	$ 7.00	$ 7.00
Herbicide	6	$ 18.00	$ 18.00	$ 15.00	$ 12.00	$ 9.00	$ 9.00	$ 9.00
Fertilize	6	$ 7.00	$ 8.50	$ 10.00	$ 12.00	$ 14.00	$ 14.00	$ 14.00
Pest Control	1	$ 3.00	$ 3.00	$ 3.00	$ 3.00	$ 3.00	$ 3.00	$ 3.00
Hand Weeding	6	$ 25.00	$ 8.00	$ -	$ -	$ -	$ -	$ -
Replant	1	$ 3.00	$ 6.00	$ 6.00	$ 6.00	$ 6.00	$ 9.00	$ 9.00
Pruning	1	$ -	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00
Crop Log	1	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00
Other	1	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50

		Unit Cost	
Harvesting	$	0.10	per pound
Packing	$	0.10	per pound
Packing Materials	$	0.06	per pound
Hauling	$	0.02	per pound
Total Harvest, Pack & Haul	$	0.28	per pound
Post-harvest Treatment	$	0.05	per pound
Management - Cultivation		25%	of operating costs
Management - Harvesting		15%	of harvesting, packing & post-harvest treatment costs.
GET on Operating Costs		4.166%	
GET on Revenue		0.500%	

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LIMES

Brief History: The origin of Bearss' lime (*Citrus latifolia* Tanaka) is unknown. It is not a true lime, probably being a hybrid between the true lime and another citrus species. It first appeared in California about 1875. It is also known as 'Persian' lime and 'Tahiti' lime. Bearss' lime accounts for the commercial lime industry in south Florida.

Description: The fruit is medium-small, often shaped much like a small lemon or a large 'Key' lime but shape is variable. The peel is thin, smooth, tightly adherent and medium to dark green when harvested, but yellow at full maturity. The flesh is pale greenish-yellow, very acid and juicy. Seeds are rare. There are about 10 segments around a small, solid axis.

The tree is small to medium in size, spreading, vigorous and nearly thorn-less.
It does best in the lowland tropics and warm subtropics. The main crop matures in the summer but some mature fruit are present year round.

Basic Cultivation Requirements:
Soil: Bearss'limes can be grown successfully in a variety of soils. Well-drained locations are essential for good fruit production and growth.

Temperature: It does best in the lowland tropics and warm subtropics.

Elevation: Sea level to 2500 feet.

Rainfall: Bearss' limes are not tolerant of drought. Irrigation is essential for commercial fruit production in areas with a dry season. The trees require a minimum of 60 inches of rainfall per year in order to be commercially productive. If the water is applied uniformly, through a drip irrigation system, the requirement is reduced to 52 inches per year (1 inch per week).

At maturity, the water requirement for irrigation is 15,229 gallons per acre per week. This assumes that only the area under the tree canopy will be irrigated and that the canopy diameter at maturity is 18 feet.

Cultural: The Bearss' lime is small, reaching 20 feet in height, with a round canopy hanging to the ground. It is easily pruned to any shape. The leaves are dark green, oval, 3.5 to 5 inches long, and persist up to 3 years on the tree. The wing on the petiole is usually narrow, but can vary. Flowers are white, fragrant, 1 inch in diameter, and borne in clusters of 5 to 10 on new shoots at the tip and several nodes back. Some bloom occurs all year. Bearss' limes are oval, 2 1/4 - 2 3/4 inches length, and 1 7/8 - 2 1/2 inches diameter. The fruit are medium to dark green at commercial maturity, becoming yellow before dropping from the tree. When grown in solid plantings, the fruit is seedless. Acids are 5 - 6%, solids 8 - 10%, and juice content 45 - 55% by volume. Flavor and aroma are good.

Requires 100 - 120 days from bloom to maturity. Trees can be grown satisfactorily without pruning except for occasional removal of suckers and dead branches.

However, in closely spaced groves it is desirable to limit size of trees by regular pruning. Annual topping to a height of 8 - 12 feet and hedging to a width of 6 - 8 feet are practical, making trees resistant to wind damage, and to facilitate harvesting operations.

Bearss' lime groves are planted in rows 20 to 25 feet apart. Tree spacing in the row varies from 10 to 20 feet, depending upon grower preference.

Shield budding is the preferred method of propagation and can be done at any time of year when suitable buds and rootstocks are available. Buds should be selected from mature, round wood on which leaves are still present. Rootstocks should be in active growth. If condition of rootstock is not suitable for shield budding, chip budding is the best alternative.

Trees can be propagated easily by air layering (marcottage).

Diseases: Tristeza virus, Lime blotch disease, Stylar end breakdown (Stylar end rot), Fungus disease, and Algal disease.

Pests: Mites, Scale insects, White fly.

Nutrients: Limes have a high nitrogen requirement for maximum fruit production. Nitrogen rates of 300 - 350 pounds per year yield enough extra fruit to be economical. Potassium is less limiting than nitrogen, but may be required in amounts equal to nitrogen where there is nutrient leaching because of excessive rainfall. Minor elements may be deficient, especially manganese and zinc. Leaf analysis during the year to monitor crop nutrient levels will assist the grower in selecting the necessary fertilizer program.

Maturity: Bearss' limes trees in Hawaii are grown from grafts. The trees will begin Bearing fruit within 2 to 3 years reaching full production in 6 to 7years. The main crop matures in the summer but some mature fruit are present year round.

Sources of Nursery Stock:

1. Plant It Hawaii, Kurtistown, Hawaii
2. Kahili Farm Nursery, Kilauea, Kauai

Production: The harvest season in Hawaii is from October through May. Climate has a strong influence on fruit size, shape, flavor and juice content, as well as color, texture, and thickness of skin. Once established trees need minimal maintenance.

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With good planting stock and good care, groves can be in production in 3 years after planting. Isolated mature trees are capable of producing 400 to 3500 pounds of fruit per year. Trees planted close together in the grove produce less fruit. Good groves will produce 30,000 - 40,000 pounds of fruit per acre per year.

If handled and stored correctly, limes can remain in acceptable condition under commercial conditions for six to eight weeks.

Uses: Fresh fruit is used as garnish for meats and drinks. Fresh juice is used in beverages, marinating fish and meats and seasoning many foods. Frozen and canned juice is used in similar ways. Lime oil is widely used in flavorings and cosmetics.

Marketing: The general range in price for citrus is $0.30 to $0.75 cents per pound depending on market conditions such as competition from mainland. The large tourist trade in the state's hotels and restaurants makes limes for drinks and cooking a necessary food item. Hawaii has historically been a net importer of limes and has not been able to produce enough to fill the supply required by both the local and visitor generated market. Grown efficiently this fruit has an excellent potential, as the demand is consistent and local fruit preferred. Local fruit is fresher and has a longer shelf life.

Limes can be marketed in Alaska and Canada without post harvest quarantine treatment, but not to the mainland U.S. At this time no growers are exporting limes out of Hawaii.

Packaging: Export markets require that minimum size specifications be met and that limes in each carton are of similar size. Fruit are loose packed to 11 to 29 lbs. Two-piece full or half-telescopic fiberboard cartons, bursting strength 250 to 275 lb/in., are used.

Transport: Barge services or airfreight.

Oneloa Development Project: Cash Flow for Limes.

28-Jun-99 **Acreage:** **20**

Production & Revenue		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Pounds Harvested		-	-	35,207	70,414	140,828	228,846	316,863	387,277	457,691	510,000
Revenue		$0	$0	$21,124	$42,248	$84,497	$137,307	$190,118	$232,366	$274,615	$306,000
Average price per lb	$	0.60									
Operating Costs											
Mowing		$2,448	$2,448	$2,040	$2,040	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428
Herbicide		$1,836	$1,836	$1,530	$1,224	$918	$918	$918	$918	$918	$918
Fertilize		$714	$867	$1,020	$1,224	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428
Pest Control		$170	$170	$170	$85	$85	$85	$85	$85	$85	$85
Hand Weeding		$2,550	$816	$0	$0	$0	$0	$0	$0	$0	$0
Replant		$51	$102	$102	$102	$102	$102	$102	$102	$102	$102
Pruning		$255	$255	$255	$510	$510	$510	$510	$510	$510	$510
Crop Log		$17	$17	$17	$17	$17	$17	$17	$17	$17	$17
Other		$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing		$0	$0	$7,041	$14,083	$28,166	$45,769	$63,373	$77,455	$91,538	$102,000
Post-harvest Treatment		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Management Fee		$2,021	$1,638	$2,350	$3,424	$5,357	$7,998	$10,639	$12,751	$14,863	$16,433
General Excise Tax		$421	$341	$713	$1,159	$2,008	$3,115	$4,223	$5,109	$5,995	$6,653
Total Operating Costs		$10,104	$8,192	$14,568	$22,751	$38,054	$58,298	$78,542	$94,737	$110,932	$122,963
Net Operating Profit (Loss)		($10,104)	($8,192)	$6,556	$19,498	$46,443	$79,010	$111,576	$137,629	$163,683	$183,037
Capital Expenditures	$	82,030	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow		($92,134)	($8,192)	$6,556	$19,498	$46,443	$79,010	$111,576	$137,629	$163,683	$183,037
Cumulative Cash Flow			($100,326)	($93,770)	($74,272)	($27,829)	$51,181	$162,757	$300,386	$464,069	$647,106

Oneloa Development Project: Cash Flow for Limes

28-Jun-99 **Acreage:** 20

Production & Revenue	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Pounds Harvested	510,000	510,000	510,000	510,000	510,000	510,000	510,000	510,000	510,000	510,000
Revenue	$306,000	$306,000	$306,000	$306,000	$306,000	$306,000	$306,000	$306,000	$306,000	$306,000
Average price per lb	$0.60									
Operating Costs										
Mowing	$714	$714	$714	$714	$714	$714	$714	$714	$714	$714
Herbicide	$918	$918	$918	$918	$918	$918	$918	$918	$918	$918
Fertilize	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428
Pest Control	$85	$85	$85	$85	$85	$85	$85	$85	$85	$85
Hand Weeding	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Replant	$153	$153	$153	$153	$153	$196	$196	$196	$196	$196
Pruning	$510	$510	$510	$510	$510	$510	$510	$510	$510	$510
Crop Log	$17	$17	$17	$17	$17	$17	$17	$17	$17	$17
Other	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing	$102,000	$102,000	$102,000	$102,000	$102,000	$102,000	$102,000	$102,000	$102,000	$102,000
Post-harvest Treatment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Management Fee	$16,267	$16,267	$16,267	$16,267	$16,267	$16,278	$16,278	$16,278	$16,278	$16,278
General Excise Tax	$6,618	$6,618	$6,618	$6,618	$6,618	$6,620	$6,620	$6,620	$6,620	$6,620
Total Operating Costs	$122,134	$122,134	$122,134	$122,134	$122,134	$122,188	$122,188	$122,188	$122,188	$122,188
Net Operating Profit (Loss)	$183,866	$183,866	$183,866	$183,866	$183,866	$183,813	$183,813	$183,813	$183,813	$183,813
Capital Expenditures	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow	$183,866	$183,866	$183,866	$183,866	$183,866	$183,813	$183,813	$183,813	$183,813	$183,813
Cumulative Cash Flow	$830,971	$1,014,837	$1,198,702	$1,382,568	$1,566,434	$1,750,246	$1,934,059	$2,117,871	$2,301,684	$2,485,496

28-Jun-99 **Acreage:** 20

Acreage and Yield Assumptions

Acreage & Tree Count Assumptions:

Acreage		
Total acres		20.00
Estimated net tree acres	85%	17.00
Tree Data		
Density, trees per acre (10'x20')		218
Theoretical trees on net acres		3,706

Yield Assumptions:

Category	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Lbs/Tree/Year	-	-	10.0	20.0	40.0	65.0	90.0	110.0	130.0	150.0
Lbs Adjusted for Spoilage	-	-	9.5	19.0	38.0	61.8	85.5	104.5	123.5	142.5
Lbs per Tree Acre per Year	-	-	2,071	4,142	8,284	13,462	18,639	22,781	26,923	30,000

Category	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Lbs/Tree/Year	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0
Lbs Adjusted for Spoilage	142.5	142.5	142.5	142.5	142.5	142.5	142.5	142.5	142.5	142.5
Lbs per Tree Acre per Year	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000

Key Assumptions	
Estimated Producing Tree Density (tpa)	218
Spoilage	5.0%
Maximum Lbs per Tree Acre per Year	30,000

Average Price Assumptions:

Average Price	$	0.60

28-Jun-99 **Acreage:** **20**

Cost Assumptions

Establishment Cost:

Category	Total Cost	Unit Cost	
Land Clearing	$ 16,000	$ 800	per acre
Planting	$ 55,590	$ 15	per tree
Management fee	$ 7,159	10%	
Sub-Total	$ 78,749		
GET	$ 3,281	4.166%	
Total	$ 82,030		

Planting Cost Detail:

Trees	$ 7.00
Soil	$ 2.00
Dig holes	$ 2.50
Labor	$ 3.00
Fertilizer	$ 0.50
Total	$ 15.00

Operating Costs:

Cost per Acre per Round:

Category	Rds. per Yr.	Year 1	Year 2	Year 3	Year 4	Yr 5 thru 10	Yr 11 thru 15	Yr 16 thru 20
Mowing	6	$ 24.00	$ 24.00	$ 20.00	$ 20.00	$ 14.00	$ 7.00	$ 7.00
Herbicide	6	$ 18.00	$ 18.00	$ 15.00	$ 12.00	$ 9.00	$ 9.00	$ 9.00
Fertilize	6	$ 7.00	$ 8.50	$ 10.00	$ 12.00	$ 14.00	$ 14.00	$ 14.00
Pest Control	1	$ 10.00	$ 10.00	$ 10.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00
Hand Weeding	6	$ 25.00	$ 8.00	$ -	$ -	$ -	$ -	$ -
Replant	1	$ 3.00	$ 6.00	$ 6.00	$ 6.00	$ 6.00	$ 9.00	$ 11.50
Pruning	1	$ 15.00	$ 15.00	$ 15.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00
Crop Log	1	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00
Other	1	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50

	Unit Cost	
Harvesting	$ 0.10	per pound
Packing	$ 0.05	per pound
Packing Materials	$ 0.03	per pound
Hauling	$ 0.02	per pound
Total Harvest, Pack & Haul	$ 0.20	per pound
Post-harvest Treatment	$ -	per pound
Management - Cultivation	25%	of operating costs
Management - Harvesting	15%	of harvesting, packing & post-harvest treatment costs.
GET on Operating Costs	4.166%	
GET on Revenue	0.500%	

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LYCHEE

Brief History: *Litche chinensis Sonn* is native to southern China but is now grown commercially in southern China, Taiwan, north-central India, South Africa, Australia and the United States: Florida and Hawaii. It is closely related to the longan (Dimocarpus longan), which is another tropical fruit species that has commercial promise in Hawaii.

Lychee was first introduced into Hawaii in 1873 by Ching Chock. It was a single tree (variety Kwai Mi) planted in the Nuuanu area above Honolulu. There have been a few commercial orchards planted in Hawaii over the past 100 years. There are also a large number of trees planted by homeowners throughout the state.

Description: Lychee is a round-topped, long-lived, subtropical evergreen tree growing to 40 feet in height. Leaves are pinnate with one to five pairs of leaflets, 3 to 7 inches long. Fruits are spherical, ovoid or ovate in shape, 2.5-4 cm long, weighing 12-25g, borne in clusters. The pericarp is leathery and covered with small conical protuberances. External color at ripeness is greenish-yellow, yellow, or various shades of red. Flesh color is a translucent, whitish, juicy aril, which surrounds the single, large dark brown seed.

Basic Cultivation Requirements:
Soil: Lychee is adaptable over a wide range of soil types, from heavy clays to a'a lavas, but good drainage is a must. Lychee tolerates wet soils to some degree. Deep, fertile, loamy soils of pH 5.0 to 6.5 are best, but other kinds of soils are used successfully where growers give attention to proper nutrition. Coral sands are the least desirable soil type.

Temperature: Lychees are better adapted to subtropical than to tropical climates. The best climates for growing lychee have a warm, wet spring and summer followed by a cool, dry fall and winter. Ideal conditions for lychee production occur in subtropical China, where the temperatures drop below 50 F in January and rise above 90 F in the summer. Under less-than-ideal conditions, yields are usually variable and erratic. Temperature affects flowering and fruiting of lychees. Varieties such as Kaimana, Kwai Mi Pink, Bosworth, Groff and Hak Ip often flower and fruit in spite of warm winter temperatures.

Elevation: In Hawaii, most lychees are grown below the 1500-foot level, but trees are found from sea level to an elevation of 2000 feet. Hilo, at sea level to a few hundred feet elevation, is a major lychee homeowner growing area.

Rainfall: The lychee is cultivated under a wide rainfall range. Trees can be grown in areas with less than 10 inches of rain with supplementary irrigation, as well as in areas with up to 140 inches of rain annually. Areas with 60-140 inches of rainfall per year are suitable for lychees. Short periods of soil waterlogging and light flooding are tolerated, but standing water is not.

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Cultural: Tree spacing recommended is 30' x 30'. This spacing allows room for the tree's growth so that sunlight and air circulation are adequate, and harvesting completely around the tree can be done without injury to the tree. Weeds and grass under the trees can be controlled with the herbicide Roundup and heavy mulching. As the trees age, they form their own mulch from normal leaf drop and annual prunings, which can be dropped under the tree. Young plants should be trained to establish good tree structure, avoiding sharp crotch angles. Air-layered plants tend to develop low branches and should be pruned to a single leader at transplanting time. Later, pruning should direct growth into about four well-spaced scaffold branches. Acute-angled branches form weak crotches, which often split, and should be removed. When the trees reach bearing age, they should be pruned immediately after harvest each year to remove the tips of the branches and any weak or poorly formed limbs. Lychee cannot withstand high winds. The branches are brittle and the flowers are readily blown off. It is extremely important to provide adequate windbreaks. Suggested windbreak trees are ironwood, paperbark, and box brush.

Diseases: There are no serious disease problems in this crop in Hawaii at the present time.

Pests: The most common pest is erinose mite, which can cause damage to the leaves. The leaves become curled, distorted and small, and velvety with rust colored protuberances on them. Control can be maintained by spraying with an organic insecticide. As the trees age, mite damage becomes less of a problem. Other pests are the lychee fruit moth, the koa seedworm, and the Oriental fruit fly. Trapping with pheromone traps, Malathion baits around the edge of the orchard, and harvesting the fruit in a very timely manner are the main controls for the fruit fly. There is minor damage from thrips and scales that occasionally attack the foliage. Birds can be a pest of the fruit just prior to harvest.
Pests: Litchi mite, erinose (Eriophyes litchi). Green scale (Coccus viridis). Hemispherical scale (Saissetia coffeae). White litchi scale (Pseudaulacaspis major). Chinese rose beetle (Adoretus sinicus). Litchi fruit moth (Cryptophlebia ombrodelta). Koa seedworm, macadamia husk borer (Cryptophlebia illepida). Anthurium thrips (Chaetanaphothrips orchidi). Red banded thrips (Selenothrips rubrocintus). Black twig borer (Xylosandrus compactus). A twig borer (Xylosandrus crassiusculus). An ambrosia beetle (Xyleborus fornicatus.

A spider mite (Oligonychus biharensis). Ants. Birds. Red-vented bulbul (Pycnonotus cafer). Red-whiskered bulbul (P. jocosus). Mejiro, Japanese white-eye (Zosterops japonicus).

Nutrients: A composite fertilizer is applied generally 6 times per year. Fertilizer can be applied through an irrigation system. Soil and leaf tissue are analyzed periodically to assist in determining nutrient requirement. Potassium, an element that is important for flowering and fruiting should be carefully monitored.

Compost is recommended. Research by University of Hawaii College of Tropical Agriculture and Human Services on optimum nutrition for lychees is in progress.

Fruit Maturity: Flowering usually starts in late January through February with the first fruit ripe in late May or early June. The lychee must be picked ripe from the tree, when the skin turns red, as it will not ripen after harvesting.

Sources of Nursery Stock: Lychee propagation from seed is not satisfactory because varieties do not produce true from seed, and the trees can take 10 years to bear. Air layering is the most common method of propagation. Most of the commercial trees today are air layered Kaimana lychees. Patch budding can be done and produces better root systems that air layered trees. The nurseries use air layering because it is quicker and most cost effective for them. The preferred varieties are Groff, Kaimana, Kwai Mi Pink, and Bosworth 3. Groff, developed from a 'Hak Ip' seedling, is an up-right tree of medium vigor that bears somewhat regularly and is often late maturing (late August through September). Its fruits are dull red and small, 38-42 to a pound, and a high percentage has abortive seeds. Kaimana, also a 'Hak Ip' seedling, is a medium- sized, compact, rounded tree that usually matures fruit from mid-June through July. Like 'Groff, it is considered good bearing compared with most other varieties in Hawaii. Its fruits are deep maroon with a smooth, leathery skin. Fruits average 1.2 to 1.6 inches in diameter and weigh 0.7 to 0.9 oz.; the edible pulp is 71 to 75 percent of the total fruit weight. Usually about 40 percent of the seeds are abortive. Kwai Mi Pink is tall and upright cultivar. The fruits average 30 to a pound. Bosworth 3 is a variety that produces fruit later in the season, July and August. The fruit is small and very sweet with a light pinkish-brown shell. There are approximately 35 fruits to a pound. None of these varieties bears a crop every year. Research is being done to understand the exact nature of the problem.

Nurseries that sell air layered lychee trees:

1. Plant It Hawaii, Kurtistown, Hawaii
2. Manelo Orchard, Hilo, Hawaii
3. Kahili Farm Nursery, Kilauea, Kauai

Production: After planting, the air layered and grafted lychee tree will produce its first fruit in 3 to 5 years. Fruits mature three to five months after flowering. In Hawaii, early cultivars are harvested in May and June, late cultivars from mid-July through September. Yield and maturity are variable by location and year. The estimated yield is 22 pounds per tree per year at the start of its bearing. Yield will increase each year and peak at approximately 350 pounds per tree per year between the eighteenth and twentieth year. The harvest season lasts approximately 8 weeks in a uniform orchard.

Packing: The fruits are hand picked from the tree using ladders or hydraulic lifts for access. The fruits are perishable and must be handled quickly and carefully.

They should be chilled at approximately 50' F to remove field heat after removing them from the pedicel, sorting, and boxing. For storage and to maintain shelf life the lychees should be refrigerated at 32' to 40' F and packed in plastic bags that have minute air holes. Freshness and color can be maintained by this method for up to three weeks.

Uses: Lychees are the most popular as fresh fruit. However, lychees can be frozen and maintain their flavor for approximately a year. Lychees can also be dried. The chefs in the gourmet restaurants use lychees in their entrée dishes and in sauces. The lychee is also used for flavoring in an ice cream. Southeast Asian countries can lychees. These can be 100% lychees or such combinations as lychees stuffed with a pineapple wedge. Lychees are also being used more recently in tropical juice blends.

Marketing: The lychee industry in Hawaii at present is comprised of approximately 70 growers farming 225 acres that produce 114,300 pounds. The farm value of the industry's production is $206,400. Data for 1997 shows production increasing substantially over the next few years as only 75 acres of the 225 acres planted are presently in production. Commercial growers received an average of $1.81 per pound for their 1997 lychee crop. These statistics are from the 1997 Hawaii Agricultural Statistics Service tropical specialty fruits annual report dated September 14, 1998.

The market for fresh lychees is primarily on the islands of Oahu and Hawaii at the present time. In 1969, prior to fruit fly quarantine for local fruits, Hawaii shipped the U.S. mainland 89,000 pounds of fresh lychees. However, shipments to the US mainland have been made over the last couple of years in sealed containers to an irradiation facility in Chicago. This followed the United States Food and Drug Administration's approval of irradiation of specific doses for post harvest quarantine treatment for certain tropical fruits. After treatment in this facility to kill the fruit fly pest, the lychee fruit has been distributed to wholesalers. The quality of the fruit is the same as fresh fruit without treatment. Demand for this fruit has been excellent, and customer resistance to the irradiated fruit negligible. Grower price for the Kaimana lychees shipped to the mainland were $3.00 per pound f.o.b. the island airport.

The state Department of Agriculture has a temporary permit from the United States Department of Agriculture Animal and Plant Inspection Service (USDA-APHIS) to ship certain Hawaii fruits to the mainland U.S. for irradiation. In the meantime an irradiation facility specifically for post harvest quarantine treatments of local agricultural products may be built in Hilo. Meanwhile, the use of the electron beam process is being researched as a more environmentally preferred post harvest treatment. The impact on the marketing of lychees where a fast, convenient post harvest treatment is constructed will be substantial. The lychee season is short and every backyard grower with more lychees than he or his family can consume sells lychees at a reduced price and no uniformity as to size or quality. This impacts the commercial grower who must compete in a saturated local market. The capability of developing mainland markets for graded quality fruit will be greatly enhanced by the construction of a post harvest irradiation facility in Hilo.

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There is some concern that Southeast Asian countries, such as Malaysia and Thailand, will also build post harvest facilities to treat their lychees for export to the U.S. market. The Hawaii grower should have a head start into the mainland market, but will have to develop a broad-based clientele for the fruit as well as secondary products for the off-grade fruit.

United States Department of Agriculture Agricultural Research Service (USDA-ARS) in Hilo has developed an approved post harvest quarantine treatment that has a minor impact on the fruit quality and allows shipment of the fruit to the mainland at the present time. This is a hot water dip for 20 minutes at 49'C followed by a cooling dip. This treatment will be used by commercial growers for the first time in the 1999 season. The facilities required for this treatment are not elaborate and can be constructed easily on individual farms. Exact construction costs are not known at this time.

Packaging: Corrugated cardboard box, 2 ply, 200 lb tested. This is available at Weyerhaeuser Paper Company

Transport: At this time fresh lychees are shipped by airfreight at a cost of $0.20 per pound to Honolulu. During the lychee season shipments are daily six days a week, so barge service in refrigerated containers to Honolulu is not practical at this time. The lychees are usually priced f.o.b. at the grower's island.

Oneloa Development Project: Cash Flow for Lychee

28-Jun-99 **Acreage:** **20**

Production & Revenue		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Pounds Harvested		-	-	-	3,876	19,380	38,760	58,140	58,140	62,016	77,520
Revenue		$0	$0	$0	$6,899	$34,496	$68,993	$103,489	$103,489	$110,388	$137,986
Average price per lb	$	1.78									
Operating Costs											
Mowing		$2,448	$2,448	$2,448	$2,448	$2,040	$2,040	$2,040	$2,040	$2,040	$2,040
Herbicide		$1,836	$1,836	$1,836	$1,530	$918	$918	$918	$918	$918	$918
Fertilize		$816	$1,632	$3,264	$3,944	$3,944	$3,944	$3,944	$3,944	$3,944	$3,944
Pest Control		$170	$170	$170	$85	$85	$85	$85	$85	$85	$85
Hand Weeding		$2,550	$816	$0	$0	$0	$0	$0	$0	$0	$0
Replant		$51	$102	$102	$102	$102	$102	$102	$102	$102	$102
Pruning		$255	$255	$255	$510	$510	$510	$510	$510	$510	$510
Crop Log		$17	$17	$17	$17	$17	$17	$17	$17	$17	$17
Other		$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing		$0	$0	$0	$2,364	$11,822	$23,644	$35,465	$35,465	$37,830	$47,287
Post-harvest Treatment		$0	$0	$0	$775	$3,876	$7,752	$11,628	$11,628	$12,403	$15,504
Management Fee		$2,046	$1,830	$2,034	$2,641	$4,269	$6,624	$8,979	$8,979	$9,450	$11,333
General Excise Tax		$426	$381	$424	$637	$1,323	$2,248	$3,172	$3,172	$3,357	$4,097
Total Operating Costs		$10,232	$9,148	$10,168	$14,459	$27,626	$45,678	$63,731	$63,731	$67,341	$81,783
Net Operating Profit (Loss)		($10,232)	($9,148)	($10,168)	($7,559)	$6,871	$23,315	$39,759	$39,759	$43,047	$56,203
Capital Expenditures	$	39,838	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow		($50,070)	($9,148)	($10,168)	($7,559)	$6,871	$23,315	$39,759	$39,759	$43,047	$56,203
Cumulative Cash Flow			($59,218)	($69,386)	($76,946)	($70,075)	($46,760)	($7,001)	$32,757	$75,805	$132,007

Oneloa Development Project: Cash Flow for Lychee.

28-Jun-99 **Acreage:** 20

Production & Revenue	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Pounds Harvested	96,900	96,900	100,776	116,280	122,400	122,400	122,400	122,400	122,400	122,400
Revenue	$172,482	$172,482	$179,381	$206,978	$217,872	$217,872	$217,872	$217,872	$217,872	$217,872
Average price per lb	$1.78									
Operating Costs										
Mowing	$1,428	$1,428	$1,428	$1,428	$1,428	$714	$714	$714	$714	$714
Herbicide	$918	$918	$918	$918	$918	$918	$918	$918	$918	$918
Fertilize	$3,944	$3,944	$3,944	$3,944	$3,944	$3,944	$3,944	$3,944	$3,944	$3,944
Pest Control	$85	$85	$85	$85	$85	$85	$85	$85	$85	$85
Hand Weeding	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Replant	$153	$153	$153	$153	$153	$196	$196	$196	$196	$196
Pruning	$510	$510	$510	$510	$510	$510	$510	$510	$510	$510
Crop Log	$17	$17	$17	$17	$17	$17	$17	$17	$17	$17
Other	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing	$59,109	$59,109	$61,473	$70,931	$74,664	$74,664	$74,664	$74,664	$74,664	$74,664
Post-harvest Treatment	$19,380	$19,380	$20,155	$23,256	$24,480	$24,480	$24,480	$24,480	$24,480	$24,480
Management Fee	$13,548	$13,548	$14,019	$15,902	$16,646	$16,478	$16,478	$16,478	$16,478	$16,478
General Excise Tax	$4,992	$4,992	$5,177	$5,917	$6,209	$6,174	$6,174	$6,174	$6,174	$6,174
Total Operating Costs	$99,134	$99,134	$102,745	$117,187	$122,887	$122,048	$122,048	$122,048	$122,048	$122,048
Net Operating Profit (Loss)	$73,348	$73,348	$76,637	$89,792	$94,985	$95,824	$95,824	$95,824	$95,824	$95,824
Capital Expenditures	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow	$73,348	$73,348	$76,637	$89,792	$94,985	$95,824	$95,824	$95,824	$95,824	$95,824
Cumulative Cash Flow	$205,355	$278,703	$355,339	$445,131	$540,116	$635,940	$731,764	$827,587	$923,411	$1,019,235

Acreage and Yield Assumptions

Acreage & Tree Count Assumptions:

Acreage		
Total acres		20.00
Estimated net tree acres	85%	17.00
Tree Data		
Density, trees per acre (30'x30')		48
Theoretical trees on net acres		816

Yield Assumptions:

Category	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Lbs/Tree/Year	-	-	-	5.0	25.0	50.0	75.0	75.0	80.0	100.0
Lbs Adjusted for Spoilage	-	-	-	4.8	23.8	47.5	71.3	71.3	76.0	95.0
Lbs per Tree Acre per Year	-	-	-	228	1,140	2,280	3,420	3,420	3,648	4,560

Category	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Lbs/Tree/Year	125.0	125.0	130.0	150.0	200.0	250.0	300.0	300.0	300.0	300.0
Lbs Adjusted for Spoilage	118.8	118.8	123.5	142.5	190.0	237.5	285.0	285.0	285.0	285.0
Lbs per Tree Acre per Year	5,700	5,700	5,928	6,840	7,200	7,200	7,200	7,200	7,200	7,200

Key Assumptions	
Estimated Producing Tree Density (tpa)	48
Spoilage	5.0%
Maximum Lbs per Tree Acre per Year	7,200

Average Price Assumptions:

Grade 1	70%	$	2.00
Grade 2	20%	$	1.75
Grade 3	5%	$	0.60
Average Price		$	1.78

Cost Assumptions

Establishment Cost:

Category	Total Cost	Unit Cost	
Land Clearing	$ 16,000	$ 800	per acre
Planting	$ 18,768	$ 23	per tree
Management fee	$ 3,477	10%	
Sub-Total	$ 38,245		
GET	$ 1,593	4.166%	
Total	$ 39,838		

Planting Cost Detail:

Trees	$ 15.00
Soil	$ 2.00
Dig holes	$ 2.50
Labor	$ 3.00
Fertilizer	$ 0.50
Total	$ 23.00

Operating Costs:

Category	Rds. per Yr.	Cost per Acre per Round: Year 1	Year 2	Year 3	Year 4	Yr 5 thru 10	Yr 11 thru 15	Yr 16 thru 20
Mowing	6	$ 24.00	$ 24.00	$ 24.00	$ 24.00	$ 20.00	$ 14.00	$ 7.00
Herbicide	6	$ 18.00	$ 18.00	$ 18.00	$ 15.00	$ 9.00	$ 9.00	$ 9.00
Fertilize	8	$ 6.00	$ 12.00	$ 24.00	$ 29.00	$ 29.00	$ 29.00	$ 29.00
Pest Control	1	$ 10.00	$ 10.00	$ 10.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00
Hand Weeding	6	$ 25.00	$ 8.00	$ -	$ -	$ -	$ -	$ -
Replant	1	$ 3.00	$ 6.00	$ 6.00	$ 6.00	$ 6.00	$ 9.00	$ 11.50
Pruning	1	$ 15.00	$ 15.00	$ 15.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00
Crop Log	1	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00
Other	1	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50

		Unit Cost	
Harvesting	$	0.20	per pound
Packing	$	0.30	per pound
Packing Materials	$	0.07	per pound
Hauling	$	0.04	per pound
Total Harvest, Pack & Haul	$	0.61	per pound
Post-harvest Treatment	$	0.20	per pound
Management - Cultivation		25%	of operating costs
Management - Harvesting		15%	of harvesting, packing & post-harvest treatment costs.
GET on Operating Costs		4.166%	
GET on Revenue		0.500%	

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MANGOSTEEN

Brief History: The mangosteen family (Clusiaceae) includes about 46 genera and 1,000 species of trees, shrubs, or herbs, with yellow or white resinous sap, from tropical and temperate regions, among them ornamental plants and others yielding fruit, oil resin, dye, medicine, and hard wood. The mangosteen, *Garcinia mangostana*, is the best-known species of the family Clusiaceae, and originates in Southeast Asia. A mangosteen specimen is located in the Hawaii Forestry Division arboretum in Hilo that is over 20 years old. No one knows who brought the first mangosteen tree to the state.

Description: The tree is a densely foliaged broad based evergreen of columnar or pyramidal form reaching a mature height of 36 to 60 feet. Leaves are opposite or whorled, feather-veined 1/2 to 2 inches long. Flowers develop singly at the tip of branches. Some productive trees may bear two, three or four flowers at the tip of the branches. Flowers are pistillate.

The mangosteen is polyploid with double the numbers of chromosomes of all other Garcinia species. It may well be a natural hybrid. Since no pollen is produced and fruits are formed parthenocarpicly, the seedling progeny are identical to the parent and no cultivars exist. Fruits are ovoid, 1 1/2 to 3 1/2 in diameter and 2.5 to 5 ounces in weight. Fruit are initially green in color but at maturity turn red and then purple.

The pericarp is thick and tough commonly 1/4 inch thick. The edible aril is pearl white in color, slightly translucent and consists of 4 to 8 segments with 1 or 2 larger segments containing seeds. The edible portion is approximately 30% of total fruit weight.

Basic Cultivation Requirements:

Soil: Preferred soil types are heavy clay alluvial loams with high organic matter content and good water holding capacity. Permanently water logged soils are not desirable, but the mangosteen is comparatively tolerant of seasonally waterlogged conditions. A soil pH of 5 to 6 is desirable. Excessive liming can be detrimental. Do not use lime when pH is above 6.5

Temperature: The mangosteen is ultra tropical. It cannot tolerate temperatures below 40 F nor above 100 F. High radiation, low humidity and temperatures above 95 F induce sunburn on leaves, but trees become more tolerant as they get older.

Elevation: Hot, wet tropical lowlands.

Rainfall: Permanently moist soil is desirable in order to maximize growth, yield and fruit quality. There must be supplementary irrigation in months with less than 6 inches of rainfall except that a short period of moisture stress in January is beneficial for flower induction.

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Cultural: Minimum spacing recommended is 25 feet between trees in the row and 30 feet between the rows. The alternative is to start with 30 x 40 ft. spacing and interplant with other species e.g. carambola for short term yields.

Shading of juvenile trees is essential, otherwise growth rates are excessively slow and trees may even die. The best arrangement is Sarlon shade cloth of 30 to 50 % shade rating for a period of 1 to 2 years following field planting. If shade exceeds 50% then trees become excessively leggy with long internodes and later have an unsatisfactory thin bearing surface.

Pruning in the young tree is minimal. A single trunk to at least 10 ft. height is desirable and the dominant side branches and water suckers should be removed in juvenile trees. Thereafter thin out dead branches and water shoots.

Windbreaks are essential for maximum growth and protection of the tree canopy. Bana grass will provide a good temporary windbreak while permanent species are being established.

This tree would be an excellent crop for organic cultivation techniques.

Diseases: Very little is known about disease susceptibility of the mangosteen. At this time there is no known disease problem.

Pests: Red banded thrips, *Selenothrips rubrocinctus (Giard)*, are known to damage young mangosteen leaves. These thrips can be controlled with organic sprays.

Nutrients: Mangosteens do not seem to require any special nutrient program. A well-balanced fertilizer program that includes trace elements is satisfactory.

Fruit Maturity: Fruit is produced in 6 to 8 years from seed, 4-5 from grafts. Grafting has not been successful in Southeast Asia and Australia, where it has been used. The plants do not develop strong root systems; therefore, most commercial growers use seedlings. Fruit matures in 150-180 days. Fruit are edible at the first sign of color change from green to red, but maximum quality and shelf life are obtained from fruit picked at the uniform red stage. Fruit turned fully purple are often too mature to withstand packaging and transport with damage. The major cause of internal breakdown is from picking over mature fruit. Most fruit are produced first inside the outer canopy on short laterals.

Sources of Nursery Stock:

1. Plant It Hawaii, Kurtistown, Hawaii
2. Manelo Orchard, Hilo, Hawaii
3. Kahili Farm, Kilauea, Kauai
4. Frankie Sekiya Nursery, Oahu

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Production: Crop yield is irregular and varies from tree to tree and from season to season. Average yield of a full-grown tree is about 500 fruits. Yield steadily increases up to the 30th year of bearing when crops of 1,000 to 2,000 fruits may be obtained. Observations on mature trees in Hawaii indicate the main flowering occurs during March and April with fruit maturity in July and August. Fruit are easily detached with a twist and pull action of the wrist. Harvesting at this time is done by hand.

Packing: Fruit picked at the red stage will have an attractive shelf life of 2 to 3 weeks at ambient temperature. Cool storage at 50 F will extend shelf life to 6 weeks. The critical aspect is to pack only sound red fruit. Older fruit will succumb to a number of rots. The USDA-ARS has stated that the mangosteen may not be a fruit fly host. Research will be done to verify this as more crop becomes available in Hawaii for testing. If the mangosteen can be shown to be fruit fly free, it can be shipped to the U.S. mainland without post harvest quarantine restrictions.

Uses: Mangosteen is considered by the Southeast Asian peoples to be the "queen of fruits". It is eaten fresh and can be used in desserts and sauces.

Marketing: Markets are being developed for the tropical fruit rambutan in state supermarkets and the Hawaii food service industry. These same markets can be introduced to the mangosteen when the trees start producing. There is a large market on the U.S. mainland for this fruit among the Asian immigrants. Because of its good shelf life and delicious flavor, the mangosteen market will grow rapidly.

The Hawaii industry is in its infancy with approximately 75 acres planted. Some orchards have bearing trees, but most of the production will start entering the market place in about four to five years.

Transport: Transportation has not been defined, as there is insufficient fruit production to justify anything more than casual local sales.

Oneloa Development Project: Cash Flow for Mangosteen

28-Jun-99 **Acreage:** **20**

Production & Revenue		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Pounds Harvested		-	-	-	-	-	-	-	3,876	15,504	38,760
Revenue		$0	$0	$0	$0	$0	$0	$0	$12,694	$50,776	$126,939
Average price per lb	$	3.28									
Operating Costs											
Mowing		$2,448	$2,448	$2,448	$2,448	$2,040	$2,040	$2,040	$2,040	$2,040	$2,040
Herbicide		$1,836	$1,836	$1,836	$1,530	$918	$918	$918	$918	$918	$918
Fertilize		$816	$1,632	$3,264	$4,896	$4,896	$4,896	$4,896	$4,896	$4,896	$4,896
Pest Control		$85	$85	$85	$85	$85	$85	$85	$85	$85	$85
Hand Weeding		$4,080	$2,448	$1,632	$816	$136	$136	$136	$136	$136	$136
Replant		$85	$170	$170	$170	$170	$170	$170	$170	$170	$170
Pruning		$17	$17	$17	$17	$17	$17	$17	$17	$17	$17
Crop Log		$34	$34	$34	$34	$34	$34	$34	$34	$34	$34
Other		$1,020	$1,020	$1,020	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing		$0	$0	$0	$0	$0	$0	$0	$2,364	$9,457	$23,644
Post-harvest Treatment		$0	$0	$0	$0	$0	$0	$0	$194	$775	$1,938
Management Fee		$2,605	$2,423	$2,627	$2,510	$2,085	$2,085	$2,085	$2,468	$3,620	$5,922
General Excise Tax		$543	$505	$547	$523	$434	$434	$434	$620	$1,178	$2,295
Total Operating Costs		$13,026	$12,113	$13,133	$12,548	$10,423	$10,423	$10,423	$13,365	$22,191	$39,842
Net Operating Profit (Loss)		($13,026)	($12,113)	($13,133)	($12,548)	($10,423)	($10,423)	($10,423)	($671)	$28,585	$87,097
Capital Expenditures	$	58,538	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow		($71,564)	($12,113)	($13,133)	($12,548)	($10,423)	($10,423)	($10,423)	($671)	$28,585	$87,097
Cumulative Cash Flow			($83,677)	($96,809)	($109,357)	($119,780)	($130,204)	($140,627)	($141,298)	($112,713)	($25,616)

Oneloa Development Project: Cash Flow for Mangosteen.

28-Jun-99 Acreage: 20

Production & Revenue	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Estimated lbs nut-in-shell	58,140	116,280	135,660	139,536	155,040	155,040	155,040	155,040	155,040	155,040
Estimated revenue	$190,409	$380,817	$444,287	$456,980	$507,756	$507,756	$507,756	$507,756	$507,756	$507,756
Average price per lb, NIS	$3.28									
Fixed Costs:										
Mowing	$1,428	$1,428	$1,428	$1,428	$1,428	$714	$714	$714	$714	$714
Herbicide	$918	$918	$918	$918	$918	$918	$918	$918	$918	$918
Fertilize	$6,528	$6,528	$6,528	$6,528	$6,528	$6,528	$6,528	$6,528	$6,528	$6,528
Pest Control	$85	$85	$85	$85	$85	$85	$85	$85	$85	$85
Tree Decline	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Replant	$255	$255	$255	$255	$255	$255	$255	$255	$255	$255
Brush Clearing & Pruning	$170	$170	$170	$170	$170	$850	$850	$850	$850	$850
Crop Log	$34	$34	$34	$34	$34	$34	$34	$34	$34	$34
Other	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing	$35,465	$70,931	$82,753	$85,117	$94,574	$94,574	$94,574	$94,574	$94,574	$94,574
Post-harvest Treatment	$2,907	$5,814	$6,783	$6,977	$7,752	$7,752	$7,752	$7,752	$7,752	$7,752
Management Fee	$8,121	$13,877	$15,795	$16,179	$17,714	$17,706	$17,706	$17,706	$17,706	$17,706
General Excise Tax	$3,283	$6,074	$7,004	$7,190	$7,934	$7,932	$7,932	$7,932	$7,932	$7,932
Total Operating Costs	$55,954	$100,082	$114,792	$117,733	$129,501	$129,458	$129,458	$129,458	$129,458	$129,458
Net Operating Profit (Loss)	$134,455	$280,735	$329,495	$339,247	$378,255	$378,298	$378,298	$378,298	$378,298	$378,298
Capital Expenditures	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow	$134,455	$280,735	$329,495	$339,247	$378,255	$378,298	$378,298	$378,298	$378,298	$378,298
Cumulative Cash Flow	$108,839	$389,574	$719,069	$1,058,316	$1,436,571	$1,814,868	$2,193,166	$2,571,463	$2,949,761	$3,328,058

28-Jun-99 **Acreage:** 20

Acreage and Yield Assumptions

Acreage & Tree Count Assumptions:

Acreage		
Total acres		20.00
Estimated net tree acres	85%	17.00
Tree Data		
Density, trees per acre (30'x30')		48
Theoretical trees on net acres		816

Yield Assumptions:

Category	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Lbs/Tree/Year	-	-	-	-	-	-	-	5.0	20.0	50.0
Lbs Adjusted for Spoilage	-	-	-	-	-	-	-	4.8	19.0	47.5
Lbs per Tree Acre per Year	-	-	-	-	-	-	-	228	912	2,280

Category	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Lbs/Tree/Year	75.0	150.0	175.0	180.0	200.0	200.0	200.0	200.0	200.0	200.0
Lbs Adjusted for Spoilage	71.3	142.5	166.3	171.0	190.0	190.0	190.0	190.0	190.0	190.0
Lbs per Tree Acre per Year	3,420	6,840	7,980	8,208	9,120	9,120	9,120	9,120	9,120	9,120

Key Assumptions	
Estimated Producing Tree Density (tpa)	48
Spoilage	5.0%
Maximum Lbs per Tree Acre per Year	10,000

Average Price Assumptions:

Grade 1	70%	$	3.50
Grade 2	30%	$	2.75
Average Price		$	3.28

Cost Assumptions

Establishment Cost:

Category	Total Cost	Unit Cost	
Land Clearing	$ 16,000	$ 800	per acre
Planting	$ 26,928	$ 33	per tree
Screens	$ 8,160	$ 10	per tree
Management fee	$ 5,109	10%	
Sub-Total	$ 56,197		
GET	$ 2,341	4.166%	
Total	$ 58,538		

Planting Cost Detail:

Trees	$ 25.00
Soil	$ 2.00
Dig holes	$ 2.50
Labor	$ 3.00
Fertilizer	$ 0.50
Total	$ 33.00

Operating Costs:

Cost per Acre per Round:

Category	Rds. per Yr.	Year 1	Year 2	Year 3	Year 4	Yr 5 thru 10	Yr 11 thru 15	Yr 16 thru 20
Mowing	6	$ 24.00	$ 24.00	$ 24.00	$ 24.00	$ 20.00	$ 14.00	$ 7.00
Herbicide	6	$ 18.00	$ 18.00	$ 18.00	$ 15.00	$ 9.00	$ 9.00	$ 9.00
Fertilize	8	$ 6.00	$ 12.00	$ 24.00	$ 36.00	$ 36.00	$ 48.00	$ 48.00
Pest Control	1	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00
Hand Weeding	8	$ 30.00	$ 18.00	$ 12.00	$ 6.00	$ 1.00	$ -	$ -
Replant	1	$ 5.00	$ 10.00	$ 10.00	$ 10.00	$ 10.00	$ 15.00	$ 15.00
Pruning	1	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 10.00	$ 50.00
Crop Log	2	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00
Other (incl. screen maint.)	1	$ 60.00	$ 60.00	$ 60.00	$ 2.50	$ 2.50	$ 2.50	$ 2.50

	Unit Cost	
Harvesting	$ 0.20	per pound
Packing	$ 0.30	per pound
Packing Materials	$ 0.07	per pound
Hauling	$ 0.04	per pound
Total Harvest, Pack & Haul	$ 0.61	per pound
Post-harvest Treatment	$0.050	per pound
Management - Cultivation	25%	of operating costs
Management - Harvesting	15%	of harvesting, packing & post-harvest treatment costs.
GET on Operating Costs	4.166%	
GET on Revenue	0.500%	

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'AWA

'Awa (Kava or Kava Kava) is to be planted in a natural forest within the development. Fifty acres of 'awa will be planted in a forest of approximately 250 acres. The "old style" of farming will be utilized. The community will be involved in the farming, harvesting and marketing of the crop. The development would be responsible for the initial planting and for providing materials, such as fertilizer, to the project. The community involvement would be in the on-going cultivation, harvesting, and replanting of the crop. Revenue from the sale of the crop would be shared between the development and the community.

Included in this section on 'awa are a detailed description, basic cultivation requirements, and a cash flow showing the level of profitability that may be expected based upon the farming method described. Along with the cash flow is a list of assumptions used to create the cash flow.

Brief History: The 'awa plant (*Piper methysticum Forst)*, is a member of the pepper family. It is closely related to pepper (*P. nigrum I*) a climbing shrub. 'Awa is indigenous to Polynesia and Indonesia. The exact origin is uncertain, but is believed to have originated in northern Vanuatu, an island chain of the Solomon Islands. In early times it was distributed eastward by migrating peoples.

In Hawaii 'awa was part of the mythical lore of ancient gods. In daily life chiefs and priests used the 'awa in ceremonial drinks and offerings to the gods, and the common people drank it as a mild and relaxing beverage, especially after long, arduous days farming or fishing. Even babies were given the extract in a juice to sooth them. The chiefs used the rarer varieties and the commoners used the common varieties.

'Awa was cultivated throughout Hawaii with almost proprietary cultivation and processing methods in specific locations. In these specific locations *pupu 'awa,* condiments eaten with or mixed with the 'awa, were thought to enhance the potency of the 'awa or provide a cultural symbolism to the use. Native writings mention the special *pupu 'awa* of Puna in *Ka Hoku o H'awai'i* documented by Kepa Maly in his 'AWA: CULTURAL-HISTORICAL PERSPECTIVES IN H'AWAI'I.

Ka 'awa 'ili lena a ka manu i kanu ai iluna o ka la'au - The yellow skinned *'awa* planted by birds atop the tree branches (grown in Puna)

Ka 'awa kau la'au a ka manu i Kealakomo - The *'awa* of Kealakomo, placed upon the branches by the birds (grown in Puna)

At Kalapana (Puna) there grew the famous coconut stand called Niu moe o Kalapana (Reclining coconut trees of Kalapana), also know as Niu-a-poe in ancient times. In Puna the water from the coconuts of Niu-a-poe was used as the *pupu 'awa*, while preparing a highly coveted *'awa* drink for *ali'i* and dignitaries.

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Although used by the indigenous people of Hawaii and the South Pacific for thousands of years, it was Captain Cook who first brought back reports to Europe of the 'awa plant's very special properties in the early 1700's. The uses of 'awa evolved to include it as an herbal medicine as well as a culturally significant drink.

In Hawaii, as modern farming techniques and both agricultural and urban development increased, 'awa became a crop that was cultivated less and less. Many Hawaiian cultivars of 'awa could be found only in isolated valleys and gulches. As the interest in natural medicines has increased over the last couple of decades 'awa has been rediscovered and is now considered one of the premiere herbal crops.

Description: The 'awa plant is a shrub 4 to12 feet tall, with green, jointed stems, swollen at the joints (nodes), with alternate, heart-shaped leaves about 5 to 8 inches long and nearly as wide. The petioles are about 1 inch long, the leaves with 11 to 13 prominent veins originating at the base. The yellow-green flowers are borne on narrow spikes and hang from burgundy stems. They are about 3 inches in length with the sexes on separate plants. 'Awa is a sterile decaploid and incapable of sexual reproduction. Propagation is by vegetative methods.

Basic Cultivation Requirements:
Soil: Rich, well composted soil, well watered and well drained.

Temperature: 'Awa cannot tolerate full sunlight and burns easily. In areas where cloud cover is prevalent and fairly constant, the shrub may be set out in less shaded areas. It grows best in cool (60' low, 78' to low 80's high) moist, partially shaded locations. An over-story or edging of trees historically provided shade in many island areas.

Elevation: Formerly, when 'awa was cultivated, the Hawaiians planted it in or just below the borders of the lower forest zone, in clearings within the lower ranges of the forest, along streams, and in pockets along the base of and upon wet escarpments (sea level to approximately 2500' elevation depending on the climate conditions). 'Awa is now being planted from sea level to approximately 1000' elevation. No research has been done on the effect of elevation on the growth and vigor of the crop.

Rainfall: 'Awa grows well where there is consistent moisture and not too much sun. There is little information on specific rainfall requirements or the effect of irrigation.

Cultural: 'Awa used to be widely grown as a crop in Hawaii and lately there has been increasing interest in it among farmers.

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A fundamental element in growing 'awa is to grow it in a forest like environment, rich in organic matter with the right amount of cloud cover or a partially open canopy to allow for adequate sunlight. In a true forest environment in a wet climate like the Puna forest area 'awa cultivation was grown successfully in ancient times. This is an excellent environment for optimum growth. 'Awa needs to grow on swales, mounds, or banked ditches to promote root growth, provide some nematode protection and resistance to fugal disease.

Because 'awa cultivation is in a major resurgence at the present time growers and researchers are experimenting with plant spacing that will promote heavy production. Using an approximate spacing of 6 feet by 4 feet in an open field would result in 1,815 plants per acre. In a natural forest, because of the necessity of planting in a more random pattern with this spacing it is estimated there will be 20% coverage. After 2 years, 1/3rd is harvested and replanted, and 1/3rd in years 3 and 4. In year 5, the first replant (still 1/3rd) is harvested and replanted. From here on, each year 1/3rd is harvested. This harvesting sequence yields material that will always be 3 years old.

Diseases: 'Awa diseases in Hawaii are at this time not significant. Pythium root rot can be found on plant roots at times, but researchers think this can be minimized by varietal selection. Anthracnose has been detected, but is at this time not a problem. The fungus *Pestalotia sp.* and bacterial leaf spot do present a problem during continual very wet weather. Copper based fungicides provide some control for these wet weather problems. There is serious concern that introduction of plant material from other Pacific areas with disease, such as Fiji, Tonga, Vanuatu and Samoa, will bring 'awa diseases into the state. The Dept. of Agriculture is adopting a rule restricting the importation of 'awa plants and plant parts into the state while more research is conducted on possible quarantine regulations.

Pests: Root-knot nematodes (*Meloidogyne spp., M konaensis, M. incognita*); burrowing nematode (*Radopholu similis)*, and other plant parasitic nematodes are present on roots of Hawaiian 'awa. The nematodes can cause substantial loss of production damaging the root system if control is not exercised. Planting sites should be tested for nematodes and clean planting material used.

Use of organic mulches and compost can help to control the population. Allowing adequate spacing between plants also helps to limit nematode population explosions. Intercropping with crops such as tumeric and marigold can help in nematode control. No chemical pesticides are approved for use on 'awa.

Nutrients: Organic fertilizers are preferred for 'awa. Chemical fertilizers are used, but the plant's special nutrient requirements and growth rates are just starting to be researched. As tissue samples are analyzed for nutrient content and standards developed, that are then related to root production, optimum fertilizer regimes will be developed.

Fresh 'awa root may be harvested after a 2 year growing period.

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Sources of Nursery Stock: To prevent importing disease and pests importation of 'awa plant material from outside Hawaii is discouraged. Plants may be purchased at the nurseries listed below and once established may be propagated by cuttings or seeds. Tissue culture of 'awa is difficult and requires developing a very careful protocol. However, it is being done and the techniques will continue to improve.

Hawaiian varieties available are Makea, Kumakua, Hiwa, Purple Moi, Ne-Ne, Mokihana Purple, Green Moi, Ne-Ne Ele Ele, Mapulehu, Mahakea.

'Awa may be purchased at:

1. Royal Palm Enterprises, Mountain View Hawaii
2. Grow Native, Pahoa, Hawaii
3. Alia Point 'Awa Nursery, Pepeeko Hawaii
4. Nuka Hiva Trading Company, Pahoa Hawaii
5. Hoowaiwai Farms, Papaikou, Hawaii
6. Paradise Propagations, Hilo, Hawaii (tissue cultured plants)

Production: 'Awa plants are usually harvested after 2-5 years but may be left growing for more than 20 years. The stump and roots become larger over time, although soil fertility and genotype are more important factors than plant age in determining yield. The green weight of an individual rootstock varies from 10 to 100 pounds, depending upon a plant's maturity and the type of cultivar. A three-year-old plant yields about 22 pounds of fresh material, four-fifths of which is the stump and the rest is the radicles. The harvested portion of the plant includes the lateral roots, the stump, and part of the basal system.
According to one source, a conservative yield estimate is 10 pounds of fresh root per plant after a two-year period, 22 pounds at 3 years and 30 pounds at 4 years.

Processing: Roots are washed in water, chopped into small pieces, and dried in the sun or by hot air. Washing necessitates a large volume of water. Sun drying must be on tables that can be rapidly covered because rainfall causes mold.

Hot air drying can be used also. Current practice is for stumps and roots to be further processed by grinding. Dried material is ground into a fine powder, from which the drink can easily be prepared by infusion in fresh water followed by filtration.

The quality of 'awa after processing can be expected to be affected by cultivar and the growing environment, the physico-chemical characteristics of the roots, harvesting, drying, and storage conditions. Except for cultivar differences, little is known about the effects of environmental or processing factors on the quantity and quality of the kavalactones and other minor active ingredients in a particular sample of dried root. Pieces of dry stump and roots are also exported in bulk to laboratories overseas. This 'awa product is processed into hydro-alcoholic extracts that are partially soluble in water and alcohol.

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Now that the export market is expanding, more refined extraction processes are being developed and these processes vary according to the required end product and the raw material used. Industrial extraction methods can create a wide range of products including freeze-dried extract obtained from a filtered macerate, an essential oil obtained by distilling leaves with water, an extract of active kavalactones isolated using volatile solvents and spray drying of enriched fresh juices. Spray-dried hydrosoluble powder is a promising product that could be locally produced and exported. Manufacture of an instant, ready-to-use 'awa is probably the most promising use for such powder.

Uses: Unlike many popular prescribed relaxation drugs, 'awa reduces anxiety but does not impair mental function or promote sedation. 'Awa contains compounds called kavalactones. There are presently six important kavalactones, although fifteen have been identified. Hawaiian varieties have a high concentration of the important kavalactones, ranging from 11% to 20%. Pacific Islanders use 'awa to help reduce pain. It works on the central nervous system and promotes relaxation to those suffering from anxiety or depression. 'Awa can also help promote more restful sleep to those struggling with insomnia or restlessness, as it helps the muscles of the body to relax. Although 'awa is a social beverage in the Pacific Islands, it is used for medicinal purposes in Europe and the United States. Several significant human clinical trials show that standardized extracts of 'awa are highly effective in relieving anxiety, sleeplessness and some cases of depression.

Market: It is now sold in various forms throughout the world for its stress-relieving properties. Presently because of recent worldwide popularity, a current resurgence has sparked great interest in Hawaii and consequently, cutting-edge research and cultivation are taking place. Hawaii is preparing to be a major player in the 'awa market. Most 'awa in the United States is imported from developing countries in the South Pacific. Considering the increasing quantity and quality demands on the herb, buyers are concerned about 'awa originating from areas where no systematic cultivation has ever taken place. Hawaiian growers see unlimited potential, especially since research results are establishing which varieties of 'awa are most desirable. However, expansion accompanied by research is needed before 'awa becomes an important economic crop for Hawaii. There are fewer than 100 acres of 'awa being commercially grown in Hawaii and under 50 farmers.

'Awa is a significant cash crop in several Pacific regions, providing higher returns than other crops. This is particularly true in Fiji, Tonga, Samoa, Pohnapei, and Vanuatu where recent economic surveys document the increasing commercial value of 'awa. 'Awa is a high value, low volume, crop similar to spices, convenient to store and transport. The growth can be attributed to the corresponding expansion in both domestic and export markets. For example, in Samoa, there is estimated to be 2,600 acres in 'awa, and that figure will likely increase by 30% over the next year.

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The Central Bank of Samoa reports export value of 'awa in Samoa was $3,500,000 in 1998. The main international markets for 'awa are the United States, Germany, France, and New Zealand.

Quarantine: Fresh 'awa root can be shipped to the mainland U.S. if it is free of disease and pests and has been washed to remove any soil residue. The root must be inspected by USDA-APHIS prior to shipment.

Oneloa Development Project: Cash Flow for Awa

28-Jun-99 **Acreage:** **250**

Production & Revenue	Year 1	2	3	4	5	6 & on
Pounds Harvested	-	-	302,500	665,500	907,500	665,500
Revenue	$ -	$ -	$ 756,250	$ 1,663,750	$ 2,268,750	$ 1,663,750
Average price per lb	$ 2.50					
Capital Costs						
Planting	$ 252,966					
Operating Costs						
Fertilizer	$ 45,375	$ 45,375	$ 45,375	$ 45,375	$ 45,375	$ 45,375
Replanting	$ -	$ -	$ 84,322	$ 84,322	$ 84,322	$ 84,322
Cultivation	$ -	$ -	$ -	$ -	$ -	$ -
Harvesting	$ -	$ -	$ -	$ -	$ -	$ -
Packing & Shipping	$ -	$ -	$ 127,050	$ 279,510	$ 381,150	$ 279,510
Total Operating Costs	$ 45,375	$ 45,375	$ 256,747	$ 409,207	$ 510,847	$ 409,207
Cash Flow	$ (45,375)	$ (45,375)	$ 499,503	$ 1,254,543	$ 1,757,903	$ 1,254,543

28-Jun-99 Acreage: 250

Assumptions

Acreage & Tree Count Assumptions:

Acreage

Gross land area (acres)	250.00
Net crop acres	50.00

Plant Data

Density, plants per crop acre	1,815
Total plants	90,750

Yield Assumptions:

	Year 1	2	3	4	5	6 & on
Pounds per plant per year	-	-	10	22	30	22
No. of plants harvested/acre	-	-	605	605	605	605
Pounds per acre per year	-	-	6,050	13,310	18,150	13,310

Key Assumptions on Yield

One-third of an acre is harvested each year.

Pounds harvested equals wet pounds at 75% moisture.

Capital Costs

Planting (per plant)		$	2.79
Labor - manhours		0.25	
Labor - rate per hour	$	7.15	
Total labor per plant	$	1.79	
Materials - plants	$	0.50	
Materials - soil media	$	0.50	
Total materials per plant	$	1.00	

Initial planting is for the complete 50 acres (year one). Year two, no planting.

Year three and on, one-third of the acreage is harvested and replanted each year.

Operating Costs:

Fertililzer material - triple 8 organic

Pounds per plant per year		1.00	4 applications at 1/4 pound.
$ per pound	$	0.50	
Pounds per acre per year	$	908	

Replanting - see captial costs

Cultivation - assumes labor to come from the local community.

Harvesting - assumes labor to come from the local community.

Packing & Shipping.		Unit Cost	
Packing	$	0.30	per pound
Packing Materials	$	0.07	per pound
Hauling	$	0.04	per pound
Ag Inspection		0.01	per pound
Total	$	0.42	per pound

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HAWAIIAN MEDICINAL PLANTS

Hawaiian medicinal plants will be planted in selected areas of the golf course. Maintenance and harvesting will be accomplished by golf course maintenance personnel. The medicinal product harvested will be used within the development. These plantings will provide both landscaping and items of interest for guests of the development.

The following section provides a list of Hawaiian medicinal plants and brief history and description for each.

AWAPUHI - HUAHIWI

Brief History: *Zingiber zerumbet.* Family: Zingberaceae. This wild ginger originated in India was distributed eastward through Polynesia and introduced to these islands by early Hawaiian settlers.

Description: Awapuhi is a perennial. The 10-12 blade-shaped leaves grow to 6-8 inches on the approximately 3 foot long stalks. The leaves grow in an alternate arrangement on the upright, thin, fleshy stalk. The conical or club-shaped flower heads bloom in the summer. As the 2-3 inch long bracts/flower heads mature, they gradually fill with an aromatic, slimy liquid. The heads are reddish-green with overlapping scales, producing small yellowish-white flowers. These tiny flowers are similar in fragrance to the larger and more delicate butterfly-like yellow and white ginger blossoms, growing from the base toward the head. awapuhi grows wild in patches at low altitudes in the open damp forest. This plant can easily be cultivated. Awapuhi cultivation requires a large area. The plant tends to form thick stands, following their large underground stems horizontally. awapuhi is best propagated in autumn by planting a piece of rootstock with buds, in a shallow trench of broken and composted soil.

The Hawaiians have many uses for the awapuhi. The leaves and leaf stalks were used in baking in the imu, (underground oven), and to enhance the flavor of pork and fish as they cooked.

Traditionally, the aromatic underground roots/rhizomes were sliced, dried and pounded into a powder, then added to the folds of stored tapa cloth. The fresh roots were pounded and used as medicine for indigestion. The root was ground and mixed with a ripe noni fruit and then used to treat severe sprains. The pulp was placed in a cloth and loosely bound around the injured area. The dressing was changed daily until the sprain healed.

For a toothache or a cavity, the cooked and softened awapuhi root was pressed into the hollow and left for as long as was needed. To ease a stomachache, the ground and strained root material was mixed with water and drunk.

Finally, perhaps the most common use of awapuhi is as a shampoo and a conditioner for the hair. The clear slimy juice present in the mature flower heads is excellent for softening and bringing shine to the hair. It can be left in the hair or rinsed out, as you wish. The sudsy juice is also excellent for massage. The roots can be stored in a cool, dark place to keep for use when needed.

HAU

Brief History: *Hibiscus tiliaceus*, Family: Malvaceae. Its native region is still uncertain. It is generally believed that the early Polynesian immigrants brought cuttings of hau with them to Hawaii.

Description: Hau is a true hibiscus, with five crepe-like petals with a central column. The 2-3 inch long bright yellow cup-shaped flowers have reddish centers, and form at the ends of the branches. As the day goes by, the flower changes color to orange and then to reddish-brown, before it falls off the plant by the next morning. The inch long dry downy brown fruiting capsule contains 5 valves, each with 3 smooth seeds. The leaves are heart-shaped and round, from 2 to 12 inches in diameter. They are leathery, with a smooth surface, while the underside is velvety and consists of matted white hairs. Sometimes the leaf edges are scalloped, but usually not.

Hau grows well near the ocean, streams, and in moist sloping areas up to the 2000-foot elevation. Hau is propagated from cuttings, and the trunks can be trained to create a garden shelter or arbor called a hau lanai. This plant is also grown as a natural fence barrier. In the old days this plant was so highly valued that permission to cut it was required of the village chief.

Today it is often called "hau bush" and is termed an invasive plant, as it has taken over some areas, at the same time creating windbreaks and stabilizing the soil.

Traditionally, hau branches were piled near the shoreline to indicate fishing was kapu, because spawning was occurring in that area.

The naturally curved branches of this plant's softwood are used to make canoe outriggers. Hau wood pieces were used as floats on fishnets. The soft wood was also helpful in making fires. Adze handles were most often made of hau; as were lightweight practice spears, massage sticks, brooms, and the crossbeams for kites.

Hau cordage provided tying material used daily. The cordage is made by cutting off stems and younger smooth branches, making a slit lengthwise and removing the bark. The bark strips are then soaked. When the outer bark is slipped off, remaining are cream-colored smooth fibers for braiding and twisting into cordage.

Hau cordage provided ropes for hauling and many other needs: slings; canoe lashing; strings for bows; net bags; carrying handles for water gourds, fasteners for lauhala baskets, shark nooses; strands for lei making, strainers for coconut cream and 'awa drinks, sewing material to piece together tapa cloth for clothing and bedding, a form of tapa itself, hula skirts of hau bark, sandals, and cord for snapping dyes into line designs onto tapa cloth.

A slimy juicy sap found in the dome of the flower bud and in the bark was used as a mild laxative. The buds were also chewed and eaten for dry-throat. Slime from soaking the bark of the stems was medicine for congested chests. The lubricant quality of the inner bark was of value as an enema or could assist in the passage of a baby at childbirth.

KAMANI

Brief History: *Calophyllum inophyllum,* Family: Guttiferae. A member of the mangosteen family, also called Alexandrian laurel. Kamani was brought north to Hawaii from the South Pacific islands in early migrations of Polynesian settlers. Kamani was probably introduced by seed, which is how it is propagated. This native of the Pacific and of tropical Africa grows slowly along sandy shores and in lowland forests. It was cultivated in villages, near houses and also in groves away from villages.

Description: Kamani is a large attractive spreading tree up to 60 feet high, with a rounded head of dense foliage and rough gray bark. A reddish-brown hardwood is derived from the trunk. From this was carved many objects including canoes, homes, wooden containers or calabash. As with milo and kou wood, there is no bad-tasting taste or odor in kamani wood, so it is perfect for vessels that will be contacting or containing food.

The leaves of kamani are large, stiff, shiny, leathery and oblong with a blunt tip. They are 3-8 inches long, arranged opposite each other and have closely placed fine parallel veins running from a prominent raised yellow-green midrib to the leaf margin.

The delightfully fragrant (when new) flowers are small, 1 inch wide, and white with 4-8 petals. They smell like orange blossoms and were used to give fragrance to kapa cloth, and also for lei making. They are waxy and showy with golden yellow stamens and a pink pistil, and grow in clusters of a dozen or so flowers found hanging from a long stalk.

The fruit begins pinkish-green, rounds out to about 2 inches long and becomes bright green. When mature, it has a thin leathery dark gray-brownish skin, which covers a bony shell that holds a partly poisonous kernel or seed surrounded by a cork-like substance. A lamp oil for light was produced from the kernel and was used at times instead of kukui nut oil.

The kernel is called a "punnai nut" in some areas of the Pacific, and the oil is dark, green, thick and called "dilo oil". Sometimes this oil is useful for lomi lomi, massage, especially when enhanced with coconut oil or flower fragrances. The oil may have been useful in waterproofing tapa cloth.

The seed, leaves, gum and bark are said to have medicinal properties. In the old days an extract from the fruit was used to make a brown dye to color tapa cloth.

Kamani was often planted around heiau, temples.

Kamani was mentioned in early chants, and considered a sacred tree in parts of Polynesia. An especially fine grove is to be found on the island of Molokai.

KUKUI

Brief History: *Aleurites moluccana*. Family: Euphorbiaceae. The first Polynesian voyagers brought the seeds of this plant to Hawaii. The tree is also called the candlenut.

Description: The kukui is a large tree often growing to heights 80 feet or more. The leaves are a distinctive light silvery green. It has small five-petaled white flowers and hard, dark nuts over an inch in diameter incased in a green hard skinned husk. The tree is a symbol of enlightenment.

It grows wild in the lower mountain forest areas and is used in gardens as a shade tree, although it is a bit messy due to dropping its leaves and nuts.

The kukui nut has many uses. Originally it was most valued for its light, the oil of the white kernels being extracted for its use in stone lamps and in ti leaf sheath torches. The shelled nuts were skewered on a coconut frond mid-rib and lit one by one, from the top to bottom, as they sat in a container of sand or dirt or in the earth itself.

The nuts are widely used as a traditional lei. The white flowers and leaves are also strung as leis. The bark, flowers and nuts are all used for medicine. As food, a small amount of the pounded roasted nuts, plus salt and sometimes chili peppers, is used as a relish and is called Inamona.

The flowers were chewed by the parents of a young child and given to the child to aid in healing of thrush sores inside the mouth and upon the tongue. Also used for this problem was the juicy sap that fills up the depression left when the stem is pulled off the green fruit. This is applied with the finger and rubbed inside of the child's mouth and on the tongue. This sap is also a healing application for chapped lips, cold sores and mild sunburn.

One mashed nut (sometimes the raw kernel, sometimes the roasted) or the sap of the green nut was often used in combination with other traditional medicinal plants, particularly when a purgative for constipation was needed. The potency of this plant is so strong that these internal remedies are administered only by the knowledgeable.

For bad cases of ulcers and other skin sores, the baked meat of ripe kukui nuts was pounded and mixed with other plants, such as noni. In the treatment of rheumatic joints or deep bruises and wounds, kukui and noni leaves were wrapped around the afflicted places and heat applied by hot packs of salt, sand or rocks wrapped in tapa cloth.

The inner bark provided a red-brown dye for tapa cloth, while the gum from the bark strengthened the tapa. The soot of burned nuts provided a black dye for tattooing and for painting designs on canoes and on tapa cloth. The soft light-colored wood of the tree trunk was fashioned into canoes. The oil provided a varnish similar to linseed oil. Roasted kernels, pulverized by fishermen while on the reef or in canoes, were blown upon the ocean surface where there were small ripples and waves. The film increased underwater visibility by creating a lens on the water's surface. A coating of kukui oil preserved fishing nets.

NONI

Brief History: *Morinda citrifolia*. Family: Rubiaceae. Also known as Indian Mulberry. Noni is believed to have been brought here centuries ago by early Polynesian settlers, and is a native of the pacific islands, Asia and Australia.

Description: The noni is a small evergreen shrub or tree, usually less than 10 feet high, occasionally up to 20 feet. The conspicuous large dark green shiny leaves are generally paired, except where forming fruit.

Thick and oval in shape, they are deep veined, short-stemmed and 8 inches or longer. The flowers form in globose heads, about an inch long and bearing many small white flowers. The flower heads grow to become mature fruit, 3 to 4 inches in diameter. The surface is divided into somewhat warty polygonal pitted cells.

The noni fruit begins green, turns yellow, and has an unpleasant odor, especially as it ripens to whiteness and falls from the tree. Noni will bear fruit all year long in some areas.

Cultivation is either by seed or cutting. Noni is a valuable plant to have nearby the home of anyone wishing to utilize the many natural healing properties of this remarkable life sustaining plant.

The early morning is the best time to pick the yellow fruits. A method taught by Hawaii's healers is to pick the fruit before ripe, letting it ripen within the home. When soft, place it in a blender with a little fresh water and make into a sauce. Then mash and strain through a sieve. This concoction can be refrigerated in a clean glass jar.

As a medicine, the fruit and its juices have been used in the treatment of diabetes, heart troubles and high blood pressure, with different portions prescribed for different illnesses. The juices can be diluted with clean water or a fruit juice such as apple, and drunk before meals and at resting periods. Treatment should always be at a relaxed time, not before going to work. It is good to seek the advice of a Hawaii health practitioner before using any plant medicines.

The young unripe fruit can be pounded thoroughly with salt and the mixture placed carefully on deep cuts and on broken bones. Sometimes the juice is squeezed out of this mixture, boiled and applied to the wounds. The ripe fruit can be used as a poultice for facial blemishes, rubbed until the oil disappears, and also to draw out the pus and core from an infected sore or boil, such as with a staph infection. Noni's fruit may be eaten unripened, either as a food in times of scarcity, or as a tonic when needed. The fruit was used in a recipe for a reputed remedy against tuberculosis, arthritis, rheumatism and the changes of old age. The leaves and bark of the stem were pounded and strained, resulting in a liquid drunk as a tonic or for urinary disorders, muscle and joint pain. The juice of the fruit was applied to the hair to rid it of head lice.

Other uses for this ancient Polynesian plant: the bark yields a red dye, while a yellow dye can be prepared from the root. Both colors were use to dye the tapa cloth of the chiefs of ancient Hawaii.

OLENA

Brief History: *Curcuma domestica*. Family: Zingberaceae. It is best known throughout the world as Turmeric. Originating in Polynesia, this species of turmeric has been grown and used in Hawaii for a long time.

Description: This humble little root, about the size of an adult thumb, was one of the two dozen or so plants brought to Hawaii by early Polynesian settlers.

Olena is rarely found in Hawaii today. It grows in cultivation and in the wild in moist forested valleys, up to altitudes of 3000 feet, preferring shade, yet able to tolerate heat. The olena is without a stem, yet the overlapping clustered leaves appear to be growing out of a stem above ground. The leaves are blade-like, 8 inches long by 3 inches wide, and rise to about 20 inches high, directly from the underground root.

Olena prefers rich soil, some shade and plenty of water. After the rhizomes are planted, olena hides in the garden for three or more months. In addition, this plant is usually dormant from about September to March, but the roots do survive and will revive to come up with green leaves once again. When they do, they will later show flowers on a stem developing from the center of the leaf stalks, called petioles. The cylindrical flower cluster is about 5 inches long. The pale yellow and white flowers grow on the lower pale green bract, while the upper pinkish part of the bract grows no flowers.

It is olena's rhizome, which is precious. The root is thick and orange or yellow-colored on the inside. It is the bright color that is characteristic of turmeric, the cooking spice. In the language of Hawaii, olena means yellow. Dyes from these roots were used to color tapa cloth. Young roots were steamed to provide a light yellow dye and the steamed older mature roots provided a golden or a deep orange dye. The juice of crushed raw roots produces stain also.

Traditionally, this root can be used medicinally. The roots are pounded and pressed to extract a juice that, when mixed with water, is helpful in earaches and to clear the sinuses through nasal application. The astringent qualities of olena are also useful in cases of consumption, tuberculosis, bronchitis, colds and asthma, the root being lightly cooked and then eaten. At times olena has been taken as a diuretic, and topically it can be helpful with pimples or to stop bleeding.

Ceremonially, the traditional use for olena is as a purifier, containing much mana, spiritual power. Pieces of the crushed root mixed with seawater are sprinkled to remove negative influences from places, persons and things. Typically, when someone is ill, or when a home or other place is to be newly occupied and needing blessing, a ceremony is held. To sprinkle, a ti leaf is dipped into a calabash or bowl containing the olena and seawater. Prayers accompany the sprinkling.

OLONA

Brief History: *Touchardia latifolia.* Family: Urticaceae (Nettle). One of the plants brought to Hawaii long ago by Polynesian settlers, olona is found only in the Hawaiian Islands, especially in windward Maui and in east Molokai.

Description: In a society without nails, olona fibers were a true blessing to the life of the Hawaiian people. Although it is not common today, this stout-stemmed rain forest shrub can still be found in the gullies of lower elevation forests, near the 2,000 foot level, or in very wet boggy interior valleys near streams.

With 4 to 8 foot tall stems in the wild, the bark of olona slips off easily, revealing the inner bark or bast, which is made up of fine quality fibers that are durable and said to be many times stronger than hemp fiber. When young, the outer bark is green, turning brown as the plant ages. The large dark green serrated ovate leaves are 9 to 16 inches long with broad bases, 5 to 9 inches wide.

The leaves have netted veins that are more prominent on the underside, due to their reddish-brown color. Olona has multiple flowers that turn to clustered flesh-orange colored fruit at the ends of the branches.

Propagation is from rooted stem cuttings, root shoots and occasionally from seeds, all of which were thickly planted in previously cleared areas. Although seldom cultivated these days, in ancient Hawaii olona was widely cultivated in very wet interior valleys. The cuttings were planted close together to encourage straight unbranched stems.

The few branches that did grow were removed regularly. In a year's time the plants were mature enough to harvest. They were 6 to 10 feet tall, and the bark could be easily stripped at this young age. The leaves were removed, and the stems cut at soil level, so shoots would re-grow. The stems (with a few leaf nodes) which were taken were ripped into strips, usually 6 feet long and 1 to 2 inches wide. The outer bark was carefully stripped off with opihi shells or with pearl shells, usually over hardwood boards or large flat stones. The strips were then rolled inside out, and soaked for a few short days in a shallow place in a nearby stream. The next step was to scrape off the remaining pulp with seashell or turtle shell scrapers. The strips were then hung to dry and bleached in the sunlight and later to be twisted by the village women into fine cordage of varying thickness.

The white cordage was highly valued for its lightweight and its exceeding great strength *under duress*. After Captain Cook's arrival, traders prized olona cordage for ship's rigging and for whalers harpoon lines.

The pliable whitish cordage and twine from olona remains soft and resists breaking down from exposure to sea water, so here in Hawaii it was the main fiber used for fishing line, fishnets, net bags for carrying containers, feather cloaks and helmets, feather standard, ti leaf capes, thread, to tie off the umbilical cord after a birth, for canoes lines and for every possible purpose that we today might use rope, twine, string or thread. To prolong its life, it was often treated with kukui oil.

TI

Brief History: *Cordyline terminalis*, Family: Liliacae. Introduced to Hawaii by the earliest Polynesian settlers.

Description: Ti (pronounced tee) has tall, sparingly branched wood stalks 3 to 10 or more feet high. The tightly spiraled leaf cluster is in a tuft at the top of the ringed stalk. The plant's green leaves are pointed, oval and blade-shaped, about 4 inches wide and vary from 1 to 2 feet long.

As new leaves form at the center, the outside older leaves turn yellow and fall, leaving a circular ring on the plant's stalk. The thick, shiny and flexible leaves do not wilt quickly, making them useful for many purposes. Varieties of the ti plant have colored foliage and variously shaped leaves. Besides the original and sacred green ti, the plant ranges in leaf color from pale white and yellow with green tones, to reds, covering a broad spectrum from pale to pink to a maroon, that appears almost black.
The root is thick, white and sweet, growing very large in older plants. The plant's flower stalk emerges in winter. With the coming of spring, a many-branched drooping cluster of flowers comes into bloom. Its' hundreds of tiny half-inch whitish purple flowers resemble miniature lilies.

The ti plant is common from sea level in the lower wetlands up to the 4,000-foot elevation.

New plants propagate easily from cuttings and grow best where sunlight and moisture are both available. The cutting can be planted vertically for one plant, or horizontally for several.

The ti's versatile leaves have many uses, roof thatching, as fly whisks or fans, wrappings for food storage, and cooking, as plates or cups, as fishing lures on nets, as clothing apparel.

Ti leaves are also decorative; they are braided, twisted or woven into lei for numerous special and celebratory occasions; used as a covering for luau tables; and, they provide Hawaii's tropical flower industry with a wonderful variety of foliage for impressive floral arrangements.

This versatile plant has many medicinal uses, either alone or as a wrapping for other herbs needing to be steamed or boiled. For fever, the entire body of an unclothed prone person is covered from the neck down with large green ti leaves. After the patient sweats and fever is broken, the leaves are removed. Cool, freshly washed damp green ti leaves, held and wrapped around the forehead and temples, can be helpful in relieving headache and fever. Hot stones are wrapped in ti leaves and used to soothe sore back muscles.
A drink from boiled green ti leaves is used to aid nerve and muscle relaxation. Steam from boiled young shoots and leaves make an effective decongestant. The pleasantly fragrant flowers are also used for asthma. A popular use of this plant was in making Okolehau, a potent liquor much like a clear brandy. The baked roots are also an emergency famine food and have been eaten as a confection. The leaves are also worn or carried as protection to ward off evil spirits and to call in good.

WAUKE

Brief History: *Broussonetia papyrifera*. Family: Moraceae. Also known as the paper mulberry tree. Wauke is one of the principle plants introduced by early Polynesian settlers.

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The ancient practice of making bark cloth and bark paper likely began in Asia, where other species of Broussonetia are known. It is the principle plant used in the making of **kapa, tapa cloth.** Kapa means the beaten thing.

Description: Wauke is thought to have been carried in the canoes as root shoots, but can also be grown from cuttings and occasionally by seed. Wauke grows best in moist areas, along streams, in forests, wherever soil is rich, and where there is protection from the wind. Usually a small tree or shrub, wauke can grow as tall as 50 feet, but in cultivation, the plants were kept small. The leaves of the wauke are thick and rough on top, woolly underneath and are lobed, they are heart shaped with serrated edges, and are 4-6 inches long by 3-5 inches wide. The flowers are rare and sparse, fuzzy, one inch round with hairy bracts and long stigmas. Fruit are rare, and are orange and one inch round.

The quality of its cloth is prized. Warm, water resistant, long lasting, washable, soft, mothproof, flexible and white.

Once planted the wauke can be harvested in 6-10 months. The trunk shoots were cut down and the roots and tops removed. The trunks were stripped of bark, as thick as a finger and about 4 feet long. The outer bark was slit and peeled off. The inner bark fibers, called bast, were then soaked in running water, with stones placed on top of the fiber pile. A complicated process of soakings and fermentation followed, leaving the fine fibers of the moist inner bark still tough and resilient when finally removed from the waters. At this time in the process, the women of Hawaii would often twist cordage out of the fibers, for use as fishnets, and as carrying nets. The women then spread the strips of inner bark to be used for cloth into several layers, all of the same thickness. After the water was drained away, the fibers began to stick together and the entire bundle could be lifted as one mass. It was beaten on smooth rocks and sun dried. When enough bundles were accumulated, these were soaked for half a day, and then pounded gently to loosen the fibers. They were then laid between layers of banana leaves, for a week to mature and ferment, making the fibers softer, almost like the leavening process in bread making. These cakes of wauke were then kneaded until elastic. When ready, the women laid the bundle on a long piece of wood with a flat even surface. Then the women beat the pulp with a simple heavy mallet until a solid strip formed. After this, the strips were soaked again. The cloth expanded greatly with each beating. It was often doubled over and beaten again. At this point in the process, the cloth was hung in the sun to dry and to bleach whiter. The quality of the kapa varied according to the bark quality and the skills of the maker. After the kapa was completed, intricate designs were added to some of the cloth with dyes and a high quality of colored stamped patterns.

Medicinally, the slimy sap of wauke is a mild laxative. Thrush, a mouth disease, is said to be improved when the ash from burned kapa made from wauke is applied to the mouth.

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EQUESTRIAN CENTER

Description: The equestrian center is a versatile facility that will provide the visitor and resident with horse related activities on five acres.

The physical plant will include a 130 by 280 feet arena constructed of galvanized steel. There will be 18 covered horse stalls, 12 feet by 24 feet each, with a tack-room and feed room; and a 16-foot center aisle that can be used for equipment storage at night and an area for grooming or saddling horses during wet weather. The stalls will be equipped with feeders and waterers. The entire area will be covered. There will be tie racks for washing and clipping horses. Uncovered livestock pens will provide holding areas for horses and other livestock. In addition there will be pastures for the livestock to graze in large paddocks near the center.

This facility will have 20 horses for public trail riding. In addition residents from the area will be able to board horses here and participate in the activities at the center.

Management: The facility will be constructed and then leased to an experienced operator.

Community Benefit: This facility will provide a place for jackpot ropings, rodeos, horse shows, trail rides and riding lessons in the Puna area. One of the biggest problems throughout the state for the people of Hawaii who enjoy horse sports is the lack of enough multi-purpose equestrian facilities. All of East Hawaii has only two major arena facilities, one of which is privately owned. There is great need for a recreational equestrian center in Puna.

Jackpot Ropings: Jackpot ropings are very popular and regular events at roping arenas throughout Hawaii. These ropings are usually attended by residents who enjoy competing against each other on weekends and afternoons during their leisure time. It is their sport. The children in the family often learn to rope at these informal ropings where comradery and friendly competition are enjoyed. The center will schedule jackpot ropings throughout the year for the benefit of the community.

Rodeos: There are approximately 8 to 10 major rodeos held throughout Hawaii each year with anywhere from 100 to 500 contestants participating in these rodeos. Most of these major rodeos are sanctioned by Hawaii Rodeo Cowboys' Association (HRCA). Winnings in HRCA rodeos count toward qualification for the State Finals Rodeo and the opportunity to win the annual state championships in the various rodeo events. The HRCA encourages more rodeos for its members, as there are not enough rodeos statewide for the cowboys at this time.

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One of the most popular rodeo organizations is the Hawaii High School Rodeo Association, which encourages young people in high school to participate in rodeo and sponsors rodeos throughout the state. The top two winners in each event for the year are sent to the National High School Rodeo Finals on the mainland to represent Hawaii. Recent participants in this rodeo program have benefited by receiving scholarships to colleges and universities that have rodeo teams. Another rodeo for these young riders is planned for this facility and would greatly benefit the youth of the area. Local high school students will have the chance to learn new skills and compete for trips to the mainland rodeo.

The Keiki Rodeo Association is the companion organization to the Hawaii High School Rodeo Association. These two associations have their rodeos in conjunction with each other. The Keiki Rodeo Association has events for children 5 years to 13 years. The events include some of the standard rodeo events, but also have events that are geared to the smaller children. Some of these are the calf scramble, goat undecorating, and dummy roping. There are district finals and state finals for the keiki rodeo contestants. A Keiki Rodeo at the center will be an exciting and challenging sports event for the community children.

The rodeos held at this center would afford the residents of the Puna area the opportunity to have these events in their own district. In addition the rodeos provide an opportunity for local 4-H and civic clubs to make money providing lunches and snacks to the contestants and the spectators. Often local clubs sell tee shirts, hats, and other items, as the rodeos provide a place where they can make money for their club activities.

Horse Shows: These shows often include both English and Western riding events and are very popular in Hawaii. However, again the participants are lacking shows in Hawaii in which to participate. In addition there are specialized events such as cutting, where the horse and rider compete to separate one head of cattle from a herd in a timed event. The center will offer many horse related competitions such as these that the community can enjoy and that would provide an opportunity for family participation.

Trail Rides: Trail rides appeal both to the visitor and to community members who cannot afford to own a horse and very often do not ride well or at all. Trail rides give people an opportunity to enjoy horseback riding in a safe and affordable manner. Both the resident and visitor will be able to take advantage of this activity at the center. Planned trail events also will be structured to interest the experienced rider as well. These longer trail rides will be enjoyable social events combining horseback riding, meals such as a picnic or barbecue, and exploring areas that are off the beaten track.

Lessons: Riding and roping lessons will be given at the center to encourage both children and adults to improve their skills in horse activities. The riding lessons are very popular with young children, who learn not only to ride, but how to take care of the horse.

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They are taught nutrition and the importance of proper diet for the horse, health care, and grooming as well as how to bridle and saddle their horses. There is a great need and tremendous interest in lesson activities for the community.

There will be the added benefit of interesting jobs for young people at the center helping to feed and water the horses, exercise the horses, and maintain the tack and stable area. Trail ride guides will be needed, as well as persons who can give lessons. In addition a horse shoer will be required on a regular basis to shoe the horses, both for the center and for those in the community who acquire horses to participate in the activities. A veterinarian will have work there assisting with the health problems and nutrition of the livestock. The feed stores and stores that sell horse equipment will also benefit.

The center will be a hub around which many community and individual activities will occur that will enhance the lives of those who participate. People utilizing this facility will be purchasing gasoline and food, and shopping in the area. This will bring money into the area for the local businesses and the residents who operate these businesses.

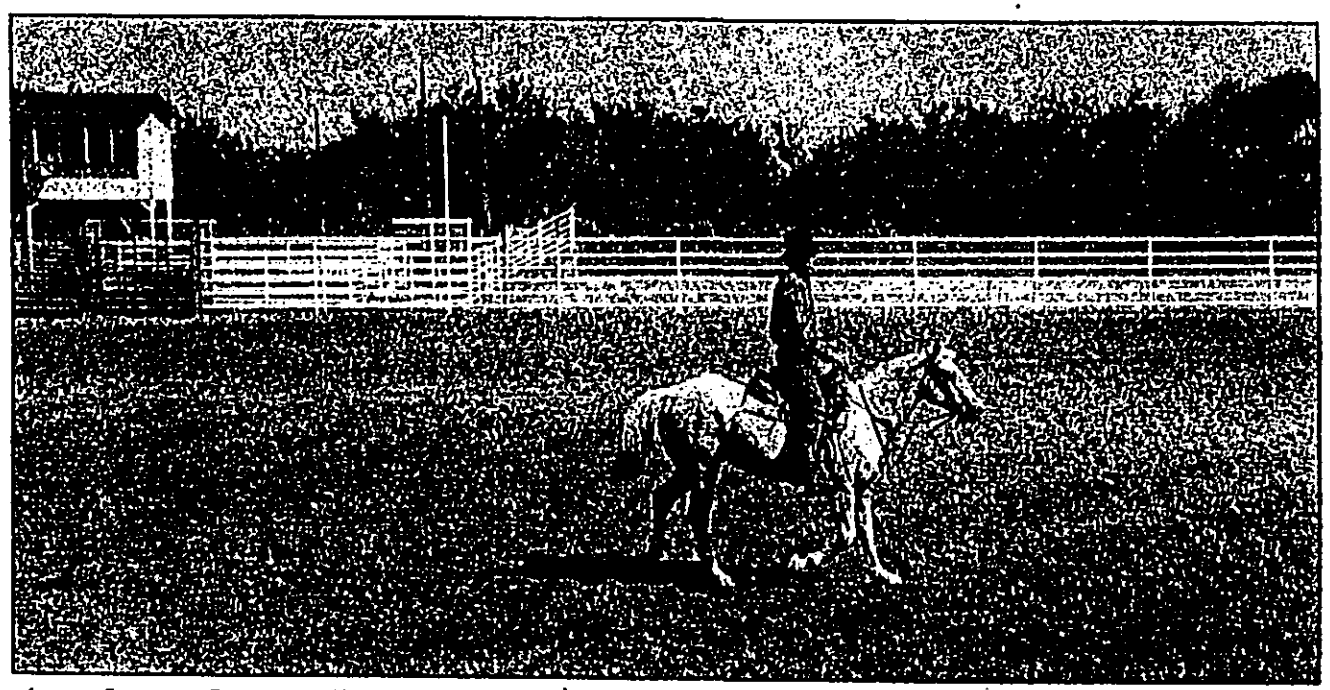
Facilities Estimated Cost*

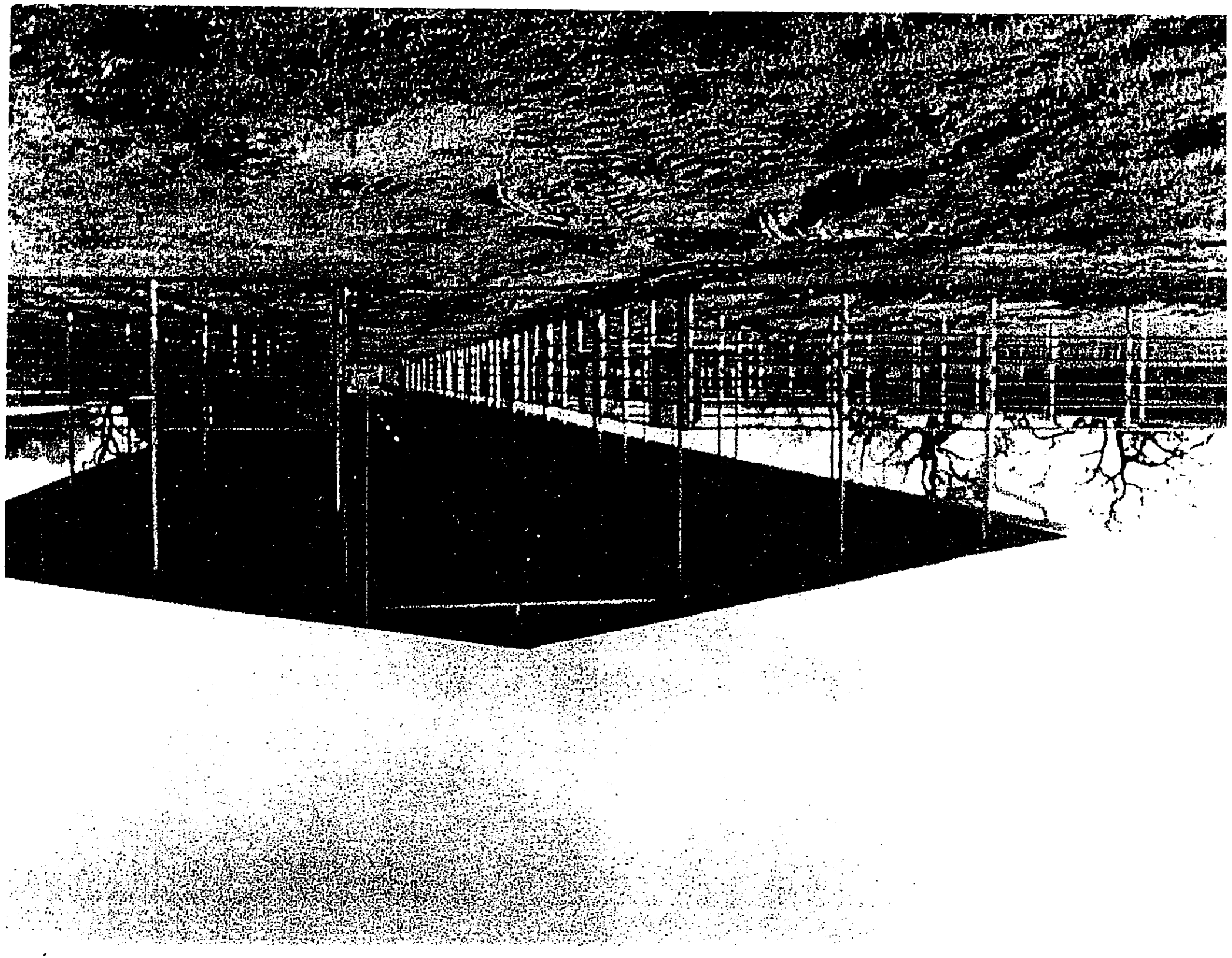
Arena		$48,500
Materials - 130' x 280" galvanized steel	$35,000	
Construction, including ground preparation	$10,000	
Judges & timers stand	$3,500	
Stalls, Tack Room, Feed Room		$55,000
Materials for 18 - 12' x 24' galvanized steel stalls, tack room, and feed room	$35,000	
Construction	$20,000	
Accessories		$10,000
Feeders, waterers, tie racks, other.		
Fencing		$7,000
TOTAL		$120,500

*Installation of utilities & road not included (part of overall development cost)

Lease Rent:
Lease rent should be a function of the capital costs, less land value. Normally, lease rent should be 10% of the capital costs or $12,050 annually for the center. This provides a 10% pay back time on capital.

This lease rent determination is a guide to be used in negotiating the lease rent charged to an operator. The negotiated lease rent will need to consider the operator's ability to pay based upon projected the revenue from the venture.





Oneloa Development Project: Cash Flow for the Equestrian Center.

28-Jun-99

Revenue		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Lease Rent	$	12,050	$ 12,050	$ 12,050	$ 12,050	$ 12,050	$ 12,050	$ 12,050	$ 12,050	$ 12,050	$ 12,050

Assumes annual lease rent to be 10% of facilities costs.

Capital Cost

Arena	$	48,500
Stalls, tack room, feed room	$	55,000
Accessories	$	10,000
Fencing	$	7,000
Total Capital Cost	$	120,500

Operating Costs

Leasee to pay all operating costs.

Cash Flow	$	(108,450)	$ 12,050	$ 12,050	$ 12,050	$ 12,050	$ 12,050	$ 12,050	$ 12,050	$ 12,050	$ 12,050
Cumulative			$(96,400)	$(84,350)	$(72,300)	$(60,250)	$(48,200)	$(36,150)	$(24,100)	$(12,050)	$ -

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'Awa Mo'i. Courtesy of the Association for Hawaiian 'Awa Newsletter, Volume I, Issue 2.

'Awa Nene. Courtesy of the Association for Hawaiian 'Awa Newsletter, Volume I, Issue 1.

Spotted Hiwa. Courtesy of the Association for Hawaiian 'Awa Newsletter, Volume I, Issue 3.

APPENDIX B

BIOLOGICAL RECONNAISSANCE OF PORTIONS OF THE LAEPAO'O, ONELOA AND 'AHALANUI LAND SECTIONS

by:

The Nature Conservancy of Hawaii

Biological Reconnaissance of Portions of the Laepāo'o, Oneloa and 'Ahalanui Land Sections, Puna, Hawai'i

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Biological Reconnaissance of Portions of the Laepāo'o, Oneloa and 'Ahalanui land sections, Puna, Hawai'i

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Biological Reconnaissance of Portions of the Laepāo'o, Oneloa and 'Ahalanui land sections, Puna, Hawai'i

EXECUTIVE SUMMARY

Surveyed portions of the Laepāo'o, Oneloa, and 'Ahalanui land sections in Puna District were a mix of post-agricultural fallow vegetation (mixed alien shrubland and grassland) and native-dominated forest and shrubland. The native-dominated sections were largely restricted to the 'Ahalanui land section, and included lowland mesic forest dominated by 'ōhi'a (*Metrosideros polymorpha*) and hala (*Pandanus tectorius*). Stands of native alahe'e lowland dry shrubland, a vegetation type considered rare and imperiled by the Hawai'i Natural Heritage Program, were observed in the makai portion of the 'Ahalanui section, mauka of the coastal road. One relatively recent sighting of 'ōpe'ape'a (Hawaiian bat, *Lasiurus cinereus semotus*) along the Pohoiki-Pahoa Road, and a report that 'io (Hawaiian hawk, *Buteo solitarius*) has been seen in the area represent the only documentation of rare, threatened, or endangered vertebrates currently in the area. While not in the study area, anchialine pools supporting a red shrimp ('ōpae'ula, *Metabetaeus lohena*) are present in parcels immediately makai of the coastal road. The shrimp is a "species of concern" (SOC) in U.S. Fish and Wildlife Service listings. The developer may consider modifying development plans to avoid damage to the alahe'e shrubland areas, and anticipate that certain land use practices may affect the water quality of the anchialine pools makai of the study area. Land management practices should also be considered that remove or control certain noxious alien plant pests in native vegetation, particularly, *Melochia umbellata*, strawberry guava (*Psidium cattleianum*) and shoebutton ardisia (*Ardisia elliptica*). The forested portions of 'Ahalanui also contain living resources of cultural importance, including Kīpaipai coconut grove and a portion of Kahaleolono agricultural area, both containing remnant cultivated plants descended from past Hawaiian agricultural plantings: pia (*Tacca leontopetaloides*), pi'a (*Dioscorea pentaphylla*), noni (*Morinda citrifolia*), kī (*Cordyline fruticosa*), kukui (*Aleurites moluccana*), etc.

INTRODUCTION AND METHODS:

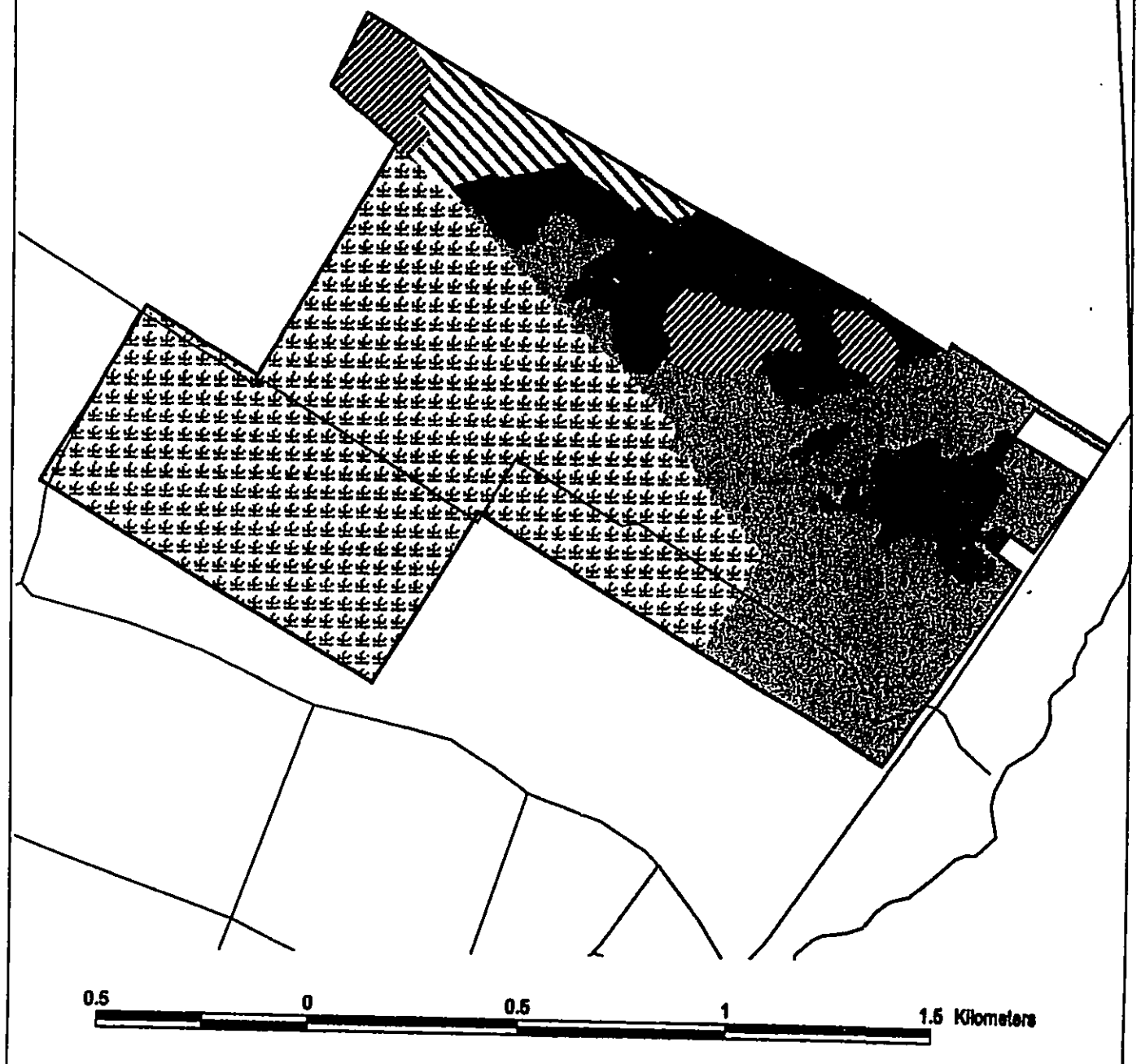
Between January 12 and 15, 1998, a walk-through survey of the plants and vegetation structure of the study area was conducted by Joel Lau (Botanist, Hawai'i Specialist) and Sam Gon III (Ecologist) of the Hawai'i Natural Heritage Program, The Nature Conservancy of Hawai'i. One day was spent characterizing the post-agricultural mixed shrub and grassland of the Laepāo'o and Oneloa land sections, while the majority of time was spent exploring and characterizing the forested land section of 'Ahalanui, which contained both native and alien-dominated sections. Figure 1 depicts the study area and the major vegetation types. A plant list was generated for each of the vegetation types encountered. Incidental observations of vertebrates and other animals were recorded. Records of rare species reported for the area were extracted from the databases of the Hawai'i Natural Heritage Program and are included in this report.

RESULTS AND DISCUSSION:

Rare species reported by the Hawai'i Natural Heritage Program database:

The only rare species reported for the study area was an observation of the endangered 'ōpe'ape'a (Hawaiian bat, *Lasiurus cinereus semotus*) made from the south side of the study area in 1993-94. There is no indication that the area is particularly important Hawaiian bat habitat, however, bats were detected on one of five surveys conducted along the Pahoa-Pohoiki road in mixed lowland forest adjacent to agricultural lands and 'ōhi'a forest (Reynolds 1995). The endangered 'io (Hawaiian hawk, *Buteo solitarius*) has been informally reported from the area (pers. comm., David Matsuura 1998). Although not in the study area, anchialine pools along the coast are considered rare and imperiled aquatic communities and are habitat for one shrimp species of concern, an 'ōpae'ula (*Metabetaeus lohena*). There were no reports of rare or endangered plants from the area.

Vegetation Types of the Study Area



Vegetation Types:

- Alahe'e Lowland Dry Shrubland
- Alien-dominated forest
- Alien-dominated mixed shrub and grassland
- Hala Coastal Mesic Forest
- 'Ohi'a Lowland Mesic Forest
- 'Ohi'a/Hala Lowland Mesic Forest

- Study Area
- Highway
- Roads

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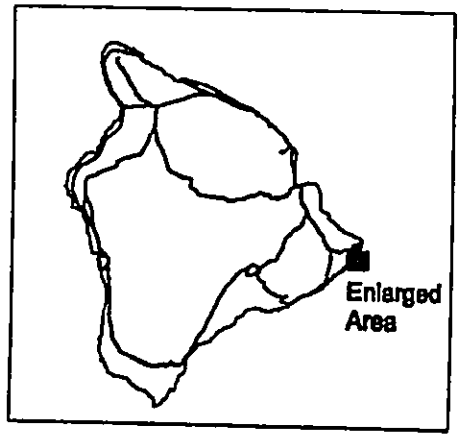

Vegetation of the study area:

A vegetation map of the parcel is presented in Figure 1. Six vegetation types were defined and are listed (Table 1). Of these, two were mixed alien-dominated vegetation types, and four were native dominated forest or shrubland. One of the native vegetation types (Alahe'e Lowland Dry Shrubland) is considered rare and imperiled. Each type is described below.

Table 1: Vegetation types of the study area:

Name of vegetation type	Global Rank*
Alien-dominated mixed shrub and grassland	GX
Alien-dominated forest	GX
Alahe'e (*Psydrax odorata*) Lowland Dry Shrubland	G1
Hala (*Pandanus tectorius*) Coastal Mesic Forest	G3
'Ōhi'a/Hala (*Metrosideros polymorpha/Pandanus tectorius*) Lowland Mesic Forest	G3
'Ōhi'a (*Metrosideros polymorpha*) Lowland Mesic Forest	G3

*Explanation of global ranks: GX = non-native; G1 = imperiled; G3 = restricted range

Vegetation type descriptions:

Alien-dominated mixed shrubland and grassland:

In the Laepāo'o and Oneloa land sections fallow papaya orchards were cleared, and a succession of alien-dominated grasses and shrubs have been establishing. This mixed vegetation is quite variable, with different grasses and shrubs locally dominant from place to place. Prominent grasses included Natal redtop (*Rhynchelytrum repens*), feathery pennisetum (*Pennisetum polystachyon*), and molasses grass (*Melinis minutiflora*), while the most prominent shrubs included *Melochia umbellata*, Jamaican vervain (*Stachytarpheta jamaicensis*), comb hyptis (*Hyptis pectinata*), butterfly bush (*Buddleia asiatica*), partridge pea (*Chamaecrista nictitans*), tall tick clover (*Desmodium cajanifolium*), sensitive plant (locally, sleeping grass, *Mimosa pudica*), and noni (*Morinda citrifolia*). Many other roadside grasses, herbs, and shrubs were also present.

Alien-dominated forest:

Along the edges of the ʻAhalanui land section and extending to the interior portions in the makai half of the parcel was a mixed forest dominated by a variety of alien trees. These included Polynesian introductions such as kukui (*Aleurites moluccana*), milo (*Thespesia populnea*), hau (*Hibiscus tiliaceus*), kamani (*Calophyllum inophyllum*), and niu (coconut, *Cocos nucifera*), as well as post-contact introductions such as *Melochia*, mango (*Mangifera indica*), *Trema*, strawberry guava (*Psidium cattleianum*), common guava (*Psidium guajava*), Java plum (*Syzygium cumini*), and monkeypod (*Samanea saman*). The understory was often open, and included such shrubs as strawberry guava (*Psidium cattleianum*), coffee (*Coffea arabica*), noni (*Morinda citrifolia*), kī (ti, *Cordyline fruticosa*), black-eyed Susan (*Abrus precatorius*), herbs such as Malayan ground orchid (*Spathoglottis plicata*), *Phaius tankarvilleae*, bamboo orchid (*Arundina graminifolia*), honohono kukui (*Oplismenus hirtellus*), and ferns such as laua'e (*Phymatosorus scolopendria*), and swordfern (*Nephrolepis multiflora*). Remnant native shrubs and trees were occasionally present, including ʻōhiʻa (*Metrosideros polymorpha*), hala (*Pandanus tectorius*), lama (*Diospyros sandwicensis*), and alahe'e (*Psydrax odorata*).

Alahe'e (*Psydrax odorata*) Lowland Dry Shrubland:

In portions of ʻAhalanui mauka of the coastal road, generally on ʻaʻā lava substrate, the canopy was clearly dominated by the native shrub alahe'e (*Psydrax odorata*). Alahe'e shrublands are known from fewer than six sites in the world, all in the Hawaiian Islands, so this vegetation type is considered rare and imperiled. The example in ʻAhalanui is not pristine, but regeneration of the alahe'e shrubs is good, and other native plants such as lama (*Diospyros sandwicensis*), ʻākia (*Wikstroemia sandwicensis*), ʻūlei (*Osteomeles anthyllidifolia*), kāʻeʻe (*Mucuna gigantea*), kākalaioa (*Caesalpinea bonduc*), kauna'oa pehu (*Cassytha filiformis*), and ʻala'alawainui (*Peperomia leptostachya*) were present. The alahe'e canopy

was typically lower than 5 m in height, but at the margin of surrounding forest, the alahe'e stature sometimes approached 7 m in height. Important alien weeds invading the alahe'e shrubland included strawberry guava (*Psidium cattleianum*), *Melochia umbellata*, and shoebutton ardisia (*Ardisia elliptica*).

Hala (*Pandanus tectorius*) Coastal Mesic Forest

In the mauka portion of the surveyed 'Ahalanui land section, and extending makai along the northern edge of the land section, the forest canopy was dominated by hala (*Pandanus tectorius*) on a substrate of both 'a'ā and pāhoehoe lava. Hala coastal mesic forest is known from many sites in the Hawaiian chain, and the forest type is not considered rare. Relatively few rare plants are known from hala forest, and none were detected in this forest type during this survey. The hala canopy was generally closed and typically about 10 m in height. Occasionally there were other trees such as 'ōhi'a (*Metrosideros polymorpha*), or lama (*Diospyros sandwicensis*) growing among the hala. Thick hala leaf litter inhibited understory plants, but there were occasional native shrubs such as alahe'e (*Psydrax odorata*), and 'ākia (*Wikstroemia sandwicensis*), especially in more open-canopied areas. A number of Polynesian introduced species were present, especially in areas that had been actively cultivated by Hawaiians a century or more ago. These included kukui (*Aleurites moluccana*), ti (*Cordyline fruticosa*), pi'a (*Dioscorea pentaphylla*), niu (*Cocos nucifera*), 'awapuhi (*Zingiber zerumbet*), and pia (*Tacca leontopetaloides*). The relative abundance of pia is notable, as this plant rarely persists in the wild outside of cultivation. The most important weed invading the hala forest was *Melochia umbellata*, but other post-contact introductions were also present (see Table 2, plant list).

'Ōhi'a/Hala (*Metrosideros polymorpha/Pandanus tectorius*) Lowland Mesic Forest

Stands of forest with canopy dominated by both 'ōhi'a (*Metrosideros polymorpha*) and hala (*Pandanus tectorius*) were present in the surveyed portion of 'Ahalanui land section, generally on 'a'ā substrate. This forest type is best

developed on the islands of Hawai'i, Maui, and Kaua'i, and is not considered rare, although most examples are invaded to greater or lesser extent by alien species. In the 'Ahalanui example, an open canopy of 'ōhi'a of 10 to over 30 m height emerged above a closed canopy of hala generally between 5 and 10 m height. Occasional lama trees (*Diospyros sandwicensis*) were present. As in adjacent hala forest, the understory was often fairly sparse, due to a heavy hala leaf litter load. However, native shrubs such as alahe'e (*Psydrax odorata*), and 'ākia (*Wikstroemia sandwicensis*) were observed, especially in more open-canopied areas. Other constituents were similar to adjacent hala forest (see separate description of that forest type above).

'Ōhi'a (*Metrosideros polymorpha*) Lowland Mesic Forest

At least two patches of forest along the south edge of the 'Ahalanui forested area were dominated by middle-statured 'ōhi'a trees (*Metrosideros polymorpha*), generally about 10 m height. 'Ōhi'a-dominated forest in lowland mesic settings are relatively widespread, known from the islands of Hawai'i, Maui, Moloka'i, Lāna'i, O'ahu, and Kaua'i. On some islands, this forest type contains many rare and endangered plant species, but none were observed in the 'Ahalanui forest. Other native trees and shrubs observed included lama (*Diospyros sandwicensis*), alahe'e (*Psydrax odorata*), and 'ākia (*Wikstroemia sandwicensis*). Occasional 'ala'alawainui (*Peperomia leptostachya*) and 'ōkupukupu (*Nephrolepis exaltata*) were observed in the understory. However, there were many alien weeds invading the subcanopy, including *Melochia umbellata*, strawberry guava (*Psidium cattleianum*), common guava (*Psidium guajava*), and gunpowder tree (*Trema orientalis*). Other constituents of this forest type are listed in Table 2.

Vegetation changes in the study area:

In prehuman times, the volcanically active Puna coast and lowlands would have been occupied by a variety of vegetation types, based on prevalent moisture, age and type of substrate, and proximity to the ocean. If remnant native vegetation of

the present is any indication, coastal forest of hala and ʻōhiʻa may have been the prominent forest types, with lama forest and ʻalaheʻe shrubland in older, drier settings inland.

Traditional Hawaiian uses of the landscape may have been restricted to the coast and some inland arable sections with soil deep and rich enough for cultivation of crops such as ʻuala (sweet potato, *Ipomoea batatas*), pia (*Tacca leontopetaloides*), niu (coconut, *Cocos nucifera*), ipu (gourd, *Lagenaria siceraria*), ʻawa (*Piper methysticum*) and perhaps kalo (taro, *Colocasia esculenta*). A map of the study area of over a hundred years ago (Loebenstein 1895) indicates a named cultivation area (Kahaleolono cultivating grounds) in the ʻAhalanui land section, and this area, although today dominated by native trees such as ʻōhiʻa and hala, were rich in walls, terraces, and remnant Polynesian introduced plants. Also indicated on the Loebenstein map are a coconut grove (named Kīpaipai), walls and other human features. We observed these features during our survey. Perhaps more instructive are mappings of the extent of hala forest and ʻōhiʻa forest in the land section that persist today. Although the alaheʻe shrublands are not mentioned on the map, they occur in a portion of lower ʻAhalanui that did not receive detailed vegetation descriptions in the Loebenstein map.

The adjacent lands of Laepāoʻo and Oneloa were largely in native forest in 1895, but by the seventies were cleared of native forest and put in orchard cultivation. Papaya was the crop prior to the discontinuation of agriculture. Weeds typically invading fallow fields rapidly overtook the discontinued fields, and rapidly reestablish after clearing.

Plants of the study area:

There were 122 species of plants observed during the survey. Of these, 24 were native or possibly native. None of the native plants are considered rare, threatened or endangered. Eight plants are of Polynesian introduction, and are associated

with past Hawaiian cultivation or occupation of the landscape. They constitute the biological part of the cultural landscape, which includes native vegetation and plants of significance to Hawaiians. Together with non-living cultural features (such as walled enclosures, agricultural terraces, walls, etc.) they represent the physical cultural values of the study area. Of particular note is the relative abundance of pia (*Tacca leontopetaloides*) seen in the study area. In Hawai'i, pia is very rarely found persisting in a wild state from old Hawaiian cultivation. A listing of vascular plants observed during this survey is presented in Table 2, attached to this report.

Animals of the study area:

Two endangered animal species, 'ōpe'ape'a (Hawaiian bat, *Lasiurus cinereus semotus*), and 'io (Hawaiian hawk, *Buteo solitarius*) have been observed in the study area. No nests or unusually large numbers of either of these animals has been made in the area. A species of concern in anchialine pools, one of several species of the red shrimp generally referred to as 'ōpae'ula (*Metabetaeus lohena*), has been observed in at least one anchialine pool along the coast makai of the study area.

Other vertebrates observed incidentally during the survey included mongoose (*Herpestes auropunctatus*), and typical alien birds of the lowlands such as mynah (*Acridotheres tristis*), spotted dove (*Streptopelia chinensis*), zebra dove (*Geopelia striata*), house finch (*Carpodacus mexicanus*), and Japanese white eye (*Zosterops japonica*).

Planning modifications to minimize damage and enhance biological resources

The developer may consider modifying development plans to avoid or minimize damage to the alahe'e shrubland areas, and anticipate that certain land use practices may affect the water quality of the anchialine pools makai of the study area. Land management practices should also be considered that remove or control

certain noxious alien plant pests in remaining native vegetation, particularly, *Melochia umbellata*, strawberry guava (*Psidium cattleianum*) and shoebutton ardisia (*Ardisia elliptica*). Native forest and ethnobotanically important plants can be highlighted in any interpretive treatment for the site.

Table 2: Vascular Plants Observed in the Laepao'o, Oneloa and 'Ahalanui Land Sections, Puna, Hawai'I

The plant taxa listed below are the native and naturalized vascular plants observed on the Hawai'i Natural Heritage Program field survey. The taxonomy and nomenclature of the flowering plants are according to Wagner *et al.* (1990), except where more recent studies and new discoveries have necessitated modifications.

There has been no comprehensive treatment of the Hawaiian ferns and fern allies in recent decades. However, there are two unpublished lists of Hawaiian ferns and fern allies currently in use: Lamoureux (1988) and Wagner and Wagner (1992). This species list uses the names listed in Wagner and Wagner (1992). If the Lamoureux list gives a different name for a given taxon, that name is placed in brackets following the name used in Wagner and Wagner (1992).

Status Codes:
E = Endemic, native only to the Hawaiian Islands
I = Indigenous, native to the Hawaiian Islands and elsewhere
A = Alien, not native to the Hawaiian Islands (purposely or accidentally introduced by humans)

Natural Community Codes:
1 = Alien - dominated mixed shrub and grassland
2 = Alien - dominated forest
3 = Alahe'e (*Psydrax odorata*) Lowland Dry Shrubland
4 = Hala (*Pandanus tectorius*) Coastal Mesic Forest
5 = 'Ohi'a/Hala (*Metrosideros polymorpha/Pandanus tectorius*) Lowland Mesic Forest
6 = 'Ohi'a (*Metrosideros polymorpha*) Lowland Mesic Forest

STATUS	TAXON	COMMON NAME	NATURAL COMMUNITY					
			1	2	3	4	5	6
	FERNS AND FERN ALLIES							
	Aspleniaceae							
I	Asplenium nidus L.	`Ekaha, bird's-nest fern				x	x	x
	Dryopteridaceae							
E	Nephrolepis exaltata (L.) Schott	Kupukupu, ni`ani`au		x	x			
	var. hawaiiensis W.H. Wagner							
	[N. exaltata (L.) Schott]							
A	Nephrolepis multiflora (Roxb.)	Kupukupu, ni`ani`au	x	x	x	x	x	x
	Jarrett ex Morton							

STATUS	TAXON	COMMON NAME	NATURAL COMMUNITY					
			1	2	3	4	5	6
	Hymenophyllaceae							
I	Gonocormus minutus (Blume) v. d. Bosch				x			
	Polypodiaceae							
I	Lepisorus thunbergianus (Kaulf.)	Pakahakaha,			x	x	x	x
	Ching [Pleopeltis thunbergiana Kaulf.]	`ekaha `akolea						
A	Phymatosorus scolopendria (Burm.)	Laua`e		x	x	x	x	x
	Pic.-Ser.							
	Psilotaceae							
I	Psilotum nudum (L.) Beauv.	Moa		x	x	x	x	x
	Thelypteridaceae							
A	Thelypteris parasitica (L.) Fosberg			x	x	x	x	x
	[Christella parasitica (L.) Levl.]							
	GYMNOSPERMS							
	Araucariaceae							
A	Araucaria columnaris (Forst. fil.) Hook.	Cook pine	x					
	FLOWERING PLANTS: DICOTS							
	Acanthaceae	**Acanthacea family**						
A	Thunbergia fragrans Roxb.	White thunbergia	x	x	x	x	x	x
	Anacardiaceae	**Mango family**						
A	Mangifera indica L.	Mango		x	x	x	x	x
E	Rhus sandwicensis A. Gray	Neneleau, sumac	x					
A	Schinus terebinthifolius Raddi	Christmas berry, wilelaiki		x	x			
	Araliaceae	**Ginseng family** -						
A	Schefflera actinophylla	Octopus tree		x				
	(Endl.) Harms							
	Asclepiadaceae	**Milkweed family**						
A	Asclepias curassavica L.	Butterfly weed, laulele	x					
	Asteraceae	**Sunflower family**						
A	Ageratum conyzoides L.	Maile hohono	x	x				
A	Bidens pilosa L.	Spanish needle, beggartick	x	x				
A	Crassocephalum crepidioides	-		x				
	(Benth.) S. Moore							
A	Emilia fosbergii Nicolson	Flora's paintbrush		x				
A	Emilia sonchifolia (L.) DC	Flora's paintbrush	x	x				

STATUS	TAXON	COMMON NAME	NATURAL COMMUNITY					
			1	2	3	4	5	6
A	Erechtites valerianifolia (Wolf) DC	Fireweed			x			
A	Pluchea symphytifolia (Mill.) Gillis	Sourbush		x				
A	Synedrella nodiflora (L.) Gaertn.	Nodeweed		x				
A	Vernonia cinerea (L.) Less.	Little ironweed		x				
	var. parviflora (Reinw.) DC							
A	Wedelia trilobata (L.) Hitchc.			x				
	Balsaminaceae	**Touch-me-not family**						
A	Impatiens wallerana J. D. Hook.						x	
	Begoniaceae	**Begonia family**						
A	Begonia sp.	Begonia		x				
	Buddlejaceae	**Butterfly bush family**						
A	Buddleia asiatica Lour.	Dogtail	x	x				
	Caricaceae	**Papaya family**						
A	Carica papaya L.	Papaya, mikana, he`i	x					
	Casuarinaceae	**She-oak family**						
A	Casuarina equisetifolia L.	Common ironwood, paina		x				
	Cecropiaceae	**Cecropia family**						
A	Cecropia obtusifolia Bertol.	Guarumo, trumpet tree		x		x	x	x
	Clusiaceae	**Mangosteen family**						
A	Calophyllum inophyllum L.	Kamani		x				
A	Clusia rosea Jacq.	Autograph tree		x	x			
	Convolvulaceae	**Morning glory family**						
I	Ipomoea indica (J. Burm.) Merr.	Koali `awa, koali `awahia	x					
A	Ipomoea triloba L.	Little bell	x	x				
	Crassulaceae	**Orpine family**						
A	Kalanchoe pinnata (Lam.) Pers.	Air plant, `oliwa ku kahakai		x				
	Ebenaceae	**Ebony family**						
E	Diospyros sandwicensis (A. DC) Fosb.	Lama, elama		x	x	x	x	x
	Euphorbiaceae	**Spurge family**						
A	Aleurites moluccana (L.) Willd.	Candlenut, kukui					x	
A	Chamaesyce hirta (L.) Millsp.	Hairy spurge, koko kahiki	x	x				
A	Chamaesyce hypericifolia (L.) Millsp.	Graceful spurge	x	x				

STATUS	TAXON	COMMON NAME	NATURAL COMMUNITY					
			1	2	3	4	5	6
A	Chamaesyce hyssopifolia (L.) Small		x	x				
A	Phyllanthus debilis Klein ex Willd.	Niruri	x	x				
A	Ricinus communis L.	Castor bean, pa`aila, koli	x					
	Fabaceae	**Pea family**						
A	Abrus precatorius L.	Black-eyed Susan, pukiawe		x	x		x	
A	Acacia confusa Merr.	Formosan koa	x					
I	Caesalpinia bonduc (L.) Roxb.	Kakalaioa, gray nickers				x	x	x
A	Chamaecrista nictitans (L.) Moench		x	x	x			
	ssp. patellaria (DC ex Collad.)							
	H. Irwin & Barneby	Partridge pea, lauki						
	var. glabrata (Vogel)							
	H. Irwin & Barneby							
A	Desmodium cajanifolium (Kunth) DC		x	x				
A	Desmodium incanum DC	Spanish clover, ka`imi	x	x	x			
A	Desmodium tortuosum (Sw.) DC	Florida beggarweed	x	x				
A	Desmodium triflorum (L.) DC	Three-flowered beggarweed		x				
A	Indigofera suffruticosa Mill.	Indigo	x					
A	Macroptilium atropurpureum (DC) Urb.			x				
A	Macroptilium lathyroides (L.) Urb.	Wild bean, cow pea	x					
A	Mimosa pudica L. var. unijuga	Sensitive plant, pua hilahila	x	x				
	(Duchass. & Walp.) Griseb.							
I	Mucuna gigantea (Willd.) DC	*Ka`e`e`e, ka`e`e, sea bean*		x	x			
A	Samanea saman (Jacq.) Merr.	Monkeypod, `ohai		x				
A	Senna occidentalis (L.) Link	Coffee senna, mikipalaoa, `auko`i	x					
A	Fabaceae indet.		x	x				
	Lamiaceae	**Mint family**						
A	Hyptis pectinata (L.) Poit.	Comb hyptis	x	x				
	Lauraceae	**Laurel family**						
I	Cassytha filiformis L.	Kauna`oa pehu		x	x	x	x	x
	Malvaceae	**Mallow family**						
A?	Sida rhombifolia L.			x				
I?	Thespesia populnea (L.) Sol. ex Correa	Milo		x				
	Melastomataceae	**Melastoma family**						
A	Melastoma candidum D. Don					x	x	x
	Menispermaceae	**Moonseed family**						
I	Cocculus trilobus (Thunb.) DC	Huehue		x	x	x	x	x
	Moraceae	**Mulberry family**						
A	Artocarpus altilis (S.Parkinson ex Z)	Breadfruit, `ulu				x	x	x

STATUS	TAXON	COMMON NAME	NATURAL COMMUNITY					
			1	2	3	4	5	6
	Myrsinaceae	**Myrsine family**						
A	Ardisia elliptica Thunb.	Shoebutton ardisia		x	x			
	Myrtaceae	**Myrtle family**						
E	Metrosideros polymorpha	`Ohi`a, `ohi`a lehua, lehua		x		x	x	x
	Gaud. var. incana							
	(H. Lev.) St. John							
A	Psidium cattleianum Sabine	Strawberry guava, waiawi		x	x	x	x	x
A	Psidium guajava L.	Guava, kuawa	x	x	x	x	x	x
A	Syzygium cumini (L.) Skeels	Java plum		x				
	Passifloraceae	**Passion flower family**						
A	Passiflora edulis Sims	Passion fruit, liliko`i		x		x	x	x
A	Passiflora foetida L.	Love-in-a-mist, pohapoha	x	x	x			
	Piperaceae	**Pepper family**						
I	Peperomia leptostachya	`Ala`ala wai nui		x	x	x	x	x
	Hook. & Arnott							
	Polygalaceae	**Milkwort family**						
A	*Polygala paniculata L.*	Milkwort		x				
	Rosaceae	**Rose family**						
I	Osteomeles anthyllidifolia (Sm.) Lindl.	`Ulei			x			
A	Rubus rosifolius Sm.	Thimbleberry				x	x	x
	Rubiaceae	**Coffee family**						
A	Coffea arabica L.	Arabian coffee		x	x			
A	Morinda citrifolia L.	Noni	x	x	x	x	x	x
A	Paederia scandens (Lour.) Merr.	Maile pilau	x	x		x	x	x
I	Psydrax odoratum (G. Forster)	Alahe`e		x	x	x	x	x
	A.C. Smith & S. Darwin.							
A	Spermacoce assurgens Ruiz & Pav.	Buttonweed	x	x				
A	Spermacoce mauritiana Gideon		x	x				
	Scrophulariaceae	**Figwort family**						
A	Castilleja arvensis	Indian paintbrush		x				
	Cham. & Schlechtend							
	Solanaceae	**Nightshade family**						
I?	Solanum americanum Mill.	Glossy nightshade, popolo		x				
	Sterculiaceae	**Cacao family**						
A	Melochia umbellata (Houtt.) Stapf		x	x	x	x	x	x

STATUS	TAXON	COMMON NAME	NATURAL COMMUNITY					
			1	2	3	4	5	6
	Thymelaeaceae	**`Akia family**						
E	Wikstroemia sandwicensis Meisn.	`Akia		x		x	x	x
	Ulmaceae	**Elm family**						
A	Trema orientalis (L.) Blume	Gunpowder tree, charcoal tree		x				
	Urticaceae	**Nettle family**						
E	Pipturus albidus	Mamaki		x	x	x	x	x
	(Hook. & Arnott) A. Gray							
	Verbenaceae	**Verbena family**						
A	Lantana camara L.	Lantana		x				
A	Stachytarpheta dichotoma	Oi	x	x				
	(Ruiz & Pav.) Vahl							
A	Stachytarpheta jamaicensis	Jamaica vervain, oi		x				
	(L.) Vahl							
	FLOWERING PLANTS: MONOCOTS							
	Agavaceae	**Agave family**						
A	Cordyline fruticosa (L.) A. Chev.	Ti, ki	x	x		x	x	x
	Araceae	**Philodendron or aroid family**						
A	Epipremnum pinnatum (L.) Engl.	Taro vine, golden pothos		x				
	Arecaceae	**Palm family**						
A	Cocos nucifera L.	Coconut, niu		x	x	x	x	x
	Commelinaceae	**Spiderwort family**						
A	Commelina diffusa N. L. Burm.	Honohono	x	x				
	Cyperaceae	**Sedge family**						
A	Kyllinga brevifolia Rottb.	Kili`o`opu	x					
I	Pycreus polystachyos		x					
	(Robbt.) P. Beauv.							
	Dioscoreaceae	**Yam family**						
A	Dioscorea bulbifera L.	Bitter yam, hoi					x	
A	Dioscorea pentaphylla L.	Pi`a				x	x	x
	Orchidaceae	**Orchid family**						
A	Arundina graminifolia (D. Don) Hochr.	Bamboo orchid		x	x	x	x	x
A	Phaius tankarvilleae	Chinese ground orchid				x	x	x
	(Banks ex L'Her.) Blume							
A	Spathoglottis plicata Blume	Malayan ground orchid,		x	x			

STATUS	TAXON	COMMON NAME	NATURAL COMMUNITY					
			1	2	3	4	5	6
	Pandanaceae	**Screw pine family**						
I?	Pandanus tectorius	Hala, screw pine						
	S. Parkinson ex Z.			x	x	x	x	x
	Poaceae	**Grass family**						
A	Andropogon virginicus L.	Broomsedge, yellow bluestem		x	x			
A	Axonopus fissifolius (Raddi) Kuhlm.	Narrow-leaved carpet grass		x				
A	Brachiaria mutica (Forssk.) Stapf	California grass, para grass	x					
A	Digitaria insularis (L.) Mez ex Ekman	Sourgrass	x					
I?	Digitaria setigera Roth	Kukaepua`a, itchy crabgrass	x	x				
A	Digitaria violascens Link	Smooth crabgrass, violet crabgrass	x					
A	Eleusine indica (L.) Gaertn.	Wiregrass	x	x				
A	Melinis minutiflora P. Beauv.	Molasses grass	x	x				
A	Oplismenus hirtellus (L.) P. Beauv.	Basketgrass, honohono kukui			x	x	x	x
A	Panicum maximum Jacq.	Guinea grass	x					
A	Paspalum conjugatum Bergius	Hilo grass		x				
I?	Paspalum scrobiculatum L.	Ricegrass	x	x	x			
A	Pennisetum polystachion (L.) Schult.	Feathery pennisetum	x	x				
A	Rhynchelytrum repens (Willd.) Hubb.	Natal redtop	x	x				
A	Schizachyrium condensatum	Little bluestem, beardgrass		x				
	(Kunth) Nees							
A	Setaria gracilis Kunth	Yellow foxtail		x				
	Taccaceae	**Tacca family**						
A	Tacca leontopetaloides (L.) Kuntze	Polynesian arrowroot, pia			x	x	x	
	Zingiberaceae	**Ginger family**						
A	Zingiber zerumbet (L.) Sm.	Shampoo ginger, `awapuhi kuahiwi					x	

June 1999 APPENDIX C
Oneloa Development project

APPENDIX C

ONELOA DEVELOPMENT PROJECT: AGRICULTURAL CONCEPT

by:

Agricon Hawaii LLC

Oneloa Development Project

Agricultural Concept

June 1999

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Oneloa Development Project
Agricultural Concept

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SUMMARY

The agricultural concept for the Oneloa Development Project contains the following components.

- Tropical fruit trees for the 18-hole golf course.
- Hawaiian medicinal plants for the areas within the golf course.
- Commercial tropical fruit crops.
- A 50 acre 'awa planting within a native forest.
- An equestrian center.

Tropical fruit trees will be planted within the golf course, each hole having a different group of trees. In addition, Hawaiian medicinal plants will be planted in selected areas of the golf course. These plants will serve as both landscaping and a source of medicinal product.

Commercial crops will be planted in blocks within the development. These commercial plantings will provide product for sale within the development and to local markets.

The 'awa planting will be a cooperative effort between the development and the community.

The equestrian center will provide trail rides for guests and related community activities, such as rodeos, for both guests and the local community.

The development is committed to the principles and practices of sustainable agriculture. These practices are designed to maintain and enhance the economic viability of agricultural production, the natural resource base, and other ecosystems that may be influenced by the agricultural activities at Oneloa.

INTRODUCTION

As an integral part of the development, an agricultural concept is desired, as a method of creating a viable enterprise that is visually acceptable and self-sustaining.

Tropical fruit trees will planted within the golf course. Eight to ten trees of a selected variety will be planted at each hole. Each hole will have a different tropical fruit tree variety. Golf course maintenance personnel will accomplish the maintenance and harvesting. Fruit harvested will be used within the development by the lodge, the sports complex, the beach club, and the retail outlet.

Selected Hawaiian medicinal plants will also be planted at various locations within the golf course. These plants will also be maintained and harvested by golf course maintenance personnel. Product harvested will be used within the development and by the community.

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Economically viable tropical fruit crops will be farmed within the golf course in contiguous blocks between the fairways, using commercial farming techniques. The goal of these operations is profit oriented. Fruit will be sold to enterprises within the development and to other markets.

An 'awa planting of approximately 50 acres will be established in a 250-acre natural forest within the development. The 'awa will be planted in the "old style" using the natural forest as cover and community labor to cultivate and harvest the crop.

An equestrian center, encompassing approximately five acres, will be constructed as part of the development. This center will be leased to an independent organization that will operate the center. The center's functions will include trail rides through the resort and periodic rodeo and horse show activity.

TROPICAL FRUIT – GOLF COURSE

The following tropical fruit varieties are suggested for the golf course. Eight to ten trees will be planted around each hole. Trees should be identified in order to provide an item of interest to golfers. Maintenance and harvesting is to be accomplished by golf course maintenance personnel as part of their normal golf course maintenance program. Fruit harvested will be used within the development by the various entities.

Each crop listed below includes a brief history and a description.

ATEMOYA

Brief History: *Annona squamosa* L. x A. *cherimola* Mill. Family: Annonaceae. Originated as a man-made hybrid between the sugar apple, *annona squamosa* L.,and the cherimoya, A. *cherimola* Mill. developed in Florida. The best varieties of atemoya combine the best qualities of both parent species and are adapted to a wider range of environmental conditions than either of them. The atemoya is well known in Australia, Central America, Florida, India, Israel, New Zealand, Philippines, South Africa, and South America. It is becoming well known in Hawaii as more growers develop commercial plantings

Description: Atemoya is a small tree. Mature specimens can reach a height and spread of 32 feet, but for successful commercial production the tree is kept smaller by periodic pruning. The leaves are alternate, 10 to 20 centimeters long and 4 to 8 centimeters wide. They may be lanceolate, elliptic, or ovate. The fruit is spherical, conical, or ovate, with a weight of 8 ounces to 21 ounces. The shape and surface texture of the fruit are quite variable, even among fruit from the same tree. The fruit surface may be relatively smooth, or the distal ends of the individual carpels may project as rounded protuberances. The fruit has a thin green rind that becomes yellowish green at ripeness. The flesh of good varieties makes up a large proportion of the fruit weight.

It is very sweet, with a pleasant flavor, and is soft when ripe. The hard black seeds are 10 to 15 millimeters long, and there are 15 to 40 seeds per fruit. Fruit production starts in 2 to 3 years from grafted seedlings.

The trees are grown from grafts and begin flowering in the spring with the harvest season in late fall. The trees have one major bloom per year and usually an additional minor bloom. The period from bloom to fruit maturity is 5 to 6 months. The fruit can be harvested when mature but still firm and will ripen to excellent eating quality. This allows it to be shipped to distant markets. Studies show that with good care, hand pollination and favorable weather conditions mature trees can yield 200 to 500 pounds of fruit per year. A spacing of 20 feet between trees in a row and 25 feet between rows is used. Best fruit production occurs when trees have an adequate supply of moisture throughout the year. Irrigation insures proper water distribution. Methods of pollination are either self-fruiting or hand pollination. Some varieties need hand-pollination for good production. Atemoyas do have some pest problems and diseases. Fruit flies and the chalcid wasp are the main fruit pests. Some control can be achieved with approved chemicals but more research needs to be done in this area. Field sanitation is beneficial.

The atemoya is sold in the expanding Asian markets in Hawaii and in Oahu supermarkets. The tropical fruit industry has organized supermarket demonstrations and promotions of the atemoya. Although customers are unfamiliar with the fruit at first they express great interest after tasting the atemoya, enjoying its exotic flavor. The atemoya is a superb fruit for fresh consumption. The pulp can be used in sherbets and ice creams. The fruit is a good source of phosphorus and a fair to good source of thiamine and ascorbic acid.

AVOCADO
See Tropical Fruit - Commercial.

BREADFRUIT
See Tropical Fruit - Commercial.

CARAMBOLA (STARFRUIT)
See Tropical Fruit - Commercial.

FIG

Brief History: *Ficus carica* L. Family: Moraceae. The fig is believed to be indigenous to Western Asia and to have been distributed by man throughout the Mediterranean area. It has been cultivated for thousands of years. Remnants of figs have been found in excavations of Neolithic sites traced to at least 5,000 B.C. As time went on, the fig-growing territory stretched from Afghanistan to southern Germany and the Canary Islands. The first figs in the New World were planted in Mexico in 1560. Figs were introduced into California when the San Diego Mission was established in 1769.

The Smyrna fig was brought to California in 1881-82 but it was not until 1900 that the wasp was introduced to serve as the pollinating agent and make commercial fig culture possible.

Description: The fig is most commonly cultivated in mild-temperate climates; it nevertheless has its place in tropical and subtropical horticulture. It is unique in a genus embracing perhaps over 1,000 species, mostly giant "rubber trees", and mostly tropical. It is almost universally known simply as fig, common fig, or edible fig.

The fig is a tree of small dimensions, 10 to 30 feet high, with numerous spreading branches and a trunk rarely more than 7 inches in diameter. It contains copious milky latex. The root system is typically shallow and spreading, sometimes covering 50 feet of ground, but in permeable soil some of the roots may descend to 20 feet. The deciduous leaves are palmate, deeply divided into 3 to 7 main lobes, these more shallowly lobed and irregularly toothed on the margins. The blade is up to 10 inches in length and width, fairly thick, rough on the upper surface, softly hairy on the underside.

What is commonly accepted as a "fruit" is technically a synconium, that is, a fleshy, hollow receptacle with a small opening at the apex partly closed by small scales. It may be obovoid, turbinate, or pear-shaped, 1 to 4 inches long, and varies in color from yellowish-green to coppery, bronze, or dark-purple.

Tiny flowers are massed on the inside wall. In the case of the common fig discussed here, the flowers are all female and need no pollination. There are 3 other types, the "Caprifig" which has male and female flowers requiring visits by a tiny wasp, *Blastophaga grossorum*; the "Smyrna" fig, needing crosspollination by Caprifigs in order to develop normally; and the "San Pedro" fig which is intermediate, its first crop independent like the common fig, its second crop dependent on pollination. The skin of the fig is thin and tender; the fleshy wall is whitish, pale-yellow, or amber, or more or less pink, rose, red or purple; juicy and sweet when ripe, gummy with latex when unripe. Seeds may be large, medium, small or minute and range in number from 30 to 1,600 per fruit.

There is no commercial market for figs at this time because there is no commercial production. Figs from existing small plantings are sold at the local farmer's markets as both fresh and dried.

GUAVA

Brief History: *Psidium guajava L.* Family: *Myrtaceae.* The guava originates from the American tropics but can now be found naturalized in many parts of the world in both tropical and subtropical climates. The guava is best adapted to the warm climate of Hawaii and Florida, although it can be grown in coastal Southern California.

Description: Guavas are evergreen, shallow-rooted shrubs or small trees to 33 feet, with spreading branches. The bark is smooth, mottled green or reddish brown and peels off in thin flakes to reveal the attractive "bony" aspect of its trunk. The plant branches close to the ground and often produces suckers from roots near the base of the trunk. Guava leaves are opposite, short petioled, oval or oblong-elliptic, somewhat irregular in outline, 2 - 6 inches long and 1 - 2 inches wide. The dull-green, stiff but leathery leaves have pronounced veins, and are slightly downy on the underside.

The flowers are faintly fragrant, white and borne singly or in clusters in the leaf axils, are 1-inch wide, with 4 or 5 white petals. These petals are quickly shed, leaving a prominent tuft of perhaps 250 white stamens tipped with pale-yellow anthers. Guava fruits may be round, ovoid or pear-shaped, 2 - 4 inches long, and have 4 or 5 protruding floral remnants (sepals) at the apex. Varieties differ widely in flavor and seediness. The better varieties are soft when ripe, creamy in texture with a rind that softens to be fully edible. The flesh may be white, pink, yellow, or red. The sweet, musky odor is pungent and penetrating. The seeds are numerous but small and fully edible. Actual seed counts have ranged from 112 to 535.

The guava will tolerate many soil conditions, but will produce better in rich well-drained soil types. Guavas are grown from grafts. They are not easy to graft, but satisfactory techniques have been worked out for patch budding. Guavas can bloom throughout the year in mild-winter areas, but the heaviest bloom occurs with the onset of warm weather in the spring. Guavas can take considerable neglect, withstanding temporary waterlogging and very high temperatures. The adaptability of the guava makes it a serious weed tree in some tropical areas. The smaller guava cultivars can make an excellent container specimen.

Dessert Guava Variety: Hong Kong Pink
Selected at Poamoho Experimental Farm, Oahu, Hawaii from seed obtained from a clone grown in Hong Kong. Medium to large, roundish fruit, weighing 6 - 8 ounces. Flesh is pinkish-red, very thick, and smooth-textured. The flavor is sub-acid to sweet, very pleasant, few seeds. The plant breeding to secure more desirable varieties of dessert guava is continuing.

Guavas can be eaten fresh or processed into juices, jams, jellies and candies. Baked goods, soups, and ketchup may be incorporated into main courses.

JABOTICABA

Brief History: *Myrciaria cauliflora* Berg. Family: Myrtaceae. The jaboticaba is native to the hilly region surrounding Rio de Janeiro, Brazil.

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Description: The jaboticaba is a slow growing large shrub or small, bushy tree. It reaches a height of 10 - 45 feet, depending on the species. The trees are profusely branched, beginning close to the ground and slanting upward and outward so that the dense, rounded crown may attain an ultimate spread as wide as it is tall. The evergreen, opposite leaves are lanceolate to elliptic, 1 - 4 inches in length and 1/2 - 3/4 inch wide. In color they are a glossy dark green with a leathery texture.

The small yellow-white flowers dramatically emerge from the multiple trunks, limbs and large branches in groups of four. It has been reported from Brazil that solitary jaboticaba trees bear poorly compared with those planted in groups, which indicates that cross-pollination enhances productivity.

Jaboticaba fruit is grape-like in appearance and texture but with a thicker, tougher skin. Averages size is one inch in diameter but can run from 3/4 to 1-1/2 inches, depending on species and variety. The gelatinous whitish pulp contains from one to four small seeds and has a pleasant, sub acid flavor markedly similar to certain muscadine grapes. The skin has a slight resinous flavor that is not objectionable. Fruit may be produced singly or in clusters from the ground up all over the trunk and main branches, and the plant may fruit up to five times per year.

Jaboticaba trees are will take full sun or some shade. They are fairly wind tolerant but do not like salty sea air. Small, young trees do best with some protection. Jaboticabas grow and fruit best in rich deep soil with a pH of 5.5 to 6.5. Water should be supplied as needed to maintain good soil moisture and prevent wilting, but constant flooding is undesirable. As the root system is somewhat shallow, irrigation is usually required when the upper inch or two of soil becomes dry. Most seeds are polyembryonic, producing a plant that is true or close to the parent plant. The seeds germinate in about one month. The grafted plant will fruit considerably earlier than a seedling. One may expect a grafted plant to produce fruit within three years. It can take from 8 to 15 years for a seedling to mature into a fruiting tree. It is this very slow growth that has kept this plant from becoming as popular as it deserves to be. Grafting older trees over to a different variety is inadvisable because it is the trunk and inner branches, which produce the fruit. One would have to cut the tree back to a one-inch stump in order to change its fruiting nature.

When planting a jaboticaba, the crown (uppermost) roots should be 2 to 3 inches higher than the surrounding soil levels to provide water runoff. Peat, compost or rotted manure may be mixed with the soil from the planting hole to improve it. The soil should be a well-aerated mixture.

Jaboticaba fruit is grape-like in appearance and texture but with a thicker, tougher skin. The fresh fruit is delicious eaten out-of-hand and can be made into jellies, jams and wine. The skin is high in tannin and should not be consumed in large quantities over a long period of time.

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JACKFRUIT

Brief History: *Artocarpus heterophyllus* Lam. Family: Moraceae. The jackfruit is believed indigenous to the rain forests of the Western Ghats of India. It spread early on to other parts of India, Southeast Asia, the East Indies and ultimately the Philippines. It is often planted in central and eastern Africa and is fairly popular in Brazil and Surinam.

Description: Jackfruit is adapted to humid tropical and near-tropical climates. Young trees are likely to be killed at temperatures below 32°F. The jackfruit tree is handsome and stately. In the tropics it grows to an enormous size, like a large eastern oak. All parts contain sticky, white latex.

The leaves are oblong, oval, or elliptic in form, 4 to 6 inches in length, leathery, glossy, and deep green in color. Juvenile leaves are lobed. Male and female flowers are borne in separate flower heads. The stalks of both male and female flower heads are encircled by a small green ring.

Jackfruit is the largest tree-borne fruit in the world, reaching 80 pounds in weight and up to 36 inches long and 20 inches in diameter. The exterior of the compound fruit is green or yellow when ripe. The interior consists of large edible bulbs of yellow, banana-flavored flesh that encloses a smooth, oval, light-brown seed. The seed is 3/4 to 1-1/2 inches long and 1/2 to 3/4 inches thick and is white and crisp within. There may be 100 or up to 500 seeds in a single fruit, which are viable for no more than three or four days. When fully ripe, the unopened jackfruit emits a strong disagreeable odor, resembling that of decayed onions, while the pulp of the opened fruit smells of pineapple and banana.

The jackfruit tree should have a location that is sunny and warm. The jackfruit flourishes in rich, deep soil of medium or open texture. Planting on top of an old compost heap would be ideal. The tree needs the best drainage and cannot tolerate "wet feet". The jackfruit's nutrient requirements are not known, but frequent, weak solutions of all-purpose fertilizer will speed the plant's growth without causing burn. In the regions where it is commonly grown, it succeeds without much care from man, the sole necessity being abundant moisture. Propagation is usually by seeds, which can be kept no longer than a month before planting. Germination requires 3 to 8 weeks. The seedlings should be moved when no more than 4 leaves have appeared. A more advanced seedling, with its long and delicate taproot is very difficult to transplant successfully. Cutting-grown plants and grafted seedlings are possible. Air layering is common in India.

The flesh and the seeds comprise the edible portion. The flesh contains 23.4% carbohydrate and the seed 38.4 %. The seed contains 6.6 % protein.

The seeds can be boiled or roasted and eaten similar to chestnuts. In Southeast Asia dried slices of unripe jackfruit are sold in the markets. The ripe bulbs, fermented and then distilled, produce potent liquor.

LIMES

See Tropical Fruit - Commercial.

LONGAN

Brief History: .*Euphoria longana.* Family: Sapindaceae. Longan is native to southern China. The USDA introduced the Longan to Florida in 1903 directly from southern China. From Florida it was taken to Bermuda, Cuba, Puerto Rico, Hawaii. The Longan original to the New World was not one of the best varieties and was not a good fruit. In the late 1950's, improved varieties were brought to the US, the 'Fukien' and the 'Kohala', the latter developed in Hawaii.

Description: The longan is member of the Sapindaceae family; it is an erect tree with spreading, slightly drooping, heavily foliaged branches. It is evergreen and has ovate-oblong, blunt-tipped leathery leaves, glossy on the upper surface and minutely hairy beneath. New growth is wine colored, turning grayish green. Pale yellow, hairy stalked flowers are borne upright with male and female mingled.

The fruit droops in clusters of yellow-brown globose with a translucent, sweet flesh that has a musky bouquet. Inside the flesh is a jet black, shiny seed.

Longans perform well in a subtropical to temperate climate, with a temperature range of 32 to 95 degrees. Longan thrives best on rich sandy loam or organic sand. They need adequate water, and can stand flooding but not prolonged drought. Annual rainfall required is 59 to 120 inches. Longan may be grown from sea level to 3,000 feet temperature permitting. Longan trees are grown from grafts and begin to produce fruit in two to four years. Longan trees need 20 feet to properly produce full growth. They are relatively free of pests and diseases but can show signs of mineral deficiency.

Fertilization, including the addition of nitrogen and minor elements, should take place after fruit harvest and during blooming season.

Medical uses of longan include stomachache, insomnia, and as an antidote for poison. Dried leaves and flowers are sold in Chinese herb markets.

Food uses include out-of-hand, canned, dried, used in salads and deserts.

Longan, Papaya, & Pineapple: 2 C seeded, halved longans, 2 C diced papaya, 2 C diced fresh pineapple, 2 T lemon juice, 1/2 C mayonnaise, lettuce. Combine, chill, serve on lettuce.

LYCHEE

See Tropical Fruit - Commercial.

MANGO

Brief History: *Mangifera indica*, Family: Anacardiaceae. The mango is a popular evergreen fruit tree native to southeastern Asia. It has been in cultivation for over 4,000 years, during which time it has spread from Asia to tropical and subtropical countries. According to recent research there are hundreds of different varieties. The first introduction was brought to Hawaii about 1825 by Captain Meek from Manila on the ship Kamehameha. These mango trees were planted by Don Marin in Honolulu and Reverend Joseph Goodrich, a missionary in Wailuku, Maui.

Description: Mango is a large, deep-rooted, symmetrical evergreen tree growing to 90 feet and 80 feet wide. It has simple, alternate, lanceolate leaves 12 to 16 inches long that are yellow-green, purple, or copper colored when young, turning leathery, glossy, and deep green when mature. Fruits weigh about 1/4 pound to 3 pounds. Fruit shape varies according to variety and may be round, ovate, or obovate. The color of immature fruit is green, gradually turning to yellow, orange, purple, red or combinations of these colors as the fruit matures. Internal flesh color of ripe mangos is pale yellow to orange. The single seed usually is large and flattened and adheres to the flesh.

Mangos can be grown on a wide range of soil types, from light sandy loams to red clay soils. Mangos are best adapted to hot tropical lowlands, seasonally dry. Mangos will grow from sea level to an elevation of 2,800 feet in Hawaii, but are most productive below 1,200 feet. The best fruit production occurs when the weather is dry during the flowering period. Mangos are large trees and should be planted 35 to 40 feet apart. Also, good air circulation and exposure to sunlight is better if the trees are not crowded for space. Grafted mangos usually produce fruit in three to five years. The tree will produce for 30 or 40 years or longer with good cultural care. The mango fruit can be picked when it has reached full size, but is not fully colored. The fruit will ripen after harvesting. Green mango is picked for specialty food products.

The fruit bruises easily and must be handled carefully to avoid damage. Fruit is harvested from the tree by hand using long poles and baskets. The industry has numerous modifications of this equipment. Mechanical harvesting equipment (e.g., hydraulic lifts) can be used if the ground is level. Most growers use what is more commonly known as a mango picker (long bamboo or aluminum pole with a net basket attach) to pick the fruit from the ground or in the tree.

Mango are commonly peeled and eaten fresh but are also used in juice preparation and made into preserves, chutney, dried slices, gourmet sauces, ice cream, ices, baked goods and pickles.

MANGOSTEEN

See Tropical Fruit - Commercial.

PULASAN

Brief History: *Nephelium mutabile.* Family: Sapindaceae. The pulasan has its origins in west Malaysia, Borneo and Sumatra. The pulasan is a close relative of the rambutan. The tree form and foliage are similar to the rambutan but are smaller in characteristics.

Description: Under normal conditions the pulasan is a medium size tree, 32 feet to 50 feet in height, with a canopy width approximately two-thirds the height. Leaves are petioled, alternate and pinnate with two to four pairs of leaflets arranged alternately or sub-opposite on the rachis.

The inflorescences are axillary and terminal, erect and widely branched, rusty pubescent and bear numerous small, greenish white flowers. The fruit is attractively colored and varies from green to yellow to pink to dark red to dark purple according to cultivar. The skin is about 1/8 inch thick and is covered with soft spines. Fruit shape is globose to ovoid, 1 ¼ to 2 ¾ inches in length and 1 to 3 ounces in weight. Edible flesh varies from 30 to 60 % of total fruit weight. The aril in preferred varieties is translucent cream white, sweet and juicy with a slight sub-acid tang. The pulasan fruit is a little larger than the rambutan, with fewer fruit per panicle, but appearance and eating quality is very similar.

Pulasan prefers a high humidity and rainfall. They are best suited to a tropical climate where winter temperatures rarely fall below 50 F. or peak above 104 F. Rainfall parameters should be between 60 to 120 inches of rain annually. Deep, rich, well-drained soils are generally preferred but pulasan is tolerant of a wide range of soil types. Grafting is the preferred method of propagation. Grafted trees will begin to fruit in 3 to 5 years. Fruit maturity takes from 100 to 130 days in warm tropical areas. Records show an average of 44 pounds of fruit may be harvested in year 5 and 440 pounds in 15 years.

Pulasan are normally eaten as a fresh fruit. However, pulsan can be frozen or dried, used for flavoring in ice cream, puddings, can be made into preserves, jams, jellies and sauces

The chefs in the gourmet restaurants use pulsan in their entrée dishes and in sauces. Pulasan is also being used more recently in tropical juice blends.

RAMBUTAN

Brief History: *Nephelium lappaceum L.* Family: Sapindaceae. The rambutan originated in the rain forests of Malaysia and is widely cultivated throughout the lowland tropics of Southeast Asia. In Hawaii, rambutans have fruited on Maui, Oahu, and the Big Island (Hilo and Kona).

Description: The tree is evergreen and may reach 32 to 82 feet high and 19 feet wide. Rambutans perform best with 80-120 inches of well-distributed rainfall throughout the year. It requires permanently moist soil, except for a few weeks prior to flowering. Sufficient moisture is essential from antithesis to harvest.

The trunk, which reaches 30 centimeters in diameter, is upright, with rather large branches. The bark is very dark and rugose. The crown is somewhat open. The leaves are pinnately compound and consist of 2 to 4 pairs of leaflets and sometimes a terminal leaflet. The leaflets are oblong or elliptical, shiny dark green above and lighter below. The leaf measures 5 to 10 centimeters in length and 2 to 10 centimeters in width. The fruit is an ovate or ellipsoidal drupe 3 to 8 centimeters long and 2 to 4 centimeters wide, borne in clusters, with a short, thick pedicel. The skin is red or yellow and is covered with smooth appendages that look like curved thorns but that are soft and flexible. The interior aril is smooth, white, translucent, juicy and sweet.

The seeds, usually one to a fruit, are ellipsoidal and 2 to 3 centimeters long. The fruit is attractively colored and varies from yellow to pink to dark red according to cultivar.

Trees are propagated by aerial layering, approach grafting, or by budding, using buds from matured wood and a modified forkert method. Grafted rambutan trees may begin to bear as early as the second year of growth, but they normally begin to bear in 3 to 5 years. If grown from seed, trees bear fruit in 6 to 8 years. Figures show yields of 44 pounds per tree in year 5, 242 pounds per tree in year 10, and 485 pounds per tree in year 17. The harvest season in Hawaii is August through March.

The fruits can be collected when they begin to turn from green to reddish. Fruit should be harvested when full color saturation is reached. Full maturity takes from 100 to 130 days in warm tropical areas and up to 150 days in cooler sub-tropical climates.

Rambutans are predominantly sold as a fresh fruit item in local markets. Rambutan, like its close relatives the lychee and pulasan can be frozen or dried, used for flavoring in ice cream, puddings, can be made into preserves, jam, jellies and sauces. The chefs in the gourmet restaurants use rambutan in their entrée dishes and in sauces.

STAR APPLE

Brief History: *Chrysophyllum Cainito.* Family: Sapotaceae. The star apple or camito is indigenous to the West Indies and Central American regions, where it is grown extensively. Although not common in Hawaii, there are good specimens to be found in many gardens.

Description: It is a very attractive tree growing to the height of 50 feet with dark green leaves 6 inches long, which have a silky golden-brown undersurface. The small purplish white flowers are borne in axillary clusters on mature twigs. Fruits are green, purple or copper colored, round and up to 3 inches in diameter with a smooth skin containing a white sweet pulp arranged in eight segments surrounding 3 to 5 hard, brown, glossy seeds. When halved, these segments give the fruits a star-shaped pattern.

The tree is tropical in its requirements and less tolerant of low temperatures then the sapodilla. The star apple is reported to grow well in a range of soils from sands to clay loams. The reported times of cropping vary from early spring, late spring to midsummer, two crops per year have been reported for some varieties. Trees grown from grafts will begin fruiting in 2 to 3 years.

The purple variety of star apple is an attractive fruit and sells well in all types of markets. The flavor is very pleasant and the color eye-catching. The flesh is tender, mild and sweet in flavor. The fruits are allowed to ripen to full maturity as under ripe fruit contains some latex.

Analyses shows the fruit contains 85.7 gm moisture; 1.2 gm fiber; .130 gm nitrogen; .44 gm ash; 17.3 mg calcium; 16.4 mg phosphorus; .48 mg iron; .027 mg thiamine; .015 mg carotene; .018 mg riboflavin; 1.053 mg niacin; 9.1 mg ascorbic acid.

It is strictly a dessert fruit and not suitable for cooking. The fruits are very popular in Asian countries.

STRAWBERRY GUAVA

Brief History: *Psidium Cattleianum* Sabine. Family: Myrtaceae. Strawberry guava is one of the hardiest of guava varieties. It is said to be a native of Brazil.

Description: A shrubby tree 15 to 20 feet in height. The bark is smooth, mottled green or reddish brown and peels off in thin flakes to reveal the attractive "bony" aspect of its trunk. Strawberry guava leaves are opposite, short petioled, oval or oblong-elliptic, somewhat irregular in outline, 2 - 4 inches long and 1 inch wide. The leaves are leathery, shiny dark green, and are slightly downy on the underside. The flowers are faintly fragrant, white and borne singly or in clusters in the leaf axils, are 1-inch wide, with 4 or 5 white petals. These petals are quickly shed, leaving a prominent tuft of perhaps 250 white stamens tipped with pale-yellow anthers. The fruit is spherical, about 1 inch in diameter and purple-reddish when ripe, the flesh is whitefish pink and is soft and juicy with an agreeable flavor, containing many small white seeds.

The strawberry guava will tolerate many soil conditions, but will produce better in rich well-drained soil types. Strawberry guavas are grown from grafts. They are not easy to graft, but satisfactory techniques have been worked out for patch budding. Strawberry guavas can bloom throughout the year in mild-winter areas, but the heaviest bloom occurs with the onset of warm weather in the spring. Strawberry guavas can take considerable neglect, withstanding temporary water logging and very high temperatures.

The smaller size of the tree and the shape, color of the leaves of the strawberry guava make it a very attractive landscape plant, but the adaptability of the guava makes it a serious weed tree in Hawaii. The strawberry guava makes an excellent container plant.

Strawberry guava can be eaten fresh or processed into juices, jams, jellies, and candies. Baked goods, soups, and ketchup may be incorporated into main courses.

WHITE SAPOTE

Brief History: The white sapote, *Casimiroa edulis* Llave & Lex. Family: Rutaceae. The genus *Casimiroa* of the family Rutaceae was named in honor of Cardinal Casimiro Gomez de Ortega, a Spanish botanist of the 18th Century. It embraces 5 or 6 species of shrubs or trees.

The white sapote originated in Mexico. Its range is broad, extending down into Central America as far as Costa Rica. The white sapote, *C. edulis*, remains the preferred fruit of the genus due to its delicious flavor and wide appeal.

Description: White sapote trees range from 15 to 20 feet up to 30 to 60 feet in height. They have light-gray, thick, warty bark and often develop long, drooping branches. The leaves, mostly evergreen are alternate, palmately compound, with 3 to 7 lanceolate leaflets, smooth or hairy on the underside. The odorless flowers, small and greenish-yellow, are 4- or 5-parted, and borne in terminal and axillary panicles. They are hermaphrodite or occasionally unisexual because of aborted stigmas. The fruit is round, oval or ovoid, symmetrical or irregular, more or less distinctly 5-lobed; 2 1/2 to 4 1/2 inches wide and up to 4 3/4 inches in length; with thin green, yellowish or golden skin coated with a very thin bloom, tender but inedible; and creamy-white or yellow flesh glinting with many tiny, conspicuous, yellow oil glands.

The flavor is sweet with a hint or more of bitterness and sometimes distinctly resinous. There may be 1 to 6 plump, oval, hard, white seeds, 1 to 2 inches long and 1/2 to 1 inches thick, but often some seeds are under-developed (aborted) and very thin. The kernels are bitter and narcotic.*C. edulis* has leaves that are usually composed of 5 leaflets, glabrous to slightly pubescent on the underside, and 5-parted flowers. The fruit is somewhat apple-like externally, generally smooth, fairly symmetrical and 2 1/2 to 3 inches wide. The fruits are usually 4 to 4 1/2 inches wide, ovoid, irregular and knobby, with rough, pitted skin, and there are often gritty particles in the flesh.

The white sapotes can be classed as subtropical rather than tropical. *C. edulis is* usually found growing naturally at elevations between 2,000 and 3,000 feet and occasionally in Guatemala up to a maximum of 9,000 feet in areas not subject to heavy rainfall. As long as there is good drainage, the trees will do very well on sandy loam or even on clay. White sapotes are commonly grown from seeds and seedlings usually begin to bear in 7 or 8 years. Grafting is a common practice. Grafted trees will start bearing in 3 or 4 years.

Within its native range, the white sapote is commonly eaten out-of-hand. The flesh of ripe fruits may be added to fruit cups and salads or served alone as dessert, but it is best cut into sections and served with cream and sugar. Sometimes it is added to ice cream mix or milk shakes, or made into marmalade.

The wood is yellow, fine-grained, compact, moderately dense and heavy, medium strong and resistant, but not durable for long.

The ancient Nahuatl name for the fruits, "cochiztzapotl", is translated "sleepy sapote" or "sleep-producing sapote", and it is widely claimed in Mexico and Central America that consumption of the fruit relieves the pains of arthritis and rheumatism.

TROPICAL FRUIT - COMMERCIAL

Commercial tropical fruit is to be planted in approximately 20-acre blocks located within the development. These crops will be farmed using commercial methods by either qualified farmers or by personnel hired by the development specifically for this purpose. Crops harvested will be sold in both local and out of State markets. The intent of the commercial farming operation is to create a profit.

Included in this section is a list of the suggested commercial crops, a detailed description of each and a cash flow showing the level of profitability that may be expected from each crop. Along with each cash flow is a list of assumptions used to create the cash flow.

AVOCADO

Brief History: *Persea americana* Mill. is a traditional crop of Central America that now grows in most subtropical and tropical countries. There are three distinct races of avocados: Mexican, Guatemalan, and West Indian. Some important commercial cultivars are hybrids of the various races. Don Marin, a horticulturist who lived in Pauoa Valley in Honolulu, is considered to be the person who planted the first avocado trees in Hawaii.

Description: Avocado is a much-branched evergreen tree 40 to 80 feet in height with elliptic leaves 3 to 10 inches long. Fruit: spherical, ovoid, ellipsoid, or pyriform. External color: green, reddish-purple, purple or black. Internal color: greenish yellow to bright yellow when ripe. Fruits have a single large seed making up 10 to 25 percent of the fruit weight.

Basic Cultivation Requirements:
Soil: The avocado may be grown in many soil types as long as the soil is well drained. Good drainage is critical. A soil pH level between 5.7 and 6.5 is preferred.

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Temperature: Optimum temperatures for growth and flowering according to research done in Florida and Australia is moderate day (77 F) and cool nights (68 F).

Elevation: Avocados can be grown from 0-3,500 ft. Microclimates suited to the culture of different cultivars are found throughout Hawaii.

Rainfall: Rainfall of 50 inches of well-distributed rainfall throughout the year is adequate; higher rainfall is tolerated if drainage is good. Rainfall in the Puna district generally ranges 80 to 100 inches per year. Relative humidity of 50% or more is desirable during flowering and fruit set.

Cultural: Trees should be spaced 25 to 35 feet apart. Weeds and grass under the trees can be controlled with the herbicide Roundup or heavy mulching. A combination using Best Management Practices (BMP) is recommended.

Organic mulches are recommended for weed control and maintenance of good soil condition. Early pruning of young trees is done to shape young trees and remove dead branches. Bearing trees are pruned, usually annually, after harvest to control tree height and to open the interior of the tree to light. Areas exposed to high winds should be avoided because branches are easily broken, and flowers and fruits may be damaged. Windbreaks are recommended where there is consistent wind exposure.

Diseases: In general avocados are not susceptible to disease unless their overall tree health is poor or water accumulates around the root system. The list of avocado diseases is dodder (*Cuscuta sandwichiana*), avocado root rot (*Phytohthora cinnamomi*), stem-end rot (*Phomopsis sp., Dothiorella sp.*), fruit rot (*Dothiorella sp.*), anthracnose (*Colletotrichum gloeosporioides*), algal leaf spot (*Cephaleuros virescens*), scab (cause unknown; resistant varieties available), and leaf tip-burn (various causes, not all disease related, including salt accumulation from over fertilizing).

Pests: Pests are generally not a problem in avocado cultivation. However, some control with organic sprays may be required occasionally, especially in young trees. The major pests are red-banded thrips (*Selenothrips rubrocinctus*), armored scales (several species), Chinese rose beetle (*Adoretus sinicus*), fruit fly, mites, black twigborer (*Xylosandrus compactus*), mealybug (*Dysmicoccus neobrevipes, Nipaecoccus nipae*), and plantbugs (*Hyalopeplus pellucidus* and other species).

Nutrients: Important plant nutrients applied as fertilizer to avocado are nitrogen (N), phosphorus (P), potassium (K), and calcium (Ca). Among micronutrients, zinc (Zn) is important to avocado and should be applied whenever deficiency is indicated. Boron can be deficient and is an element needed by the avocado for proper fruit development. If soil is strongly acidic, add calcium carbonate to raise pH. If soil pH is adequate calcium sulfate can be used to provide calcium without increasing pH. A soil analysis is recommended to determine basic nutrient levels in the soil. Even more important is a tissue analysis done at least annually to determine nutrient levels in the tree.

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From observation, production records, and the soil and tissue analysis a fertilizer regime can be designed to suit the orchard. This fertilizer regime must be closely monitored and changed as the indicators dictate.

Fruit Maturity: Fruit is produced in 5-8 years from seed, 3-4 years from grafts, continuing for about 25 years and in some cases even longer. Several approximate methods are used to determine fruit maturity, such as the presence of fallen fruit which ripen when stored, lack of glossy skin, historic picking date, mature fruit size, seed membrane change, stem turns yellowish brown and snaps more easily, and skin color change.

Sources of Nursery Stock: Seedling plants fail to reproduce true to type, and grafting is necessary to maintain desired growth, bearing and fruit characteristics. Grafted trees usually begin to bear fruit three to four years after transplanting.

Various grafting techniques such as side, whip and bark grafting can be employed. The preferred commercial varieties are Hass and Sharwil. Hass is a black-skinned, ovate cultivar whose fruit weighs 5 to 12 oz. It descends primarily from the Guatemalan race. Sharwil is a green-skinned, pyriform cultivar whose fruit weighs 8 to 20 oz. It is a Mexican and Guatemalan cross. The Sharwil, a variety propagated by the University of Hawaii, is considered by many to be the finest quality commercial avocado in the world, considered better tasting than the popular California variety known as Hass.

Nurseries that sell grafted avocado plants are:

1. Plant It Hawaii, Kurtistown, Hawaii
2. Kahili Farms Nursery (Candace Strong), Kilauea, Kauai

Production: Once planted, orchards of grafted varieties will begin producing a harvestable crop in 3 to 4 years. The estimated yield at this point is 20 to 50 pounds per tree per year. Yields will increase each year and peak at 500 to 1,000 pounds per tree per year at between 10 and 15 years. The large yield variation is attributed to varying year-to-year climate conditions and to the specific variety. In Hawaii, the 1997 average yield per acre was 2,300 pounds.

The Hass avocado and the Sharwil are harvested generally from late winter to May. Fruits are picked when mature but still hard and then allowed to ripen. Fruit is harvested from the tree by hand, generally with pruning shears, special clippers, poles and baskets and never pulled from the branch. The pedicel (fruit stem) should remain attached to the fruit. When the stem is pulled out, the fruit often spoils. Fruits are easily bruised, and windfall fruits are not marketable. The industry has numerous modifications of this equipment. Mechanical harvesting equipment (e.g., hydraulic lifts) can be used if the land is level.

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Packing: The ripening and storage vary with the variety. In general avocados will ripen during storage, and the best ripening temperature range is between 55 and 75 F. Ripening avocados generate much heat. In closed packages or containers, fruit can be heat- damaged. Vented and screened boxes and airfreight containers designed for fresh products should be used. Ripe fruit can be refrigerated at 40' to obtain maximum shelf life of the product.

Uses: Avocado is eaten as a fresh fruit worldwide. This is its most important commercial use. The increasing popularity of the Mexican guacamole, which is pureed avocado with seasoning, is a large user of avocados. Fine oil is also made from the avocado. This oil is used in salad dressings and in cosmetics and health food products.

Marketing: The avocado industry in Hawaii at present is comprised of approximately 95 growers farming 340 acres and producing 500,000 pounds. The estimated farm value of the industry's production is $265,000.

The average price per pound paid to the grower was $0.53. Current wholesale prices on the spot market are between $0.65 and $0.90 per pound for Hass and Sharwil. These statistics are from the 1997 Hawaii Agricultural Statistics Service avocado annual report dated September 3, 1998.

Current federal regulations will permit export of fresh Hawaii avocados to the U.S. Mainland. The United States Department of Agriculture regulations require that the avocado fruit use an approved 10 to 14 day cold treatment to kill fruit flies. These regulations apply to all Hawaii grown avocado varieties. Shippers have to determine if the fruit needs a preconditioning heat treatment to maintain quality. Transshipment through U.S. ports is permitted if certain conditions are met. Seattle and Chicago being bonded as transshipment points have opened up more opportunities for the industry.

The existing markets are the state supermarkets, state food service industry, the mainland, and Canada. The price is determined by the mainland fruit supply, and there is at this time no premium for Hawaii grown avocados. Fruit sent to Canada does not require post harvest quarantine treatment.

Local markets have been dominated by the Hass variety of avocado, and are somewhat familiar with the Sharwil. The November-May harvest season for Sharwil avocados enables growers to market some of their crop before California's peak Hass avocado harvest in April-October, during which time Hass are exported to Hawaii' supermarkets in large quantities. The food service industry and supermarkets that are located near middle or upper income residential areas in Hawaii look for the high quality Hawaii grown products and will pay a premium for those. Locally grown Sharwil and Hass compete with the California Hass for markets. The KTA Supermarket chain on Hawaii supports local agricultural products and will purchase those in preference to mainland products if the price is competitive.

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Packaging: Corrugated cardboard box, 2 ply, 200 lb tested, can be used. This is available at Weyerhaeuser Paper Company in Honolulu.

Transport: Barge service or airfreight. Fruits are shipped inter-island to Honolulu either by Young Bros. barge (1-1/2 - 3-1/2 cents/lb) or by air (19-20 cents/lb) or (10 cents/lb for 1,000 lbs or more).

Oneloa Development Project: Cash Flow for Avocado

28-Jun-99 **Acreage:** **20**

Production & Revenue	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Pounds Harvested	-	-	-	-	58,140	77,520	116,280	155,040	204,000	204,000
Revenue	$0	$0	$0	$0	$37,791	$50,388	$75,582	$100,776	$132,600	$132,600
Average price per lb	$ 0.65									
Operating Costs										
Mowing	$2,448	$2,448	$2,448	$2,448	$2,040	$2,040	$2,040	$2,040	$2,040	$2,040
Herbicide	$1,836	$1,836	$1,836	$1,530	$918	$918	$918	$918	$918	$918
Fertilize	$612	$1,224	$2,448	$3,672	$3,672	$3,672	$3,672	$3,672	$3,672	$3,672
Pest Control	$85	$85	$85	$85	$85	$85	$85	$85	$85	$85
Hand Weeding	$2,550	$816	$0	$0	$0	$0	$0	$0	$0	$0
Replant	$51	$102	$102	$102	$102	$102	$102	$102	$102	$102
Pruning	$255	$255	$255	$510	$510	$510	$510	$510	$510	$510
Crop Log	$17	$17	$17	$17	$17	$17	$17	$17	$17	$17
Other	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing	$0	$0	$0	$0	$15,698	$20,930	$31,396	$41,861	$55,080	$55,080
Post-harvest Treatment	$0	$0	$0	$0	$5,814	$7,752	$11,628	$15,504	$20,400	$20,400
Management Fee	$1,974	$1,706	$1,808	$2,102	$5,073	$6,149	$8,300	$10,451	$13,169	$13,169
General Excise Tax	$411	$355	$377	$438	$1,604	$2,011	$2,824	$3,637	$4,664	$4,664
Total Operating Costs	$9,871	$8,532	$9,042	$10,508	$33,972	$42,218	$58,710	$75,203	$96,035	$96,035
Net Operating Profit (Loss)	($9,871)	($8,532)	($9,042)	($10,508)	$3,819	$8,170	$16,872	$25,573	$36,565	$36,565
Capital Expenditures	$ 35,163	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow	($45,034)	($8,532)	($9,042)	($10,508)	$3,819	$8,170	$16,872	$25,573	$36,565	$36,565
Cumulative Cash Flow		($53,566)	($62,607)	($73,116)	($69,296)	($61,126)	($44,254)	($18,681)	$17,884	$54,449

Oneloa Development Project: Cash Flow for Avocado

28-Jun-99 **Acreage:** 20

Production & Revenue	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Pounds Harvested	204,000	204,000	204,000	204,000	204,000	204,000	204,000	204,000	204,000	204,000
Revenue	$132,600	$132,600	$132,600	$132,600	$132,600	$132,600	$132,600	$132,600	$132,600	$132,600
Average price per lb	$0.65									
Operating Costs										
Mowing	$1,428	$1,428	$1,428	$1,428	$1,428	$714	$714	$714	$714	$714
Herbicide	$918	$918	$918	$918	$918	$918	$918	$918	$918	$918
Fertilize	$4,896	$4,896	$4,896	$4,896	$4,896	$4,896	$4,896	$4,896	$4,896	$4,896
Pest Control	$85	$85	$85	$85	$85	$85	$85	$85	$85	$85
Hand Weeding	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Replant	$153	$153	$153	$153	$153	$196	$196	$196	$196	$196
Pruning	$510	$510	$510	$510	$510	$510	$510	$510	$510	$510
Crop Log	$17	$17	$17	$17	$17	$17	$17	$17	$17	$17
Other	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing	$55,080	$55,080	$55,080	$55,080	$55,080	$55,080	$55,080	$55,080	$55,080	$55,080
Post-harvest Treatment	$20,400	$20,400	$20,400	$20,400	$20,400	$20,400	$20,400	$20,400	$20,400	$20,400
Management Fee	$13,334	$13,334	$13,334	$13,334	$13,334	$13,167	$13,167	$13,167	$13,167	$13,167
General Excise Tax	$4,698	$4,698	$4,698	$4,698	$4,698	$4,663	$4,663	$4,663	$4,663	$4,663
	$96,864	$96,864	$96,864	$96,864	$96,864	$96,025	$96,025	$96,025	$96,025	$96,025
Net Operating Profit (Loss)	$35,736	$35,736	$35,736	$35,736	$35,736	$36,576	$36,576	$36,576	$36,576	$36,576
Capital Expenditures	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow	$35,736	$35,736	$35,736	$35,736	$35,736	$36,576	$36,576	$36,576	$36,576	$36,576
Cumulative Cash Flow	$90,185	$125,921	$161,657	$197,393	$233,129	$269,705	$306,280	$342,856	$379,431	$416,007

Acreage and Yield Assumptions

Acreage & Tree Count Assumptions:

Acreage		
Total acres		20.00
Estimated net tree acres	85%	17.00
Tree Data		
Density, trees per acre (30'x30')		48
Theoretical trees on net acres		816

Yield Assumptions:

Category	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Lbs/Tree/Year	-	-	-	-	75.0	100.0	150.0	200.0	300.0	400.0
Lbs Adjusted for Spoilage	-	-	-	-	71.3	95.0	142.5	190.0	285.0	380.0
Lbs per Tree Acre per Year	-	-	-	-	3,420	4,560	6,840	9,120	12,000	12,000

Category	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Lbs/Tree/Year	500.0	500.0	750.0	750.0	750.0	750.0	750.0	750.0	750.0	750.0
Lbs Adjusted for Spoilage	475.0	475.0	712.5	712.5	712.5	712.5	712.5	712.5	712.5	712.5
Lbs per Tree Acre per Year	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000

Key Assumptions	
Estimated Producing Tree Density (tpa)	48
Spoilage	5.0%
Maximum Lbs per Tree Acre per Year	12,000

Average Price Assumptions:

Average Price	$ 0.65

28-Jun-99 **Acreage:** **20**

Cost Assumptions

Establishment Cost:

Category		Total Cost	Unit Cost	
Land Clearing		$ 16,000	$ 800	per acre
Planting		$ 14,688	$ 18	per tree
Management fee		$ 3,069	10%	
	Sub-Total	$ 33,757		
	GET	$ 1,406	4.166%	
	Total	$ 35,163		

Planting Cost Detail:

Trees	$ 10.00
Soil	$ 2.00
Dig holes	$ 2.50
Labor	$ 3.00
Fertilizer	$ 0.50
Total	$ 18.00

Operating Costs:

Category	Rds. per Yr.	Cost per Acre per Round: Year 1	Year 2	Year 3	Year 4	Yr 5 thru 10	r 11 thru 15	r 16 thru 20
Mowing	6	$ 24.00	$ 24.00	$ 24.00	$ 24.00	$ 20.00	$ 14.00	$ 7.00
Herbicide	6	$ 18.00	$ 18.00	$ 18.00	$ 15.00	$ 9.00	$ 9.00	$ 9.00
Fertilize	6	$ 6.00	$ 12.00	$ 24.00	$ 36.00	$ 36.00	$ 48.00	$ 48.00
Pest Control	1	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00
Hand Weeding	6	$ 25.00	$ 8.00	$ -	$ -	$ -	$ -	$ -
Replant	1	$ 3.00	$ 6.00	$ 6.00	$ 6.00	$ 6.00	$ 9.00	$ 11.50
Pruning	1	$ 15.00	$ 15.00	$ 15.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00
Crop Log	1	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00
Other	1	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50

	Unit Cost	
Harvesting	$ 0.10	per pound
Packing	$ 0.10	per pound
Packing Materials	$ 0.05	per pound
Hauling	$ 0.02	per pound
Total Harvest, Pack & Haul	$ 0.27	per pound
Post-harvest Treatment	$ 0.10	per pound
Management - Cultivation	25%	of operating costs
Management - Harvesting	15%	of harvesting, packing & post-harvest treatment costs.
GET on Operating Costs	4.166%	
GET on Revenue	0.500%	

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BREADFRUIT

Brief History: The breadfruit belongs to the Moracceae (fig or mulberry) family. Its scientific name is *Artocarpus altilis* Fosberg. The breadfruit is believed to be native to a vast area extending from New Guinea through the Indo-Malayan Archipelago to Western Micronesia.

It is said to have been widely spread in the Pacific area by migrating Polynesians. Hawaiians believe that it was brought from the Samoan island of Upalu to Oahu in the 12th Century A.D. It is said to have been first seen by Europeans in the Marquesas in 1595, then in Tahiti in 1606.

Description: The breadfruit tree is handsome and fast growing, reaching 85 feet in height, often with a clear trunk to 20 feet becoming 2 to 6 feet in width and often buttressed at the base, though some varieties may never exceed 1/4 or 1/2 of these dimensions. There are many spreading branches, some thick with lateral foliage-bearing branchlets, others long and slender with foliage clustered only at their tips. The leaves, evergreen or deciduous depending on climatic conditions, on thick, yellow petioles to 1 1/2 inches long, are ovate, 9 to 36 inches long, 8 to 20 inches wide, entire at the base, then more or less deeply cut into 5 to 11 pointed lobes. They are bright green and glossy on the upper surface, with conspicuous yellow veins; dull, yellowish and coated with minute, stiff hairs on the underside.

The tree bears a multitude of tiny flowers, the male densely set on a drooping, cylindrical or club-shaped spike 5 to 12 inches long and 1 to 1 1/2 inches thick, yellowish at first and becoming brown. The female are massed in a somewhat rounded or elliptic, green, prickly head, 2 1/2 inches long and 1 1/2 inches across, which develops into the compound fruit (or syncarp), oblong, cylindrical, ovoid, rounded or pearshaped, 3 1/2 to 18 inches in length and 2 to 12 inches in diameter. The thin rind is patterned with irregular, 4- to 6-sided faces, in some "smooth" fruits level with the surface, in others conical; in some, there may rise from the center of each face a sharp, black point, or a green, pliable spine to 1/8 inches long or longer. Some fruits may have a harsh, sandpaper-like rind. Generally the rind is green at first, turning yellowish-green, yellow or yellow-brown when ripe, though one variety is lavender.

In the green stage, the fruit is hard and the interior is white, starchy and somewhat fibrous. When fully ripe, the fruit is somewhat soft, the interior is cream colored or yellow and pasty, also sweetly fragrant.

The seeds are irregularly oval, rounded at one end, pointed at the other, about 3/4 inches long, dull-brown with darker stripes. In the center of seedless fruits there is a cylindrical or oblong core, in some types covered with hairs bearing flat, brown, abortive seeds about 1/8 inches long. The fruit is borne singly or in clusters of 2 or 3 at the branch tips. The fruit stalk (pedicel) varies from 1 to 5 inches long.

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Basic Cultivation Requirements:
Soil: Breadfruit is tolerant of a wide range of soil types. Fertile, well-drained, volcanic soils is recommended.

Temperature: The breadfruit is ultra-tropical, much more sensitive than the mango tree. It has been reported that it requires a temperature range of 60° to 100°F. Young plants do best in partial shade.

Elevation: Breadfruit has been cultivated at sea level and up humid slopes to an altitude of 3,500 feet. In Central America, it is grown only below 2,000 feet. The Hawaiian windward coasts are ideal growing locations.

Rainfall: Requires 60 to 100 inches of rain annually but will tolerant a minimum rainfall of 50 inches and a relative humidity of 70 to 80%.

Cultural: Breadfruit is propagated from shoots growing from the roots or from one inch diameter root cuttings, 9 to 10 inches long. These can be placed in a shaded bed until a 2-3 foot top has grown. Young breadfruit trees are planted in well-enriched holes 15 inches deep and 3 feet wide. The breadfruit plant grows an extensive root system, so it is best to plant it where it will have plenty of room to stretch out and also up. The trees are spaced 25 to 40 feet apart in plantations.

Those grown from root suckers will bear in 5 years and will be productive for 50 years. Some growers recommend pruning of branches that have borne fruit and would normally die back, because this practice stimulates new shoots and also tends to keep the tree from being too tall for convenient harvesting.

Diseases: Young breadfruit trees have been killed by a disease caused by *Rosellinia* sp. In the Pacific Islands *Fusarium* sp. is believed to be the cause of die back, and *Pythium* sp. is suspected in cases of root rot. The fungus, *Phytophthora palmivora*, attacks the fruit and *Phomopsis*, *Dothiorella* and *Phylospora* cause stem-end rot.

Pests: Soft-scales and mealybugs are found on breadfruit trees and ants infest branches that die back after fruiting.

Nutrients: Standard mixtures of NPK are applied seasonally. When the trees reach bearing age, they each receive, in addition, 4.4 pounds superphosphate per year to increase the size and quality of the fruits.

Maturity: Trees begin to bear fruit five to seven years after planting the root shoot. In the South Seas, the tree fruits more or less continuously, fruit in all stages of development being present on the tree the year around, but there are two or three main fruiting periods. Breadfruits are most abundant in Hawaiian markets off and on from July to February. But some fruits may mature at other times during the year.

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Sources of Nursery Stock:

1. Plant It Hawaii, Kurtistown, Hawaii
2. Frankie Sekiya Nursery, Honolulu, Oahu
3. Kahili Farm Nursery, Kilauea, Kauai
4. Lyon Arboretum, Honolulu, Oahu

Production: Breadfruit is usually picked while still firm and will soften in a few days. If not picked before it softens on the tree, it often falls and smashes. Breadfruits are picked when maturity is indicated by the appearance of small drops of latex on the surface. It is recommended to pick breadfruit with the aid of a "picker", as the branches are brittle and can easily break. However, harvesters do climb the trees and break the fruit stalk with a forked stick so that the fruit will fall. Even though this may cause some bruising or splitting, it is considered better than catching the fruits by hand because the broken pedicel leaks much latex.

A mature tree may bear 50 to 150 fruits with two harvestable crops per year. A conservative estimate of 100 fruits weighting 8 to 10 pounds depending on the varieties used will yield 1,600 pounds of fruit per tree per year.

Uses: Breadfruit is a high carbohydrate vegetable, not a fruit as we generally use the term. It is a good source of calcium, a wholesome food high in vitamin B, with some ascorbic acid and thiamin. In green breadfruit, the carbohydrates are in the form of starch, turning to sugar as the fruit ripens.

There are recipes throughout the islands indicating many ways to prepare breadfruit. It may be steamed, baked, boiled, dried, fermented, marinated, fried and ground in to a powder for baked goods. It is also made into poi and desserts.

Like the banana and plantain, the breadfruit may be eaten ripe as a fruit or under ripe as a vegetable. For the latter purpose, it is picked while still starchy and is boiled or, in the traditional Pacific Island fashion, roasted in an underground oven on pre-heated rocks.

The breadfruit tree has many uses other than for food. All parts of the plant give off the milky sticky sap. When the sap is used alone or when mixed with other plants, it can be applied to the skin to heal cuts, scratches and various skin diseases. It is also used as a moisturizer for wind-cracked or scaly skin. Mouth sores can be treated with the sap and the leaf buds. The sap can also be used as a chewing gum, and more importantly was used in ancient days as a glue and caulking material, for such as canoe building.

In the old times, a birdlime made from the sap was used to catch nectar-feeding birds for their brightly colored feathers. These were collected for their service as warm and colorful capes for the chiefly ones. The fallen and sun-dried male flowers of the breadfruit can be lit, and the smoke is a nontoxic mosquito repellent.

The wood of the tree's trunk is light in weight. Hawaii's craftsmen used it for making canoes, woodwork for homes, drums, surfboards, and for poi boards. A low-grade tapa cloth was made from the inner bark of young branches. The rough sheath was used as a dry abrasive in the final polishing of bowls and utensils. It was also used to sand candlenut before they were strung into leis.

Marketing: The mainland markets, both the West Coast and East Coast, are importing breadfruit from the South Pacific and the Caribbean for the large Samoan population on the West Coast and Southeast Asians on both coasts. There are pockets of ethnic markets throughout the mainland, in Canada, and in Europe that are receiving small shipments of breadfruit. Breadfruit is also attracting the attention of gourmets. These markets have a good potential for Hawaiian breadfruit. Hawaii has a shelf life advantage as it is closer to these markets than the other exporters from the South Pacific and, therefore, shipping time is less.

The local market in Hawaii has never been developed for breadfruit. There is an opportunity for market expansion if the supermarkets promoted breadfruit and stocked it more consistently. Another opportunity is more use of Hawaiian breadfruit by the local chefs in restaurants and hotels. This would require a concerted effort by the farmers, wholesalers, and retailers.

Breadfruit is not a fruit fly host and may be shipped to the mainland without a post harvest treatment.

Packaging: Breadfruit is packed in cartons in which they are separated individually by dividers. Fully ripe fruits can be wrapped in polyethylene, or put into polyethylene bags, and kept for 10 days in storage at a temperature of 53.6°F. At lower temperatures, the fruit shows chilling injury. Slightly unripe fruits that have been caught by hand when knocked down can be maintained for 15 days under the same conditions. The thickness of the polyethylene is important: 38-or even 50-micrometer bags are beneficial, but not 25-micrometer.

Some Jamaican exporters partly roast the whole fruits to coagulate the latex, let them cool, and then ship them by sea to New York and Europe. In Jamaica, surplus breadfruits are often kept under water until needed.

Transport: Breadfruit can be transported by refrigerated containers either on ships or planes.

Oneloa Development Project: Cash Flow for Breadfruit

28-Jun-99 **Acreage:** **20**

Production & Revenue	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Pounds Harvested	-	-	-	-	43,605	65,408	87,210	119,914	152,618	196,223
Revenue	$0	$0	$0	$0	$21,803	$32,704	$43,605	$59,957	$76,309	$98,111
Average price per lb	$ 0.50									
Operating Costs										
Mowing	$2,448	$2,448	$2,448	$2,448	$2,040	$2,040	$2,040	$2,040	$2,040	$2,040
Herbicide	$1,836	$1,836	$1,836	$1,530	$918	$918	$918	$918	$918	$918
Fertilize	$408	$816	$1,632	$2,448	$2,448	$2,448	$2,448	$2,448	$2,448	$2,448
Pest Control	$85	$85	$85	$85	$85	$85	$85	$85	$85	$85
Hand Weeding	$2,550	$816	$0	$0	$0	$0	$0	$0	$0	$0
Replant	$51	$102	$102	$102	$102	$102	$102	$102	$102	$102
Pruning	$170	$170	$170	$170	$170	$170	$170	$170	$170	$170
Crop Log	$17	$17	$17	$17	$17	$17	$17	$17	$17	$17
Other	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing	$0	$0	$0	$0	$6,541	$9,811	$13,082	$17,987	$22,893	$29,433
Post-harvest Treatment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Management Fee	$1,902	$1,583	$1,583	$1,711	$2,437	$2,927	$3,418	$4,154	$4,890	$5,871
General Excise Tax	$396	$330	$330	$356	$726	$937	$1,148	$1,465	$1,782	$2,204
Total Operating Costs	$9,509	$7,916	$7,916	$8,553	$14,800	$18,561	$22,322	$27,963	$33,605	$41,127
Net Operating Profit (Loss)	($9,509)	($7,916)	($7,916)	($8,553)	$7,003	$14,143	$21,283	$31,994	$42,704	$56,985
Capital Expenditures	$ 26,748	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow	($36,258)	($7,916)	($7,916)	($8,553)	$7,003	$14,143	$21,283	$31,994	$42,704	$56,985
Cumulative Cash Flow		($44,173)	($52,089)	($60,642)	($53,639)	($39,497)	($18,213)	$13,780	$56,484	$113,469

Oneloa Development Project: Cash Flow for Breadfruit

28-Jun-99 **Acreage:** 20

Production & Revenue	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Pounds Harvested	239,828	283,433	327,038	370,643	414,248	457,853	479,655	479,655	479,655	479,655
Revenue	$119,914	$141,716	$163,519	$185,321	$207,124	$228,926	$239,828	$239,828	$239,828	$239,828
Average price per lb	$0.50									
Operating Costs										
Mowing	$1,428	$1,428	$1,428	$1,428	$1,428	$714	$714	$714	$714	$714
Herbicide	$918	$918	$918	$918	$918	$918	$918	$918	$918	$918
Fertilize	$2,448	$2,448	$2,448	$2,448	$2,448	$2,448	$2,448	$2,448	$2,448	$2,448
Pest Control	$85	$85	$85	$85	$85	$85	$85	$85	$85	$85
Hand Weeding	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Replant	$153	$153	$153	$153	$153	$196	$196	$196	$196	$196
Pruning	$170	$170	$170	$170	$170	$170	$170	$170	$170	$170
Crop Log	$17	$17	$17	$17	$17	$17	$17	$17	$17	$17
Other	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing	$35,974	$42,515	$49,056	$55,596	$62,137	$68,678	$71,948	$71,948	$71,948	$71,948
Post-harvest Treatment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Management Fee	$6,711	$7,693	$8,674	$9,655	$10,636	$11,449	$11,940	$11,940	$11,940	$11,940
General Excise Tax	$2,597	$3,019	$3,442	$3,864	$4,287	$4,674	$4,885	$4,885	$4,885	$4,885
	$47,947	$55,469	$62,991	$70,513	$78,035	$84,717	$88,478	$88,478	$88,478	$88,478
Net Operating Profit (Loss)	$71,967	$86,247	$100,528	$114,809	$129,089	$144,209	$151,350	$151,350	$151,350	$151,350
Capital Expenditures	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow	$71,967	$86,247	$100,528	$114,809	$129,089	$144,209	$151,350	$151,350	$151,350	$151,350
Cumulative Cash Flow	$185,436	$271,683	$372,211	$487,019	$616,109	$760,318	$911,667	$1,063,017	$1,214,366	$1,365,716

Acreage and Yield Assumptions

Acreage & Tree Count Assumptions:

Acreage		
Total acres		20.00
Estimated net tree acres	85%	17.00
Tree Data		
Density, trees per acre (40'x40')		27
Theoretical trees on net acres		459

Yield Assumptions:

Category	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Lbs/Tree/Year	-	-	-	-	100.0	150.0	200.0	275.0	350.0	450.0
Lbs Adjusted for Spoilage	-	-	-	-	95.0	142.5	190.0	261.3	332.5	427.5
Lbs per Tree Acre per Year	-	-	-	-	2,565	3,848	5,130	7,054	8,978	11,543

Category	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Lbs/Tree/Year	550.0	650.0	750.0	850.0	950.0	1,050.0	1,100.0	1,100.0	1,100.0	1,100.0
Lbs Adjusted for Spoilage	522.5	617.5	712.5	807.5	902.5	997.5	1,045.0	1,045.0	1,045.0	1,045.0
Lbs per Tree Acre per Year	14,108	16,673	19,238	21,803	24,368	26,933	28,215	28,215	28,215	28,215

Key Assumptions	
Estimated Producing Tree Density (tpa)	27
Spoilage	5.0%
Maximum Lbs per Tree Acre per Year	30,000

Average Price Assumptions:

Average Price	$	0.50

Cost Assumptions

Establishment Cost:

Category	Total Cost	Unit Cost	
Land Clearing	$ 16,000	$ 800	per acre
Planting	$ 7,344	$ 16	per tree
Management fee	$ 2,334	10%	
Sub-Total	$ 25,678		
GET	$ 1,070	4.166%	
Total	$ 26,748		

Planting Cost Detail:

Trees	$ 8.00
Soil	$ 2.00
Dig holes	$ 2.50
Labor	$ 3.00
Fertilizer	$ 0.50
Total	$ 16.00

Operating Costs:

Category	Rds. per Yr.	Cost per Acre per Round: Year 1	Year 2	Year 3	Year 4	Yr 5 thru 10	r 11 thru 15	r 16 thru 20
Mowing	6	$ 24.00	$ 24.00	$ 24.00	$ 24.00	$ 20.00	$ 14.00	$ 7.00
Herbicide	6	$ 18.00	$ 18.00	$ 18.00	$ 15.00	$ 9.00	$ 9.00	$ 9.00
Fertilize	4	$ 6.00	$ 12.00	$ 24.00	$ 36.00	$ 36.00	$ 36.00	$ 36.00
Pest Control	1	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00
Hand Weeding	6	$ 25.00	$ 8.00	$ -	$ -	$ -	$ -	$ -
Replant	1	$ 3.00	$ 6.00	$ 6.00	$ 6.00	$ 6.00	$ 9.00	$ 11.50
Pruning	1	$ 10.00	$ 10.00	$ 10.00	$ 10.00	$ 10.00	$ 10.00	$ 10.00
Crop Log	1	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00
Other	1	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50

	Unit Cost	
Harvesting	$ 0.05	per pound
Packing	$ 0.05	per pound
Packing Materials	$ 0.03	per pound
Hauling	$ 0.02	per pound
Total Harvest, Pack & Haul	$ 0.15	per pound
Post-harvest Treatment	$ -	per pound
Management - Cultivation	25%	of operating costs
Management - Harvesting	15%	of harvesting, packing & post-harvest treatment costs.
GET on Operating Costs	4.166%	
GET on Revenue	0.500%	

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CARAMBOLA (STARFRUIT)

Brief History: *Averrhoa carambola* L. originated in Southeast Asia but is now grown in tropical and warm subtropical lowland areas of the world.

Description: Carambola is a fast growing evergreen, symmetrical in form, 25-30 feet in height and 20-25 feet in spread. The leaves are light to dark green, alternate and compound with 2 to 11 ovate leaflets, 1-3 inches long. Fruit is ovoid to ellipsoid, 2.5-7 inches in length, with 5 prominent longitudinal ribs, star- shaped in cross section. Skin thin light to dark yellow, smooth, with a waxy cuticle. Flesh is light yellow-to-yellow, translucent, crisp, and very juicy, without fiber. Seeds are usually no more than 10-12 per fruit, sometimes none, 1/4 to 1/2 inch long, thin light brown, enclosed by gelatinous aril.

Basic Cultivation Requirements:
Soil: Carambola is tolerant of a wide range of soil types from sand to heavy clay loam. However, carambola grows best in deep clay loam with good drainage and where soil reaction is moderately acid. In calcareous soils, special care is required to prevent minor element deficiencies, particularly iron and zinc. It is tolerant of a wide range of pH levels, but 5.6 to 6.5 are preferred.

Temperature: Carambola grows best in a tropical or warm subtropical lowland climate. The East Hawaii temperatures, with lows of 60's and 70's and highs in 80's and low 90's are excellent for carambola.

Elevation: Tropical lowlands, sea level to 1500 ft., have the best fruit production.

Rainfall: Best fruit production occurs when trees have an adequate supply of moisture throughout the year, irrigation is advisable in times of drought. Optimum rainfall is 59 inches to 118 inches of rain, well distributed throughout year.

Cultural: In orchard planting, a spacing of 15 to 18 feet within the rows by 22 to 25 feet between rows is recommended. Carambola requires full sunlight and should not be shaded. Pruning is minimal and is done to promote a strong central leader and keep lower branches off the ground. Windbreaks are desirable to reduce limb breakage and in particular, fruit drop and fruit rub damage.

Diseases: Anthracnose caused by (*Colletotrichum gloeosporioides)* may be a problem, and leaf spot may arise from attack by (*Phomopsis sp., Phyllosticta sp.)* or (*Cercospora averrhoae).*

Pests: The carambola is relatively pest-free in Hawaii, except for fruit flies. In Malaya, fruit flies (especially *Dacus dorsalis*) are so troublesome on carambolas that growers have to wrap the fruits on the tree with paper.

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In Florida, a small stinkbug causes superficial blemishes and a black beetle attacks overripe fruits. Reniform nematodes may cause tree decline.

Nutrients: At the Research Center in Homestead, trees 8 to 10 ft (2.4-3 m) high respond well to 1 lb (0.5 kg) applications of N, P, K, Mg in the ratio of 6-6-6-3 given 3 to 4 times per year. If chlorosis occurs, it can be corrected by added iron, zinc and manganese. Some advisers recommend minor-element spraying 4 times during the year if the trees are on limestone soils.

Fruit Maturity: Fruit production starts in 5 to 8 years from seedlings and 1 to 2 years from rafts. Fruit develop evenly over a period of 10 to 14 weeks varying with cultivar and climate. Maturity is determined by color change, which is sometimes very slight. It may also depend on the cultivar's acceptable sweetness.

Sources of Nursery Stock: Grafted nursery stock is recommended to insure quality and fruit production, as seedlings are not true to type. Preferred varieties are Sri Kembangan, a bright yellow fruit 5 to 7 inches in length, with wide angled wings, and very sweet flesh; Kary which has flesh sweeter than Sri Kembangan, but identical in most other respects; Kajang, Kyra; and Arkin.

Nurseries that sell grafted carambola plants:
Plant It Hawaii, Kurtistown, Hawaii
Sekiya Nursery, Honolulu, Hawaii

Production: Grafted trees start flowering the first year after planting and yields increase annually. By the third year 50 pounds per tree can be expected. Production usually runs from September through January. Mature trees will yield 200 to 300 pounds of fruit per year starting in their fifth to eighth year. Fruits are picked singly, by hand; care being necessary, as bruised wing edges will discolor rapidly. Mechanical harvesting equipment (e.g., hydraulic lifts) would aid in harvesting but can only be used if the ground is level.

Processing: Pre-cooling and refrigeration (50' to 65' F) (10' to 20'C) together with P.V.C. wrap will give 10 to 20 days shelf life.

Use: The fruit is eaten fresh or made into preserves, jellies, juices, or dried. Its attractive star shape, when cut, is an excellent decorative addition to salads and main dishes.

Marketing: The market of carambola has increased dramatically with the development of cultivars superior in appearance and taste. These new varieties are recognized as a very attractive addition to menus in the gourmet hotels and restaurants. There is also a demand for this fruit in the expanding Asian markets and restaurants.

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Under current regulations, fresh fruit may be exported to the mainland with a cold treatment for 12 days at 1.1'C (34'F) or below. Irradiation at 250 Gy in an approved facility in Hawaii or in non-fruit fly supporting areas of the mainland U.S. is acceptable for export also.

Packaging: Hula Brothers, Inc. in Hilo has had the most experience in growing and selling carambola in Hawaii. Hula Brothers recommends wrapping the fruit individually in foam within specially designed cardboard cells, stem end down, in corrugated cardboard boxes (2 ply, 200 lb tested) of 20 to 25 fruit per box depending on size. Net box weight was 11 pounds.

Transport: Airfreight or refrigerated containers on the freight ships are used to ship the fruit to other islands and to the mainland.

Onelua Development Project: Cash Flow for Carambola (Starfruit)

28-Jun-99 **Acreage:** 20

Production & Revenue	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Pounds Harvested	-	28,101	93,670	187,340	318,478	430,882	515,185	562,020	562,020	562,020
Revenue	$0	$21,076	$70,253	$140,505	$238,859	$323,162	$386,389	$421,515	$421,515	$421,515
Average price per lb	$ 0.75									
Operating Costs										
Mowing	$2,448	$2,448	$2,040	$2,040	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428
Herbicide	$1,836	$1,836	$1,530	$1,224	$918	$918	$918	$918	$918	$918
Fertilize	$714	$867	$1,020	$1,224	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428
Pest Control	$51	$51	$51	$51	$51	$51	$51	$51	$51	$51
Hand Weeding	$2,550	$816	$0	$0	$0	$0	$0	$0	$0	$0
Replant	$51	$102	$102	$102	$102	$102	$102	$102	$102	$102
Pruning	$0	$85	$85	$85	$85	$85	$85	$85	$85	$85
Crop Log	$17	$17	$17	$17	$17	$17	$17	$17	$17	$17
Other	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing	$0	$7,868	$26,228	$52,455	$89,174	$120,647	$144,252	$157,366	$157,366	$157,366
Post-harvest Treatment	$0	$1,405	$4,684	$9,367	$15,924	$21,544	$25,759	$28,101	$28,101	$28,101
Management Fee	$1,927	$2,957	$5,859	$10,470	$16,783	$22,347	$26,520	$28,838	$28,838	$28,838
General Excise Tax	$401	$876	$2,087	$3,914	$6,441	$8,640	$10,289	$11,205	$11,205	$11,205
Total Operating Costs	$9,637	$18,495	$41,657	$77,077	$125,952	$168,609	$200,602	$218,376	$218,376	$218,376
Net Operating Profit (Loss)	($9,637)	$2,581	$28,595	$63,428	$112,907	$154,552	$185,787	$203,139	$203,139	$203,139
Capital Expenditures	$ 52,227	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow	($61,864)	$2,581	$28,595	$63,428	$112,907	$154,552	$185,787	$203,139	$203,139	$203,139
Cumulative Cash Flow		($59,283)	($30,687)	$32,740	$145,647	$300,199	$485,986	$689,125	$892,264	$1,095,403

Oneloa Development Project - Cash Flow for Carambola (Starfruit)

28-Jun-99 **Acreage:** 20

Production & Revenue	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Pounds Harvested	562,020	562,020	562,020	562,020	562,020	562,020	562,020	562,020	562,020	562,020
Revenue	$421,515	$421,515	$421,515	$421,515	$421,515	$421,515	$421,515	$421,515	$421,515	$421,515
Average price per lb	$0.75									
Operating Costs										
Mowing	$714	$714	$714	$714	$714	$714	$714	$714	$714	$714
Herbicide	$918	$918	$918	$918	$918	$918	$918	$918	$918	$918
Fertilize	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428
Pest Control	$51	$51	$51	$51	$51	$51	$51	$51	$51	$51
Hand Weeding	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Replant	$153	$153	$153	$153	$153	$153	$153	$153	$153	$153
Pruning	$85	$85	$85	$85	$85	$85	$85	$85	$85	$85
Crop Log	$17	$17	$17	$17	$17	$17	$17	$17	$17	$17
Other	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing	$157,366	$157,366	$157,366	$157,366	$157,366	$157,366	$157,366	$157,366	$157,366	$157,366
Post-harvest Treatment	$28,101	$28,101	$28,101	$28,101	$28,101	$28,101	$28,101	$28,101	$28,101	$28,101
Management Fee	$28,672	$28,672	$28,672	$28,672	$28,672	$28,672	$28,672	$28,672	$28,672	$28,672
General Excise Tax	$11,171	$11,171	$11,171	$11,171	$11,171	$11,171	$11,171	$11,171	$11,171	$11,171
Total Operating Costs	$217,547	$217,547	$217,547	$217,547	$217,547	$217,547	$217,547	$217,547	$217,547	$217,547
Net Operating Profit (Loss)	$203,968	$203,968	$203,968	$203,968	$203,968	$203,968	$203,968	$203,968	$203,968	$203,968
Capital Expenditures	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow	$203,968	$203,968	$203,968	$203,968	$203,968	$203,968	$203,968	$203,968	$203,968	$203,968
Cumulative Cash Flow	$1,299,371	$1,503,339	$1,707,306	$1,911,274	$2,115,242	$2,319,210	$2,523,178	$2,727,145	$2,931,113	$3,135,081

28-Jun-99 **Acreage:** 20

Acreage and Yield Assumptions

Acreage & Tree Count Assumptions:

Acreage		
Total acres		20.00
Estimated net tree acres	85%	17.00
Tree Data		
Density, trees per acre (15'x25')		116
Theoretical trees on net acres		1,972

Yield Assumptions:

Category	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Lbs/Tree/Year	-	15.0	50.0	100.0	170.0	230.0	275.0	300.0	300.0	300.0
Lbs Adjusted for Spoilage	-	14.3	47.5	95.0	161.5	218.5	261.3	285.0	285.0	285.0
Lbs per Tree Acre per Year	-	1,653	5,510	11,020	18,734	25,346	30,305	33,060	33,060	33,060

Category	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Lbs/Tree/Year	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0
Lbs Adjusted for Spoilage	285.0	285.0	285.0	285.0	285.0	285.0	285.0	285.0	285.0	285.0
Lbs per Tree Acre per Year	33,060	33,060	33,060	33,060	33,060	33,060	33,060	33,060	33,060	33,060

Key Assumptions

Estimated Producing Tree Density (tpa)		116
Spoilage		5.0%
Maximum Lbs per Tree Acre per Year		35,000

Average Price Assumptions:

Grade #1	80%	$	1.00
Grade #2	20%	$	0.50
Average Price		$	0.75

28-Jun-99 **Acreage:** 20

Cost Assumptions

Establishment Cost:

Category		Total Cost	Unit Cost	
Land Clearing		$ 16,000	$ 800	per acre
Planting		$ 29,580	$ 15	per tree
Management fee		$ 4,558	10%	
	Sub-Total	$ 50,138		
	GET	$ 2,089	4.166%	
	Total	$ 52,227		

Planting Cost Detail:

Trees	$ 7.00
Soil	$ 2.00
Dig holes	$ 2.50
Labor	$ 3.00
Fertilizer	$ 0.50
Total	$ 15.00

Operating Costs:

Cost per Acre per Round:

Category	Rds. per Yr.	Year 1	Year 2	Year 3	Year 4	Yr 5 thru 10	Yr 11 thru 15	Yr 16 thru 20
Mowing	6	$ 24.00	$ 24.00	$ 20.00	$ 20.00	$ 14.00	$ 7.00	$ 7.00
Herbicide	6	$ 18.00	$ 18.00	$ 15.00	$ 12.00	$ 9.00	$ 9.00	$ 9.00
Fertilize	6	$ 7.00	$ 8.50	$ 10.00	$ 12.00	$ 14.00	$ 14.00	$ 14.00
Pest Control	1	$ 3.00	$ 3.00	$ 3.00	$ 3.00	$ 3.00	$ 3.00	$ 3.00
Hand Weeding	6	$ 25.00	$ 8.00	$ -	$ -	$ -	$ -	$ -
Replant	1	$ 3.00	$ 6.00	$ 6.00	$ 6.00	$ 6.00	$ 9.00	$ 9.00
Pruning	1	$ -	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00
Crop Log	1	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00
Other	1	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50

		Unit Cost	
Harvesting	$	0.10	per pound
Packing	$	0.10	per pound
Packing Materials	$	0.06	per pound
Hauling	$	0.02	per pound
Total Harvest, Pack & Haul	$	0.28	per pound
Post-harvest Treatment	$	0.05	per pound
Management - Cultivation		25%	of operating costs
Management - Harvesting		15%	of harvesting, packing & post-harvest treatment costs.
GET on Operating Costs		4.166%	
GET on Revenue		0.500%	

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LIMES

Brief History: The origin of Bearss' lime (*Citrus latifolia* Tanaka) is unknown. It is not a true lime, probably being a hybrid between the true lime and another citrus species. It first appeared in California about 1875. It is also known as 'Persian' lime and 'Tahiti' lime. Bearss' lime accounts for the commercial lime industry in south Florida.

Description: The fruit is medium-small, often shaped much like a small lemon or a large 'Key' lime but shape is variable. The peel is thin, smooth, tightly adherent and medium to dark green when harvested, but yellow at full maturity. The flesh is pale greenish-yellow, very acid and juicy. Seeds are rare. There are about 10 segments around a small, solid axis.

The tree is small to medium in size, spreading, vigorous and nearly thorn-less.
It does best in the lowland tropics and warm subtropics. The main crop matures in the summer but some mature fruit are present year round.

Basic Cultivation Requirements:
Soil: Bearss'limes can be grown successfully in a variety of soils. Well-drained locations are essential for good fruit production and growth.

Temperature: It does best in the lowland tropics and warm subtropics.

Elevation: Sea level to 2500 feet.

Rainfall: Bearss' limes are not tolerant of drought. Irrigation is essential for commercial fruit production in areas with a dry season. The trees require a minimum of 60 inches of rainfall per year in order to be commercially productive. If the water is applied uniformly, through a drip irrigation system, the requirement is reduced to 52 inches per year (1 inch per week).

At maturity, the water requirement for irrigation is 15,229 gallons per acre per week. This assumes that only the area under the tree canopy will be irrigated and that the canopy diameter at maturity is 18 feet.

Cultural: The Bearss' lime is small, reaching 20 feet in height, with a round canopy hanging to the ground. It is easily pruned to any shape. The leaves are dark green, oval, 3.5 to 5 inches long, and persist up to 3 years on the tree. The wing on the petiole is usually narrow, but can vary. Flowers are white, fragrant, 1 inch in diameter, and borne in clusters of 5 to 10 on new shoots at the tip and several nodes back. Some bloom occurs all year. Bearss' limes are oval, 2 1/4 - 2 3/4 inches length, and 1 7/8 - 2 1/2 inches diameter. The fruit are medium to dark green at commercial maturity, becoming yellow before dropping from the tree. When grown in solid plantings, the fruit is seedless. Acids are 5 - 6%, solids 8 - 10%, and juice content 45 - 55% by volume. Flavor and aroma are good.

Requires 100 - 120 days from bloom to maturity. Trees can be grown satisfactorily without pruning except for occasional removal of suckers and dead branches.

However, in closely spaced groves it is desirable to limit size of trees by regular pruning. Annual topping to a height of 8 - 12 feet and hedging to a width of 6 - 8 feet are practical, making trees resistant to wind damage, and to facilitate harvesting operations.

Bearss' lime groves are planted in rows 20 to 25 feet apart. Tree spacing in the row varies from 10 to 20 feet, depending upon grower preference.

Shield budding is the preferred method of propagation and can be done at any time of year when suitable buds and rootstocks are available. Buds should be selected from mature, round wood on which leaves are still present. Rootstocks should be in active growth. If condition of rootstock is not suitable for shield budding, chip budding is the best alternative.

Trees can be propagated easily by air layering (marcottage).

Diseases: Tristeza virus, Lime blotch disease, Stylar end breakdown (Stylar end rot), Fungus disease, and Algal disease.

Pests: Mites, Scale insects, White fly.

Nutrients: Limes have a high nitrogen requirement for maximum fruit production. Nitrogen rates of 300 - 350 pounds per year yield enough extra fruit to be economical. Potassium is less limiting than nitrogen, but may be required in amounts equal to nitrogen where there is nutrient leaching because of excessive rainfall. Minor elements may be deficient, especially manganese and zinc. Leaf analysis during the year to monitor crop nutrient levels will assist the grower in selecting the necessary fertilizer program.

Maturity: Bearss' limes trees in Hawaii are grown from grafts. The trees will begin Bearing fruit within 2 to 3 years reaching full production in 6 to 7years. The main crop matures in the summer but some mature fruit are present year round.

Sources of Nursery Stock:

1. Plant It Hawaii, Kurtistown, Hawaii
2. Kahili Farm Nursery, Kilauea, Kauai

Production: The harvest season in Hawaii is from October through May. Climate has a strong influence on fruit size, shape, flavor and juice content, as well as color, texture, and thickness of skin. Once established trees need minimal maintenance.

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With good planting stock and good care, groves can be in production in 3 years after planting. Isolated mature trees are capable of producing 400 to 3500 pounds of fruit per year. Trees planted close together in the grove produce less fruit. Good groves will produce 30,000 - 40,000 pounds of fruit per acre per year.

If handled and stored correctly, limes can remain in acceptable condition under commercial conditions for six to eight weeks.

Uses: Fresh fruit is used as garnish for meats and drinks. Fresh juice is used in beverages, marinating fish and meats and seasoning many foods. Frozen and canned juice is used in similar ways. Lime oil is widely used in flavorings and cosmetics.

Marketing: The general range in price for citrus is $0.30 to $0.75 cents per pound depending on market conditions such as competition from mainland. The large tourist trade in the state's hotels and restaurants makes limes for drinks and cooking a necessary food item. Hawaii has historically been a net importer of limes and has not been able to produce enough to fill the supply required by both the local and visitor generated market. Grown efficiently this fruit has an excellent potential, as the demand is consistent and local fruit preferred. Local fruit is fresher and has a longer shelf life.

Limes can be marketed in Alaska and Canada without post harvest quarantine treatment, but not to the mainland U.S. At this time no growers are exporting limes out of Hawaii.

Packaging: Export markets require that minimum size specifications be met and that limes in each carton are of similar size. Fruit are loose packed to 11 to 29 lbs. Two-piece full or half-telescopic fiberboard cartons, bursting strength 250 to 275 lb/in., are used.

Transport: Barge services or airfreight.

Oneloa Development Project: Cash Flow for Limes

28-Jun-99 **Acreage:** 20

Production & Revenue	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Pounds Harvested	-	-	35,207	70,414	140,828	228,846	316,863	387,277	457,691	510,000
Revenue	$0	$0	$21,124	$42,248	$84,497	$137,307	$190,118	$232,366	$274,615	$306,000
Average price per lb	$ 0.60									
Operating Costs										
Mowing	$2,448	$2,448	$2,040	$2,040	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428
Herbicide	$1,836	$1,836	$1,530	$1,224	$918	$918	$918	$918	$918	$918
Fertilize	$714	$867	$1,020	$1,224	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428
Pest Control	$170	$170	$170	$85	$85	$85	$85	$85	$85	$85
Hand Weeding	$2,550	$816	$0	$0	$0	$0	$0	$0	$0	$0
Replant	$51	$102	$102	$102	$102	$102	$102	$102	$102	$102
Pruning	$255	$255	$255	$510	$510	$510	$510	$510	$510	$510
Crop Log	$17	$17	$17	$17	$17	$17	$17	$17	$17	$17
Other	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing	$0	$0	$7,041	$14,083	$28,166	$45,769	$63,373	$77,455	$91,538	$102,000
Post-harvest Treatment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Management Fee	$2,021	$1,638	$2,350	$3,424	$5,357	$7,998	$10,639	$12,751	$14,863	$16,433
General Excise Tax	$421	$341	$713	$1,159	$2,008	$3,115	$4,223	$5,109	$5,995	$6,653
Total Operating Costs	$10,104	$8,192	$14,568	$22,751	$38,054	$58,298	$78,542	$94,737	$110,932	$122,963
Net Operating Profit (Loss)	($10,104)	($8,192)	$6,556	$19,498	$46,443	$79,010	$111,576	$137,629	$163,683	$183,037
Capital Expenditures	$ 82,030	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow	($92,134)	($8,192)	$6,556	$19,498	$46,443	$79,010	$111,576	$137,629	$163,683	$183,037
Cumulative Cash Flow		($100,326)	($93,770)	($74,272)	($27,829)	$51,181	$162,757	$300,386	$464,069	$647,106

Onoloa Development Project: Cash Flow for Limes

28-Jun-99 **Acreage:** 20

Production & Revenue	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Pounds Harvested	510,000	510,000	510,000	510,000	510,000	510,000	510,000	510,000	510,000	510,000
Revenue	$306,000	$306,000	$306,000	$306,000	$306,000	$306,000	$306,000	$306,000	$306,000	$306,000
Average price per lb	$0.60									
Operating Costs										
Mowing	$714	$714	$714	$714	$714	$714	$714	$714	$714	$714
Herbicide	$918	$918	$918	$918	$918	$918	$918	$918	$918	$918
Fertilize	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428	$1,428
Pest Control	$85	$85	$85	$85	$85	$85	$85	$85	$85	$85
Hand Weeding	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Replant	$153	$153	$153	$153	$153	$196	$196	$196	$196	$196
Pruning	$510	$510	$510	$510	$510	$510	$510	$510	$510	$510
Crop Log	$17	$17	$17	$17	$17	$17	$17	$17	$17	$17
Other	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing	$102,000	$102,000	$102,000	$102,000	$102,000	$102,000	$102,000	$102,000	$102,000	$102,000
Post-harvest Treatment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Management Fee	$16,267	$16,267	$16,267	$16,267	$16,267	$16,278	$16,278	$16,278	$16,278	$16,278
General Excise Tax	$6,618	$6,618	$6,618	$6,618	$6,618	$6,620	$6,620	$6,620	$6,620	$6,620
Total Operating Costs	$122,134	$122,134	$122,134	$122,134	$122,134	$122,188	$122,188	$122,188	$122,188	$122,188
Net Operating Profit (Loss)	$183,866	$183,866	$183,866	$183,866	$183,866	$183,813	$183,813	$183,813	$183,813	$183,813
Capital Expenditures	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow	$183,866	$183,866	$183,866	$183,866	$183,866	$183,813	$183,813	$183,813	$183,813	$183,813
Cumulative Cash Flow	$830,971	$1,014,837	$1,198,702	$1,382,568	$1,566,434	$1,750,246	$1,934,059	$2,117,871	$2,301,684	$2,485,496

Acreage and Yield Assumptions

Acreage & Tree Count Assumptions:

Acreage		
Total acres		20.00
Estimated net tree acres	85%	17.00
Tree Data		
Density, trees per acre (10'x20')		218
Theoretical trees on net acres		3,706

Yield Assumptions:

Category	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Lbs/Tree/Year	-	-	10.0	20.0	40.0	65.0	90.0	110.0	130.0	150.0
Lbs Adjusted for Spoilage	-	-	9.5	19.0	38.0	61.8	85.5	104.5	123.5	142.5
Lbs per Tree Acre per Year	-	-	2,071	4,142	8,284	13,462	18,639	22,781	26,923	30,000

Category	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Lbs/Tree/Year	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0
Lbs Adjusted for Spoilage	142.5	142.5	142.5	142.5	142.5	142.5	142.5	142.5	142.5	142.5
Lbs per Tree Acre per Year	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000

Key Assumptions

Estimated Producing Tree Density (tpa)	218
Spoilage	5.0%
Maximum Lbs per Tree Acre per Year	30,000

Average Price Assumptions:

Average Price	$	0.60

28-Jun-99 **Acreage:** 20

Cost Assumptions

Establishment Cost:

Category	Total Cost	Unit Cost	
Land Clearing	$ 16,000	$ 800	per acre
Planting	$ 55,590	$ 15	per tree
Management fee	$ 7,159	10%	
Sub-Total	$ 78,749		
GET	$ 3,281	4.166%	
Total	$ 82,030		

Planting Cost Detail:

Trees	$ 7.00
Soil	$ 2.00
Dig holes	$ 2.50
Labor	$ 3.00
Fertilizer	$ 0.50
Total	$ 15.00

Operating Costs:

Cost per Acre per Round:

Category	Rds. per Yr.	Year 1	Year 2	Year 3	Year 4	Yr 5 thru 10	Yr 11 thru 15	Yr 16 thru 20
Mowing	6	$ 24.00	$ 24.00	$ 20.00	$ 20.00	$ 14.00	$ 7.00	$ 7.00
Herbicide	6	$ 18.00	$ 18.00	$ 15.00	$ 12.00	$ 9.00	$ 9.00	$ 9.00
Fertilize	6	$ 7.00	$ 8.50	$ 10.00	$ 12.00	$ 14.00	$ 14.00	$ 14.00
Pest Control	1	$ 10.00	$ 10.00	$ 10.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00
Hand Weeding	6	$ 25.00	$ 8.00	$ -	$ -	$ -	$ -	$ -
Replant	1	$ 3.00	$ 6.00	$ 6.00	$ 6.00	$ 6.00	$ 9.00	$ 11.50
Pruning	1	$ 15.00	$ 15.00	$ 15.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00
Crop Log	1	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00
Other	1	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50

	Unit Cost	
Harvesting	$ 0.10	per pound
Packing	$ 0.05	per pound
Packing Materials	$ 0.03	per pound
Hauling	$ 0.02	per pound
Total Harvest, Pack & Haul	$ 0.20	per pound
Post-harvest Treatment	$ -	per pound
Management - Cultivation	25%	of operating costs
Management - Harvesting	15%	of harvesting, packing & post-harvest treatment costs.
GET on Operating Costs	4.166%	
GET on Revenue	0.500%	

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LYCHEE

Brief History: *Litche chinensis Sonn* is native to southern China but is now grown commercially in southern China, Taiwan, north-central India, South Africa, Australia and the United States: Florida and Hawaii. It is closely related to the longan (Dimocarpus longan), which is another tropical fruit species that has commercial promise in Hawaii.

Lychee was first introduced into Hawaii in 1873 by Ching Chock. It was a single tree (variety Kwai Mi) planted in the Nuuanu area above Honolulu. There have been a few commercial orchards planted in Hawaii over the past 100 years. There are also a large number of trees planted by homeowners throughout the state.

Description: Lychee is a round-topped, long-lived, subtropical evergreen tree growing to 40 feet in height. Leaves are pinnate with one to five pairs of leaflets, 3 to 7 inches long. Fruits are spherical, ovoid or ovate in shape, 2.5-4 cm long, weighing 12-25g, borne in clusters. The pericarp is leathery and covered with small conical protuberances. External color at ripeness is greenish-yellow, yellow, or various shades of red. Flesh color is a translucent, whitish, juicy aril, which surrounds the single, large dark brown seed.

Basic Cultivation Requirements:
Soil: Lychee is adaptable over a wide range of soil types, from heavy clays to a'a lavas, but good drainage is a must. Lychee tolerates wet soils to some degree. Deep, fertile, loamy soils of pH 5.0 to 6.5 are best, but other kinds of soils are used successfully where growers give attention to proper nutrition. Coral sands are the least desirable soil type.

Temperature: Lychees are better adapted to subtropical than to tropical climates. The best climates for growing lychee have a warm, wet spring and summer followed by a cool, dry fall and winter. Ideal conditions for lychee production occur in subtropical China, where the temperatures drop below 50 F in January and rise above 90 F in the summer. Under less-than-ideal conditions, yields are usually variable and erratic. Temperature affects flowering and fruiting of lychees. Varieties such as Kaimana, Kwai Mi Pink, Bosworth, Groff and Hak Ip often flower and fruit in spite of warm winter temperatures.

Elevation: In Hawaii, most lychees are grown below the 1500-foot level, but trees are found from sea level to an elevation of 2000 feet. Hilo, at sea level to a few hundred feet elevation, is a major lychee homeowner growing area.

Rainfall: The lychee is cultivated under a wide rainfall range. Trees can be grown in areas with less than 10 inches of rain with supplementary irrigation, as well as in areas with up to 140 inches of rain annually. Areas with 60-140 inches of rainfall per year are suitable for lychees. Short periods of soil waterlogging and light flooding are tolerated, but standing water is not.

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Cultural: Tree spacing recommended is 30' x 30'. This spacing allows room for the tree's growth so that sunlight and air circulation are adequate, and harvesting completely around the tree can be done without injury to the tree. Weeds and grass under the trees can be controlled with the herbicide Roundup and heavy mulching. As the trees age, they form their own mulch from normal leaf drop and annual prunings, which can be dropped under the tree. Young plants should be trained to establish good tree structure, avoiding sharp crotch angles. Air-layered plants tend to develop low branches and should be pruned to a single leader at transplanting time. Later, pruning should direct growth into about four well-spaced scaffold branches. Acute-angled branches form weak crotches, which often split, and should be removed. When the trees reach bearing age, they should be pruned immediately after harvest each year to remove the tips of the branches and any weak or poorly formed limbs. Lychee cannot withstand high winds. The branches are brittle and the flowers are readily blown off. It is extremely important to provide adequate windbreaks. Suggested windbreak trees are ironwood, paperbark, and box brush.

Diseases: There are no serious disease problems in this crop in Hawaii at the present time.

Pests: The most common pest is erinose mite, which can cause damage to the leaves. The leaves become curled, distorted and small, and velvety with rust colored protuberances on them. Control can be maintained by spraying with an organic insecticide. As the trees age, mite damage becomes less of a problem. Other pests are the lychee fruit moth, the koa seedworm, and the Oriental fruit fly. Trapping with pheromone traps, Malathion baits around the edge of the orchard, and harvesting the fruit in a very timely manner are the main controls for the fruit fly. There is minor damage from thrips and scales that occasionally attack the foliage. Birds can be a pest of the fruit just prior to harvest. Pests: Litchi mite, erinose (Eriophyes litchi). Green scale (Coccus viridis). Hemispherical scale (Saissetia coffeae). White litchi scale (Pseudaulacaspis major). Chinese rose beetle (Adoretus sinicus). Litchi fruit moth (Cryptophlebia ombrodelta). Koa seedworm, macadamia husk borer (Cryptophlebia illepida). Anthurium thrips (Chaetanaphothrips orchidi). Red banded thrips (Selenothrips rubrocintus). Black twig borer (Xylosandrus compactus). A twig borer (Xylosandrus crassiusculus). An ambrosia beetle (Xyleborus fornicatus.

A spider mite (Oligonychus biharensis). Ants. Birds. Red-vented bulbul (Pycnonotus cafer). Red-whiskered bulbul (P. jocosus). Mejiro, Japanese white-eye (Zosterops japonicus).

Nutrients: A composite fertilizer is applied generally 6 times per year. Fertilizer can be applied through an irrigation system. Soil and leaf tissue are analyzed periodically to assist in determining nutrient requirement. Potassium, an element that is important for flowering and fruiting should be carefully monitored.

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Compost is recommended. Research by University of Hawaii College of Tropical Agriculture and Human Services on optimum nutrition for lychees is in progress.

Fruit Maturity: Flowering usually starts in late January through February with the first fruit ripe in late May or early June. The lychee must be picked ripe from the tree, when the skin turns red, as it will not ripen after harvesting.

Sources of Nursery Stock: Lychee propagation from seed is not satisfactory because varieties do not produce true from seed, and the trees can take 10 years to bear. Air layering is the most common method of propagation. Most of the commercial trees today are air layered Kaimana lychees. Patch budding can be done and produces better root systems that air layered trees. The nurseries use air layering because it is quicker and most cost effective for them. The preferred varieties are Groff, Kaimana, Kwai Mi Pink, and Bosworth 3. Groff, developed from a `Hak Ip' seedling, is an up-right tree of medium vigor that bears somewhat regularly and is often late maturing (late August through September). Its fruits are dull red and small, 38-42 to a pound, and a high percentage has abortive seeds. Kaimana, also a `Hak Ip' seedling, is a medium- sized, compact, rounded tree that usually matures fruit from mid-June through July. Like `Groff, it is considered good bearing compared with most other varieties in Hawaii. Its fruits are deep maroon with a smooth, leathery skin. Fruits average 1.2 to 1.6 inches in diameter and weigh 0.7 to 0.9 oz.; the edible pulp is 71 to 75 percent of the total fruit weight. Usually about 40 percent of the seeds are abortive. Kwai Mi Pink is tall and upright cultivar. The fruits average 30 to a pound. Bosworth 3 is a variety that produces fruit later in the season, July and August. The fruit is small and very sweet with a light pinkish-brown shell. There are approximately 35 fruits to a pound. None of these varieties bears a crop every year. Research is being done to understand the exact nature of the problem.

Nurseries that sell air layered lychee trees:

1. Plant It Hawaii, Kurtistown, Hawaii
2. Manelo Orchard, Hilo, Hawaii
3. Kahili Farm Nursery, Kilauea, Kauai

Production: After planting, the air layered and grafted lychee tree will produce its first fruit in 3 to 5 years. Fruits mature three to five months after flowering. In Hawaii, early cultivars are harvested in May and June, late cultivars from mid-July through September. Yield and maturity are variable by location and year. The estimated yield is 22 pounds per tree per year at the start of its bearing. Yield will increase each year and peak at approximately 350 pounds per tree per year between the eighteenth and twentieth year. The harvest season lasts approximately 8 weeks in a uniform orchard.

Packing: The fruits are hand picked from the tree using ladders or hydraulic lifts for access. The fruits are perishable and must be handled quickly and carefully.

They should be chilled at approximately 50' F to remove field heat after removing them from the pedicel, sorting, and boxing. For storage and to maintain shelf life the lychees should be refrigerated at 32' to 40' F and packed in plastic bags that have minute air holes. Freshness and color can be maintained by this method for up to three weeks.

Uses: Lychees are the most popular as fresh fruit. However, lychees can be frozen and maintain their flavor for approximately a year. Lychees can also be dried. The chefs in the gourmet restaurants use lychees in their entrée dishes and in sauces. The lychee is also used for flavoring in an ice cream. Southeast Asian countries can lychees. These can be 100% lychees or such combinations as lychees stuffed with a pineapple wedge. Lychees are also being used more recently in tropical juice blends.

Marketing: The lychee industry in Hawaii at present is comprised of approximately 70 growers farming 225 acres that produce 114,300 pounds. The farm value of the industry's production is $206,400. Data for 1997 shows production increasing substantially over the next few years as only 75 acres of the 225 acres planted are presently in production. Commercial growers received an average of $1.81 per pound for their 1997 lychee crop. These statistics are from the 1997 Hawaii Agricultural Statistics Service tropical specialty fruits annual report dated September 14, 1998.

The market for fresh lychees is primarily on the islands of Oahu and Hawaii at the present time. In 1969, prior to fruit fly quarantine for local fruits, Hawaii shipped the U.S. mainland 89,000 pounds of fresh lychees. However, shipments to the US mainland have been made over the last couple of years in sealed containers to an irradiation facility in Chicago. This followed the United States Food and Drug Administration's approval of irradiation of specific doses for post harvest quarantine treatment for certain tropical fruits. After treatment in this facility to kill the fruit fly pest, the lychee fruit has been distributed to wholesalers. The quality of the fruit is the same as fresh fruit without treatment. Demand for this fruit has been excellent, and customer resistance to the irradiated fruit negligible. Grower price for the Kaimana lychees shipped to the mainland were $3.00 per pound f.o.b. the island airport.

The state Department of Agriculture has a temporary permit from the United States Department of Agriculture Animal and Plant Inspection Service (USDA-APHIS) to ship certain Hawaii fruits to the mainland U.S. for irradiation. In the meantime an irradiation facility specifically for post harvest quarantine treatments of local agricultural products may be built in Hilo. Meanwhile, the use of the electron beam process is being researched as a more environmentally preferred post harvest treatment. The impact on the marketing of lychees where a fast, convenient post harvest treatment is constructed will be substantial. The lychee season is short and every backyard grower with more lychees than he or his family can consume sells lychees at a reduced price and no uniformity as to size or quality. This impacts the commercial grower who must compete in a saturated local market. The capability of developing mainland markets for graded quality fruit will be greatly enhanced by the construction of a post harvest irradiation facility in Hilo.

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There is some concern that Southeast Asian countries, such as Malaysia and Thailand, will also build post harvest facilities to treat their lychees for export to the U.S. market. The Hawaii grower should have a head start into the mainland market, but will have to develop a broad-based clientele for the fruit as well as secondary products for the off-grade fruit.

United States Department of Agriculture Agricultural Research Service (USDA-ARS) in Hilo has developed an approved post harvest quarantine treatment that has a minor impact on the fruit quality and allows shipment of the fruit to the mainland at the present time. This is a hot water dip for 20 minutes at 49'C followed by a cooling dip. This treatment will be used by commercial growers for the first time in the 1999 season. The facilities required for this treatment are not elaborate and can be constructed easily on individual farms. Exact construction costs are not known at this time.

Packaging: Corrugated cardboard box, 2 ply, 200 lb tested. This is available at Weyerhaeuser Paper Company

Transport: At this time fresh lychees are shipped by airfreight at a cost of $0.20 per pound to Honolulu. During the lychee season shipments are daily six days a week, so barge service in refrigerated containers to Honolulu is not practical at this time. The lychees are usually priced f.o.b. at the grower's island.

Onolea Development Project: Cash Flow for Lychee

28-Jun-99 **Acreage:** **20**

Production & Revenue		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Pounds Harvested		-	-	-	3,876	19,380	38,760	58,140	58,140	62,016	77,520
Revenue		$0	$0	$0	$6,899	$34,496	$68,993	$103,489	$103,489	$110,388	$137,986
Average price per lb	$	1.78									
Operating Costs											
Mowing		$2,448	$2,448	$2,448	$2,448	$2,040	$2,040	$2,040	$2,040	$2,040	$2,040
Herbicide		$1,836	$1,836	$1,836	$1,530	$918	$918	$918	$918	$918	$918
Fertilize		$816	$1,632	$3,264	$3,944	$3,944	$3,944	$3,944	$3,944	$3,944	$3,944
Pest Control		$170	$170	$170	$85	$85	$85	$85	$85	$85	$85
Hand Weeding		$2,550	$816	$0	$0	$0	$0	$0	$0	$0	$0
Replant		$51	$102	$102	$102	$102	$102	$102	$102	$102	$102
Pruning		$255	$255	$255	$510	$510	$510	$510	$510	$510	$510
Crop Log		$17	$17	$17	$17	$17	$17	$17	$17	$17	$17
Other		$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing		$0	$0	$0	$2,364	$11,822	$23,644	$35,465	$35,465	$37,830	$47,287
Post-harvest Treatment		$0	$0	$0	$775	$3,876	$7,752	$11,628	$11,628	$12,403	$15,504
Management Fee		$2,046	$1,830	$2,034	$2,641	$4,269	$6,624	$8,979	$8,979	$9,450	$11,333
General Excise Tax		$426	$381	$424	$637	$1,323	$2,248	$3,172	$3,172	$3,357	$4,097
Total Operating Costs		$10,232	$9,148	$10,168	$14,459	$27,626	$45,678	$63,731	$63,731	$67,341	$81,783
Net Operating Profit (Loss)		($10,232)	($9,148)	($10,168)	($7,559)	$6,871	$23,315	$39,759	$39,759	$43,047	$56,203
Capital Expenditures	$	39,838	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow		($50,070)	($9,148)	($10,168)	($7,559)	$6,871	$23,315	$39,759	$39,759	$43,047	$56,203
Cumulative Cash Flow			($59,218)	($69,386)	($76,946)	($70,075)	($46,760)	($7,001)	$32,757	$75,805	$132,007

Oneloa Development Project - Cash Flow for Lychee

28-Jun-99 **Acreage:** **20**

Production & Revenue	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Pounds Harvested	96,900	96,900	100,776	116,280	122,400	122,400	122,400	122,400	122,400	122,400
Revenue	$172,482	$172,482	$179,381	$206,978	$217,872	$217,872	$217,872	$217,872	$217,872	$217,872
Average price per lb	$1.78									
Operating Costs										
Mowing	$1,428	$1,428	$1,428	$1,428	$1,428	$714	$714	$714	$714	$714
Herbicide	$918	$918	$918	$918	$918	$918	$918	$918	$918	$918
Fertilize	$3,944	$3,944	$3,944	$3,944	$3,944	$3,944	$3,944	$3,944	$3,944	$3,944
Pest Control	$85	$85	$85	$85	$85	$85	$85	$85	$85	$85
Hand Weeding	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Replant	$153	$153	$153	$153	$153	$196	$196	$196	$196	$196
Pruning	$510	$510	$510	$510	$510	$510	$510	$510	$510	$510
Crop Log	$17	$17	$17	$17	$17	$17	$17	$17	$17	$17
Other	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing	$59,109	$59,109	$61,473	$70,931	$74,664	$74,664	$74,664	$74,664	$74,664	$74,664
Post-harvest Treatment	$19,380	$19,380	$20,155	$23,256	$24,480	$24,480	$24,480	$24,480	$24,480	$24,480
Management Fee	$13,548	$13,548	$14,019	$15,902	$16,646	$16,478	$16,478	$16,478	$16,478	$16,478
General Excise Tax	$4,992	$4,992	$5,177	$5,917	$6,209	$6,174	$6,174	$6,174	$6,174	$6,174
Total Operating Costs	$99,134	$99,134	$102,745	$117,187	$122,887	$122,048	$122,048	$122,048	$122,048	$122,048
Net Operating Profit (Loss)	$73,348	$73,348	$76,637	$89,792	$94,985	$95,824	$95,824	$95,824	$95,824	$95,824
Capital Expenditures	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow	$73,348	$73,348	$76,637	$89,792	$94,985	$95,824	$95,824	$95,824	$95,824	$95,824
Cumulative Cash Flow	$205,355	$278,703	$355,339	$445,131	$540,116	$635,940	$731,764	$827,587	$923,411	$1,019,235

Acreage and Yield Assumptions

Acreage & Tree Count Assumptions:

Acreage		
Total acres		20.00
Estimated net tree acres	85%	17.00
Tree Data		
Density, trees per acre (30'x30')		48
Theoretical trees on net acres		816

Yield Assumptions:

Category	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Lbs/Tree/Year	-	-	-	5.0	25.0	50.0	75.0	75.0	80.0	100.0
Lbs Adjusted for Spoilage	-	-	-	4.8	23.8	47.5	71.3	71.3	76.0	95.0
Lbs per Tree Acre per Year	-	-	-	228	1,140	2,280	3,420	3,420	3,648	4,560

Category	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Lbs/Tree/Year	125.0	125.0	130.0	150.0	200.0	250.0	300.0	300.0	300.0	300.0
Lbs Adjusted for Spoilage	118.8	118.8	123.5	142.5	190.0	237.5	285.0	285.0	285.0	285.0
Lbs per Tree Acre per Year	5,700	5,700	5,928	6,840	7,200	7,200	7,200	7,200	7,200	7,200

Key Assumptions	
Estimated Producing Tree Density (tpa)	48
Spoilage	5.0%
Maximum Lbs per Tree Acre per Year	7,200

Average Price Assumptions:

Grade 1	70%	$	2.00
Grade 2	20%	$	1.75
Grade 3	5%	$	0.60
Average Price		$	1.78

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Cost Assumptions

Establishment Cost:

Category	Total Cost	Unit Cost	
Land Clearing	$ 16,000	$ 800	per acre
Planting	$ 18,768	$ 23	per tree
Management fee	$ 3,477	10%	
Sub-Total	$ 38,245		
GET	$ 1,593	4.166%	
Total	$ 39,838		

Planting Cost Detail:

Trees	$ 15.00
Soil	$ 2.00
Dig holes	$ 2.50
Labor	$ 3.00
Fertilizer	$ 0.50
Total	$ 23.00

Operating Costs:

Cost per Acre per Round:

Category	Rds. per Yr.	Year 1	Year 2	Year 3	Year 4	Yr 5 thru 10	Yr 11 thru 15	Yr 16 thru 20
Mowing	6	$ 24.00	$ 24.00	$ 24.00	$ 24.00	$ 20.00	$ 14.00	$ 7.00
Herbicide	6	$ 18.00	$ 18.00	$ 18.00	$ 15.00	$ 9.00	$ 9.00	$ 9.00
Fertilize	8	$ 6.00	$ 12.00	$ 24.00	$ 29.00	$ 29.00	$ 29.00	$ 29.00
Pest Control	1	$ 10.00	$ 10.00	$ 10.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00
Hand Weeding	6	$ 25.00	$ 8.00	$ -	$ -	$ -	$ -	$ -
Replant	1	$ 3.00	$ 6.00	$ 6.00	$ 6.00	$ 6.00	$ 9.00	$ 11.50
Pruning	1	$ 15.00	$ 15.00	$ 15.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00
Crop Log	1	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00
Other	1	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50

	Unit Cost	
Harvesting	$ 0.20	per pound
Packing	$ 0.30	per pound
Packing Materials	$ 0.07	per pound
Hauling	$ 0.04	per pound
Total Harvest, Pack & Haul	$ 0.61	per pound
Post-harvest Treatment	$ 0.20	per pound
Management - Cultivation	25%	of operating costs
Management - Harvesting	15%	of harvesting, packing & post-harvest treatment costs.
GET on Operating Costs	4.166%	
GET on Revenue	0.500%	

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MANGOSTEEN

Brief History: The mangosteen family (Clusiaceae) includes about 46 genera and 1,000 species of trees, shrubs, or herbs, with yellow or white resinous sap, from tropical and temperate regions, among them ornamental plants and others yielding fruit, oil resin, dye, medicine, and hard wood. The mangosteen, *Garcinia mangostana*, is the best-known species of the family Clusiaceae, and originates in Southeast Asia. A mangosteen specimen is located in the Hawaii Forestry Division arboretum in Hilo that is over 20 years old. No one knows who brought the first mangosteen tree to the state.

Description: The tree is a densely foliaged broad based evergreen of columnar or pyramidal form reaching a mature height of 36 to 60 feet. Leaves are opposite or whorled, feather-veined 1/2 to 2 inches long. Flowers develop singly at the tip of branches. Some productive trees may bear two, three or four flowers at the tip of the branches. Flowers are pistillate.

The mangosteen is polyploid with double the numbers of chromosomes of all other Garcinia species. It may well be a natural hybrid. Since no pollen is produced and fruits are formed parthenocarpicly, the seedling progeny are identical to the parent and no cultivars exist. Fruits are ovoid, 1 1/2 to 3 1/2 in diameter and 2.5 to 5 ounces in weight. Fruit are initially green in color but at maturity turn red and then purple.

The pericarp is thick and tough commonly 1/4 inch thick. The edible aril is pearl white in color, slightly translucent and consists of 4 to 8 segments with 1 or 2 larger segments containing seeds. The edible portion is approximately 30% of total fruit weight.

Basic Cultivation Requirements:

Soil: Preferred soil types are heavy clay alluvial loams with high organic matter content and good water holding capacity. Permanently water logged soils are not desirable, but the mangosteen is comparatively tolerant of seasonally waterlogged conditions. A soil pH of 5 to 6 is desirable. Excessive liming can be detrimental. Do not use lime when pH is above 6.5

Temperature: The mangosteen is ultra tropical. It cannot tolerate temperatures below 40 F nor above 100 F. High radiation, low humidity and temperatures above 95 F induce sunburn on leaves, but trees become more tolerant as they get older.

Elevation: Hot, wet tropical lowlands.

Rainfall: Permanently moist soil is desirable in order to maximize growth, yield and fruit quality. There must be supplementary irrigation in months with less than 6 inches of rainfall except that a short period of moisture stress in January is beneficial for flower induction.

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Cultural: Minimum spacing recommended is 25 feet between trees in the row and 30 feet between the rows. The alternative is to start with 30 x 40 ft. spacing and interplant with other species e.g. carambola for short term yields.

Shading of juvenile trees is essential, otherwise growth rates are excessively slow and trees may even die. The best arrangement is Sarlon shade cloth of 30 to 50 % shade rating for a period of 1 to 2 years following field planting. If shade exceeds 50% then trees become excessively leggy with long internodes and later have an unsatisfactory thin bearing surface.

Pruning in the young tree is minimal. A single trunk to at least 10 ft. height is desirable and the dominant side branches and water suckers should be removed in juvenile trees. Thereafter thin out dead branches and water shoots.

Windbreaks are essential for maximum growth and protection of the tree canopy. Bana grass will provide a good temporary windbreak while permanent species are being established.

This tree would be an excellent crop for organic cultivation techniques.

Diseases: Very little is known about disease susceptibility of the mangosteen. At this time there is no known disease problem.

Pests: Red banded thrips, *Selenothrips rubrocinctus (Giard)*, are known to damage young mangosteen leaves. These thrips can be controlled with organic sprays.

Nutrients: Mangosteens do not seem to require any special nutrient program. A well-balanced fertilizer program that includes trace elements is satisfactory.

Fruit Maturity: Fruit is produced in 6 to 8 years from seed, 4-5 from grafts. Grafting has not been successful in Southeast Asia and Australia, where it has been used. The plants do not develop strong root systems; therefore, most commercial growers use seedlings. Fruit matures in 150-180 days. Fruit are edible at the first sign of color change from green to red, but maximum quality and shelf life are obtained from fruit picked at the uniform red stage. Fruit turned fully purple are often too mature to withstand packaging and transport with damage. The major cause of internal breakdown is from picking over mature fruit. Most fruit are produced first inside the outer canopy on short laterals.

Sources of Nursery Stock:

1. Plant It Hawaii, Kurtistown, Hawaii
2. Manelo Orchard, Hilo, Hawaii
3. Kahili Farm, Kilauea, Kauai
4. Frankie Sekiya Nursery, Oahu

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Production: Crop yield is irregular and varies from tree to tree and from season to season. Average yield of a full-grown tree is about 500 fruits. Yield steadily increases up to the 30th year of bearing when crops of 1,000 to 2,000 fruits may be obtained. Observations on mature trees in Hawaii indicate the main flowering occurs during March and April with fruit maturity in July and August. Fruit are easily detached with a twist and pull action of the wrist. Harvesting at this time is done by hand.

Packing: Fruit picked at the red stage will have an attractive shelf life of 2 to 3 weeks at ambient temperature. Cool storage at 50 F will extend shelf life to 6 weeks. The critical aspect is to pack only sound red fruit. Older fruit will succumb to a number of rots. The USDA-ARS has stated that the mangosteen may not be a fruit fly host. Research will be done to verify this as more crop becomes available in Hawaii for testing. If the mangosteen can be shown to be fruit fly free, it can be shipped to the U.S. mainland without post harvest quarantine restrictions.

Uses: Mangosteen is considered by the Southeast Asian peoples to be the "queen of fruits". It is eaten fresh and can be used in desserts and sauces.

Marketing: Markets are being developed for the tropical fruit rambutan in state supermarkets and the Hawaii food service industry. These same markets can be introduced to the mangosteen when the trees start producing. There is a large market on the U.S. mainland for this fruit among the Asian immigrants. Because of its good shelf life and delicious flavor, the mangosteen market will grow rapidly.

The Hawaii industry is in its infancy with approximately 75 acres planted. Some orchards have bearing trees, but most of the production will start entering the market place in about four to five years.

Transport: Transportation has not been defined, as there is insufficient fruit production to justify anything more than casual local sales.

Onelca Development Project: Cash Flow for Mangosteen

28-Jun-99 **Acreage:** 20

Production & Revenue		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Pounds Harvested		-	-	-	-	-	-	-	3,876	15,504	38,760
Revenue		$0	$0	$0	$0	$0	$0	$0	$12,694	$50,776	$126,939
Average price per lb	$	3.28									
Operating Costs											
Mowing		$2,448	$2,448	$2,448	$2,448	$2,040	$2,040	$2,040	$2,040	$2,040	$2,040
Herbicide		$1,836	$1,836	$1,836	$1,530	$918	$918	$918	$918	$918	$918
Fertilize		$816	$1,632	$3,264	$4,896	$4,896	$4,896	$4,896	$4,896	$4,896	$4,896
Pest Control		$85	$85	$85	$85	$85	$85	$85	$85	$85	$85
Hand Weeding		$4,080	$2,448	$1,632	$816	$136	$136	$136	$136	$136	$136
Replant		$85	$170	$170	$170	$170	$170	$170	$170	$170	$170
Pruning		$17	$17	$17	$17	$17	$17	$17	$17	$17	$17
Crop Log		$34	$34	$34	$34	$34	$34	$34	$34	$34	$34
Other		$1,020	$1,020	$1,020	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing		$0	$0	$0	$0	$0	$0	$0	$2,364	$9,457	$23,644
Post-harvest Treatment		$0	$0	$0	$0	$0	$0	$0	$194	$775	$1,938
Management Fee		$2,605	$2,423	$2,627	$2,510	$2,085	$2,085	$2,085	$2,468	$3,620	$5,922
General Excise Tax		$543	$505	$547	$523	$434	$434	$434	$620	$1,178	$2,295
Total Operating Costs		$13,026	$12,113	$13,133	$12,548	$10,423	$10,423	$10,423	$13,365	$22,191	$39,842
Net Operating Profit (Loss)		($13,026)	($12,113)	($13,133)	($12,548)	($10,423)	($10,423)	($10,423)	($671)	$28,585	$87,097
Capital Expenditures	$	58,538	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow		($71,564)	($12,113)	($13,133)	($12,548)	($10,423)	($10,423)	($10,423)	($671)	$28,585	$87,097
Cumulative Cash Flow			($83,677)	($96,809)	($109,357)	($119,780)	($130,204)	($140,627)	($141,298)	($112,713)	($25,616)

Oneloa Development Project: Cash Flow for Mangosteen

28-Jun-99 **Acreage:** 20

Production & Revenue	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Estimated lbs nut-in-shell	58,140	116,280	135,660	139,536	155,040	155,040	155,040	155,040	155,040	155,040
Estimated revenue	$190,409	$380,817	$444,287	$456,980	$507,756	$507,756	$507,756	$507,756	$507,756	$507,756
Average price per lb, NIS	$3.28									
Fixed Costs:										
Mowing	$1,428	$1,428	$1,428	$1,428	$1,428	$714	$714	$714	$714	$714
Herbicide	$918	$918	$918	$918	$918	$918	$918	$918	$918	$918
Fertilize	$6,528	$6,528	$6,528	$6,528	$6,528	$6,528	$6,528	$6,528	$6,528	$6,528
Pest Control	$85	$85	$85	$85	$85	$85	$85	$85	$85	$85
Tree Decline	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Replant	$255	$255	$255	$255	$255	$255	$255	$255	$255	$255
Brush Clearing & Pruning	$170	$170	$170	$170	$170	$850	$850	$850	$850	$850
Crop Log	$34	$34	$34	$34	$34	$34	$34	$34	$34	$34
Other	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
Harvesting & Packing	$35,465	$70,931	$82,753	$85,117	$94,574	$94,574	$94,574	$94,574	$94,574	$94,574
Post-harvest Treatment	$2,907	$5,814	$6,783	$6,977	$7,752	$7,752	$7,752	$7,752	$7,752	$7,752
Management Fee	$8,121	$13,877	$15,795	$16,179	$17,714	$17,706	$17,706	$17,706	$17,706	$17,706
General Excise Tax	$3,283	$6,074	$7,004	$7,190	$7,934	$7,932	$7,932	$7,932	$7,932	$7,932
Total Operating Costs	$55,954	$100,082	$114,792	$117,733	$129,501	$129,458	$129,458	$129,458	$129,458	$129,458
Net Operating Profit (Loss)	$134,455	$280,735	$329,495	$339,247	$378,255	$378,298	$378,298	$378,298	$378,298	$378,298
Capital Expenditures	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow	$134,455	$280,735	$329,495	$339,247	$378,255	$378,298	$378,298	$378,298	$378,298	$378,298
Cumulative Cash Flow	$108,839	$389,574	$719,069	$1,058,316	$1,436,571	$1,814,868	$2,193,166	$2,571,463	$2,949,761	$3,328,058

Acreage and Yield Assumptions

Acreage & Tree Count Assumptions:

Acreage		
Total acres		20.00
Estimated net tree acres	85%	17.00
Tree Data		
Density, trees per acre (30'x30')		48
Theoretical trees on net acres		816

Yield Assumptions:

Category	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Lbs/Tree/Year	-	-	-	-	-	-	-	5.0	20.0	50.0
Lbs Adjusted for Spoilage	-	-	-	-	-	-	-	4.8	19.0	47.5
Lbs per Tree Acre per Year	-	-	-	-	-	-	-	228	912	2,280

Category	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Lbs/Tree/Year	75.0	150.0	175.0	180.0	200.0	200.0	200.0	200.0	200.0	200.0
Lbs Adjusted for Spoilage	71.3	142.5	166.3	171.0	190.0	190.0	190.0	190.0	190.0	190.0
Lbs per Tree Acre per Year	3,420	6,840	7,980	8,208	9,120	9,120	9,120	9,120	9,120	9,120

Key Assumptions	
Estimated Producing Tree Density (tpa)	48
Spoilage	5.0%
Maximum Lbs per Tree Acre per Year	10,000

Average Price Assumptions:

Grade 1	70%	$	3.50
Grade 2	30%	$	2.75
Average Price		$	3.28

28-Jun-99 **Acreage:** 20

Cost Assumptions

Establishment Cost:

Category	Total Cost	Unit Cost	
Land Clearing	$ 16,000	$ 800	per acre
Planting	$ 26,928	$ 33	per tree
Screens	$ 8,160	$ 10	per tree
Management fee	$ 5,109	10%	
Sub-Total	$ 56,197		
GET	$ 2,341	4.166%	
Total	$ 58,538		

Planting Cost Detail:

Trees	$ 25.00
Soil	$ 2.00
Dig holes	$ 2.50
Labor	$ 3.00
Fertilizer	$ 0.50
Total	$ 33.00

Operating Costs:

Cost per Acre per Round:

Category	Rds. per Yr.	Year 1	Year 2	Year 3	Year 4	Yr 5 thru 10	Yr 11 thru 15	Yr 16 thru 20
Mowing	6	$ 24.00	$ 24.00	$ 24.00	$ 24.00	$ 20.00	$ 14.00	$ 7.00
Herbicide	6	$ 18.00	$ 18.00	$ 18.00	$ 15.00	$ 9.00	$ 9.00	$ 9.00
Fertilize	8	$ 6.00	$ 12.00	$ 24.00	$ 36.00	$ 36.00	$ 48.00	$ 48.00
Pest Control	1	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00
Hand Weeding	8	$ 30.00	$ 18.00	$ 12.00	$ 6.00	$ 1.00	$ -	$ -
Replant	1	$ 5.00	$ 10.00	$ 10.00	$ 10.00	$ 10.00	$ 15.00	$ 15.00
Pruning	1	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 10.00	$ 50.00
Crop Log	2	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00
Other (incl. screen maint.)	1	$ 60.00	$ 60.00	$ 60.00	$ 2.50	$ 2.50	$ 2.50	$ 2.50

	Unit Cost	
Harvesting	$ 0.20	per pound
Packing	$ 0.30	per pound
Packing Materials	$ 0.07	per pound
Hauling	$ 0.04	per pound
Total Harvest, Pack & Haul	$ 0.61	per pound
Post-harvest Treatment	$0.050	per pound
Management - Cultivation	25%	of operating costs
Management - Harvesting	15%	of harvesting, packing & post-harvest treatment costs.
GET on Operating Costs	4.166%	
GET on Revenue	0.500%	

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'AWA

'Awa (Kava or Kava Kava) is to be planted in a natural forest within the development. Fifty acres of 'awa will be planted in a forest of approximately 250 acres. The "old style" of farming will be utilized. The community will be involved in the farming, harvesting and marketing of the crop. The development would be responsible for the initial planting and for providing materials, such as fertilizer, to the project. The community involvement would be in the on-going cultivation, harvesting, and replanting of the crop. Revenue from the sale of the crop would be shared between the development and the community.

Included in this section on 'awa are a detailed description, basic cultivation requirements, and a cash flow showing the level of profitability that may be expected based upon the farming method described. Along with the cash flow is a list of assumptions used to create the cash flow.

Brief History: The 'awa plant (*Piper methysticum Forst)*, is a member of the pepper family. It is closely related to pepper (*P. nigrum I*) a climbing shrub. 'Awa is indigenous to Polynesia and Indonesia. The exact origin is uncertain, but is believed to have originated in northern Vanuatu, an island chain of the Solomon Islands. In early times it was distributed eastward by migrating peoples.

In Hawaii 'awa was part of the mythical lore of ancient gods. In daily life chiefs and priests used the 'awa in ceremonial drinks and offerings to the gods, and the common people drank it as a mild and relaxing beverage, especially after long, arduous days farming or fishing. Even babies were given the extract in a juice to sooth them. The chiefs used the rarer varieties and the commoners used the common varieties.

'Awa was cultivated throughout Hawaii with almost proprietary cultivation and processing methods in specific locations. In these specific locations *pupu 'awa,* condiments eaten with or mixed with the 'awa, were thought to enhance the potency of the 'awa or provide a cultural symbolism to the use. Native writings mention the special *pupu 'awa* of Puna in *Ka Hoku o H'awai'i* documented by Kepa Maly in his 'AWA: CULTURAL-HISTORICAL PERSPECTIVES IN H'AWAI'I.

Ka 'awa 'ili lena a ka manu i kanu ai iluna o ka la'au - The yellow skinned *'awa* planted by birds atop the tree branches (grown in Puna)

Ka 'awa kau la'au a ka manu i Kealakomo - The *'awa* of Kealakomo, placed upon the branches by the birds (grown in Puna)

At Kalapana (Puna) there grew the famous coconut stand called Niu moe o Kalapana (Reclining coconut trees of Kalapana), also know as Niu-a-poe in ancient times. In Puna the water from the coconuts of Niu-a-poe was used as the *pupu 'awa*, while preparing a highly coveted *'awa* drink for *ali'i* and dignitaries.

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Although used by the indigenous people of Hawaii and the South Pacific for thousands of years, it was Captain Cook who first brought back reports to Europe of the 'awa plant's very special properties in the early 1700's. The uses of 'awa evolved to include it as an herbal medicine as well as a culturally significant drink.

In Hawaii, as modern farming techniques and both agricultural and urban development increased, 'awa became a crop that was cultivated less and less. Many Hawaiian cultivars of 'awa could be found only in isolated valleys and gulches. As the interest in natural medicines has increased over the last couple of decades 'awa has been rediscovered and is now considered one of the premiere herbal crops.

Description: The 'awa plant is a shrub 4 to12 feet tall, with green, jointed stems, swollen at the joints (nodes), with alternate, heart-shaped leaves about 5 to 8 inches long and nearly as wide. The petioles are about 1 inch long, the leaves with 11 to 13 prominent veins originating at the base. The yellow-green flowers are borne on narrow spikes and hang from burgundy stems. They are about 3 inches in length with the sexes on separate plants. 'Awa is a sterile decaploid and incapable of sexual reproduction. Propagation is by vegetative methods.

Basic Cultivation Requirements:
Soil: *Rich, well composted soil, well watered and well drained.*

Temperature: 'Awa cannot tolerate full sunlight and burns easily. In areas where cloud cover is prevalent and fairly constant, the shrub may be set out in less shaded areas. It grows best in cool (60' low, 78' to low 80's high) moist, partially shaded locations. An over-story or edging of trees historically provided shade in many island areas.

Elevation: Formerly, when 'awa was cultivated, the Hawaiians planted it in or just below the borders of the lower forest zone, in clearings within the lower ranges of the forest, along streams, and in pockets along the base of and upon wet escarpments (sea level to approximately 2500' elevation depending on the climate conditions). 'Awa is now being planted from sea level to approximately 1000' elevation. No research has been done on the effect of elevation on the growth and vigor of the crop.

Rainfall: 'Awa grows well where there is consistent moisture and not too much sun. There is little information on specific rainfall requirements or the effect of irrigation.

Cultural: 'Awa used to be widely grown as a crop in Hawaii and lately there has been increasing interest in it among farmers.

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A fundamental element in growing 'awa is to grow it in a forest like environment, rich in organic matter with the right amount of cloud cover or a partially open canopy to allow for adequate sunlight. In a true forest environment in a wet climate like the Puna forest area 'awa cultivation was grown successfully in ancient times. This is an excellent environment for optimum growth. 'Awa needs to grow on swales, mounds, or banked ditches to promote root growth, provide some nematode protection and resistance to fugal disease.

Because 'awa cultivation is in a major resurgence at the present time growers and researchers are experimenting with plant spacing that will promote heavy production. Using an approximate spacing of 6 feet by 4 feet in an open field would result in 1,815 plants per acre. In a natural forest, because of the necessity of planting in a more random pattern with this spacing it is estimated there will be 20% coverage. After 2 years, 1/3rd is harvested and replanted, and 1/3rd in years 3 and 4. In year 5, the first replant (still 1/3rd) is harvested and replanted. From here on, each year 1/3rd is harvested. This harvesting sequence yields material that will always be 3 years old.

Diseases: 'Awa diseases in Hawaii are at this time not significant. Pythium root rot can be found on plant roots at times, but researchers think this can be minimized by varietal selection. Anthracnose has been detected, but is at this time not a problem. The fungus *Pestalotia sp.* and bacterial leaf spot do present a problem during continual very wet weather. Copper based fungicides provide some control for these wet weather problems. There is serious concern that introduction of plant material from other Pacific areas with disease, such as Fiji, Tonga, Vanuatu and Samoa, will bring 'awa diseases into the state. The Dept. of Agriculture is adopting a rule restricting the importation of 'awa plants and plant parts into the state while more research is conducted on possible quarantine regulations.

Pests: Root-knot nematodes (*Meloidogyne spp., M konaensis, M. incognita*); burrowing nematode (*Radopholu similis)*, and other plant parasitic nematodes are present on roots of Hawaiian 'awa. The nematodes can cause substantial loss of production damaging the root system if control is not exercised. Planting sites should be tested for nematodes and clean planting material used.

Use of organic mulches and compost can help to control the population. Allowing adequate spacing between plants also helps to limit nematode population explosions. Intercropping with crops such as tumeric and marigold can help in nematode control. No chemical pesticides are approved for use on 'awa.

Nutrients: Organic fertilizers are preferred for 'awa. Chemical fertilizers are used, but the plant's special nutrient requirements and growth rates are just starting to be researched. As tissue samples are analyzed for nutrient content and standards developed, that are then related to root production, optimum fertilizer regimes will be developed.

Fresh 'awa root may be harvested after a 2 year growing period.

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Sources of Nursery Stock: To prevent importing disease and pests importation of 'awa plant material from outside Hawaii is discouraged. Plants may be purchased at the nurseries listed below and once established may be propagated by cuttings or seeds. Tissue culture of 'awa is difficult and requires developing a very careful protocol. However, it is being done and the techniques will continue to improve.

Hawaiian varieties available are Makea, Kumakua, Hiwa, Purple Moi, Ne-Ne, Mokihana Purple, Green Moi, Ne-Ne Ele Ele, Mapulehu, Mahakea.

'Awa may be purchased at:

1. Royal Palm Enterprises, Mountain View Hawaii
2. Grow Native, Pahoa, Hawaii
3. Alia Point 'Awa Nursery, Pepeeko Hawaii
4. Nuka Hiva Trading Company, Pahoa Hawaii
5. Hoowaiwai Farms, Papaikou, Hawaii
6. Paradise Propagations, Hilo, Hawaii (tissue cultured plants)

Production: 'Awa plants are usually harvested after 2-5 years but may be left growing for more than 20 years. The stump and roots become larger over time, although soil fertility and genotype are more important factors than plant age in determining yield. The green weight of an individual rootstock varies from 10 to 100 pounds, depending upon a plant's maturity and the type of cultivar. A three-year-old plant yields about 22 pounds of fresh material, four-fifths of which is the stump and the rest is the radicles. The harvested portion of the plant includes the lateral roots, the stump, and part of the basal system.
According to one source, a conservative yield estimate is 10 pounds of fresh root per plant after a two-year period, 22 pounds at 3 years and 30 pounds at 4 years.

Processing: Roots are washed in water, chopped into small pieces, and dried in the sun or by hot air. Washing necessitates a large volume of water. Sun drying must be on tables that can be rapidly covered because rainfall causes mold.

Hot air drying can be used also. Current practice is for stumps and roots to be further processed by grinding. Dried material is ground into a fine powder, from which the drink can easily be prepared by infusion in fresh water followed by filtration.

The quality of 'awa after processing can be expected to be affected by cultivar and the growing environment, the physico-chemical characteristics of the roots, harvesting, drying, and storage conditions. Except for cultivar differences, little is known about the effects of environmental or processing factors on the quantity and quality of the kavalactones and other minor active ingredients in a particular sample of dried root. Pieces of dry stump and roots are also exported in bulk to laboratories overseas. This 'awa product is processed into hydro-alcoholic extracts that are partially soluble in water and alcohol.

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Now that the export market is expanding, more refined extraction processes are being developed and these processes vary according to the required end product and the raw material used. Industrial extraction methods can create a wide range of products including freeze-dried extract obtained from a filtered macerate, an essential oil obtained by distilling leaves with water, an extract of active kavalactones isolated using volatile solvents and spray drying of enriched fresh juices. Spray-dried hydrosoluble powder is a promising product that could be locally produced and exported. Manufacture of an instant, ready-to-use 'awa is probably the most promising use for such powder.

Uses: Unlike many popular prescribed relaxation drugs, 'awa reduces anxiety but does not impair mental function or promote sedation. 'Awa contains compounds called kavalactones. There are presently six important kavalactones, although fifteen have been identified. Hawaiian varieties have a high concentration of the important kavalactones, ranging from 11% to 20%. Pacific Islanders use 'awa to help reduce pain. It works on the central nervous system and promotes relaxation to those suffering from anxiety or depression. 'Awa can also help promote more restful sleep to those struggling with insomnia or restlessness, as it helps the muscles of the body to relax. Although 'awa is a social beverage in the Pacific Islands, it is used for medicinal purposes in Europe and the United States. Several significant human clinical trials show that standardized extracts of 'awa are highly effective in relieving anxiety, sleeplessness and some cases of depression.

Market: It is now sold in various forms throughout the world for its stress-relieving properties. Presently because of recent worldwide popularity, a current resurgence has sparked great interest in Hawaii and consequently, cutting-edge research and cultivation are taking place. Hawaii is preparing to be a major player in the 'awa market. Most 'awa in the United States is imported from developing countries in the South Pacific. Considering the increasing quantity and quality demands on the herb, buyers are concerned about 'awa originating from areas where no systematic cultivation has ever taken place. Hawaiian growers see unlimited potential, especially since research results are establishing which varieties of 'awa are most desirable. However, expansion accompanied by research is needed before 'awa becomes an important economic crop for Hawaii. There are fewer than 100 acres of 'awa being commercially grown in Hawaii and under 50 farmers.

'Awa is a significant cash crop in several Pacific regions, providing higher returns than other crops. This is particularly true in Fiji, Tonga, Samoa, Pohnapei, and Vanuatu where recent economic surveys document the increasing commercial value of 'awa. 'Awa is a high value, low volume, crop similar to spices, convenient to store and transport. The growth can be attributed to the corresponding expansion in both domestic and export markets. For example, in Samoa, there is estimated to be 2,600 acres in 'awa, and that figure will likely increase by 30% over the next year.

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The Central Bank of Samoa reports export value of 'awa in Samoa was $3,500,000 in 1998. The main international markets for 'awa are the United States, Germany, France, and New Zealand.

Quarantine: Fresh 'awa root can be shipped to the mainland U.S. if it is free of disease and pests and has been washed to remove any soil residue. The root must be inspected by USDA-APHIS prior to shipment.

Oneloa Development Project: Cash Flow for Awa

28-Jun-99 **Acreage:** 250

Production & Revenue	Year 1	2	3	4	5	6 & on
Pounds Harvested	-	-	302,500	665,500	907,500	665,500
Revenue	$ -	$ -	$ 756,250	$ 1,663,750	$ 2,268,750	$ 1,663,750
Average price per lb	$ 2.50					
Capital Costs						
Planting	$ 252,966					
Operating Costs						
Fertilizer	$ 45,375	$ 45,375	$ 45,375	$ 45,375	$ 45,375	$ 45,375
Replanting	$ -	$ -	$ 84,322	$ 84,322	$ 84,322	$ 84,322
Cultivation	$ -	$ -	$ -	$ -	$ -	$ -
Harvesting	$ -	$ -	$ -	$ -	$ -	$ -
Packing & Shipping	$ -	$ -	$ 127,050	$ 279,510	$ 381,150	$ 279,510
Total Operating Costs	$ 45,375	$ 45,375	$ 256,747	$ 409,207	$ 510,847	$ 409,207
Cash Flow	$ (45,375)	$ (45,375)	$ 499,503	$ 1,254,543	$ 1,757,903	$ 1,254,543

28-Jun-99 **Acreage:** **250**

Assumptions

Acreage & Tree Count Assumptions:

Acreage

Gross land area (acres)	250.00
Net crop acres	50.00

Plant Data

Density, plants per crop acre	1,815
Total plants	90,750

Yield Assumptions:

	Year 1	2	3	4	5	6 & on
Pounds per plant per year	-	-	10	22	30	22
No. of plants harvested/acre	-	-	605	605	605	605
Pounds per acre per year	-	-	6,050	13,310	18,150	13,310

Key Assumptions on Yield

One-third of an acre is harvested each year.
Pounds harvested equals wet pounds at 75% moisture.

Capital Costs

Planting (per plant)			$	2.79
Labor - manhours		0.25		
Labor - rate per hour	$	7.15		
Total labor per plant	$	1.79		
Materials - plants	$	0.50		
Materials - soil media	$	0.50		
Total materials per plant	$	1.00		

Initial planting is for the complete 50 acres (year one). Year two, no planting.
Year three and on, one-third of the acreage is harvested and replanted each year.

Operating Costs:

Fertililzer material - triple 8 organic

Pounds per plant per year		1.00	4 applications at 1/4 pound.
$ per pound	$	0.50	
Pounds per acre per year	$	908	

Replanting - see captial costs
Cultivation - assumes labor to come from the local community.
Harvesting - assumes labor to come from the local community.

Packing & Shipping.		Unit Cost	
Packing	$	0.30	per pound
Packing Materials	$	0.07	per pound
Hauling	$	0.04	per pound
Ag Inspection		0.01	per pound
Total	$	0.42	per pound

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HAWAIIAN MEDICINAL PLANTS

Hawaiian medicinal plants will be planted in selected areas of the golf course. Maintenance and harvesting will be accomplished by golf course maintenance personnel. The medicinal product harvested will be used within the development. These plantings will provide both landscaping and items of interest for guests of the development.

The following section provides a list of Hawaiian medicinal plants and brief history and description for each.

AWAPUHI - HUAHIWI

Brief History: *Zingiber zerumbet*. Family: Zingberaceae. This wild ginger originated in India was distributed eastward through Polynesia and introduced to these islands by early Hawaiian settlers.

Description: Awapuhi is a perennial. The 10-12 blade-shaped leaves grow to 6-8 inches on the approximately 3 foot long stalks. The leaves grow in an alternate arrangement on the upright, thin, fleshy stalk. The conical or club-shaped flower heads bloom in the summer. As the 2-3 inch long bracts/flower heads mature, they gradually fill with an aromatic, slimy liquid. The heads are reddish-green with overlapping scales, producing small yellowish-white flowers. These tiny flowers are similar in fragrance to the larger and more delicate butterfly-like yellow and white ginger blossoms, growing from the base toward the head. awapuhi grows wild in patches at low altitudes in the open damp forest. This plant can easily be cultivated. Awapuhi cultivation requires a large area. The plant tends to form thick stands, following their large underground stems horizontally. awapuhi is best propagated in autumn by planting a piece of rootstock with buds, in a shallow trench of broken and composted soil.

The Hawaiians have many uses for the awapuhi. The leaves and leaf stalks were used in baking in the imu, (underground oven), and to enhance the flavor of pork and fish as they cooked.

Traditionally, the aromatic underground roots/rhizomes were sliced, dried and pounded into a powder, then added to the folds of stored tapa cloth. The fresh roots were pounded and used as medicine for indigestion. The root was ground and mixed with a ripe noni fruit and then used to treat severe sprains. The pulp was placed in a cloth and loosely bound around the injured area. The dressing was changed daily until the sprain healed.

For a toothache or a cavity, the cooked and softened awapuhi root was pressed into the hollow and left for as long as was needed. To ease a stomachache, the ground and strained root material was mixed with water and drunk.

Finally, perhaps the most common use of awapuhi is as a shampoo and a conditioner for the hair. The clear slimy juice present in the mature flower heads is excellent for softening and bringing shine to the hair. It can be left in the hair or rinsed out, as you wish. The sudsy juice is also excellent for massage. The roots can be stored in a cool, dark place to keep for use when needed.

HAU

Brief History: *Hibiscus tiliaceus*, Family: Malvaceae. Its native region is still uncertain. It is generally believed that the early Polynesian immigrants brought cuttings of hau with them to Hawaii.

Description: Hau is a true hibiscus, with five crepe-like petals with a central column. The 2-3 inch long bright yellow cup-shaped flowers have reddish centers, and form at the ends of the branches. As the day goes by, the flower changes color to orange and then to reddish-brown, before it falls off the plant by the next morning. The inch long dry downy brown fruiting capsule contains 5 valves, each with 3 smooth seeds. The leaves are heart-shaped and round, from 2 to 12 inches in diameter. They are leathery, with a smooth surface, while the underside is velvety and consists of matted white hairs. Sometimes the leaf edges are scalloped, but usually not.

Hau grows well near the ocean, streams, and in moist sloping areas up to the 2000-foot elevation. Hau is propagated from cuttings, and the trunks can be trained to create a garden shelter or arbor called a hau lanai. This plant is also grown as a natural fence barrier. In the old days this plant was so highly valued that permission to cut it was required of the village chief.

Today it is often called "hau bush" and is termed an invasive plant, as it has taken over some areas, at the same time creating windbreaks and stabilizing the soil.

Traditionally, hau branches were piled near the shoreline to indicate fishing was kapu, because spawning was occurring in that area.

The naturally curved branches of this plant's softwood are used to make canoe outriggers. Hau wood pieces were used as floats on fishnets. The soft wood was also helpful in making fires. Adze handles were most often made of hau; as were lightweight practice spears, massage sticks, brooms, and the crossbeams for kites.

Hau cordage provided tying material used daily. The cordage is made by cutting off stems and younger smooth branches, making a slit lengthwise and removing the bark. The bark strips are then soaked. When the outer bark is slipped off, remaining are cream-colored smooth fibers for braiding and twisting into cordage.

Hau cordage provided ropes for hauling and many other needs: slings; canoe lashing; strings for bows; net bags; carrying handles for water gourds, fasteners for lauhala baskets, shark nooses; strands for lei making, strainers for coconut cream and 'awa drinks, sewing material to piece together tapa cloth for clothing and bedding, a form of tapa itself, hula skirts of hau bark, sandals, and cord for snapping dyes into line designs onto tapa cloth.

A slimy juicy sap found in the dome of the flower bud and in the bark was used as a mild laxative. The buds were also chewed and eaten for dry-throat. Slime from soaking the bark of the stems was medicine for congested chests. The lubricant quality of the inner bark was of value as an enema or could assist in the passage of a baby at childbirth.

KAMANI

Brief History: *Calophyllum inophyllum,* Family: Guttiferae. A member of the mangosteen family, also called Alexandrian laurel. Kamani was brought north to Hawaii from the South Pacific islands in early migrations of Polynesian settlers. Kamani was probably introduced by seed, which is how it is propagated. This native of the Pacific and of tropical Africa grows slowly along sandy shores and in lowland forests. It was cultivated in villages, near houses and also in groves away from villages.

Description: Kamani is a large attractive spreading tree up to 60 feet high, with a rounded head of dense foliage and rough gray bark. A reddish-brown hardwood is derived from the trunk. From this was carved many objects including canoes, homes, wooden containers or calabash. As with milo and kou wood, there is no bad-tasting taste or odor in kamani wood, so it is perfect for vessels that will be contacting or containing food.

The leaves of kamani are large, stiff, shiny, leathery and oblong with a blunt tip. They are 3-8 inches long, arranged opposite each other and have closely placed fine parallel veins running from a prominent raised yellow-green midrib to the leaf margin.

The delightfully fragrant (when new) flowers are small, 1 inch wide, and white with 4-8 petals. They smell like orange blossoms and were used to give fragrance to kapa cloth, and also for lei making. They are waxy and showy with golden yellow stamens and a pink pistil, and grow in clusters of a dozen or so flowers found hanging from a long stalk.

The fruit begins pinkish-green, rounds out to about 2 inches long and becomes bright green. When mature, it has a thin leathery dark gray-brownish skin, which covers a bony shell that holds a partly poisonous kernel or seed surrounded by a cork-like substance. A lamp oil for light was produced from the kernel and was used at times instead of kukui nut oil.

The kernel is called a "punnai nut" in some areas of the Pacific, and the oil is dark, green, thick and called "dilo oil". Sometimes this oil is useful for lomi lomi, massage, especially when enhanced with coconut oil or flower fragrances. The oil may have been useful in waterproofing tapa cloth.

The seed, leaves, gum and bark are said to have medicinal properties. In the old days an extract from the fruit was used to make a brown dye to color tapa cloth.

Kamani was often planted around heiau, temples.

Kamani was mentioned in early chants, and considered a sacred tree in parts of Polynesia. An especially fine grove is to be found on the island of Molokai.

KUKUI

Brief History: *Aleurites moluccana*. Family: Euphorbiaceae. The first Polynesian voyagers brought the seeds of this plant to Hawaii. The tree is also called the candlenut.

Description: The kukui is a large tree often growing to heights 80 feet or more. The leaves are a distinctive light silvery green. It has small five-petaled white flowers and hard, dark nuts over an inch in diameter incased in a green hard skinned husk. The tree is a symbol of enlightenment.

It grows wild in the lower mountain forest areas and is used in gardens as a shade tree, although it is a bit messy due to dropping its leaves and nuts.

The kukui nut has many uses. Originally it was most valued for its light, the oil of the white kernels being extracted for its use in stone lamps and in ti leaf sheath torches. The shelled nuts were skewered on a coconut frond mid-rib and lit one by one, from the top to bottom, as they sat in a container of sand or dirt or in the earth itself.

The nuts are widely used as a traditional lei. The white flowers and leaves are also strung as leis. The bark, flowers and nuts are all used for medicine. As food, a small amount of the pounded roasted nuts, plus salt and sometimes chili peppers, is used as a relish and is called Inamona.

The flowers were chewed by the parents of a young child and given to the child to aid in healing of thrush sores inside the mouth and upon the tongue. Also used for this problem was the juicy sap that fills up the depression left when the stem is pulled off the green fruit. This is applied with the finger and rubbed inside of the child's mouth and on the tongue. This sap is also a healing application for chapped lips, cold sores and mild sunburn.

One mashed nut (sometimes the raw kernel, sometimes the roasted) or the sap of the green nut was often used in combination with other traditional medicinal plants, particularly when a purgative for constipation was needed. The potency of this plant is so strong that these internal remedies are administered only by the knowledgeable.

For bad cases of ulcers and other skin sores, the baked meat of ripe kukui nuts was pounded and mixed with other plants, such as noni. In the treatment of rheumatic joints or deep bruises and wounds, kukui and noni leaves were wrapped around the afflicted places and heat applied by hot packs of salt, sand or rocks wrapped in tapa cloth.

The inner bark provided a red-brown dye for tapa cloth, while the gum from the bark strengthened the tapa. The soot of burned nuts provided a black dye for tattooing and for painting designs on canoes and on tapa cloth. The soft light-colored wood of the tree trunk was fashioned into canoes. The oil provided a varnish similar to linseed oil. Roasted kernels, pulverized by fishermen while on the reef or in canoes, were blown upon the ocean surface where there were small ripples and waves. The film increased underwater visibility by creating a lens on the water's surface. A coating of kukui oil preserved fishing nets.

NONI

Brief History: *Morinda citrifolia*. Family: Rubiaceae. Also known as Indian Mulberry. Noni is believed to have been brought here centuries ago by early Polynesian settlers, and is a native of the pacific islands, Asia and Australia.

Description: The noni is a small evergreen shrub or tree, usually less than 10 feet high, occasionally up to 20 feet. The conspicuous large dark green shiny leaves are generally paired, except where forming fruit.

Thick and oval in shape, they are deep veined, short-stemmed and 8 inches or longer. The flowers form in globose heads, about an inch long and bearing many small white flowers. The flower heads grow to become mature fruit, 3 to 4 inches in diameter. The surface is divided into somewhat warty polygonal pitted cells.

The noni fruit begins green, turns yellow, and has an unpleasant odor, especially as it ripens to whiteness and falls from the tree. Noni will bear fruit all year long in some areas.

Cultivation is either by seed or cutting. Noni is a valuable plant to have nearby the home of anyone wishing to utilize the many natural healing properties of this remarkable life sustaining plant.

The early morning is the best time to pick the yellow fruits. A method taught by Hawaii's healers is to pick the fruit before ripe, letting it ripen within the home. When soft, place it in a blender with a little fresh water and make into a sauce. Then mash and strain through a sieve. This concoction can be refrigerated in a clean glass jar.

As a medicine, the fruit and its juices have been used in the treatment of diabetes, heart troubles and high blood pressure, with different portions prescribed for different illnesses. The juices can be diluted with clean water or a fruit juice such as apple, and drunk before meals and at resting periods. Treatment should always be at a relaxed time, not before going to work. It is good to seek the advice of a Hawaii health practitioner before using any plant medicines.

The young unripe fruit can be pounded thoroughly with salt and the mixture placed carefully on deep cuts and on broken bones. Sometimes the juice is squeezed out of this mixture, boiled and applied to the wounds. The ripe fruit can be used as a poultice for facial blemishes, rubbed until the oil disappears, and also to draw out the pus and core from an infected sore or boil, such as with a staph infection. Noni's fruit may be eaten unripened, either as a food in times of scarcity, or as a tonic when needed. The fruit was used in a recipe for a reputed remedy against tuberculosis, arthritis, rheumatism and the changes of old age. The leaves and bark of the stem were pounded and strained, resulting in a liquid drunk as a tonic or for urinary disorders, muscle and joint pain. The juice of the fruit was applied to the hair to rid it of head lice.

Other uses for this ancient Polynesian plant: the bark yields a red dye, while a yellow dye can be prepared from the root. Both colors were use to dye the tapa cloth of the chiefs of ancient Hawaii.

OLENA

Brief History: *Curcuma domestica*. Family: Zingberaceae. It is best known throughout the world as Turmeric. Originating in Polynesia, this species of turmeric has been grown and used in Hawaii for a long time.

Description: This humble little root, about the size of an adult thumb, was one of the two dozen or so plants brought to Hawaii by early Polynesian settlers.

Olena is rarely found in Hawaii today. It grows in cultivation and in the wild in moist forested valleys, up to altitudes of 3000 feet, preferring shade, yet able to tolerate heat. The olena is without a stem, yet the overlapping clustered leaves appear to be growing out of a stem above ground. The leaves are blade-like, 8 inches long by 3 inches wide, and rise to about 20 inches high, directly from the underground root.

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Olena prefers rich soil, some shade and plenty of water. After the rhizomes are planted, olena hides in the garden for three or more months. In addition, this plant is usually dormant from about September to March, but the roots do survive and will revive to come up with green leaves once again. When they do, they will later show flowers on a stem developing from the center of the leaf stalks, called petioles. The cylindrical flower cluster is about 5 inches long. The pale yellow and white flowers grow on the lower pale green bract, while the upper pinkish part of the bract grows no flowers.

It is olena's rhizome, which is precious. The root is thick and orange or yellow-colored on the inside. It is the bright color that is characteristic of turmeric, the cooking spice. In the language of Hawaii, olena means yellow. Dyes from these roots were used to color tapa cloth. Young roots were steamed to provide a light yellow dye and the steamed older mature roots provided a golden or a deep orange dye. The juice of crushed raw roots produces stain also.

Traditionally, this root can be used medicinally. The roots are pounded and pressed to extract a juice that, when mixed with water, is helpful in earaches and to clear the sinuses through nasal application. The astringent qualities of olena are also useful in cases of consumption, tuberculosis, bronchitis, colds and asthma, the root being lightly cooked and then eaten. At times olena has been taken as a diuretic, and topically it can be helpful with pimples or to stop bleeding.

Ceremonially, the traditional use for olena is as a purifier, containing much mana, spiritual power. Pieces of the crushed root mixed with seawater are sprinkled to remove negative influences from places, persons and things. Typically, when someone is ill, or when a home or other place is to be newly occupied and needing blessing, a ceremony is held. To sprinkle, a ti leaf is dipped into a calabash or bowl containing the olena and seawater. Prayers accompany the sprinkling.

OLONA

Brief History: *Touchardia latifolia*. Family: Urticaceae (Nettle). One of the plants brought to Hawaii long ago by Polynesian settlers, olona is found only in the Hawaiian Islands, especially in windward Maui and in east Molokai.

Description: In a society without nails, olona fibers were a true blessing to the life of the Hawaiian people. Although it is not common today, this stout-stemmed rain forest shrub can still be found in the gullies of lower elevation forests, near the 2,000 foot level, or in very wet boggy interior valleys near streams.

With 4 to 8 foot tall stems in the wild, the bark of olona slips off easily, revealing the inner bark or bast, which is made up of fine quality fibers that are durable and said to be many times stronger than hemp fiber. When young, the outer bark is green, turning brown as the plant ages. The large dark green serrated ovate leaves are 9 to 16 inches long with broad bases, 5 to 9 inches wide.

The leaves have netted veins that are more prominent on the underside, due to their reddish-brown color. Olona has multiple flowers that turn to clustered flesh-orange colored fruit at the ends of the branches.

Propagation is from rooted stem cuttings, root shoots and occasionally from seeds, all of which were thickly planted in previously cleared areas. Although seldom cultivated these days, in ancient Hawaii olona was widely cultivated in very wet interior valleys. The cuttings were planted close together to encourage straight unbranched stems.

The few branches that did grow were removed regularly. In a year's time the plants were mature enough to harvest. They were 6 to 10 feet tall, and the bark could be easily stripped at this young age. The leaves were removed, and the stems cut at soil level, so shoots would re-grow. The stems (with a few leaf nodes) which were taken were ripped into strips, usually 6 feet long and 1 to 2 inches wide. The outer bark was carefully stripped off with opihi shells or with pearl shells, usually over hardwood boards or large flat stones. The strips were then rolled inside out, and soaked for a few short days in a shallow place in a nearby stream. The next step was to scrape off the remaining pulp with seashell or turtle shell scrapers. The strips were then hung to dry and bleached in the sunlight and later to be twisted by the village women into fine cordage of varying thickness.

The white cordage was highly valued for its lightweight and its exceeding great strength under duress. After Captain Cook's arrival, traders prized olona cordage for ship's rigging and for whalers harpoon lines.

The pliable whitish cordage and twine from olona remains soft and resists breaking down from exposure to sea water, so here in Hawaii it was the main fiber used for fishing line, fishnets, net bags for carrying containers, feather cloaks and helmets, feather standard, ti leaf capes, thread, to tie off the umbilical cord after a birth, for canoes lines and for every possible purpose that we today might use rope, twine, string or thread. To prolong its life, it was often treated with kukui oil.

TI

Brief History: *Cordyline terminalis*, Family: Liliacae. Introduced to Hawaii by the earliest Polynesian settlers.

Description: Ti (pronounced tee) has tall, sparingly branched wood stalks 3 to 10 or more feet high. The tightly spiraled leaf cluster is in a tuft at the top of the ringed stalk. The plant's green leaves are pointed, oval and blade-shaped, about 4 inches wide and vary from 1 to 2 feet long.

As new leaves form at the center, the outside older leaves turn yellow and fall, leaving a circular ring on the plant's stalk. The thick, shiny and flexible leaves do not wilt quickly, making them useful for many purposes. Varieties of the ti plant have colored foliage and variously shaped leaves. Besides the original and sacred green ti, the plant ranges in leaf color from pale white and yellow with green tones, to reds, covering a broad spectrum from pale to pink to a maroon, that appears almost black.
The root is thick, white and sweet, growing very large in older plants. The plant's flower stalk emerges in winter. With the coming of spring, a many-branched drooping cluster of flowers comes into bloom. Its' hundreds of tiny half-inch whitish purple flowers resemble miniature lilies.

The ti plant is common from sea level in the lower wetlands up to the 4,000-foot elevation.

New plants propagate easily from cuttings and grow best where sunlight and moisture are both available. The cutting can be planted vertically for one plant, or horizontally for several.

The ti's versatile leaves have many uses, roof thatching, as fly whisks or fans, wrappings for food storage, and cooking, as plates or cups, as fishing lures on nets, as clothing apparel.

Ti leaves are also decorative; they are braided, twisted or woven into lei for numerous special and celebratory occasions; used as a covering for luau tables; and, they provide Hawaii's tropical flower industry with a wonderful variety of foliage for impressive floral arrangements.

This versatile plant has many medicinal uses, either alone or as a wrapping for other herbs needing to be steamed or boiled. For fever, the entire body of an unclothed prone person is covered from the neck down with large green ti leaves. After the patient sweats and fever is broken, the leaves are removed. Cool, freshly washed damp green ti leaves, held and wrapped around the forehead and temples, can be helpful in relieving headache and fever. Hot stones are wrapped in ti leaves and used to soothe sore back muscles.
A drink from boiled green ti leaves is used to aid nerve and muscle relaxation. Steam from boiled young shoots and leaves make an effective decongestant. The pleasantly fragrant flowers are also used for asthma. A popular use of this plant was in making Okolehau, a potent liquor much like a clear brandy. The baked roots are also an emergency famine food and have been eaten as a confection. The leaves are also worn or carried as protection to ward off evil spirits and to call in good.

WAUKE

Brief History: *Broussonetia papyrifera*. Family: Moraceae. Also known as the paper mulberry tree. Wauke is one of the principle plants introduced by early Polynesian settlers.

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The ancient practice of making bark cloth and bark paper likely began in Asia, where other species of Broussonetia are known. It is the principle plant used in the making of **kapa, tapa cloth**. Kapa means the beaten thing.

Description: Wauke is thought to have been carried in the canoes as root shoots, but can also be grown from cuttings and occasionally by seed. Wauke grows best in moist areas, along streams, in forests, wherever soil is rich, and where there is protection from the wind. Usually a small tree or shrub, wauke can grow as tall as 50 feet, but in cultivation, the plants were kept small. The leaves of the wauke are thick and rough on top, woolly underneath and are lobed, they are heart shaped with serrated edges, and are 4-6 inches long by 3-5 inches wide. The flowers are rare and sparse, fuzzy, one inch round with hairy bracts and long stigmas. Fruit are rare, and are orange and one inch round.

The quality of its cloth is prized. Warm, water resistant, long lasting, washable, soft, mothproof, flexible and white.

Once planted the wauke can be harvested in 6-10 months. The trunk shoots were cut down and the roots and tops removed. The trunks were stripped of bark, as thick as a finger and about 4 feet long. The outer bark was slit and peeled off. The inner bark fibers, called bast, were then soaked in running water, with stones placed on top of the fiber pile. A complicated process of soakings and fermentation followed, leaving the fine fibers of the moist inner bark still tough and resilient when finally removed from the waters. At this time in the process, the women of Hawaii would often twist cordage out of the fibers, for use as fishnets, and as carrying nets. The women then spread the strips of inner bark to be used for cloth into several layers, all of the same thickness. After the water was drained away, the fibers began to stick together and the entire bundle could be lifted as one mass. It was beaten on smooth rocks and sun dried. When enough bundles were accumulated, these were soaked for half a day, and then pounded gently to loosen the fibers. They were then laid between layers of banana leaves, for a week to mature and ferment, making the fibers softer, almost like the leavening process in bread making. These cakes of wauke were then kneaded until elastic. When ready, the women laid the bundle on a long piece of wood with a flat even surface. Then the women beat the pulp with a simple heavy mallet until a solid strip formed. After this, the strips were soaked again. The cloth expanded greatly with each beating. It was often doubled over and beaten again. At this point in the process, the cloth was hung in the sun to dry and to bleach whiter. The quality of the kapa varied according to the bark quality and the skills of the maker. After the kapa was completed, intricate designs were added to some of the cloth with dyes and a high quality of colored stamped patterns.

Medicinally, the slimy sap of wauke is a mild laxative. Thrush, a mouth disease, is said to be improved when the ash from burned kapa made from wauke is applied to the mouth.

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EQUESTRIAN CENTER

Description: The equestrian center is a versatile facility that will provide the visitor and resident with horse related activities on five acres.

The physical plant will include a 130 by 280 feet arena constructed of galvanized steel. There will be 18 covered horse stalls, 12 feet by 24 feet each, with a tack-room and feed room; and a 16-foot center aisle that can be used for equipment storage at night and an area for grooming or saddling horses during wet weather. The stalls will be equipped with feeders and waterers. The entire area will be covered. There will be tie racks for washing and clipping horses. Uncovered livestock pens will provide holding areas for horses and other livestock. In addition there will be pastures for the livestock to graze in large paddocks near the center.

This facility will have 20 horses for public trail riding. In addition residents from the area will be able to board horses here and participate in the activities at the center.

Management: The facility will be constructed and then leased to an experienced operator.

Community Benefit: This facility will provide a place for jackpot ropings, rodeos, horse shows, trail rides and riding lessons in the Puna area. One of the biggest problems throughout the state for the people of Hawaii who enjoy horse sports is the lack of enough multi-purpose equestrian facilities. All of East Hawaii has only two major arena facilities, one of which is privately owned. There is great need for a recreational equestrian center in Puna.

Jackpot Ropings: Jackpot ropings are very popular and regular events at roping arenas throughout Hawaii. These ropings are usually attended by residents who enjoy competing against each other on weekends and afternoons during their leisure time. It is their sport. The children in the family often learn to rope at these informal ropings where comradery and friendly competition are enjoyed. The center will schedule jackpot ropings throughout the year for the benefit of the community.

Rodeos: There are approximately 8 to 10 major rodeos held throughout Hawaii each year with anywhere from 100 to 500 contestants participating in these rodeos. Most of these major rodeos are sanctioned by Hawaii Rodeo Cowboys' Association (HRCA). Winnings in HRCA rodeos count toward qualification for the State Finals Rodeo and the opportunity to win the annual state championships in the various rodeo events. The HRCA encourages more rodeos for its members, as there are not enough rodeos statewide for the cowboys at this time.

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One of the most popular rodeo organizations is the Hawaii High School Rodeo Association, which encourages young people in high school to participate in rodeo and sponsors rodeos throughout the state. The top two winners in each event for the year are sent to the National High School Rodeo Finals on the mainland to represent Hawaii. Recent participants in this rodeo program have benefited by receiving scholarships to colleges and universities that have rodeo teams. Another rodeo for these young riders is planned for this facility and would greatly benefit the youth of the area. Local high school students will have the chance to learn new skills and compete for trips to the mainland rodeo.

The Keiki Rodeo Association is the companion organization to the Hawaii High School Rodeo Association. These two associations have their rodeos in conjunction with each other. The Keiki Rodeo Association has events for children 5 years to 13 years. The events include some of the standard rodeo events, but also have events that are geared to the smaller children. Some of these are the calf scramble, goat undecorating, and dummy roping. There are district finals and state finals for the keiki rodeo contestants. A Keiki Rodeo at the center will be an exciting and challenging sports event for the community children.

The rodeos held at this center would afford the residents of the Puna area the opportunity to have these events in their own district. In addition the rodeos provide an opportunity for local 4-H and civic clubs to make money providing lunches and snacks to the contestants and the spectators. Often local clubs sell tee shirts, hats, and other items, as the rodeos provide a place where they can make money for their club activities.

Horse Shows: These shows often include both English and Western riding events and are very popular in Hawaii. However, again the participants are lacking shows in Hawaii in which to participate. In addition there are specialized events such as cutting, where the horse and rider compete to separate one head of cattle from a herd in a timed event. The center will offer many horse related competitions such as these that the community can enjoy and that would provide an opportunity for family participation.

Trail Rides: Trail rides appeal both to the visitor and to community members who cannot afford to own a horse and very often do not ride well or at all. Trail rides give people an opportunity to enjoy horseback riding in a safe and affordable manner. Both the resident and visitor will be able to take advantage of this activity at the center. Planned trail events also will be structured to interest the experienced rider as well. These longer trail rides will be enjoyable social events combining horseback riding, meals such as a picnic or barbecue, and exploring areas that are off the beaten track.

Lessons: Riding and roping lessons will be given at the center to encourage both children and adults to improve their skills in horse activities. The riding lessons are very popular with young children, who learn not only to ride, but how to take care of the horse.

They are taught nutrition and the importance of proper diet for the horse, health care, and grooming as well as how to bridle and saddle their horses. There is a great need and tremendous interest in lesson activities for the community.

There will be the added benefit of interesting jobs for young people at the center helping to feed and water the horses, exercise the horses, and maintain the tack and stable area. Trail ride guides will be needed, as well as persons who can give lessons. In addition a horse shoer will be required on a regular basis to shoe the horses, both for the center and for those in the community who acquire horses to participate in the activities. A veterinarian will have work there assisting with the health problems and nutrition of the livestock. The feed stores and stores that sell horse equipment will also benefit.

The center will be a hub around which many community and individual activities will occur that will enhance the lives of those who participate. People utilizing this facility will be purchasing gasoline and food, and shopping in the area. This will bring money into the area for the local businesses and the residents who operate these businesses.

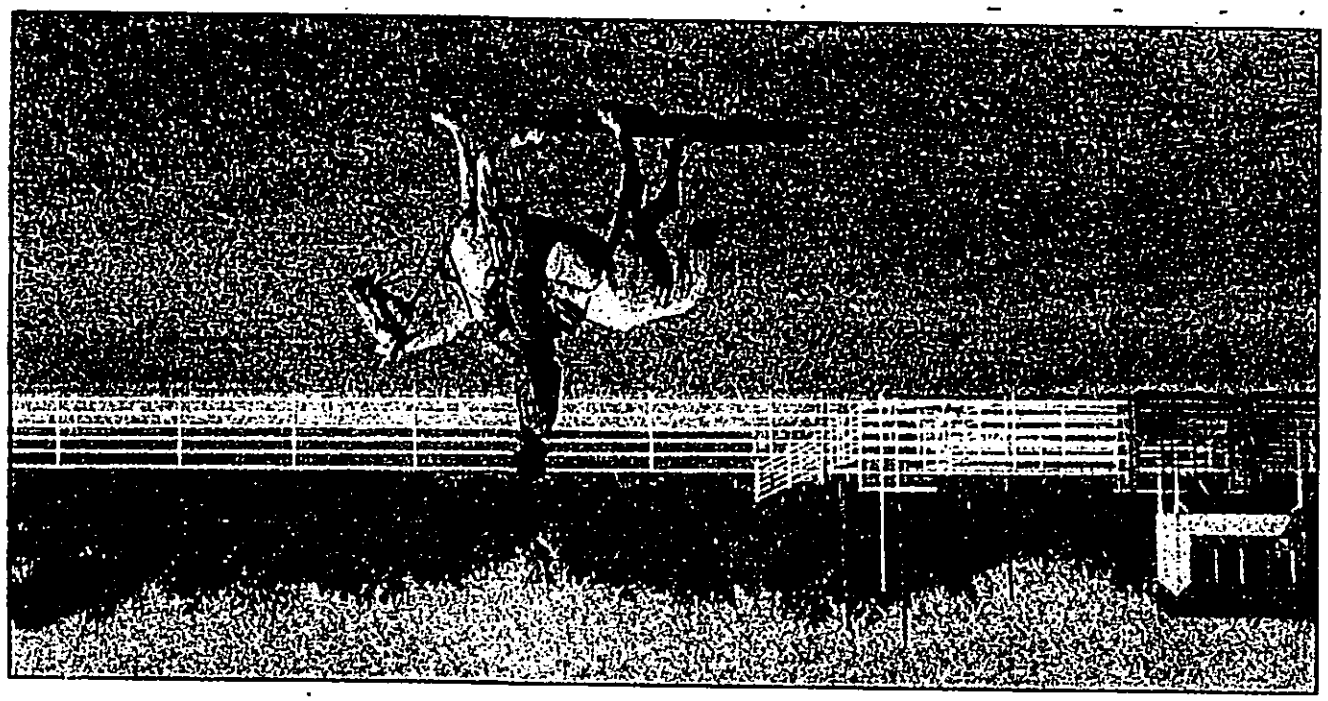
Facilities Estimated Cost*

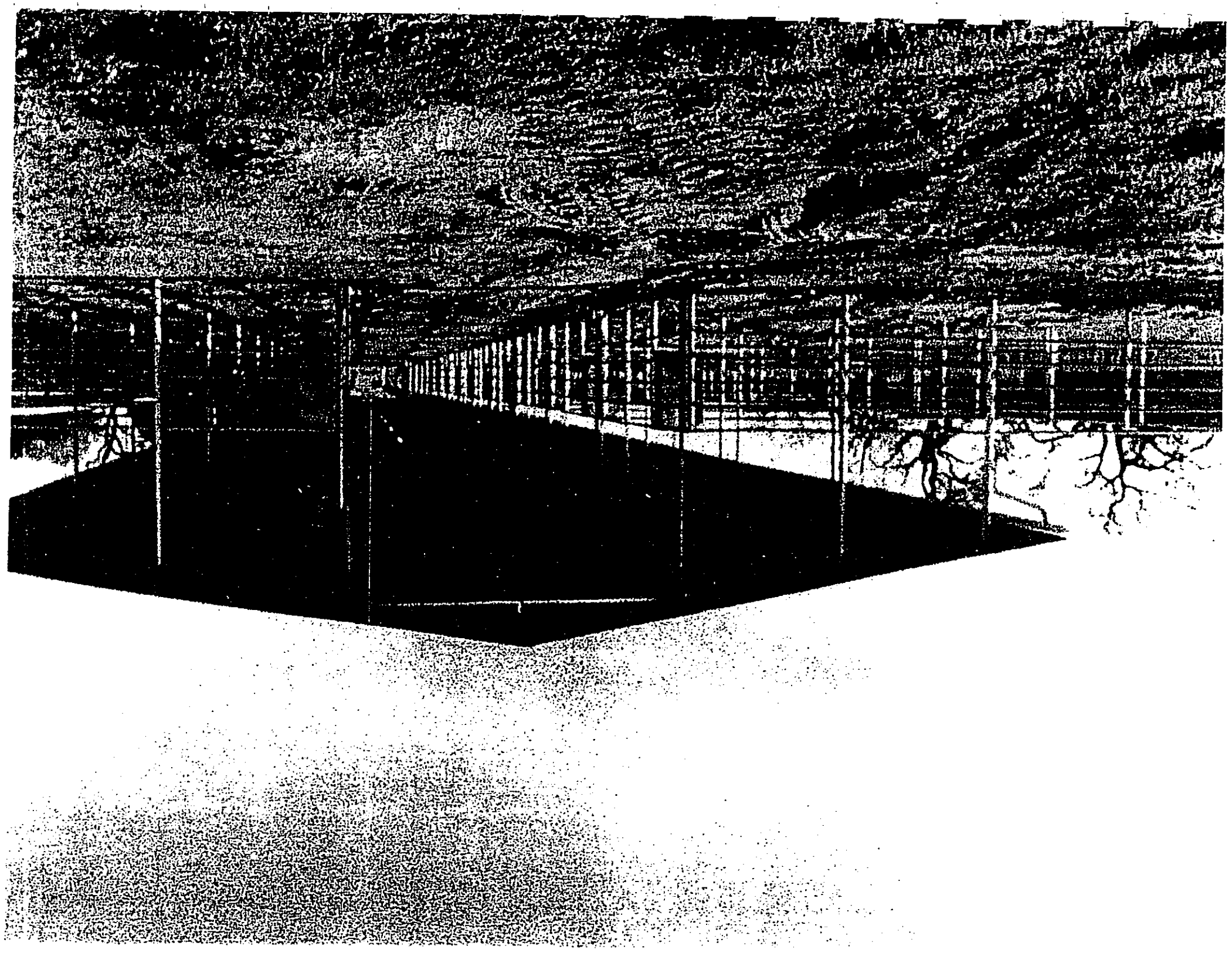
Arena		$48,500
Materials - 130' x 280" galvanized steel	$35,000	
Construction, including ground preparation	$10,000	
Judges & timers stand	$3,500	
Stalls, Tack Room, Feed Room		$55,000
Materials for 18 - 12' x 24' galvanized steel stalls, tack room, and feed room	$35,000	
Construction	$20,000	
Accessories		$10,000
Feeders, waterers, tie racks, other.		
Fencing		$7,000
TOTAL		$120,500

*Installation of utilities & road not included (part of overall development cost)

Lease Rent:
Lease rent should be a function of the capital costs, less land value. Normally, lease rent should be 10% of the capital costs or $12,050 annually for the center. This provides a 10% pay back time on capital.

This lease rent determination is a guide to be used in negotiating the lease rent charged to an operator. The negotiated lease rent will need to consider the operator's ability to pay based upon projected the revenue from the venture.





Oneloa Development Project: Cash Flow for the Equestrian Center.

28-Jun-99

Revenue		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Lease Rent	$	12,050	$ 12,050	$ 12,050	$ 12,050	$ 12,050	$ 12,050	$ 12,050	$ 12,050	$ 12,050	$ 12,050

Assumes annual lease rent to be 10% of facilities costs.

Capital Cost

Arena	$	48,500
Stalls, tack room, feed room	$	55,000
Accessories	$	10,000
Fencing	$	7,000
Total Capital Cost	$	120,500

Operating Costs

Leasee to pay all operating costs.

Cash Flow	$	(108,450)	$ 12,050	$ 12,050	$ 12,050	$ 12,050	$ 12,050	$ 12,050	$ 12,050	$ 12,050	$ 12,050
Cumulative			$(96,400)	$(84,350)	$(72,300)	$(60,250)	$(48,200)	$(36,150)	$(24,100)	$(12,050)	$ -

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'Awa Mo'i. Courtesy of the Association for Hawaiian 'Awa Newsletter, Volume I, Issue 2.

'Awa Nene. Courtesy of the Association for Hawaiian 'Awa Newsletter, Volume I, Issue 1.

Spotted Hiwa. Courtesy of the Association for Hawaiian 'Awa Newsletter, Volume I, Issue 3.

APPENDIX D

MARINE ENVIRONMENTAL ASSESSMENT: ONELOA MASTER PLAN DEVELOPMENT

by:

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MARINE ENVIRONMENTAL ASSESSMENT, ONELOA MASTER PLAN DEVELOPMENT PUNA, HAWAII

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INTRODUCTION AND PURPOSE

Planning is underway for development of the Oneloa Master Planned Development on a 500-acre site along the Puna coastline of the Island of Hawaii. The project site is just to the northwest of the Pohoiki boat ramp and Isaac Hale Park (Figure 1). The proposed project includes a state-of-the-art Sports and Health Spa Complex, Four-Star Boutique Hotel, Oceanfront Beach Club, Village Style Restaurant and Retail Center, 18-hole and 9-hole golf courses. Also included in the plan are "onsen" ponds, which are heated steam baths derived from natural ponds and steam vents existing on the site. The overall intent of the development is to provide a rehabilitative facility for professional and amateur athletes. None of the proposed plans call for any alteration of the shoreline or nearshore region.

While all planning and construction activities will place a high priority on maintaining the existing nature of the marine environment, it is nevertheless important to address any potential impacts that may be associated with the planned project. In order to evaluate the existing condition of the marine environment, as well as to assess the potential for impacts, a pre-construction baseline survey of the marine environment has been conducted. Presented below are methods and results from the assessment of marine water chemistry and biotic community structure conducted in June 1998 offshore of the proposed Oneloa Master Planned project site.

PHYSICAL STRUCTURE OF THE NEARSHORE ENVIRONMENT

The entire area offshore of the proposed project is exposed to long-period swells generated by storms in the north Pacific during the winter months and the south Pacific in summer months. In addition, the coastline is directly exposed to northeast tradewind generated swells. As a result of the physical forces associated with waves, the nearshore areas off Puna are subjected to extreme stress from wave impact and scouring of sediment from wave action. As in many locations in the Hawaiian Islands, the composition of coral reef communities is structured primarily in response to physical forces of breaking waves (Dollar 1982, Dollar and Tribble 1993).

The intertidal area is comprised primarily of a lava flow that forms a relatively flat bench at the shoreline. In some areas this lava bench is covered with basalt rocks ranging in size from cobble (25 cm in diameter) to boulders (up to 2 m in diameter). Many of the

boulders are water worn and now lie well above the high water mark attesting to the wave energy that must occasionally impact this shoreline. At the southern end of the property, the rocky shoreline extends approximately 50 m from the coastal road to the intertidal area. Off the central and northern areas of the property that do not contain structures, vegetation extends to near the shoreline. Low areas on the basalt bench form ponds which contain water that is a mix of ocean water and seaward flowing groundwater. Size of the ponds varies according to tidal stand, as there appears to be direct contact between the ponded areas and the open ocean.

Al unique aspect of the shoreline includes a large anchialine pond complex on the mauka side of the road near the southern end of the property. By definition, anchialine ponds contain a mixture of salt water and freshwater, but have no open connection to the ocean. The pond was estimated to extend approximately 50 m parallel to the road, and 25-30 m inland from the road. At the northern end of the property, a large inlet connected to the ocean is maintained as a swimming and recreational park by the County.

Bottom composition and structure of the offshore area along the entire property is generally similar. Seaward of the shoreline, bottom topography consists of a solid basalt platform that slopes gradually downward with distance offshore. This platform extends to a depth of approximately 3 meters (m) and is the area that appears to absorb most of the energy of breaking waves that impinge of the shoreline. The platform ends abruptly in a small vertical cliff face that extends to a depth of approximately 5 m. At the bottom of the cliff, bottom topography consists of large boulders interspersed over a steeply sloping (~20°) sloping basalt bottom. The boulder-reef platform zone contains substantial cover of living reef corals, and a diverse community of invertebrates and reef fish. At a depth of approximately 15 m, a second drop-off occurs at the seaward end of the boulder-reef platform zone. The near vertical face extends to a depth of approximately 20 m. At the bottom of the second drop, bottom structure consists of sand and rubble channels which extends seaward to abyssal depths.

WATER CHEMISTRY

Methods

Three locations fronting the Oneloa Master Planned Development were selected as sampling sites for evaluation of existing water chemistry. Site 1 lies at the northern end of the property; Site 2 lies in the central portion; and Site 3 lies along the southern boundary of the property (Figure 1). Water chemistry was evaluated along sampling transects at each site. Each transect was oriented perpendicular to the shoreline, and extended from the highest wash of waves across the nearshore reef platform out to the open ocean, a distance of approximately 200 meters (m).

Water samples were collected at five stations seaward of the shoreline along each transect. In addition, samples were collected in tidepools and anchialine ponds landward of the shoreline. Such sampling was intended to span the greatest range of salinity with respect to freshwater efflux at the shoreline. Sampling was more concentrated in the nearshore zone as this area is most likely to show the effects of shoreline modification. At each ocean station a surface sample was collected within approximately 10 centimeters (cm) of the surface. With the exception of the stations located within 5 m of the shoreline, a bottom sample was collected within 1 m of the sea floor.

Surface water samples were collected by opening triple-rinsed, 1-liter polyethylene bottles near the air-sea interface. Bottom samples were collected either by divers opening 1-liter bottles, or by using a 1.8-liter Niskin-type oceanographic sampling bottle. These bottles were lowered to the desired depth in an open position, where spring-loaded endcaps were triggered to close by a messenger released from the surface. Subsamples for nutrient analyses from both surface and deep samples were immediately placed in 125-milliliter (ml) acid-washed, triple rinsed, polyethylene bottles and stored on ice until returned to Honolulu.

Water quality constituents that were measured included the specific criteria designated for open coastal waters in Chapter 11-54, Section 06 (Open Coastal waters) of the State of Hawaii, Department of Health (DOH) Water Quality Standards. These criteria include: total nitrogen (TN), nitrate + nitrite nitrogen (NO_3^- + NO_2^-, hereafter referred to as NO_3^-), ammonium (NH_4^+), total phosphorus, chlorophyll a (Chl a), turbidity,

temperature, pH and salinity. In addition, orthophosphate phosphorus (PO_4^{-3}) and silica (Si) are also reported because these parameters are sensitive indicators of biological activity and the degree of groundwater mixing, respectively.

Analyses for NH_4^+, PO_4^{3-}, and $NO_3^- + NO_2^-$ were performed with a Technicon autoanalyzer using standard methods for seawater analysis (Strickland and Parsons 1968, Grasshoff 1983). TN and TP were analyzed in a similar fashion following oxidative digestion. Dissolved organic nitrogen (DON) and dissolved organic phosphorus (DOP) were calculated as the difference between TDN and dissolved inorganic N, and TDP and dissolved inorganic P, respectively. The level of detection for the dissolved nutrients is 0.2 µM for TN and Si, 0.02 µM for TP, NO_3^- and NH_4^+, and 0.01 µM for PO_4^{3-}.

Water for other analyses was subsampled from 1-liter polyethylene bottles and kept chilled until analysis. Turbidity was determined on 60-ml subsamples fixed with $HgCl_2$ to terminate biological activity. Fixed samples were kept refrigerated until turbidity was measured on a Monitek Model 21 nephelometer, and reported in nephelometric turbidity units (NTU). Chl a was measured by filtering 300 ml of water through sub-micron glass-fiber filters (GF/F); pigments on filters were extracted in 90% acetone in the dark at -5° C for 12-24 hours, and the fluorescence before and after acidification of the extract was measured with a Turner Designs fluorometer. Salinity was determined using an AGE Model 2100 laboratory salinometer with a precision of 0.0003‰.

All analyses were conducted by Marine Analytical Specialists (Honolulu, HI). This laboratory possess the required approval ratings for the analyses.

Results

Horizontal and Vertical Stratification

Table 1 shows the results of all water chemistry analyses for samples collected off of the Oneloa Development site on June 4, 1998. Values of salinity, dissolved nutrient concentrations, turbidity, and Chl a as functions of distance from shore are shown in Figures 2-4.

Examination of Figures 2 and 3 reveal several distinct patterns with respect to horizontal stratification of water chemistry. The plot of salinity vs distance from shore reveals a sharp gradient at the shoreline (Figure 2). Samples from tidepools and anchialine ponds landward of the shoreline contained water that was near an equal mix of saltwater and freshwater with salinities ranging from 10-25‰. Freshwater input to the area appears to be from substantial efflux of groundwater in the nearshore zone. At the shoreline, however, the signature of groundwater efflux is essentially obliterated by water of oceanic salinity (~35‰). It is apparent that there is essentially no zone of mixing in the nearshore area seaward of the shoreline. The lack of such a mixing zone is a result of the substantial energy, primarily from wave action, that rapidly mixes the freshwater input to background ocean levels. Hence, within only 10 m of the shoreline, there is very little indication of freshwater input from land.

The plots of dissolved nutrients (Si, NO_3^-, NH_4^+, PO_4^{3-}, TP and TN) exhibit patterns that are mirror images of the patterns of salinity (Figures 2-3). Nutrient concentrations in the anchialine pools and tidepools landward of the shoreline are extremely elevated for nearshore marine environments in Hawaii. At the shoreline, concentrations drop radically by several orders of magnitude, and remain low throughout the span of the ocean transects. From a distance of 5 m from the shoreline seaward, concentrations of nutrients and salinity are nearly constant across the length of the ocean transect.

The mirror images of salinity and concentrations of dissolved nutrients (Si, NO_3^-, PO_4^{3-}, TN and TP) in surface waters in the nearshore zone off the Oneloa parcel suggest input of groundwater at the shoreline. Groundwater normally contains high concentrations of these nutrients and low salinity. While salinity is also generally low in surface runoff (i.e. rainfall), nutrients are also low; hence there is no typical mirror image effect. The lack of horizontal gradients in nutrient concentrations or salinity within the oceanic portion of the nearshore marine environment indicates that the magnitude of physical mixing processes is sufficient to entirely mask the freshwater input at the shoreline. These high energy conditions translate into high mixing of any groundwater entering the area. As a result, any materials emanating from future anthropogenic activities would be rapidly diluted within the marine environment

The patterns of distribution of dissolved organic nutrients (DON, DOP) that are not present in relatively high concentrations in groundwater are distinctly different than the

patterns for inorganic nutrients. The concentrations of DON and DOP in tidepools and anchialine ponds landward of the shoreline are generally lower than the values in oceanic samples (Figures 3,4). Hence, there is no sharp gradient at the shoreline for the organic constituents.

At all three transect sites, turbidity peaked at the sampling stations in the stations landward of the shoreline (tidepools, anchialine pools). In the ocean samples, turbidity is uniformly low on all three transects, and is nearly constant across the sampling range (~0.1 ntu) (Figure 5). Similarly, concentrations of Chl a peaked in the anchialine pools and tidepools, and was uniformly low at all ocean sampling stations (Figure 5).

Table 1 and Figures 2-5 also show patterns of water chemistry measurements from deep samples collected at stations beyond 5 m of the shoreline. As a result of lower density groundwater entering the ocean, a surface layer characterized by high nutrient concentrations and low salinity often forms in areas of relatively calm nearshore water. Examination of Table 1 reveals that at all sampling locations on the south transect salinity is measurable lower, and Si and NO_3^- are slightly higher in surface samples compared to deep samples. On the central and north transects, the pattern holds for salinity, but not for nutrient concentrations. Hence, it appears that the input of freshwater at the shoreline is higher at the southern end of the project site than at the more northerly areas.

Compliance with DOH Standards

DOH standards include specific criteria that are not to be exceeded during either 10% or 2% of the time, or as the geometric mean of the sampling set. With only one sample set collected to date from each sampling station, comparison of the 10% or 2% criteria or the geometric mean criteria for any sampling station are not statistically meaningful. However, comparing sample concentrations to these criteria provide an indication of whether water quality is near the stated specific criteria.

Tables 1 shows samples seaward of the shoreline that exceed DOH water quality standards for open coastal waters under "wet" conditions. The criteria for wet conditions are applied to the Oneloa area because this region probably receives at least 3 million gallons of groundwater input per mile per day. During the June 1998 survey,

the only samples of NO_3^-, TP, TP and Chl *a* that exceeded the 10% or 2% limits were located at the shoreline sampling stations (0 meters from shore) at the south and north transects. No samples on the central transect exceeded any of the DOH limits.

These comparisons indicate that marine waters off the Oneloa area beyond the immediate shoreline are not substantially influenced by activities on land. While the concentrations of many of the water quality constituents are extremely high in the tidepools and anchialine ponds, the effect to the nearshore ocean is minimal, apparently as a result of turbulent mixing processes. It is also important to note that the survey was carried out during an unusually calm period of wind and wave action. During "normal" conditions of tradewind weather, turbulent mixing in the nearshore zone would be expected to be even greater.

BIOTIC COMMUNITY STRUCTURE

Methods

All fieldwork was carried out on June 4, 1998, and was conducted from a 21-foot boat using SCUBA gear. Biotic structure of benthic (bottom dwelling) and fish communities inhabiting the reef environment were evaluated by establishing a descriptive and semi-quantitative baseline between the shoreline and the 20 meter (m) (~60 foot) depth contour. Reconnaissance surveys were conducted by divers swimming from the shallowest accessible areas near the shoreline seaward to a depth of approximately 20 m at five locations along the length of the development parcel. During the swims, diver-biologists noted abundance and density of community components on underwater writing slates. These reconnaissance surveys were useful in making relative comparisons between areas, identifying any unique or unusual biotic resources, and providing a general picture of the physiographic structure and benthic assemblages occurring throughout the region off the proposed development site.

Biotic Community Structure

Coral Communities

The predominant taxon of macrobenthos (bottom-dwellers) throughout the reef off the Oneloa area are Scleractinian (reef-building) corals. Results of qualitative surveys revealed several reef zones, each with distinctive coral community structure. As described in the section above on physical structure, the nearshore marine environment consists of several distinct physical zones. Adjacent to the shoreline fronting the project site is a relatively barren flat basaltic shelf. Corals were relatively sparse in this habitat due to exposure to impinging ocean swells. The only commonly occurring corals on the shelf were *Pocillopora meandrina* and *Palythoa tuberculosa.*

Seaward of the basaltic shelf, bottom composition consists a boulder-covered shelf that comprises the main zone of coral community structure. The shallow, nearshore region of the boulder zone is populated by numerous colonies of *Pocillopora meandrina,* covering up to 25% of the bottom. This species is generally regarded as a "pioneering" species that occurs in areas too harsh for other corals. Such appears to be the case on the shallow nearshore reef platform that typically experiences substantial turbulence from breaking waves. Other corals that occurred in the area included small, flat encrustations of *Porites lobata* and *Montipora spp.*

On the outer portions of the boulder-reef platform, corals become more abundant, both in terms of number of species and percentage coverage of the bottom. At a depth of 6-10 m, the reef face consists of a gently sloping lava shelf with substantial cover of living corals. Coral cover ranged from approximately 35-50% of bottom cover, and consisted of a variety of species. The most common species were *Porites lobata, Pocillopora meandrina, Montipora patula, M. flabellata, M. verrucosa, Leptastrea purpurea, Pavona varians and Porites (Synaraea) canvexa.* The coverage by *Pocillopora meandrina* was estimated to be approximately 20%, while *Porites lobata* covered approximately 25% of bottom cover in this area. The growth form of virtually all of the corals that were present on the reef bench area consisted of flat encrustations or low sturdy lobate structures. Few branched or vertically plated species were observed. Flat or lobed break-resistant growth forms are typically found in exposed habitats, where breaking waves routinely produces conditions of severe physical stress.

At the seaward edge of the reef zone, a second break in slope occurs to a depth of approximately 20 m. This area is marked by large lava boulders and blocks, beyond which the bottom is composed primarily of sand and rubble. Corals growing on the

boulders and blocks consisted primarily of the species occurring on the shallower reef zone. Coral cover beyond the shelf break consisted largely of the branching coral *Porites compressa*, which grows in interconnected thickets, generally at depths below damaging wave forces.

Other Benthic Macroinvertebrates

The other dominant group of macroinvertebrates are the sea urchins (Class Echinoidea). The most common urchins were *Echinometra matheai* and *Echinometra aciculatus*, which are small urchins that are generally found within interstitial spaces bored into the basaltic substrata. *Echinothrix diadema*, *Tripneustes gratilla*, and *Heterocentrotus mammillatus* were other species of urchins that occurred commonly on many transects. Both of these urchins occur as larger individuals (compared with *E. matheai*) that are generally found on the reef surface, rather than within interstitial spaces. Numerous sponges were also observed on the reef surface, often under ledges and in interstitial spaces.

Reef Fish Community Structure

Discounting the anthropogenic impacts of fishing and pollution, much of the abundance of Hawaiian reef fishes is related to the degree of local cover and shelter available. Thus, where cover and topographical complexity is higher, the abundance of many reef fish species is greater. Off Oneloa, the reef flat habitat provides relatively little cover and the overall abundance of fishes is not particularly high. However, where the boulder and reef-face habitats are encountered, more shelter is available and accordingly, the abundance of fishes is usually greater.

As the name implies, the reef flat habitat provides relatively little shelter for fishes and these resources are not well developed in this habitat. Fish species encountered in this habitat are all common to high energy areas. Among those seen on our survey were the po'opa'a (*Cirrhitus pinnulatus*), the hilu piliko'a (*Paracirrhites forsteri*), pililo'a (*P. arcatus*), moano (*Parupeneus multifasciatus*), nenue (*Kyphosus biggibus*), kikakapu (*Chaetodon lunula* and *C. ornatissimus*), lau hau (*C. quadrimaculatus*), lauwiliwili nukunuku'oi'oi (*Forcipiger flavissimus*), omilu (*Caranx melampygus*), damselfishes (*Plectroglyphidodon imparipennis, P. johnstonianus, Stegastes fasciolatus, Chromis*

vanderbilti), hinalea 'akilolo (*Coris gaimard*), hinalea lauwili (*Thalassoma duperrey*), 'awela (*T. trilobatum*), 'akilolo (*Gomphosus varius*), ponuhunuhu (*Calotomus carolinus*), uhus (*Scarus sordidus* and *S. psittacus*), uhu ahu'ula (*S. perspicillatus*), palukaluka (*S. rubroviolaceus*), kihikihi (*Zanclus cornutus*), 'api (*Acanthurus guttatus*), manini (*A. triostegus*), maikoiko (*A. leucoparius*), na'ena'e (*A. olivaceus*), paku'iku'i (*A. achilles*), ma'i'i'i (*A. nigrofuscus*), kole (*Ctenochaetus strigosus*), lau'ipala (*Zebrasoma flavescens*), umaumalei (*Naso lituratus*), humuhumu nukunuku apua'a (*Rhinecanthus rectangulatus*), humuhumu lei (*Sifflamen bursa*), humuhumu mimi (*Sufflamen fraenatus*) and 'o'ililepa (*Cantherhines sandwichensis*).

The boulder-reef platform habitat is encountered further offshore at a depths from 5 to 7.5 m below which the water depth increases to about 10 m. At the base of the slope are large basalt boulders affording considerable coverage for fishes. Besides the species given above, other fishes encountered in this area include puhi paka (*Gymnothorax flavimarginatus*), nunu (*Aulostomus chinensis*), ala'ihi (*Adioryx diadema* and *A. xantherythrus*), menpachi (*Myripristes amaenus*), aweoweo (*Priacanthus cruentatus*), upapalu (*Apogon kallopterus*), ta'ape (*Lutjanus kasmira*), mu (*Monotaxis grandoculis*), paopao (*Gnathanodon speciosus*), weke'ula (*Mulloides vanicolensis*), blenny (*Runula ewaensis*), munu (*Parupeneus bifasciatus*), lau wiliwili (*Chaetodon miliaris*), kikakapu (*C. auriga, C. lunula* and *C. ephippium*), roi (*Cephalopholis argus*), la'i (*Scombroides laysan*), po'ou (*Cheilinus unifasciatus*), hilu (*Coris flavovittata),* wahanui (*Aphareus furcatus*), kala (*Naso unicornis*), pualu (*Acanthurus blochii*), palani (*A. dussumieri*), black kole (*Ctenochaetus hawaiiensis*), mane'one'o (*Zebrasoma veliferum*), humuhumu hi'ukole (*Melichthys vidua*), humuhumu ele'ele (*M. niger*), 'o'opuhue (*Arothron memeagris*) and 'o'opu okala (*Diodon holocanthus*). Occasionally, juvenile green sea turtles (*Chelonia mydas*) were seen either resting under ledges or slowly swimming through the area and spiny lobsters or 'ula (*Panulirus penicillatus*) are present under the boulders and ledges.

At the outer area of the reef platform, fish communities are dominated by schooling surgeonfishes, parrotfishes and wrasses. Besides those noted above, other fish species encountered in this area include ala'ihi (*Adioryx spinifer*), mamo (*Abudefduf abdominalis*), menpachi (*Myripristes kuntee*), piliko'a (*Cirrhitops fasciatus*), malu (*Parupeneus pleurostigma*), kikakapu (*Chaetodon kleinii* and *C. multicinctus*), angelfish (*Centropyge potteri*), butterfly fishes (*Hemitaurichthys polylepis* and *H. thompsoni*), damselfish (*Chromis ovalis*), cleaner wrasse (*Labroides phthirophagus*), a'awa (*Bodianus*

bilunulatus), hinaleas (*Macropharyngodon geoffroy, Pseudojuloides cerasinus, Pseudocheilinus octotaenia*), maiko (*Acanthurus nigroris*), kala holo (*Naso hexacanthus*), 'o'ili (*Cantherhines dumerili*), puffer (*Canthigaster coronata*) and keke (*Arothron hispidus*).

Because the shelter is well-developed the standing crops of fishes is greater here than in most other habitats, often attaining estimated values from 100 to 200 g/m^2. In the shallower water adjacent to the shoreline the biomass of fish is usually about 50 to 80 g/m^2 and along the steep offshore reef slope habitat the biomass is often greater (i.e., 80 to 120 g/m^2) due to the large mixed schools of plankton-feeding, schooling fishes such as the butterflyfishes (*Hemitaurichthys polylepis, H. thompsoni, Chaetodon miliaris, C. kleinii, Heniochus diphreutes*), mamo (*Abudefduf abdominalis*), damselfishes (*Chromis verator* and *C. ovalis*), kala holo (*Naso hexacanthus*) and kala lolo (*N. brevirostris*).

The fish communities fronting the Oneloa project site are well-developed and many of the commercially-sought after species are seen. The relatively large sizes of these individuals suggests that fishing pressure on these communities is light. As noted above, the coastline in the area receives long-period and tradewind swells coming from both the north and south, resulting in rough seas during the majority of the time. Relatively high coastal surf is the norm making the fishing of inshore fishery resources both difficult and sometimes dangerous resulting in relatively light fishing pressure exerted on these resources.

Anchialine Pool Resources

The Puna area has considerable groundwater discharge along the shoreline fronting the project site. Where the pahoehoe lava flows are close to sea level along the coast, any depressions with sufficient depth will intersect the water table. Some of these depressions in the lava boulder field near the southern boundary of the Oneloa property are cut off from the ocean at low tides, but at have surface connections with the ocean at high tide. As a result of the surface connection, these "ponds" do not meet the definition of an anchialine pool. However, just mauka of the coastal road at the southern end of the property is a relatively large anchialine pool that has an orientation with the long axis parallel to the road and shore. This pool is surrounded by a thicket of milo (*Thespesia populnea*) and hau (*Hibiscus tiliaceus*). The long axis of the pool is

estimated to be more than 50 m and the greatest width is about 30 m. Much of the apparent edge of the pond has little slope, thus the apparent size of the pool is strongly related to the state of the tide. Maximum depth is about 1 m (at low tide) but most of the pool ranges from 10 to 30 cm in depth. The pool is best developed at it's southwest end.

A common feature of the makai tidally influenced pools and the large anchialine pool on the project site is that all have thermally elevated waters. An effort was made to locate aquatic fauna in the anchialine pool but none were seen. We hypothesize that the temperature elevation is great enough to preclude colonization by the usual anchialine biota.

Endangered and Protected Species

Three species of marine animals that occur in Hawaiian waters have been declared threatened or endangered by Federal jurisdiction. The threatened green sea turtle (*Chelonia mydas*) occurs commonly throughout the island chain, and is known to feed on selected species of macroalgae. The endangered hawksbill turtle (*Eretmochelys imbricata*) also occurs, but in considered rare compared to the green turtle. Several sub-adult green sea turtles were sighted on the surface and underwater during the surveys off Oneloa. The turtles sighted underwater were either swimming slowly near the bottom or resting within crevices or under ledges in the reef.

Populations of the endangered humpback whale (*Megaptera novaeangliae*) are known to winter in the Hawaiian Islands from December to April. The present survey was conducted in June, when whales are not present in Hawaiian waters. Hawaiian monk seals (*Monachus schauinslandi*) also occur occasionally in waters off the high islands. No monk seals were observed during the surveys off Oneloa.

DISCUSSION and CONCLUSIONS

The ultimate purpose of this baseline survey is to estimate the potential for impact to environments from shoreline development. Implementation of the proposed Oneloa Master Plan would involve grading, vegetation removal, new construction and other changes to the existing environment on land. However, at present there are no plans for

any alteration of the shoreline or offshore areas. Therefore, potential impacts to the marine environment can only be considered from activities on land that may result in delivery of materials to the ocean through infiltration to groundwater, changes in surface runoff, and wind transport. Presented below are considerations of potential impacts from sedimentation, nutrient enrichment and biocides that may are considerations for the planned project.

Sedimentation

A potential mechanism for negative impact to nearshore marine systems is increased sedimentation from wind or runoff as a consequence of grading and changes in land use. With respect to alteration to the marine community offshore of the Oneloa site from increased sedimentation, several environmental conditions suggest little chance for impacts to the marine environment. In addition to the required best management practices that would be mandated to minimize erosion during excavation, the porous nature of the lava rock substratum would likely prevent erosional materials from reaching the ocean. In addition, the extremely high rates of mixing and water exchange in the nearshore area off the project site would likely result in very rapid flushing of sediment from the area. Corals and other reef organisms are capable of removing sediment suspended by natural phenomena, up to threshold levels of deposition where cleaning mechanisms are overwhelmed and organisms become buried. As a result of normally turbulent conditions, it is very unlikely that sediments would ever be deposited. In comparison to the frequent natural sediment resuspension within the study area, any additional input from land resulting from construction activity would probably not have the potential to accumulate to the point were organisms could be buried.

Several other scenarios around the Hawaiian Islands can also be drawn upon to estimate the potential for impact from sedimentation at Oneloa. In particular, a study conducted at Princeville, Kauai (Grigg and Dollar, 1980) compared the reef environments off the completed phase of the resort with the environments off an area of pristine coastline. The hypothesis tested during this comparison was that increased sedimentation from exposure of soil during construction caused some modification of the coral reef environments offshore. Results of the survey showed that, if anything, the coral environments were better developed off of the existing Princeville development that

was potentially subjected to increased runoff than off the unperturbed parcel. Even though the resort construction might have temporarily increased suspended sediment loads, this increase would have been insignificant in comparison to the natural sediment loads to which the reef communities are already pre-adapted. Therefore, the hypothesis was rejected that developmental alteration of land for Princeville construction, and by inference for similar developments such as the Oneloa Development, would result in offshore impacts to the marine environment.

In addition, while it is generally accepted that sedimentation is a major source of impact on coral reefs throughout the world, several studies show that Hawaiian reefs may be significantly more resistant to heavy sediment loads than other reef areas. Results of surveys conducted at French Frigate Shoals (Dollar and Grigg, 1981) following the inadvertent grounding of a freighter and subsequent dumping of 2000 tons of a fine-grained mineral clay indicated that there was no damage to the reef corals and associated communities except where the organisms were actually buried by clay deposits for greater than a two-week period. Another study, conducted in Hilo Bay where natural sediment loads are very high and water is extremely turbid, reported that the dominant bottom cover consisted of nearly solid living coral--a condition rarely found under even the most "optimal" conditions (Dollar 1985).

Runoff

As with sedimentation, it is not expected that runoff during construction would provide any negative stimulus to the marine environment. While rainfall is high in the area, the porous nature of the lava substratum, sheet flow to the ocean during construction is rather unlikely. Rather, most rainwater that would enter the ocean as runoff would do so following percolation through the surface rock layers to the water table, followed by groundwater extrusion at the shoreline.

Normal volumes of groundwater extrusion in the Pohoiki area are probably range in the neighborhood of 3-6 million gallons per day (mgd) per mile. Results of water chemistry surveys conducted for this report have shown while there is a substantial groundwater signature in the bodies of water mauka of the shoreline, vigorous marine mixing processes result in very small changes to open oceanic conditions in the nearshore zone. As a result, the increase to the volume of groundwater extrusion and resulting

change in water chemistry owing to changes in shoreline characteristics is likely to be insignificant. For a development on the south Kohala coast at Waikoloa, it was estimated that the annual discharge of storm water runoff is roughly equivalent to the amount of groundwater which enters the ocean each day (U. S. Army Corps of Engineers 1985). Therefore, the only major effect of rain during the period of grading might be to significantly decrease the amount and distribution of airborne dust--a circumstance that would have to be considered a beneficial side effect.

At this time no estimates exist of how drainage patterns might be changed as a result of the development plans. There appear to be no areas offshore of the Oneloa Development property where marine systems have been adversely affected by runoff to date. It is expected that this would remain the case. However, if analyses indicate that the proposed changes in land use and drainage patterns might result in substantial changes in water quality, additional field surveys will be conducted to determine the best location for the discharge of drainage and to assess the significance of expected water quality with respect to marine community structure.

Golf Course Irrigation, Fertilization, and Pest Control

The Oneloa Master Plan call for construction of golf courses that might be irrigated and fertilized with treated sewage effluent, as well as commercial fertilizer mixes. The potential for impacts to the aquatic ecosystems owing to possible increases in rates of nutrient loading must be considered. When subjected to substantial increases in nutrients, the response of some marine and freshwater systems is termed "eutrophication," and consists of increased growth of a portion of the community that is able to directly utilize the nutrients (phytoplankton), generally at the expense of normal community integrity. The overall result of this process is usually a degradation of environmental quality.

At the Oneloa site, it is anticipated that no such impacts will occur for several reasons. Most importantly, the unrestricted circulation of the offshore zone by tidal and wind-driven currents, large-scale eddies, and wave action promotes rapid dilution and water exchange. Residence time of a parcel of water fronting the development is probably on the order of minutes to hours, so buildup of any nutrient is unlikely.

Another reason that the marine environment will probably show no effects as a result of golf course irrigation is that much of the nutrient load is taken up by the vegetation on the golf course. Chang and Young (1977) report that on a golf course on Oahu irrigated with treated sewage effluent 98% of the total nitrogen and 100% of the total phosphorus was taken up by the soil-plant surface layer. Chemical processes that account for the uptake include incorporation into plant biomass, cation exchange, fixation and adsorption on the soil, biological oxidation and denitrification. The important aspect of the study conducted on the Oahu golf course is that essentially none of the nutrient load reached the marine environment through groundwater runoff. While the underlying substrata on the Oahu course may differ from substrata at the Oneloa site, the soil mantle, where most of the chemical uptake and adsorption takes place should be similar at the two locations. Murdoch and Green (1987) also investigated the influence of golf course irrigation and pesticide application to nearshore marine waters. After 23 years of operation, material used to fertilize the golf course at the Westin Mauna Kea Resort could not be detected in the ocean.

Dollar and Atkinson (1992) modeled the input of golf course nutrients to the ocean downslope from two golf courses in West Hawaii over a four-year period. Results of the studies showed that at a location where fertilizer nutrients entered an embayment with restricted circulation relative to open coastal shorelines, nitrates increased by about 100% and phosphate increased by about 20% over natural input. However, because the nutrients were retained within a surface layer, there was no exposure to the benthos. Circulation within the embayment was also rapid enough to prevent phytoplankton blooms. These results indicated that even with long-term input of extremely high nutrient subsidies, there are situations where there are no negative effects to the receiving environment.

Another factor that accounts for the lack of potential for impact is the secondary level of sewage treatment commonly used by resort developments for irrigants and fertilizers. Studies done at several of the ocean discharges on Oahu show that intentional discharges of greater volumes of secondary sewage into marine environments caused no detrimental effects whatsoever. In fact, the impacts that have been reported all can be considered beneficial since they result in increased fish populations, apparently in response to increased particulate food and shelter due to the outfall structure. Coral communities have also been documented to increase near the

outfalls because diffuser structures provide settling sites that appear to be superior to natural sites.

A final consideration is the relatively high levels of nitrogen presently entering the nearshore marine environment through groundwater extrusion. Marine communities are therefore pre-adapted to high nitrogen loads. More importantly, the added nutrients are rapidly mixed during periods of intense water motion so virtually no buildup in nutrient concentration persists. In fact, there are currently no reports in the scientific literature of detrimental impacts to reef communities directly caused by increased nutrient loads. Based on these observations, it is probable that even if malfunctions in sewage plants cause temporary discharge directly into the ocean, there will be little or no effect to water quality or biotic communities.

Potential for negative alteration to marine ecosystems owing to pesticides and herbicides also seems to be nil. It has not been found necessary to utilize substantial quantities of pesticides on golf courses in Hawaii, and only very small applications of herbicides are periodically made to the greens (N. Bustamente, Mauna Lani Resort, personal communication). Such small quantities do not appear to be of a magnitude great enough to leach through the soil and lava, be carried to the ocean via groundwater extrusions, and then bioaccumulate to the point of producing a noticeable effect. To date, there have been no substantiated instances of even detection of golf course biocides in any marine biota in Hawaii.

Potential Effects to Protected Species

As mentioned in the Results, there are several protected marine species that may inhabit the offshore environment. Because there is no plan for any work in the nearshore region, there is no potential for blasting or excavation that might affect behavior of whales and other marine mammals. Short term changes in water quality resulting from construction would also not be of a magnitude to affect the behavior of sea turtles that might inhabit the reefs off of Oneloa. Thriving turtle populations have been documented off many of the existing resort projects in West Hawaii. The area already has open access to the ocean. In addition, the harsh conditions, both in terms of wave action and lack of beaches, limits easy entry to the ocean. Hence, it is not likely that the proposed project would result in substantial changes to human activities in the

marine environment. Thus, any human-induced effects to turtle populations have probably already occurred.

The potential for impacts to marine communities as a result of development of the Oneloa Master Plan project appear to be minimal. None of the developmental activities appear to have the potential to induce long-term changes in physio-chemical water quality parameters of a magnitude sufficient to cause changes in biological community structure. Marine environments are routinely subjected to stresses that can be much more destructive than the incremental changes that could result from any development activity. If some unexpected event related to development activities does occur, the resulting alterations to marine community structure would probably be reversible and recovery rapid once the stress factor is mitigated. Tolerance to such changes appears to already be part of the physiological range of the community.

It can be concluded that as long as reasonable steps are taken in construction practices, and operational procedures for the shoreline projects do not involve substantial changes in material delivery to the nearshore ocean, there should be no adverse impacts to the marine environment. However, *regardless of how unlikely*, there is always the potential for an unexpected event. It is recommended that the development plan includes a time-course monitoring program. If any development practices cause changes in physical-chemical parameters which lead to changes in environmental integrity, these effects could be quantified through time-series monitoring surveys. Such changes in water quality would be indicative of potential changes to marine community structure. Thus, any changes in water quality owing to shoreline development would trigger mitigative action, hopefully at a level below that capable of inducing change in biotic structure.

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TABLE 1. Water chemistry measurements on transects off the site of the proposed Oneloa Master Planned Development in Puna Hawaii DFS" represents distance from shore; negative distances indicate sampling locations in ponds landward of the shoreline; positive distances indicate sampling locations in the open ocean. Boxed values exceed DOH water quality standards for wet condition in open coastal waters. For transect locations, see Figure 1.

TRANSECT LOCATION	DFS (m)	PO4 (µg/L)	NO3 (µg/L)	NH4 (µg/L)	Si (µg/L)	DOP (µg/L)	DON (µg/L)	TP (µg/L)	TN (µg/L)	TURB ntu	SALT (o/oo)	Chl-a (µg/l)	pH (rel)
SOUTH	-25	51.15	514.08	86.52	36902.6	15.81	159.60	66.96	760.20	0.30	9.210	1.575	7.316
	-20	39.99	384.44	4.34	35710.4	5.89	73.22	45.88	462.00	0.12	11.931	0.852	7.721
	-10	34.41	440.72	0.42	32312.3	6.82	104.16	41.23	545.30	0.11	14.100	0.412	7.723
	-5	24.18	353.50	5.04	26429.8	5.89	87.22	30.07	445.76	0.13	17.285	2.686	7.913
	-1	17.98	247.10	0.28	19253.1	7.13	115.50	25.11	362.88	0.17	22.884	0.953	8.012
	0	13.95	236.32	0.14	16110.6	8.37	125.86	22.32	362.32	0.13	24.611	0.546	8.007
	5s	2.48	4.48	0.56	971.0	11.78	129.92	14.26	134.96	0.10	33.993	0.584	8.149
	25s	3.10	5.88	0.98	1389.6	11.16	130.62	14.26	137.48	0.09	34.084	0.632	8.163
	25b	4.03	3.22	1.12	528.9	12.40	141.54	16.43	145.88	0.08	34.545	0.645	8.149
	50s	4.65	8.12	2.38	1224.2	12.09	137.62	16.74	148.12	0.15	34.177	0.771	8.161
	50b	2.48	1.12	2.10	340.8	13.33	143.50	15.81	146.72	0.09	34.648	0.803	8.146
	100s	2.48	1.26	1.26	413.0	12.09	138.74	14.57	141.26	0.11	34.616	0.552	8.139
	100b	2.48	0.14	1.82	185.6	12.09	152.04	14.57	154.00	0.10	34.724	0.404	8.148
	200s	3.72	3.36	2.94	728.3	13.02	147.14	16.74	153.44	0.10	34.464	0.702	8.139
	200b	3.10	0.42	2.66	129.6	13.64	141.96	16.74	145.04	0.07	34.836	0.386	8.151
CENTRAL	5s	3.41	0.98	2.52	145.0	13.64	123.76	17.05	127.26	0.09	34.810	0.396	8.158
	25s	4.03	0.98	3.50	156.5	11.47	148.54	15.50	153.02	0.10	34.795	0.386	8.138
	25b	3.41	0.70	3.50	160.4	11.47	128.66	14.88	132.86	0.08	34.764	0.399	8.153
	50s	3.41	0.14	2.94	152.3	14.88	141.54	18.29	144.62	0.09	34.763	0.412	8.151
	50b	6.20	0.28	2.24	142.0	10.23	181.02	16.43	183.54	0.08	34.804	0.316	8.155
	100s	2.79	0.28	3.22	173.0	13.33	156.94	16.12	160.44	0.10	34.771	0.498	8.148
	100b	2.17	0.14	5.04	87.4	12.09	133.70	14.26	138.88	0.07	34.904	0.236	8.156
	200s	2.79	0.14	3.64	157.4	10.85	139.30	13.64	143.08	0.09	34.783	0.450	8.129
	200b	2.79	0.14	4.76	68.0	13.33	144.76	16.12	149.66	0.08	34.911	0.163	8.153
NORTH	-25.00	39.99	430.92	10.50	38790.9	8.99	130.06	48.98	571.48	0.25	10.301	25.173	7.782
	-10.00	44.64	447.02	4.20	37060.0	7.44	75.88	52.08	527.10	0.16	9.719	1.302	7.713
	0	38.75	445.90	7.14	38431.7	7.13	73.22	45.88	526.26	0.17	10.685	0.977	7.750
	5s	2.79	2.10	3.36	404.3	12.71	123.90	15.50	129.36	0.12	34.539	0.418	8.175
	25s	2.48	1.12	4.76	379.7	10.85	137.34	13.33	143.22	0.13	34.533	0.611	8.171
	25b	1.55	1.12	3.78	354.8	11.47	129.78	13.02	134.68	0.10	34.524	0.544	8.170
	50s	3.72	1.68	5.32	325.4	11.78	121.94	15.50	128.94	0.11	34.592	0.619	8.149
	50b	3.41	2.66	5.32	339.9	12.40	130.90	15.81	138.88	0.12	34.572	0.388	8.156
	100s	3.10	1.96	5.60	369.0	12.40	158.34	15.50	165.90	0.09	34.573	0.672	8.136
	100b	3.41	1.54	4.34	152.6	12.09	155.68	15.50	161.56	0.08	34.812	0.418	8.148
	200s	3.72	3.36	5.32	587.7	11.78	131.32	15.50	140.00	0.09	34.450	0.648	8.134
	200b	4.34	1.26	2.66	139.7	12.09	125.44	16.43	129.36	0.09	34.851	0.343	8.153
MAUKA POND		38.13	623.14	2.52	38359.2	9.61	81.48	47.74	707.14	0.17	9.447	1.101	7.614

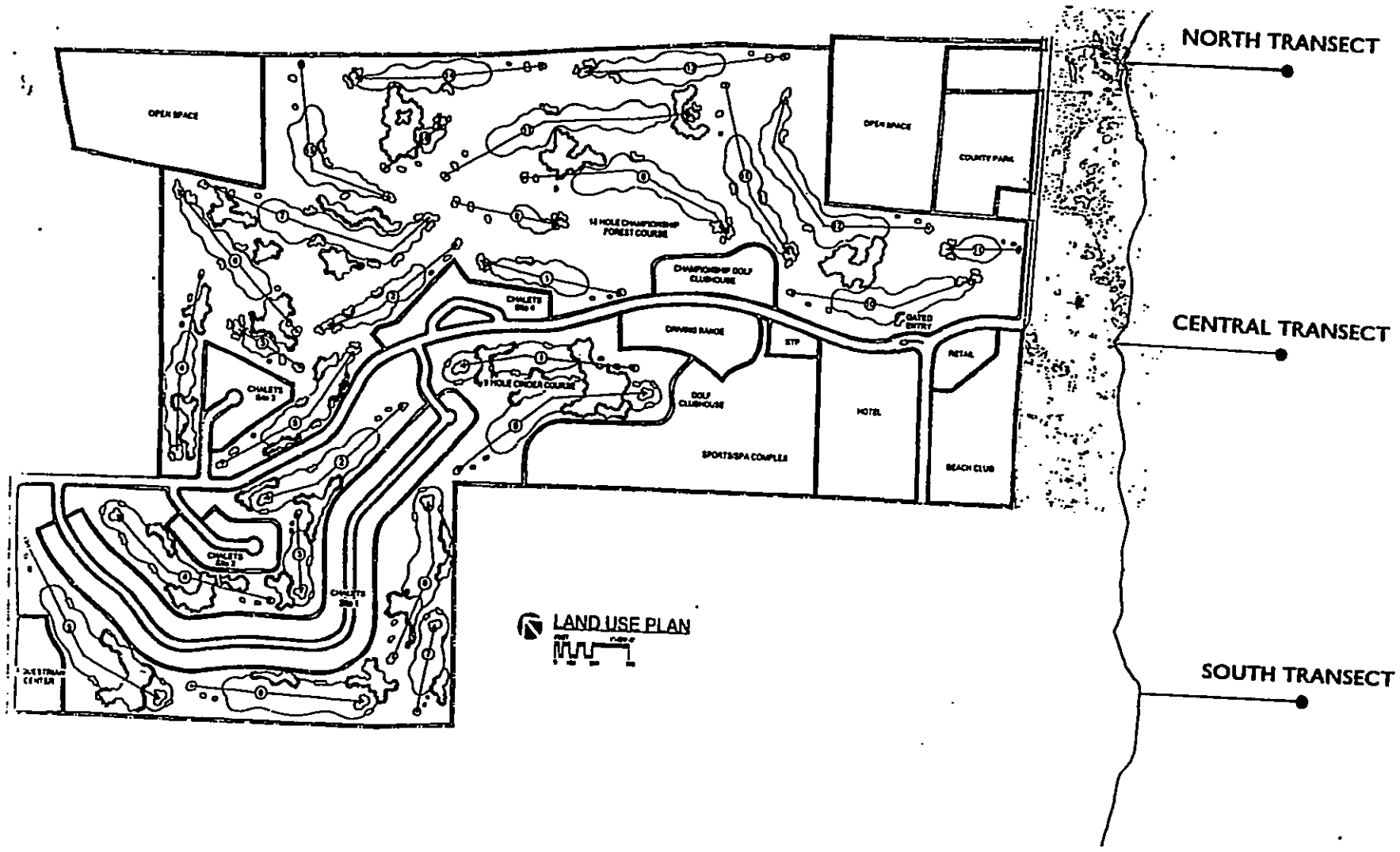


FIGURE 1. Map of proposed land use plan for the Oneloa Master Plan Development in Puna, Island of Hawaii, along with locations of three water sampling transects.

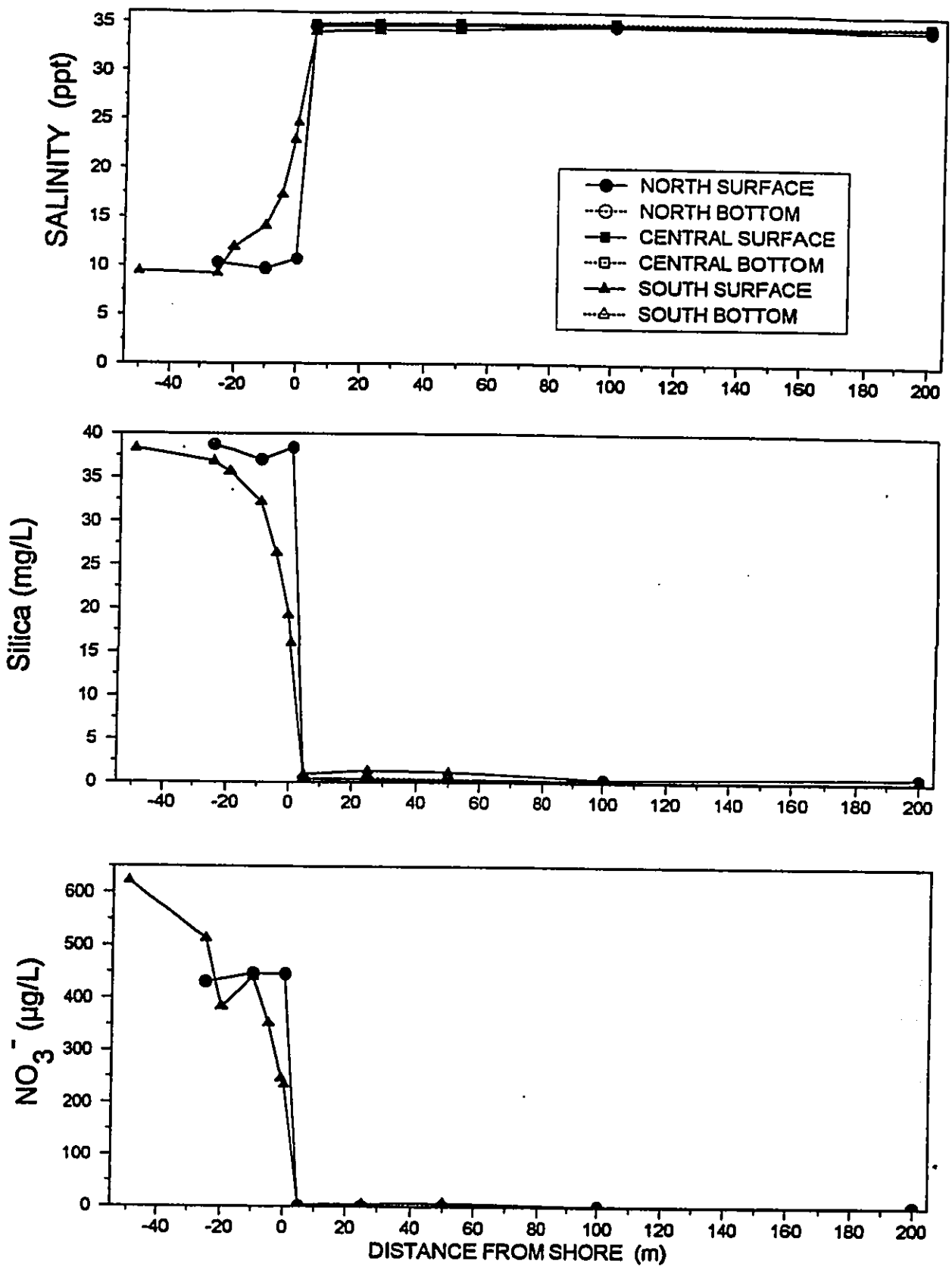


FIGURE 2. Plots of salinity, silica and nitrate in surface and bottom water samples collected on three transects off the location of the proposed Oneloa development. Negative distances denote inland from the shoreline. For transect locations, see Figure 1.

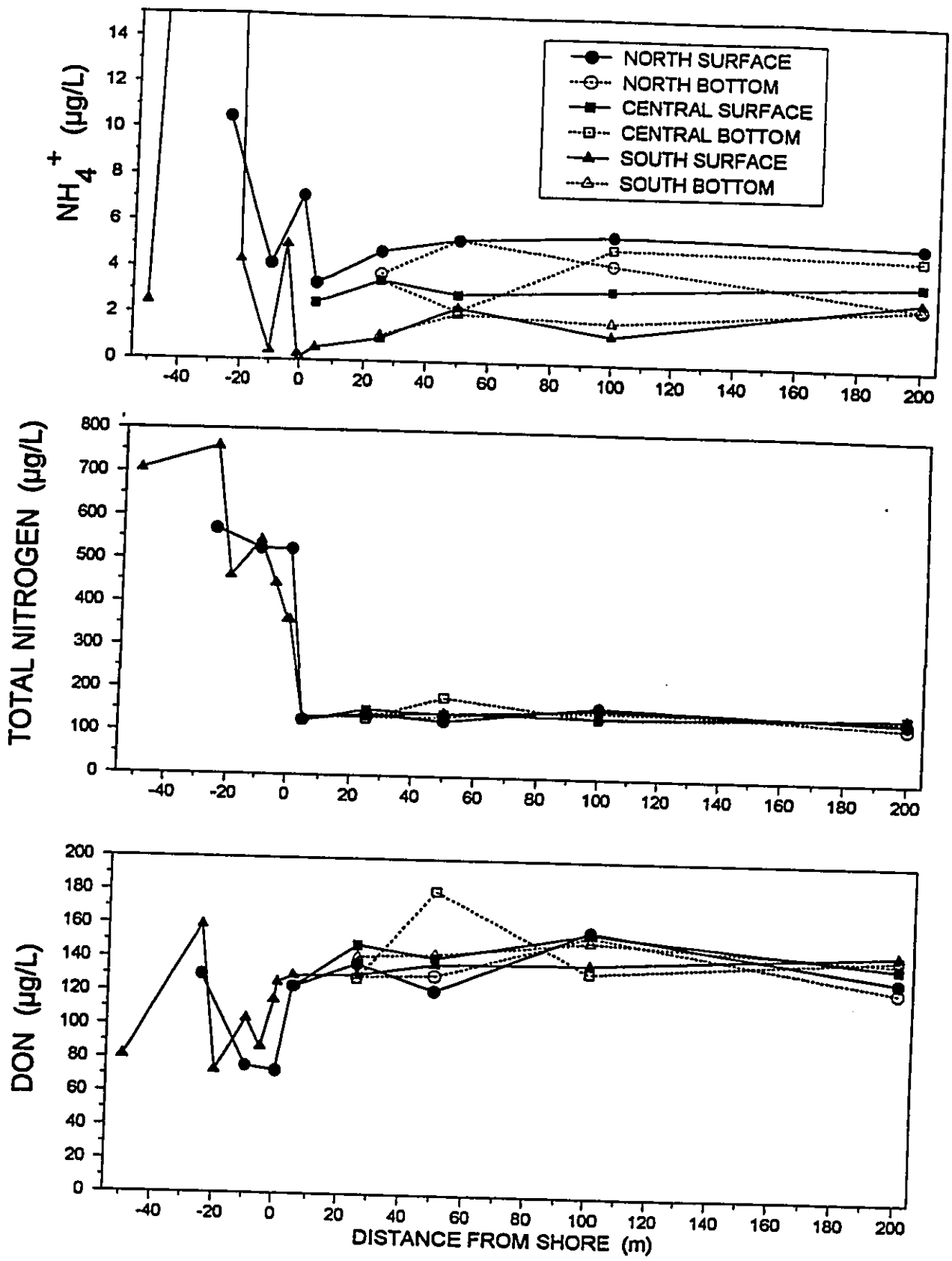


FIGURE 3. Plots of ammonium, total nitrogen and dissolved organic nitrogen in surface and bottom water samples collected on three transects off the location of the proposed Oneloa development. Negative distancesd denote inland from the shoreline. For transect locations, see Figure 1.

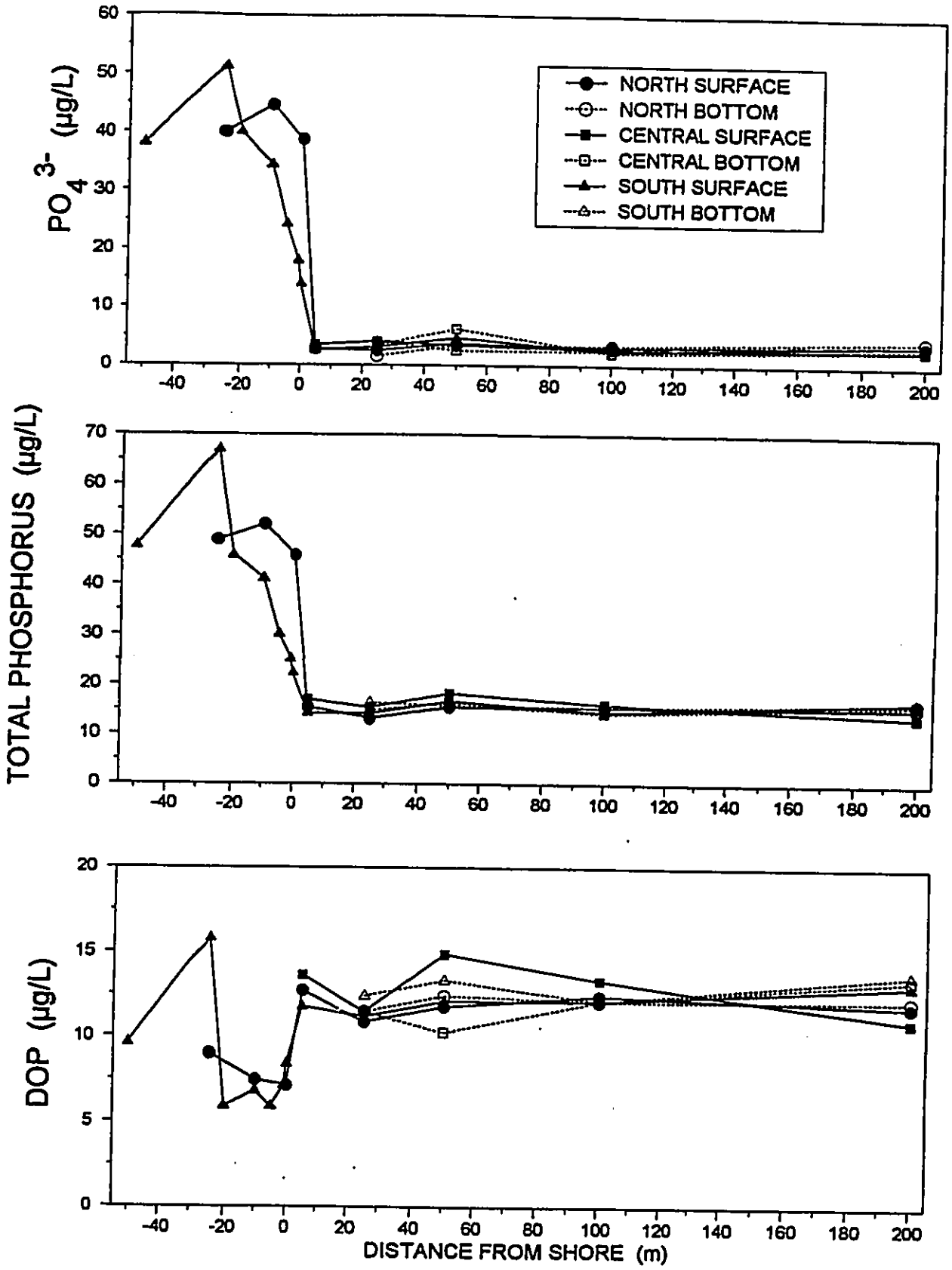
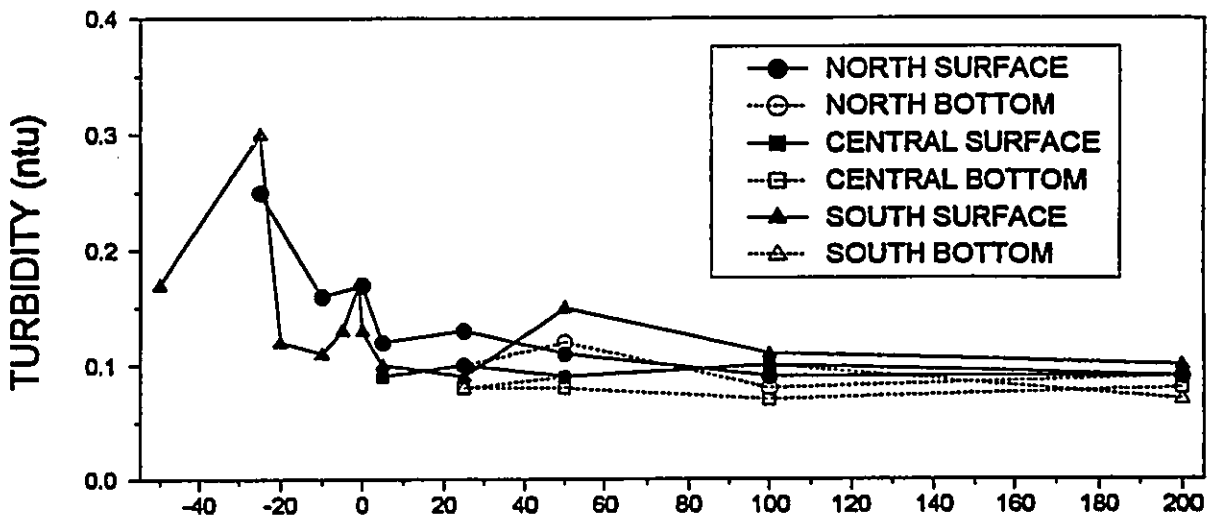


FIGURE 4. Plots of phosphate, total phosphorus, and dissolved organic phosphorus in surface and bottom water samples collected on three transects off the location of the proposed Oneloa development. Negative distancesd denote inland from the shoreline. For transect locations, see Figure 1.



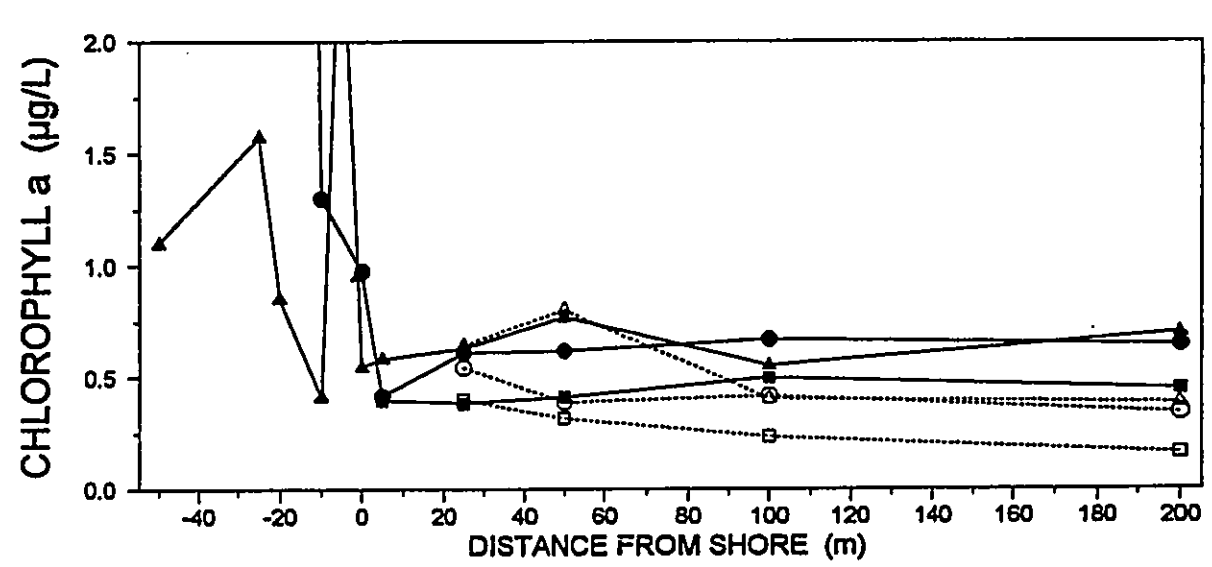


FIGURE 5. Plots of turbidity and chlorophyll a in surface and bottom water samples collected on three transects off the proposed Oneloa Development. Negative distances denote inland from the shoreline. For transect locations, see Figure 1.

APPENDIX E

HYDROGEOLOGY OF ONELOA, HAWAII

by:

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Hydrogeology of Oneloa, Hawaii

January 1999

Prepared by Waimea Water Services, Inc.

Introduction

The Oneloa project is situated in an area underlain by lava extruded from the east rift zone of the Kilauea volcano (see project location map). The land surface slopes gently in a southeasterly direction away from the rift zone. The highest elevation within the project is about 220 feet above mean sea level. There are no hills or puu of significance on the land. A number of lava tube features are found in the northeastern portion of the project area.

Rainfall occurs primarily as a result of orographic tradewind sweeping in from the ocean. Occasional cyclonic storms of the winter months produce heavy rains. The annual average precipitation is about 100 inches. There are no streams found in the area and runoff is confined to local sheet runoff. A significant percentage of all rainfall percolates rapidly into the underlying lava as the area is devoid of structured soils.

There are numerous warm springs found along the coastline in the near shore waters. Recent sampling, (Marine Research Consultants, 1998), indicates the presence of geothermal alteration of the groundwater discharging to inshore pools and ponds.

As described elsewhere in the project reports, potable water will be provided via the County Department of Water Supply system. Wastewater will be treated on site and used for irrigation. Provision will be made for limited irrigation on golf course and grounds. The abundant rainfall will provide most of the plant watering.

Hydrogeology

As indicated above, young , (1500 years Before Present), lavas from the active rift zone of Kilauea underlie the project area. The most recent eruption nearby occurred in 1960 and buried the village of Kapoho. Numerous eruptions have occurred along the rift zone, which remains active. The nearby Puna Geothermal Venture wells derive their heat from the depths of the rift zone.

Geothermal heat and gaseous alteration of the groundwater dominate the shallow hydrogeology. A single well, known as the Allison well (# 2881-01) was drilled on the property. The well no longer functions inspite of efforts to remove a damaged pump. According to State records, the well was drilled in 1973 for agricultural purposes. Water pumped from the well showed a strong influence of geothermal activity (Novak and Thomas, 1995). Although the information is limited, it is expected that a brackish basal lens underlies the lands encompassed by the project. The warm springs along the shore and the warm,

chemically enriched water produced by the well, indicate that the lens will be highly altered everywhere beneath the project.

The young lavas are very permeable and tidal transmission within the basal lens can be expected to extend inland to the edge of the rift zone. Water level measurements by Novak and Thomas (1995) indicate a daily tidal fluctuation of 1.8 feet in the Allison well. Such oscillations of the water table will result in a thick transition zone between fresh (< 250 Mg/L chlorides) water and the underlying salt water. To date, only wells within (Kapoho #3080-01) or north of the rift zone have located a quality useable for potable purposes. The Allison well and the well at Malama Ki, to the west, both have produced very brackish water.

Recharge to the basal lens to the south of the east rift zone is estimated at about 2 to 4 mgd (million gallons daily)/ mile of shoreline. There are no streams or defined drainageways near the project. It is reasonable to assume that rainfall in excess of 1 inch per week (consumptive use) most probably will rapidly percolate to the water table as recharge. The Oneloa project is about 1 mile wide at a maximum. Assuming that the recharge area extends inland about 2 miles, the total recharge area is about 2 square miles. Rainfall over the recharge area averages about 100 inches per year. The estimated evapotranspiration is 52 inches per year, which implies that the recharge for the 2 square mile area averages about 4.6 mgd.

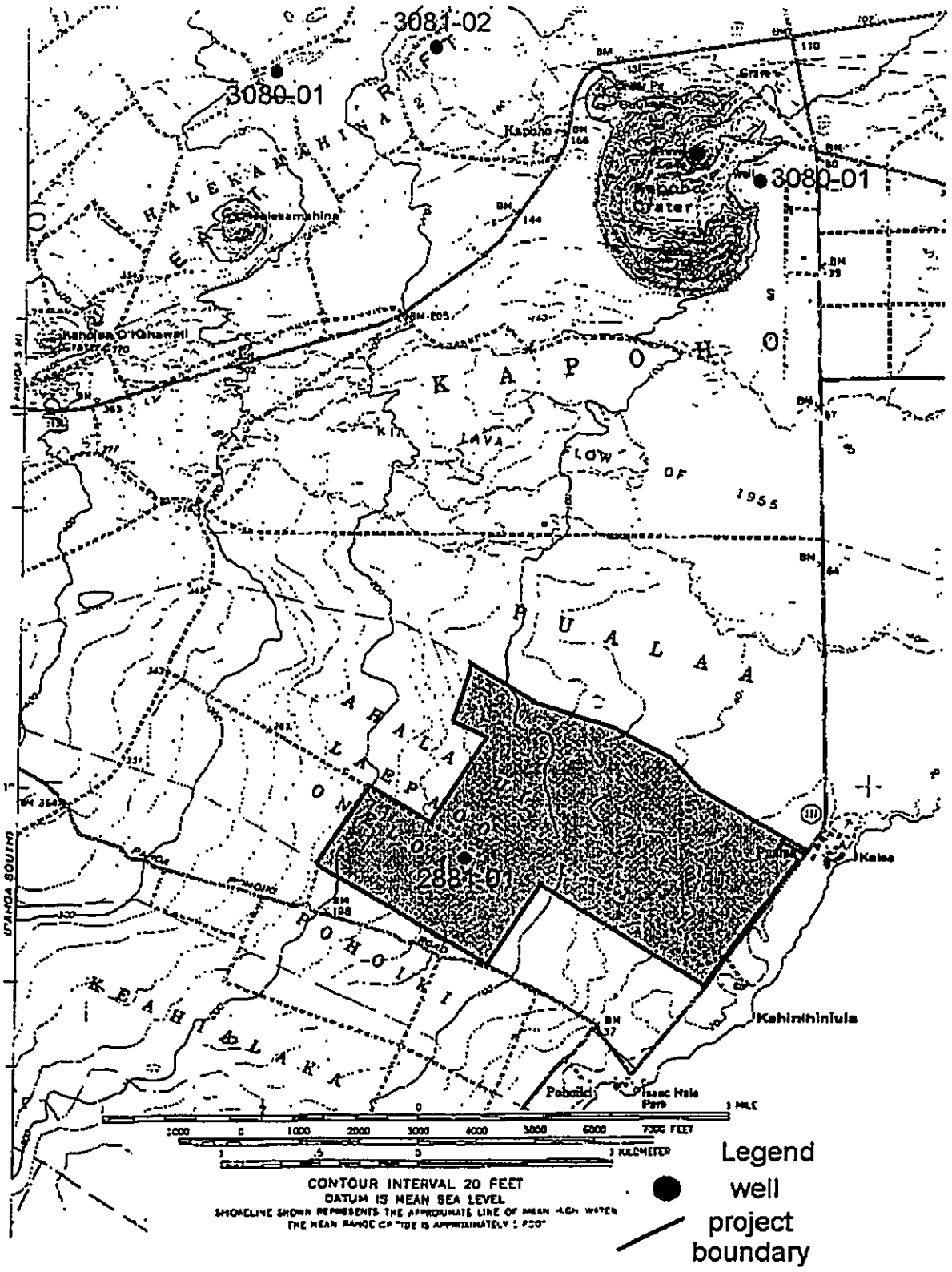
According to Takasaki (1993), the hydraulic conductivity in the vicinity of Pohoiki is about 6,670 ft/day. By calculating the groundwater flow using Darcy's Law as $Q = TIL$:

Where Q = the ground water recharge
T = the transmissivity
I = the gradient in feet per mile
L = the aquifer
Using Takasaki's aquifer thickness of 70 feet for warmed water and an aquifer width of 1 mile, the estimated groundwater flow through the project area is calculated at about (6,670x70 x 2.0x 1=) 933,800 gallons per day.

This latter estimate of groundwater flow seems extremely low in light of the estimate from rainfall. Regardless, the primary water requirement from an onsite well(s) will be for limited irrigation. This irrigation will need to be supplemented with reclaimed wastewater. Under the state Department of Health rules, a monitoring program will be needed.

As stated, the known data on groundwater quality indicates that the entire project area is underlain by a very brackish basal aquifer. Since the imported potable supply will be significantly fresher and higher quality, it is unlikely that treated wastewater, when used for irrigation, will have a negative impact on the basal lens.

In summary, the project overlies a very brackish basal lens which has a seaward flow estimated at from 2 to 4 Mgd. The high (100") annual rainfall minimizes the need to irrigate except for critical golf areas of tees and greens. Irrigation may require a supplement of up to 300,000 gallons per day, depending on the extent of the area to be irrigated . The drinking water will be supplied from existing sources and irrigation will be supplemented with treated and reclaimed wastewater and on site wells.



Project Location Map

Selected References

1) Marine Research Consultants; 1998; MARINE ENVIRONMENTAL ASSESSMENT, ONELOA MASTER PLAN DEVELOPMENT, Puna, Hawaii; manuscript report.

2) DLNR-Commission on Water Resource Management ; well data

2) E. W. Wolfe and J. Morris, 1996, GEOLOGIC MAP OF THE ISLAND OF HAWAII; U. S. Geological Survey, Map 1-2524-A.

4) H.T.Stearns and G.A.Macdonald ; 1946; GEOLOGY AND GROUND WATER RESOURCES OF THE ISLAND OF HAWAII; Division of Hydrography,Territory of Hawaii, Bulletin 13.

5) K.J.Takasaki; 1993; GROUND WATER IN KILAUEA VOLCANO AND ADJACENT AREAS OF MAUNA LOA VOLCANO, ISLAND OF HAWAII, U.S. Geological Survey, Open-File Report 93-82.

6) E. Novak and D.Thomas; 1995; A CONCEPTUAL MODEL OF SHALLOW GROUNDWATER FLOW WITHIN THE LOWER EAST RIFT ZONE OF KILAUEA VOLCANO, HAWAII; unpublished document, University of Hawaii.

APPENDIX F

"PUNA, KA AINA I KA HIKINA A KA LA": A CULTURAL ASSESSMENT STUDY– ARCHIVAL AND HISTORICAL DOCUMENTARY RESEARCH AND ORAL HISTORY INTERVIEWS FOR THE AHUPUA'A OF 'AHALANUI, LAEPAO'O, AND ONELOA (WITH POHOIKI),

by:

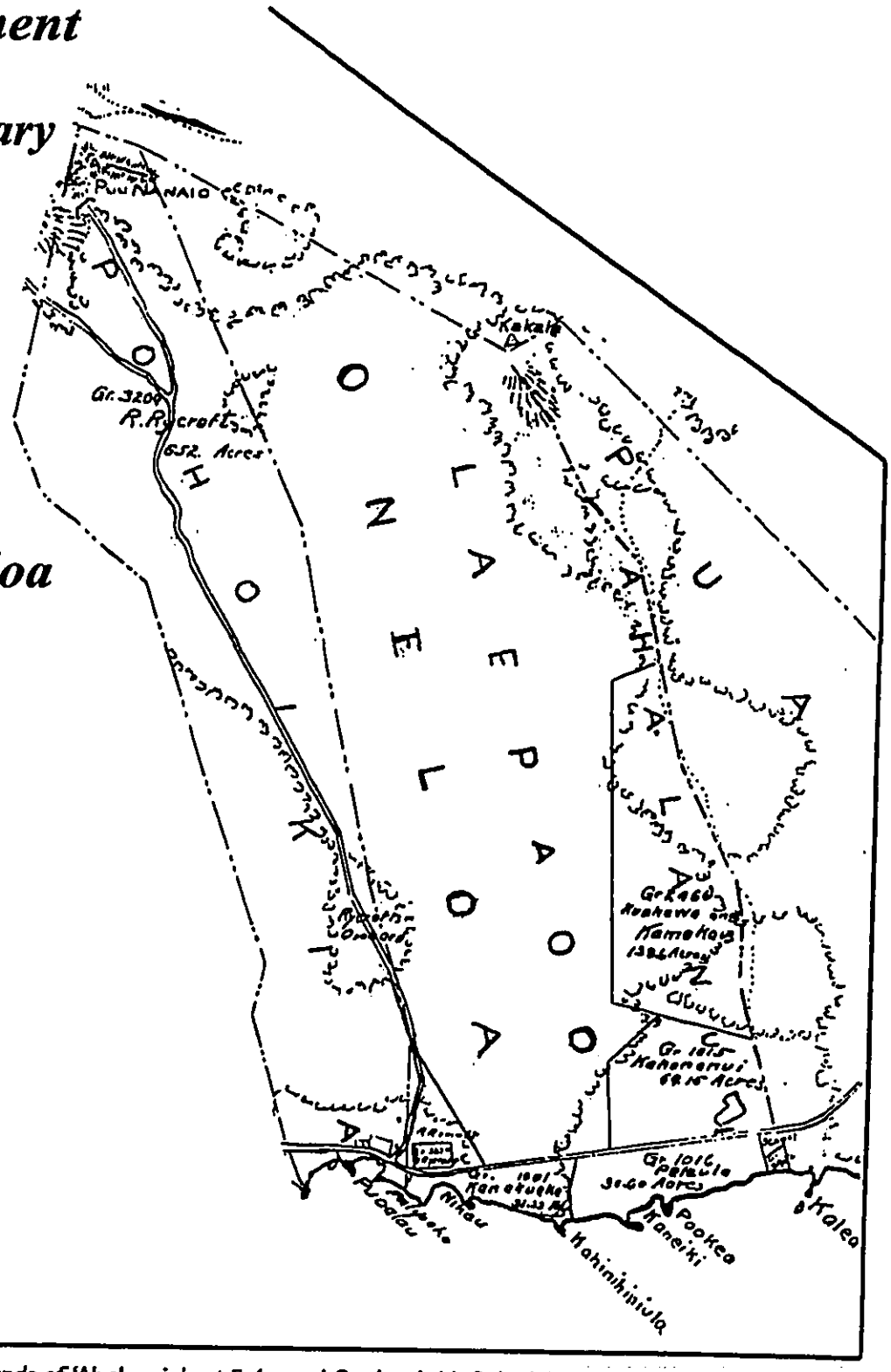
Kepa Maly, Cultural Resources Specialist, Kumu Pono Associates

Report HiPu-15b (073198)

"PUNA, KA ʻĀINA I KA HIKINA A KA LĀ"

A Cultural Assessment Study –Archival and Historical Documentary Research and Oral History Interviews

For the Ahupuaʻa of ʻAhalanui, Laepāoʻo, and Oneloa (with Pohoiki), District of Puna, Island of Hawaiʻi



Lands of ʻAhalanui, Laepāoʻo, and Oneloa (with Pohoiki), Puna, Hawaiʻi (Portion of Register Map No. 2191; June 1904)

Kumu Pono Associates

Historical & Archival Documentary Research · Oral History Studies · Partnerships in Cultural Resources Management · Developing Preservation Plans and Interpretive Programs

Report HiPu-15b (073198)

"PUNA, KA ʻĀINA I KA HIKINA A KA LĀ"
A Cultural Assessment Study – Archival and Historical Documentary Research and Oral History Interviews

For the Ahupuaʻa of ʻAhalanui, Laepāoʻo, and Oneloa (with Pohoiki), District of Puna, Island of Hawaiʻi (TMK:1-4-02, por.07,13,73,74,75)

BY

Kepā Maly • Cultural Resources Specialist

PREPARED FOR

David Matsuura,
A & O International Corporation; Oneloa Development
458 Pōnahawai Street
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July 31, 1998

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Kepā Maly, Consultant
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EXECUTIVE SUMMARY

Overview

At the request of Mr. David Matsuura, of A & O International Corporation–Oneloa Development, Kepā Maly, Cultural Resources Specialist (*Kumu Pono Associates*), conducted a cultural assessment study (including archival and historical documentary research and oral history interviews) in conjunction with the preparation of an Environmental Assessment Study (EA), for the *ahupua'a* (native land divisions) of 'Ahalanui, Laepāo'o, and Oneloa, in the district of Puna, Island of Hawai'i (TMK:1-4-02; por.07,13,73,74,75). The overall project area consists of approximately 500 acres on the southeastern side of the island of Hawai'i. The property extends approximately 1¼ miles from the mountain to the shore, descending from the 200 foot elevation to 20 feet above sea level.

Archival and Oral Historical Research

The archival historical documentary research reported in this study was conducted primarily between November 1997 to February 1998, and includes archival resources from land documents, survey and cartographic records, historic literature and journals, native Hawaiian texts from Hawaiian language newspapers, and selected archaeological studies. As a part of this study, the author also conducted oral history interviews with Hawaiian *kūpuna* (elders) and representatives of native families with generational residency ties to the lands of eastern Puna. The oral history interviews reported in this study were conducted between November 21, 1997 to July 21, 1998. The interviews add important documentation to the historical record, and specifically describe the continuing relationship shared between native residents of the land, and the natural landscape and resources of the project area *ahupua'a* and the larger Puna District.

It is noted here that this study does not duplicate all that has been previously written in archaeological and ethnographic studies about the 'Ahalanui-Oneloa vicinity. Instead, pertinent references are cited, and the primary texts focus on historical records which have been recently identified as valuable sources of information for the study area lands.

Findings and Recommendations

As a result of the literature research and oral historical interviews, readers are given access to rich traditional and historical narratives. To the greatest extent possible, the documentation is site specific (recorded for the immediate study area), but because of the limited historical resources for the lands of 'Ahalanui, Laepāo'o, and Oneloa, and close relationship of the lands to the Pohoiki community, additional documentation from neighboring *ahupua'a* and the larger Puna district is also cited here. This information may be used to formulate a better understanding the general practices and customs of the native residents of the 'Ahalanui-Oneloa area.

The interviews cited in this study also document the continuation of certain aspects of traditional knowledge and practices associated with the land, as handed down in families over the generations. The interviews record that families share a "cultural attachment[Ψ]" with

[Ψ] "*Cultural Attachment*" embodies the tangible and intangible values of a culture—how a people identify with, and personify the environment around them. It is the intimate relationship (developed over generations of (continued on the following page)

the lands, sites, resources, and place names of Puna. This is seen as love for the landscape, a sense of the importance of the history of the land, and the continuation of native practices—whether occurring physically on the land, or being orally taught to successive generations.

As a result of the combined records of archival and oral historical accounts, a wide range of features in the cultural landscape were identified within, and neighboring the Oneloa Development project area. These features fall into at least six general categories, including — (a) the cultural-geographic landscape (e.g. the Haleolono agricultural complex of 'Ahalanui); (b) ceremonial sites (e.g., Kuaokalā Heiau); (c) native Hawaiian *ilina*, or burials; (d) *ala loa* and *ala hele* (regional and inner *ahupua'a* trail systems); (e) sites associated with permanent and temporary habitation activities; and (f) sites associated with resource collection and stewardship practices.

Based upon the commitment of A&O International Corporation-Oneloa Development to preserve the Hawaiian cultural sites (site identified during archaeological investigations), and to protect the remnant native forest in 'Ahalanui, the interviewees generally feel that the proposed project will have no adverse effect on the lands of 'Ahalanui, Laepāo'o, and Oneloa. It was noted by all the interviewees—individuals who have lived on, and/or worked the land since ca. 1919—that the area of the primary area of proposed development and construction, has been previously cleared and bulldozed for papaya cultivation.

During the course of conducting the interviews, several recommendations were offered, that provide A&O International Corporation-Oneloa Development with guidance for development of long-term management objectives. These recommendations include historic site preservation, protection of natural resources, and interpretive programs in the study area. Because of their importance to the interviewees, key recommendations for the care of cultural and natural resources in the study area—based on either specific interview comments, or significance of text in the interviews—are cited here:

1 – *Pā ilina* (burial sites): Family members should be consulted regarding treatment and long term protection of the *pā ilina*. It is generally felt that burials should be preserved in place.

2 – Work with the families of the land in developing preservation plans for cultural resources in the 'Ahalanui-Oneloa area.

3 – Protect the native forest and other trees such as *kamani* (*Calophyllum inophyllum*), *niu* (*Cocos nucifera*), and *'ulu* (*Artocarpus altilis*).

4 – Work to protect the quality of the water, ponds, and fisheries.

5 – provide people with historical information on the lands, families and customs of the 'Ahalanui-Pohoiki vicinity.

6 – Develop work opportunities for native families and residents of Puna.

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experiences) that people of a particular culture feel for the sites, features, phenomena, and natural resources etc., that surround them—their sense of place. This attachment is deeply rooted in the beliefs, practices, cultural evolution, and identity of a people. The significance of cultural attachment in a given culture is often overlooked by others whose beliefs and values evolved under a different set of circumstances (cf. James Kent, "Cultural Attachment: Assessment of Impacts to Living Culture." September 1995).

ACKNOWLEDGMENTS

There is a Hawaiian proverb, "*A 'ohe hana nui, ke alu 'ia*" (No task is too big, when done by all). Completion of this study was made possible because many people contributed to it. Among the many contributions to this study, are the writings of *kūpuna*, who in the nineteenth and early twentieth centuries chose to record both traditional accounts and historical events on the lands, and in the lives of the residents of the land. There are also, the *kūpuna* who are with us today, that share decades of relationship with the lands and families of the Kapoho-Pohoiki, and 'Ōpihikao vicinity. Also, there are the individuals who have taken the responsibility to serve as stewards of the land in these changing times. To all of you who shared your *mana 'o*, *aloha*, and history —

George Enriquez, Sam Gon III, John and William Hale, Gabriel Kealoha, Keikialoha Kekipi, Joel Lau, Arthur Lyman, Kahu John and Violet Makuakāne, Joni Mae Makuakāne-Jarrell, Kamakaonaona Pomroy-Maly, Randy Hashimoto (State Survey Division), and Marc Smith (State Historic Preservation Division). Also, to the many people unnamed here, who provided logistical support, and helped to ensure that the archival research and interviews could be completed. And to David Matsuura and his team who cared enough about the land to encourage the undertaking of this historical work by which to best formulate a plan for the perpetuation, protection, and interpretaion of the cultural and natural resources of the 'Ahalanui-Oneloa area —

— Mahalo nui nō, ke aloha o ke Akua pū me 'oukou a pau!

In reading this collection of archival documentation and oral histories, I wish to ask you to think of a saying taught to me by my *kūpuna hānai* (adoptive grandparents) on Lāna'i — "*O ka mea maika'i mālama, o ka mea maika'i 'ole, kāpae 'ia*" (Keep that which is good and set that which is not good aside). With this saying, I wish to share with readers that I can only speak from the door of my own house, from that of which I have experienced. I do not profess to have recorded all that could have, or should be said about the 'Ahalanui-Oneloa area, the neighboring Puna region, or the study matter. But, a sincere effort has been made to present readers with an overview of the rich and varied history of the area, and to accurately relay the thoughts and recommendations of the people who contributed to this study.

'o wau nō me ka ha'aha'a — Kepā Maly

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I. INTRODUCTION

BACKGROUND

At the request of David Matsuura, of A & O International Corporation–Oneloa Development, Kepā Maly, Cultural Resources Specialist (*Kumu Pono Associates*), conducted a cultural assessment study (including archival and historical documentary research and oral history interviews) in conjunction with the preparation of an Environmental Assessment Study (EA), for the *ahupua'a* (native land divisions) of 'Ahalanui, Laepāo'o, and Oneloa, in the district of Puna, Island of Hawai'i (TMK:1-4-02; por.07,13,73,74,75). The overall project area consists of approximately 500 acres on the southeastern side of the island of Hawai'i. The property extends approximately 1¼ miles from the mountain to the shore, descending from the 200 foot elevation to 20 feet above sea level (*Figure 1.*).

This study was conducted in a manner so as to comply with the basic guidelines and requirements of the Antiquities Act of 1906, as amended (16 U.S.C. 431-433); the Historic Sites Act of 1935, as amended (16 U.S.C. 461-467 [cf. Sections 106, 110, 111, 112, and 402]); the Advisory Council on Historic Preservation's "Guidelines for Consideration of Traditional Cultural Values in Historic Preservation Review" (ACHP 1985); National Register Bulletin 38, "Guidelines for Evaluating and Documenting Traditional Cultural Properties" (Parker and King 1990); the Hawai'i State Historic Preservation Statue (Chapter 6E), which affords protection to historic sites, including traditional cultural properties of ongoing cultural significance; the criteria, standards, and guidelines currently utilized by the Department of Land and Natural Resources-State Historic Preservation Division (DLNR-SHPD) for the evaluation and documentation of cultural sites (cf. Title 13, Sub-Title 13:274-4,5,6; 275:6); and recently adopted guidelines of the Office of Environmental Quality Control (OEQC), for development of cultural impact assessment studies (November 1997).

Approach to Conducting the Study

The primary objectives of this study were to — (1) identify native Hawaiian cultural sites or other historic properties within the project area; (2) to describe the historical context of those sites in the larger *ahupua'a* (land divisions) of 'Ahalanui, Laepāo'o, Oneloa, in the district of Puna; (3) based on archival and oral historical documentation, to describe the Hawaiian cultural or historic significance of those sites; (4) to assess the effect of the project on the significant sites; and (5) based on interviews and consultation discussions, recommend mitigation of possible adverse effects of the project.

This study seeks to provide readers with detailed narratives that describe the cultural landscape—which in this context, also includes the natural environment—of the 'Ahalanui-Laepāo'o-Oneloa study area. Because the traditional Hawaiian system of land management by *ahupua'a* (a native land division based on traditional knowledge of the landscape and ecosystems management practices), the study extends beyond the proposed project area, and provides readers with an overview of native accounts that describe the relationship between both coastal and inland resources of the *ahupua'a*. The study also describes some of the recorded customs and practices of native families within those *ahupua'a*, and their relationship to lands and people of neighboring *ahupua'a* of Puna district.

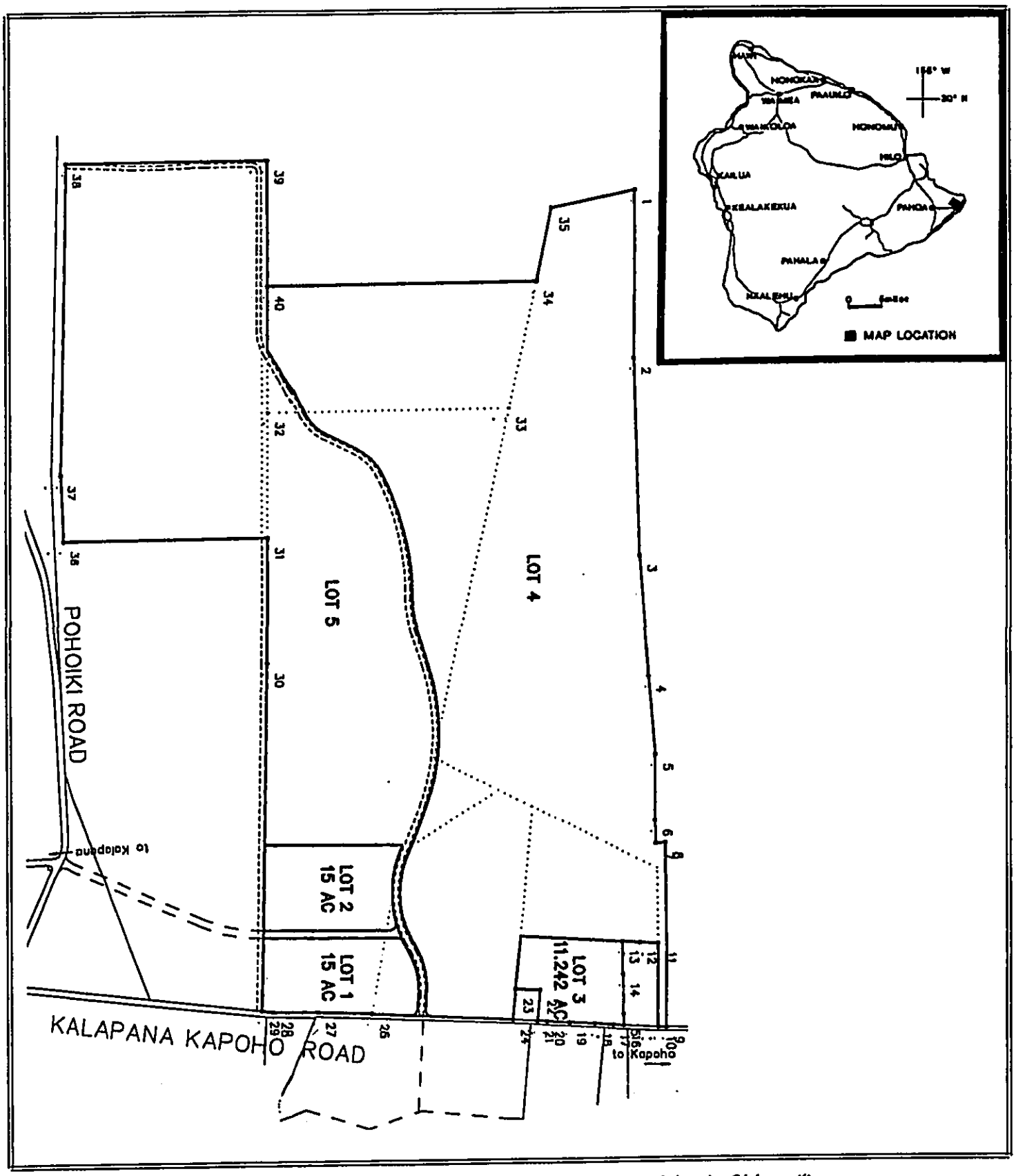


Figure 1. The 'Ahalanui, Laeþāo'o, Oneloa Study Area, District of Puna, Island of Hawai'i

Archival Research

In preparing the archival-historical documentary report for this study, the author reviewed both published and manuscript references in English and Hawaiian. These references included, but were not limited to: land use records, including Hawaiian Land Commission Award (LCA) records from the *Māhele* (Land Division) of 1848, and Boundary Commission Testimonies and Survey records of the Kingdom and Territory of Hawai'i (c. 1874-1876); D. Malo (1951); S. Kamakau (1961, 1964, 1976, and 1991); Wm. Ellis (1963); Titus Coan (1882); Chester Lyman (1924); A. Fornander (1917-1919 and 1973); Thrum (1908); Stokes and Dye (1991); J. W. Coulter (1931); M. Beckwith (1919, 1970); Hudson (ms. 1932); Barrère (1959); Handy and Handy with Pukui (1972); Bevacqua and Dye (1972); and McEldowney (ms. 1979). The study also includes several native accounts from Hawaiian language newspapers (compiled and translated from Hawaiian to English, by the author), and historical records authored by nineteenth century visitors to the region.

Archival resources were located in the collections of the Hawai'i State Archives, Land Management Division, Survey Division, and Bureau of Conveyances; the Bishop Museum Archives; University of Hawai'i-Hilo Mo'okini Library; and private collections. The documentation cited here-in was compiled primarily between November 1997 to February 1998.

It is noted here, that only a limited number of ethnographic and archaeological studies have been previously conducted and published for the 'Ahalanui-Laepāo'o-Oneloa study area. As a part of the present project, archaeological inventory surveys and subsurface testing were conducted by Archaeological Consultants of Hawaii (Kennedy et al. 1990 & 1991) and P. H. Rosendahl, Ph.D., Inc. (PHRI) (Dunn et al., 1995), and those studies may be referenced for additional site descriptions and limited historical documentation. Because of the limited number of studies conducted in the immediate project area, this study also includes documentation recorded for neighboring lands in the district of Puna. From the combined information—that written specifically for the 'Ahalanui-Laepāo'o-Oneloa study area and Pohoiki, as well as historical documentation from neighboring lands—we are able to gain a fairly detailed understanding of practices and customs of native residents in the area.

Oral Historical Research

As a part of this study, the author conducted four oral history interviews, with seven participants, between November 21, 1997 to July 21, 1998. The interviewees included *kūpuna* (elders) and representatives of native families with generational residency ties to the lands in and neighboring the study area. The primary focus of the interviews was to elicit information from knowledgeable individuals regarding traditional Hawaiian lore and practices (both past and those that are on-going), spiritual beliefs, the presence of traditional sites, land and resource use, and on-going subsistence practices in the study area. Interviewees were also encouraged to offer recommendations for long-term protection and interpretation of the cultural and natural resources of the 'Ahalanui-Laepāo'o-Oneloa study area.

Study Organization

As noted above, this study includes documentation that has been collected from two primary resources. The first chapters of this study report on documentation gathered from literature and archival resources. This information is generally cited in the chronological order of

original publication. Subsequent chapters introduce the oral history study, present an overview of the methodology of the oral history interview process, and provide a summary of the documentation collected as a result of the oral history interviews. The final chapters of the study presents the complete interview transcripts, as released by interview participants, including the personal release of interview record forms. *The interview records are the result of both* formal, tape recorded interviews and informal interviews for which hand written notes were taken and later expanded. All interview narratives (recorded and written) were reviewed by the interviewees for accuracy and context.

II. PUNA, ʻĀINA I KA HIKINA A KA LĀ — PUNA, LAND AT THE ARRIVAL POINT OF THE SUN

In the ancient lore of the people of Hawai'i, there are several things for which Puna is most famed—among them are the rising of the sun; Pele and the geologic phenomena; the groves of *hala* (pandanus); and growth of *'awa* (*Piper methysticum*). Perhaps because of her ever present eruptive and geologic presence, Pele, goddess of the volcanoes is first in the minds of many people today. But of greater antiquity, Puna is famed for its association with Kāne, a Hawaiian god and ancestor of the chiefs and commoners, a god of sunlight, fresh water, verdant growth, and forests (cf. Pukui 1973). Puna's association with Kāne is described in the Hawaiian saying —

Puna, ka ʻāina i ka houpo o Kāne
Puna, land [held] in the breast of Kāne
(Kihe, Wise, and Desha – In *Ka Hōkū o Hawai'i*; Sept. 16, 1915)

The saying commemorates Puna, of which it is said that before Pele migrated to Hawai'i from Kahiki, there was that "no place in the islands was more beautiful than Puna" (Pukui 1983:11, No. 79). More than a god of the verdant forests of Puna, Kāne is also the Hawaiian god of sun light. And the relationship between Kāne, the sun and Puna is significant throughout the Hawaiian Islands. In his role as giver of light, Kāne, also known as Kāne-i-ka-ʻōnohi-o-ka-lā (Kāne-in-the-eyeball-of the sun). One of the *mele* (chants) handed down from the *kūpuna* (elders) of this land, demonstrates the significance of this portion of Puna in Hawaiian traditions of the arrival of the sun in Hawai'i —

Hiki mai ka lā ma ka hikina
Ke piʻi mai aʻe la i Hanakaʻulua
Ka hikina a ka lā ma Kumukahi,
Ka welona a ka lā, kau i Lehua...

The sun arrives from the east
Climbing above Hanakaʻulua[1]
The sun arrives at Kumukahi,
And the sun is seen fluttering as it sets at Lehua...
(pers comm., M.K. Pukui; 1977)

In the context of her landscape, Puna is synonymous with the groves of *pū hala* (pandanus trees) with their fragrant clusters of *hua hala* (pandanus fruit born on the female trees), and the *hīnano* (blossoms of the male pandanus). The fragrance of which permeated the *kula* (plains) and *kahakai* coastal region of most of Puna, hence the saying —

Puna pāia ʻala i ka hala (Puna, with walls fragrant with pandanus blossoms)
Puna, Hawai'i, is a place of *hala* and *lehua* forests. In olden days the people would stick the bracts of *hala* into the thatching of their houses to bring some of the fragrance indoors (Pukui 1983:301. No. 2749)

Also, the people who dwelt in Puna were known as master weavers. The most famous mat of Puna was one which was called *puahala* (G.S. Kahanai IN Fornander 1919 Vol. V-Part III:626). This mat was woven from the leaf sheaths of the *pua hīnano* (male pandanus tree

[1] *Hanakaʻulua* is a cove in the land of Kapoho, near the southwestern the boundary of Kapoho and Pūʻālaʻa; *Kumukahi* is the eastern most point on the island of Hawai'i, situated in the land of Kula; and *Lehua* is one of the Northwestern most of the Hawaiian Islands.

blossoms), and it was particularly favored because of its silky texture and pleasant fragrance. To this day, Puna is known for its growth of *hala*, and the floors and furniture of some of the old households are still covered with fine woven mats and cushions. Weaving remains an important occupation of many native families of Puna as well.

Puna: An Overview of Hawaiian Settlement

The information presented in this section of the study provides readers with a general overview of Hawaiian colonization, population expansion, and land management practices in on the island of Hawai'i and in the Puna study area. A more detailed discussion on settlement, based on archaeological evidence is presented in the final report on the "Archaeological Inventory Survey, A & O Golf Course Project; Lands of Ahalanui, Oneloa, and Laepao'o, Puna District, Island of Hawai'i" (Dunn et al., 1995). That report should be read for further site-specific details.

For many years, archaeologists have proposed that early Polynesian settlement voyages between Kahiki (the ancestral homelands of the Hawaiian gods and people) and Hawai'i were underway by AD 300, with long distance voyages occurring fairly regularly to ca. AD 1250. It has been similarly reported that the early Hawaiian population came primarily from the Marquesas and Society Islands (Emory in Tatar 1982:16-18). For generations following initial settlement, communities were clustered along the watered, windward (*ko 'olau*) shores of the Hawaiian Islands. Along these *ko 'olau* shores, streams flowed and rainfall was abundant, and agricultural production became established. The *ko 'olau* regions also offered sheltered bays from which fisheries could be easily accessed. It was around these bays that clusters of houses where families lived, could be found (McEldowney ms. 1979:15). In these early times, the residents generally engaged in subsistence practices in the forms of agriculture and fishing (Handy and Handy 1972:287).

Over the period of several centuries, areas with the richest natural resources became populated and perhaps crowded (by ca. 800 to 1000 AD), and the residents began expanding out into more remote regions of the island. While the Puna study area generally receives ample rainfall (nearly 100 inches annually) and is graced by mature forests which could shelter cultivated crops and provide natural resources necessary to life, it was (and remains) also subject to the affects volcanic and other geologic phenomena. Thus, even with the pressures of growing populations, the *ahupua'a* of 'Ahalanui-Laepāo'o-Oneloa and neighboring lands, may not have been actively sought out for long-term residency and investment of labor resources until such time as population demands made it absolutely necessary.

Lava flow ages in the Ahalanui-Laepāo'o-Oneloa *ahupua'a* range from c. 750 years before present to 200 years before present. Following flow patterns from the inland east rift zone vents, the lava flows are made up of both *pāhoehoe* and *'a'ā* which cross the 'Ahalanui-Laepāo'o-Oneloa *ahupua'a* at various elevations (cf. Dunn et al. 1995:6,7). The lower elevations (those extending from near sea level to approximately the 50 foot elevation) and the upper project area (around the 200 foot elevation) in 'Ahalanui are made up of the oldest flows. It is also in those areas where only minimal historic modification has occurred, that the greatest density of Hawaiian and early historic sites have been recorded. Indeed, the upland corner of the project area in 'Ahalanui, is within an agricultural field system that

native residents in the mid to late 1800s identified as "[Ka] Haleolono" (see records from Land Grants, Boundary Commission Testimonies, and Surveys later in this study).

One interesting historical record regarding the larger district of Puna—and one which is of relevance to the discussion of settlement in Puna—is found in the writings of Hawaiian historian, Samuel Mānaiakalani Kamakau, in the Hawaiian Language newspaper, *Ku 'Oko'a*. Kamakau wrote of the arrival of the priest, Pā'ao, came to Hawai'i from Kahiki in c. 1275 AD (cf. Barrère 1959:28):

> *O Puna ka aina o Hawaii i loaa mua ia Paao, aia ma Puna ka haiau mua a Paao i kukulu ai i hale no kona akua, o Ahaula ka inoa, ua kapa ia o Ahaula, he luakini. Mai Puna mai o Paao ma a pae ma Kohala...* (*Ku 'Oko'a Ianuari* 5, 1867)
>
> Puna was the land on Hawai'i that Pā'ao first landed at, there in Puna, is the first temple built by Pā'ao for his god. 'Aha'ula was the (god's) name, and the *luakini* [a temple at which human sacrifice could be offered] was called 'Aha'ula [Waha'ula]. Pā'ao and his companions then departed from Puna and landed at Kohala... (*Kū 'Oko'a*, January 5, 1867; see also Kamakau 1991:100).

If the date of ca. AD 1275 for Pā'ao's arrival in Puna (based on successive generations since that time) is correct, his arrival in Puna would generally coincide with the occurrence of the oldest surface flows in the 'Ahalanui-Laepāo'o-Oneloa study area. One might wonder if Pā'ao's move from Puna was at least partially influenced by the volcanic activity of Puna's goddess Pele[2], or if the population necessary to support a royal priestly order, had not yet developed in Puna.

The earliest dates recorded at Hawaiian sites in the present study area are c. AD 1250 (Site 12125) in the land of 'Ahalanui, and c. AD 1284 (Site 12131) in the land of Laepāo'o (Dunn et al. 1995:48, B-28, B-72). The dates from Site 12125 (Feature T) and Site 12131 (Feature 12148) were found in residential complexes—Feature 12148 is also interpreted as having a possible ceremonial function. While we may never know if earlier sites once existed in the study area—their evidence covered by ancient lava flows, lost as a result of other geologic phenomena, and/or their having been destroyed by historic period land use—the above referenced sites appear to be among the earliest permanent residences in the study area. It is also interesting to see that the legendary, geological, and available archaeological records all come together in a fairly close time period.

With the above discussion in mind, and based on patterns witnessed throughout the Hawaiian Islands (cf. Malo 1951, Ellis 1963, Fornander 1973, Stokes and Dye 1991, Handy and Handy with Pukui 1972, McEldowney ms. 1979, Kirch 1983 & 1985), the following settlement and population expansion pattern may be applied to the study area:

1– By the 12th-13th centuries the lands of 'Ahalanui-Laepāo'o-Oneloa were being settled. It is likely that the early settlers brought with them those things which were necessary for their survival—e.g., dry- and wet-land *kalo*

[2] The *heiau* complex at Waha'ula remained in use till c. 1817, and remained unimpacted by lava flows until the 1980s.

(taro); *'uala* (sweet potatoes), *pi'a*[3], *uhi*, and *hoi* (yams); *hue* (gourds), *pia* (arrowroot); *'awa* (*Piper methysticum*), *kō* (sugarcanes); *wauke* (paper mulberry); *mai'a* (bananas); *'ulu* (breadfruit); and *niu* (coconuts) etc. Also, as a result of the Hawaiian place- and environment-based religious system, the ancient settlers also brought with them their gods and goddesses, as "they were in their minds and souls..." (M.K. Pukui Ms.:2). In this early time, the primary livelihood focused near-residence agriculture, and on the collection of marine resources.

2 – By the 14th-16th centuries, the population increased, thus, the need to expand agricultural systems to the uplands increased. The *'ohana* (extended family) system of social, religious, political, and economic values linked coastal and inland inhabitants. The stringent political and religious system introduced during the Pā'ao-Pili migration gained increasing control in the islands.

3 – By the 16th-18th centuries, there evolved a greater separation between the *ali'i*, or chiefly class and the *maka'āinana* (commoners). Concurrently, as the Hawaiian population grew, land use practices expanded and became further formalized. In Puna, residences began expanding away from sheltered bays with near-shore forested zones and ample rainfall, pushing southwest towards more arid coastal regions with longer stretches of dry land between the shore and forests.

It was also in the early sixteenth century, that the entire island of Hawai'i came under the rule of one chief, 'Umi-a-Līloa, and the native system of land management by district (*moku-o-loko*), smaller land divisions (*ahupua'a*), and still smaller land units (e.g. *'ili, kō'ele, māla*, and *kihāpai*, etc.) was formalized. In this system, the land provided the fruits and vegetables for the diet, and the ocean provided most of the protein, and in communities with long-term royal residents, divisions of labor came to be strictly adhered to.

This system of land established by the late 17th and early 18th centuries, and strictly adhered to, also set the basis of Hawaiian land use and distribution through the nineteenth century.

Hawaiian Land- and Resource-Management Practices

As briefly discussed above, the ancient Hawaiians developed a sophisticated system of land and resources management. By the time 'Umi-a-Līloa came to rule the island of Hawai'i in ca. 1525, the island (*moku-puni*) was divided into six districts (*moku-o-loko*). Puna, the eastern-most of the districts on the island of Hawai'i, is also the smallest district on the island, and is the only one that does not take in a mountain peak. The boundaries of Puna are described by the saying —

Puna, mai 'Oki'okiaho a Mawae.

Puna, from 'Oki'okiaho to Mawae.

The extent of Puna is from 'Oki'okiaho on the Ka'ū side to Mawae on the Hilo side (Pukui 1983:301, No. 2747)

[3] *Pi'a* and *pia* are still found among the agricultural terraces, planting mounds and pits in the 'Ahalanui study area.

The large districts like Puna, were further divided into manageable units of land, and were tended to by the *maka'āinana* (people of the land) (cf. Malo 1951:63-67). Of all the land divisions, perhaps the most significant management unit was the *ahupua'a*; these are subdivisions of land that were usually marked by an altar with an image or representation of a pig placed upon it (thus the name *ahu-pua'a* or pig altar). *Ahupua'a* may be compared to pie-shaped wedges of land that extended from the mountain peaks, or in the present case in Puna, some other feature of geological significance (e.g., a rift zone or crater) to the ocean fisheries fronting the land unit. The boundaries of the *ahupua'a* were generally defined by cycles and patterns of natural resources occurring within the lands (cf. Lyons, 1875; In The Islander).

The *ahupua'a* were also divided into smaller, manageable parcels in which cultivated resources could be grown and natural resources harvested. As long as sufficient tribute was offered and *kapu* (restrictions) were observed, the common people, who lived in a given *ahupua'a* had access to most of the resources from mountain slopes to the ocean. These access rights were almost uniformly tied to residency on a particular land, and earned as a result of taking responsibility for stewardship of the natural environment, and supplying the needs of ones' *ali'i* (cf. Malo 1951:63-67; Kamakau 1961:372-377; and Boundary Commission testimonies in this study).

Entire *ahupua'a*, or portions of the land were generally under the jurisdiction of appointed *konohiki* or lesser chief-landlords, who answered to an *ali'i-'ai-ahupua'a* (chief who controlled the *ahupua'a* resources). The *ali'i-'ai-ahupua'a* in turn answered to an *ali'i 'ai moku* (chief who claimed the abundance of the entire district). Thus, *ahupua'a* resources supported not only the *maka'āinana* and *'ohana* who lived on the land, but also contributed to the support of the royal community of regional and/or island kingdoms. This form of district subdividing was integral to Hawaiian life and was the product of strictly adhered to resources management planning.

The Ahupua'a of 'Ahalanui, Laepāo'o, and Oneloa

'Ahalanui, Laepāo'o, and Oneloa are three of some 50 *ahupua'a* found in the district of Puna. These *ahupua'a* extend from the fisheries fronting them, approximately 4 miles inland reaching about the 390 foot elevation, where they are terminated (cut off) by the larger *ahupua'a* of Kapoho. Within these *ahupua'a* are found resources for deep sea and near shore fisheries, fresh and brackish water wells or springs, humus covered lava flows, which, with ample rains allow for extensive cultivation and the growth forest resources. Thus, residents in these *ahupua'a* were able to sustain their families and contribute to the larger community which supported the *ali'i* of Puna.

Inoa 'Āina (Place Names)

There are a number of place names that have been recorded within the *ahupua'a* of 'Ahalanui, Laepāo'o, and Oneloa (*Figure 2 – at end of study*). The occurrence of place names demonstrates the broad relationship of the natural landscape to the culture and practices of the people. In "A Gazetteer of the Territory of Hawaiian," Coulter (1935) observed that Hawaiians had place names for all manner of feature, ranging from "outstanding cliffs" to what he described as "trivial land marks" (Coulter 1935:10). In 1902, W.D. Alexander, former Surveyor General of the Kingdom (and later Government) of

Hawai'i, wrote and account of "Hawaiian Geographic Names" (1902). Under the heading "Meaning of Hawaiian Geographic Names" he observed:

> It is very difficult, if not impossible, to translate most of these names, on account of their great antiquity and the changes of which many of them have evidently undergone. It often happens that a word may be translated in different ways by dividing it differently. Many names of places in these islands are common to other groups of islands in the South Pacific, and were probably brought here with the earliest colonists. They have been used for centuries without any thought of their original meaning... (Alexander 1902:395)

History tells us that named locations were significant in past times, and it has been observed that "Names would not have been given to [or remembered if they were] mere worthless pieces of topography" (Handy and Handy with Pukui, 1972:412). In ancient times, named localities served a variety of functions, including — (1) triangulation points such as *ko'a* (markers for fishing grounds); (2) residences; (3) areas of planting; (4) water sources; (5) trails and trail side resting places (*o'io'ina*), such as a rock shelter or tree shaded spot; (6) *heiau* or other features of ceremonial importance; (7) may have been the source of a particular natural resource or any number of other features; or (8) the names may have recorded a particular event that occurred in a given area.

Two of the three *ahupua'a* names in the study area may be translated in a straight forward manner, the meaning of the name of the third *ahupua'a*, remains uncertain:

1 - One-loa may be literally translated as meaning "Long-sand" or "Long-cinder."

2 – Lae-pāo'o may be literally translated as meaning "Goby fish point."

3 – 'Ahalanui on the other hand, has perhaps undergone changes over the centuries, and its origins have perhaps been lost. In old survey and Boundary Commission texts, the name is written both "Ahalanui" and "Aahalanui." Over years of working in old survey documents, the author has found that not every double occurrence of the same vowel is meant to be pronounced. Some surveyors and transcribers in the mid to late 1800s often wrote the same vowel twice, as a way of indicating emphasis, a lengthening of the single vowels' pronunciation. In other words, two of the same vowels in a row would be written with a macron today. Based on how the author has heard the name pronounced by older native residents of the Puna region, a glottal mark has been put at the beginning of the name; this because the name is pronounced with emphasis with other words in sentences, and not slurred together with the word that proceeds it.

   As Alexander pointed out above, depending on spelling, pronunciation and how the words within the name "Ahalanui" are broken apart, the name could mean any number of things, including, but not limited to: "Large-pandanus-root;" Gathering-on-a-great-day;" and perhaps the most logical "[the "a" indicating that the land has the nature of] A-large-pandanus-grove;" etc. (please note that the preceding translations are interpretive, and the original "meaning" has not been identified to-date).

Fortunately, historic land records have preserved a number of place names within each *ahupua'a*, and those names tell us something about the natural or cultural landscapes, and history of the name localities.

Table 1 is a list of selected place names that have been recorded for sites and features in the lands of 'Ahalanui, Laepāo'o, and Oneloa. Where possible, the author has included either literal or interpretive translations for place names that lend themselves to such interpretations. It is noted here, that some place names are easily translated, being either a single word, or a compound of two or more words that remain in common usage. Such names are generally descriptive of a landscape or event. Between 1975-1977, the author discussed place names and their interpretations with *kūpuna*, Dr. Mary Kawena Pukui (Tūtū Kawena). In those conversations, Tūtū Kawena shared with the author her opinion that where obvious translations could be made (ones for which traditional interpretations existed, or which were made up of words that remained in common use in the language); those names could be given "literal" translations. For other names, generally, a compound of two or more words that lent themselves to various translations, "interpretive translations" might be given. But, it is important to make clear that the translations are "interpretive." And for some names, it is inappropriate to offer translations, as the possible meaning is too obscure (pers comm. M.K. Pukui).

Table 1. Selected Place Names of the Study Area Ahupua'a

Place Name & Source	***Meaning***	***Ahupua'a and Location***
Pali-poko (BC, HGS[4])	Short-cliff – literal	Pohoiki-Oneloa (shore line) and *ko'a 'ōpelu*
Kupakia (BC)	(pronunciation and meaning uncertain)	Upper point, inland on boundary of Pohoiki and Oneloa
Ka-'ena (BC)	The-heat or the-wrath – literal	Lower, mid zone *ulu hala* (pandanus grove) on boundary of Pohoiki and Oneloa
Pu'u-'ula'ula (BC, HGS)	Red-hill – literal	Oneloa (inland boundary)
Nīheu [transposed to "Niehu" on some maps] (HGS)	Perhaps named for the *kūpua* (a supernatural dual-formed demigod), Nīheu, who had both human and sand crab body forms. With his brother Kana, the two traveled the islands fighting evil *kūpua*. One such *kūpua* had the body form of a *pāo'o* (Goby fish). The fights took place in Puna, with encounters both along the shore and at various craters of the east rift zone. A place called Kapua'i-a-Nīheu (The-foot-print-of-Nīheu), is situated near the shore of Kūpahu'a, Puna (near Waha'ula Heiau).	Oneloa (shore)

[4] Table Key: BC=Boundary Commission Testimony; HGS=Hawaiian Government Survey Records.

Table 1. Selected Place Names of the Study Area Ahupua'a (continued)

Place Name & Source	*Meaning*	*Ahupua'a and Location*
Ka-hinihini-'ula (HGS)	The-red-moss (or algae) – literal	Laepāo'o (shore)
Pakoi (BC)	(pronunciation and meaning uncertain)	Upper point, inland on boundary of Pohoiki & Laepāo'o
Kīpaepae (Reg. Map 1884) or Kipaipai (Reg. Map 1777)	This name is written in the two forms (to the left) on early maps. Though the Register Map numbering sequence is higher, Reg. Map 1884 is the older of the two maps; the preliminary map that Loebenstein used to develop Reg. Map 1777. Written "Kīpaepae," the place name literally translates as "Paved with stones," and is perhaps descriptive of the area around the waterhole.	A coconut grove and water hole in 'Ahalanui, near the boundary of Pū'āla'a; on the *makai* side of Grant 2466, also on the *mauka-makai* trail.
Iawa (BC)	(pronunciation and meaning uncertain) Identified as the name of an ancient *kō 'ele* (royal cultivating field). By association of the cultivating ground, the "*awa*" may have had to do with cultivation of the *'awa* (*Piper methysticum*) for which Puna was famed.	Near boundary of 'Ahalanui/Pū'ala'a
Kaloi	(pronunciation and meaning uncertain)	Near boundary of 'Ahalanui/Pū'ala'a
Kua-o-ka-lā (native account in this study)	Back-of-the-sun – literal. Figuratively, the name describes the alignment followed by the sun as it rises and crosses over the area of that name. A native writer in 1929 (in this study), identified Kuaokalā[5] as a *heiau* near the government road–from where one could look inland and see the hills of Kalehua. By association with the sun, it can be posited that the functions of the *heiau* were tied to the god Kāne, who is closely associated with Puna.	Visible from the Government Road in 'Ahalanui

[5] While conducting research for this study, the author reviewed all historic maps and original field survey note books in the collection of the Hawai'i State Survey Division in an effort to identify the location of Kuaokalā Heiau (or some feature that surveyors may have identified as a possible ceremonial site in the Pū'āla'a-'Ahalanui-Oneloa and Pohoiki study area. The material reviewed included note books dating from the ca. 1852 surveys of the Lyman brothers and continued through the 1907 surveys of Cook and Arioli. Unfortunately, no references to Kuaokalā or the "hills of Kalehua" were located.

III. NĀ MOʻOLELO ʻĀINA – TRADITIONS OF THE LAND

Overview

This section of the study presents readers with historical accounts from the nineteenth and twentieth centuries (narratives written by both native and foreign historians). The texts include accounts that describe native traditions (those generally before 1778), and historical narratives that record events following western contact. From such narratives we can begin to understand how this land shaped the lives, customs, and practices of its native inhabitants, and how their attachment to the land has been expressed in successive generations. Because no early traditional accounts for the lands of ʻAhalanui, Laepāoʻo, or Oneloa have be identified in archival research, pertinent narratives from neighboring lands and the larger east Puna region are included here to provide some cultural context to the features and customs of the land.

Puna: An Overview of Native Traditions and Customs of the Land

Kāne, the Forests, Sun, and Shark Deity

As discussed earlier in this study, native accounts describe a period in Puna's history when Pele did not cause lava flows to move across the face of the land. Puna was loved by the god Kāne, and forests seemed to move from the mountains to the shore. Sayings like —

> ***Ka makani hali ʻala o Puna***
> The fragrance bearing wind of Puna (Pukui 1983:158, No. 1458)
>
> and
>
> ***Maʻemaʻe Puna i ka hala me ka lehua***
> Lovely is Puna with the *hala* and *lehua* (ibid.:221, No. 2035)
>
> — were used to describe Puna which was famed for the fragrance of its forest of *maile*, *lehua*, and *hala*. Pukui (1983) observed, "It is said that when the wind blew from the land, fishermen at sea could smell the fragrance of these leaves and flowers (ibid.: 158, No. 1458)

In this early time, Puna was not only famed for its verdant growth, but throughout history, it has been noted as the "portal" of the rising sun. The god Kāne in his attributes as giver of light and life, plays an important role as healer, and many native customs and practices of healing are associated with the sun rising from the east in Puna. In the Hawaiian Ethnological Notes (HEN) of the Bishop Museum, compiled by Mary Kawena Pukui, we find an account that describe Puna and the rising sun. Though not specifically named, the geographic location of this narrative includes the lands of ʻAhalanui, Laepāoʻo, and Oneloa:

> In Hawaii the sun strikes first at Ka-lama-ula, the seashore at Poho-iki, Puna, then rises above Hana-ka-ulua (*ka-ulua*, delay), three *eho* rocks (*eho* is a hard stone that rings when struck), I have heard at least one of which was taken by King Kalakaua for the Palace [from] Cape Kumukahi where the rocks of Hana-ka-ulua were located; [the sun] then passes over the high hill of Haʻehaʻe at Kapoho. [source, Mrs. Kukona Porter]
>
> The daily journey of the sun, typifying the span of life, is expressed by the saying, "From the rising of the sun at Cape Kumu-kahi to its setting at Lehua (the Sun-snatching Isle, Ka moku Ka-ili La) – "*Mai ka hikina a ka la*

ma Kumu-kahi a ka welona a ka la i Lehua." The N. and S. boundaries of the journey of the sun [in Puna] are Ha'eha'e and Makānoni.

At Cape Kumukahi, Queen Emma erected two stone heaps (*eho*) [in 1883]. Queen Liliuokalani erected one there, too. Each of Emma's marked the northern and southern limit of the sun. When she died, her stone heaps fell down. [Bishop Museum HEN Vol. I:799-800]

In her compilation of "Hawaiian Mythology" Martha Beckwith (1971) adds to the information regarding Kumukahi. The point was reportedly named for an *'aumakua* (family god) that came to Hawai'i with the chief-navigator, Mo'ikeha. One of Kumukahi's forms was that of a *kōlea* (golden plover). Kumukahi —

...settles at the point of land that bears his name, where he is represented by a red stone at the extreme end of the point. Two of his wives, also in the form of stones, manipulate the seasons by pushing the sun back and forth between them at the two solstices. The place is called "Ladder of the sun" and "Source of the sun" and here at the extreme eastern point of the whole [island] group, where the sun rises up out of the sea, sun worshipers bring their sick to be healed[6] [information from M.K. Pukui]... [Beckwith 1971:119]

In other notes compiled by M.K. Pukui, we also find that guardian sharks (*manō kia 'i*) lived in the waters of the Kapoho vicinity. Paraphrased, the notes record:

Pani-lā (shutting out the sun) was so called because of his enormous size. He was the largest of the Hawaiian sharks, and he lived off of Cape Kumukahi. His usual haunts extended from Ka-lae-o-Lamaulu in Kapoho, to Ka-lae-o-Kumukahi at the eastern extremity of Hawai'i. He was a friend of the natives and by appearing at times above the surface of the sea, would give them timely warning of the approach of hostile sharks...

Another shark, Keau also lived at Kapoho, where the sun rises out of the ocean. At Kumukahi, there are two *eho* (sharp rocks), the most northerly is Makanoni, and the southern most is Ha'eha'e. In the summer, the sun rises between them. Another shark of Puna was Hīkawelo'ula, the son of a shark of Ka'ū and a woman of Kalapana. He had two forms, that of a shark in the sea, and that of a human on land. [April 2, 1886 and December 1892; Bishop Museum HEN I:573-574]

Nā Huaka'i a Pele
(Journeys of Pele)

Following the arrival of Pele on Hawai'i, Puna changed. One might wonder, if perhaps the early accounts of Puna in which lava flows were quiet and forests matured, are traditional descriptions of a period of relative geologic quiet in Kīlauea's eruptive cycle. That Puna has undergone significant changes as a result of geologic phenomena is well documented in both native traditions and scientific documents. In his compilation of "Pele and Hiiaka" Nathaniel Emerson (1915) published a detailed account of the arrival of Pele in Hawai'i and subsequent events in which she participated (that publication should be referenced for further

[6] The tradition of healing in association with the sun and the Kumukahi vicinity is discussed in the interview with Mr. Arthur Lyman.

details). Another account of Pele's arrival at Puna, was written by native writers and published in the Hawaiian newspaper *Ka Hōkū o Hawai'i* (1916), has recently been translated by the author of this study. That account is presented here. The narratives come from the tradition of Ka-Miki (in *Ka Hōkū o Hawai'i* 1914-1915; cited later in this section), but were written as a historical footnote about the history of the area from Koa'e to Keahialaka and further along the east rift zone of Kīlauea (thus passing the lands of the present study area).

> The land of Koa'e (Tropic bird) lies a short distance north of Kapoho and Kumukahi. Ke-awa-o-Pele (The-canoe-landing-of-Pele), at Koa'e is one of the most celebrated canoe landings in all of Puna. Here is the story of this place:
>
> > When Pele came to the Hawaiian Islands from Tahiti Pakapaka-ua, she landed at various places on the islands searching out a suitable home. Pele first sought out a home for her family on *ka moku kā 'ili lā* (the island that snatches the sun), which is also called Kamāwaelualani or Kāwili; and known today as Kaua'i, *ka mokupuni kīhāpai pua* (the garden island). On Kaua'i, Pele dug at a few places seeking a home for herself and her family. She dug into the earth at Ka'inapele, Pu'uopāpa'i, and Leleiwi at Pu'ukāpele, but none of the places were suitable.
> >
> > Pele-Honuamea (Pele of the red earth) then moved to the island of O'ahu-a-Lua, and for a short time she dwelt at Āliapa'akai and Kalua'ōlapa. Because Pele was not satisfied on O'ahu, she departed and went to Moloka'i-nui-a-Hina, where she dug a new home at Kauhakō. But there, she struck water. Pele then moved once again, and dwelt at Honokalani, Maui, and she dug a new home for her for herself at Haleakalā.
> >
> > It is at this point that some stories of Pele differ. Some people say that Pele was killed at Haneo'o and that she left her body at Ka-iwi-o-Pele (The-bones-of-Pele), at a hill near the pond of Haneo'o, between Hāmoa and Ka'uiki. Though another story states that *Pele* was not killed, but that she dwelt with her sister Kapo-kohelele, and that when she left Maui, she built the hill Kaiwiopele, which is also called Pu'u-a-Pele (Hill-made-by-Pele).
> >
> > Before Pele-Honuamea departed from Honokalani, Maui, she sent one of her sisters, Hi'iaka-pa'i-kauhale (Hi'iaka-who-thatches-the-house) to find a home for her on the island of Hawai'i. The first place that this Hi'iaka arrived at was Kona, and she dwelt at a cape which came to be called Hi'iaka-noho-lae (Hi'iaka-who-dwells-at-the-point). That is why to this day, the place is still Hi'iaka-noho-lae.
> >
> > Because of the long delay in Hi'iaka's return, Pele journeyed to Puna, near Pū'ula (Red-conch-shell), Koa'e, and landed at the place called Keawaopele. From Pū'ula, Pele dug the hills above Poho-iki (Little-depression or Little-hollow) and Ke-ahi-a-Laka (The-fire-of-Laka). From there, she moved up to He'eia (To be washed away or to have slipped away) and on to Ka'auea, where she looked upon Kīlauea and made her royal home at Moku'āweoweo – *Mele pule* (prayer chant):

Eō o Pele Honuamea

O hulinu'u ke ahi 'ā loa
naueue Tahiti
Ho'ohāku'i nei nākolo
ka leo o ka pōhaku
Kawewe 'u 'ina ka ua maka o
ka uwila
Nākolo nakeke i ka mole o
Ho'okūhonua
'Ōlapa ke ahi - Kūlapa ke kai
Hō'e'e ke kai a Pele haki nu'anu'a
i ka moana
Ko kapua'i e Pele Honuamea
e ke'ehia
Kuhia i ou pōki'i la
I-ka-'ale-i,
I-ka-'ale-moe
E ala Mihakalani,

Mihakahonua
Hālō-pā 'eli'eli kau mai e
Eō i ka inoa
O Pele ke Ahi 'ā loa – e ola!

Respond o Pele Honuamea of the
sacred earth
Of the highest rank, long burning
fire which shakes Kahiki
Striking and rumbling are the
voices of the rocks
Crackling and ringing rains fall
before the thunder
Snapping, crackling at the
very core of Ho'okūhonua
The fire flashes, the sea is writhing
The sea of Pele rises breaking
upon the swelling ocean
It is your foot steps that
cause this
Direct your siblings
Hi'iaka of the rising waves (*'ale 'i*),
Hi'iaka of the receding waves (*'ale moe*)
To arise and quiet the heavens
(*Mihakalani*),
And quiet the earth (*Mihakahonua*)
Peering upon this, awe posses me
Answer to the name
O Pele the long burning fire,
let there be life!

(*Ka Hōkū o Hawai'i*; December 16, 1915)

Around the turn of the century, W.D. Westervelt compiled a collection of "Hawaiian Legends of Volcanoes" (1963). One of his tales provides readers with an account of one of Pele's journeys to the shore of Puna, and describes how certain rift zone features were formed. This tradition also describes eruptive activities that were in the upland region near the Kapoho-'Ahalanui boundary, and interestingly also describes native *hōlua* (sledding) activities in the region. Register Map 1777 (*Figure 2*) in this study, documents the vicinity of one of the *hōlua* "training grounds" near the *mauka* boundary of Pū'āla'a and 'Ahalanui. Paraphrased, the narratives state:

> Kahawali was a chief who dwelt for a while at Kapoho during the time when Kahoukapu was king of Hawai'i (ca. thirteenth century). Kahawalis' mother lived at Kūki'i, and his sister Koa'e, lived at Kula. Kahawali and his younger brother, Ahua were skilled in the sport of riding the *hōlua* [a narrow Hawaiian sled], down the lava hills that were covered with verdant grass, ferns, and forest growth. One such hill is situated in the land called Halekamahina, and the sled track on it is still pointed out as Ka-hōlua-o-Kahawali (The-sledding-track-of-Kahawali). One day, Kahawali and Ahua were competing with other Puna residents, and a woman appeared before him, asking if she might use his *hōlua*. Not knowing the woman was Pele, Kahawali refused and teased her. He then jumped on his *hōlua* and began his ride down the slope. When he turned around, the woman had assumed her goddess form, and stamped her foot, causing a lave flow to arise. Pele

then chased Kahawali on her own *hōlua*. Kahawali then fled to Pu'u-kea, he kissed his prized pig, Ālo'i-pua'a goodbye. At Kūki'i, he bid *aloha* to his mother, and near the shore of Kula, Kahawali bid *aloha* to his sister, Koa'e. He then leapt into a canoe and paddled out to sea. Standing on the shore, Pele threw molten lava after him, and where the lava landed, there can still be seen outcroppings extending out from the shore... [Westervelt 1963:37-44; see also Ellis 1963:207-210]

In the 1920s, historian Theodore Kelsey collected two native sayings which illustrate the effects of the volcano on the landscape and community of Puna. One saying records —

> "My house of *lehua* [figuratively the forest] by the sea in Puna, is leveled flat by the water" (ms. Kelsey; from the collection of June Gutmanis). This saying perhaps describes the events associated with the April 1868 earthquakes, *tsunami*, and subsidence of the shoreline of Puna.

Another saying collected by Kelsey observed —

> "My house of *lehua* [the forest] is seaward of Ku-ki'i;" site of the *heiau* near the sea below Kapoho, Puna (ibid.). Today, when one looks at that are, the Kapoho flows of 1960 cover what was once described as a *lehua* forest.

"Ka'ao Ho'oniua Pu'uwai no Ka-Miki (The Heart Stirring Story of Ka-Miki)

One of the most detailed native accounts of places, people, and events of the island of Hawai'i, was recorded in "The Heart Stirring Story of Ka-Miki" (Ka-Miki). Ka-Miki was published over a period of four years (1914-1917) in the weekly Hawaiian-language newspaper *Ka Hōkū o Hawai'i*. The narratives were primarily recorded for the paper by Hawaiian historians John Wise and J.W.H.I. Kihe (with contributions from Steven Desha Sr.). While Ka-Miki is not an ancient account, the authors set the account in the thirteenth century (by association with the chief Pili, who came to Hawai'i with Pā'ao). They used a mixture of local stories, tales, and family traditions in association with place names to tie together fragments of site specific history that had been handed down over the generations. Thus, while in many cases, the personification of individuals and their associated place names may not be "ancient," the site documentation within the "story of Ka-Miki" is of both cultural and historical value.

It is in this account, that we find detailed discussions of the "traditional" communities and customs of Puna (the longer narratives include documentation on approximately 800 place names of the island of Hawai'i). While the narratives do not specifically mention the 'Ahalanui-Laepāo'o-Oneloa study area, they do provide us with a cultural context within which to describe the general practice of the ancient residents of this area of Puna. The narratives below, describe features and resources of the forests of Kali'u, extending from the coast to the uplands at Kapu'euhi (Glenwood); and the forest of Malama which extended east to Kaniahiku in Kapoho. They also tell readers of how Pū'āla'a came to be named, and about the royal community center of this region which was situated in the vicinity of Pū'āla'a, at Koa'e, Puna (a short distance north of Kapoho).

The English translations below (prepared by the author of this study), are a synopsis of the Hawaiian texts, with emphasis upon the main events of the narratives. Also, when the

meaning was clear, diacritical marks have been added to help with pronunciation of the Hawaiian.

> Ka-Miki is an account of two supernatural brothers, Ka-Miki (The quick, or adept, one) and Maka-'iole (Rat [squinting] eyes], who traveled around the island of Hawai'i along the ancient *ala loa* and *ala hele* (trails and paths) that encircled the island. During their journey, the brothers competed alongside the trails they traveled, and in famed *kahua* (contest arenas) and royal courts, against *'ōlohe* (experts skilled in fighting or in other competitions, such as running, fishing, debating, or solving riddles, that were practiced by the ancient Hawaiians). They also challenged priests whose dishonorable conduct offended the gods of ancient Hawai'i. Ka-Miki and Maka-'iole were empowered by their ancestress Ka-uluhe-nui-hihi-kolo-i-uka (The great entangled growth of *uluhe* fern which spreads across the uplands), one of the embodiments of the goddess *Haumea* (the creative force of nature; also called *Papa* or *Hina*; who was also a goddess of priests and competitors).
>
> ...While traveling through Puna –*ka 'āina i ka houpu o Kāne*– Ka-Miki and Maka-'iole met Kapu'euhi[7] at his trail side compound. Feigning friendship, Kapu'euhi secretly plotted to ensnare the brothers and steal their possessions. Discerning his true intentions, Ka-Miki thwarted Kapu'euhi's plans and defeated him in a contest. Kapu'euhi then devised another plan by which he could kill the brothers. To do so, Kapu'euhi enlisted the aid of the *'ōlohe* chiefess Kaniahiku (of Kapoho) to help him fulfill his quest...
>
> Kaniahiku was a guardian of the forests of Kali'u and Malama, and the famous *'awa kau lā'au a ka manu* (*'awa* [*Piper methysticum*] placed in the branches by the birds) which grew in the grove called Mauānuikananuha. This *'awa* grove was also a body form of Kaniahiku's god *Kūlilikaua-i-kanahele-o-Kali'u*, and was poetically referred to as "*Ka 'awa 'ili lena a ka manu i kanu ai iluna o ka lā'au* — The yellow skinned *'awa* planted by birds atop the tree branches. Strict *kapu* [restrictions] were observed while picking this *'awa*, and one fish each of the *'āhuluhulu* and *'ōlapa* needed to be placed in the spot from where the *'awa* was removed. People who broke the *kapu* [restrictions] associated with gathering *'awa, lehua, 'ōhelo*, and various plants that grew the forests of Puna, were enveloped in mist rains, and lost in the forest. Many people died while carelessly traveling through the forests, breaking plants, or loudly calling out and disturbing the silence. [October 14, 1915]
>
> Once lost in this forest, there was no way out. Calling out in the forest caused an echo which sounded like a person calling, but following the echo led one deeper into the forest, and this is that those who travel through Puna's forests are warned —
>
> *E nihi e ka hele mai ho'opā, mai pūlale i ka 'ike a ka maka o ako hewa i ka nui o ka lehua, a ho'opuni 'ia e ka 'ino*

[7] Kapu'euhi is the ancient name of the area now called Glenwood.

(Travel cautiously, being careful not to touch [the *lehua*], don't rush to see things lest you mistakenly break something and the many *lehua* become offended, causing you to be overcome by misfortune).

Hearing his request for help, Kaniahiku told Kapu'euhi that to kill Ka-Miki and Maka-'iole he should gather offerings from Kalapana and Kapu'ulena and prepare them for the god of Mauānuikananuha. She told him to gather a little *'awa* from Mauānuikananuha, and place the offerings at the site where the *'awa* was taken from. Kapu'euhi was to take this *'awa* to Ka-Miki and tell him that the grove guardians had nearly killed him while gathering the *'awa*, thus he was unable to get enough *'awa* to satisfy Ka-Miki *mā* [*mā* is a Hawaiian word that means "folks, them, and companions"].

Kapu'euhi was to then urge Ka-Miki *mā* to avenge this wrong and lead the brothers into the forest. Kaniahiku told Kapu'euhi to secretly pick *lehua* (*Metrosideros polymorpha*), *'ōhelo papa* (*Fragaria chiloensis*), and *kupali'i* (*Peperomia*) along the way. When Kaniahiku saw the signs that Kapu'euhi had picked these plants, she would know they had proceeded into the depths of the forest, and she would send a thick cloud cover to block the trail from view.

Kaniahiku then told Kapu'euhi that she would call on her elder female relatives to cause forest growth of *'ie'ie* (*Freycinetia arborea*), *hāpu'u* (*Cibotium splendens*), *'āma'uma'u* (*Sadleria*), and other plants to securely envelope them in the forest. The elder relatives of Kaniahiku included her mother *Oloke'a-nui-a-hinapū*, an aunt *Manono-nui-aloha*, and the five sisters *'Ōpiko'ula*, *Ka-lehua-'apapane*, *Ka-lehua-kea*, *Ka-lehua-makanoe*, and *Ka-uhi-wai-noho-i-ka-liko*, goddesses of the Puna forests. The five sisters were the supernatural children of *Kū* and *Hina-nui-moku-lehua-i-ka-wao*; the sisters were exceedingly beautiful, and their history is told in the story of *Ka-lā-puka-i-Ha'eha'e* – The sun arrives at Ha'eha'e... Lastly, Kaniahiku told Kapu'euhi that she would then send her sister, who had the body form of an *'Akialoa* (*Hemignathus obscurus*) bird to guide Kapu'euhi out of the forest, thus leaving Ka-Miki *mā* lost and wandering in the tangled growth of Kali'u. [October 21, 1915]

Following Kaniahiku's instructions, Kapu'euhi led Ka-Miki *mā* deep into the forest. Once there, Kaniahiku caused a thick mist to cover over the forest, blocking the sun from sight, and the forest plants grew in tangled mats. Anticipating the deception, Ka-Miki called out in a *mele* [chant] to Ka-uluhe and his forest formed ancestresses to assist them:

Lani-pipili, Lani-'oaka,[8]	Clinging and flashing heavens,
Lani-ki'ei, Lani-hālō,	Peering and peeking gods,
Lani-kilo, Lani-papanu'u,	Divining gods and gods of the highest stratum,
Lani-ka'ahele, Lani-hāko'i,	Traveling and agitated gods
Lani-mamao,	God who clears (the heavens),

[8] Each of the names called upon in the *mele* are various forms of female deities of nature.

Lani-Uli-wahine o Nu'umealani,	Uli-wahine of Nu'umealani
Ia Haumea! Ia Haumea-nui-a ke aīwaiwa...	Oh Haumea! Great mysterious Haumea...

Thus, the darkening of the sun was ended, the sun deity, *Ka-'ōnohi-o-ka-lā* caused the mists to recede. The forest growth withdrew before Ka-Miki *mā*, and was scattered as a path way for their feet.

Seeing that Ka-Miki *mā* had escaped from her efforts at killing them in the forest, Kaniahiku sent her 'Akialoa formed sister to warn Mauānuikananuha and Kūlilikaua and have them carry the sacred *'awa* to her compound and hide it in her house where an altar was prepared. Ka-Miki *mā* reached Mauānuikananuha and climbed upon the tree form of the god. Kaniahiku called to Mauānuikananuha to extend its body high into the sky and then fall to the forest, thinking this would kill Ka-Miki *mā*. But before the deity could grow, Ka-uluhe caused forest growth to cover Mauānuikananuha, and thus this plan was thwarted as well.

Ka-Miki then captured Kapu'euhi and imprisoned him underneath the tangled branching growth of Mauānuikananuha, telling him that he would remain there until Maka-'iole and he had their fill of the *'awa*. Kaniahiku then sent her sister *'Akialoa* to fetch her grandson Keahialaka, and she herself prepared to fight Ka-Miki.

Now at that time, Keahialaka was under the guardianship of Pānau and Kaimū, and he enjoyed the ocean waters from Nānāwale to Kaunaloa, Puna *[symbolic of controlling those regions]. [October 28, 1915]*

Ka-Miki turned to Kaniahiku, and told her, "It is because of your mistaken ways, that we two are here before you." They exchanged taunts, and Kaniahiku stood up and turned to fold her *pā'ū* [skirt], at the same time, she reached and took up her *pikoi* [tripping club] and a *lā'au* [spear]. Kaniahiku then attacked Ka-Miki with the *pikoi* but he dodged it, and it became tangled in the branches of Mauānuikananuha.

Kaniahiku then threw her spear, Papalauahi, which Ka-Miki dodged as well. Where the spear landed, the hills named Nā-pu'u-o-Kaniahiku were formed; the place is now called Nā-pu'u-a-Pele. Kaniahiku then prepared to use her sling stone, Kaueleau. This stone was eight feet long and weighed several hundred pounds, whatever it hit was completely crushed. Kaueleau was made of dense *'alā* stone and was bound with coconut sennit and *olonā* [*Touchardia latifolia*] cordage, in a technique called *maku'u*.

When Kaniahiku swung her sling above her head the cordage broke, sending the stone flying to the sea where it landed. The stone was so large that it caused the ocean mist to rise, darkening [hanging over] the shore. To this day the place where the stone landed is called Kaueleau [interpretably translated as – suspended, or placed above; and also the name of deity associated with the red glow of the eruption]. When the cordage broke, it flew in the opposite direction of Kaueleau, and landed at the place now called Maku'u [for the lashing technique].

Kaniahiku called her ocean-form brothers Pūhi-kauila [Red-eel] and Nalu-nui-o-Kumukea [Great-wave-of-Kumukea] to her aid, they took the stone and threw it back to the uplands for her, but she was unable to retrieve the stone. Seeing that all her weapons had missed, Kaniahiku took up her *hōkiokio* [gourd nose flute] Waha-lau-li'i, and called to Keahialaka, urging him to hurry to her aid. Hearing the *hōkiokio*, Keahialaka rushed to his grandmother, and seeing Kaniahikus' predicament, he leapt to attack Ka-Miki. Though Keahialaka was exceptionally skilled in various fighting techniques, he was worn out and bound by Ka-Miki. [November 4, 1915]

Kaniahiku urged Keahialaka to release himself, but he was unable to. And when Kaniahiku attempted to release Keahialaka, Ka-Miki threatened to kill her should she try breaking his *kapu* — that all outside of her compound was his, while that which was in side remained hers. Thus Maka-'iole bound Kaniahiku and placed her with Keahialaka. Ka-Miki compared his easy victory over Kaniahiku *mā* to the simple action of birds gathering *'ōhelo* berries to eat; or children playing *kimo* [a Hawaiian game of jacks]; he then chanted —

O pū 'ili 'ai 'ōhelo a ka manu	The *'ōhelo* (*Vaccinium reticulatum*) berries are grasped as the food of the birds
Ke 'ai holoholo ala i ka uka o Puna	Eaten while traveling to the uplands of Puna
I walea ka manu i ka 'ula o ka lehua	The birds rejoice in the beauty of the red *lehua* blossoms [descriptive of the *pōhaku kimo* (game stone) being tossed in the air]
Kohākohā i ka lani, 'elima ia lohelohe	Resounding in the heavens, five *'ai* (stones pieces) are retrieved
'Eono ia kau a ono,	Then six are placed together,
'Ehiku ia kau a hiku	Then seven are set aside
'Ewalu ia Kamalālāwalu	Eight to Kamalālāwalu
'Eiwa ia Kaholokuaiwa	Nine to Kaholokuaīwa
I ka holo keke'e ia a 'umi	And with a jagged sweep ten are taken
'Eiwa au puni i ka 'umi la pa'i wale	Nine are encircled with ten and all are drawn together.

Kaniahiku and Keahialaka realized that the wisdom and stamina of these two youth excelled any *'ōlohe* they had ever met, for Kaniahiku *mā* had never been beaten. Kaniahiku wondered if even her teachers, Kahulu'ilio-a-me'eulani, the spear fighting expert of Ka'ū; and Kaho'ālalā'au, the war club fighter, instructor of the Pili chiefs (sons of Olokuamea and Kahuilanui-mākēhā) of the land of the waterfall of Hi'ilawe on the sacred cliffs of Waipi'o, would be defeated as well. [November 11, 1915]

Ka-Miki then went into Kaniahiku's house to get the *'awa* from the altar, but she called to him asking that he allow her to care for the ceremonies of the god Kūlilikaua, which were associated with collection and preparation of the *'awa* of Puna. Kaniahiku told Ka-Miki *mā,* "We surrender to your knowledge," she then asked Ka-Miki *mā* to take Keahialaka as a

ho'āikāne (companion) stating, "Anywhere you travel through Puna, you will be welcomed." Ka-Miki agreed and Maka-'iole released Kaniahiku *mā*.

The offerings were made to the gods, a pig and other foods were prepared and they enjoyed the *'awa* of Kali'u. The *'awa* was so powerful that it seemed the house itself shook, the fragrance of the forest danced across the *pāhoehoe* plains, like the wavering waters of Mānā and Nohili, Kaua'i.

Kaniahiku, Keahialaka and Maka-'iole were embraced by sleep, and Ka-Miki left them sleeping in the house. Stepping outside, Ka-Miki saw Kapu'euhi in his sorrowful state, where he left him till later... Ka-Miki then departed for the royal compound of the chief Pū'ula.

Descending to Keawaopele, Ka-Miki met with the chief Pū'ula (Red-conch shell). Pū'ula inquired of Ka-Miki where he was from and what the nature of his journey was. Ka-Miki responded, telling the chief that he was from Puna, but that he rarely traveled from the uplands of Kali'u and Malama, where his elder female relative, Kaniahiku dwelt. Ka-Miki then told Pū'ula that he had come to gather some fish as the *pūpū 'awa* [condiments for the *'awa* drink] for his companions.

When Pū'ula heard the name of Kaniahiku, he asked Ka-Miki if he had been trained in fighting skills; for everyone knew of Keahialaka's exceptional skills. Ka-Miki said, "Yes," and Pū'ula then asked what was the purpose of his training. Ka-Miki answered —

> *Hele ka'apuni i Kuauli [Hawai'i] a puni ma ke 'ano ho'opāpā ikaika, ho'opāpā 'ike, ho'opāpā kama'ilio, ho'opāpā 'ōlelo, ho'opāpā nanenane a me nā 'ike apau o ka 'oihana mokomoko.*
> [It is] A journey around Kua-uli [Hawai'i] to compete in contests of strength, knowledge, conversation, words, riddles, and all manner of fighting skills.

Pū'ula invited Ka-Miki to join him at his *hālau* [long house], and instructed his fishermen to get the fish for Ka-Miki. Pū'ula had a large compound which had many houses dedicated to contests. There, Ka-Miki and Pū'ula discussed arrangements for contests with some *'ōlohe* of Puna. Pū'ula told Ka-Miki about the *'ōlohe* chiefs, 'Ōpihikao and Kūpahu'a, who were experts in *ha'iha'i* and *lua* (hand to hand combat techniques), and who had trained under Me'eulani and Ka'auea (who was also called 'Uwēkahuna). He also told Ka-Miki that Keoneopokoiki had been his own instructor, and that Keoneopokoiki was a master with war clubs, weapons, and all manner of hand to hand combat... [November 18, 1915]

Ka-Miki and Pū'ula agreed to share a friendly contest to see if Pū'ula should call his master *'ōlohe* to meet with Ka-Miki. Though Pū'ula had learned all he could from his instructors, their knowledge had not prepared him to meet with Ka-Miki, and shortly Pū'ula was securely bound. It was from this account that the saying about the spring of Pū'ula came about —

Pau ka wai o ka punawai o Pū'ula
The water [knowledge] is gone from the spring of Pū'ula
[meaning–it is useless to continue on a journey, or pursue a particular task]

Pū'ula was the son of Keauohana (k) and Kehena (w); Kamā'ili was their *konohiki* [land administrator], Ke'eke'e was their *kūkini* [runner-messenger], and Mākena was Pū'ula's *kia'i*, or guardian and *'ā'ipu'upu'u* [steward]. [November 25, 1915] Pū'ula sent Ke'eke'e to call the Puna *'ōlohe* to his contest *hālau*. After Pū'ula and his master instructor, Keoneopokoiki sparred, Ka-Miki told Pū'ula that meeting *'ōlohe* like Keoneopokoiki was the reason for his journey around Hawai'i. And much to the surprise of Pū'ula, Ka-Miki compared Keoneopokoiki to a *kōnane* pebble about to be eaten —

O ke ku'i kēlā, O ka holo kēia, Hāpala ke kea, Na ka 'ele ka 'ai
That one is hit, This one moves, The white one is smeared, The black one devours.

Pū'ula arranged the contests for Ka-Miki, and Pū'ula served as the *ilāmuku* [overseer] of the contests between Ka-Miki and the Puna *'ōlohe*...

...Kūpahu'a was called to compete with Ka-Miki, during their contest the roar of the crowds gathered at the *hālau*, reached Kaniahiku, Keahialaka and Maka-'iole, in the uplands of Kali'u. Kaniahiku was curious about the source of these voices, and Maka-'iole told her that it was Ka-Miki competing with the *'ōlohe* of Puna...

...Maka-'iole and Keahialaka then went to the *hālau* and contest site of Pū'ula, and Keahialaka told Maka-'iole that various land parcels and districts of Puna were named for the *'ōlohe* of this district. Kūpahu'a was quickly beaten and he called upon his alternate, Kahauale'a to fight for him... [December 2-30, 1915]

...The lands of Kahauale'a were named for Kahauale'a, one of the famous warriors and *'ōlohe* of Puna. Kahauale'a dwelt near Ko'oko'olau. After Ka-Miki defeated Kūpahu'a, he called upon Kahauale'a as his alternate. As Kahauale'a prepared to enter the *kahua*, Pū'ula called out in a chant in which he spoke of Puna —

...Pa'a 'ia ka hanohano o Puna i ke kai Kōloa	...Secured is the glory of Puna along the sea of Kōloa
E nū mai la i ka ulu hala o Kea'au	The sea that rumbles through the pandanus grove of Kea'au
I ka lā puka i Ha'eha'e	(Puna) the source of the sun rising at Ha'eha'e
I ka lae oni o Kūki'i a me Makanoni	(Puna) of the protruding points of Kūki'i and Makanoni
Oni mai o Mauna loa me Kūlilikaua	Mauna loa appears above with [the mist of] Kūlilikaua
Nā lae ani makani o Kaniahiku	The points of Kaniahiku wave in the breeze
Huki iluna ka papa lohi o 'Āpua...	Pulled upon the long plain of 'Āpua...

It was agreed that Kahauale'a and Ka-Miki would compete in three contests; *uma* (hand wrestling), *kūpahu* (pushing one's opponent from the arena), and *kūkini* (running) contests. In the *kūkini* contest, Ka-Miki and Kahauale'a were to required to gather certain famous items to prove that they had actually reached the designated places. These things were: [1] the sacred water of the goddess *Waka-keaka-i-ka-wai* and accurately describe the nature of the spring Keakaikali'ulā and forest of Pali-uli; [2] a valuable bark-cloth sheet–*kuina kapa 'Ō'ūholowai-o-La'a* for which Puna was famed; [3] ten *olonā* (*Touchardia latifolia*) leaves of 'Ōla'a; [4] one of Puna's famed *moena makali'i pua hinano* (fine mesh mats woven from the pandanus flower sheaths); and [5] to bring back living *'o'opu 'ai lehua* (*Gobidae* fish) of Hi'ilawe and *'anae momona* (fat plump rich mullet) which swam in the waters of Pāka'alana. [January 6, 1916]

At the outset of the competition, Keahialaka provided the *kapa*, *olonā* leaves, and *moena*, thus eliminating Ka-Miki's need to gather those items. The two competitors then participated in the *uma* and *kūpahu* contests and the roar of the crowd was heard from the shore to the depths of the *waokele*, the upper forests of Kali'u and Malama [c/3]. Kahauale'a was defeated in both of those contests. Then the *kūkini* contest between Kahauale'a and Ka-Miki began. Ka-Miki was carried to Pali-uli on *'Ōhi'a-nui-moe-awakea* [one of the body forms of Ka-uluhe]. Thus, he arrived at the spring Keaka-i-ka-li'u-lā which was the dwelling place of Lā'ie-wai (who came to be called Ka-wahine-i-ka-li'ulā) and Lā'ie-lohelohe, the scared chiefesses and wards of Waka-ke-aka-i-ka-wai and Ka-puka-i-haoa-ka-lā-o-lalo. This was an exceedingly sacred area. Guarded by Waka, it was encircled by rainbows, filled with the songs of *'i'iwi*, and *'ō'ō* birds, and surrounded by all manner of plants. On the lands around the spring were grown the prostrate sugar cane called *Mikioi-o-lehua*, the bananas called *Mānai-'ula-i-ka-wao*, the taro called *Pāpākole-koa'e-o-lele-kea*, and the *'awa* called *Waimaka-a-ka-manu o Puna*.

Ka-Miki took a leaf of the *pāpākolekoa'e* taro, and folded it into a cup (*'a'apu lā'alo*) to hold the water...and returned to Pū'ula *mā*. Ka-Miki presented the water to Pū'ula and described the beauty of Paliuli to those assembled. Kahauale'a had been unable to reach Paliuli and the spring of Keakaikali'ulā, so instead, he brought the water of Wai-uli, at Kapu'euhi. His deception was detected, because of the dark nature of the water, thus Ka-Miki won this part of the *kūkini* contest... [January 13, 1916]

The two contestants then departed for Waipi'o, Ka-Miki was carried upon the mist body form of Ka-uluhe, Ka-'ohu-kolo-mai-iluna-o-ka-lā'au. Ka-Miki visited the cliffs and wondrous waterfall of Hi'ilawe which cascades from the cliff of Kapa'ihi, below the long plain [cliff face] of Maukele.

The voice of Hi'ilawe was carried to the ocean at Pāka'alana, and the water flowed with such force, that it broke the sand ridges allowing the *'anae* (mullet) and fish of all kinds to swim in the river water. When Ka-Miki took the *'anae momona o Pāka'alana*, some of the *'ālapa* (warrior -

fishermen) of the sacred Pili chiefs of Waipi'o tried to stop him. *Ka-'ohu-kolo-mai-iluna-o-ka-lā'au* caused a thick mist to settle on Waipi'o, and Ka-Miki bound the *'ālapa* in the supernatural net *Ku'uku'u*, leaving them along the cliff of Ha'inakolo.

Ka-Miki then went and gathered the famous *o'opu 'ai lehua o Hi'ilawe* ['*o'opu* [goby fish] that eat the *lehua* flowers (petals) which fall into the pool at the base of Hi'ilawe] and returned to Pū'ula *mā* with the items. Kahauale'a arrived at Waipi'o later, and was set upon by the *'ālapa*, and barely escaped with his life...

Thus, Ka-Miki won all the contests, and Kahauale'a surrendered, giving his thanks to Ka-Miki and acknowledging Ka-Miki's superior skills... [February 10, 1916]

As the narratives continue, readers learn that Keahialaka, left Puna with Ka-Miki and Maka'iole, and traveled through the districts of Hilo, Hāmākua, and Kohala, and returned to Kona, with the brother. Along the way, they participated in many events. One additional narrative from this tradition tells readers that the land of Pū'āla'a was named for a chief who shared a relationship with other ali'i and lands on the island of Hawai'i:

Pū-'āla'a [interpretive translations – Mound-of small taro tubers; or *'Āla'a* (*Planchonella sandwicensis*) tree]. In Puna, there are two lands named Pū'āla'a, one is at the 'Āpua boundary of Ka'ū and Puna, and the other is the *ahupua'a* which bounds 'Ahalanui on the east. [February 3, 1916]

The lands of Pū'āla'a were named for the chief and fisherman, Pū'āla'a, the eldest son of Wa'awa'a [a chief and place in Puna and Kona, and Anahulu a chiefess-seer, and site in Kona]. Pū'āla'a was an expert fisherman, but he was hard pressed to provide adequate supplies of *he'e* [octopus] and *pā'ou'ou* (young fish of the *Thalassoma* species] to satisfy his sisters Puakō and 'Anaeho'omalu. As a result, Puakō and 'Anaeho'omalu traveled from Puna, in search of suitable husbands, who could satisfy their needs. They settled in the lands of Kohala which now bear their names. Because of their great love for their daughters, Wa'awa'a, Anahulu and their attendants also moved to be near the chiefesses.

Puakō married Lālāmilo and she discovered the *leho* (cowry octopus lure shell) which came to be known as *Kalo-kunu*, a famous octopus lure... Ka-Miki stole this lure for the chief Pili-a-Ka'aiea. With the help of 'Iwa (the grandson of Ha'aluea an octopus goddess), Lālāmilo retrieved his lure... [July 19, 1917] After Lālāmilo retrieved the octopus lure, he divided it with Pū'āla'a, who returned to dwell in Puna. The divided lure looked like broiled taro thus it came to be called *Kalo-kunu* or broiled taro... [September 6, 1917]

Puna: Political Alignment and Chiefly Associations

Citing native accounts, ethnographer, Dorothy Barrère (1959) offered the following summary o Puna's political environment in pre-contact Hawai'i:

> ...Puna, as a political unit, played an insignificant part in shaping the course of history of Hawai'i island. Unlike the other districts of Hawai'i, no great family arose upon whose support one or another of the chiefs seeking power had to depend for his success. Puna lands were desirable, and were eagerly sought, but their control did not rest upon conquering Puna itself, but rather upon control of the adjacent districts of Ka'ū and Hilo (Barrère 1959:15).

By the time of Līloa (ca. 1475), Hawai'i had been divided into the six major district that remain intact today. While each of the districts were ruled by independent chiefs, all of them recognized Līloa as the supreme chief (Kamakau 1961:1). When 'Umi-a-Līloa, the son of Līloa ascended to the throne of his father (ca. 1525), he brought all of the districts directly under his rule, subjugating rebel chiefs. Kamakau reports that:

> Hua-'a was the chief of Puna, but Puna was seized by 'Umi and his warrior adopted sons... Hua-'a was killed by Pi'i-mai-wa'a on the battle field of Kuolo in Kea'au, and Puna became 'Umi-a-Liloa's (Kamakau 1961:17-18)

Fornander (1996) also notes that at this time, parts of Puna came under the rule of the famed, blind chief 'Ī-mai-ka-lani, of Ka'ū. It was only after lengthy battles, that 'Umi was able to secure all of Puna and Ka'ū under his rule (Fornander 1996:34). Another one of the early "legendary" accounts which discusses Puna, documents the relationship between various *ahupua'a* of the district, and ties Puna's history to that of other islands, was collected by Abraham Fornander prior to the 1880s (Fornander 1919). The legend is titled "*Ka'ao no Halemano*," and is set in the period of ca. 1500, just before 'Umi's rise to power. The account also supports the previous statements regarding Puna's joint rule under chiefs of neighboring districts.

> Halemano was the royal son of Kukaniloko and Wahiawā, of the O'ahu line of chiefs. In his dreams, Halemano met with the sacred chiefess Kamalālāwalu of Puna. Kamalālāwalu was the daughter of Hanaka'ulua and Ha'eha'e, and they were the chiefs of the land of Kapoho. Falling in love with Kamalālāwalu, Halemano's health began to fail, because he could not locate the chiefess. Laenihi, the supernatural sister of Halemano instructed Halemano how to learn the whereabouts of Kamalālāwalu. And when he did, Laenihi consented to travel to Puna and make preparations for Halemano to meet with her.
>
> At this time, Hua'a was the king of Puna, and Kulukulu'a was the king of Hilo. Both of these kings were courting Kamalālāwalu, giving her large quantities of properties from Puna and Hilo, with the idea that in time one of them would win her hand and take her as a wife... When Laenihi arrived at Kapoho, she learned that Kamalālāwalu loved to surf at Kaimū, and she devised a plan to meet Kamalālāwalu and her brother, Kumukahi on the shore there. Hearing of the good surf at Kaimū, Kamalālāwalu traveled there to go surfing. She was able to befriend Kumukahi, and in that way, she met Kamalālāwalu... (Fornander 1919 Vol. V-Part II:228-232).

Based on her study of all available historic literature, Barrère (1959) noted that Puna remained under the control of outside chiefs from the time of 'Umi, through the rule of Alapa'i-nui, which ended in c. 1752. Alapa'i-nui was succeeded by Kalani'ōpu'u, and shortly before his death in 1782, Kalani'ōpu'u's rule of Puna and portions of Ka'ū were challenged by the Puna chief, 'Ī-maka-kōloa, a descendant of 'Ī-mai-ka-lani. Fornander (1996) reported Kalani'ōpu'u had arranged his "worldly and spiritual affairs, and then:

> ...started with his chiefs and warrior for Hilo, in order to subdue the rebel chief of Puna. In Hilo, *Kalaniopuu* consecrated the *Heiau* called Kanowa, in Puueo, to the service of his war-god; then took up his abode at Ohele, in Waiakea, and then the war with *Imakakola* commenced. The rebel chieftain fought long and bravely, but was finally overpowered and beaten. For upwards of a year he eluded capture, being secreted by the country-people of Puna. In the meanwhile *Kalaniopuu* moved from Hilo to the Kau district, stopping fist at Punaluu, then at Waiohinu, then at Kamaoa, where he built the *Heiau* of Pakini in expectation of the capture of *Imakakoloa*. Finally exasperated at the delay, and the refuge given to the rebel chief by the Puna people, *Kalaniopuu* sent *Puhili*, one of his Kahus, to ravage the Puna district with fire, i.e., to burn every village and hamlet until Imakakoloa should be found or the people surrender him. Commencing with the land of Apua, it was literally laid to ashes... (Fornander 1996:201-202)

After Kalani'ōpu'u's death in 1782, Kamehameha I, moved to make the rule of Hawai'i his. In the battle of Moku'ōhai, South Kona, Kamehameha's uncle Ke'eaumoku (later, his father-in-law), killed Kalani'ōpu'u's heir, Kīwala'ō. Discord among the remaining chiefs, saw the island of Hawai'i divided into three chiefdoms — Kamehameha I (Kona, Kohala, and a portion of Hāmākua); Keawemauhili (the remaining portion of Hāmākua, Hilo, and part of Puna); and Keōua-kuahu-'ula (the remainder of Puna, and Ka'ū). By 1793, Kamehameha I brought all of the island of Hawai'i, including Puna under his control (cf. Kamakau 1961:121,151,153,157).[9]

[9] Historical accounts describing the political environment of Puna and its relationship to the *ali'i* of Ka'ū and Hilo were handed down in the family of Mr. John Hale (oral history interview of June 12, 1998). Mr. Hale's family has resided in the vicinity of the study area since before 1850. He conveys that as a youth, he heard his *kūpuna* describe Puna as traditionally being under the rule of chiefs of the neighboring districts of Ka'ū and/or Hilo.

IV. PUNA: DESCRIBED IN HISTORICAL LITERATURE (CA. 1779 TO 1845)

The earliest written account describing the district of Puna comes from off-shore, recorded by early European visitors from their ships in 1779. By the beginning of the nineteenth century, an increasing number of foreign visitors brought with it further recordation, but it does not appear that a well recorded walk through in Puna occurred until 1823. This section of the study includes excerpts from a few of the early narratives that describe Puna (the natural landscape and practices of the residents). The narratives come from both native and foreign writers, and as in preceding sections of the study, because there is only limited documentation for the 'Ahalanui-Laepāo'o-Oneloa study area, the materials are representative of neighboring lands and the eastern Puna region.

The Journal of Captain James Cook and Officers

In March 1779, the ships Resolution and Discovery sailed along the shores of Puna and Ka'ū, Hawai'i. Captain King, commented on the apparent scarcity of inhabitants and provided the following description of the landscape:

> ...the SE sides of the districts of *Opoona* & *Kaoo* [Puna and Ka'ū]. The East part of the former is flat, coverd with Coco nut trees, & the land far back is of a Moderate height. As well as we could judge this is a very fine part of the Island, perhaps the best. *Terreeoboo* [Kalei'ōpu'u] has one of his residences here.
>
> On the SW extremity of *Opoona* the hills rise abruptly from the Sea side, leaving but a narrow border, & although the sides of the hills have a fine Verdure, yet they do not seem Cultivated, & when we saild pretty near & along this end of Opoona, we did not observe that it was equally Populous with the Eastern parts; before we reachd the East point of the Island, & all along this SE side the snowy mountain calls *Roa* (or extensive) [Mauna Loa] is very conspicuous. It is flattish at the top or makes what we call Table land... (Beaglehole 1967:606)

The Journal of William Ellis

Following the death of Kamehameha I in 1819, the Hawaiian religious and political systems began undergoing radical change. Just moments after his death, Ka'ahumanu proclaimed herself "*Kuhina nui*" (Prime Minister), and within six months the ancient *kapu* system was overthrown. Less than a year after Kamehameha's death, Protestant missionaries arrived from America (cf. I'i 1959, Kamakau 1961, and Fornander 1973). In 1823, British missionary William Ellis and members of the American Board of Commissioners for Foreign Missions (ABCFM) toured the island of Hawai'i seeking out communities in which to establish church centers for the growing Calvinist mission. Ellis' writings (1963) generally offer readers important glimpses into the nature of native communities and history as spoken at the time. Ellis and his party offer a few specific references to the area neighboring the Puna study area. While no specific reference is made of 'Ahalanui, Laepāo'o, or Oneloa, the narratives provide us with descriptions residences and practices that are applicable to the study area.

Departing from Kilauea, Ellis and party entered Puna, stopping first at Kealakomo; he wrote:

> ***[Southwestern Puna, traveling east]***
>
> As we approached the sea, the soil became more generally spread over the surface, and vegetation more luxuriant. About two p.m. we sat down to rest. The natives ran to a spot in the neighbourhood, which had formerly been a plantation, and brought a number of pieces of sugar-cane, with which we quenched our thirst, and then walked on through several plantations of sweet potato belonging to the inhabitants of the coast... [Ellis 1963:182-183]

Leaving Kealakomo, walking towards Kaimū, Ellis observed:

> The population in this part of Puna, though somewhat numerous, did not appear to possess the means of subsistence in any great variety or abundance; and we have often been surprised to find desolate coasts more thickly inhabited than some of the fertile tracts in the interior; a circumstance we can only account for, by supposing that the facilities which the former afford for fishing, induce the natives to prefer them as places of abode; for they find that where the coast is low, the adjacent water is usually shallow.
>
> We saw several fowls and a few hogs here, but a tolerable number of dogs, and quantities of dried salt fish, principally albacores and bonitos. This latter article, with their *poë* [*poi*] and sweet potatoes, constitutes nearly the entire support of the inhabitants, not only in this vicinity, but on the sea coasts of the north and south parts of the island.
>
> ***Dried Fish an Article of Commerce.***
>
> Besides what is reserved for their own subsistence, they cure large quantities as an article of commerce, which they exchange for the vegetable productions of Hilo and Mamakua [Hāmākua], or the *mamake* and other tapas of Ora [ʻŌlaʻa] and the more fertile districts of Hawaii.
>
> When we passed through Punau [Pānau], Leapuki [Laeapuki], and Kamomoa [Kamoamoa], the country began to wear a more agreeable aspect. Groves of coca-nuts ornamented the projecting points of land, clumps of kou-trees appeared in various directions, and the habitations of the natives were also thickly scattered over the coast... [ibid.:190]
>
> ***[Kaimū and vicinity]***
>
> ...About three p.m. we approached Kaimu. This was the birth-place of Mauae [Ellis' guide], and the residence of most of his relations... The old people from the houses welcomed him as he passed along, and numbers of the young men and women came out to meet him, saluted him by touching noses, and wept for joy at his arrival. Some took off his hat, and crowned him with a garland of flowers; others hung around his neck wreaths of a sweet-scented plant resembling ivey [*maile*], or necklaces composed of the nut of the fragrant pandanus oddoratissime... [ibid.:191]

While being hosted at the home of Mauaʻe's father, Ellis and his companions met with the natives in worship services, and also learned about some of their beliefs and events which

had occurred around Kaimū. Ellis notes that it was during the time of the chief Alapa'i (c. AD 1736-1754) that Kaimū was overflowed by lava (Ellis 1964:194). Ellis and his companions were also told of a great earthquake which had struck about two months earlier. A four foot thick stone wall which surrounded a garden on the north side of the village had been demolished, and Ellis also went to a house site of sixteen by twelve feet through which a chasm had passed (ibid.:195). Ellis offered the following description:

> ***Geologic-Volcanic Phenomena***
>
> We examined the aperture, that still remained open at one end of the house, and found its sides perpendicular, and its breadth one foot and eleven inches. The north-west corner of the house was broken by the shock.
>
> We next traced its course through the fields of potatoes. in some places the ground seemed hardly disturbed, yet it sunk six or eight inches beneath our tread. At other places we saw apertures upwards of two feet wide. The potatoes that were growing immediately in the direction of the fissure, were all spoiled. Several roots of considerable size were thrown out of the ground, and, according to the representations of the natives, appeared as if they had been scorched... [ibid.:195-196]
>
> ...In the afternoon, Messrs. Thurston and Bishop walked over to Makena, a pleasant village about a mile southward of Kaimu where they collected about one hundred people...a greater number would probably have attended, but for the rain which fell during most of the afternoon. Mr. Bishop numbered the houses in the village, and found them, including Makena to be 145.
>
> Kaimu is pleasantly situated near the sea shore, on the S.E. side of the island, standing on a bed of lava considerably decomposed, and covered with a light and fertile soil. It is adorned with plantations of cocoa-nuts, and clumps of kou-trees. It has a fine sandy beach, where canoes may land with safety; and, according to the houses numbered to-day, contains about 725 inhabitants.
>
> Including the villages in its immediate vicinity, along the coast, the population would probably amount to 2000; and, if water could be procured near at hand, it would form an eligible missionary station... The extent of cultivation in the neighborhood, together with the decent and orderly appearance of the people, induced us to think they are more sober and industrious than those of many villages through which we have passed... [ibid.:196-197].

Continuing their journey eastward, Ellis' party drew closer to the Pohoiki-Pū'āla'a area (neighboring the study area):

> ***At Keahialaka.***
>
> Near five p.m. we reached Keahialaka, the residence of Kinao, chief or governor of Puna. We found him lying on a couch of sickness, and felt anxious to administer to his comfort, yet did not like at so early an hour to halt altogether for the night. I therefore remained with the suck chief, while Messrs. Thurston and Bishop went on to a village at the east point, about

two miles distant. When they reached Pualaa, the above mentioned village, they were kindly welcomed by the headman...The chief furnished the travellers with a hospitable supper and comfortable lodgings. [ibid.:201]

At Pualaa—Discussion with Three Priests

...I joined Messrs. Thurston and Bishop at Pualaa, where we took breakfast, and afterwards spent the forenoon in conversations with the natives who thronged us. Two or three old men, whom we afterwards learned were priests, seemed to dispute what we said about Jehovah's being the only true God, and the Christian the only true religion. They said they thought their taõ [*ka 'ao*] (traditions) respecting Tu, Tanaroa, Rono, or Orono, and Tairi, were as authentic as the accounts of our book, though ours, from the circumstance of their being written, or, as they expressed it, "*hana paia i ka palapala*," (made fast on paper,) were better preserved... We continued talking to them on the subject of their traditions, one of which we wrote down as they repeated it.

Lava Flow During Time of Capt. Cook

About half-past eleven we took leave of them, and directed our way across the eastern point. A most beautiful and romantic landscape presented itself on our left, as we travelled out of Pualaa. The lave covered with a tolerably thick layer of soil, and the verdant plain, extending several miles towards the foot of the mountains, was agreeably diversified by groups of picturesque hills, originally craters, but now clothed with grass, and ornamented with clumps of trees.

The natives informed us that three of these groups, Honuaura, Malama, and Mariu [Kali'u], being contiguous, and joined at their base, arrested the progress of an immense torrent of lava, which, in the days of Taraiopuu, the friend of Captain Cook, inundated all of the country beyond them. We soon left this cheerful scenery, and entered a rugged tract of lava, over which we continued our way till about two p.m., when we reached Kapoho... [ibid.:205]

Early Nineteenth Century Population Statistics

One year after Ellis' tour, the ABCFM established a base church in Hilo. From that church (Hāili), the missionaries traveled to the more remote areas of the Hilo and Puna Districts. David Lyman who came to Hawai'i in 1832, and Titus Coan who arrived in 1835 were two of the most influential Congregational missionaries in Puna and Hilo.

Based on missionary calculations (partially a result of the Ellis Tour cited above), the population on the island of Hawai'i was estimated at 85,000 individuals in 1823 (Schmitt 1973:8). In his analysis of census records, Schmitt (1973) reports that the Missionary Census of 1831-1832 combined the total figures for Puna, 'Ōla'a, and Hilo, giving a total population of 12,500 (ibid.:9). In 1835-1836, we find a figure of 4,800 individuals residing in the district of Puna (ibid.); the smallest total district Population on the island of Hawai'i. In 1841, Titus Coan recorded that most of the 4,371 recorded residents of Puna, lived near the shore, though there were hundreds of individuals who lived inland (Coan IN Holmes 1985:7). By 1850, the total population of the island of Hawai'i had dropped to 25,864 (Schmitt 1973:8).

The United States Exploring Expedition of 1841

In 1841, Commander Charles Wilkes of the United States Exploring Expedition, toured the Hawaiian Islands (Wilkes 1845, Vol. IV). Though not making specific reference to the ʻAhalanui-Laepāoʻo-Oneloa study area, Wilkes does provide readers with documentation of the landscape and practices of the natives in the lands around Kapoho (*Figure 3*). His narratives include the following documentation:

> ...Almost all of 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."
>
> After leaving the *pahoihoi* plain, we passed along the line of cone-craters towards Point Kapoho, the Southeast part of the island.
>
> Of these cone-craters we made out altogether, large and small, fifteen, trending about east-northeast. The names of the seven last are Pupukai, Poholuaokahowele [Puʻu-hōlua-o-Kahawali], Punomakalua, Kapoho, Puukea, Puuku, and Keala. On some of these the natives pointed out where there had formerly been slides, an amusement or game somewhat similar to the sport of boys riding down hill on sleds. These they termed *kolua* [sic – *holua*].
>
> This game does not appear to be practiced now, and I suppose that the chiefs consider themselves above such boyish amusements. The manner in which an old native described the velocity with which they passed down these slides was, by suddenly blowing a puff; according to him, these amusements were periodical, and the slides were usually filled with dried grass.
>
> As we approached the sea-shore, the soil improved very much, and was under good cultivation, in taro, sweet-potatoes, sugar cane, and a great variety of fruit and vegetables. At about four o'clock, we arrived at the house of our guide, Kekahunanui, who was the "head man." I was amused to find that none of the natives knew him by this name, and were obliged to ask him, before they could give it to Dr. Judd...
>
> ...The view from the guide's house was quite pretty, the eye passing over well-cultivated fields to the ocean, whose roar could be distinctly heard... [Wilkes 1845: Vol. 4:186]
>
> During the night, one of the heaviest rains I had experienced in the island, fell; but the morning was bright and clear,—every thing seemed to be rejoicing around, particularly the singing-birds, for the variety and sweetness of whose notes Hawaii is distinguished.
>
> ***[Departing from Kapoho, traveling towards Nānāwale]***
>
> ...Previous to our departure, all the tenantry, if so I may call them, came to pay their respects, or rather to take a look at us. We had many kind wishes, and a long line of attendants, as we wended our way among the numerous taro patches of the low grounds, towards Puna; and thence along the sea-coast where the lava entered the sea, at Nanavalie. The whole population of this section of the country was by the wayside, which gave me an

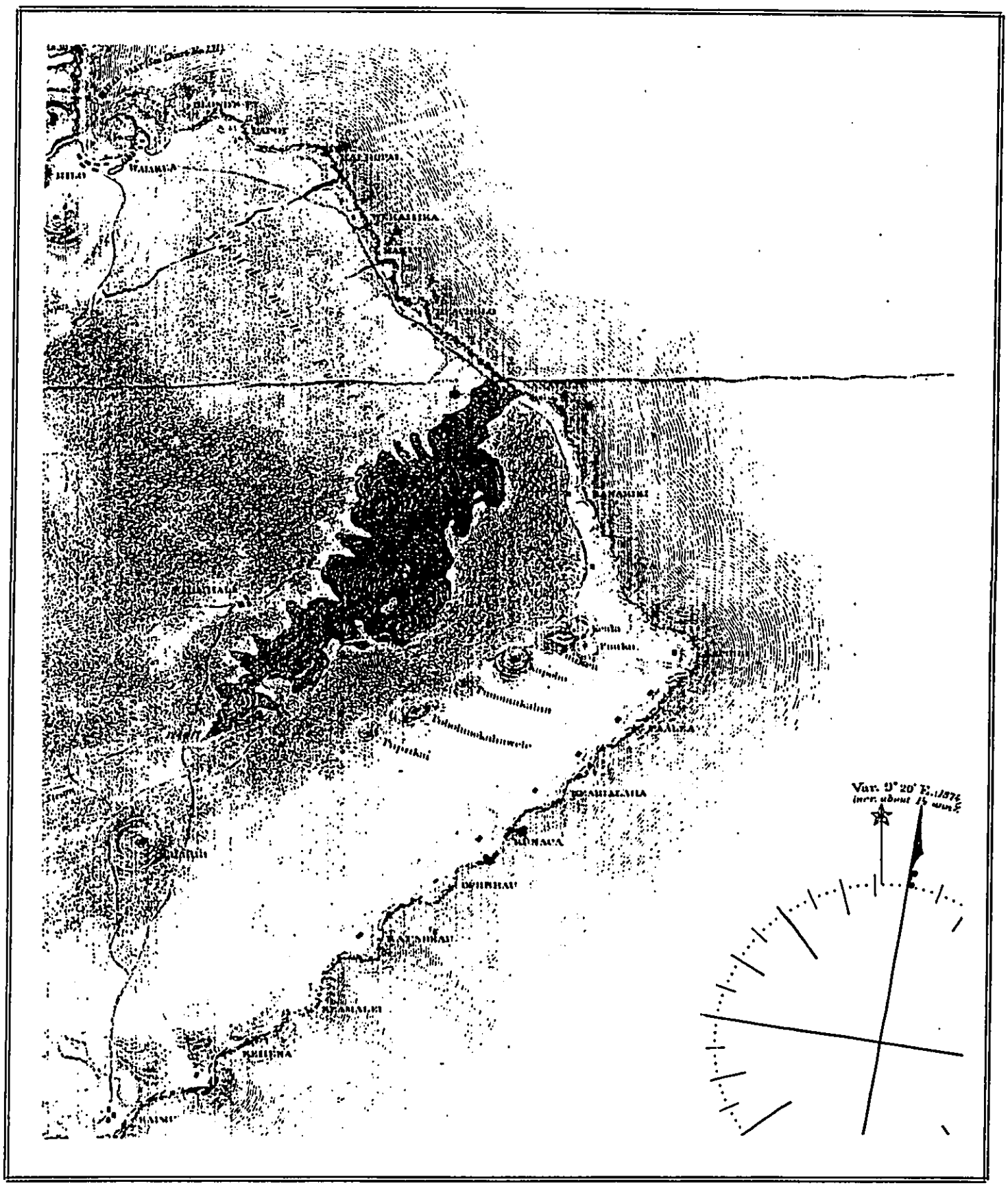


Figure 3. Part of the Island of Hawaii. U.S. Exploring Expedition; Wilkes, 1841 (Hawaiian Government Survey Map No. 424; State Survey Division)

> opportunity of judging of their number; this is much larger than might be expected from the condition of the country, for with the exception of the point at Kapoho, very little ground that can be cultivated is to be seen. The country, however, is considered fruitful by those who are acquainted with it, notwithstanding its barren appearance on the roadsides. The inhabitants seemed to have an abundance if bread-fruit, bananas, sugar-cane, taro, and sweet-potatoes. The latter, however, are seen to be growing literally among heaps of stones and pieces of lava, with scarcely soil enough to cover them; yet they are, I am informed, the finest on the island... [ibid.:188]

The Journals of Titus Coan and Chester Lyman

Titus Coan arrived at Hilo, Hawai'i in 1835. From Hāili Church, he *directed* the Protestant congregations of Hilo and Puna. During his tenure, he traveled throughout Puna, and in his autobiographic journal, he recorded various aspects of the work he undertook. Coan also commented on the native communities and districts through which he traveled (Coan 1882). Very focused on the conversion of the natives, he wrote little of native customs or practices, but from his narratives we find a few references that are perhaps relevant to the present study. Of interest, Coan records the occurrence of bird catcher's dwellings being situated in the upland forests of Puna. Traveling through Puna with Chester Lyman in 1846, Coan wrote:

> We were returning from Puna over the highlands where, for fifteen miles there were no inhabitants. Our trail lay through forest and jungle and open fields of wild grasses and rushes. We heard that about midway between the shore and an inland village there was a small grass hut built by bird-catchers, but now abandoned... [Coan 1882:144-145]

Writing of the great earthquakes in March and April 1868, and their impacts on the native communities of Puna and Ka'ū, Coan recorded that on:

> April 2d, a terrific shock rent the ground, sending consternation through all Hilo, Puna, and Kau. In some places fissures of great length, breadth, and depth were opened... Stone houses were rent and ruined, and stone walls sent flying in every direction... ...the sea rose twenty feet along the southern shore of the island, and in Kau 108 houses were destroyed and forty-six people drowned... Many houses were also destroyed in Puna, but no lives were lost. During this awful hour the coast of Puna and Kau, for the distance of seventy-five miles subsided seven feet on average, submerging a line of small villages all along the shore. One of my rough stone meeting houses in Puna [Kapoho-Koa'e], where we once had a congregation of 500 to 1,000 was swept away with the influx of the sea, and its walls are now under water... [ibid.:314-316]

In 1846, Chester S. Lyman, "a sometime professor" at Yale University visited Hilo, Hawai'i, and stayed with Titus Coan (Lyman ms., in the collection of the Hawaiian Historical Society). Traveling the almost 100 mile long stretch of the "Diocese" of Mr.. Coan, Lyman reported that the district of Puna had somewhere between "3000 & 4000 inhabitants (Lyman ms. Book III:3). Entering Puna from Hilo, and traveling to Kea'au along the coast, Lyman

offered the following observations, commenting on the condition of the land, agriculture, and communities of Puna. He reported:

> ...The groves of Pandanus were very beautiful, and are the principal tree of the region. There is some grass and ferns, and many shrubs; but the soil is very scanty. Potatoes are almost the only vegetable that can be raised, and these seem to flourish will amid heaps of stone where scarcely a particle of soil could be discovered. The natives pick out the stones to the depth often of from 2 to 4 feet, and in the bottom plant the potato – how it can expand in such a place is a wonder.
>
> Nearly all Puna is like this. The people are necessarily poor – a bare subsistence is all they can obtain, and scarcely that. Probably there are not $10 in money in all Puna, and it is thought that not over one in five hundred has a single cent. The sight of some of these potatoe patches would make a discontented N.E. farmer satisfied with his lot. Yet, I have no where seen the people apparently more contented & happy... [Lyman ms. Book III:3]

Lyman described the warm reception he and Coan received at Koa'e and the church of Pū'ula, commenting on the abundance of food which was provided for them and a group of nearly 300 residents (Lyman ms. Vol. III:3). Departing from the church, Coan and Lyman traveled to Pohoiki, passing Waiapele (Kapoho Crater). Though not mentioned by name, Lyman's narratives describe the warm pools on the shore of Pū'āla'a-'Ahalanui. Departing from Waiapele, he observed:

> ...we passed over a rough and naked lava flow, doubtless comparatively recent. Just before arriving at our stopping place we came to a small pool of brackish water in the lava, warmed by heat from below – Temp. 83° – Enjoyed a fine bath. The water 2 or 3 feet deep, and full of minute red fishes[10] from ¼ to ½ inch in length. [Lyman ms. Book III:7]

Lyman's narrative continues, describing the village and landscape at Pohoiki, and he also notes that the population was aging, with only a few young children present:

> Our stopping place for the night was *Pohoiki*, about 7 miles from *Koae* and nearly the same distance S.W. from the Eastern point of the island. The natives brought us the *Ki* or *Ti* root baked – it was very sweet & juicy. There are fine groves of cocoanut and the situation of the hamlet on an inlet of the sea is very pleasant...
>
> Friday July 10th. At low water a small spring of warm water issues from the beach – the temperature I found to be 90°.
>
> Mr. Coan began his meeting in the church at 8. There being much preliminary business I did not go in till 9. There were several infants baptized, and I noticed a greater proportion of old people than I had observed before. About 200 people were present – mostly seated on the ground, as is usually the case except in the larger and more central churches... [Lyman ms. Book III:7]

[10] Probably the *'ōpae 'ula* (*Crangon ventrosus*), described in oral history interviews with John Hale, Gabriel Kealoha, and Arthur Lyman (see the oral history section of this study).

V. RESIDENCY AND LAND USE (ca. 1848 to 1917) ('AHALANUI, LAEPĀO'O, ONELOA AND VICINITY)

Overview

As noted in the preceding section of the study, in the early to middle nineteenth century, Puna's population was the smallest of the six districts on the island of Hawai'i. This apparent scarcity of residents was reported in the earliest records of foreign visitors to Hawai'i, in 1779. It is possible that the accounts of the conflict between Kalani'ōpu'u and 'Īmakakōloa to determine the rule of Puna, which culminated in c. 1780, had a greater impact on Puna's residents than recorded by native historians (cf. *Section III*). An example of the oft-times devastating effects that the battles between warring chiefs had on native communities, can be found in Hawaiian history of the period. On Lāna'i, during the rules of Alapa'i-nui, Kalani'ōpu'u, and Kamehameha I (cf. Kamakau 1961:85-91), the native population was decimated, and never recovered (cf. Menzies 1920, and Munro ms. 13-14). Similar events in Puna, even in the time of Kamehameha I (cf. Kamakau 1961:151-153), may also have had a negative affect on the numbers of native residents, and may subsequently have led to the dispersal of communities in the district (cf. Jarves IN the Pacific Commercial Advertiser; July 2, 1857).

The decline of remote area populations is also partially explained by the missionary's efforts at converting the Hawaiian people to Christianity. One year after the ABCFM tour around Hawai'i (cf. Ellis 1963 in *Section IV*), mission centers around the island were established. Logically, churches were placed first in the areas with the largest native communities and where chiefly support could be easily maintained. On the eastern coast of Hawai'i, this was in Hilo, at what became the Hāili Church. In this way, the missionaries got the most out of the limited number of foreign ministers and teachers. Being situated in the large community centers also meant that large groups of natives could live under the watchful eyes of church leaders, close to churches, and in "civilized" villages and towns.

Overall, historic records document the significant effect that western settlement practices had on Hawaiians throughout the islands. Drawing people from isolated native communities into selected village parishes and Hawaiian ports-of-call, had a dramatic, and perhaps unforeseen impact on native residency patterns, health, and social and political affairs. In single epidemics hundreds, and even thousands of Hawaiians died in short periods of time (cf. I'i 1959, Kamakau 1961, Doyle 1953, and McEldowney 1979).

This section of the study includes documentation of residency and land use as recorded in several sources, among which are Interior Department; Public Instruction; the Boundary Commission and Hawaiian Government Survey Division; Hawaiian newspaper articles written by native residents and documentation from other historical publications; and church records. The documentation is generally presented in chronological order, under various headings which identify the primary sources of the documentation. This approach of presentation has been employed here to help readers put into perspective, the context of the documentation.

Land Tenure: Ka Māhele 'Āina (The Land Division) of 1848

In pre-western contact Hawai'i, all land and natural resources were held in trust by the high chiefs (*ali'i 'ai ahupua'a* or *ali'i 'ai moku*). W.D. Alexander, Surveyor General of the Hawaiian Kingdom wrote:

> ...It is admitted that under the ancient feudal system, the allodium of all land belonged to the King, not, however, as an individual, but "as the head of the nation or in his corporate right..." (Alexander; Survey Letter Book No. 9, September 30, 1891:107. Hawaii State Archives)

The use of lands and resources were given to the *hoa'āina* (native tenants), at the prerogative of the *ali'i* and their representatives or land agents (*konohiki*), who were generally lesser chiefs as well. In 1848, the Hawaiian system of land tenure was radically altered by the *Māhele 'Āina* (Division of Land). The *Māhele* defined the land interests of Kamehameha III (the King), the high-ranking chiefs, and the *konohiki*. As a result of the Māhele, all land in the Kingdom of Hawai'i came to be placed in one of three categories: (1) Crown Lands (for the occupant of the throne); (2) Government Lands; and (3) *Konohiki* Lands (Chinen 1958:vii and Chinen 1961:13).

Laws in the period of the Māhele record that ownership rights to all lands in the kingdom were "*subject to the rights of the native tenants*;" those individuals who lived on the land and worked it for their subsistence and the welfare of the chiefs (*Kanawai Hoopai Karaima...* {Penal Code} 1850:22). The 1850 resolutions in "*Kanawai Hoopai Karaima no ko Hawaii Pae Aina,*" authorized the newly formed Land Commission to award fee-simple title to all native tenants who occupied and improved any portion of Crown, Government, or Konohiki lands. These awards were to be free of commutation except for house lots located in the districts of Honolulu, Lāhainā, and Hilo (cf. Penal Code, 1850:123-124; and Chinen 1958:29).

In order to receive their awards from the Land Commission, the *hoa'āina* were required to prove that they cultivated the land for a living. They were not permitted to acquire "wastelands" (e.g. fishponds) or lands which they cultivated "with the seeming intention of enlarging their lots." Once a claim was confirmed, a survey was required before the Land Commission was authorized to issue any award (ibid.). The lands awarded to the *hoa'āina* became known as "*Kuleana* Lands." All of the claims and awards were numbered (Land Commission Awards or LCA), and the LCA numbers remain in use today to identify the original owners of lands in Hawai'i.

By the time of its closure on March 31, 1855, the Land Commission issued only 8,421 *kuleana* claims, equaling only 28,658 acres of land to the native tenants (Kame'eleihiwa 1992:295). None of those claims were made for the lands of 'Ahalanui, Laepāo'o, or Oneloa. Indeed, except for the islands of Kaho'olawe and Ni'ihau, no other land division of its size (Puna consists of c. 325,120 acres), had fewer claims for *kuleana* from native tenants, than the district of Puna.

Disposition of 'Ahalanui, Laepāo'o, Oneloa (and neighboring lands): Hawaiian Government Land Records

Records found in the collections of the Hawaii State Archives, Department of Land and Natural Resources-Land Management Division, and Bureau of Conveyances, provide us with detailed documentation of residency and land use in 'Ahalanui, Laepāo'o, and Oneloa. Because so much of the activity that occurred at Pohoiki was of direct importance to the welfare of families who resided in the study area *ahupua'a*, selected documentation for Pohoiki is also included here.

One of the interesting facts that comes out in the records cited below, is that upon R. Rycroft's moving into the Pohoiki area of Puna in ca. 1877, native families and the original lessee of 'Ahalanui, Laepāo'o, Oneloa, and Pū'āla'a (J.E. Elderts), began having trouble with Mr. Rycroft (cf. communications of April 26th and July 28th, 1884). Additionally, we learn several important things about land use and agriculture in the area from at least the 1870s: (1) lands of 'Ahalanui, Laepāo'o, and Oneloa were valued for there groves of coconuts and breadfruit trees; (2) *'awa* was licensed and grown commercially in the Pohoiki-study area vicinity; and (3) that portions of the land from Pohoiki–including the lands of the study area–to Kapoho, were used for pasturage from at least the 1870s to the 1950s (ibid. and oral historical records).

One of the most significant sources of historic information on land use and residency in the Puna District, is found in testimonies to the Commission on Boundaries (from ca. 1874-1876). Further documentation—on residency, customs, and the community—*both pre- and* post-dating the Commission proceedings, is summarized in *Table 2* (beginning on page 44), covering the period from ca. 1848 to 1953. Because of the extent of the documentation presented to the Boundary Commission, excerpts from those testimonies are presented separately, below.

Puna: Proceedings of the Boundary Commission (1874-1876)

In 1862, a Commission of Boundaries (the Boundary Commission) was established in the Kingdom of Hawai'i to legally set the boundaries of all the *ahupua'a* that had been awarded as a part of the Māhele. Subsequently, in 1874, the Commissioners of Boundaries was authorized to certify the boundaries for lands brought before them (W.D. Alexander in Thrum 1891:117-118). While no testimonies were collected for the Government land of 'Ahalanui, Laepāo'o, and Oneloa, testimony was required for the neighboring lands of Pū'āla'a and Kapoho on the northeast and Pohoiki and Keahialaka on the southwest–lands which share common boundaries with the *ahupua'a* of the study area.

The primary informants for the boundary descriptions were old native residents of the area being discussed; in this case some of the witnesses had been born in 'Ahalanui in the late 1700s and early 1800s. The native witnesses usually spoke in Hawaiian, which was translated into English and transcribed as the proceedings occurred. The narratives below are excerpts from the testimonies given the by native residents of the area, or that were given by surveyors who recorded the boundaries based on the testimony of native guides. Not all of the documentation provided by each witness, is repeated here. All documentation regarding *ahupua'a* boundaries in the study area, and narratives regarding native customs and practices are cited. Underlining and square bracketing are the author's, and used to highlight particular points of historical interest.

Pū'āla'a

February 29, 1876 [Vol. B:406-407] D. A. Alapai K. Sworn says:

I was born at Ahalanui, Puna, Hawaii. I do not know when. My mother tells me that I was able to walk when Keopuolani died [1823]. I have always lived there. I know land of Pualaa, and a *kamaaina* there. I know the boundaries between this land and Ahalanui, and have been told the points on the boundary between this land, Pualaa and Kapoho, but have never been all along that boundary. Oili an old *kamaaina* told me the boundary between this land and Kapoho. Oili is dead. I went with Henry M. Lyman when he surveyed the boundary between Pualaa and Kapoho. He surveyed from the shore to an *ohia* tree by the Govt. road at place called Kapele o Kane. He marked the letter H. on the tree. Oili was the *kamaaina* who pointed out the boundary. A point at shore called Pohakuopala is the boundary at the shore between these two lands. A *mawae* [fissure or fracture] called Kakala is where land of Kapoho cuts this land off. It is *mauka* of the trees, *mauka* of where the old *kauhale* [dwelling] was. The tree that was marked at the *mauka* corner of this land at time of survey, has been killed by fire and is dry now. Kalaiwaa [also written Kalauwaa, and the name of a grantee in 'Ahalanui] and I went with F.S. Lyman when he surveyed the boundary between this land and Ahalanui. I was the *kamaaina* as Oili was dead. Kalaiwaa was a *malihini* [newcomer], but was *konohiki* [overseer] of the land. The land of Ahalanui has been sold and patented from the shore to place called Haleolono. The land of Ahalanui is on the Kau side of this land and Kapoho on the Hilo side. From Haleolono *mauka*, this land is bounded by the Govt. portion of Ahalanui, and the boundary runs to *the old koele* [field cultivated for the chief] called Iawa. There is a large *iwi aina* [rock wall] on the boundary. Thence the boundary runs *mauka* to place called Kaloi, where it is cut off by land of Kapoho. There is a large wall (or *paa* [*pā*]) on the boundary. I didn't go with Pele (F.S. Lyman) above Haleolono as I fell in to a hole and hurt my foot. It is only a short distance from there to the *mauka* boundary. I told Kalaiwaa where to go. Kaloi is an old *kauhale* on Pualaa by boundary. There is an *iwi aina nui* [large rock wall] on the boundary between these lands. The *mawae* is by the *ohia* at *mauka* end of the land on the boundary of Kapoho...

...Pualaa is bounded *makai* by the sea and had ancient fishing rights extending out to sea.

F.S. Lyman K. Sworn says [Vol. B:407]

I surveyed the land of Pualaa in 1855, I think it was [cf. Reg. Map 923]. Kalaiwaa was the *konohiki*, and I think he went with me, also Oili and Alapai. The boundary between this land and Kapoho was on the *aa* [rough lava] so we could not go along it. We surveyed across the land at the seashore to the boundary of Kapoho, and surveyed across again at the Govt. road, and marked an *ohia* tree on the boundary of Kapoho. The tree is still standing. I saw it the last time I was in Puna. The map and notes of survey I have filed, agree with the notes of survey of land patented on Ahalanui. I

have compared it with the notes of survey given in our book of surveys, made by my brothers and myself. H.M. Lyman surveyed Kahananui's land and School lot. I surveyed the small lot at the shore and Hewahewa's [more commonly written as Kuahewa – Grant 2466 to Kuahewa and Kamakau] lot. *Mauka* of land sold I surveyed the boundary between this land and Ahalanui as the *kamaaina* pointed it out to me...

Pohoiki
February 29, 1876 [Vol. B:408-409] Kaluahine K. Sworn:

I was born at Keahialaka, Puna, Hawaii, at time of the death of Kamehameha I [May 1819]. I now live on Pohoiki. I have always lived on these two lands, and am a *kamaaina* of these lands. I know part of the boundaries of Pohoiki. There are old *ahupohaku* [stone cairns] on the boundary. Kaulana an old *kamaaina* of these lands pointed out part of the boundaries to me. He is dead now. The land of Keahialaka bounds Pohoiki on the Kau side. The boundary between them at the shore is at a point called Kahuna...

...thence to place called Paakoi, where Keahialaka and Kapoho cut this land off. This place is *mauka* of place called Punanaio. Thence the boundary between this land and Kapoho runs *makai* along old trail. Pohoiki ends at *Oioina* Pakoi [the trailside resting place, Pakoi]; and the boundary runs *makai* along trail along land of Laepaoo, until come to *pahoehoe* at the *mauka* corner of land of Oneloa, Pohoiki being on *Aa*, and Oneloa on Hilo side of *Aa*. Thence boundary runs *makai* to place called Kupakia. Thence *makai*, both lands being on *Aa* to *ahu* [cairn] at place called Paliuli. Thence *makai* into *uluhala* [pandanus grove] called Kaena to an old pile of stones. Thence *makai* to Govt. road on Hilo side of church . Thence *makai* along land on Oneloa, sold and patented to Makaimoku, to place called Palipoko. Bounded *makai* by sea, ancient fishing rights extending out to sea.

[Vol. B:409] D.A. Alapai K. Sworn (same witness as on Pualaa)

I was born at Ahalanui, Puna, Hawaii. My mother says that I was able to walk when Keopuolani died. My *kupuna* were from land of Pohoiki. I have heard them tell what the boundaries of Pohoiki are, between it, and the lands on the Hilo side of it. And they always told me the same boundaries as the last witness has given...

Keahialaka
June 2, 1873 [Vol. A:177-178] Owiholu K. Sworn

I was born at Keahialaka at the time of *Kui o ka wai o ka Lae* [digging of the water hole at Kalae, in c. 1815]; in Puna, Hawaii. Have always lived on said land and Pualaa. Am a *kamaaina* of the former. My father showed me boundaries. It was at a time of famine, and we went into *nahelehele* [forest] to collect food, and it was then he showed them to me so as to keep me from trespassing on other lands. For if we were caught on other lands, the people of that land took our food away from us. Kaukulau, is the land is on the southern boundary, it is at a place called Pokea, an old canoe landing. The

boundary is a few rods on the south side, then the line between these lands runs to a wall built by prisoners for Mr. Coney's wife. The boundary between Keahialaka and Kaukulau runs to Kalehuapau a mound in *Nahelehele* and *uluhala* [pandanus grove]. Thence to wall which is the *mauka* end of Kaukulau, and where Ki joins Keahialaka. Thence *mauka* to Komo in *Uluhala*, an *oioina* [resting place] on old cultivating ground, where Malama cuts Ki off. Thence the boundary between Keahialaka and Malama runs to Puulena, a crater, passing the *makai* side toward Kau to Kanunu, where the old road used to be in the *ohia* woods. Thence to Kilohana, Malama ends at the crater and Kaaula joins Keahialaka there. And from thence these two lands run side and side to Kilohana, an *oioina* on the *pahoehoe* in the woods. Kilohana is a low hill. Waikahiula cuts off Keahialaka at Kilohana, and Kapoho joins said land at Papalauahi, an old *pahoehoe* field where the old road to Hilo used to go. Thence the boundary between Kapoho and Keahialaka runs *makai* to Papakoi, a *pali* [cliff] covered with lava on Kapoho. Keahialaka is at the foot of the *pali*. Thence *makai* to place called Punanaio where houses used to be and a cultivating ground was at the *mauka* side of it. Here Kapoho leaves Keahialaka and Pohoiki joins and bounds it to the shore ending at the *pali* on the Kau side of Pohoiki landing. The beach in the cove belonging to Pohoiki and said land belonging to King Lunalilo. I did not see Keahialaka surveyed. The land has ancient fishing rights.

Kamilo K. Sworn [Vol. A:178-179]

I was born at Keahialaka, at time of Aikapu [perhaps the breaking of the 'ai kapu, or eating restriction in 1820]. Am a *kamaaina* of said land and know the boundaries. My parents, now dead, showed them to me, and their parents showed them. As we lived on Keahialaka we could not go on to other lands for if we did the people belonging to them would take our things away from us... ...along Kapoho to Punanaio (woods being on Kapoho) the *mauka* boundary of Pohoiki. Thence the land of Pohoiki bounds Keahialaka to the sea. Tall *ohia* trees and *kipuka pili* [an open area of *pili* grass growth], an old cultivating ground are at Punanaio. Thence along Pohoiki to grove of *ohia* trees. Kaumaumahooho on Keahialaka, thence *makai* to *lae hala* [prominence of pandanus growth] called Kukuikukii, the middle of grove. Thence *makai* to Government road to Keahupuaa the *pali*, cracks are on the brow of the *pali*. Thence to seashore, & point called Palikaha on the Puna side of Laeakahuna on Puna side of Pohoiki harbor...

Kapoho
July 15, 1873 [Vol. A:204-205] Hoapili Sworn

I was born at Kehena, Puna, at time of Keoua [pre 1793]. I have lived on Kapoho with Keawe [K.] my father now dead. Am a *kamaaina* of Kapoho and know a part of the boundaries. Pualaa bounds Kapoho on the Kau side next to the shore. The boundary running on the Kau side of a point called Kapahu, thence *mauka* to the Government road and to Kapeleokane, an *ahua* [mound] by *awaawa* [a little gulch or valley-like feature]; said *awaawa* is the boundary. Thence *mauka* to Mohonui, a *mawae* [fracture] on

the Kau side being the boundary. Thence to Kahuamoa a *puupili* [*pili* grass covered hill], thence to Kaluaelapii, a chasm. Thence the boundary follows along said chasm to three small hills called Puuainako. At this place Pualaa ends and Pohoiki bounds Kapoho. My father pointed out these boundaries to me.

Thence Pohoiki bounds Kapoho to Pakoiki. Thence the boundary runs *mauka* to Kepaahi an *ahu pohaku* [stone cairn] on the line where Keahialaka cuts Pohoiki off and bounds Kapoho. Thence the boundary runs along the *pahoehoe* to Kiapu a large hill on Keahialaka. The boundary runs some distance this side of the hill on the *pahoehoe*, and a short distance from Kaukiwai a swampy place on Keahialaka. Thence *mauka* the *pahoehoe* on Keahialaka and *aa* on Kapoho. Papalauahi is on Kapoho. From Kaukiwai the boundary runs to Puainako, on the *makai* side of *oioina* [a trailside resting place], on the *pahoehoe* is Kauaea, ending at Wahineloa...

Table 2. Disposition of Land (Residency and Land Use) in 'Ahalanui, Laepāo'o, and Oneloa (with Selected Information from Neighboring Lands)

Date	Source	Documentation
1848	Public Instruction (State Archives, Series 262: 1848-Hawaii)	For the year 1848: Kanono, the teacher at Pohoiki, recorded that 52 students attended classes. At Pualaa, Mose recorded that 35 students attended classes [note below: Following the Māhele, the Pū'āla'a school lot was moved to 'Ahalanui.]
Sept. 10, 1850	Int. Dept. Bk. 3:3	Laepaoo (having been previously held by Wm. Lunalilo, ceded to the Government in the division (Māhele) of 1850.
1850	Privy Council Vol. 6:146 & Vol. 6:160	Kahale applies for a 10 acre parcel in Ahalanui. Application of Kahale approved, reserving the rights of the natives.
1850	Privy Council Vol. 7:37	The sale of 30 acres in Laepaoo to Peleula, approved. The sale of 60 acres in the lands of Laepaoo and Ahalanui to Kahananui, approved.
Oct. 18, 1850	Royal Patent 1001	Makaimoku to Minister of Interior; applies to purchase 25 acres of government land in the *ahupuaa* of Oneloa. He offers 25 cents per acre for the fertile land (*aina momona*); 12.5 cents per acre for poor quality land (*aina ino*); and 5 cents per acre for very poor quality land (*aina ino loa*). (*Figure 4*)

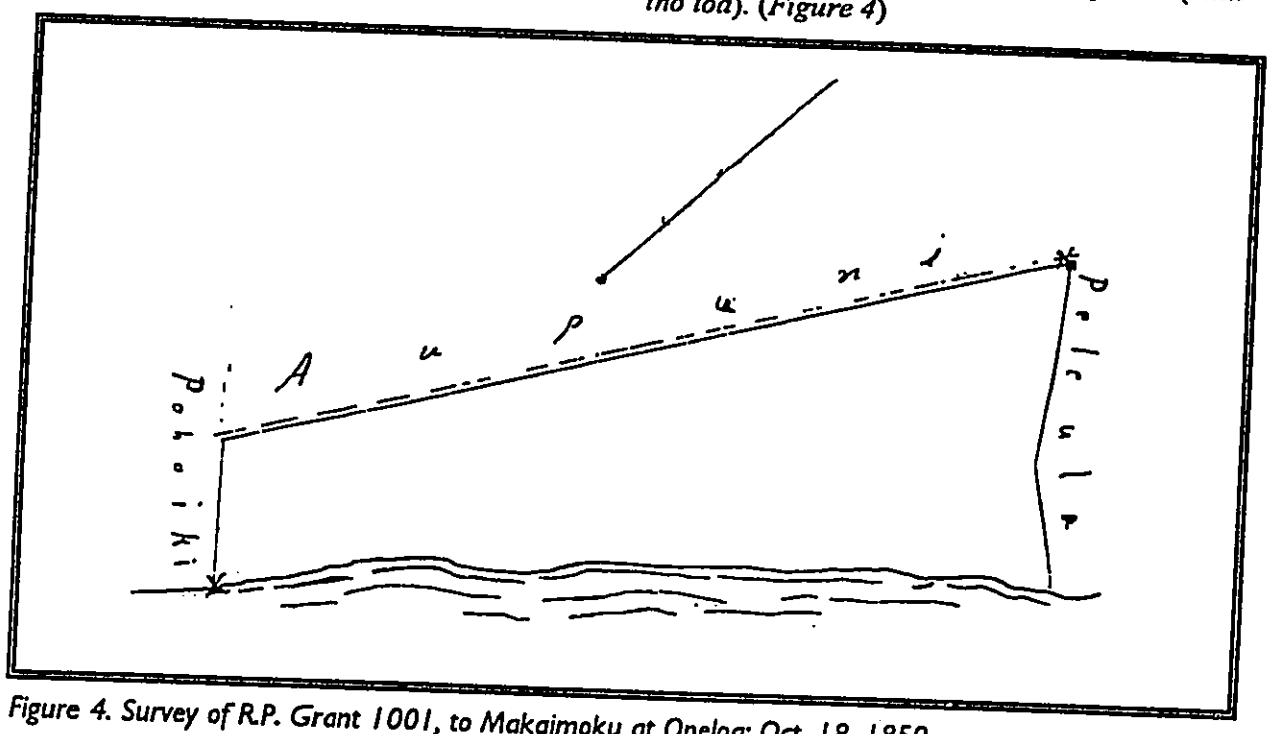


Figure 4. Survey of R.P. Grant 1001, to Makaimoku at Oneloa; Oct. 18, 1850 (Land Management Division)

Table 2. (continued)

Date	Source	Documentation
Nov. 22, 1850	Privy Council Vol. 6A	Approval of sale of land to: • App. No. 338 – Makaimoku; 25 acres in Oneloa for 50 cents per acre; and • App. No. 339 – Kahale; 10 acres in Ahalanui for 50 cents per acre.
Dec. 28, 1850	Int. Dept. Bk. 3:106	Notifying Kahale that the 10 acres in Ahalanui will be sold to him at 50 cents an acre; reserving the rights of the native tenants etc; (Kahale's claim was never formalized and patented).
Dec. 30, 1850	Int. Dept. Bk. 3:107	S.P. Kalama to Makaimoku; the Privy Council approved sale of 25 acres in Oneloa, 50 cents an acre; reserving the rights of the native tenants etc.
Dec. 3, 1852	Public Instruction Reports (Archives Series 262 Hawaii Reports – 1852)	Kamakau [co-recipient of Grant 2466] was the teacher at the Pualaa School. In the period between Sept. 1st to Dec. 3rd, 1852, 28 students were enrolled in classes
Dec. 13, 1852	Int. Dept. Ltr.	Privy Council – Resolved that the following sales by Rev. D.B. Lyman in...Puna...be and are hereby Confirmed to: • Kamakaimoku at Oneloa; 31 acres at 25 cent per acre. • Peleula at Laepaoo; 30 acres at 20 cents per acre (*Figure 5*);

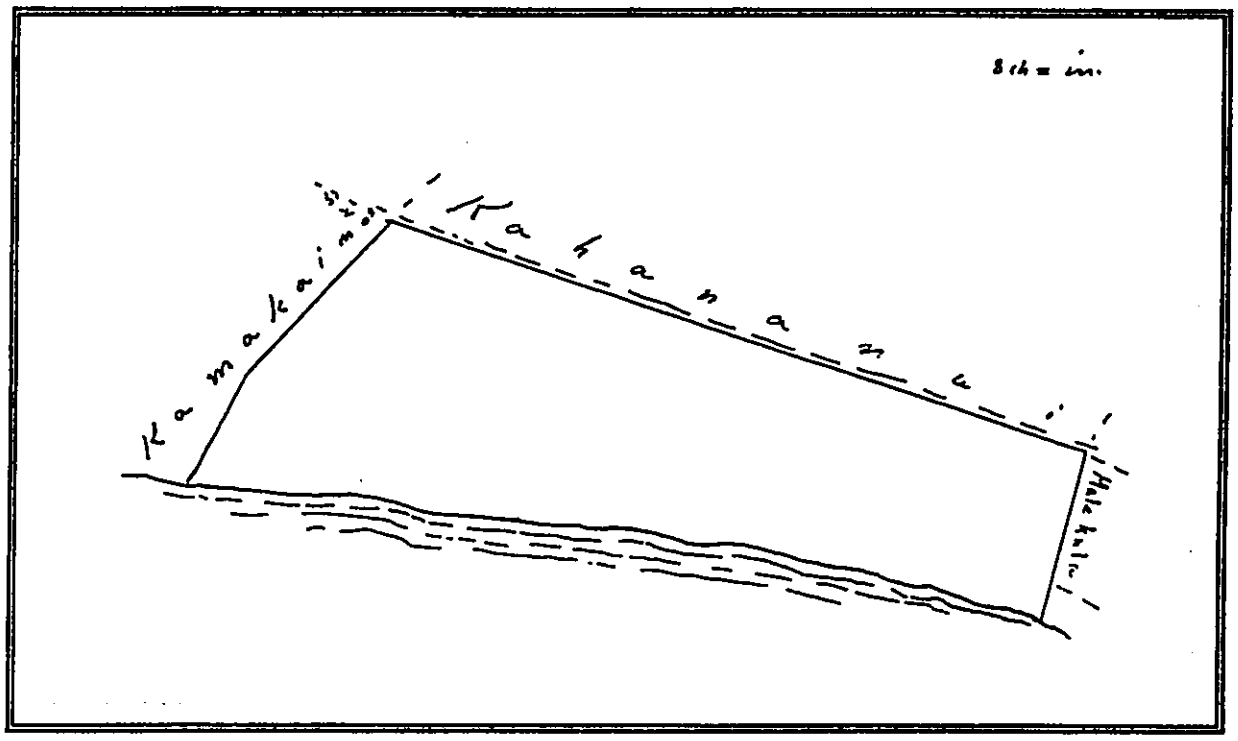


Figure 5. Royal Patent Grant 1016 to Peleula; lands of Laepaoo & Aahalanui, Puna, Hawaii (Land Management Division)

Table 2. (continued)

Date	Source	Documentation
Dec. 13, 1852 (cont'd.)		· Kahananui at Laepaoo & Ahalanui; 69 acres at 19.50 cents per acre (*Figure 6*).

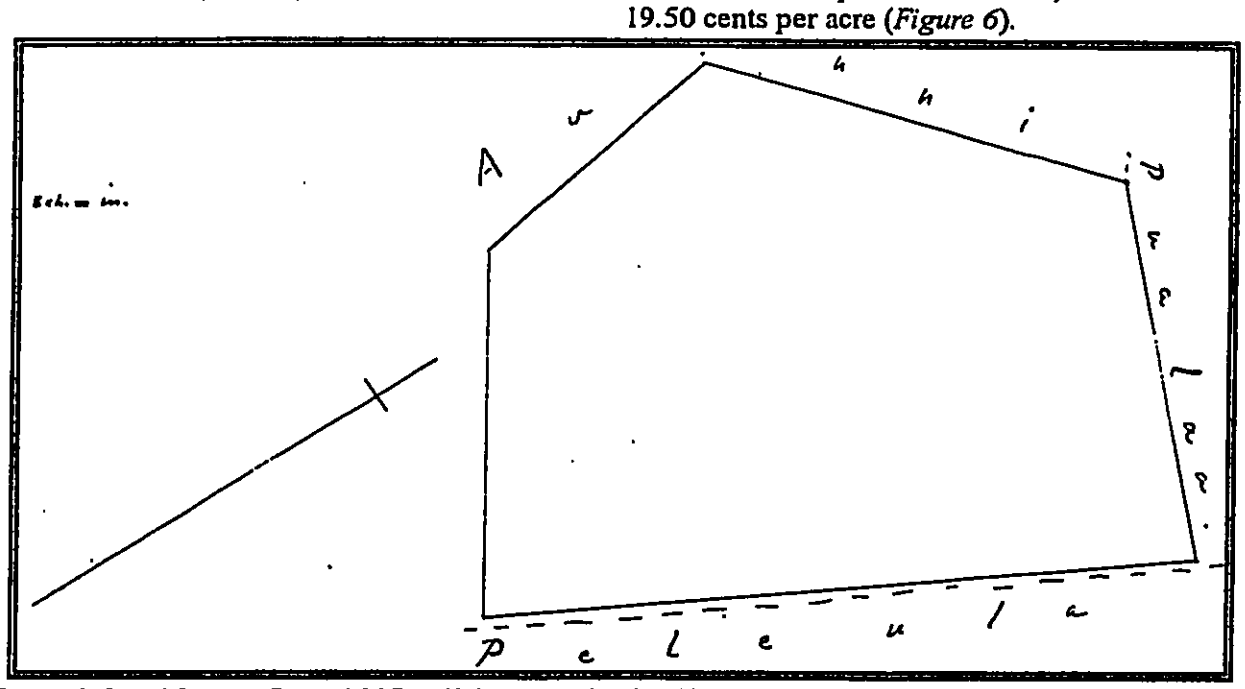


Figure 6. Royal Patent Grant 1015 to Kahananui; lands of Laepaoo & Aahalanui, Puna, Hawaii (Land Management Division)

Aug. 30, 1853:2 Public Instruction	Survey of 1.75 acre school lot at Aahalanui, Puna, approved (*Figure 7*). Pohoiki school lot of 1.40 acres approved on same date.

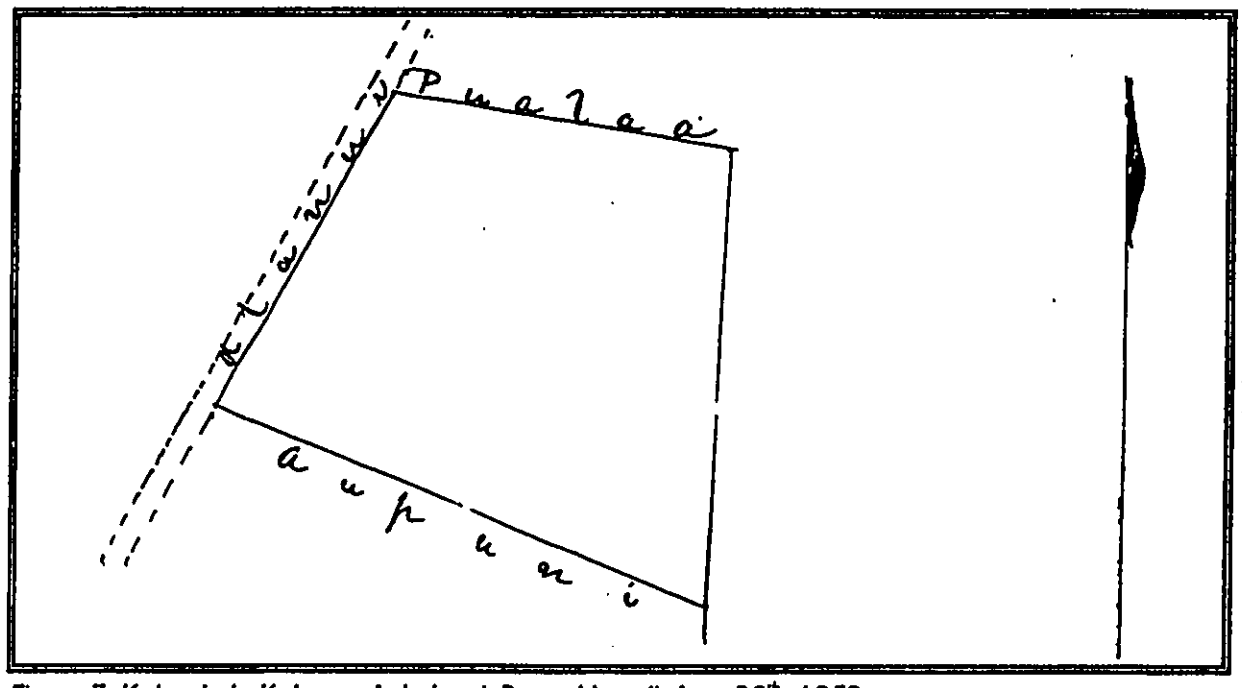


Figure 7. Kahuahale Kula ma Aahalanui, Puna, Hawaii; Aug. 30th, 1853 (State Archives, Public Instruction Survey Book)

Table 2. (continued)

Date	Source	Documentation
1858	Royal Patent Grant 2466	F. S. Lyman submits the survey of the lot at Ahalanui and Laepaoo, Puna; 139 6/10th acres awarded to Kuahewa and Kamakau (*Figure 8*).

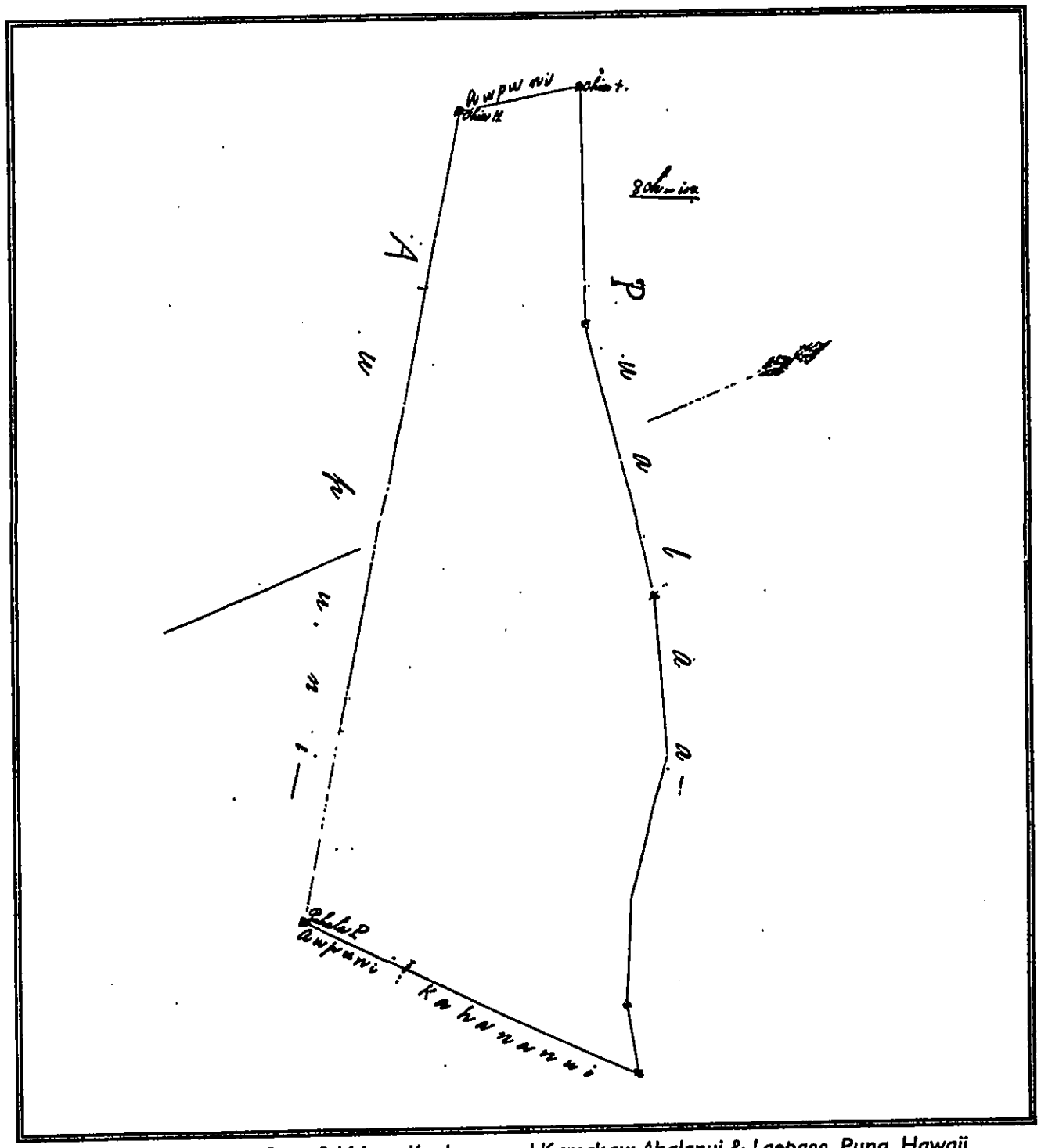


Figure 8. Royal Patent Grant 2466, to Kuahewa and Kamakau; Ahalanui & Laepaoo, Puna, Hawaii 1858 (Land Management Division) (reduced to 80% of original)

Table 2. (continued)

Date	Source	Documentation
Nov. 1862	Royal Patent Grant 2982	F. S. Lyman submits the survey of the lot at Ahalanui, Puna; 1 3/10th acres awarded to Kalauwaa [also written as Kalaiwaa] (*Figure 9*). Conditions of the grant, state – "Reserving the (public) place where canoes land, near the large stone."

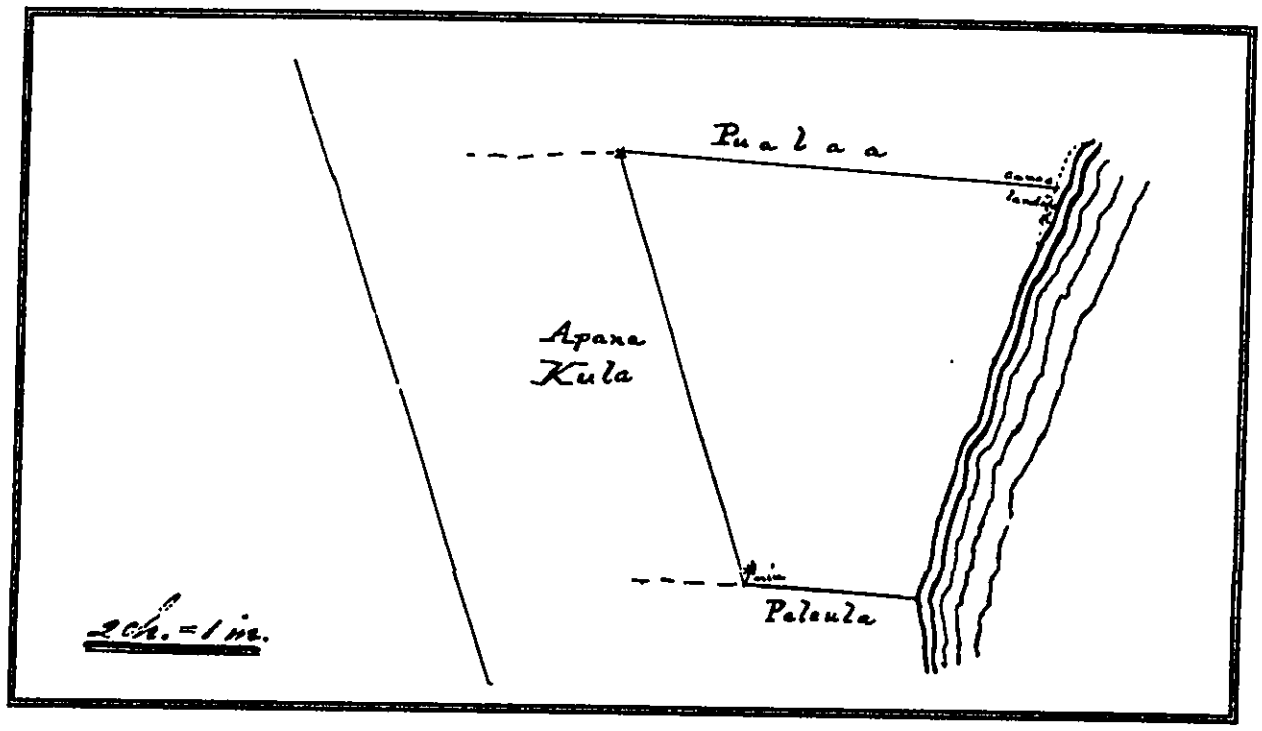


Figure 9. Royal Patent Grant 2982, to Kalauwaa at Ahalanui, Puna, Hawaii; Nov. 1862 (Land Management Division)

Dec. 31, 1862 Jan. 26, 1865 Dec. 31, 1868	Int. Dept. Letters	L. Kaina, Government Land Agent, Puna, submits rental payments for land in Oneloa.
1865	Public Instruction School Reports (Archives Series 262 Hawaii Folder - 1865)	Pohoiki, a stone concern standing on original ground, including a church site. Reading, writing, and geography were good, but arithmetic was not so good. 37 scholars. There is an ancient school lot at Aahalanui, not far off, which should be occupied as working grounds for the children, or else exchanged for a nice site *mauka* of the road near the present school house... (page 24)
March 4, 1869	Int. Dept. Letter	Father Clement to Minister of Interior; requesting a piece of land in Oneloa for a church site.

Table 2. (continued)

Date	Source	Documentation
Apr. 27, 1869	Int. Dept. Letter	L. Kaina to Minister of Interior; reporting that 5 acres for the church site is good, and that the Catholics are building a church thereon.
Apr. 28, 1869	Int. Dept. Letter	Having not received a response, Father Clement Resubmits application for a piece of land in Oneloa.
May 10, 1869	Int. Dept. Book 11:33	Minister of Interior notifies Father Clement that a Resolution was passed, granting a *kuleana* piece of Oneloa in order to build a church.
Jan. 25, 1871 Jan. 11, 1872	Int. Dept. Letters	Rental fees for lands in Oneloa transmitted to Min. of Interior.
Feb. 25, 1874	Int. Dept. Letter	L. Kaina notifies Min. of Interior that remaining Government lands in Oneloa are covered with rocks & *Ohia* trees.
Jan. 1, 1875	Bureau of Conveyances Lib. 41:441-443	Ten year lease agreement for the land of Pualaa between H.R.H. Ruth Keelikolani and J.E. Elderts; for the period of ten years. [Elderts also leased Kahuwai from R. Keʻelikōlani at the same time. Additional documentation on Elderts business operations and interest in the study area lands is presented below.]
Apr. 28, 1877	Board of Education (Archives Series 262 Hawaii Report 1877)	H.R. Hitchcock to C.R. Bishop. ...The schools of Opihikao and Pohoiki are in the hands of in-experienced teachers and have rather retrograded. I have asked the school agent to make up a complete statement of the amount of money obtained by the pupils of the schools, since the operation of the school labor law. Puna is a district overrun by cattle, goats and hogs, which regard not stone walls, and patiently wait until the crops begin to be valuable, then appropriate them largely to their own use. This has a depressing effect upon the little workers, who add cubits to the height of the walls, until it becomes a matter of peril to the inspector to climb over them in order to enter the school house... (pages 1 & 2)
June 13, 1877	Bureau of Conveyances Lib. 51:80-81	*Bill of Sale* – R. Oliver, having obtained a lease on an area of about 2 ½ acres of land in Pohoiki, grants said lease to R. Rycroft. The parcel included the store of the grantor, as well as out buildings, fixtures and appurtenances (stock and trade in the store valued at $1896.24). Also included in the Bill of Sale were:

Table 2. (continued)

Date	Source	Documentation
(June 13, 1877, continued)		
		• About 20 acres of pasture land in Pohoiki; • All, *awa* belonging to the grantor, cultivated and uncultivated in the Detract of Puna; guaranteed to be of an amount not less than "five thousand walus;" • Also one half interest in the *Awa* License at Hilo…
Oct. 27, 1877	Bureau of Conveyances Lib. 51:334-335	Kaluhiwaha (residing at Ponahawai), widow and sole heir of Peleula, grants the deed to the land in Laepaoo and Ahalanui, described in Royal Patent Grant 1016, to her grandchild, Ainaike.
April 28, 1882	Int. Dept. Letter	R. Rycroft to W. Armstrong, Minister of Interior; petitions for year-to-year lease of the lands of Oneloa, Laepaoo, Ahalanui, Malama, Kaukulau, Puna, at $40.00 per year.
May 9, 1882	Int. Dept. Letter	C. Lyons to W. Armstrong; replies that Judge Lyman has said that the lands of Oneloa, Laepaoo, Ahalanui, Malama, and Kaukulau are of "little value." As such, he recommends that the lands be rented, providing that "no valuable trees be cut down."
May 9, 1882	Int. Dept. Bk. 20:450	Records that a certificate of rental for the lands of Oneloa, Laepaoo, Ahalanui, Malama, and Kaukulau in the amount of $40.00 a year has been made to R. Rycroft; with the condition that not trees shall be cut down upon any of said lands during the terms of this rental.
May 13, 1883	Bureau of Conveyances Lib. 86:43-44	Kekuko (w), her husband, Joseph Flores, and Kekuko's daughter, Ainaike (granddaughter of Peleula); sell the land of Laepaoo & Ahalanui, as described in Royal Patent grant 1016 (30 6/10^{ths} acres) to R. Rycroft.
Nov. 8, 1883	Int. Dept. Bk. 23:257	Minister of Interior to R. Rycroft, confirming that he became the tenant for one year or at will of the Minister of Interior for "the remaining unoccupied portions" of the following named lands situated in the District of Puna Island of Hawaii, Oneloa, Laepaoo, Ahalanui, Malama, and Kaukulau. A lease of the lands was not granted in regular form because the location and area etc., were not definitely known.
Jan. 7, 1884	Int. Dept. Letter	J.E. Elderts, Kapoho Ranch; to the Min. of Interior, stating:

Table 2. (continued)

Date	Source	Documentation

(January 7, 1884, continued)

In 1871 he entered into a lease with L. Kaina, Government Land Agent, for lands between Pualaa and Pohoiki, known as Analoa [Oneloa] and Ahalanui, etc., and paid $30.00 per year, paid up to 1883.

States that Rycroft knew that he was occupying and paying rent for the whole of the lands of Oneloa, Laepaoho [Laepaoo], & Ahalanui, etc...

Jan. 15, 1884 — Int. Dept. Book 23:454 — J.A. Hassinger, Chief Clerk to J.E. Elderts, Kapoho Ranch replies:

In your letter you describe the lands and between Pualaa and Pohoiki and named Analoa and Ahalanui and part of Kiipuka. We find none of these names on our Record of Leases to you, but they may perhaps be included in the lands above described [several lands of Puna, north of Kapoho].

In regard to Mr. Rycrofts claim, we can only say that under date of May 9th 1882; he became tenant at will of the Minister of the Interior of the remaining unoccupied portions of Oneloa, Laepaoho, Ahalanui, Malama, and Kaukulau, Puna...

I suggest that where you have leases nearly expiring, and you desire to retain the lands that you make prompt application for renewal.

Apr. 26, 1884 — Int. Dept. Letter — J.E. Elderts (Kapoho) to Chas. Gulick, Minister of the Interior. Elderts, having made inquiries of the old natives, replied to the Minister's letter of January 15, 1884:

[Elderts names lands in northeastern Puna, within Lease #180; transferred by Hawaiian Agricultural Company, in 1877 to Shipman and Elderts, and subsequently transferred to W.H. Shipman upon dissolution of their partnership.]

...You say that in my letter to you, I describe certain land between Pualaa and Pohoiki (the lands that I asked for information about) as named Analoa and Ahalanui, and part of Kiipuka, which is an error on the part of someone, either the one who wrote the letter for me, or you must have misunderstood my meaning, as there is no Kiipuka between the land of Pualaa and Pohoiki. The names of the three lands that I wish information about are Oneloa, Laepaoho, and Ahalanui, and they are land that I rented from L. Kaina, Govt. Land Agent (at the time), somewhere about the year 1871, for five years at an annual rent of twenty dollars per annum.

These three lands, with one-half of a Kiipuka [*kāpuka*] (or an opening in the Aa), on the land of Koae, and also leased from L. Kaina (but at a later date than the first three lands.) at an annual rent of Ten dollars, makes the annual rent of thirty dollars, which I have always paid year after year, form that date until now (13 years).

You say that under date of May 9th 1882, Mr. Rycroft became Tenant at will, from or by your consent, of the unoccupied, or rather, remaining unoccupied portions of Oneloa, Laepaoho, Ahalanui, Malama and Kaukulau in Puna.

Now, Mr. Rycroft knew that I had been, and was occupying, and paying the rent year after year for the whole of the lands of Oneloa, Laepaoho, and Ahalanui. For when he first came to Pohoiki to live [c. 1877], the natives wished to make him trouble for allowing his stock to run on the above three lands, but as I saw him soon after that, I told him that I had all the Government Lands between him and

Table 2. (continued)

Date	Source	Documentation

(continued from communication of April 26, 1884)

me rented [the lands from Oneloa to Kapoho], and that I was willing for him to let his stock run on the lands without any charge to him for it...

Mr. Rycroft claims the whole of the lands of Oneloa, Laepaoho, and Ahalanui, and says that he has a written lease of them, but that he could not show it to me, as it is in Mr. M.P. Robinson's safe in Honolulu. And further, he has ordered my men off those lands when they were sent by be after Breadfruit and Cocoa-nuts, and taken all to himself for his own use...

July 28, 1884 — Hawaii Government Survey (DAGS 6, Box 10) — Letter of J.E. Elderts, Kapoho Ranch; to C.J. Lyons, Government Surveyor, states:

As I have written to the present Minister of the Interior several times about the Govt. Lands of Oneloa, Laepaoho, and Ahalanui, and cannot get a satisfactory answer from him, I now address you on the same matter... [reviews information as cited above, and adds]

Now, I cannot get a lease from the Govt. to show that I am entitled to the land and what Cocoa-nuts, Breadfruit, &c grows on it, to them, and as I cannot get them without being in trouble and hot water all the time the aforementioned R. Rycroft, and as I prefer to live in peace with my neighbors, I now hereby notify you that I give up and relinquish all my rights in anyway in and to the aforesaid lands.

And in doing so, I would ask that you will use your influence to obtain a lease of them for a native named Kapukini (K.) who is now living on the land, and who is a constable and the Jailer of our jail in the district, and a good man to have the lease, and I think if it is possible to obtain a lease of said lands the he, Kapukini is entitled to, and should have the first chance to lease them.

Any information I can give you in addition to what I have already written, I shall be pleased to impart, and any communication you may wish to sent to the said Kapukini, through me, I will see that he gets it... [11]

Aug. 12, 1884 — ditto — Elderts to Lyons – further documentation as above. (also, cf. Elderts to L.A. Thurston; Int. dept. Letters, Oct. 13, 1887)

Dec. 23, 1884 — Int. Dept. Book 25:435 — J.A. Hassinger, Chief Clerk, on behalf of the Minister of the Interior to R. Rycroft, Esq.: Acknowledging Rycroft's proposal for construction of the landing and breakwater at Pohoiki; the Department will assist in the amount of $350.00. When the work passes inspection, Rycroft's draft in the above amount will be honored.

Aug. 17, 1887 — Int. Dept. Book 30:206 — J.A. Hassinger to C.N. Arnold, Esq., R.S. in Chief Hilo, Hawaii:

In re – the landing at Pohoiki Puna – which was built or being built in December 1884, by Mr. Rycroft and for which he was to receive $350...and which wharf was

[11] Kapukini (John Kapukini) was a native of Maui, who moved to Puna sometime prior to 1884. Kapukini was the great grandfather of John Hale (see interview of June 12, 1998).

Table 2. (continued)

Date	Source	Documentation
		(continued from communication of August 17, 1887) swept away before completion. Mr. Rycroft now reports the wharf rebuilt... Mr. Rycroft also giving a written agreement that the landing which is on his private property shall be allowed free for the use of the public as a consideration for this assistance...
Aug. 15, 1891	Int. Dept. Letter	R. Rycroft applies to purchase lands of Ahalanui, Laepaoo, and Oneloa etc.
Sept. 1, 1892	Int. Dept. Letter	J. Kapukini to Minister of Interior; applies to purchase 4 acres of land in Laepaoo, adjoining Rycroft's land in Pohoiki.
		A note with the same communication also references the application of A. Dickman. Loebenstein's Reg. Map 1777 places Dickman's house in Pū'āla'a, with coffee patch in an opening of the *hala* forest crossed by the 'Ahalanui-Pū'āla'a boundary. Dickman's coffee patch is situated mid way between the Kahaleolono and Kākala agricultural fields, 'Ahalanui side of the old *hōlua* at Pū'āla'a (*Figure 2*).
June 8, 1893	A.B. Loebenstein – Field Survey Book Vol. 37 State Survey Division	A.B. Loebenstein surveyed and pinned a 2 acre lot in Oneloa for John Kapukini (*Figure 10*).
		[As will be seen in the following documentation, Kapukini's Oneloa grant parcel was not patented, it was absorbed into R. Rycroft's Grant No. 3670 on Nov. 16, 1893. Interestingly, the oral history interview with John Hale (June 12, 1998), records that Mele Kapukini-Hale (J. Kapukini's daughter and John Hale's grandmother) lived in Rycroft's house on that lot until her passing away in c. 1928.]
Feb. 22, 1893	Government Survey Office Letter	J.T. Brown to R.A. King – recommends approval of the sale, at auction, of 4 acres of lands in Laepaoo to Kapukini (Application No. 494).
Nov. 16, 1893	Patent Grant 3670	Sold at Auction to R. Rycroft; 4.12/100th acres at Oneloa, Puna (*Figure 11*).
Mar. 5, 1894	Int. Dept. Letter	A.B. Loebenstein to Minister of Interior, transmitting request of R. Rycroft to purchase remaining portions of Government land in Oneloa, Laepaoo, and Ahalanui.

Table 2. (continued)

Date	Source	Documentation

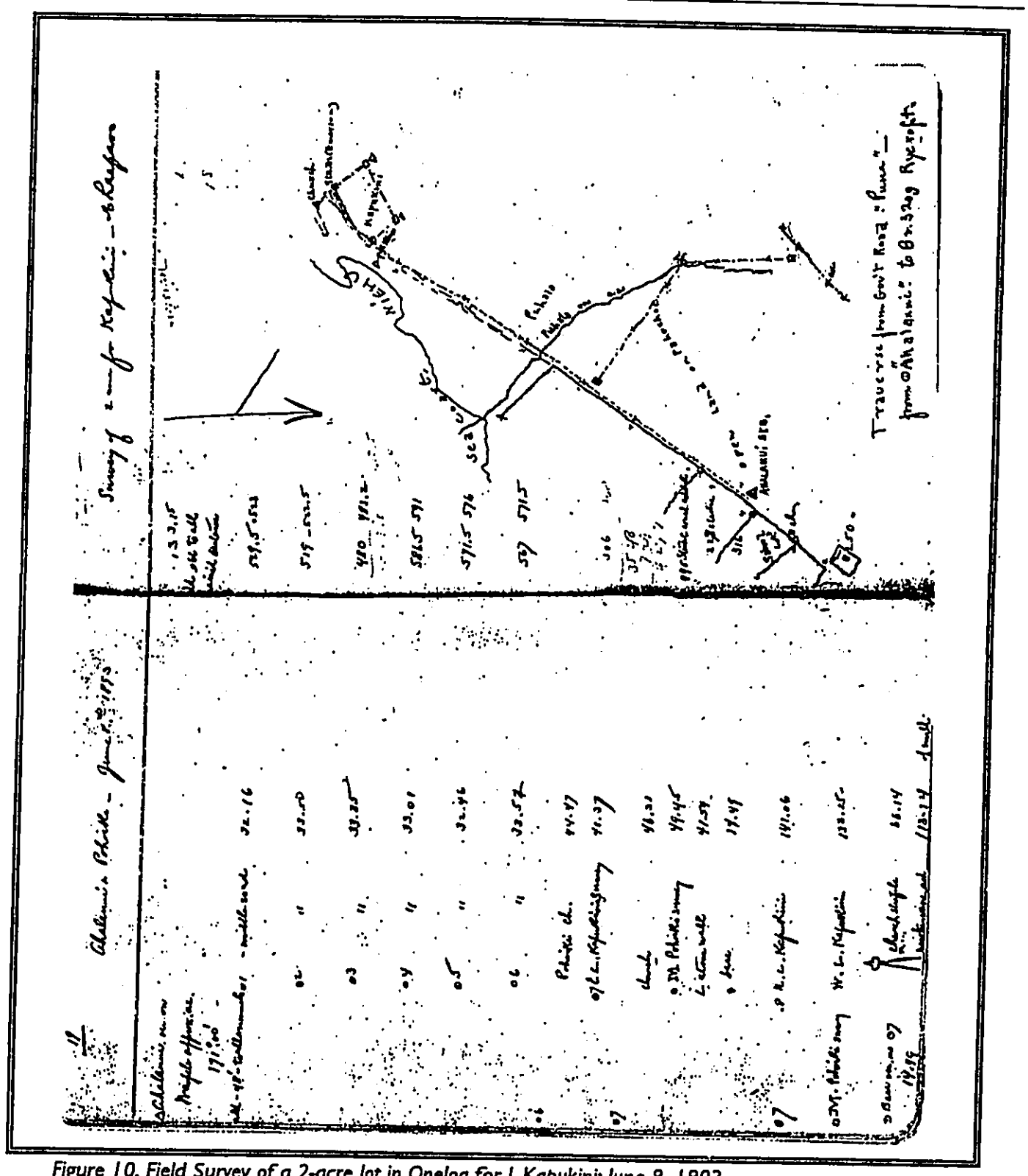


Figure 10. Field Survey of a 2-acre lot in Oneloa for J. Kapukini; June 8, 1893.
(A.B. Loebenstein Field Note Book No. 37:19; State Survey Division – 74% of original)

Table 2. (continued)

Date	Source	Documentation

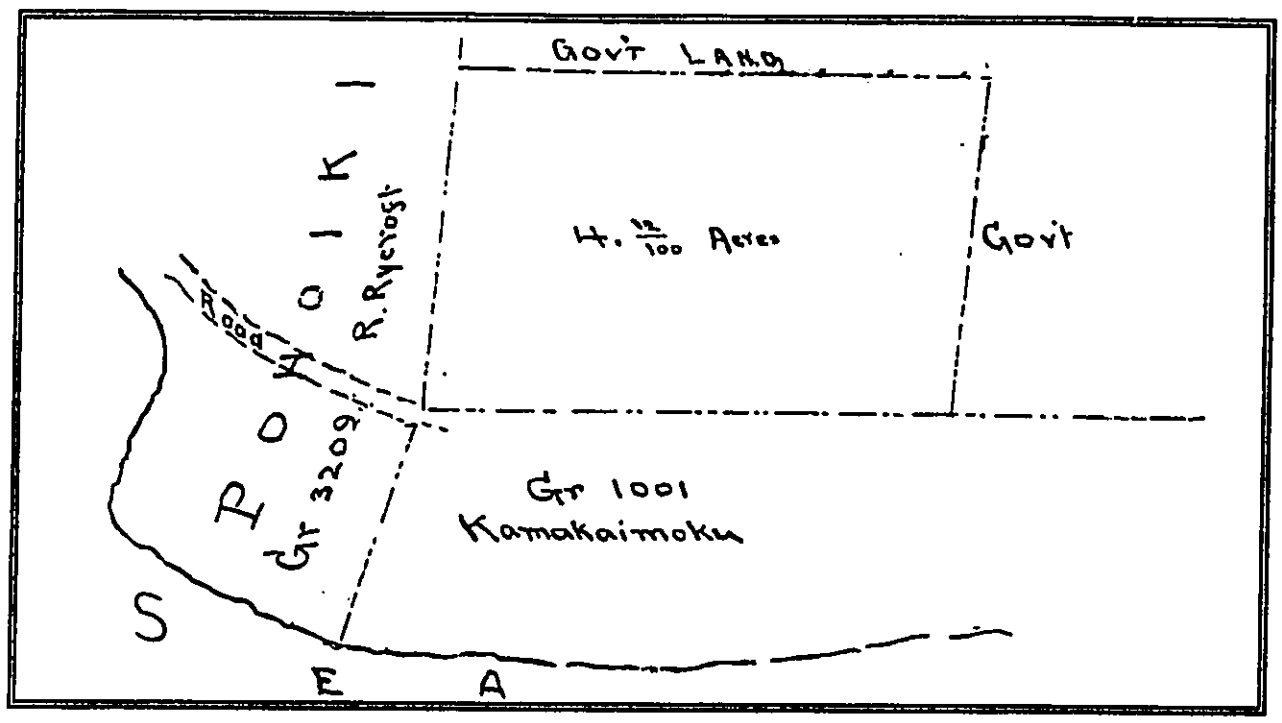


Figure 11. Survey of Patent Grant 3907, to R. Rycroft at Oneloa, Puna, Hawaii; Nov. 16, 1893 (Land Management Division)

Apr. 6, 1895	Int. Dept. Letter	Wm. Kumahoa, Constable (Pohoiki), to J.A. King, Minister of Interior; asking for permission to fence a one acre parcel of land at Oneloa, and to build a house there.
Apr. 27, 1895	Int. Dept. Letter	R. Rycroft to J.A. King, Min. of Interior; applying to purchase and additional parcel of approximately 15 acres in Oneloa, situated "just *mauka*" of Grant 3970; and adjoining Pohoiki. It is *āā* with *lauhala*. Offering an "upset price" of $1.50 cents per acre.
May 8, 1895	Int. Dept. Letter.	J.T. Brown, of the Hawaiian Government Survey Office to J.A. King; reports that he believes the price of $1.50 per acre as offered by R. Rycroft is too low.
May 20, 1895	Int. Dept. Letter	Harry Rycroft, to J.A. King; applying to purchase an additional 50 acres in Oneloa. Reporting that the previous piece was smaller than anticipated, and that a large percentage of the land included in the survey is not capable of cultivation...

Table 2. (continued)

Date	Source	Documentation
May 28, 1895	Int. Dept. Letter	Wm. N. Kumahoa to J.A. King; applies for a 30 acre homestead lot in Oneloa. (Note: J.A. King recommends waiting on decision, until action in matter of new land law are resolved; June 21, 1895 — this was resolved by the "Home-Stead Lease and Right of Purchase Lease" system; Part VII, Land Act of 1895)
July 31, 1895	Patent Grant 3940	Awarding to R. Rycroft, the 14.78 acre parcel in Oneloa which he had requested on Apr. 27, 1895 (*Figure 12*).
June 26, 1900	Bureau of Conveyances Lib. 209:267-268	A.D. Kanaaukahi, son of Kahananui, sold his interest in Grant 1015 (conveyed to Kahananui n 1850), totaling 34 ½ acres more or less to Mele Hale.
June 12, 1902 & Aug. 1, 1902	C.P.L. to Gov. Letters Public Lands Letters	Lands of Oneloa and Ahalanui now opened for Settlement purposes under the Homestead-Right of Purchase system of 1895.
Sept. 1, 1902	Right of Purchase Lease (RPL) No. 424	RPL 424 – Grant 6845, to Napalapalai for a 999 acre pastoral lot in Oneloa and Ahalanui. The grant required that: ...He shall allow the Agents of the Territory of Hawaii and the United State at all times to enter and examine said premises. The lessor herein, on behalf of the Territory of Hawaii, reserves the right to take any fifty foot strips across their Lot for Roads, also the right to quarry rock, or reserve a portion of this Lot for a quarry, for Road building purposes, whenever the same may be required; and to take same without compensation, if from unimproved land. All trails crossing this Lot are reserved for the use of the Public... (*Figure 13*)
Feb. 4, 1903	Bureau of Conveyances Lib. 269:482-483	Maunakea, son of Makaimoku – recipient of Grant 1001 at Oneloa in 1850 – and wife, Lilia, resident at Laepaoo; conveyed four acres of Grant 1001, *makai* of the Government Road, to Mele Hale of Pohoiki.
May 6, 1903	Bureau of Conveyances Lib. 269:481-482	Mele Hale and husband, Keoni (John) Hale, of Pohoiki, convey four acres of the Ahalanui parcel purchased from D. Kanaaukahi – son of Kahananui (Grant 1015) – to Maunakea of Laepaoo.

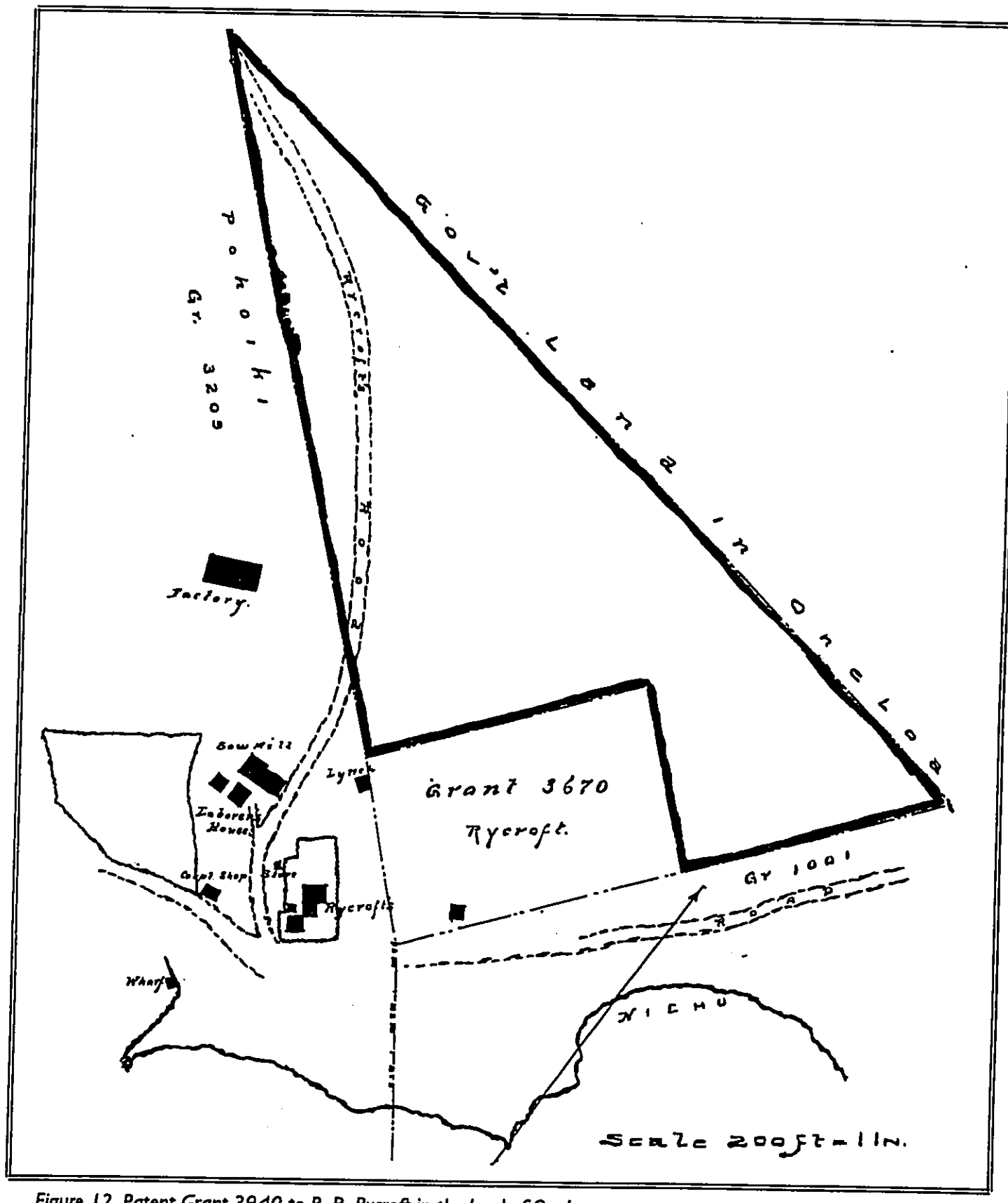


Figure 12. Patent Grant 3940 to R. R. Rycroft in the land of Oneloa (Hawaii State Archives)

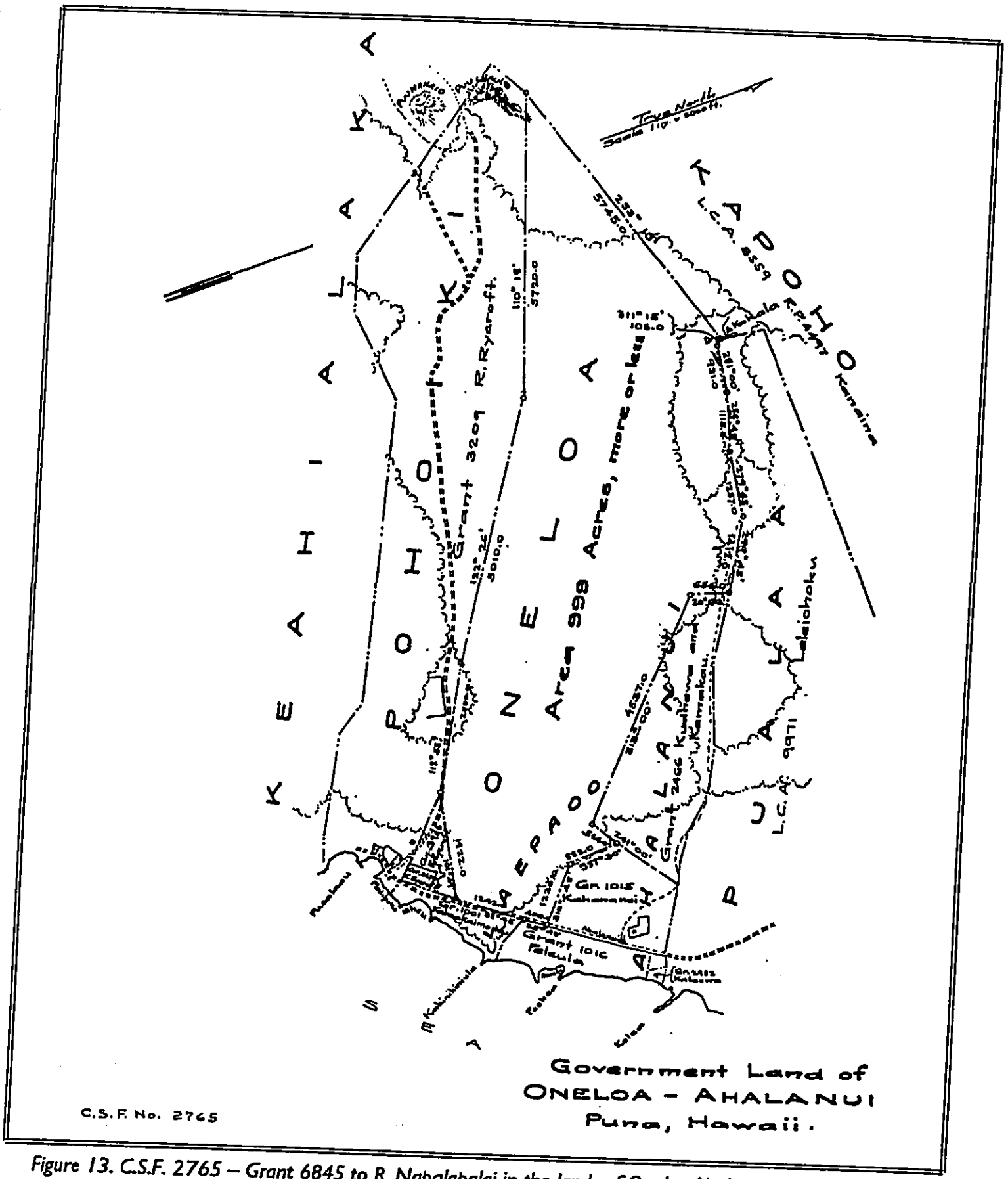


Figure 13. C.S.F. 2765 – Grant 6845 to R. Napalapalai in the lands of Oneloa-Ahalanui (Map from Survey Approved Apr. 16, 1917; State Survey Division – reduced to 85%)

Table 2. (continued)

Date	Source	Documentation
Jan. 30, 1911	Ex. CPL to Gov.	CPL applies to Gov. Frear for permission of taking possession of RPL 424; 999 acres in Oneloa and Ahalanui, as a result of Napalapalai's non-Compliance with conditions of said lease. Governor's approval granted.
Jan. 8, 1917	RPL No. 424 – Grant 6845	Napalapalai appeals loss of RPL 424 – Grant 6845 Eugene Lyman provided the following documentation regarding Napalapalai and the subject property under "Testimony of Witness:"

I have known R. Napalapalai since boyhood, living first at Pa'auhau, Hilo, then on Homestead, then Waimea...

Mele Hale & Maunakea have residences near this lot.

He uses it for pasture. Napalapalai has been a cowboy at Hilo for Lyman & Co., then a homesteader & since 1906, a laborer for Parker Ranch. His family lived on the land from 1903 to 1906; they now reside in Waimea. Their house on the land is a frame building 16x20 ft., – 3 rooms – value $50.00. There is no cultivation because it is classed as pastoral. There are quite a number of cocoa-nut trees & pandanus.

R. Napalapalai testifies:

I am 46 years of age, and a laborer. I applied for and received the 999 acre pastoral lease and moved on the land in March 1903. My wife and I resided there continually between March 1903 to 1906. At present, we live in Waimea.

We built a frame house, 16 x 20 ft.; 3 rooms, iron roofing, and habitable at all seasons of the year. It is valued at $50.00. The house was built by myself and a Japanese in January 1903. The house was moderately furnished when we lived there.

On average, there are over 2000 trees per acre planted and/or maintained on the land. Because I am employed by Parker Ranch, I have lived at Waimea. I use the land as pasture.

Apr. 16, 1917	C.S.F. 2765 – Grant 6845	Certified Survey (2765) approved for Grant 6845; awarding lot to R. Napalapalai. (see *Figure 13*, above)
Feb. 5, 1927	Bureau of Conveyances Lib. 864:181-182	Mele Hale, resident of Pohoiki, conveys to her nephew, Lawrence Rowe (of Honolulu), the four acre parcel of land at Oneloa (her portion of Grant 1001). Mele Hale included specific documentation pertaining to succession of title; specifying that: "...I command by this document, that the land parcel conveyed by this document not be sold or mortgaged..."

Table 2. (continued)

Date	Source	Documentation
Oct. 22, 1953	Royal Patent Grant 2982 Land Management Division files	M.K. Ashford, Commissioner of Public Lands, to N. Doi, County Attorney (Hawaii); regarding ancient trail, path or road over and across Grant 2982 to Kalauwaa, situate at Aahalanui, Puna (*Figure 14*). Abstractor George Awai reports:

There is no map showing any roadway across Grant 2982 to Kalauwaa. Issued 4/13/[18]65, this grant is subject to the following reservations: 'Reserving the canoes landing place near the said large rock' Sketch plan shows the landing place near the northeast corner of said grant.) 'Reserving the rights of the natives' (This would include roadway, etc. C. Code 1859, Chap. 34. Sec. 1447)

Undoubtedly there must have been a roadway from the government road to this spot, and possibly the only landing place of canoes in that locality of Puna district.

Solution – contact old kamaaina of that area, especially those who attended the Hawaiian School at Aahalanui, School Grant 3 Apana 2.

[refer to File No. 2.1231]

Another interesting historical record regarding the 'Ahalanui parcels of Kalauwa'a (generally written as Kālaiwa'a) and the neighboring *mauka* land of Kahananui (Grant 1015), was found in the genealogical records of Elizabeth Makuakāne (in the collection of the author). David Kapuaaloha Makuakāne (born ca. 1848), grandfather of Kahu John Kumukahi Makuakāne was married twice (see interview of July 21, 1998). His first wife, Emily Kalāiwa'a Kahananui-Makuakāne (who passed away at a young age), was descended from both the Kahananui and Kālaiwa'a lines. As noted above, Kahananui received Grant 1015 (a portion of the land was retained by members of the Makuakāne family until ca. 1989). Kālaiwa'a received Grant 2982, which now makes up a portion of the County's 'Ahalanui Park. It was from that genealogy that the late Daniel Makuakāne was descended (see interview of July 21, 1998).

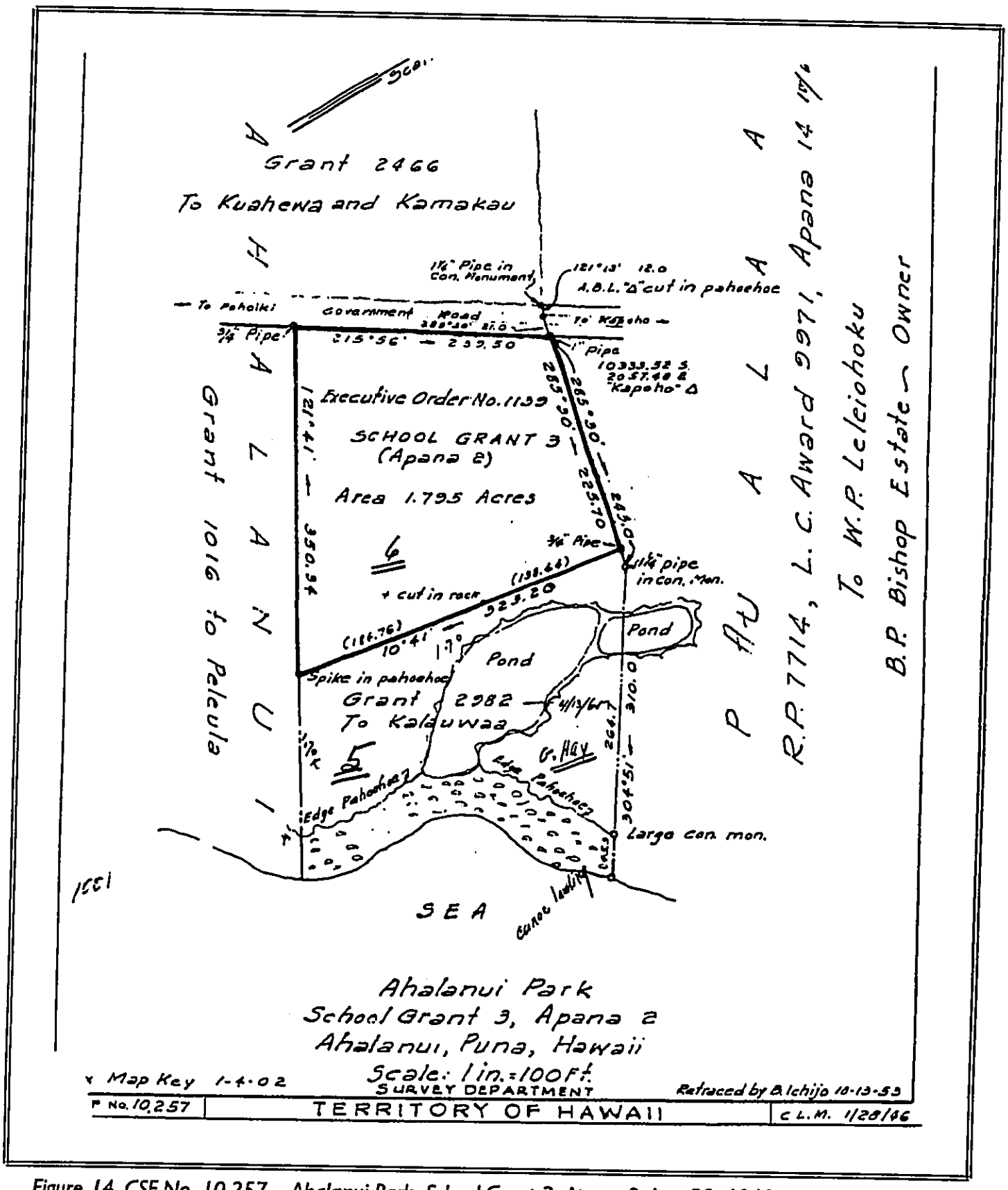


Figure 14. CSF No. 10,257 – Ahalanui Park, School Grant 3, Apana 2; Jan. 28, 1946 (Land Management Division) (reduced to 80% of original)

Hawaiian Government Field Surveys

As seen the documentation cited above, in this section of the study, surveyors collected a great deal of information regarding the natural and cultural landscapes of Puna. They also provide us information on who the native resident were, and where they lived; and documented a wide range of native customs and practices. The author has been conducting a review of original field survey note books and correspondence from the field staff to Surveyor General, W.D. Alexander, and various parties[12]. As a result, additional documentation relative to the lands of ʻAhalanui, Laepãoʻo, Oneloa, Pohoiki, and the larger Puna District has been identified. Some of this information is useful in helping to explain historical data that was cited above, or adds to the general historical record if residency and land use in Puna. Unfortunately, some of the original Hawaiʻi Island survey documentation is not presently available for public review, because it was chemically treated in the 1920s-1930s, and is highly toxic. So it is possible that some time in the future, following decontamination of those records, that additional survey documentation of historical importance will become available for the study area and other lands of Hawaiʻi. The following excerpts come from some of the available field survey communications:

Table 3. Field Survey Documentation (1878 to 1895)

Date	Source	Documentation
1876	Reg. Book No. 304	Notes from the surveys of Hamakua and Pohoiki by J.S. Emerson and C.J. Lyons:

p. 36: Sta. I of Pohoiki corner of Kapoho & Laipaoo – *Lehua* tree marked I just *makai* of large boulder by path.

p. 40 Sta. J of Pohoiki corner of Laipaoo & Oneloa – *lehua* tree marked J surrounded by large pile of stones on aa lave flow.

p. 46 Sta. K between Oneloa and Pohoiki – large pile of stones by *hala* tree marked K at Kahalewela.

p. 48 Sta L between Pohoiki and Oneloa – large pile of stones on N side of Rycroft road marked L.

Sept. 12, 1878 — HGS DAGS 6, Box 10 (Hawaii State Archives) — J.S. Emerson, Surveyor to C.J. Lyons, Government Survey Div; from R. Rycroft's at Pohoiki:

We arrived here all right Friday evening, Sept. 6, and have been very kindly provided for. Saturday, Monday & Tuesday morning I went with Mr. Rycroft & a *kamaaina* around Pohoiki fixing the corners of the land. Since then have proceeded with the regular survey. As the place is densely covered with trees and brush so as to shut out the view, I can but guess roughly at the area. It is probably over 350 acres, most of it very rough *aa*, some pasturage, and considerable fine *Ohia lehua* timber, with a good supply of cocoanut trees. The only landing between Hilo & Keauhou [Kaʻū] is in the little bay *makai* of this land. The whole country here is fearfully rough on shoe leather. Scarce any soil. Cocoanuts, potatoes, breadfruit & *awa* do well. The best *awa* in the country.

[12] Materials housed in the collections of the State Survey Division and State Archives.

Table 3. (continued)

Date	Source	Documentation

(Sept. 12, 1878 continued)

The timber would be valuable if it were accessible. Mr. Rycroft thinks the land is worth $300. The native judge says it is worth 50 cents an acre...

July 20, 1891 — HGS DAGS 6, Box 3 (Hawaii State Archives) — A.B. Loebenstein, Surveyor to W.D. Alexander, Surveyor General; reports:

...I have been engaged for some time on the location & preliminary survey of a road through Puna. It was at the minister's request this job was undertaken. My instructions were to pick out if possible a suitable location of an eventual carriage road through the interior, & by means of this road to open up tracts suitable for agriculture or homestead purposes. The actual field work was begun about the middle of May & up to date has progressed as far as Kamaili, a short distance from Kaimu. The initial pt. of the survey starts from the junction of the Volcano and Puna road Ramie ranch about 1 mile outside of the Panaewa woods (a short cut to the seacoast at Makuu, begun but not completed by the Thurston administration) & follows a general contour line. A bench mark established by McBruner at the time of his survey of the Volcano Road, served as the basis of elevations carried forward. The features of the country of one which the road traverses for the first 10 miles are of little account for purposes of agriculture, consisting mainly of broad & flat belts of Pahoehoe. It is of a very friable nature however & there are few irregularities, rendering the construction of a road over the same a simple and comparatively cheap affair.

Between the 10th and 13th miles are large tracts of fine agricultural land, among them being the lands of Nanawale & Kaniahiku, those being the tracts you have instructed me to subdivide for homestead purposes...

Beyond the 14th & to the 17th mile old aa flows are again met with. Most of them however, in a very decomposed state of a friable nature & covered with dense jungles of *Ti, Ie,* and *Ohia.* Between the 17th & 19th miles, the road crosses the head of the lands of Kapoho, Keahialaka, Malama & Opihikao. In this section are to be found the grand craters and crevasses which extend from Heheihulu & the Volcano down to the Pukii [Kukii] hill of Kapoho. From Kapoho to the terminus of the survey, the land is all fit for agricultural purposes...

Aug. 1, 1991 — HGS DAGS 6, Box 3 (Hawaii State Archives) — A.B. Loebenstein, to W.D. Alexander; reports:

...I note your instructions in the matter of Honuaula hill station [directly inland of the Oneloa-'Ahalanui boundary] & will get a couple of men to clear the top of the hill which like all the other Puna hills is covered to the crest with *ohia* timber...it is going to be a difficult matter to get men for the Puna work. In itself it is a "*mehameha*" [lonely or solitary] place with few inhabitants...

Table 3. (continued)

Date	Source	Documentation
Jan. 3rd, 1892	HGS DAGS 6, Box 3 (Hawaii State Archives)	E.D. Baldwin, to W.D. Alexander. Speaking of the survey of lands in the Kaimū to Kahauale'a vicinity, Baldwin describes the value of inland kalo, or taro lands in Puna:

> ...in the woods the natives say there is good soil, and that they raise all their *kalo* there, so that the real demand here is for upland or *kalo* land...

June 26, 1893 HGS DAGS 6, Box 3 A.B. Loebenstein to J.A. King, Minister of Interior:

> ...Gov't. remnants Oneloa, Laepaoo & Ahalanui, Puna. I enclose communications just come to hand from R. Rycroft re. The same. Your Ex. will please note that though frequently requested by him to survey the aforesaid tract, I could not properly do so without first receiving instructions from your department, although he verbally to me accepted the proposition made him by the Gov't. in December 1891 to the effect that they would put up the land at auction at the upset price of $500, with the understanding that he was to pay the costs of survey...

Hawaiian Agricultural and Subsistence Practices

In "Native Planter in Old Hawaii," Handy, Handy, and Pukui (1972) provide readers with descriptions of the practices of native Hawaiian farmers in the Puna region. As noted by Wilkes (cf. *Section IV*), and Loebenstein and Baldwin above, the land, though not richly soiled, was known for its agricultural production.

A walk-through of the coastal portion of the study area and *mauka* in the land of 'Ahalanui, on the Pū'ala'a boundary, still provides visitors with examples of ancient and early historic period agricultural features. On a January 15th, 1998 site visit with botanists Sam Gon III and Joel Lau, remnant plantings of the *pia* (the arrowroot – *Tacca leintopetaloides*) were observed among various walled planting features (*Figure 15*). This is an interesting find, as *pia* is not a hardy plant, and generally disappears when left untended.

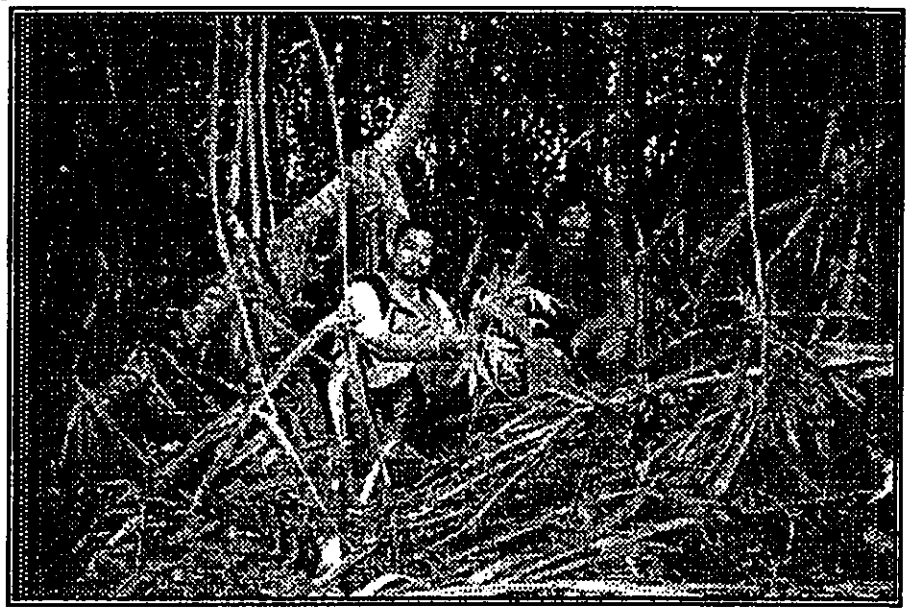


Figure 15. Pia (Tacca leintopetaloides) Growing at 'Ahalanui (Sam Gon III and Joel Lau in the field)

Discussing agriculture in Puna, Handy *et al.* observed that in the upland forests of the region, there was rich humus, and in such areas (like the older section of ʻAhalanui—the Hale-o-Lono a cultivating ground) patches of the forest were opened (Handy et al. 1972:103). The authors explained:

> Holes about nine inches deep are dug in the soul just large enough (about 9 to 12 inches across) to take two [taro] cuttings. With rootlets already sprouting, the cuttings are dropped into the holes and left uncovered until they have begun to root vigorously. The holes are then filled with earth and the taros are straightened when the first two leaves (*lau paʻi*) have unfurled. Then the whole field is covered with a mulch of fern leaves, or rubbish in general... In Puna and Hilo, where it rained during all seasons, dry planting may be done any time... [Handy et al. 1972:103-104]

Handy et al., also described a particular type of planting that was apparently unique in the south-eastern portion of the Puna District; a method that made use to the abundant growth of *pū hala* (pandanus trees). Joseph ʻĪlālāʻole, an elder relative of Mary Pukui's noted that, in certain area, wholes would be made in the *ʻaʻā*, by clearing out selected stones. Mulching material would be placed in the wholes and allowed to rot. Then young *huli* (taro cuttings) would be wrapped in *lau hala* (pandanus leaves) and placed in the mulched holes. After leaves began to appear on the *huli*, a sign that rooting had occurred, large branches of the *hala* trees would be cut and placed over the planting holes. These branches with the *lau hala* attached covered everything in the planting field, including the young *huli*. After the *hala* dried, a fire would be lit, burning off all of the leaves. The *huli* would remain undamaged and the ashes provided the new taro growth with all the nutrients needed for the growing season. This method of planting was called "*pā-hala*" or "pandanus clearing" (Handy et al. 1972:104-105).

Describing the lands in and neighboring the study area on the northeast and southwest, Handy et al. wrote:

> The fern-covered plains between the forest and seacoast in northeast Puna used to be planted in taro by the burning-over, digging up, and planting process...On the outer slopes of Kapoho crater there were a few dry-taro patches in 1935. Inside the valley made by the craters are now many old breadfruit trees...The wet and sometimes marshy pandanus forests from Kapoho through Poho-iki to ʻOpihikao used to be planted with taro in places [as well]...Seven miles inland from Kapoho through Malama to Kamaili [passing to the southwest of the study area], there are steep slopes largely covered with rich soil. These slopes are now mostly in sugar, but anciently were planted throughout with taro. That this was ideal taro land is demonstrated by the flourishing plantations still maintained by several Hawaiian families in the Malama homestead area... [ibid.:540-541]

As noted in several locations above, one of the important native crops in this region of Puna was the *ʻawa* (*Piper methysticum*). In the mid 1800s, Hawaiian historian S.M. Kamakau (1976) wrote :

> *ʻAwa* was one of the choice foods of the planter. *ʻAwa* is a handsome plant, with nicely rounded leases and stems and shiny jointed sections... *ʻAwa* grows well on lands with plenty of rain, and on warm lands... From of old

there are places made famous by the intoxicating quality of their *'awa*, such as...Puna on Hawaii. In places where *wauke* and dry taro are planted, *'awa* may also be planted. These plantings together with those of bananas and sugar canes, were the pride of the farmer [Kamakau 1976:41].

Tradition relays that the gods Kāne and Kanaloa brought the *'awa* to Hawai'i from Kahiki, and planted it various localities. In places where no water could be found with which to prepare the *'awa*, Kāne even caused water to appear, thus forming many springs and streams in the islands (cf. Kamakau 1961:193 & Handy et al., 1972:189). The *'awa* was important as an offering in rituals, used in ceremonies, and in general use among the people of the land. Kamakau wrote:

> *'Awa* was a refuge and an absolution. Over the *'awa* cup were handed down the tabus and laws of the chiefs, and the tabus of the gods, and the laws of the gods governing solemn vows and here the wrongdoer received absolution of his wrongdoing... [Kamakau 1976:43]

Through prayers and offerings of *'awa*, the ancient people sought to ensure the well-being of the native population. Planters offered *'awa* to ensure the success of future crops, and the fishermen did so, to ensure bountiful catches (ibid.:43-44).

In the traditional period (pre 1800), many sayings were used to describe the rich and potent growth of *'awa* in Puna. In the recently translated legend of Ka-Miki, cited earlier in this study, are several descriptions of Puna's *'awa* and its effects on those who drank it. We find that Kali'u, just inland of the study area, was praised for it's growth of *'awa* in chant:

Mūkīkī wai 'ale lehua a ka manu	The birds sip the nectar of the *lehua* blossoms
O ka 'awa 'ili lena i ka uka o Kali'u	(Above) The yellow barked *'awa* which grows in the uplands of Kali'u
O ka manu 'āha'iha'i lau 'awa o Puna	It was the birds who carried the *'awa* to Puna
Aia i ka uka lā'au ka 'awa o Puna	The *'awa* grows there in the uplands of Puna
Māpunapuna mai ana ko aloha io 'u nei...	Your love stirs within me...

[In *Ka Hōkū o Hawai'i* May 20, 1915]

One of the varieties of *'awa* which grew in this region, was also famous, because it reportedly grew in the branches of trees, and is commemorated by the saying:

Ka 'awa 'ili lena a ka manu i kanu ai iluna o ka lā'au

The yellow skinned *'awa* planted by birds atop the tree branches. [ibid. Oct. 21, 1915]

The *'awa* was also evidently so potent that drinking it caused one to become intoxicated as with no other *'awa*. It brought about:

> ...a comfortable sleep nestling the drinker in the gentle whisper of the sea of Kōloa, Puna; [the sea] which caresses the *hinano* (pandanus) grove and the fragrant pandanus flowers of Kea'au...And perhaps one might dream of

Hōpoe the woman who gently moves, dancing in the ocean spray of Hā'ena.
[ibid. June 22, 1916]

Puna: A Community in Transition

As was the case throughout Hawai'i, the nineteenth century brought with it significant changes in the Hawaiian community in Puna. The writings of both natives and foreign visitors from ca. 1864 to 1930 provide readers with both compelling and entertaining descriptions of circumstances in Puna. The selected excerpts from some of these accounts, help to fill in further details on the community, which have been already introduced under preceding titles in this section of the study.

The first account was written by J.W.H. Kamohai, who visited the Kula-Kapoho vicinity of Puna and saw first hand, some of the famous places that he had only heard of, and apparently not believed to be true:

Not to be Mistaken Again!

On the 3rd of February, 1864, we went to Hilo and then to Kula, Puna on the 5th. We stayed at the house of one of the natives there and on the 7th, I went to see Waiakaea and Kamiloholu. Waiakaea is a fishpond and Kamiloholu is where the *milo* trees encircle the edge of the fishpond with the leaves (falling) within the pond. Thus, it is called "Kamiloholu at Waiakaea," and it is a famous place. Traveling to the left of Waiakaea there is a great amount aa along the trail, by which one reaches to Kumukahi. The nature of this place is one with mounds of *pahoehoe* and *aa*. At this place, there are two jagged stone cairns. One stands on the eastern side and the other on the western side. One mound is to the east, that is the side from which the sun rises; and another mound is on the western side, where the sun sets towards Lehua. Each one looks to be about 6 feet tall. I asked one of the natives, "Is this Kumukahi?" To which the native answered, "Yes!" So I then composed this little song:

Ma kai au o Puna i hele ae nei,	I traveled to the shore of Puna,
Kau pono ana ka la i Makanoni.	Where the sun sits directly over Makanoni.

I thought to myself, "So this is Kumukahi, and the mounds of *aa*." I went to the northeast and came to Haehae. Haehae, is like a pond and beyond it, one can see Makanoni set out there. It is a stone that is there in the ocean, and its length is about 3 cubits. On the 11th, I climbed up to the diving place at Waiwelawela. The nature this pond is that it is very clear and when you enter the water, your skin glistens like that of the people of Africa. This pond is there on the shoreward side of *ala loa* (trail) on the southeast of Kukii. I then looked and saw the fluttering of [the stone] Pohakuolekia and then went on to Waiapele where I saw the large pond. Based on what I saw, it is about 80 fathoms long and 30 fathoms wide, perhaps more. It is a yellowish pond there above Kula. Then on the 19th of that month I heard the call of the rain *huki-he'e nehu* of Hilo calling me to return, and on the way, I saw the *lehua* trees moving [spread out] upon the plain of Hopoe, and extending down to Haena. Thus bringing to mind thoughts of wonder upon

seeing Wahine-ami. The length of this stone [*Hopoe, ka wahine ami i ke kai*] is about like the height of a person and it is there in the sea. So finished is this account of the new things I've seen. [*Kuokoa* April 30, 1864:3/c3]

The second narrative was written by Robert Kahao, Kauaea, Puna, in it he speaks of some of the sites in the Kapoho-Kula area, and describes the difficulty of maintaining the churches in Puna:

Na Hiohiona o ka Apana o Puna nei
The Appearance of the District of Puna

The nature of this land is good, and it is extensive. The great problem, given by God are the *a'a* and the great forests of *hala* and *lehua* trees. They are very difficult to penetrate. When visitors come to this land they sometimes speak despairingly of it, looking to the east, north and all around the district. But, within this district there are many *wahi pana* (storied place). The point of Kumukahi is in this district. It faces directly to the portals of the sun. And many visitors travel to see it. It is also there that you will see the two winds. The winds separate there, one wind blowing into Puna and another wind blowing into Hilo.

Also here, are Waiakaea, Kukii, and Kamiloholu, and atop the hill [Kukii] is the *heiau* of Umi, that may still be seen to this day. Waiapele is also here. It is a mysterious pond. The water is like the urine of a pig, greenish, with an unpleasant odor. But the really peculiar thing about it is that when the thunder claps, all of the fish in the pond die. It is also in this district that Kamapuaa mated with Pele following the end of their battle. There also is Nakiokanu, the reclining coconut trees of Kalapana, and the dancing woman Hopoe.

About the Churches–There are six churches in the district, two Catholic and four Protestant.

About the fish–There are great quantities of *opelu* fish. In one day, six *lau* [2,400] can be caught.

The nature of work being done for God–The work of God moves slowly in this district. The brethren go to church, but do not contribute to the well being of the minister. At Opihikao they do not properly care for the minister, and he does not even have a house for his family. The church at Pu'ula is without a minister. Because of the lack of care Rev. Hanu left to go work the *pulu* harvest at Kau. Thus, the church has been left in great distress. Therefore I ask all of you church members from Hawaii to Niihau, not to be like these churches. [*Ku 'Oko'a* Dec. 7, 1873:3/c2]

In 1875, Henry M. Whitney, Editor of the Hawaiian Gazette, published a "Hawaiian Guide Book." The publication was produced as one of the early promotional guide to encourage visitation to the Hawaiian Islands, and included descriptions of the islands, harbors, agriculture, plantations, scenery, volcanoes, climate, population, commerce, and places to stay while visiting. His publications of 1875, 1890, and 1895 provide readers with interesting commentary on the district of Puna, and of particular interest to this study, he describes the endeavors of J.E. Elderts and R. Rycroft. *Figure 2* (Reg. Map 1777) provides readers with

the locations of sites described by Whitney. It will also be noted that in the 1895 guide, Whitney transposed the names of Kapoho and Pohoiki (fixed in square brackets by the author of this study). The author here, also posits that Whitney's description of the Pohoiki community actually includes the residences of the Oneloa to 'Ahalanui area. His narratives described the scattered houses of the various villages, and his description of Rycroft's business interests, were likely the primary employment of residents in the Pohoiki-'Ahalanui region.

To The Volcano Kilauea [1875]

> ...Two routes may be taken to the crater Kilauea, on the slope of Mauna Loa, one by Puna, the other by Olaa. It will be advisable to combine both, by going one way and returning the other... [Whitney 1875:78]
>
> The Puna route leaves Hilo by way of the bay beach, through cocoanut groves, bamboo thickets and fish ponds across the Waiahuma [Waiolama] and the Waiakea bridge, through the bread-fruit orchard, out of Hilo village into the uneven pasture land of Waiakea, whose broad acres soon become thickly set with the pandanus (screw palm), and after four or five miles enters the forest that stretches from the ocean to the limit of vegetation on Mauna Loa... [ibid.:79]
>
> Twenty-five miles of fair riding will carry the traveler to the comfortable ranch of Capt. Eldarts, who entertains guests for a reasonable compensation. This vicinity is noticeable for the ancient *heiau* upon a palm crowned cone [Kukii]; for a fresh water reservoir in an extinct crater [Waiapele]; for a hot water cave; and for an open stone basin, below a lofty cliff which contains a pool of warm, blue water that sparkles when stirred [Waiwelawela]. The temperature is so delightful that a half hour's bath is delicious. The greatest depth is not less than 18 feet, and the water is so buoyant as to make diving difficult. This section of Puna is quite fertile, whenever soil for cultivation can be found. Bread-fruit and cocoanuts are abundant. After a good rest at Eldart's the route continues over a vast tract of rough lava, on which the *ohia* woods are beginning to secure firm and permanent hold; the sea is skirted by successive rows of cocoanut trees, some so thickly planted as to hide the ground from the rays of the sun. Eighteen miles of road rough and smooth, volcanic scenery variegated by bread-fruit, guava, *ohia*, pandanus and cocoanut trees, and interspersed with miniature churches and grass houses, ends the journey at Kaimu, near the sea, where comfortable quarters for the night may be obtained at a native house...[ibid.:78-79]

District of Puna [1890]

> ...Some 18 miles from Hilo the country begins to improve, and away from the main road, upon the slopes of the mountain there are many acres of excellent land, suitable for coffee and fruit growing. The south eastern part of Puna has some celebrity for its groves of cocoanuts, the trees being more abundant here than in any other part of the islands. The traces of volcanic action are extremely prominent in this district, flow after flow of lava from the disintegrated ones of ages past to those of a comparatively recent date are to be found. The most striking flow is that of 1840, which after pursuing

an underground course for many miles suddenly burst forth in the woods and rushed down to the sea, overwhelming a small village in its course. During the great earthquakes of 1868, the southern coast of Puna was lowered. Traces of this may be seen in the stumps of cocoanut trees which are left sticking up amid the constant surf.

The tourists selecting to go through Puna should obtain letters for either Kapoho or Pohoiki, where the first night would be spent, and for Kaimu, which should be the second stopping place.... [Whitney 1890:64]

Kapoho, twenty-three miles from Hilo, is a ranch occupied by Captain Eldart, an old pioneer. The position of the ranch buildings is quite picturesque. Behind, or *mauka* of the ranch, are a group of volcanic cones, embosomed in the lower of these is the famous Green Lake [Waiapele]. The water of this lake has always an olive green tint. It occupies a circular basin, the tides [sic? – sides] of which rise at a slope of forty-five degrees. Around the edge are cocoanuts, guavas, bananas and other trees and shrubs. In 1868, when the coast sank some four feet, the water in this lake rose just that height. Before that time it was possible to walk round the edge, but the former beach has sunk beneath the surface, and those desiring to reach the other side must now swim for it... [ibid.:65]

About a mile *makai* or seaward of Kapoho ranch is a warm pool or spring [Waiwelawela]...The water is pleasantly warm, not hot. It has the curious property of making the skin look like alabaster. Constant bathing in this pool is said to be very good for rheumatism. The hill or mound [Kukii], at the foot of which this spring lies, is of itself a curiosity. On the top are the foundations of a temple made of the most accurately dressed stone. It was built in two terraces and a long flight of steps must have approached it from the lower portion of the mound. The stones are well made but set together without cement. This was the site of a fishing temple. It commands a magnificent view. Due east is Cape Kumukahi, north and south stretches the open sea, while west lie the slopes of Maunaloa, the foreground relieved by the broken mass of craters, among which is embosomed Green Lake. On the cape are numerous heaps of stones each representing the work of an Hawaiian Sovereign. The most recent have of course been erected by King Kalakaua and Queen Kapiolani.

At Pohoiki three miles from Kapoho is another cattle ranch. A saw mill has also been established here and a quantity of lumber is exported to Honolulu. The place is the property of the Hon. M. Robinson, and is in charge of Mr. R. Rycroft.

From hence to Kalapana the road presents varied scenic beauties and the traveler has an opportunity of seeing the Hawaiian in his villages away from any foreign influence. After leaving Pohoiki there is no white family resident till the Volcano House... [ibid.:65-66]

[1895] COFFEE DISTRICT. – A number of coffee planters have located in this vicinity, and groves of coffee trees may be seen every few miles. Among those engaged in this business, are Mr. Gowdie, at Waikahiola [Waiakahi'ulā], Mr. R. Lyman near Pohoiki, and Mr. R. Rycroft. Each of these have fine healthy groves, numbering from 25,000 to 60,000 trees. It is

probable that during the next year or two, several hundred thousand coffee trees will be growing in this vicinity. At Pohoiki [sic – Kapoho] three miles from Kapohoiki [sic – Pohoiki] is Mr. R. Lyman's cattle ranch [formerly Elderts', Kapoho Ranch]. At Kapoho [sic – Pohoiki] a saw mill has also been established, and a quantity of lumber is exported to Honolulu. The place is the property of Mr. R. Rycroft [see *Figure 12*]...From hence to Kalapana the road presents varied scenic beauties and the traveler has an opportunity of seeing the Hawaiian in his villages away from any foreign influence. After leaving Pohoiki the villages are all small , the houses being scattered irregular along the road. Opihikao is about five miles from Pohoiki, and Kaimu is some eight miles still further on.... [Whitney 1895:93]

Another article published in the 1890s, reported on an interview with A.B. Loebenstein, who surveyed much of Puna, including lands of the study area. Excerpts from that interview provide readers with a first hand account of the landscape and features seen in the district.

WONDERS OF PUNA

Mr. Loebenstein Gives a Few Pointers on the District

IT WILL FETCH TOURISTS

Thousands of Acres of Coffee and Tobacco Land–Ancient Burial Caves of Hawaii–Pit Craters and Tree Ferns–A Monster Petition for a New Road.

Mr. A.B. Loebenstein, who has been in town for the past few days, has for a long time been engaged in making surveys in Puna, and has acquired in consequence a more thorough knowledge of that district than perhaps anyone else in the group... Asked his opinion on the agricultural resources of Puna.

Mr. Loebenstein said: "There is an extensive acreage in Puna suitable for cultivation of different products, particularly of coffee and tobacco."

"How much is there of it?" asked the reporter. "Well, it is scattered... Sometimes there are large tracts and sometimes pieces of a few hundred acres only. Twenty-two miles from Hilo, by the new road survey above Kapoho, on the lands of Rycroft and others, there must be 10,000 acres of the finest coffee land. This land can't be plowed–it is rocky, but very rich. Most of the good lands are covered with a dense forest, but here and there are open spots called *kipuka*, covered with a growth of the *ki* plant, tree-ferns, sugar cane etc., which are patches cultivated by the natives in ancient times, and were called by them "*kihapai*" and "*mahinaai*."

"What do you think of Puna as a coffee district?"

"It is the coffee district... The climate is dry and the drainage perfect. It is good for tobacco too... There is plenty of tobacco growing wild, which has received no cultivation for years. It grows where the soil is very thin, in crevices of stone walls and rocky localities..." [Hawaiian Gazette , March 22, 1892]

In 1894, Robert Rycroft himself wrote an article on coffee cultivation on his Pohoiki-Oneloa and vicinity lands, and about developments in the community. Excerpts from his article, published in Paradise of the Pacific (August 1894) are included here, as they help describe the community and changes which were underway at the time.

Coffee Culture in Puna, Hawaii

> The cultivation of coffee in Puna is still in its infancy and it will remain in its present state until a good road runs through the district. The surveyed line of the proposed "new road" is about three miles from the coast... [cf. Loebenstein, July 20, 1891, above] If this road is built it will open up a large area of coffee land that is now inaccessible. Then again, good landings are scarce in Puna, there being but two, viz., Keauhou and Pohoiki, but notwithstanding these drawbacks there is more or less evidence of moving forward on the part of the people, and new places are being started with a view to raising coffee...
>
> William Gowdie has two hundred acres in Wakahiola [Waiakahi'ulā], and is going ahead as though he meant business. He has twenty men on his roll, and at this writing they have cleared about fifteen acres...Mr. Gowdie's Chinese are now clearing it under contract. Then there are four foreigners who are located on Government homesteads who own trees, now about two years old. The Natives in the vicinity have more or less coffee. All of these places are on the line of the proposed road...
>
> Mr. Lyman, who is located three miles to the east of Pohoiki, and about one and a miles from the sea-coast, is also planting and has quite a lit of coffee in, and all of it is looking well. At Pohoiki we are more advanced than any other portion of the district. Our planting place is situated about three miles from the beach, at an altitude of four hundred and fifty or five hundred feet. We have about thirty-five acres planted, about one-half of which will bear light crop this year... I have cleared about twenty more acres of land and will soon fill it up with some very fine nursery places... [Rycroft 1894:99]

Rycroft died on February 3, 1909, in Honolulu, where he had relocated. His obituary, in the Honolulu Advertiser provides us with a closing chapter in Rycroft's Pohoiki-vicinity agriculture ventures. Rycroft first came to Hawai'i in 1859, when he was 16 years old. After staying for several years, he left for Australia, returning in 1877. At that time, Rycroft moved to the island of Hawai'i, Pohoiki, where he went into the *'awa* shipping business. He did well in this and took up land, going later into the cattle business (Honolulu Advertiser Feb. 3, 1909:5). The notice then reported:

> He was one of the first to start coffee growing and planted three hundred acres in lower Puna, but this venture was not a great success and he sold out his Puna holdings to a sugar syndicate. He had so much faith in the future of Puna as a sugar raising country that he took a large amount of stock in the new company [Puna Sugar Company] and came to Honolulu in 1899... [ibid.]

Schools and Churches of 'Ahalanui and Pohoiki

Of interest to the 'Ahalanui study area, are records of the lot set aside for a school near the shore of 'Ahalanui. Based on Government records, it appears that while the lot was confirmed, a school was never opened there. Tax records indicate that prior to the Māhele of 1848, the area school was at Pū'āla'a, but by 1853, it had been, or was in the process of being moved to Pohoiki (cf. pages 42 & 44 of this study). It may be recalled, that in writing of his travels through the Puna District with Titus Coan in 1846, Lyman (1924) stated that the church of the area was at Pohoiki. He also recorded that approximately 200 people from around the area had gathered for the service, but the population appeared older to him, than that of other areas he had visited (Lyman 1924:96). In his own writings, Coan recorded that it was not until 1868 that the first of the Puna churches with a native pastor, became established. And in 1869, two other Puna churches with native pastors were established (Coan 1882:136). Though not named, it is likely that these churches were Pū'ula, 'Ōpihikao, and Kalapana. (See letter of Rev. William Kama'u, below; observing that the pastor of 'Ōpihikao also held services at Pohoiki.)

As noted in *Sections IV & V*, from the period of western contact, throughout the nineteenth century, the population of Puna was in continuous decline. Schmitt (1968) reports that in 1860, the population of Puna totaled 2,156 people, but by 1890, there were only 834 people (Schmitt 1968:71). Interestingly, in 1896, the population throughout the island, including the district of Puna began to increase (ibid.). Rather than reflecting a growing Hawaiian population, this increase reflects new policies of plantation immigration following the overthrow of the Hawaiian monarchy. Thus, it is unlikely that the increase in Puna's population which began in c. 1896, had little immediate effect on the Pohoiki-'Ahalanui vicinity.

Records from the Hawai'i State Archives, Public Instruction files provide readers with documentation of the changing community of the Pohoiki-'Ahalanui community by the turn of the century. Among the records, is the following documentation (see *Figure 2* for location of church and school lots).

On October 14, 1907, W. Babbitt, Superintendent of Public Instruction wrote to Theo. Richards, Esq., of the Hawaiian Evangelical Assoc., regarding the church and school at Pohoiki. He reported:

> I have learned that the church was broken down about six or seven years go. There is no church there now. The only buildings standing on the lot are small huts that belong to some fishermen. [Hawaii State Archives, Public Instruction, Folder 261]

On October 18, 1907, Theo. Richards responded to W. Babbitt, writing:

> As the people of the church in that community claim to have services it is possible that these fishermen's huts of which you speak are used for services. I am referring, however, your letter to those people who were at one time intensely interested in this matter... [ibid.]

Responding to a communication from Richards, Reverend William Kama'u (an elder relative of the Mākuakāne family, members of which still tend to the 'Ōpihikao Protestant Church), wrote:

> *Aloha oe;*
>
> I have received a letter from J.P. Kuaioholani asking me to answer you with reference to the church and school land at Pohoiki, Puna, Hawaii. I am of the opinion that the land belongs to the church and here are the facts:
>
> (1) In 1886 I came to Puna and became a preacher for three months of the United churches of Kalapana and Opihikao and this church site at Pohoiki then belonged to the church of Opihikao.
>
> (2) In the year 1887 I became a regularly installed pastor of the United churches of Kalapana and Opihikao and it was my regular duty to go on Sunday to Pohoiki for six years. I do not remember any school house or any teaching there. I lived as pastor from March 1888 to September 1904 and at all that time there was no school house at Pohoiki.
>
> (3) The church has been standing there and services have been continually held although the church itself has rotted out of existence, - since 1901. I sold the old lumber for $25.00 to J.P. Kuaioholani and he has the money at the time of my writing. The purpose was to build again the church at Pohoiki. The following sums were received.
>
> | | |
> |---|---|
> | William K. Kalaiwaa | $ 15.00 |
> | J.P. Kuaioholani | 25.00 |
> | W. Kamau | 10.00 |
> | | $ 50.00 |
>
> As this work has come under the charge of J.N. Kamoku I left the matter of collection at Pohoiki.
>
> (4) J.P. Kuiaoholani built on this site a summer house not however with the idea of taking the site from the church. Mrs. Kuaioholani and all her family are members of this church and she very greatly aids in the good cause therefore I granted them this permission. The time will come to build again the church on this site at Pohoiki. There are standing here a boat house of Mr. R. Rycroft's and a ware house for Mr. C.L. Wight. On this same site also is a wharf for receiving freight of R. Rycroft. In all there are about four houses standing on this site. Two of these people built at their own risk but Kuaioholani on account of my giving permission.
>
> What is this agitation of the Board of Education? Look up the law concerning church and school house. They have held services constantly at Pohoiki and at the house of Kuaioholani when they had no other house of worship. What does the Board of Education wish? I do not understand what they would like to do.
>
> With kind regards. Signed W. Kamau [ibid.: Nov. 19, 1907]

He Huaka'i Māka'ika'i—A Site-Seeing Journey (1929)

One of the few articles written which specifically mentions a land in the study area—'Ahalanui—was written by George K. Kāne in the Hawaiian language newspaper, *Ka Hōkū o Hawai'i*. The article series titled "*Huakai Makaikai a ike i ka He o kou Kupunawahine Aloha o Mauhonua Lapuwale*" (A Site Seeing Journey to see the Grave of my beloved grandmother Mauhonua Lapuwale), ran from September 10th to December 17th, 1929. In his introduction, Kāne reported that though he was born and raised on Kaua'i, his beloved grandmother, Mauhonua, had been the wife of Lapuwale, the *konohiki* of Ahukini, Kea'ā, and Kamā'oa, Ka'ū, under Kamehameha I, and his family originated on the island of Hawai'i.

Excerpts from this article have been cited in several earlier ethnographic and archaeological studies of the Puna District, with the article cited as "anonymous." This is not the case, a review of the Hawaiian texts offers "*Kakauia e George K. Kane*" (Written by George K. Kane). Also, it has been previously reported that the name of the *ahupua'a* mentioned in the article was written "Aa-hala-nui" (cf. Barrère 1959:32); this also, is not the case[13]. Below, is a verbatim transcript of the original Hawaiian text, and a translation prepared by the author for the area of immediate interest to this study:

> *...hala mai la hoi o Kapoho, a ia hele ana aku ma keia wahi, he pololei ke alanui a aole hoi nukee i ke kapakahi, he pololei wale no a o keia o na alanui ui o Puna, a ia hele ana mai la au a loaa ia oe o pahoehoe Kuaokala, he heiau hoi keia makai o Ahalanui, na puu hoi o Kalehua mauka, a loaa mai la oe o Pohoiki he awa pae keia i ka wa o na moku pea kuna e holoholo ana ma keia mau kai... O keia kekahi wahi kaikuono nani, a he oluolu nae ke kai o keia wahi ma ka'u nana aku, a o ka mea kupaianaha he kakaikahi no na wahi hale, aole hoi o'u i ike aku i ka nui o na wahi hale, ua paa paha i ka nahelehele...* [George K. Kane In *Ka Hoku o Hawaii*, Oct. 15, 1929]
>
> ...having passed Kapoho, traveling in this place, the road is straight, with nothing causing one to go astray, or off to the side. This is the straightest section of the beautiful roads of Puna. Traveling as I did, you will come upon the *pahoehoe* [stones of] Kuaokala, a temple near the coast of Ahalanui, with the hills of Kalehua to the inland. Then you arrive at Pohoiki, which was the harbor, at the time when the sailing schooners plied these waters... As I've seen it, this is a beautiful bay with pleasant waters, but the amazing thing is that there are few homes. I did not see many places with houses, perhaps they are surrounded by shrubbery...

By the articles and letters cited above, we begin to see the nature of the community in the late 1800s and early 1900s. The Hawaiian families worked at trying to maintain their community. Some native families in the Pohoiki vicinity tried to enter into coffee cultivation, and worked at gaining a livelihood from the land. The closure of Rycroft's operation, selling of his land interests, and shifting economic development (with plantation operations focused in the Pāhoa to Kapoho vicinity), probably had a significant impact on the remaining native residents. The necessary incomes, with which to pay property taxes,

[13] Dorothy Barrerè (1959) cites the original translation as done by M.K. Pukui. It is possible the Tūtū Kawena wrote the name–Aa-hala-nui–as she heard it spoken earlier by natives of the area; thus "correcting" the spelling–Ahalanui–used by the author of the 1929 article.

maintain a residence, and pay for various living expenses were tied to jobs that were removed from the small 'Ahalanui-Pohoiki community. The result being that more families left the area. While families maintained attachments and short-term residences on the land, for the most part, by the 1920s, only a few full time residents remained in the 'Ahalanui-Oneloa area.

Overview of Historic Archaeology

The most recent archaeological study conducted in the 'Ahalanui-Laepāo'o-Oneloa study area was conducted by PHRI in 1990-1991 (Dunn *et al.* 1995). The PHRI report includes a detailed overview of archaeology in the district of Puna, and review of findings for the immediate study area. Rather than repeat that information here, this section of the study provides an overview of findings reported in historic studies, and lists the types of sites discussed in the historic documentation cited above. The PHRI report should be referenced for further sites specific information.

The earliest report on archaeological features on the island of Hawai'i, was compiled by Thos. Thrum (1908). Thrum work was the result of a literature review and field visits. Thrum listed one *heiau* each at Keahialaka (Mahinaakaaka), Pohoiki (Oolo), and in the Kapoho vicinity (Kukii); no sites were identified in the study area (Thrum 1908:38-40). In 1906-1907, J.F.G. Stokes conducted a field survey of *heiau* on the island of Hawai'i for the B.P. Pauahi Bishop Museum (Stokes and Dye 1991). Like Thrum, Stokes did not record any sites in the present study area. Stokes did record that local information indicated that Mahinaakaaka was "dedicated to Kamehameha's god Kā'ili," and used for human sacrifice (Stokes and Dye 1991:151). Stokes repeats the information regarding the association of 'Umi-a-Līloa with the *heiau* of Kūki'i, in the land of Kula, near Kapoho (as cited in historic accounts earlier in this study). Though he adds another account, stating that it had built by Pāka'a, and used for "poisoning" (Stokes and Dye 1991:152).

In between 1929 to 1932, A.E. Hudson conducted an archaeological survey of sites from Hāmākua to Ka'ū, on the island of Hawai'i for the Bishop Museum (Hudson ms. 1932). The study has remained in manuscript form since 1932. While it is noted as having weaknesses, Hudson collected information on some sites from area residents, who are no longer living, and he collected documentation that would otherwise have been lost. The following narratives are among the observations Hudson made regarding archaeological features in Puna:

> [paraphrased] Cracks in lava flows are often filled with stones and boulders in Puna and Ka'ū, and many such filled cracks were used to conceal burials [Hudson ms. 1932:301]
>
> The region around Kapoho was well known for its *holua* slides for which the steep slopes of the numerous cone craters were well adapted [ibid.:332]
>
> Site 109. *Holua* slide; in the land of Pualaa about 1500 feet east of the railroad and midway between the north and south boundaries of the land of Pualaa... [ibid.:334]
>
> Site 110. In the vicinity of the *holua* slide are former agricultural patches marked by piles of stones cleared from the small plots.

> Site 111. Among the agricultural patches are a number of areas averaging 15 feet by 4 feet which are outlined on three sides by a rectangular border of stones. The open side is always the short dimension of the area... [ibid.:336]

Lower Puna to Pulama

> The southern part of Puna district offers more favorable conditions for archaeological investigation that any other of the regions examined...A large part of the region is semi-arid or covered with lava flows... Furthermore there is still a numerous Hawaiian population whose ancestors lived in the same locality so that it is relatively easy to obtain information about particular sites... [ibid.:337]
>
> The whole coastline and particularly the northern part around Kapoho is subject to marked seismological changes. Brigham (13, p. 112) quotes a letter from Coan of August 1868 explaining that after the earthquake of that year the "...subsidence along the coast of Puna, from the east cape at Kapoho to Apua on the western line, is four to seven feet..."
>
> ...A further subsidence, though limited to the area around Kapoho, occurred in April, 1924. Jaggar (42, p. 20) describes a new lagoon at Kapele which appeared at this time as extending 200 feet inland and being from 6 to 8 feet deep... [ibid.:338]
>
> The population, as elsewhere generally, lived mostly along the coast. A few sites (204 to 215), were found two or three miles inland but they may not have been inhabited permanently... [ibid.:339]

Hudson spends some time describing features in the coastal portion of Kapoho, and then moves to Pōhakupala point in Pū'āla'a, where he reports:

> Site 144. Near the large brackish pool a hundred yards from the beach at Pohakupala is a roughly built platform 16 feet square. [ibid.:364]

Entering the 'Ahalanui-Laepāo'o-Oneloa study area (by location in text, without mentioning the *ahupua'a* names), Hudson identifies the following sites:

> Site 145. Three quarters of a mile Northeast of Pohoiki an area about 24 feet square on the rough boulder-strewn beach has been cleared of stones. The beach is nearly level at this point and the spot may have been a house site without the usual platform.
>
> Site 146. Close to the site mentioned above is a triangular walled enclosure with poles laid across the top as supports for a roof. [ibid.:364]

Hudson then moves to Pohoiki, citing Thrums notation on the *heiau* called Oolo; noting, "None of my informants in the neighbourhood could give any information about it" (ibid.:365). He then reports:

> Around the boat landing at Pohoiki and for some distance up and down the coast are evidence of former extensive occupancy. The lines of old walls can be followed although the stones have been removed and there are traces of former platforms and paving on the beach. [ibid.:366]

In specific reference to sites within the lands of the study area, we find two historical references that of particular interest: (1) the *heiau* Kuaokalā; and (2) the agricultural field of (Ka)Hale-o-Lono:

(1) *Kuaokalā* — other than the information recorded in the 1929 article in *Ka Hōkū o Hawai'i*, identifying the site as a *heiau* in Ahalanui, no other information is known about it. The name may be literally translated as "Back-of-the-sun," and as such, one might expect that it has some function with the sun's travels, and possibly the god Kāne;

(2) By name, the *Hale-o-Lono* cultivating grounds of 'Ahalanui-Pū'āla'a are associated with the Hawaiian god Lono. The name may be literally translated as, "House-of-Lono" (a name associated with ceremonial functions). Not surprisingly, there are localities on all of the islands that are known by the same name. The name Hale-o-Lono is also a kind of *heiau*, of which David Malo wrote:

> When the people and the priests saw that their services of the *luakini* [*heiau* of state] were well conducted, they had confidence in the stability of the government, they put up other places of worship, such as the *mapele*, *kukoea* [sic. *kūkoa'e*], and the *hale-o-Lono*. These *heiau* were of the kind known as *hoouluulu* (*hoouluulu ai*, to make food grow) and were to bring rain from heaven and the crops abundant, bringing wealth to the people, blessing to the government, prosperity to the land. [Malo 1951:176]

Stokes (Stokes and Dye 1991) observed that the:

> Hale-o-Lono, a house of the god erected on a designated site–his temple with its ancient altar. It was for procuring rain and raising crops. When there was famine in the land on account of drought, the king built this house for the purpose of supplicating the god for rain. [1991:31]

Thus, based on the association of Lono with agriculture practices and *heiau*, it is highly possible that the Hale-o-Lono cultivating grounds of 'Ahalanui-Pū'āla'a had, or have ancient ceremonial sites associated with them. Additionally, other types of cultural sites, and their associated uses have been documented in the preceding sections of the study. *Table 4* identifies sites that have been recorded in historic literature, for the 'Ahalanui-Laepāo'o-Oneloa study area.

One additional type of site should be mentioned here, *ilina* or graves. Though not specifically mentioned in historic documentation for the 'Ahalanui-Laepāo'o-Oneloa area, it was the general practice of those individuals who lived upon the land to bury their departed family members near their place of residence. Throughout the islands, many *kuleana* and grant land awards have *ilina* associated with them. Of this practice, Kamakau (1961) commented:

> In the old days the inheritance of the family burial place, the caves and secret burial places of our ancestors was handed down from these to their descendants without the intrusion of a single stranger unless by consent of the descendant, so that wherever a death occurred the body was conveyed to its inheritance. These immovable barriers belonged to burial rights for all time. The rule of kings and chiefs and their land agents might change, but

> the burial rights of families survived on their lands. Here is one proof of the people's right to the land.
>
> With this right of the common people to the land is connected an inherent love of the land of one's birth inherited from one's ancestors, so that men do not wander from place to place but remain on the land of their ancestors... [Kamakau 1961:376]

It is noted here, that as a result of the 1990-1991 archaeological work in the study area (Dunn *et al.*, 1995), fourteen confirmed burial features and five possible burial features were identified in the study area. Of that total number of sites, seventeen(+) *ilina* were identified—most within the land of 'Ahalanui, though two of the identified *ilina* are believed to be in Laepāo'o. Twelve *ilina* are associated with platforms, five (+) *ilina* were "laid out in caves" Four *ilina* were associated with residential complexes, and four others were single feature sites. Eight of the *ilina* were identified as being associated with the historic period (generally nineteenth century), five others were identified as being from the pre-contact, and one other *ilina*—in a cave—was of an indeterminate period (Dunn et al., 1995:86). For further documentation on historic sites and *ilina* within the 'Ahalanui-Laepāo'o-Oneloa study area, see *Section VI.*, titled "*Oral History Interviews...*"

Table 4. Cultural Sites and Site Uses identified in Historic Literature

Site Type	Time Period	*Ahupua'a*	Source of Documentation
Coastal House sites	17/18[14] 19th E/20th	Study area	BC BC, RPG, & Maps RPL
Inland House sites	17/18 19th	'Ahalanui/Pū'āla'a Study area	BC BC, RPG, & Maps
Canoe Landing	19th	'Ahalanui	RPG
Trails (& associated Features)	17/18 19th E/20th	'Ahalanui/Pū'āla'a Pohoiki/Oneloa	BC BC, RPG, & Maps RPL
Agricultural fields	17/18 19th	'Ahalanui/Pū'āla'a	BC BC, RPG, & Maps
Coconut, Breadfruit, and/or Pandanus Groves	19th	'Ahalanui/Pū'āla'a Pohoiki/Oneloa	BC, RPG, & Maps
Waterhole	19th	'Ahalanui/Pū'āla'a	BC, RPG, & Maps
Stone walls	17/18 19th	Study area	BC, RPG, & Maps
Ahu or stone cairns	19th	Study area	BC, RPG, & Maps
Government Road	19th E/20th	Study area	BC, RPG, & Maps

[14] Table Key – 17/18=1700s-early 1800s; 19th=mid to late 1800s; E/20th=Early 1900s;
BC=Boundary Commission; RPG=Royal Patent Grant; RPL-Right of Purchase Lease

A & O International, Oneloa Development has committed to preservation-in-place of all burial sites, as well as the preservation of all other cultural and historic sites within the ʻAhalanui-Laepãoʻo-Oneloa project area. The natural and cultural landscape of the Puna region are seen as unique and integral parts of the area and the proposed project (pers comm. David Matsuura, March 25, 1998). For further information on preservation, restoration and interpretive-educational programs, see the archaeological mitigation plan (Walker 1998), in the EIS, which lists the mitigation measures, and the Development Agreement in the EIS, submitted for approval with the General Plan Amendment and rezoning application request.

VI. ORAL HISTORY INTERVIEWS – 'AHALANUI, LAEPĀO'O, ONELOA AND EASTERN PUNA (1997-1998)

Overview

This section of the study presents readers with oral historical accounts of individuals who lived in or near the lands of the 'Ahalanui-Pohoiki study area from ca. 1913 to the present-day. The oral historical component of this study was conducted in an effort to gather traditional and historical narratives, and documentation of the continuation of cultural attachment and on-going practices from knowledgeable individuals, familiar with the lands, cultural resources, and families of the *ahupua'a* of the study area and larger Puna region.

Oral historical studies of this nature seek to record information pertaining: to land-use; traditional sites; cultural practices; and to record traditional values, experiences, and events in the lives of both native Hawaiian residents and other individuals with several generations of residency in the lands of the study area. The interviews also sought to document past and on-going examples of the relationship of the coastal resources to the practices, beliefs, customs, and access practices of native residents (both past and present-day) and natural resources of the study area *ahupua'a* and larger Puna region. In the process of conducting the interviews, interviewees were also asked to record their concerns and recommendations for long-term protection of the cultural and natural resources of the 'Ahalanui-Laepāo'o-Oneloa study area.

Importantly, the interviews cited in this study, demonstrate that traditions of the land have been handed down through time, from generation to generation. They also provide both present and future generations with an opportunity to understand the relationships—cultural attachment—shared between people and their natural and cultural environments.

Readers are asked to keep in mind, that while this component of the study records a depth of cultural and historical knowledge of the Puna study area, this record is incomplete. In the process of conducting oral history interviews, it is impossible to record all the knowledge or information that the interviewees possess. Thus, the records provide us with only a glimpse into the stories being told, and of the lives of the participants. The author/interviewer has made every effort to accurately relay the recollections, thoughts and recommendations of the people who shared their *mo'olelo pono'ī* (personal histories) in this study.

As would be expected, participants in oral history interviews sometimes have different recollections for the same location or events of a particular period. The differences may be the result of varying values assigned to a history during an interviewees formative years, or they may reflect localized or familial interpretations of the particular history being conveyed. Also, with the passing of many years, sometimes that which was heard from elders during one's childhood 70 or more years ago, may transform into that which the interviewee recalls having actually experienced. It is noted here, that the few differences of recollections raised in the cited interviews are minor. If anything, they help direct us to questions which may be answered through additional archival research, or in some cases, pose questions which may never be answered. The diversity in the stories told, should be seen as something which will enhance preservation and interpretive opportunities in the 'Ahalanui-Laepāo'o-Oneloa study area.

Interview Methodology

The oral history interviews documented in this study were conducted between November 21, 1997 to July 21, 1998. Four primary interviewees, ranging in age from 85 years to 71 years old, participated in three interviews. The interviews were recorded on a Sony TCM-R3 cassette recorder, using TDK D90 High Output standard cassette tapes. A fourth limited interview was conducted for which hand written notes were taken and later expanded and returned to the interviewee for clarification and release.

The primary focus of the interviews was to elicit traditional information—knowledge handed down in families from generation to generation—and to document traditional values and practices that are still retained by the native Hawaiian families associated with the lands of the study area and neighboring *ahupua'a*. Interviewees were asked about their knowledge of sites or features which were associated with native families and cultural practices in, and neighboring the study area. During the course of conducting the interviews, several historic maps were referred to, and when appropriate, site names or locations were marked on the maps. *Figure 2* (at the end of this study) is an annotated interview map, including approximate locations of place names, natural features, and trails as recorded in the oral history interviews.

In order to facilitate collection of oral historical data, a general interview questionnaire was developed and referenced during the interviews (*Figure 16*). As various potential interviewees were contacted, they were told about the nature of the studies being undertaken, and asked if they had knowledge of traditional sites or practices associated with the study area, and if they would be willing to share their knowledge. In the process of identifying potential interviewees and in conducting the interviews, the author sought out individuals who:

a. Had genealogical ties to lands of the study area—were descended from families recorded as having early to mid 1800s residency ties to the land, or individuals descended from recipients of Land Grants from the Kingdom or Territory of Hawai'i (ca. 1850s to 1930s).
b. Were old enough to have heard first-hand from their elders some of the traditions, customs, practices, and beliefs of the native residents of the land (generally born prior to 1930).
c. Were identified by community members as possessing specific knowledge of lore or historical wisdom pertaining to the lands, families, practices, and land use activities in the study area.
d. were currently involved in cultural and/or natural resource stewardship activities.

Having completed the interviews, the tapes were transcribed and/or handwritten notes expanded, and draft copies of the interview transcripts were returned to the interviewees, for their review and input on corrections, modifications, and additions. Follow up discussions were then held with all of the interviewees who participated in taped interviews. The latter interview participant did not respond to further communications.

Figure 16. Oral History Interview Questionnaire

Question Outline for the 'Ahalanui, Laepāo'o and Oneloa Oral History Interviews

The following questions are meant to provide a basic format for the oral history interviews. The interviewee's personal knowledge and experiences will provide direction for the formulation of other detailed questions, determine the need for site visits, and/or other forms of documentation which may be necessary.

Interviewee–Family Background:

Name:_____ Phone #:_____

Address: _____

Interview Date:_____ Time:_____to _____ Location:_____ Interviewer:_____

When were you born? _____ Where were you born?_____

Parents? (father) _____ (mother) _____

Grew up where?_____ Also lived at? _____

Raised by? _____

- Additional family background pertinent to the Puna study area — e.g., generations of family residency in area... (time period)?

- Kinds of information learned/activities participated in, and how learned...?

Detailed Information—To Include Discussions of both Historic and Current Practices:

- Naming of the *ahupua'a* or sections of the land that are of particular significance in the history of the land and to native practices...?

- *Heiau* — Ceremonial sites or practices (for example – *kū 'ula, 'ilina*...)? Land based *ko 'a* (cross *ahupua 'a*) — ocean based *ko 'a*; *kilo i 'a* (fish spotting stations) locations and types of fish? Names of *heiau* and *ko 'a* etc.?

- Burial sites, practices, beliefs, and areas or sites of concern (ancient unmarked, historic marked / unmarked, family)...? Representing who and when interred ...?

- Fishing — describe practices (i.e., where occurred/occurring, types of fish; names of fishermen; and what protocols observed...?

- Historic and Current Practices — What was growing on the land during youth (planted and wild)? How was water obtained (i.e. wells, caves, springs, catchment)? Changes observed in life time?

- Village or house sites – church – stores – community activities — Names of native and resident families...?

  Historic residents – Kahale, Kamakaimoku, Peleula, Kahananui, Kalaiwaa (Kalauwaa), Kuahewa, Kamakau, Kaluahine, Kumahoa, Napalapalai, Maunakea, Makuakane, (others)...

- Who were/are the other families that came and/or come to collect area resources, and protocol?

Figure 16. Oral History Interview Questionnaire (continued)

- Gathering practices (who and what)? Shore line and *mauka-makai* trail accesses?
- Relationships with neighboring *ahupua'a* and residence locations?
- Historic Land Use: Agricultural and Ranching Activities...?
- Do you have any early photographs of the area?
- Are there particular sites or locations in the *ahupua'a* of 'Ahalanui, Laepāo'o and Oneloa that are of cultural significance or concern to you?
- Comments on caring for Hawaiian cultural resources and changes to the cultural and natural landscapes...?
- Do you have some particular sites or locations of concern or recommendations—cultural resources and site protection needs—regarding the proposed A & O development?

  Describe sites and define boundaries...

cf. HiPu15-QA-RL.doc / release DM 11/13/1997

For the three recorded interviews, this process resulted in the recording of additional hand written narratives with several interviewees. The hand written notes were expanded, and requested modifications made to the original interview transcripts.

Following completion of the interview and consultation process, the interviewees gave their written permission for inclusion of their "released" transcripts in this study (at the end of the individual interview transcripts). Only the final released transcripts from the interviews may be made available for public review.

Summary of Information Recorded in the Puna Oral History Interviews

As a result of the oral history interviews, a significant contribution to the history of the Kapoho-Pohoiki and ʻŌpihikao region has been compiled. There is notable similarity in the historical accounts of the four elder interviewees. Their *mo ʻolelo pono ʻi* (personal histories), bridge the past demonstrating time depth—a relationship to accounts recorded in historic literature—and demonstrating the on-going values of the customs, traditions and practices in the lives of the interviewees. All of the interviewees expressed a deep *aloha* (love) for the cultural and natural landscapes of Puna, and all share a commitment to the perpetuation of the history of the land and the continuation of native practices—whether occurring physically on the land, or being orally taught to successive generations.

Table 5, below, provides readers with an overview of key references to sites, practices, and recommendations made during the interviews.

Table 5. Overview of Historical Documentation and Recommendations made by Interviewees

Interviewee[15]*:*	*AL*	*JH*	*GK*	*JM*
Has lived on the lands of ʻAhalanui-Oneloa with elders.	No	Yes	No	No
Has walked across and worked the lands of ʻAhalanui-Oneloa with elders (e.g., gathering *lau hala*, and *ʻawa*).	No	Yes	Yes	No
Has personal knowledge of Hawaiian historical sites in ʻAhalanui-Oneloa.	Yes	Yes	Yes	Yes
Has personal knowledge of a *heiau* within the lands of ʻAhalanui-Oneloa.	No	No	No	No
Has personal knowledge of a family burial(s), or other remains In the lands of ʻAhalanui-Oneloa.	No	Yes	No	No
Has personal knowledge of fisheries (on-shore, near shore and deep sea) and fishing customs as handed down by *kūpuna*.	Yes	Yes	Yes	Yes
Has personal knowledge of grading and clearing activities on the Lands of ʻAhalanui-Oneloa (ca. 1950s to 1980s).	Yes	Yes	Yes	Yes

[15] *AL=Arthur Lyman; JH=John Hale; GK=Gabriel Kealoha; JM=John Makuakāne*

Table 5. Overview of Historical Documentation and Recommendations made by Interviewees (continued)

Interviewee:	*AL*	*JH*	*GK*	*JM*
Pā ilina (burial sites): Recommends that family members be consulted regarding treatment and long term protection of the *pā ilina*. It is generally felt that burials should be preserved in place.	Yes	Yes	Yes	Yes
Recommends working with the families of the land in developing preservation plans for cultural resources in the 'Ahalanui-Oneloa area.	Yes	Yes	Yes	Yes
Recommends protection of the native forest and other trees such as *kamani* (*Calophyllum inophyllum*), *niu* (*Cocos nucifera*), and *'ulu* (*Artocarpus altilis*).	Yes	Yes	Yes	Yes
Recommends taking steps to protect the quality of the water, ponds, and fisheries.	Yes	Yes	Yes	Yes
Recommends providing residents and visitors with historical information on the lands, families and customs of the 'Ahalanui-Pohoiki vicinity.	Yes	Yes	Yes	Yes
Recommends the develop of work opportunities for native families and residents of Puna.	Not asked	Yes	Yes	Yes

As noted in the preceding section, David Matsuura of A&O International Corporation-Oneloa Development has committed to the protection, restoration, and interpretation (when appropriate) of the Hawaiian cultural sites (sites identified during archaeological investigations) within the lands of 'Ahalanui, Laepāo'o, and Oneloa. Additionally, Mr. Matsuura has already initiated work on a plan for the protection of the remnant native forest and traditional agricultural field systems in 'Ahalanui. For further documentation on the preservation, restoration, and interpretive commitments, please see the EIS prepared as a part of the A & O proposal.

In light of the interviewees knowledge of past uses of the A&O property, and the commitments of A&O to preservation/interpretation of the historical resources in the project area, the interviewees generally feel that the proposed project will have no adverse effect on the lands of 'Ahalanui, Laepāo'o, and Oneloa.

Released Oral History Interview Transcripts

The following pages offer readers the opportunity to read the full released transcripts from three recorded interviews and follow-up discussions. Also, the record documents efforts to conduct and complete a fourth interview. Because the information was not released, it cannot be included as a part of this study.

Readers are humbly asked here — Please respect the interviewees, reference oral history narratives in their context as spoken, not selectively so as to make a point that was not the interviewee's intention.

C. Arthur Lyman
Hilo, Hawai'i
Oral History Interview of November 21, 1997 — with Kepā Maly
(with discussion notes from November 14, 1997 and June 17, 1998)

Charles Arthur Lyman (Arthur) was born in 1912, at Kapoho, Puna, and is of Caucasian-Hawaiian-Chinese ancestry. His *kūpuna* (elders and ancestors) were early missionaries on the island, and by the 1830s, the family was actively involved in mission operations in Hilo and Puna. By the early 1850s, H.M and F.S. Lyman were conducting official government surveys in the lands of Pū'āla'a, 'Ahalanui, Laepāo'o, Oneloa, and vicinity (survey records from the Lyman brothers are included in the historical report prepared as a part of this study). In the late 1880s, Arthur's grandfather, Rufus Lyman, purchased Kapoho Ranch from Captain J.E. Elderts. The family maintained ranching and agriculture operations in Kapoho and several neighboring *ahupua'a* (native land divisions), and by ca. 1899 also leased lands to the original Puna Sugar Company (ca. 1899-1905), which focused it's operations in the Kapoho-Pāhoa vicinity. Arthur has maintained a life-long interest in the family lands of Puna, and in between 1931 to 1960, Arthur worked for 'Ōla'a- and subsequently the new Puna-Sugar Company with Herbert Shipman and American Factors (AmFac).

Arthur has an intimate working knowledge of the Puna District, which includes personal knowledge and experience in the lands from Kapoho to Pohoiki. Of particular interest to the study prepared for the lands of 'Ahalanui, Laepāo'o, and Oneloa, Arthur provided documentation on early 19th century residents of the area, and described native agriculture and fishing customs which were being practiced when he was a youth. In the 1950s, he was in charge of the formal clearing of large sections of the lands in 'Ahalanui, Laepāo'o, and Oneloa for AmFac's papaya cultivation venture. In his description of the early land clearing operations, he noted that large "fruit trees" such as *'ulu* (breadfruit) and mangoes, and any stone walls and other historic features were left in place when he oversaw the clearing operations. During the interview, Register Map 1777 and HTS Plat 812 were referenced while identifying various sites and locations being discussed. Selected sites are indicated on an annotated interview map at the end of this study (*Figure 2*).

Mr. Lyman gave his release of the interview records on July 9, 1998. In doing so, he observed:

"My answers may be disputed by other historians. My answers to questions, in the interview, are from years of handed down information from my elders and my longtime residence in the area."

Interview:

KM: I'm here with Mr. Arthur Lyman, and we're going to be talking story about the land of Puna, your birth place at Kapoho. And also trying to gather a little bit of historical information, your recollections about the lands of 'Ahalanui, Laepāo'o, and Oneloa. *Mahalo*, thank you so much for agreeing to talk story. You are among the few of your generation, that lived in this land and who knew the old timers. *Mahalo!*

AL: [nods head]

KM: Could you please give me your full name?

AL: My first name is Charles. I was baptized when I was about six or seven years old, it was Charles. But my family always called me Arthur, and most my old friends still call me Arthur.

KM: Ahh. And your last name?

AL: Lyman.

KM: Do you carry a Hawaiian name as well?

AL: No, I do not.

KM: What's your birth date?

AL: August 12, 1912.

KM: Hmm, you've seen so much! Where were you born?

AL: I was born in Kapoho.

KM: We're looking at Lobenstein's 1895 map, Register Map 1777; it shows walled enclosures for Lyman's House [the old J.E. Elderts, Kapoho Ranch property] . Showing some of the houses and the ranch paddocks, on the side of Kapoho Crater. Is this where you were born?

AL: No, I was not born there. That was my grandfather's house. My grandfather moved from Pa'auhau to Kapoho to go into ranching and raising sugar cane down in the Kapoho area [in the middle 1880s]. My father lived further up the road, in a plantation home [looking at Reg. Map 1777].

KM: This map shows us a trail, sort of skirting the crater of Kapoho and Pu'u Kea. And so your house, as you'd pointed out to me when we met last week, was a little further up, on the western slope, inland side of Kapoho?

AL: Yes [looking at the map], this is a very old map, it doesn't show the present roads.

KM: Yes, I also have a 1915 map, which at least comes up to the time of your birth. This map is HTS Plat 812 [opening map]. Here are the roads that were in place when you were born. So this is Kapoho hill here, and the road comes around

[pointing out locations], there's grandpa's ranch area. Here's the road coming along the slope...

AL: Well, I was born just about here.

KM: Okay, I'm going to go ahead and mark that. Here's the road, and some railroad tracks. Do you remember the railroad running through some of this area?

AL: Oh yes, I remember it very well because I went to school on the train from Kapoho to Hilo. The reason I went to Hilo to school was because the school at Kapoho, only went to the 3rd or 4th grade, and my mother was the teacher there. A one room school, and she didn't think that it was a good idea for me to continue school there [smiling]. So I went to school in Hilo, from the 2nd grade until the 4th grade. Then [ca. 1920] I went to school in ʻŌlaʻa, which is now Keaʻau, because, at that time, they segregated the students from going outside of their district to another school. So I had to leave the Hilo Union School and transfer to ʻŌlaʻa. I finished the 8th grade at ʻŌlaʻa and then went to the Hilo Intermediate School, which is now, not in existence. At that time, the Hilo Intermediate, was directly across from the Hilo Union School. It is now a playground. Then, after I finished the 9th grade there, then I was transferred to the Hilo High School, which is in its' present location. Then I went to Punahou in my 11th and 12th grades.

KM: Oh. Was Hilo Boarding School still in operation when you were a child, of school age?

AL: Yes it was.

KM: Ahh. And did your family still have any involvement with the school?

AL: No, my father was not directly involved in the Hilo Boarding School, but his cousin, Levi Lyman, was the principal coordinator of the school services, which was teaching students from the country, and from outside islands reading, writing, arithmetic, and so on. Also, how to be cabinet makers, farmers, and blacksmith's work.

KM: Hmm. So it was similar, I guess to a program like Lāhaina Luna, with some agriculture skills?

AL: Right, exactly. After all, Hilo Boarding School was fashioned after the Lāhaina Luna High School.

KM: Ahh, interesting. Now you'd mentioned that you were born in 1912, at Kapoho. What was your father's name?

AL: Richard Lyman.

KM: Was papa the Richard Lyman, trustee at Bishop Estate?

AL: No, that wasn't my father, that was my older brother, who became trustee. He also had the same name, and naturally, he was called "Junior."

KM: *ʻAe* [yes]. And what year was papa born?

AL: Eighteen seventy-two.

KM: Who was his father?

AL: Rufus Lyman, who settled in Kapoho.

KM: So that's the ranch, Lyman's, here [pointing to the location on Reg. Map 1777]?

AL: Right.

KM: So this is Rufus Lyman. I see, just below grandpa's house, on the map, it looks like it's in Mahina or Kula, it says that there is a school lot.

AL: That's the one I went to school at.

KM: Ahh. So this is the school where mama was a teacher then also?

AL: Yes.

KM: What was your mama's name?

AL: Phoebe Williams, from Kohala.

KM: Do you remember about what year she was born?

AL: Eighteen eighty-three.

KM: Now, you're papa...you are of Hawaiian ancestry, as well. Who, of your parents, was Hawaiian, of your parents? Both your mama and papa?

AL: Yes, my father got his Hawaiian from his mother. His mother was Hawaiian Chinese, and my mother was Hawaiian Italian. My [maternal] grandfather married my grandmother over in Kohala. He was pure Italian and my grandmother on my mother's side was pure Hawaiian.

KM: Do you remember who the Hawaiian family was out in Kohala?

AL: Yes, I used to go there and stay there a couple of summers, [chuckling] I never enjoyed it because both of them spoke Hawaiian all the time and I couldn't understand a word. I'm sorry I never did learn to speak Hawaiian.

KM: *'Ae* [yes]. Do you remember the Hawaiian name of your mother's mother?

AL: [thinking] I can look it up.

KM: Okay. How about papa's side. You said that your papa was also part Hawaiian, is that correct?

AL: That's correct.

KM: So your grandfather Rufus married a part Hawaiian woman, who was Hawaiian Chinese.

AL: Yes.

KM: Who is her line?

AL: I would have to look that up too.

KM: Okay. [pauses] We were just talking story, and maybe by looking at this map, we could try to talk a little bit about some of your recollections of the different lands here in Puna. Also, last week you were sharing with me some wonderful stories about the Pu'u Kūki'i area. This is still your *'āina* [land], I understand?

AL: Correct.

KM: Could we talk a little bit about your recollections of the landscape, and about Kūki'i?

AL: My recollection of Kūki'i was that it was sort of a sacred hill. We all knew from my mother and father talking about a *heiau* [temple] up there. So it was sort of a forbidden place to go. But, the sugar company did raise sugarcane on the side of the hill.

KM: So around the slopes of the *pu'u* [hill], going up slope, had sugarcane?

AL: Correct?

KM: Puna Sugar Company?

AL: No, at that time it was 'Ōla'a Sugar Company [incorporated in 1899].

KM: Ahh.

AL: See, Puna Sugar Company was a plantation that was supposed to be only in Kapoho. They had the mill site picked out, next to Green Lake hill [in ca. 1899].

KM: Ahh. So here's the Kapoho Hill here.

AL: Yes.

KM: And Green Lake is the name for the water, the small lakes inside? Is that correct?

AL: That's correct.

KM: Did you ever hear the name Ka-wai-a-Pele?

AL: No, I can't recollect that.

KM: Okay. So Puna Sugar Company was going to build a mill on the side of the Kapoho Hill?

AL: Yeah [looking at the map], about some place in this area here.

KM: Okay, I'm going to mark this on the map as approximate location of mill. Now, you'd said that they were supposed to. Had they begun the construction, or they never did?

AL: They never got off the ground [by ca. 1905, Puna Sugar Co. was bought out by 'Ōla'a Sugar Co.]. The plantation, leased the property from my grandfather, and they must have planted some areas in sugarcane, but they never really ever harvested and milled their own cane. By that time, the Hilo Railroad had built a railroad track from Hilo to Kapoho so that they could quarry rocks for the Hilo Breakwater.

KM: Ohh! So they were gathering rocks out in Kapoho?

AL: Correct. I would say that maybe 50% or more of the Hilo Breakwater is rock that was gathered in Kapoho and transported by the railway system to the Hilo Breakwater.

KM: Wow, that's amazing. I knew that some of the stone had come from along the Hāmākua side, but I didn't know about the Kapoho source also.

AL: Yeah, some came from Hāmākua.

KM: Now, this *pu'u*, you mentioned also, that they used to dry flume the sugarcane off the side of Kūki'i like that.

AL: [chuckling] That's the only way they could get the harvested cane from the slope, down to where they could transport it to a railroad track so that they could haul it all the way to ʻŌlaʻa, which was where the mill was. ʻŌlaʻa is now called Keaʻau.

KM: Do you know where Keaʻau, as a place name came from, out of curiosity? Was there a particular area called Keaʻau.

AL: I am not sure. But I can recollect Mr. Herbert Shipman saying that ʻŌlaʻa was not a "good name, it was a bad name." That's all I can remember. And so sometime after he became a trustee, or board member of American Factors, they had the name changed from ʻŌlaʻa Sugar Company to Puna Sugar Company [in 1960].

And in a conversation with him, I said, "Mr. Shipman, you have changed the name ʻŌlaʻa Sugar company to Puna Sugar Company." I said, "Do you know that Puna Sugar Company was once a sugar company that was supposed to raise sugarcane and mill its' own sugarcane at Kapoho. It went broke." [smiling] And he just didn't like my statement, so that was the end of the conversation [chuckling].

KM: How interesting. And indeed, what you're describing about the railroad tracks, the more recent map from 1915 [HTS Plat 812], does show the track fairly close, down to Kapoho Hill, so they would have...were they using machinery, or were they hauling with horses or oxen, the sugar when you were a young boy?

[pointing to locations on map] Here's Kūkiʻi, and up by your house, you can see the railroad track coming down towards grandpa Rufus' place. And this is Kūkiʻi.

AL: Yeah. See, this is the railroad track that went all the way into Pāhoa and Keaʻau and also to Hilo.

KM: Sure, here's the section I believe that would have come up to Pāhoa.

AL: Yeah.

KM: Then it continues on to Hilo?

AL: Yeah, on to Keaʻau, Glenwood.

KM: Uh-hmm, there was a branch going up.

AL: Yeah. And all the way to Paʻauilo.

KM: Ahh. Now in Hilo, there's what they call "Railroad Avenue," that name source, was because of this railroad? That railroad ran through there?

AL: Yes.

KM: Now, you'd also shared with me some interesting recollections, that as a child, at Kūkiʻi there was a place called "Waiwelawela," a warm spring area?

AL: The warm springs was...as far as I know, we called it "Warm Springs." Waiwelawela was a pond that was below warm springs and later on, in my life, I found out that warm springs was never a spring. It was a fault line all the way from Waiwelawela up to warm springs and continuing on up through and above Kapoho.

KM: Amazing. You'd said it was like a fissure that ran down, almost to the ocean or something?

AL: Yes, right to Waiwelawela.

KM: I think you'd said that the fracture opened up as a result of the 19 [thinking]...

AL: Twenty-four earthquake. Waiwelawela, prior to 1924, was just a small pond of about half an acre, or maybe one acre. And after the 1924 earthquake, the fissure opened up some more and the pond became a 40 acre pond from a one acre pond. And warm springs was also enlarged.

KM: Wow! So it just collapsed and opened up. You'd also said, that "there were some good fish in that pond" eh?

AL: Oh yes. Well, it opened right into the ocean and because the water was warm–and still warm after the 1924 earthquake–a lot of fish went in, especially mullet and *āholehole*.

KM: And I think you'd said, had *ulua* waiting outside eh?

AL: [chuckling] The *ulua* were waiting outside. And also, I think that the *ulua* went there to cleanse themselves from a parasite that clung to their gills.

Because nearly every *ulua* that was caught in the area, that I remember, had these parasites on their gills. The parasites would be about the size of... [looking in his desk] an eraser.

KM: Oh, so about two inches long?

AL: Yeah.

KM: What you're describing as far as the fissure goes, is indicated on the 1895 map [Reg. Map 1777]. It's a line of cracks, going down here to Waiwelawela.

AL: Yeah.

KM: Now, as we go along here, there are some various place names and things that area mentioned. There's a canoe landing down here, off of the side of "Ipoho."

AL: Uh-hmm.

KM: And if we come down here, to Kumukahi, there is something called "King's Pillars." You'd mentioned, when you were a child, you could still see two columns or something, standing up?

AL: Yes. I'm sorry that I don't know the history of the King's Pillars, but it was two pillars that I can remember.

Maybe about five or six feet high. Stones piled up. You can't find it today because weathering and people removing stones to build their own shelters when they go fishing.

KM: I see. So it was like an *ahu*, a stone cairn?

AL: Yes, right.

KM: About how far apart were these two pillars?

AL: They were very close together.

KM: Close together eh. Do you think about three feet, six feet...?

AL: [gesturing with his arms] Maybe about two feet.

KM: Oh, two feet. So two pillars built in line there. Now you'd mentioned, that you don't remember hearing a story necessarily about the King's Pillar's...and on the map it has the name "*Kii Pohaku Alii*." Also, you said you heard something about the *heiau* Kūki'i, on Pu'u Kūka'e though, if I recall? That it had a special function; there some association with healing or something?

AL: Yes, I am told that the *heiau* was built by 'Umi [ca. 1525] and it was for healing purposes [healing practices at this site are also recorded in traditional accounts].

And I suppose, it all goes back to having the warm water right below the *heiau* where people could go and bath themselves in the warm water and probably go up to the top of the hill to the *heiau* and offer, or give their prayers to the gods that took care of them, or were still taking care of them [see historical report for documentation of use of warm springs as early as the 1870s for healing].

KM: Had you ever heard of a relationship between the rising sun, Kumukahi and this hill? Do you recall hearing anything about that? It is the eastern most point of the island and it's prominent for the sun rise.

AL: Well, I know that the sunrise in Kapoho is very nice. And the only thing I can remember my family telling me about, is Halekamahina. Because it talks about the moon.

During a preliminary interview meeting on November 14th, Mr. Lyman also shared the following recollections about some of the stones from the *heiau* of Kūki'i, and his personal interest in long-term protection of the site:

> The construction of the *heiau* was of a unique style, with large slabs of stone apparently cut to fit in place. Only a few of the stones can be seen on top of Kūki'i today. When he was a young boy, Mr. Lyman remembers that there was a pile of the cut stones set near his grandfather's ranch residence. At that time, no one remembered how or when the stones had gotten there. When "Sonny" Hall was working on development of Harry K. Brown Park at Kalapana, the elder Richard Lyman agreed to have the stones relocated to the Kalapana park where they would be protected with other sacred stones of the Puna District. Up until ca. 1990, there were large stone slabs (approximately 4'x8' in size) that were used as picnic table tops at the park; those stone slabs (table tops) had come from the *heiau* at Kūki'i.
>
> Arthur also lamented that his recent efforts at donating the *pu'u* to the Office of Hawaiian Affairs (OHA), in order to protect the remains of the Kūki'i Heiau, had been unsuccessful. As a result of his upbringing, he has long been concerned that the *heiau* be preserved through future generations. To date, his several offers to donate the site have generated no action (pers comm. November 14, 1997).

KM: Ahh. It's a beautiful land, so much history. You'd mentioned you remembered this fishpond area in here, identified as "Ihukapu." You'd said there was quite and extensive pond down here too eh?

AL: This was a big indentation where you had mullet ponds and my brother Richard, who became a Bishop Estate trustee, he and I were trying to restore the Hawaiian village that we found in this area.

KM: Ahh, so in the vicinity of this pond here eh?

AL: I suppose that's what this road here is [pointing to a trail alignment marked on Reg. Map 1777]. It was probably a trail going through here. On both sides of this road going through, there were enclosures where there were two ponds in each enclosure, and I suppose one was for bathing, and one was for drinking.

KM: Hmm. They were very fastidious about the separation of drinking and bathing waters eh?

AL: I suppose so, yeah. But of course, 1960, when the lava flow came, the whole area here was covered with lava and that was the end of the area.

KM: Ahh. So this section is now gone?

AL: It is gone.

KM: I see. It says the old boat entrance in here to "Kai o Kamiloholo," and you remembered the old boat entrance eh?

AL: Oh yes.

KM: By the way, it mentions here, "Ancient Burial Grounds," which are on the Kumukahi side of these fishponds, Ihukapu, like that. Is this area now covered in lava as well? This area, on this side?

AL: Nearly all of it has been covered with lava, but there is still an area, not covered, that has built up stone foundations, that look like it could be the foundation for a home or an above ground burial area.

KM: *'Ae*. They call that *pū 'o 'a*, built up mounds for burials like that.

AL: Yeah.

KM: Now, as we come further, going towards the Pohoiki side of the map, we see "1883 survey now covered at high tide." Here's Ha'eha'e, another important place name in the area.

And then we come into this whole area, the map shows sunken walls, fishponds and things like that [describing the area on the shoreward side of Hale'ōpelu and Pōhakumanō]. You said you remember this area also eh?

AL: I remember this whole area very well. As a matter of fact, when we developed this Kapoho area into a subdivision [beginning ca. 1950-1951], and before the 1960 lava flow, there was a trail, that was below the water line, that went all the way from this Ha'eha'e Point here, directly across so that you could get to this other bay here.

KM: *'Ae*, this Kamiloholo here. So there was a trail here?

AL: Under water.

On November 14th, Mr. Lyman commented that in "Several areas of the ocean fronting Kapoho, there are walls and foundations still in good shape

under water. As long as the structures are underwater, below the wave action, they remain in pretty good shape."

KM: Okay, I'm just going to mark it a little bit on the interview map.

AL: All the way, lined with stone.

KM: Ahh, look at how this one here at Ihukapu appears to be lined with stones.

AL: It was sand with stone.

KM: Ahh, and there was sand in this area also?

AL: Well, yes.

KM: Was it white-black mix, or primarily...

AL: Gray, a white-black mix.

KM: So interesting. So this is a trail here [marking the map].

Now, in 1868, I think you said you'd heard that there was a very substantial earthquake and collapse of much of this shoreline. Is that correct?

AL: Well, the collapse of the shoreline was a collapse all the way from Ka'ū all the way to Kumukahi.

KM: So that was the source of why many of these walls...last week you'd said that under water, you can still see walls when you were young, diving like that?

AL: You still can see the old fishpond walls.

KM: Ah-haa. You'd mentioned also, when you saw this place name, "Pohakumano," remembered this stone out here in the bay, yeah? When you were young, there were some *pū hala* [pandanus trees] on top of it.

AL: That's right. The island must have been about 40 feet by 60 feet long, and it had *pū hala* trees and *milo* trees growing there, and birds used to roost there at night.

KM: Hmm, and now that's all submerged as well, is that correct?

AL: That's right. During low tide, you can pick out these two islands [pointing to location on Reg. Map 1777].

KM: Yes, Pōhaku-manō and an inner one.

AL: But I can remember when they were always above the water. Of course now, when I tell people "You see those piles of rocks out there? I can remember when they were above water all the time and had trees growing on them." Of course the question I get back is "How many drinks have you had lately?" [chuckling]

KM: [laughing] But here it is too. You remember it and it's shown right here on this old map as well. What's your understanding of this region? You've pointed out to me, that there were residences, a village here, and we know of villages further towards the Hilo side.

AL: And the canoe landing at Kahuwai.

KM: Oh Kahuwai?

AL: Yes, there's a canoe landing over there.

KM: Yes, and some of those *hālau* [long houses], the stone walls are still there.

AL: The canoe landing, the sheds are still there. And the *poho* [basins] where they used to keep the bait, before the canoes when out, I guess somebody put the bait in there. And as the canoes went out, you'd scoop out what you want. Now those things are still there as far as I know.

KM: Ahh, so interesting. Now, what we see is, there are areas where there are fairly well developed villages, communities. What's your understanding, did you hear anyone talk about this land once being well populated?

[Mr. Lyman's secretary comes in – tape off, then back on]

So I had been asking you if you'd heard that since we see these villages here, what's your understanding about the native population of Puna? Was it well populated at one time? And how many Hawaiian were there, when you were a young boy, growing up? Were there still Hawaiian families living out here?

AL: Oh yes, there were quite a few. They got their subsistence, or existence from catching fish, raising their own food, whatever they could. And plus, there was always the welfare program, so what they couldn't get, the government helped provide some of it.

KM: When you were a boy also?

AL: Yes.

KM: Now, you'd mentioned they were fishing. Out of curiosity, what are some of the fishes that were famous for this area of Puna, that you might recall?

AL: Fishing was [chuckling]...you could get anything you wanted. I can remember my father telling a good throw-net fisherman, "I'm going to have some friends over for the weekend, see if you can get some *āholehole*." The next time, I'd hear his say "Get some *āholehole*, and see if you can get some mullet and some *uouoa* and stuff like that." And he'd go out with his net and he'd come back with the fish.

KM: Were there still some canoes going out doing any *'ahi* fishing...

AL: No. I have no recollection of any canoes. Although, there used to be a lot of canoes going out of Pohoiki and 'Ōpihikao.

KM: Ahh, so when you were a boy still yet?

AL: Yes.

In further discussion about fishing customs and use of *'ōpae 'ula* [*Crangon ventrosus* – small red shrimp] as bait for *'ōpelu*, Arthur added:

> The small *'ōpae 'ula* was the important bait used by the Puna fishermen. People in other districts use pumpkin, taro, and *hauna* [stink baits], which can contaminate the *'ōpelu*. But in this area of Puna—Kapoho, Pohoiki, and 'Ōpihikao—the fishermen only used *'ōpae 'ula*. That way, the Puna people didn't need to be careful about how they prepared the *'ōpelu*. Because the *'ōpae* was a fresh, live bait, and a delicacy as well, they could even eat the *ōpū* [stomach].

One of the important ponds for the *ʻōpae* was the pond called Waiʻōpae, near the Kapoho-Pūʻālaʻa boundary. The pond was large, and was filled with *ʻōpae ʻula*. The fishermen would go very early in the morning to gather the *ʻōpae* in preparation for *ʻōpelu* fishing. There was also the long green *limu* [seaweed] which grew in the pond, and that's what they used to keep the *ʻōpae* fresh until they got out to the fishery. [Hale-ōpelu (literally: *ōpelu* house) in front of Kapoho, was one of the fisheries]. Back in the 1930s-1940s, we leased the 'gathering rights for *ʻōpae ʻula* at Waiʻōpae to Hailama Kahaloa (Hailama used to work on the Puna road crew, and was a resident of the ʻŌpihikao area). He kept the lease all the up until my cousin, Norman Lyman, who was in the Territorial Legislature, introduced and passed a bill banning use of the *ʻōpae ʻula* as life bait.

It's really a shame that the *ʻōpae* were banned as bait, because the fish were clean back then. I think that the reason people get sick today, is because they use the dirty bait. When people make the *ʻōpelu* raw, they like to rub the gills and the liver on the fish to season it. The dirty bait probably contaminates the fish, whereas the *ʻōpae* was clean. People didn't get sick back then.

It's also been my experience that if you dig a hole and hit water anywhere along the shore between Kapoho to Pohoiki, when you come back to the hole the next day, you'll find the *ʻōpae ʻula*. They were ver plentiful (pers comm. June 17, 1998).

KM: Well, we're slowly moving down some of this area of the coastline here. Had you heard, by chance, that Puna used to be quite populous?

AL: [thinking]

KM: In legendary times, with the villages here? Were there many people, or were they scattered along the coastline? Even up to your time?

AL: There were a lot of small groups of families. I suppose they were families that settled on their own property. But I can not recollect any large groups of people.

KM: Uh-hmm. Who were some of the families that you remember?

AL: [thinking] The Hales.

KM: Where were they living?

AL: At Pohoiki. The Kuamoʻos, also living at Pohoiki. Maunakea, who has [looking at the map] an area called Maunakea Pond...

KM: Uh-hmm. So this is the ʻAhalanui area, then here's Laepāoʻo and Oneloa.

AL: Correct.

KM: Kalauwaʻa or Kālaiwaʻa had the Grant [No. 2982] in the 1850s, and there is a small pond and canoe landing area that was a part of his *kuleana*. Then here in Grant 1001 to Makaʻimoku, is what's now called area of Maunakea pond.

AL: Yes. Then moving further on down the coast, you have...it was part of the Hale family that had some homes in here [pointing to the shore line]. [cf. the interview of June 12, 1998, with John Hale and Gabriel Kealoha]

KM: So in Laepāo'o and 'Ahalanui.

AL: Yeah.

Arthur recalled that the Hale family had land in the uplands at Pu'ulena. It is his understanding that the family lived there at one time, and cultivated taro and other crops (this is described by John Hale; see interview of June 12, 1998). Arthur noted that the Pu'ulena area was a very rich cultivating ground. The Puna Sugar Company railroad ran through the Pu'ulena cultivating fields extending about as far as Kamā'ili, near the upper Puna Highway.

It is Arthur's understanding that there was some sort of 50-year plus, residency agreement between the Hale family and AmFac, granting the Hales a right of residency in the Pohoiki area in return for use of the Pu'ulena agricultural field (pers comm. June 17, 1998).

KM: Was there any Makuakāne down here when you were young, that you remember?

AL: [thinking] The name is very familiar. The Makuakāne family, all of them that I know originally came from the Puna area.

KM: *'Ae.* I think there are quite a number of people in the 'Ōpihikao area...

AL: 'Ōpihikao, that's Makuakāne's, and Kapoho, had Makuakānes. There was a Makuakāne that worked for the original Puna Sugar Company that never materialized, and later on, he worked for 'Ōla'a Sugar Company

KM: You also mentioned that you recognized, at least, the name Napalapalai, also, as someone that had one of the Government Grants in the 'Ahalanui-Laepāo'o-Oneloa area I think?

AL: I remember that very well because of the figure that had 999 acres.

KM: Yes, uh-hmm. As we come a little bit back towards this way [towards Kapoho], were there any families living in Pū'āla'a that you remember?

AL: No, I can't recollect.

KM: You'd also mentioned that some of the families...they were primarily subsistence fishermen, and that there was some agriculture. Were they growing things like taro or sweet potatoes, or a variety of crops that you recall?

AL: Taro and sweet potatoes, yes.

KM: Were they growing things close to their homes, or were some people still going inland. Like on this map [Reg. Map 1777] we see one example, along the edge of 'Ahalanui and Pū'āla'a, there's a trail that runs from *makai* [the shore], and here, it says "Kahaleolono Cultivating Ground." And there's another cultivating ground *mauka* [inland] here. Was there still some *mauka-makai* activity that you recall in your youth?

AL: I cannot recall them ever using those cultivating grounds. I cannot recall any stories about them, except that in the Kapoho area, where the fishponds were... Stories that I heard were that Hawaiians used to tend the fishponds for a length of time and then a new group would come in and bring food down so that they could stay maybe a week or two weeks.

And then they'd all go back inland to wherever their homes were or back to the cultivating grounds. And I think that that is how the Hawaiians probably lived in these cultivating grounds. Where they could cultivate what they needed for their existence, subsistence, they found better grounds and they used to migrate back and forth, *mauka-makai*. Probably going in shifts. A part of the family would stay *mauka* and cultivate, and then when they needed some seafood or something else to eat, then they would change. I think that's how they did it. I really don't believe that they lived in those cultivating areas.

KM: You bring up an interesting point here, the sea-foods and the migration process of moving back and forth between inland cultivating grounds and *makai* fisheries. Out of curiosity, were there also seaweeds that were noted for this area?

AL: Oh, plenty. There was plenty of seaweed. There was a lot of *limu kohu* and of course, when I say that they needed some seafood, they probably ran out of dried fish and stuff like that, so they would come down, bring breadfruit and taro down to where the family stayed along the coast, and then a new shift would go *mauka*.

KM: Yes. Did they make salt here as well, since you mentioned drying fish? Were there salt areas that you knew of, anywhere that salt was made along the coast?

AL: I cannot recollect any, but I have gathered salt in areas along different sea coasts and it is not too hard to gather salt. You would have more salt if the weather is dry all the time. That's why Kona and Ka'ū has more salt along the sea coast than any place that I know of.

KM: Yes. Coming down here then, if you recall 'Ahalanui, Laepāo'o, and Oneloa. You'd mentioned that you heard that Rycroft had cultivation operations in some of these *mauka* lands.

AL: Yes.

KM: What was he cultivating?

AL: I don't think he cultivated very much coffee. But he did have visions of a large coffee plantation. Because there are still some areas where you can see the projected railroad track bedding that was constructed prior to them going in there to raise coffee. As a matter of fact, Rycroft did bring in a steam locomotive, and I remember the thing rusting away, down at Kehena. It has now been covered by lava... [end Side A, begin Side B]

Arthur does not believe that railroad tracks were actually laid on the ground, it was in planning stages and the alignment may have been established during the latter period of Rycroft's residency (pers comm. June 17, 1998).

KM: So you saw what was left of the locomotive, and it was all the way down at Kehena rusting away?

AL: Yes.

KM: But now it's been covered by the lava flow [ca. 1955].

AL: I have no idea why it was in Kehena, but I remember the thing on the side of the road there. Whether the thing was brought in by ship and landed, or put ashore at Kehena, or whether the thing went on its own power to Kehena, I have no idea [chuckling].

KM: Now by your time, then, you'd mentioned you recalled the Maunakea family out here... [thinking], the Hale family at Pohoiki.

AL: Kuamo'o

KM: Kuamo'o, yes, thank you. Looking at this map [Reg. Map 1777], we see "Old Mill," and then "Rycroft's New Mill." What was the mill for?

AL: Processing coffee.

KM: Now the "Old Mill," you'd mentioned that you recalled hearing that they had processed jelly?

AL: I remember my dad saying that was where he [Rycroft] was going to make jelly [also marked as saw Mill on Reg. Map 1856].

KM: What kind of jelly?

AL: Guava jelly, naturally, there was so much guava in the area. The coffee mill is still standing. I would suggest that you go in there and look at it.

KM: Yes.

AL: And if you walk down towards the ocean, not too far away, you'll see the what I call the jelly factory. You'll see the toppled down smoke stack.

KM: Ohh!

AL: Whether he built that and found that it was too small, and said "I'm going to build a bigger one, and let's use this as a jelly factory," I don't know.

KM: Yeah, interesting. You can see the old road. You described to me that you would go off, follow the old road, and it would go right past the mill.

AL: Yeah, it goes between the two. Right down to the house.

KM: [looking at Reg. Map 1777] We can see also the Court House and Jail.

AL: Yes.

KM: Was that still functioning when you were a child?

AL: No.

KM: It was *pau* eh?

AL: Yes.

KM: We also see the old wharf down at Pohoiki. You mentioned that there's still one old rebar or something from that old wharf, still visible?

AL: Yes. If you go down there and you look, on the ocean side of where those tetragons are. You know where they put in the breakwater using those tetragons?

KM: Yes.

AL: You'll see that one rebar still standing.

KM: Ohh. Now Rycroft's house shows that it's enclosed by a stone wall. There's also some smaller houses, just outside of where the jail yard is, and that must have been Hale's place, or close to that area [identified as "Carpenter's Shop" on Reg. Map 1856]?

AL: Yes, I suppose so.

KM: I see there's an old boat shed, and a church. I also found a note for the old Pohoiki School Lot. Evidently, in the 1850s they had had a lot dedicated for a school out here.

AL: Uh-hmm.

KM: But that wasn't in operation when you were a child eh?

AL: No.

KM: There's also a school lot here at 'Ahalanui, but there was nothing going on there in your time?

AL: No. The kids that wanted to go to school, walked from Pohoiki to Kapoho.

KM: All the way to your mama's school?

AL: Yeah. Now, you don't walk more than a mile.

KM: Oh, a mile, that far [chuckles]? I don't think they walk far at all [laughing].

AL: [chuckles] One mile, then you get transportation.

KM: Yeah. So the families were Hale, Kuamo'o, Maunakea. Do you think there were any other families that you recall off hand, living out here ['Ahalanui, Laepāo'o, Oneloa]?

AL: I can't recall.

KM: Uh-hmm. Now, I guess, as you were describing, the families were primarily fisher-people. They probably wove *lau hala*, and did some agriculture close to the houses. Out of curiosity, have you ever heard of family burials at any of these sites here? These lands Oneloa, Laepāo'o, 'Ahalanui?

AL: Well, it's amazing, but I know for a fact that a lot of the Hawaiians buried their dead on their own property. Because even today, or during the period that I worked for the Puna Sugar Company, there were still graves, well marked graves in the cane fields.

KM: Ahh. When were you working for the sugar company?

AL: I worked for the sugar company from 1931 until 1960.

KM: Wow! You'd said also, earlier, before we got started, that it was your recollection that Rycroft was gone when you were a child.

AL: Yes.

KM: And that Puna Sugar Company? Was it Puna Sugar that bought this land?

AL: Yes, American Factors.

KM: American Factors, so the later Puna Sugar Company, not the Old Puna Sugar Company, yeah?

AL: Yeah, American Factors owned Puna Sugar Company.

KM: So they had bought this. [looking at both maps] I don't know which map is going to be easier for you to look at. It might be the little bit more recent one. How far down did the sugar cultivation come into the Laepāo'o, Oneloa, 'Ahalanui area, do you think?

AL: [chuckles–thinking; gets up to look for a map from his collection]

KM: So this is a 1938 map (revised March 1939).

AL: Uh-hmm.

KM: Sugar Cane Fields of the Kapoho Section.

AL: [pointing to location at the map] This is where our little camp was.

KM: I see the camp above Kapoho.

AL: This is our house here. I think I put it in the right place on the other map.

KM: I think you did too. I'll go ahead and confirm that. I see, this one shows the tops of the Pohoiki, Oneloa, Laepāo'o, 'Ahalanui. So the sugar is running quite a ways *mauka*?

AL: Oh yes, almost up to Pohoiki-Pāhoa junction.

KM: I see Honua'ula hill here. So they didn't actually plant sugar down into the lower area of these three *ahupua'a* [native land divisions], Oneloa, Laepāo'o, like that?

AL: No, no.

KM: But you mentioned to me, that you had actually bulldozed some of that land, cleared it for ranching or something, in the mid 1950s? Some of Oneloa and Laepāo'o like that?

AL: Oh yeah, I went in there for papayas.

KM: Papayas. This is a beautiful map.

AL: [continues looking at map] See it shows all of the secondary railroad systems?

KM: Yes.

AL: See, this is the main one, filled in to Kapoho, and this goes all the way up to Malama. We had train tracks that 'Ōla'a Sugar Company, or Puna Sugar Company had locomotives that used to use their own tracks.

KM: Uh-hmm.

AL: This doesn't show them having anything over here. It doesn't show the hill, Kūki'i.

KM: No. You see the camp though, so the hill...well, here's the old school lot, so Kūki'i was just off on the side, right in here.

AL: Well, this is the road going down to Kumukahi.

KM: Yes.

AL: So it would have been here.

KM: Uh-hmm. So if we were looking at Laepāo'o, the Oneloa-'Ahalanui area, to the best of your recollection, there was no sugar planted *makai* [shoreward]?

AL: [shaking head – no]

KM: So when you bulldozed in 1955 or thereabouts, it was pretty much *hala* and guava mix, and stuff like that?

AL: For the papaya?

KM: Yeah.

AL: Oh yeah, it was guava, *hala*, *'ōhi'a*. [rolls up his map]

KM: Thank you for sharing your map. Out of curiosity, would it be possible for me to make a copy of that?

AL: ...Yeah, just bring me back the original.

KM: ...Yes, I promise that I will, and it's on the record [chuckles].

Now, do I understand that before you began clearing some of this *mauka* area here, that this land between Oneloa-'Ahalanui, had not been cleared?

AL: I can't say that, because I don't know what Rycroft did.

KM: That's right, Rycroft was getting ready to do planting, the coffee and stuff.

AL: Yes. The only thing I remember going into those areas where we ran across some beautiful stone walls and the old railroad bedding. But no railroad tracks or anything, were ever found.

KM: Ahh. I see something interesting on this 1895 map, that says "Line of Cocoanuts and a Stone Wall," cutting right across here. There was a significant stone wall through 'Ahalanui. You'd also shared with me that you remembered when Keppeler [Bishop Estate surveyor] and [thinking]...

AL: Punini. Yeah, he went through here.

KM: Here's the boundary between Pū'āla'a and 'Ahalanui, and there's a cave eh, up in this area. That Punini and Keppeler got lost evidently in there for a while?

AL: Yeah, they got lost in there [chuckling], but they came out. They were only lost for one day.

KM: What might the old Hawaiians have used a cave like that for? Evidently, there were some walls and things inside, yeah?

AL: Well, the cave was used, I'm sure for habitation. Because, they did find where the cook area was and the pile of *'ōpihi* shells and things like that. [looking at Reg. Map 1777] This one, I can't recall.

KM: The wall eh, can't recollect it?

AL: I wonder what happened back there?

KM: Interesting, it says that there is "Kipaepae Cocoanut grove" in here on the boundary of 'Ahalanui-Pū'āla'a. There's also a waterhole up here, above that stone wall.

AL: You see, this is right next to the trail there.

KM: That's correct. The trail is right there.

AL: And you know that wherever you find a *'ulu* tree growing, a human being planted it. Because *'ulu* trees don't grow wild, you have to plant it by root.

KM: *'Ae.* So that's an indicator then that some was there, that there was some kind of activity?

AL: Yeah. So that's why, in bulldozing, if you have a Hawaiian operator on the bulldozer, he won't knock the fruit tree down. You tell him, "You've got to knock that tree down." The next day, he'll stay home.

KM: [chuckles] No come work eh?

AL: Yeah. So, in all my bulldozing, I tried to go by that same practice. You do not destroy any fruit tree, except for guava. But the mango and things like that. [looking back at the walled area in 'Ahalanui, on Reg. Map 1777] I wonder what that would be. And is that the Malama Trail?

KM: Well, this is the trail that comes down...let's see, it says "short trail from Kaniahiku."

AL: Kaniahiku?

KM: Yeah, to Rycroft's. That's what it says. And it connects back up here. See this is 'Ahalanui where Malama is a little further south-west yet.

AL: Hmm.

KM: You mentioned that the Malama Trail ran right down to the ocean also.

AL: Yeah.

KM: And that you could go to Pohoiki like that via the coastal trail.

AL: Uh-hmm. [see interview of June 12, 1998 with John Hale]

KM: So interestingly, there were some canoes out in the Pohoiki area when you were a child, yeah?

AL: Yes.

KM: And the fishermen, Hale I guess. And I don't if Kuamo'o or some other people out there...but pretty much the rest of this area, there were not too many people? Were some of the Hawaiians working for your grandpa them on the ranch or anything?

AL: No, not that I remember, because I don't remember my grandfather at all.

KM: Oh, I see. How about your dad them? What was your dad doing out there?

AL: He went there to work with his father, and then, later stayed when Puna Sugar Company started. The original Puna Sugar Company.

KM: Yes. It's so interesting. What's your sense about...when you see a Hawaiian site, say a house platform...and you never heard of a *heiau* out in the 'Ahalanui-Oneloa area. is that correct?

AL: No, I never heard of one and I never saw one there.

KM: What's your sense about caring for some of the Hawaiian sites and I guess, sharing some of the history with people today, so that they can know a little bit about the land? Is it worthwhile to try and do that, in your opinion? I know this is personal.

AL: I really don't know how to answer that.

KM: Uh-hmm. This is an interesting area, a beautiful place. So since the 1950s, when you began up in this area, up here, in the upper section of 'Ahalanui-Oneloa, how far down did you plant papaya?

AL: Oh, right down to the coastal road.

KM: So the papayas, in your time... And was it through these three lands right here, Oneloa, Laepāo'o, and 'Ahalanui?

AL: Uh-hmm.

KM: You went right down to the coastal road?

AL: Uh-hmm.

KM: Now that's interesting, because, if that's the case. If the papaya went down to the coastal road, there are still walls and some platforms and sites that are standing here. So that means that they weren't cleared. That someone made a conscious decision not to clear some of these sites/

AL: I don't remember running into any.

KM: Uh-hmm. Were you one of the operators, or did you have people operating for you?

AL: No, I had people operating, but I was there daily. I was with my operators everyday (the main operators were F.M. Hanohano, John Aiona, and Barcilio Tagalicod).

KM: That's interesting. So your papaya fields came almost all the way down to the coastal road?

AL: Yeah.

KM: When did this start, how long did you run papayas through here?

AL: Well, there still are papayas in there.

KM: *Mauka*, but not on the *makai* side.

AL: No, there was nothing below the coastal road.

KM: But even on the *mauka* side of the road, it doesn't look like there's been any papaya in there for a while eh?

AL: There's still papaya in there. Where's Pohoiki here [Oneloa land, bounding Pohoiki is still cultivated]?

KM: Here's Pohoiki. It's still a little ways inland eh, not all the way to the landing?

AL: No, no. It'll go as far down as arable land is found. [pointing to area on Reg. Map 1777] See, some of this is lava flow.

KM: Yes.

AL: So if there's no lava flow, then it's all in papaya.

KM: So obviously, soil was a determining factor in what you would clear?

AL: That's right.

KM: Okay. Now this is the *makai* road, which they are going to have to relocate because of the high water and storms.

AL: Uh-hmm.

KM: It's submerged sometimes now. Did you have papaya in certain areas, growing all the way down to the *makai* road?

AL: No, that was dependent on the soil conditions.

KM: Yeah.

AL: It does show here, this is probably all *pāhoehoe*. And this is the area that you're interested in.

KM: Yes, this section, which goes down to the *makai* road.

AL: Yes. See, and this area here, there's nothing in here. But this is all in papaya.

KM: Ahh–so basically it's Napalapalai's Grant [No. 6845] area.

AL: Yeah.

KM: That 999 acres.

AL: That was almost all in papaya at one time.

In conversation on June 17, 1998, Arthur noted that papaya were not planted throughout all of the land of 'Ahalanui, thus, there is still some of the mixed native forest there[16].

KM: Hmm. Thank you.

AL: And the Makuakāne's had a lot in here too.

KM: Uh-hmm, when you were young, or older?

AL: No, this is...what is this [pointing to names on the map]

KM: This says Kuahewa and Kamakau. So what we'd have to find out is, who Makuakāne's, maybe, *kupuna* was.

AL: Makuakāne had 70 acres in this area.

[16] At the time of this writing, the forested area near the 'Ahalanui-Pū'āla'a boundary is proposed to be established as a natural/cultural area preserve.

KM: Okay. [referencing Reg. Map 1777] This is Kahananui here, in the Grant from the 1850s. So Makuakāne had 70 acres in there. Were they still there, when you were younger?

AL: Well, they still own the property. I never knew of any of them to live there because the Makuakānes that I mentioned here, used to live right in Kapoho.

KM: Hmm. Well, thank you. I really appreciate your sharing. I know your getting ready to go to the doctor's. Let me ask one last question if I may. You started with a wonderful description when you were going to school in Hilo. [opening a map] This is a ca. 1930 Key Map for the City of Hilo. You were sharing with me a little bit about when you went to school, and we're leaving Puna. Do you remember the Hilo Boarding School Ditch?

AL: The ditch?

KM: Yeah.

AL: That was the source of water?

KM: Yes.

AL: Yeah, that goes up along the Saddle Road?

KM: *'Ae*, Kaūmana, *mauka*. The reason I'm asking is because here's the Hilo Boarding School lot.

AL: Uh-hmm, Hāla'i Hill.

KM: Yes. Here's the Hilo Jail that was built, I think the same year you were born.

AL: It's still there.

KM: Yes. You see this line here, it says "flume." Another line running here on the Waiānuenue side of the jail, says "ditch." And this would run through, I guess Hilo Union School in here.

AL: But, if you were to go up to the Hilo Jail and walk down, you can see this ditch.

KM: Uh-hmm.

AL: There's some homes in here, and I think this ditch flows nearly all the time.

KM: Yes. Is this what you know as being the Hilo Boarding School Ditch?

AL: No. I don't know. But, I know where this is.

KM: Yes that's correct. I was curious, because there is a section of a ditch behind the jail here also. This map identifies it as flume, and interestingly thought, there's nothing that says ditch coming into Hilo Boarding School.

AL: Hmm.

KM: And when I was going through the records up at the family museum, I haven't found one good map that shows us where the Hilo Boarding School Ditch was. There are several that show different alignments identified as the ditch, but they are in different places.

AL: [chuckles]

KM: So this is before your time.

AL: But this ditch is still flowing.

KM: Yes.

AL: If you were to go there and look, I think some of them...a couple of Hawaiian families living here have planted a little taro. And then this other ditch on the other side of the jail, just dies someplace.

KM: Yes it does.

AL: There's some taro growing in that ditch there.

KM: Thank you so much for agreeing to take the time. I'll take the tape and transcribe it verbatim, and I'll bring the transcript back to you. If you feel like it, if you agree, we might take the time to revisit a few of the areas we discussed.

We can clarify some questions. I think we really touched on all the key issues about who the families were, land use that you remember when you were a child, up till the period when the land was being cleared for papayas.

AL: Uh-hmm.

KM: May I ask, did you own this, when you were clearing it for papaya, or was it leased.

AL: No, I didn't own it.

KM: So it was a part of American Factors?

AL: Yes, it was part of American Factors and a part of Kealoha and Napalapalai's land.

KM: Well, thank you--*Mahalo*...

If I didn't get it, what was your mama's name?

AL: [looks through his files for a Lyman family genealogy – handing me a book] This is my father's side.

KM: [looking through documentation for documentation on Arthur Lyman's mother and father.]

Oh, this is your mother's side.

AL: My mother's family.

KM: Kapapahe'enalu-o-Puaka'ilima, which ties them to Kawaihae by the name of the surf Puaka'ilima. Stewart 'ohana. Maua'e, Ka'ōhua, Inaina... Ka'anā'anā

AL: Yeah. And this is my Aunty.

KM: Ahh, Hannah P. Williams. Kahikina married James Williams, an Italian... and Uaia. Phoebe was the daughter of Kahikina and James Williams.

AL: That's correct.

KM: Kapapahe'enalu married Maua'e, and Kahikina was one of their children. And I'm trying to get up to your papa also...

AL: My father was the third generation.

KM: Ahh. Richard Jewell Kahekili Lyman, born August 13, 1872, at Hilo. Married October 22, 1902, to Phoebe Hoakalei Williams. She was born on October 7, 1883... [looking at his brother's and sister's names] How come they left you without a Hawaiian name?

AL: I don't know, but, that's okay [chuckles].

KM: *Mahalo.*

AL: So you can see, my grandma was Hawaiian-Chinese.

KM: Yes. Thank you very, very much. [end of interview]

Because of Mr. Lyman's life-long interest in the Puna District, and 30 years of working experience with ʻŌlaʻa/Puna Sugar Company, I also inquired of his knowledge about the old Puna Government Road which passes along the shore of Puna District. Arthur noted that the road predated his lifetime, and that he had only heard his father describe it as the main access used by his elders in reaching their Kapoho Ranch holdings during the 19th century.

Personal Release of Interview Records:
'Ahalanui, Laepāo'o and Oneloa Oral History Study
Prepared in conjunction with the proposed
A & O International Development (Puna, Hawai'i)

The interview referenced below was conducted by Kepā Maly (*Kumu Pono Associates*), under a contract with A & O International Corporation in conjunction with historical and archival documentary research as a part of a cultural assessment study for portions of the *ahupua'a* of 'Ahalanui, Laepāo'o, and Oneloa (the Puna study area).

Date of Recorded Interview: November 21, 1997 (with notes from discussions of November 14, 1997, and June 17, 1998).

I, C. Arthur Lyman, participated in the above referenced oral history interview with Kepā Maly, and hereby give permission to Kepā Maly to include the released interview transcript in the study he is preparing (KPA Report HiPu15-063098). This permission is granted, subject to any restrictions listed below:

(a) Quotes from the interview(s) may be used as a part of the final report on historic and cultural sites and practices in the Puna study area, or reference may be made to the information in the interview(s). Copies of the interview records may be made available to A & O International Corporation, the County of Hawai'i, and the Department of Land and Natural Resource-State Historic Preservation Division.

Yes or no: Yes

(b) The interview records may be referenced by Kepā Maly for scholarly publication.

Yes or no: Yes

(c) The interview records may be housed in a library collection for general public access, and a copy will be provided to the Lyman Mission House Museum.

Yes or no: Yes.

(d) Restrictions:

My answers may be disputed by other historians. My answers to questions, in the interview, are from years of handed down information from my elders and my longtime residence in the area.

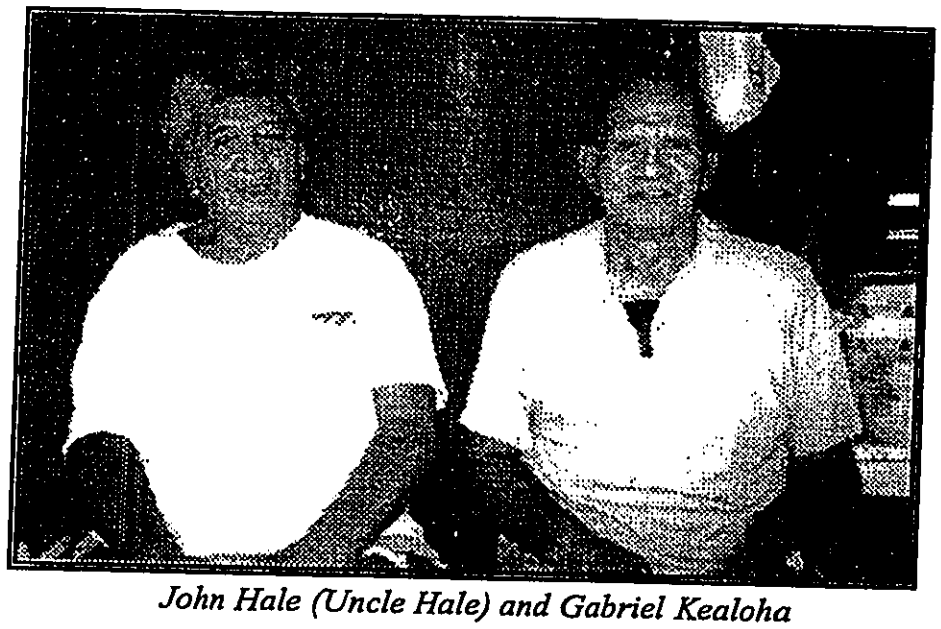
C. Arthur Lyman (Interviewee)
7/8/98

Kepā Maly (Interviewer)

Address: c/o 26 Waiānuenue Ave.
Hilo, Hawai'i 96720

July 9, 1998
Date of Release

John Hale and Gabriel Kealoha
(with William Hale on June 5th; and George Enriquez)
Interviews at Pohoiki, Puna — with Kepā Maly
June 12, 1998, 9:15 a.m. (with notes from June 5, 1998)



John Hale (Uncle Hale) and Gabriel Kealoha

Introduction

This oral history interview was con-ducted in two primary phases: the first, on June 5th, 1998, with John Hale, Gabriel Kealoha, William Hale, and George Enriquez; and the second, on June 12th, 1998, with John Hale and Gabriel Kealoha. Both of the interviews took place at the Pohoiki home of Uncle Hale. Uncle George Enriquez helped to make the arrangements for both interviews.

The interview was conducted in both Hawaiian and English, and in the transcript, Hawaiian is written as it was spoken. The English translations are set in square brackets, or in the case of large blocks of translated texts, are indented below the original text. During the interviews, Register Maps 1777, 1856, and 2191 were referenced, and certain places were marked while being spoken of. *Figure 2* at the end of this study is an annotated interview map, depicting the general locations of those sites. At the request of Uncle Hale and Uncle Gabriel, the text of the final released transcript supercedes the original taped interview (because of the confidential nature of some points of conversation, the tape recording has been retained from release).

As a result of their willingness to share some of their personal history and knowledge of the lands, people and practices of the Pohoiki-'Ahalanui vicinity, readers are provided with richly detailed narratives of the area. Of particular interest, it will be seen that Uncle Hale's memory of the families, residency, and practices associated with agriculture and fishing, are historically accurate[17]. The continuity of documentation from the archival-historical resources to the history provide by Uncle Hale provide readers with a link between the past and the present. Additionally, Uncle Gabriel's descriptions of the near-shore and deep-sea fisheries—the *ko'a* (fishing grounds) and *'ōpae 'ula* (*Crangon ventrosus*–a small red shrimp) sources—and customs which he learned and has practiced throughout his life, are important to re-establishing stewardship practices in the Puna region.

[17] For further documentation on Kapukini-Hale family residency in the 'Ahalanui-Pohoiki vicinity, see the archival-historical report of this study.

Interviewee Background

- The Hale brothers were born and raised at Pohoiki. Uncle Hale was born in 1919, and was raised with his *kūpuna*. Because of his upbringing and age, he has first-hand knowledge the families, the cultural and natural landscape, and practices of the families who lived on the lands of the Pū'āla'a-Malama region of Puna. During our conversations, Uncle Hale showed me pictures of his *kūpuna* at Pohoiki. The pictures dating from ca. 1910-1915 show Uncle Hale's grandfather John Hale; the elder John Hale and his canoe in Pohoiki Bay; and Mele Hale, Isaac and Hannah Hale with some of Uncle Hale's older siblings in front of the Pohoiki house in which Uncle Hale still lives.

  When I arrived at the Hale home in Pohoiki on June 5th, William shared with me that they did not feel that they could speak in a formal interview at that time. While Uncle Hale is the oldest family member remaining in Puna, there are also two older sisters living in Honolulu, there is a strong sense of respect for the elder members of the family. Also, it was brought to my attention, that part of the difficulty in speaking was that in the past, people had spoken with Uncle Hale, and then used the information selectively (out of context or misrepresented). Understandably, there had been some hurt among family members because of that.

  Regardless of that difficulty, following our initial discussion, both Uncle Hale and his brother William expressed an interest in participating in an interview. They are very concerned about the misrepresentation of the history of the area that has occurred in the past; primarily from people who did not have long-term residency in the area. Both the Hale brothers expressed appreciation for the opportunity to speak, and as Uncle Hale said, to "It's good for you to get the history straight from the horses' mouth, not the other side..."

- Uncle Gabriel Kealoha was born at Kaimū in January 1928. Because of the familial relationship shared by Uncle Gabriel's mother and the Kapukini line, and their relationship with Tūtū Joseph Mānoa, he has ties to the families of the Pohoiki vicinity and was regularly in the area. Later, as a teenager, Uncle Gabriel worked with Thomas Ka'ōnohiokalā Makuakāne (who later became his father-in-law), gathering *lau hala* (pandanus leaves) and *'awa* (*Piper methysticum*) for sale, from the lands of Pohoiki-'Ahalanui vicinity. As a result, Uncle Gabriel traveled throughout lands of the study area.

  Brought up with *kūpuna* in the country setting of Puna, Uncle Gabriel was taught native traditions of stewardship for land and fishery resources. His interview is of particular importance to understanding the relationships between fisheries, lands, and access to those resources. From his interview, Puna residents are given insight into how to reestablish native stewardship principles for Hawaiian fisheries. Like Uncle Hale, Uncle Gabriel felt that there was value in participating in an oral history interview.

Overview of information discussed:

- By the early 1920s, all the other families (e.g., Kālaiwa'a, Maunakea, Nāpalapalai, and Makuakāne et al.) of the Pohoiki-'Ahalanui area had left. There were no jobs, the children didn't want to live under the difficult conditions of the time, and many of the families moved to Honolulu. Only members of the Hale family, including *kūpuna* of the of the Kapukini, Mānoa, and Ko'omea lines remained. John Kapukini, cited in the archival-historical research section of the study, is the great grandfather of the Hale brothers. It was this Kapukini who applied for, and on paper, was granted a c. 2-acre parcel of land in Oneloa. Kapukini's daughter, Mele, married John Hale.

- At the time Uncle Hale was born (1919), the family maintained residency along the shore and in the uplands. The Hale family had property with houses at Oneloa (in Grant 1001 — near what is known as Maunakea Pond — owned by Mele Hale), and at two locations in the Rycroft Oneloa-Pohoiki properties. The family sustained itself by fishing and cultivation of *kalo* (taro) and other crops in the uplands of Malama.

  There was regular travel via the trails to the agricultural fields and the coastal residence. He noted that in those days there was no idle time, everyone worked.

- William Hale noted that many of the mounds of stone seen in the study area property (and neighboring lands), which the archaeologists and others call *heiau* and burials etc., were actually planting and/or clearing mounds.

- Ko'omea, Mānoa, and one other elder, were still actively practicing *lapa'au* (medicinal healing) in the native custom. They were powerful healers. Uncle Gabriel shared a story about Mānoa's medicine which was used to heal the young Kealoha's broken neck. Following an accident, the conventional doctor told Kealoha that he would never be able to move normally, and would always need to wear a brace all his life. Kealoha's mother went to Mānoa, who prayed, and then instructed her in how to make a medicine and apply it. The medicine was applied for two sets of five days [representing the five fingers of a hand—a complete entity—five was an important number in ceremonial and healing observances]. When Kealoha returned to his doctor, he was healed and the doctor was astounded. To this day, Kealoha still has full use of his body.

- Fishing was an important occupation for the old families. There are several *ko'a 'ōpelu* [dedicated *'ōpelu* fishing stations, which were fed and cared for] between 'Ahalanui and Keahialaka that the families used when the gentlemen were youth. Kealoha and William Hale still fish at these *ko'a*. One *ko'a* is in line with the "Maunakea Pond" near the Oneloa- Laepāo'o boundary (fronting Kahinihini'ula Point); another was in vicinity fronting Nīheu Bay; another outside of Pohoiki Bay; another by Laeokahuna (Keahialaka). Throughout the days of their youth, these *ko'a* were cared for by various *kūpuna*. Kealoha specifically stated that each *ko'a* was cared for by a particular family, and associated with the particular *ahupua'a* which it fronted. The Hales and Kealoha stated that out of respect for the families

who cared for *ko 'a*, no one from other lands would fish those *ko 'a*; that was the traditional way. There were always so many fish, not like today.

- The bait used by the area fishermen were the *'ōpae 'ula* which grew (and are still found) in the anchialine ponds of Wai'ōpae in Kapoho and in the pond at Keahialaka. In those early days, the *'ōpae 'ula* were the only bait used for *'ōpelu* fishing.
- Up through the 1950s-1960s the fishermen who came to Pohoiki, generally respected the Hale family's fishery rights. Whenever anyone went fishing, they would always approach the Hales first, and upon returning always bring fish to share (this is a deeply rooted cultural practice). Today (other than William Hale), Kealoha is the only fisherman practitioner who still cares for the old *ko 'a* and brings the catch to distribute among the family.
- *Pa 'akai* (salt) used for drying fish and other purposes, by the local families of the Pohoiki vicinity was generally purchased. There were no good salt making areas in the vicinity. In their youth, good *pa 'akai* was still being produced at Kapa'ahu on the *pāhoehoe* flats.
- When asked about any *heiau* that they may have heard of, including the *heiau* in 'Ahalanui (written about by Geo. Kāne in 1929), no one remembered specifically hearing their *kūpuna* speak about a *heiau*. Though William Hale recalled a platform-like feature on the *mauka* side of the road in Oneloa-Laepāo'o, where they used to gather *lau hala* with their *kūpuna*. While he did not hear it called a *heiau*, its size and features caused him to wonder if it may have been one. The Hale family also has a strong connection with the property around Mahina-akāka Heiau in Keahialaka; family burials are located on the property as well.
- While Uncle Hale *mā* are familiar with several areas at which *ilina 'ohana* (family burial remains) are present, only one of those sites is situated in the study area. That site is on the property that Mele Hale purchased in 1903 from Maunakea Maka'imoku, near the present-day Maunakea Pond. Uncle Hale identifies the site as the resting place of a young female relative, and today, it is marked by coconut trees. They also observe that it was the custom of their *kūpuna* to bury loved ones on their property of residence, thus care must be taken when working on the land.
- It is the family's wish that all *ilina* (burials) be protected in place.

Formal Interview of June 12, 1998:

KM: ...I'm here with *kupuna* John Hale.

JH: *'Ae* [yes].

KM: *Mahalo iā 'oe; a me* Uncle Gabriel Luka Kealoha. [Thank you; and with Uncle Gabriel Luka Kealoha.]

GK: Kealoha.

KM: *'Ae. Mahalo nui iā 'olua i ka 'ae ana e kūkākūkā pū ana me ia'u.* [Yes. Thank you both so much for agreeing to speak with me.]

JH: *'Ae.*

GK: *'Ae.*

KM: *Kupuna.*

JH: *'Ae.*

KM: *'O wai kou inoa piha?* [What is your full name?]

JH: *Ku'u inoa, 'o John Hale.* [My name is John Hale.]

KM: *'Ae. Hānau 'oe i ka makahiki a me ka lā hea?* [Yes. You were born what year and day?]

JH: April 29, 1919, *i kēia hale* [in this house].

KM: *O, mahalo ke Akua—i kēia hale*? [Thank God—in this house?]

JH: All us born here, then *pau, hele.*

KM: *O kēia hale a kākou i noho nei i kēia manawa i Pohoiki*? [This house that we're sitting in at Pohoiki?]

JH: Pohoiki.

KM: *'Oia ka inoa o kēia wahi?* [That's the name of this place?]

JH: *'Ae, 'ae, 'ae.* [Yes, yes, yes.]

KM: *Kēia hale, ka hale o kou po'e kūpuna?* [This house, was the house of your elders?]

JH: *Kūpuna and the po'e make. 'Oia, pau hele i ka wai, ka 'uhane, hiki no, ha'alele. Komo i loko o ka hale, po'e i make. Mamua loa. That's why, kēia hale, lo'a hale pule. The po'e, pule good.*

The elders and the people who passed away. The ones who died in the water, so their spirit could depart. The bodies were brought to this house, long before. That's why this house was like a church. The people had good (strong) prayer.

[Maps of the Rycroft properties from the 1890s identify the Hale home as a "Carpenter's shop" at the time. It is possible that one of the functions there, was the making of coffins.]

KM: *A, mamua i kēia hale?* [So before in this house?]

JH: *Ka po'e make, po'e hale pule* [The people who died and the people of the church]. This kind of *hale* [house], not like other kind of *hale* eh.

KM: *'Ae. So mana kēia wahi?* [Yes. So this place had power?]

JH: *'Ae, mana. Mana.* [Yes, power. Powerful.]

KM: *Pehea kou mana'o 'ehia mau makahiki kēia hale ke ku ia ne'i?* [What do you think, how long has this house stood here?]

JH: I tell you, *kēia hale* [this house]... I have one *ki'i* [picture] inside, from 1913. My sister was one year old. My sister make [died] already. She was 82 years old. One year old, in 1913. That *ki'i* I *lo'a*. [That picture I have.]

KM: *'Ae.*

JH: The windows in the house all broken. That's why, the po'e [people] come look, I think get 115 years.

KM: Yes. You see this house on the old maps like that, in the 1890s, 1880s .

JH: Yeah, old. Because in 1913, the picture shows the windows all broken. Now more nice [chuckles]. That's why, *kahiko* [old] this house. And all the evidence inside the *hale.*

KM: *'Ae, kahiko loa* [yes, very old].

JH: Bum-bye, you *nānā* [look], you see.

KM: *'Ae, nānā i kēlā mau ki'i.* [Yes, look at hose picture (Uncle has several pictures from ca. 1910-1915 of his family and the Pohoiki area).]

JH: Yeah [chuckles].

KM: *Maika'i. 'O wai ka inoa o kou makuakāne?* [Good. What was your father's name?]

JH: Isaac Hale.

KM: Isaac Hale. *He inoa waena kou, he inoa Hawai'i?* [Do you have a Hawaiian middle name?]

JH: Only John Hale.

KM: Hmm. So Isaac Hale, ka inoa o kou makuakāne? [So Isaac hale was your father's name?]

JH: *'Ae.*

KM: *'O wai kou makuahine?* [Who was your mother?]

JH: *Hannah Kawaiae'a, no Kaupō, Maui.* [Hannah Kawaiae'a, from Kaupō, Maui.]

KM: Hmm, Kawaiae'a, from Maui.

JH: *Mai Kaupō, Maui, a male ku'u pāpā i Hawai'i e.* [From Kaupō, Maui, and married my father at Hawai'i eh.] My mama *make* [died] in 1929. I was ten years, and *hānau* [she gave birth to] my brother Billy [pauses]...

KM: Ohh! And then *hala* [passed away]?

JH: *Hala.* There were eight of us.

KM: Hmm. *'O 'oe ka keiki 'ekolu?* [You were the third child?]

JH: Wait [thinking], was my sister Luka; I was four. *'Ehā* [fourth].

KM: Hmm. Now, *'o wai kou po'e kūpuna, ka po'e no kēia wahi?* [Who were your grandparents (elders), at this place?]

JH: [thinking]

KM: *'O wai kou kūpuna ma ka 'ao'ao Hale?* [Who were your elders on the Hale side?]

JH: *O 'ike li'ili'i wale nō* [I only know a little].

KM: *'Ae. Akā, 'o Kapukini kekāhi kupuna e?* [Yes. But Kapukini is one elder eh?]

JH: *Kapukini, kupuna, 'ae* [yes, Kapukini is an elder].

KM: *'Ae. Ua 'ike wau i ka inoa 'o Kapukini ma kekāhi o nā palapala 'āina.* [Yes. I saw the name Kapukini on some of the land documents.]

JH: Only I *ho'olohe, a'ole wau 'ike* [I only heard about him, I didn't see him].

KM: *A 'ole 'oe 'ike iāia?* [You didn't see him?]

JH: *A 'ole* [no]. Only Mele Hale. *Ku'u kūkū au e 'ike.* [My grandmother, I saw.]

KM: *'Ae. 'O wai kona inoa?* [Yes. What was her name?]

JH: Mary.

KM: Mary Kapukini?

JH: Kapukini-Hale.

KM: Oh, so Kapukini, was your grandmother Mary's father?

JH: Kapukini, yeah. My grandmother's father.

KM: *O, mau makahiki lākou i noho ia ne'i e?* [Oh they lived here for many years eh?]

JH: Yes, *mau makahiki* [many years].

KM: *Like me Kahale, ai'ole Hale e?* [The same as Kahale, or Hale eh?]

JH: *Mau makahiki loa e.* [Many years eh.]

KM: *A eia kākou me uncle. Uncle, 'o wai kou inoa?* [And we're here with uncle. Uncle, what is your name?]

GK: Gabriel Luka Kealoha.

KM: *'Ae. Hānau 'oe i ka makahiki...?* [Yes. What year were you born...?]

GK: *Hānau Ianuali iwakālua-'umikūmāhiku, 1928.* [Born January 27, 1928.]

KM: *A kanahiku, kou mau makahiki.* [Oh, so you are 70 years old.]

GK: *'Ae i kēia makahiki.* [Yes, this year.]

KM: *O aloha, mahalo ke Akua.* [Oh *aloha*, thank God.] *Ua hānau 'oe i hea?* [Where were you born?]

GK: *Kaimū, Kumaka'ula. Hānau i ke kakahiaka nui, hola 'ewalu.* [Kaimū, at Kumaka'ula. Born early in the morning, at 8 o' clock.]

KM: *Aloha. A 'ano kama'āina 'oe me nā 'ohana o kēia 'āina o Pohoiki me Oneloa, Laepāo'o, 'Ahalanui e?* [But you are familiar with the families and the lands of Pohoiki, Oneloa, Laepāo'o, and 'Ahalanui eh?]

GK: *'Ae,* yes. *Kama'āina i 1944; 'umikūmā'ono makahiki. Hana au me Thomas Ka'ōnohiokalā Makuakāne.* [Familiar since 1944; 16 years old. When I worked with Thomas Ka'ōnohiokalā Makuakāne.]

KM: *I kou wā 'ōpio, ua hele 'oe i kēia wahi a 'ohi lau hala?* [In your youth, you said you'd come here to gather pandanus leaves?]

GK: *Hana lau hala,* for pick *lau hala* [pandanus leaves].

KM: *'Ae.*

GK: *'Ohi lau hala maka* [pick green pandanus leaves]. *Au hana, a ua maopopo au i ka nunui o ka 'awa.* [when I worked, I learned that there was a lot of *'awa* (*Piper methysticum* growing here.]

KM: *'Ae, o ka 'awa, i uka o kēia 'āina?* [Yes, the *'awa* was in the uplands of these lands?]

GK: *'Ae.*

KM: Oneloa, me Laepāo'o...?

GK: *Mamua, 'ae. Ka 'āina a Napalapalai.* [Before, yes. The land of Napalapalai (Grant 6845).]

KM: *A, ka 'āina a Napalapalai* [oh, the land of Napalapalai].

GK: *'Ae. 'O wau maopopo* [I knew].

KM: *'Ae.*

[asking *kupuna* John] *I kou wā li'ili'i, ua noho 'oe i ane'i?* [Did you live here when you were small?]

JH: *'Ae.*

KM: *Heaha ka hana a kou po'e mākua a me nā kūpuna?* [What was the work of your parents and grandparents?]

JH: *Mahi'ai, po'e mahi'ai.* [Agriculture, they were cultivators of the land.]

KM: *I hea lākou i mahi'ai?* [Where did they do their cultivation?]

JH: *O, kai mālie, Pohoiki, hele lawai'a. Kai ko'o, hele mahi'ai, hele mauka.* [Oh, when the ocean was calm at Pohoiki, they went fishing. When the ocean was rough, the planted, they went to the uplands.]

KM: *Ho'i lākou i uka* [so they went to the uplands]?

JH: *I Malama, all lepo for the po'e mahi'ai.* [At Malama, it was all dirt for the agriculturists.]

KM: Hmm. *Heaha ka mea mahi'ai* [what did the grow]?

JH: *Kalo, mai'a, 'uala* [taro, bananas, sweet potatoes].

KM: *'Oia* [Oh yeah]!

JH: Yeah! That kind of *po'e* [people], no can *noho mālie* [stay still]. No can *noho i loko ka hale. Ka hale, hiamoe wale nō!* [They can't just stay in the house. The house is only to sleep in!]

KM: *'Oia. Pa'a hana lākou.* [Oh yeah. They were continuously working.]

JH: *Pa'a hana* [continuously working]. *Hana*! That's why, you look at the *kino, 'o'ole'a* [the body was hard, strong].

KM: *'Ae, 'o'ole'a* [yes, fit]. [opening Register Map 1777] Uncle, this is that map from last week, that I was showing you.

JH: Yeah, yeah, I remember.

KM: Here is your *hale ma'ane'i* [here's your house].

JH: Yeah.

KM: And this is the old mill.

JH: Right.

KM: And then has the new mill a little *mauka*. Where you folks went *mauka* to *mahi'ai*, how far up do you think you would go? A mile, two miles? Where was your *māla 'ai* [garden]?

JH: Well, about five miles I think, six miles. Follow the railroad, then turn left.

KM: Hmm, so way *mauka*.

GK: That was Malama.

JH: Malama.

GK: The *ala nui hele i Malama* [the trail the goes up to Malama].

JH: Yeah, that's the walking trail, that. The old trail.

KM: Oh, so up Malama trail, you would go?

JH: Yes.

GK: Yes.

KM: So not *mauka* here [Pohoiki]?

GK: No.

JH: Malama, Pu'ulena. Where is the Pu'ulena crater?

KM: Oh, more this side, so it's not on this map [not on Reg. Map 1777; see Reg. Map 2191]

JH: Yeah. It was right at the crater, a *kīpuka* [a vegetated area surrounded by more recent lava], we stayed in one *kīpuka*. All lava outside. The old railroad goes right through. All *lepo* [soil], no more *pōhaku* [stones].

KM: Hmm. So interesting.

GK: That's the Pu'u-hale-ka-manu. [perhaps descriptive of an old bird catcher's house, once situated in the forest; see study for details of such features]

JH: That name I don't know.

GK: That's up there.

KM: Hmm. So *'oia ka wahi māla 'ai a nā kūpuna?* [So that was the place that the elders cultivated?]

JH: Maybe that *māla 'ai* is a different place.

KM: *'Ae*, so Pu'ulena...

JH: Pu'ulena crater, we stay down. Nice place, it's important.

KM: Hmm. So you and your *kūpuna, holo wāwae* [walk there]?

JH: Yeah, *holo wāwae*, and *lo'a* house over there, *hale*. [Yes walk, and had a house over there.] While *mahi'ai* [cultivating].

KM: *O, lo'a ka hale. I kekāhi manawa, inā 'ino'ino, 'ōkaikai, ha'alele 'oukou i kai a holo i uka, a kanu, a mālama i ka māla 'ai?* [Oh, had a house. So some times, when the ocean was rough, you would leave the shore and go to the uplands and plant, take care of the gardens?]

JH: Yeah, *māla 'ai.*

KM: *A, inā mālie ke kai, ai'ole, kū ka 'ōpelu paha...?* [Oh, so if the ocean was calm, or perhaps if the 'ōpelu schooled...?]

JH: *'Ae, hele i kahakai.* [Yes, go to the shore.]

KM: *Ke ho'i i kai?* [Return to the shore.]

JH: Yeah.

KM: *O ka 'ōpelu paha, ka i'a nui o kēia 'āina?* [So was the *'ōpelu* perhaps the important fish of this land?]

JH/GK: *'Ae* [yes].

JH: *A 'oia* [that's it]!

GK: *Ko'a* [dedicated fishing grounds].

KM: *He ko'a* [It's a dedicated fishing ground]?

GK: *Ko'a.*

JH: *Ko'a.*

KM: Oh. [pauses – looking at Reg. Map 1777] I see down here, has various family names. Like Kamaka'imoku [Grant 1001], had a *hale* down here. Pele'ula [Grant 1016], that name.

JH: Yeah, I didn't hear that name.

KM: I think the *loko* [pond] that you mentioned [before the interview], is this side here [Kamaka'imoku's land; subsequently Maunakea's land].

JH: That's where we stayed when I was young.

KM: That's where you stayed.

JH: Yeah, that where I stayed, 1926, 1927. And then I stayed Rycroft house too. I'd stay over there, then when my grand mama *make* [died] over there.

KM: Mele?

JH: Yeah, *pau.*

KM: But Rycroft them were gone already eh?

JH: Pau already, no had them.

KM: So *ua noho 'oukou i ka hale o Rycroft?* [So you lived in Rycroft's house for a while?]

JH: Yeah, Rycroft. One down there, and then bum-bye, over here. 1928, broke the house. The old man *hemo* [removed] the *hale* I think.

KM: Who was living here in this *hale*, at that time?

JH: Us guys.

KM: You guys too. Big family, yeah?

JH: Uh-hmm. Big yeah. My grandfather guys.

KM: And then, here in ʻAhalanui...?

JH: Yeah, over there, my grandmother's place.

KM: That's where Kahale had also tried to get *ʻāina* back in 1850, like that. [see land record in main report]

JH: I think so, yeah.

KM: And up here, there is a water hole, a coconut grove, Kīpaepae? [pointing to locations on Reg. Map 1777]

JH: What place is that?

KM: This is ʻAhalanui, right on the boundary between Pūʻālaʻa and ʻAhalanui.

JH: Yeah.

KM: Had a coconut grove... Do you remember that coconut grove?

JH: Yeah, yeah.

KM: And had a lua wai [water hole]...?

JH: Yeah, *lua wai*, but I don't know if still yet.

KM: Yeah, kind of...

JH: *Paʻa* [overgrown].

KM: *Paʻa*. This trail goes all the *mauka*.

GK: The trail is there.

JH: What trail is that?

KM: The trail that runs *mauka*, goes up to Kākala, or... Did you ever hear the name Ka-hale-o-Lono, an old agricultural place?

JH: I don't know.

KM: Inside here, has plenty *pia* [arrow root] growing.

JH: Yeah. My brother Bill, he knows, he was working papaya. He went bull dozer up all the big trees. Papaya up there.

KM: Yes, all this area up here [pointing to the inland Oneloa-Laepāoʻo lands].

JH: Yeah.

KM: But you know, you go into here [pointing to ʻAhalanui], it still has all the *pā* [walls]...

GK: Right, yeah.

KM: The *puʻu, puʻepuʻe* [planting mounds] like that, and the little *māla ʻai* [planting areas].

JH: Yeah, *po'e mahi 'ai* [for the planters].

KM: That was the life of these people down here?

JH: Yeah, *mahi 'ai* kind. But I hear, these people over here, Koa'e, or what, they get, how they call today, "rock farmer." They make all rock, and they put...I don't know what inside, the leaves, I think. They *kanu kalo* [plant taro].

KM: *'Ae, kīpulu* [yes, mulch].

JH: Yeah, put all that. And that place, you know, past Koa'e, get one place, Kahuwai. Has one Hawaiian place, John Orr used to stay over there. He was a *haole*, *make* [died] already. Over there, you see plenty *puka* [holes], plenty *puka*. That's where they *kanu* [plant] the *kalo* [taro]...

KM: *'O wai ka inoa*? [What was the name?]

JH: John Orr, by Wa'awa'a. He *mālama* [took care of] the Hawaiian places. He lived there, that place was one Hawaiian village, Kahuwai, Wa'awa'a. That's the place, number one sacred today. But *pohō* [too bad] that *'āina*, I don't know who takes care now.

KM: KSBE [Kamehameha Schools-Bishop Estate].

JH: The old man make, you know the 200 acres?

KM: Yeah.

JH: I go over there every time. *Minamina* [regretful], he went *make* [die].

KM: It's so interesting that you see all the *'ohana* [families] that were down here...

JH: Yeah.

KM: So it was very important to have the *mauka-makai* access, 'cause the families would go *mauka* to *kanu 'uala, mai'a*... [plant sweet potatoes, bananas...]

JH: Yeah, *mahi 'ai* [farm].

KM: How about *'awa*?

JH: *'Awa*, you see 'um, you can see. They went plant that, that was common. When get *ma'i* [sick], they went to go get that. Some for *inu* [drink], some for *lā'au* [medicine], eh. The old people, some take the coconut juice, water, no?

KM: *'Ae.*

JH: Because they *mahi 'ai*, the *kino 'eha* [body is sore], the *po'e mahi 'ai* [the farmers]. Soon as the *po'e* [people] no *mahi 'ai* [farm], ah no more *ma'i* [sick], because no *hana* [work] eh? *Mahi 'ai po'e*, that's different kind *po'e* that.

KM: *'Ae.*

JH: No can stay inside the house. That's the kind breed we come from.

KM: *'Ae.*

JH: You're *'ohana* too, *mahi 'ai*?

KM: *Ku'u po'e kūpuna hānai* [my adoptive elders]...

JH: The same thing.

KM: *I ka ʻōlelo o lākou, "Maikaʻi ka hana a ka lima, ʻono no ka ʻai a ka waha"* [When the hands do good work, the mouth eats good food].

JH: Yeah [laughing]. That's the kind, no can *noho wale nō* [only sit around].

KM: *ʻAe, "Mai kaulaʻi ka lima i ka lā."* [gestures with hand – Yes, they said "Don't lay the palm out to the sun."]

JH: No [chuckles], *paʻa i ka hana* [always working]. In the *kai, ʻano ʻoniʻoni* [when the ocean is agitated], good, *hoʻomaha* [rest–don't fish], so *ulu ka iʻa* [the fish will increase]. Today, no, they like go every day. You know what *pilikia* [trouble] today; the *iʻa*, I don't know where. They go too much.

KM: Hmm. But you folks, in your young time, the *iʻa* [fish] were plentiful around here?

JH: Yeah.

GK: *Lo ʻa* [had].

KM: Uncle Gabriel, you mentioned last week, that some of these small *loko wai*, the ponds, had *ʻōpae ʻula* [*Crangon ventrosus* – small red shrimp] inside, yeah?

JH: Yeah.

GK: Yeah, plenty *ʻōpae* [shrimp].

KM: Plenty *ʻōpae ʻula*?

GK: Yeah.

KM: One pond was back this side [pointing south-east]?

JH: Yeah, that's where my brother stays, Keahialaka.

KM: So his place by Lae-o-kahuna?

JH: Yeah, by over there.

GK: And also, Kapoho.

KM: Kapoho. How about down here, by this pond where you folks lived? Had *ʻōpae* in here, this ponds too [pointing to Kamakaʻimoku's land on Reg. Map 1777]?

JH: That was our place. No more.

GK: No, no.

KM: So never had *ʻōpae* in this pond?

GK: See, that was open, close to the ocean.

JH: My brother's place, get plenty. Red!

GK: Maybe way before, but right now, no.

JH: But funny, when the land went sink, *pau*.

GK: They no go there for pick. They go Kapoho.

JH: Plenty out there.

KM: In your time too?

GK: Yeah.

KM: So when you were young, by your house, where *kūkū* [grandma] was...?

JH: We no go, our family only raised *i'a* [fish]. That kind *i'a*, was just like a pet. Plenty *i'a*, they keep that; *kahakai* [shore side] get plenty eh. That *i'a*, no *'ai* [eat]. [chuckles]

KM: Hmm. I see there's one place up here called Wai'ōpae [near the Pū'āla'a-Kapoho boundary on Reg. Map 1777].

JH: Yeah that's the one.

GK: That's where we go.

KM: *Ma'ane'i* [here]?

GK: That's where we go get the *'ōpae*.

KM: Just past Pū'āla'a.

JH: Yeah, yeah, Wai'ōpae.

KM: So is that where you folks would go *'ohi 'ōpae* [catch shrimp]?

JH: *'Ōpae*, yeah, and these guys.

GK: *I ke kakahiaka nui hele a 'ohi.* [In the early morning we'd go and gather 'um.]

JH: Yeah, the 'Ōpihikao guys.

KM: *Kā'e'e 'ōpae* [sccop net the shrimp]?

GK: *'Ae, kā'e'e 'ōpae* [yes, scoop the shrimp].

KM: Ohh! *Ka 'ōpae, ua hana 'ia i ka pōpō? He pōpō lepo paha?* [The shrimp, were made into a bundle? A dirt bait ball?] *Pehea 'oukou e maunu ai*, how do you make your bait?

GK: *Upena li'ili'i* [a little net – gestures scooping the shrimp in the pond].

KM: *Kā'e'e* [a scoop net].

GK: *'Ae. Mahope*, walk [motions walking backwards].

JH: Yeah, yeah.

GK: Walk, walk.

JH: Scoop the *'ōpae*.

GK: And when you walk, they all come up to the surface. The *'ōpae* come up.

JH: Yeah, you just walk, you back up. I make that.

GK: Then we use for *'ōpelu*.

KM: Ohh. What did you do, did you put it in a ball to make the bait?

GK: Well, we keep 'um in a bucket.

KM: But how about when you go fish? Did you just throw the *'ōpae* in the water, or did you make *lepo* [dirt balls]?

GK: Oh, we make *palu* [bait].

JH: *'Eke* [a net bag].

GK: Yeah, *'eke*.

JH: We throw the rock and all [gestures throwing the stone weighted bag with the shrimp into the water from the canoe]. Bum-bye, the *'ōpae* all swim [chuckles].

KM: *'Ae*.

GK: [gestures jerking the line] Open the bag, the bag go down and you open 'um.

JH: The *'ōpae* come out.

KM: Hmm. So no more lepo? You know, how some people the *hana lepo*, they make the dirt balls, and they drop the *'ōpae* with that, pull the bag...?

JH: Same thing.

GK: We get some kind of *limu* [seaweed], put that with the *'ōpae*.

KM: Ohh! What kind of *limu*?

GK: One kind of *limu*.

KM: Oh, so you'd see your *kūpuna* go *lawai'a 'ōpelu* [fish for *'ōpelu*] like that?

JH: Every time, every time.

KM: And you folks had *ko'a* [dedicated fishing grounds], you said?

GK: Oh yeah.

JH: Like these guys, they go 'Ōpihikao side.

GK: Yeah, we go 'Ōpihikao, that's our boundary.

JH: Them. Over here, different. Over get plenty *ko'a*.

GK: People over here, get boundary here.

JH: Yeah, we no go somebody else place *maha'oi* [be nosy or bold]. You stay in your own section. Me, I don't them, I don't take their *'ōpihi* or stuff, they stay in their own corner. We don't do that.

KM: Hmm. Like now...?

JH: Now, only *pōhaku* [stones] left.

GK: Different.

JH: No more *'ōpihi*.

KM: Hmm. So they take too much?

JH: They take too much. I look how the net [gestures small eye], that's how, all the way.

KM: Yeah. So before when you were young, when people would come fish down here, was it mostly *'ohana*?

GK: Yeah.

JH: Yeah, mostly all *'ohana.*

KM: So people from away, didn't just come and go out side fish?

GK: No!

JH: They stayed at their own place. Kapoho people don't come like that.

GK: They get their own boundaries.

JH: Yeah, they never come.

GK: Like we have 'Ōpihikao, we get Kalapana, Pohoiki...

JH: Us, we stay over here.

KM: And what, you *kūpuna* went out *hānai ko'a* [feed and care for the dedicated fishing grounds]?

JH: Yeah, they go.

KM: So they would feed and take care?

JH: Yeah.

GK: *Mamua. Mamua hānai* [Before. Before, they feed 'um.] They take the *'upena* [net].

KM: *'Ae.* So they didn't go fish every time?

JH: Yeah.

KM: Some times, they would go out with the wa'a [canoe]...

JH: *'Ae.*

KM: ...and they'd feed the *'ōpelu*, take care?

GK: Yeah, for make the *i'a*. Some times, they take their *'ōpelu* to the *po'e mauka* [to the upland people]...

JH: *Mauka.*

GK: For the *po'e māla 'ai* [farmers]. *Mamua, hele kahakai, e ho'olauna lākou.* [Before going back the ocean, they meet together and exchange goods.]

KM: So they would trade?

GK: Yeah.

KM: Oh, so some people stayed *mauka, mahi 'ai* like that...?

JH: Some *kaula'i* [dry fish].

KM: ...and the *lawai'a* [fishermen] they get the fish for exchange? And you said, *kaula'i kekāhi* [some dried]?

JH: *Kaula'i, kaula'i* [Dried, dried fish].

GK: *Kaula'i.*

KM: *O ka 'ōpelu, ka i'a nui?* [*'Ōpelu* was the main fish?]

GK: More *ʻōpelu*. Over here, most *ʻōpelu*, plenty before! Fifteen canoes, fifteen when I counted. And the big kind canoe, not small kind.

KM: Ohh! *A aia ma kēlā ʻaoʻao, o Lae*... [And there at that side, the Point...]? [pauses]

JH: Lae-kahuna.

KM: Lae-kahuna,

GK: *ʻAe.*

KM: *ʻOia kekāhi koʻa*...? [That's one fishing station (per conversation of June 5, 1998)...?]

JH: Yeah, over there.

KM: *ʻOia kekāhi koʻa?*

JH: And Pūʻālaʻa.

KM: Pūʻālaʻa?

GK: *Loʻa* [has].

KM: And Uncle Gabriel, *ua ʻōlelo ʻoe, loʻa kekāhi koʻa, mawaena paha?* [You also said that there was also a *koʻa* in between the two areas yeah?] *Loʻa kekāhi koʻa mawaho o ka loko*; has one *koʻa* outside of the pond area?

GK: Yeah.

JH: Yeah, over there, outside of the pond.

GK: *Nīheu, a mamua nei.* [At Nīheu, and one in front of here (Pali-poko)].

JH: Plenty.

GK And Keahialaka.

JH: Plenty, *mamua loa* [long before]. They *hānai* [feed and care for], that's why.

KM: *ʻOia ka hana?* [That was the custom?]

JH: Yeah.

KM: *Noʻonoʻo lākou, inā mālama lākou i ka iʻa, ola.* [They believed that if they took care of the fish, they would like.]

JH: They *mālama* [take care] and they go. *Pau*, today, only *pōhaku* [stones]. Nobody take care now.

GK: *Aʻole maopopo, ua hala.* [They don't know, the old people have passed away.] But, you take care again, *lako hou* [it will be rich again]. *Hoʻolako i ke koʻa.* [The fishing stations will be rich again.]

JH: Today, no can. If the *poʻe* like you, yeah.

KM: *Nunui ka poʻe, poʻe mai nā ʻāina like ʻole?* [So many people, people from all the different lands?]

JH: Yeah. Now, they like you go make, then they take. But nobody go make. Today style eh, you make, they go get. Ahh [shaking head]!

KM: [chuckles].

GK: Now, *kū'ai 'ōpelu, maunu* [you buy *'ōpelu*, bait]...

JH: They buy plenty.

GK: For the *i'a* [fish], more easy, instead you go out.

KM: Hmm.

GK: but when you buy, the expense too high. But when you go outside, and you get, you can save money.

JH: Had plenty fish.

KM: And uncle, you mentioned Nīheu was a *ko'a*.

JH: Nīheu.

GK: Nīheu.

KM: So "Niehu" as its written on some of the maps is *hewa* [wrong], yeah?

GK: *Pololoi* [right].

JH: That's by the coconut eh.

KM: Hmm. *Kupuna, ua 'ōlelo 'oe, mamua, kou po'e kūpuna, he po'e kālai wa'a lākou?* [*Kupuna*, you said that before, your elders were canoe makers?]

JH: *Kālai wa'a* [canoe makers].

KM: *'Oia. No hea mai ka lākou lā'au, ke kumu?* [Where did they get the wood, the trees?]

JH: Mauna Kea.

KM: Mauna Kea?

JH: *'Ae, a me Hāmākua.* [Yes, and Hāmākua.] You know, *i uka nei* [in the uplands].

GK: *Mamua, kūpuna...* [Before days, elders...]

JH: Strong kind.

GK: *Nunui kālā, hele kū'ai i'a.* [There was a lot of money in selling fish.]

KM: So, *ua hele lākou a kū'ai i kekāhi lā'au?* [So, they went to purchase a log?]

GK: Yeah.

JH: You got to buy.

KM: *A halihali lākou i kēlā lā'au, kēlā kumu nui ia ne'i?* [And then they carried the log, the large tree to here?]

JH: No. Before, my grandfather's days, no more car. Forget about that.

KM: *'Ae, holo wāwae* [yes, they traveled by foot].

JH: Ka'ilima'i, he *make* [died], the old man. He told us the story, where they come from, Hakalau or what. *Pau* they *kālai* [they completed the carving] and then bring 'um around.

KM: Oh, so they bring 'um in the ocean, around?

JH: Yeah, all *pau* already.

KM: *A, ua kālai wa'a i uka, ma Hakalau* [So they carved the canoe in the uplands of Hakalau]?

JH: Yeah. Before them days, no more the *ka'a* [car]. [chuckles] That's right, before, no more the car eh.

KM: *'Ae. Hoihoi kēia* [this is so interesting].

JH: *Hoihoi.*

KM: So *ua launa iākou me nā po'e o kēia mokupuni e?* [So they associated with the people of this island then (not just within the district)?]

JH: Yeah.

KM: *A ua kālai lākou i ka wa'a* [and they carved the canoes].

JH: Because they *ma'a* [familiar] all the families eh, because like the Mormons *mamua* [before].

KM: Hmm.

JH: They were Mormons them [speaking of elders in his family of the middle to later 19th century]. Ka'ilima'i.

KM: So that's already 1800s?

JH: Yeah, 18-something. He's the one that told us.

KM: *A lo'a kekāhi 'ohana me ka inoa 'o Kālaiwa'a ia ne'i ma 'Ahalanui?* [And has one family by the name of Kālaiwa'a here at 'Ahalanui, yeah? (Grant 2982)]

JH: Yeah, what I heard the name, Kālaiwa'a.

KM: William Kālaiwa'a.

[William Māhana Kālaiwa'a, a note Hawaiian chanter and minister (who at one time served at the Pohoiki church), was born at Pū'āla'a in 1856. At that time, his father was *Konohiki* of the area.]

JH: Yeah, and I met one old lady with that name, Kālaiwa'a, that used to stay over here.

KM: *'Ae, ua pili ke kahua hale me ke kula o 'Ahalanui.* [Yes, the house was close to the school at 'Ahalanui.]

JH: Yeah, someplace there. That's the last. Before she passed away, she went Kona.

KM: That's right, Kālaiwa'a went to Kona.

JH: Before, the *'āina* was over here.

KM: Hmm. So before your time, only had the little pier here?

GK: Pier.

JH: Yeah.

KM: But your *kūpuna* brought their canoes in here?

JH: Yeah. I have the picture of the pier, one small pier right here, and they tie the boat.

KM: *'Ae.* And who was your *tūtū*, the one who could *hāpai* [carry] the *wa'a* [canoe] all by himself to the water?

JH: Kapukini.

KM: Kapukini. *Nui 'oia e?* [He was b:g, yeah?]

JH: He was over seven feet tall. They know, the old folks. But he was *make* before I was born. I like check, so I went to look at the grave, in the *ana* [cave] no.

KM: *'Ae.*

JH: I see the bones, long [gestures with his hands – chuckles], that's *pololoi* [right]. The iwi [bones], that's the proof, see.

KM: *E kala mai ia'u, e pili ana nā iwi, he iwi paha ko kēlā wahi, 'o Laepāo'o, Oneloa, a me 'Ahalanui? Ua 'ike paha 'oe i kekāhi...?* [Pardon me, but about the remains, are there remains in that place, Laepāo'o, Oneloa, and 'Ahalanui? Did you perhaps see any...?]

JH: I know of only one *iwi* [burial]. My *'ohana* over there, one girl. She was about 16 years old. One girl.

KM: *I hea* [Where]?

JH: By Campbell's place.

KM: So Kamaka'imoku's *'āina* [land], down by the pond?

JH: Yeah, the pond.

KM: So there, or was it on the *mauka* side of the road.

JH: On the pond, right next. I know that grave. I know.

KM: *Maika'i. Inā loli ka 'āina, pono iā lākou e ho'omaopopo, "he ilina kēia."* [Good. If the land changes, it's important for them to know, "this is a grave site."]

JH: Yeah, yeah.

KM: *Pehea kou mana'o e pili ana nā ilina? Pono no lākou ke waiho, waiho mālie?* [What do you think about the burial sites? Should they just leave them, leave them alone?]

JH: Yeah!

KM: *Mai halihali i kekāhi wahi e a'e?* [Don't take them some place else?]

JH: *A 'ale* [no], leave it marked with the coconut tree. That one is all covered.

KM: *He kaikamahine* [a girl]?

JH: *Kaikamahine.* Only one grave I know. The rest, I don't know, *pau.* That's our family that used to stay over there, *mamua loa* [long before]. They *kanu* [bury] that girl over there.

KM: *'Ae.* Now, *mauka o ka ala nui, lo'a kekāhi hale mamua e?* [Before, on the inland side of the road, used to have houses before, yeah?]

JH: *Mamua loa.* [Long before.]

GK: *Mamua, 'ae.* [Before, yes.]

JH: That time, I was over here, only five, six years old [ca. 1925], those *hale* [houses], all old, already *hā 'ule* [falling down]. Old houses. Big like this kind of house [gesturing his house at Pohoiki]. But one *po'e* [person] did come inside the house, a *malihini* [stranger] from Maui. But the original owner, no more, only the old houses was.

KM: Hmm. So by the early 1920s, *pau*, all the families...

JH: Ahh—when I come [was old enough to remember], nobody was.

GK: *Pau.*

KM: Oh yeah, even when you were born, nobody?

JH: Nobody.

GK: Only the land marks stay.

JH: Land marks, that's the story, yeah.

KM: So the old houses and things?

JH: The old ones knew who this one, and that.

GK: The old foundations...

JH: Kālaiwa'a, Maunakea...they tell me only the story. But I don't see them. They went already, or make [died].

KM: Hmm. No more job over here?

JH: No more job, so they go move Honolulu. And our *'ohana* is the last one. All the others go away.

KM: How long, you guys have been on this land, yeah? A long time.

JH: Yeah. Maybe our *'ohana* was the last of the old people. The rest went go! And when I was young, we get one family that was over there [pointing across to the park area], Kuamo'o.

KM: Kuamo'o family.

JH: They were from Kaukulau, that's the original one, Kuamo'o... That's the head of the big family today, but plenty went away to Honolulu like that. But when I came back, nobody was here, only one son. No more the old ones, pau already.

KM: So you're here now, and your brother William, lives over by Lae-o-kahuna, Keahialaka?

JH: Yeah [chuckles].

KM: He lives by the *heiau*, Mahina-akāka?

JH: Yeah.

KM: And you folks told me last week, that you have *pā ilina* [grave sites] over there too eh?

JH: Yeah, that's one, and McKenzie Park, that's a big one. That's where they *kanu* [bury] twenty-seven (27), *kapu* [forbidden, no can touch]! That's our *'ohana* there. You can see from outside the *ala nui* [road] in the *lepo* [dirt].

KM: Yes. So that's your 'ohana too?

JH: Yeah.

KM: It's so important that they know, *kama'āina* to this *ilina* [burial sites]. Like this place Uncle, you knew Napalapalai eh?

GK: Yeah, but they all gone, they went back to Hilo. They lived on Hawaiian Home Lands.

JH: I think that when the Hawaiian Homes opened, they moved plenty people. And they went to Honolulu too.

GK: What's more, they get more advantage, living on Hawaiian Home Lands. More easy. But nowadays...

JH: That's why they left that place.

KM: Hmm.

GK: So I guess Jimmy Kealoha came in. I don't know the true story, but he said he bought the place.

KM: *'Ae*, Napalapalai's Grant 6845, from his *'ohana*?

GK: Yeah.

KM: Jimmy Kealoha is your relative, he's *pili* to you?

GK: No.

KM: No, different all together?

GK: Well, I'll tell you the story. His mother is Makanui. So his mother, and Kwong Chi Wong was going together...

JH: Oh, that's the one.

GK: They was going together, and that's how got Jimmy. So actually Jimmy, his name should be Makanui... But he took the name Kealoha.

KM: Oh, so he's not even *pili* [related] to you?

GK: No.

KM: But, *ua kū'ai 'oia i kēlā 'āina a Napalapalai?* [He purchased that land of Napalapalai's?]

GK: Yeah, he had money so he went for County Chairman eh. And he was there for eight years or something.

KM: Hmm. *A heaha ka lākou hana ma kēlā 'āina 'o Laepāo'o, Oneloa i uka? Ka hana a Kealoha mā. Heaha ka lākou hana?* [What did they do on the lands of Laepāo'o, Oneloa, in the upper area? The work of Kealoha them? What did they do?]

GK: *Kanu papaia* [Planted papaya].

KM: Planted papayas. I ka makahiki 19—? [In the year 19—?]

GK: [thinking] I think was somewhere in the 50s.

KM: Nineteen-fifties.

JH: Nineteen-fifties [nods head in agreement].

GK: Somewhere between the 50s and 60s.

JH: Yeah, that's why over here, all papaya. In the early 1950s had papaya.

GK: But first was John Cross. He use d to own that Fred Huff Agency in Hilo, and he opened a *lilikoi* [passion fruit] farm. That's where Bill, [pointing to John Hale], his brother worked.

JH: Yeah, he worked the papaya.

KM: John Cross.

GK: Then the *lilikoi* farm fold up...

JH: Fold up [chuckles].

GK: Kuwaye Trucking went open the land. Kealoha was afterwards.

JH: Then Kealoha took over.

KM: Oh, so John Cross, Kuwaye, and then Kealoha?

JH: Yeah. So my son-in-law worked with him.

KM: Oh wow! Now you'd said, that when you were young, you went to go *'ohi lau hala* [pick pandanus leaves]?

GK: Yeah, was with Thomas Makuakāne. I was young that time, I hadn't married his daughter yet. Thomas Makuakāne died in 1960, and my wife is his daughter. But we weren't married when I went with him to pick *lau hala*. I was single. We pick *lau hala*, and when I picked 1,000 leaves, I get $5.00. He had a contract. He got five cents per leaf, so he got $50.00 per 1000. I got $5.00, he got $45.00, so he made money.

KM: Hmm. You said that you *'ohi lau hala maka* eh, green *lau hala*?

GK: Yeah.

KM: And then what did you do?

GK: We would count them in tens and tie them up. And then you make 200. Then we'd make 1000 leafs. One time, I made 3000, $15.00 I made.

KM: Big money at that time eh?

GK: Yeah.

KM: And you also mentioned that you remember there was *'awa* growing *mauka*, in these lands too?

GK: Only *li 'ili 'i* [little bit – pointing around to spots], mostly at Oneloa.

KM: Hmm, scattered around, *kūka 'ikāhi*?

GK: Yeah.

JH: Yeah, all over the place.

KM: Because evidently, Rycroft in the 1870s-1880s, his first business he shipped ʻawa out from the pier, here.

JH: Yeah, you right.

GK: Yeah. Then, I think over here, if he take the *ʻawa* from over here, that's the reason the *ʻawa* was not big one, was still small. We used to go get ʻawa down by Kaliʻu. Me and my mother, and my sister and brother. We go up to *ʻohi* [pick] the *ʻawa*. Big kind [gestures circling arms around the root]! We bring ʻum home...we had one wooden station wagon, Ford, and we put all the *ʻawa* inside there, and bring ʻum home. The patch was about three miles from our house. So we pick ʻum and take ʻum down, and then we chopped ʻum up.

KM: Hmm. *Kaulaʻi* [dried it]?

GK: Kaulaʻi. And the trust company, that's the one that bought that.

KM: Oh, so they bought the *ʻawa* and then shipped it out. From Hilo?

GK: Yeah, from Hilo to Germany.

KM: Ahh.

GK: I guess that's why the ʻawa not that much, only scattered around?

JH: When you take care, it gets big.

GK: And the stalk, they don't throw it away, they planted it.

KM: Ohh! So the replanted it to make new *ʻawa*?

GK: Yeah.

KM: That's how it should be, yeah? Otherwise, you only take, take, take, *pau, nele* [that's it, no more]!

GK: *Nele*!

JH: We replant that.

GK: Like that place we go, no more now, get one ranch now.

KM: At Kaliʻu?

GK: Yeah.

KM: Oh, *aloha*. [Speaking to *kupuna* John] You'd mentioned that your *Kūkū*, some of your elders, down here, they used that for *lāʻau* [medicine] too, yeah?

JH: Yeah, they go up here, and get for medicine.

KM: Last week, you mentioned Joe Mānoa.

JH: Yeah, he's a good *lāʻau* [medicine] man. *Hana lāʻau* [make medicine].

GK: Good for *lapaʻau* [healing].

KM: Uncle Gabriel, you said that when you were young, you had *haki ʻāʻī e* [broken your neck eh]?

GK: Yeah.

KM: And he healed you?

GK: Yeah. The doctor told me that I would never have a normal life again. My mother went to him, he offered prayers and he told her how to prepare the medicine. For five days, morning and night I took the medicine, and when I went to the doctor, he said it was a "miracle." Mānoa had the knowledge.

KM: *'Ae*. So the people down here, were *kahuna lapa'au* [healing practitioners]?

JH: Plenty of them. And one more, Kuamo'o. Kuli, we called him, same thing. And Kupihē.

GK: Who was that *wahine* [woman], the girl married Wright. I forget her name. But this *wahine* she made *lā 'au* too.

JH: Smart this *po 'e* [people].

KM: You *kūpuna* were smart to *ho 'ōla kino* [heal the ailments of the body]?

JH: Yeah.

KM: And last week, you mentioned that they made *lā 'au kahea* [healing by sending prayers only, they did not need to be there physically, or make herbal medicines to heal]?

GK: Yeah.

JH: Yeah. That kind of people different. You talk to them, they're *'olu 'olu* [kind]. They different, not like us. You can tell, you stay with them, you feel good, they get *mana* [spiritual power]. They live their life like that.

KM: Yeah, *aloha*.

JH: Any kind *po 'e*, they give free. They no charge for heal. Good!

GK: I remember Kamoku too, he was *lapa 'au* too. My mother told me the story, my hip had dislocate when I was real young. So My father brought him, and he made *lā 'au*, and it came back in straight.

JH: Yeah, they *huki* [pull] that. The main *lā 'au* I know, that morning glory, the white one.

KM: *'Ae, kōwali* [yes, morning glory].

JH: *Kōwali*, yeah. Night time, *ulu* [grow]. But those guys get plenty *mana*. That's the *lā 'au*. Like you or use make, no work. They make, heal, *huki, pau* [pull, that's it], the *lā 'au ulu* [the medicine grow] eh.

KM: Amazing, *mana lākou* [they had power]. *Mana ka lākou leo pule* [their prayers had power].

JH: Mana ka leo [the voice had power]. They were different *po 'e*.

GK: The *pule* [prayer].

JH: You go their place, they give everything for free. They don't take *kālā* [money]. Giving.

GK: *Po 'e lapa 'au* [healers], they know, they understand your nature. If you get *mana 'o 'i 'o* [faith]...but not only *mana 'o 'i 'o* you can do 'um, you got to *hana*

[work, make it], do something about it. I think this old people, *lapa'au*, they understand that. And when they did their *lā'au*, they also prayed.

KM: *'Ae.*

JH: They *pule.*

GK: You must have faith that they can do something about the *lā'au*. So this two [faith and medicine] together, *pono* [that's right]. If they only *wala'au* [talk], and don't do, then nothing, no can.

JH: Yeah, I give you the same medicine, no work [chuckles]. That other one who only need to *wala'au* [as in the practitioners of *lā'au kahea*], that's the one, you have to work for that. For small stuff can; you make the *noni*, alright, but if you inside, no good, no work. Now, the *haole* medicine different [chuckles]. Anybody they touch, can work. Hawaiian one, no, bum-bye backfire.

KM: Hmm. *Mamua, kou po'e kūpuna, ua hana lākou i uka i ka māla 'ai, a hele lākou i ka lawai'a?* [Before then, your elders went to the uplands to cultivate, and they went to fish?]

JH: *'Ae i ka māla 'ai a lawai'a.* [Yes, planting and fishing.]

KM: And *'o 'oe pū a me 'oe uncle, ua hele 'olua i ka lawai'a...?*

JH: [pointing to Uncle Gabriel] Him, he go *lawai'a* [fishing]. Me, I don't go, I go make *'ōpae* for them.

GK: That's why, I asked Billy, he said he get plenty *talapia* now.

KM: Oh, so they eat the *'ōpae* now?

GK: Yeah.

KM: So this pond by your old house, Maunakea Pond, you don't think it had *'ōpae*?

JH: Only I know, had *i'a* [fish].

KM: Hmm. And what, when *'ōkaikai* [rough seas], did they sometimes take the *i'a* out of there to eat?

JH: They hardly ate that fish. That was just like their pet. Puna get plenty *i'a* those days. All over get i'a, so the ones in the ponds, they leave. They were like pets, nice the *i'a*, clean. The *i'a lelele* [fish jump].

KM: Hmm. So you folks would get *'ōpelu* out here?

JH/GK: Yeah, yeah.

KM: Were there other kinds of fish too?

GK: *Kā'ili* [casting], *kākā*, that's bottom fishing.

KM: And what kinds of fish?

GK: *Ulaula, koa'e* [snappers]; the Japanese call that *onaga. Ehu, paka, 'ōpakapaka,* and *kalikali, 'ukiki.*

KM: *Nui nō nā i'a. Ola kēia 'āina i ka nui o nā i'a* [Many kinds of fish. This land, the people, had life in the many fish].

JH: Oh yes.

KM: *Pehea, o ho'i i kahakai, ke ha'awi 'oe ka i'a i ka 'ohana?* [How about, when you returned to the shore, did you share fish with the family here?]

GK: *Ha'awi* [shared]. *Mamua* [before]. Now, *a'ale* [no], they don't.

JH: Nobody give.

GK: I give.

JH: Yeah, he practice the old way. [chuckles] He's *pau*, no more *i'a* [fish]. Your *i'a*, you got to go buy.

KM: [chuckles] *'Oia ka hana a nā kahiko, inā hele lākou lawai'a...* [That was the practice of the old people, if the went fishing...]

[end of Tape 1, Side A; begin Side B]

JH: ...like if I went to get *'ōpae*, I get one share.

GK: Yeah, he get one share.

KM: *'Oia ka hana a nā kūpuna?* [That was the custom of the elders?]

JH: *Kūpuna*, yeah.

KM: *Ke māhele ka i'a, alaila, pōmaika'i lākou a loa'a ka i'a hou?* [By sharing the fish, they were blessed, and would get fish again?]

GK: *Pono! Pono kēlā.* [Right! That's right.]

JH: And the *po'e* [people], you go over there, they give you *i'a*, when you *hāpai wa'a* [help carry canoe]. The old style no.

GK: Over here in Puna, *a'ole wala'au* [they don't say], "*Hele ki'i ka i i'a* " (help yourself to the fish).

JH: Not like Kona.

GK: *Puna, a'ole. Hana ka lima a ha'awi.* [Puna, no. They take with their hands and give.]

JH: Kona different.

GK: This is *pololoi* [right].

JH: Yeah. Some the tell you "*hele ki'i*" [go take], but you no like, because you *hilahila* [shame]. They *ha'awi* [give — chuckles], one *pākeke* [bucket]. That's their style.

KM: *Maika'i. 'Oia ka hana a 'oukou i Puna nei?* [Good. That's the custom of you folks in Puna?]

JH: Yeah, Puna.

GK: *Mamua* [before], everybody use *'ōpae* in Puna. In Kona the use *kalo, pala'ai* [taro, pumpkin], pear, any kind for feed.

KM: But Puna, *'ōpae*?

GK: *'Ōpae.*

JH: *'Ula 'ula* [red], the *'ōpae*. And when you *'oki* [cut] the *ōpū* [stomach], clean.

KM: *Pehea, ua hana pōpō, ka 'a'ai, me ka limu paha?* [How about, did you make the bait ball, to spread the *'ōpae* with the seaweed perhaps?]

GK: *A 'ole* [no], we'd just use the *'eke palu malalo* [bait bag underneath].

JH: *Kiloi* [throw 'um].

KM: They just dropped the *'ōpae* in the 'eke [bag]?

GK: *'Ae.*

JH: They *'au'au* [swim]; the *'ōpae.*

GK: Yeah, and we get the *limu* inside.

KM: So the net is *poepoe* [round]?

GK: Yeah, *poepoe.*

JH: *Aia a poepoe* [it's round].

GK: Over here, Puna, *pi'o ka 'upena* [the net is curved]. *A ka i'a, komo i loko o ka 'upena, a hāpai.* [When the fish come inside the net, you lift it up.] But the *'upena*, leave in the water. *'Elua kaula, huki, mamua a mahape.* [The net is pulled with two ropes, one in front and one in back.] And the *'upena* is pulled up.

KM: *'Ekolu po'e ma ka wa'a?* [Three people on the canoe?]

GK: *Mamua a mahope. Ho'okāhi hānai, ho'okāhi mākaukau, a me ho'okāhi ho'opa'a ka wa'a* [In front and in back. One would feed the fish, one makes the net and baits ready, and one keeps the canoe steady.]

KM: So *huki like lāua* [they pull together]?

GK: *Huki ka 'upena, 'ae. A ka 'ōpelu, i loko. A kau i ka wa'a i waho.* [Pull the net, yes. And the *'ōpelu* are inside the net, set on the outside of the canoe.] Kona, different. *Pi'o ka 'upena, a komo ka i'a i loko o ka 'upena, a hāpai ka 'ōpelu i ka wa'a, huki ka 'upena.* [The net is curved, but when the fish come in the net, they lift the *'ōpelu* into the canoe, pull the net.] Outside, they *hemo* [remove] the *'ōpelu.* But over here, different.

KM: So different style. The families in the various districts have their own styles, yeah.

JH: Yeah, their own style.

GK: I think maybe, that is modern, but over here is different, still the same old way.

JH: Yeah.

KM: *I kou wā li'ili'i, a i ka wā a kou po'e mākua, kou 'ohana wale nō ka po'e o kēia 'āina kahakai?* [So in your youth, and the time of your parents, it was only your family on this shoreward land?]

JH: Yeah.

KM: *Pehea, mamua, nui nā po'e hele lawai'a?* [How about before, were there a lot of people who came here to go fish?]

JH: Not many.

KM: But *kēia manawa, nui* [nowadays, plenty]?

GK: *Nui* [plenty].

JH: *Nui 'ino* [too many]!

KM: *'Oia ka pilikia, hele lākou lawai'a mau, akā a'ole lākou hānai, a'ole lākou mālama i ka i'a?* [That's trouble, they all come fish, but they don't feed, they don't take care of the fish?]

JH: No *mālama* [don't take care].

GK: Most *po'e, a'ole mālama* [most people don't take care]. *Hele lawai'a, po'e hana the boat, hana like.* [You go fish, the people who worked the boats, worked together.] If I call and gesture to the water, everybody's net doesn't go down. Me, the first one to go down. When my net comes up, then you, the next one. So everybody shares the *'ōpelu.*

KM: They share. And *he lau paha* [perhaps 400]? Plenty?

JH: Plenty.

GK: But today, the regulation now, changed. Kona, *'ōpelu*, you no can go get *'ōpelu. 'Ōpelu makau, 'ōpelu 'upena* [hook or net *'ōpelu*]. Over here, *hiki* [can].

KM: *A ua kaula'i 'oukou i ka 'ōpelu , kaha a...?* [And you would dry the *'ōpelu*, cut 'um and...?]

JH: *'Ae, kaula'i.* [Yes, dried.]

KM: *No hea mai ka pa'akai*?

JH: Over here, *kū'ai* [purchased], I think. In Kalapana, they go, no.

GK: Kekaha.

JH: Yeah, Kekaha.

KM: *Kekaha 'o Puna* [Kekaha of Puna]?

GK: In the National Park side.

KM: *'Oia Kekaha, he 'āina malo 'o, a hiki iā lākou ke kaula'i i ke kai e?* [That Kekaha, it's a dry land, so they can dry the sea water eh?]

GK: *Kaula'i ke kai* [dry the salt water.] *Mahape, kū'ai.* [later on it was bought.]

KM: Hmm, *i kou wā* [in your time]?

JH: *Kū'ai 'ia* [it was purchased]. Over here, no more that kind. No more like Kalapana and past, the *pāhoehoe* flats.

KM: Ahh. *A ua kēia 'āina.* [And this land has rain.]

JH: *'Ae. Hehe'e ka pa'akai* [the salt would be all watery].

KM: *'Ae.* So you'd said, that you'd seen some walled sites in this land over here [pointing towards the Oneloa-'Ahalanui vicinity], where they would make *māla 'ai* [agricultural areas], and kahua hale [house platforms], yeah? You said still has the mark where they lived before?

GK: Yeah.

JH: It has, the stone they went hemo [remove – relocate] eh. The *māla 'ai.*

KM: So what do you think about them? Should they take care of the old Hawaiian places that are left over there?

JH: The papaya went *huki* already.

KM: But down the road side...

JH: The road, way down still get.

GK: Close to the road.

KM: And you know, 'Ahalanui, where it bounds Pū'āla'a?

JH: Yeah.

KM: Still has one section that they never go inside with the bulldozers.

GK: No, no, no. That' area they no touch.

KM: They no touch.

GK: No touch.

KM: So is it better to leave that, where all the old walls are...?

JH: Yeah, no touch.

GK: And plus, the trail goes up too.

JH: Yeah, it goes up someplace, up there [pointing to general inland area on the map].

KM: That's right. Had the place called, on the map, in your Tūtū's time, called Kahaleolono.

JH: Oh, yeah.

KM: It was an old cultivating ground they said. Did you ever hear that name?

GK: No, that's the first time I hear that.

KM: Hmm. There on the old map.

JH: That's where we go up the forest. My brother told me about that, a nice place. They went bull doze some of that, papaya. Billy said *'ulu*, big kind trees! Was Cross guys time. That was a nice place.

GK: And then had some other growers too. Independent growers like my brother-in-law, Peter Hauani'o. P & S Hauani'o Farm. That's another independent grower.

KM: So that was still after the war, when Cross came in yeah?

JH: Fifties, I think.

GK: Before that, they didn't allow.

KM: So was only *nahelehele* [overgrown forest]?

JH: Yeah.

KM: And what, had *pipi* [cattle], had *pipi* around here?

JH: Here had.

GK: Was open range. *Pipi*...

JH: They went mark 'um, and *pu'a* [pigs].

KM: Hmm.

GK: Animals, they go back and forth, Pānau and all the way.

KM: Oh, so back forth, all the way from Pānau to Kapoho?

JH: At my brother's place, get the water they drank, *wai*.

GK: That's how the grass stayed down.

JH: Good, clean the yard, clean. You no need clean the yard.

GK: Although, get plenty pie on the road [smiling].

KM: [chuckles]

GK: No problem.

KM: That's what you said the other day, this old *ala nui* [road] here, the pipi kept everything all clean.

JH: Yeah, was clean before.

GK: My grand-uncle, some times I'd see him going this way for find his cattle. Get plenty Hawaiians, own the cattle.

KM: So it was Hawaiian families, and then Lyman had down Kapoho too eh?

GK: Yeah, Lyman had. And after, when they opened the subdivision [Kapoho lots; ca. 1950] and the papaya farms, then had a little bit wild kind cows. So me and my father-in-law, went on the trail over there [the 'Ahalanui-Pū'āla'a trail] go up. We came on a different portion.

KM: So you folks used that old trail to go up the *ala nui* [road] side like that?

GK: Yeah, we used that old trail, go up, hit the railroad trail, then we go hit home. He was leasing the place up at Malama that time. *Mauka* Malama.

KM: And you said he was still planting taro too?

GK: Yeah.

KM: When did you marry your wife?

GK: Nineteen-fifty. Wasn't my father-in-law yet, at that time, but I was working for him.

KM: That's amazing, you folks were growing all dryland taro like that, *kalo*.

JH: Dryland.

KM: *'Ono* [good]?

JH: *'Ono*.

GK: *Maika'i* [good].

KM: *Heaha ke 'ano kalo?* [What kinds of taro?]

JH: Plentiful. *Kūoho, lehua*, all the good ones

GK: *Lehua.*

JH: *Mana.*

GK: *'Ele'ele.*

JH: *Nunui nā kalo* [many taros]. *Pākeke* [gestures the corm as the size of a bucket]. The only thing, hard work, *ulu ka mau'u* [the grass grew up]. The water kind, more easy. This kind, the *mau'u* grow.

KM: Did you folks sometimes burn the fields a little bit and then *huli* [turn] the soil?

JH: [shaking head, no]

GK: No, no.

KM: So you make *kāpulu* [mulch] everything?

JH: Yeah.

GK: Yeah. We use *'ō'ō* [digging stick] to make the planting holes round.

KM: So in all the places where had *lepo* [soil], like that?

JH: You keep the *mau'u*, pile up.

GK: Because we use the *'ō'ō* [gestures, prying up the soil to make an opening for the *kalo*], put the *lepo* up, make wide *puka* like this [approximately 8 inches], that's all. *Lawa* [enough]. Then put the *huli* [taro top] inside.

KM: *'Ae. Māmalu o luna*; did the trees still grow over head for shade?

GK: *A'ale* [no].

KM: So was a wide open field?

GK: Yeah, wide open.

KM: So there were no big trees for shade?

GK: No. And the leaf, make mulch.

KM: Hmm. So *hā'ule ka ua, he kēhau paha, ka mea ho'opulu...?* [So the rains fell, the dew perhaps, to moisten...?]

JH: Yeah.

GK: And the *lā'au* [wood], *'oki* [cut] for fire wood.

JH: Every day.

KM: Every day, *hana* [work].

GK: *A'ale hana, a'ale 'oe 'ai.* [No work, you don't eat.] [chuckles]

KM: *'Ae, 'oia ke 'ano o ka po'e kūpuna.* [That was the nature of the elders.] And your *kupuna wahine*, 70s-80s, still went to *hana* [work]?

JH: She go *hana, po'e mahi'ai* [work, the farmers]. No more fun those days.

KM: Were you folks the only children down here?

JH: We get some more.

GK: Had Kupihē.

JH: They come, and then bum-bye they go back. The guys from up mountain.

GK: And the Browns.

JH: Brown.

KM: *Ihea 'oe hele i ke kula?* [Where did you go to school?]

JH: ʻŌpihikao that time.

KM: So this *kula* [school] at Pohoiki, was *pau* already.

JH: Yeah *pau*, our days, it was *pau*.

KM: And then what, *ua hele 'oe i Pāhoa* [did you go to Pāhoa as well]?

JH: I never go. No more bus those days, you no can. You got to walk too far.

KM: Yeah. This road that comes down *makai*, here, was it still all *ala lepo* [dirt road]?

JH: *Lepo* [dirt], we walk. In the 60s, I think they went pave ʻum.

KM: *Pehea ke ala nui 'aupuni ma ke kai? Lepo, ai'ole pōhaku wale nō?* [How about the Government road along the shore, only dirt or stone?]

JH: Yeah.

GK: The *ala nui* that's over here, that was *mamua* [in front — on the ocean side] more.

JH: Yeah.

GK: Was more *makai*.

JH: When I was young, the car, some times two weeks only one car come. Them days, no more car. No more car, Model A only. The people no can buy car [chuckles]. My grandmother had car, Studebaker, living the other side, the old lady had.

KM: Is that Mele Hale?

JH: Mele.

KM: Last week, you showed me that picture with Mele Hale, your papa Isaac, your mother, and some of your sisters?

JH: Yeah.

KM: So the land has changed, yeah?

JH: Yeah.

GK: Changed.

JH: *Mamua* [before] nice, because the *po'e* [people] clean the place. Had the stone walls, the flowers, no! Today's people no take care.

KM: *'Ae. 'Oia ka mea nui, inā hiki iā lākou ke a'o i nā keiki i kēia mo'olelo kūpuna...* [Yes. That's and important thing, if the can teach the children these stories of the elders...]

JH: Yes, good.

KM: *Alaila, maopopo lākou, pono iā lākou ke noho 'olu'olu, noho lōkāhi e?* [Then they will understand that it's important for them to dwell with kindness, and live in unity eh?]

JH: *Noho lōkāhi. Lōkāhi!* [live in unity. As one!] Yeah, I stayed with my *kūpuna* how many years, I never hear them *wala'au 'ino* [talk bad]. No more, *mamua* [before]. They don't talk like that, the Hawaiian words, no more.

GK: Yeah. My mama, *kumu kula*... [school teacher...]

KM: Ihea [where]?

GK: Kapoho. Then *hele* [go] Kalapana.

KM: *'O wai ka inoa o kou makuahine?* [What was your mother's name?]

GK: *Sarah Kaualalena. No Maui 'oia* [she was from Maui].

KM: Ohh!

GK: *'He keiki 'oia na Poepoe.* [She was a child of Poepoe]

KM: Oh, J.M. Poepoe [a Hawaiian historian and educator].

JH: Who was that Poepoe, your mama's father?

GK: Mama's father. So that one you mentioned earlier, Kapukini.

KM: *'Ae.*

GK: That's the line.

JH: Yeah.

GK: That's the line that comes to my mama.

JH: Yeah. Your mama was our line. We never know that, but his mama went tell me. They were the same line.

KM: So *pili 'olua* [you two are related]?

GK: Hmm.

JH: The mama *mahi 'ai* [farm], and get *'ōpihi*, no can sit down.

KM: *Hana mau* [always working].

GK: *Hana.*

KM: *Kou makuakāne, 'o wai kona inoa?* [Your father, what was his name?]

GK: Gabriel Kealoha.

JH: *No Kalapana* [from Kalapana].

GK: He *hā'ule* [died] in 1935, July 13th.

KM: So you were young yet.

JH: *Keiki ʻōpiopio, makahiki ʻeono* [youngster yet, six years old].

KM: Hmm. *Pono iā ʻoe e hele i ka hana, kōkua i ka ʻohana?* [So you had to go work to help the family?]

JH: *Hana*, hard life.

GK: [nodding head] But my mama, *aʻole walaʻau, ʻōlelo Hawaiʻi* [mama didn't speak Hawaiian to us].

KM: *Haole, Pelekāne* [English], and mama taught school eh.

JH: *Mamua loa* [before], that word was *kapu* [forbidden], that's why.

GK: Kapu [forbidden].

JH: You no can *walaʻau* [speak] Hawaiian in school.

KM: *ʻAe.*

JH: No can, you get *pilikia* [trouble].

KM: *Mahope, hoʻopaʻi* [you get punished].

JH: That's why us, we no can, *kapu.*

KM: *Akā, kou poʻe kūpuna, kamaʻilio Hawaiʻi wale nō e?* [But your grandparents only spoke Hawaiian eh?]

JH: Yeah. That's why me, I have *pilikia* [trouble], my *kūpuna* [grandparents], they *make* [died] when I was *ʻōpiopio* [young], that's why I no can *walaʻau* good. Over here, nobody walaʻau. All plantation place, no more Hawaiian too much. Pau, my old folks no more. That's why we no can *walaʻau.* That's why we at a loss. When I was ten years old, *pau.*

GK: Now, my *moʻopuna* [grandchild], one of my *moʻopuna walaʻau.*

JH: *Akamai* [smart]. The daughter go school. My niece too, all go to school, go learn.

GK: *Moʻopuna, walaʻau Hawaiʻi, ke kupuna, aʻole. Hilahila.* [Grandchild speaks Hawaiian, the grandfather can't, shame.]

KM: *Aʻole. No ka mea, o nā kūpuna, nā mea, nā kumu nō hoʻi!* [No. Because the grandparents are the ones, they are the source!] *I kēia manawa, kekāhi loʻa ka ʻōlelo, ma ka alelo wale nō, aʻale ma ka naʻau...* [Nowadays, so have the language, but it's on the tongue only, not inside...]

JH: Yeah.

GK: *ʻAe* [chuckles].

KM: So *pono iā mākou, nā ʻōpio, e hoʻolohe iā ʻoukou, nā kūpuna.* [It's best for us, the young ones, to listen to you, the elders.]

JH: [speaking to Uncle Gabriel] You know, I listen to him, it's like my Kūkū talking. Yours is pure.

KM: Oh, *mahalo. Hemahema wau, akā, mahalo i nā kūpuna.* [I'm unskilled, by give thanks to the elders]...

JH: That's why, when you talked last week, I knew already, you come straight from the old school...

[further discussion on differences in spoken Hawaiian; not included with the transcript]

KM: ...So beautiful this *'āina* down here. I see the *kamani* [*Calophyllum inophyllum* – an important Hawaiian introduction from *Kahiki*] trees...

JH: Yeah. We like them preserve that.

KM: Preserve those trees?

JH: Right.

KM: The old trees. And in the 'Ahalanui area, I see the *alahe'e* [*Canthium odoratum* – a native tree in the drier Puna forests].

JH: Yeah.

KM: So you'd like to see them take care of the old forest and Hawaiian plants?

JH: Yeah.

KM: The *pū hala* [pandanus trees] are important too.

JH: Don't touch. In 'Ahalanui too. All those coconuts over there.

GK: The *niu* [coconut trees].

KM: Got to take care?

JH: The *niu*, I like.

KM: So take of the *niu*, the *kamani*, the *alahe'e*, *lama*, *pū hala* like that?

JH: Yeah. For them, the *kūpuna*, even the *niu*, that's life. I no like them take those out.

GK: Before the missionary came, had some *po'e lāhui* [people] bring the *niu* and *kanu* [plant].

JH: Plenty was.

GK: The vision was, they *kanu* for when they travel. They get coconut for eat. Coconut for *'ai* [food].

KM: *'Ae. Ua lohe paha 'olua i ka 'ōlelo nane a nā kūpuna, "Ku'u punawai, kau i lewa, heaha lā?"* [Yes. maybe you heard the riddle of the elders, "My spring is set in the sky, what is it?"]

JH: *Niu.*

KM: *'Ae, he niu. Na'auao nā kūpuna.* [Yes, a coconut. The elders were very smart.]

JH: Smart!

KM: So they planted for take care, when they traveled?

JH: Yeah. Just like Pū'āla'a before. You know that Pū'āla'a?

KM: *'Ae.*

JH: You know the Pū'āla'a coconut, before and all at McKenzie Park. But that *haole*, he came here from Scotland, he was 18 years old, work for the plantation. He was one manager. Before he died, he went planted all that coconuts. I went plant for him. You seen that?

KM: Yeah, at Pū'āla'a.

GK: Yeah [chuckles].

JH: The three, and then the Hawaiian priest went pray. He thanked the haole for make this plant over here, make for the next generation. Plant this coconut trees. He dedicated. Was easy, I only put down. But now, they like *hemo* [take out] some trees eh. So every time they ask me, they *maka'u* [afraid]. But the prayer part, I don't like. Inside that prayer, he said just like, you destroy the tree, you going pay the price. Just like no 'oki [cut] the tree or what.

KM: Hmm. *Ua kau ka leo e* [the word was put down eh]?

JH: Yeah. That's what I went tell them. I went to a meeting for the County. I don't know if they believe, but if *hemo* [remove 'um], and *make* [kill] the tree, the *pule* [prayer] I'm afraid. Mānoa went pray.

KM: Was Joe Mānoa?

JH: [chuckles] Yeah. I call him uncle. He went pule [pray], I went with him, 'cause I went plant the tree. He thanked the *haole* for planting the trees.

GK: Mānoa was more older than him.

JH: Yeah. For think about the tree that the haole went give for the next generation for use, for eat. Not for make money. That's why when I hear them, I told the council what I think about the prayer. That kind, bum-bye they get trouble.

KM: Hmm. About when was that, do you think?

JH: About 1960.

GK: 1950s maybe.

JH: I went plant, was all barren before. Across the road, nice.

GK: That's his original house.

JH: Yeah, but he died, the old man.

KM: *'Ae, nā kumu like 'ole, mea ho'owehi 'āina.* [Yes, the different trees are an adornment on the land.]

JH: Yeah, nice.

KM: *Pono iā lākou i kēia 'āina 'o Matsuura mā, pono iā lākou ke...* [It's good for them on this land, of Matsuura folks, good for them to...]

JH: Keep the old trees.

KM: *...mālama i nā kumu* [...protect the trees]?

JH: Yeah, they know. And they like that, because they like for the golf course and what. No trouble. Over there get no more...like down the beach, coast. My brother and us, we no like touch the trees.

KM: And this *kamani* is so beautiful.

JH: If a park come in, bum-bye they going trim 'um. They no like tree because all rubbish, so they cut. Like coconut trees, they no like too.

KM: Hmm. *Akā, no wai ka hewa? Inā noho 'oe malalo o ke kumu niu a hā'ule hua...* [But who's at fault. If you sit beneath a coconut tree, and the nut falls...]

JH: [laughing] Yeah.

KM: *...no wai ka hewa? A'ale na ka niu e?* [...who's mistake was it? Not the coconut eh?]

JH: Yeah [laughing].

KM: *Na ka mea noho malalo. E ne'e mawaho.* [The one who sat underneath. So move outside.]

JH: Yeah. But about the car, they like the parking lot. So that one, I told them, If I didn't hear the prayer, would be alright. But me, I'm going to get jam up. It will hit me, 'cause I hear.

KM: Hmm. That's right, because you heard your uncle.

JH: Yeah. He talk, he thanked the haole about the tree, for give new life. The next person's food. Then, you go kill the tree, you going pay with your life. Protect the tree. That's why, that kind of prayer, no good. The old man went pray.

KM: *Mana kona leo?* [His voice was powerful?]

JH: He work. He make, somebody got to replace that tree. That's the old custom. Hawaiian kind. That's why they say, "Don't kill the old tree." That's the reason I don't want to cut.

GK: Yeah, was something like 50 trees.

JH: Danger that one.

GK: I was over there, I was approached too, But I tell no. Even the outdoor circle, they went like for themselves.

JH: Don't touch.

GK: I tell them, "No, no, no. What ever you sell that coconut tree for, that money, got to use for the Hawaiian children, scholarship.

JH: Yeah, but no can cut that kind.

KM: So they have to give back then eh?

GK: Yeah, they got to give back.

JH: But them, I don't know if they going give back [chuckles]. This kind western style. That's why I don't trust. Bum-bye *hemo* [remove 'um], no can *hiamoe* [sleep] night time [chuckles].

KM: *Aloha.*

JH: Leave 'um, that coconut trees.

KM: So they're looking at using this *'āina*, that was bulldozed before, yeah.

JH: Yeah.

KM: They want to make a golf course, and some houses and things like that.

JH: Yeah.

KM: What do you think? If they use that area, what?

JH: It was bulldozed already.

GK: If they going use that for golf course are, I think they should look to the Hawaiian people. Provide jobs for the Hawaiian people.

KM: Yeah. For the people who are kama'āina [native] to this land.

GK: Yeah.

KM: That way, the families can stay home.

GK: The family can stay. But if they don't agree, then I don't agree too.

KM: I think that's what they are looking at, a way to use...

GK: Yeah.

JH: That's right.

KM: ...to use the *'āina* and then have jobs for the families.

JH: Yeah.

GK: I know, I was talking to some of my children. I told them, "We stay working on the A & O golf course." First thing they come out, they say, "I opposed." I said, "You opposed, you come to the meeting. If you only oppose now, and you don't come to the meeting, and that thing go, hey! Next thing you say, 'I opposed this.' But I never see you." That been happen to the fishermen. I attend to the meetings, about regulation of the fish, management of the Kona one. I attend the meetings. So not too long ago, the legislature approved the regulation and the management for the fishery. Now the fishermen, they're angry. I said, "Where were you?" Not only me, I have to go. If everybody come and say their piece, they can listen to what's your idea. No come only, afterwards, "I oppose this." Too late already!

KM: *A 'ole hiki iā lākou ke ku mahope a 'ohumu wale nō, pono iā lākou ke holo i mua.* [They can't simply stand in the background grumbling, they have to move forward.]

GK: *Holo i mua* [go forward].

JH: Right.

KM: Hmm. *Mahalo, nui ka hoihoi o kēia mo'olelo.* [Thank you so much, this story is do interesting.] *Mahalo nui.* Those are good ideas, take care of the forest, take care of the old Hawaiian places.

JH: Take care of the land. That's what I like, take care.

KM: And the *'ōpae* ponds. I wonder, this water is *'ano wela* [sort of hot], yeah.

JH: *Wela.*

KM: Maybe that's why no more *'ōpae* in the Maunakea side pond.

JH: Maybe.

GK: Because, right now, it's open see. Open, so the ocean comes in, so no more *'ōpae*.

KM: How about Wai'ōpae side in Kapoho? So think there are still *'ōpae*, or no more?

GK: Still has.

KM: And brother's [Wm. Hale's] place at Keahialaka?

JH: No more.

GK: No more, has the *talapia*.

KM: Oh, so they ate the *'ōpae*. Aloha.

JH: They don't clean that place anyway.

KM: So it's hard then. If you'd like to go back to the old style of *'ōpelu* fishing, no more *'ōpae*.

JH: *Pau*.

GK: Uh-hmm. But see, the regulation...

JH: Waste time.

GK: Regulations now, they don't allow.

KM: They don't allow you to fish with the *'ōpae*?

GK: No. So pretty soon, I'm going to ask Andy Levin and Bob Herkes to introduce legislation to open that.

KM: Yeah. Because you used to fish on the canoe for *'ōpelu*, with the *'ōpae*, yeah? That was your livelihood.

GK: *'Ae*.

JH: But they went stop us, before.

GK: They went stop us.

JH: No can go back already.

KM: For you folks, that was your life. You get *'ōpelu*, you go *mahi 'ai* [farm].

JH: Yeah.

GK: We fished.

KM: And what, did you folks trade, *kālewa kekāhi*?

JH: Yeah. But then, was only a few boats. Like today, you're talking about 70 boats, or 50. Forget it, too much. Today, everything go, no more nothing. *Pōhaku wale nō* [only stones remain.]

GK: No more nothing.

KM: So before, when you lived in the *ahupua'a*...?

JH: Yeah.

KM: ...that's where you fished. Did you go *maha'oi* other *ahupua'a*?

JH: Now, *pau* that kind.

KM: Uncle Gabriel, last week, you mentioned something that you *kūpuna*, or your papa told you? "When you lived in a particular *ahupua'a*, that's where you fished, you don't go to somebody else's house."

JH: Yeah, that's how us guys. That's the old guys way.

GK: Because, this person here, doesn't go outside of here. Doesn't go to 'Ōpihikao, the *ahupua'a*. He can go if he goes in the boat of the person from there.

KM: Hmm. So if he goes with the people who lived there, then can?

GK: Right, get permission. And why, the reason they like the *'ōpae* come back, all the guts, they don't throw away. They use that for *palu* [a fish relish], to eat.

KM: So the *'ōpelu* eat the *'ōpae* and then you can make *palu*, *pa'akai* [salt]...

GK: *Pa'akai* and *inamona* [kukui nut relish].

KM: Hmm, *'ono* eh?

GK: *'Ono!*

JH: Yeah, they grumble before. I don't know why. The aku guys, maybe they think we going take all the fish.

KM: If you go make *hauna* [stink bait], all the big fish come in.

JH: Yeah, that's right.

GK: Yeah. Before, the old *kūpuna*, they use the *maunu 'ōpelu* ['ōpelu fish as bait], they use bait. And you go outside for *'ula'ula*, you get 25, 30 hook, all the hooks full with fish.

KM: So each hook got fish?

GK: Yeah. So they go over there, the *ko'a*, once or twice, then they *pau*. Then they go to another *ko'a*. That's how. But today, they go everyday. They anchor, they use chum and that's why, get other big fish, shark, and all that.

KM: Hmm. So all the big fish come in too, and eat all the good fish?

GK: Yeah.

KM: So you'd drop your line with like 25 hooks...how many fathoms, do you think?

GK: One hundred-twenty fathoms for the *'ula'ula*. [boat engine being cleaned in background, made this section of tape difficult to hear] And everything on that hook is *'ula'ula*.

KM: Amazing!

GK: And *koa'e*, 250 feet, that's way down. But you use big stone weight for go down.

KM: And what, when you get down to the right depth, you *huki* [gestures, jerking the line] and let the stone go, or do you pull it all the way back up?

GK: Let 'um go, break 'um.

JH: Let the stones go.

GK: So you don't buy the led.

JH: Different kind, yeah? More fast.

GK: Like now, they say the 'ula'ula and koa'e, safety plan. No go fish. So in the meeting, I told them "I disagree what you fellas said. You fellas may be scientist and everything, but I disagree. I think the problem now, is *ta'ape*. *Ta'ape* and *to'au*, that's the problem. This is the problem, the *ta'ape* and *to'au* is the problem. They planted all that and they eat the baby. The *ehu, 'ōpakapaka, kalikali, ukiki*; when they born, their eggs, they eat that."

JH: *Aloha ka i'a* [*aloha* (compassion) for the fish]. They went throw 'um out here too. Plenty!

GK: So I explained to them, "You folks introduced this fish, 1954. Before 1954, wasn't like that. There wasn't any *ta'ape*. Today, we no can make money with the *ta'ape*. It doesn't pay the expense, the poundage." [boat engine turned off]

JH: That's no good fish.

GK: And you know what the guy said, "Yes the poundage, why should we go take the fish? The fish is nothing for us."

JH: Yeah, they went throw 'um in water outside here.

KM: Yeah, *aloha*. These guys have *'ike palapala* [paper knowledge], but they aren't *kama'āina*, they don't know how the fish work, the seasons...

JH: That's right.

KM: So your *kūpuna*, you folks would just go out here with the canoe only, and the waves like this were okay with the canoes? [the ocean waves were at times cresting around 20 feet, during the interview]

JH: They don't go, only when good water.

GK: Only in good water.

JH: They go *mahi 'ai* [farm] when rough.

KM: So the time when *'ōkaikai* [rough ocean], that's when the fish population comes more strong too then?

JH: Yeah. They go *kanu* [plant].

GK: Yeah, they plant taro. That's why this one, they go when good.

JH: Good water, go out. Rough, no can. *Mālie* [calm water], they come down.

GK: But certain fish, like if the water isn't so calm, you get advantage for go get *'ū'ū*, the menpachi, right from the shore line.

KM: Hmm.

JH: Hoo—plenty *'ōpelu*! *Piha ka 'ōpelu* [the ocean was full of *'ōpelu*]. Just like rubbish.

GK: I think now has, nobody goes.

KM: No one goes for *'ōpelu* now?

JH: Nobody goes. Before, somebody would go, throw *palu* [feed]. You got to feed the *'ōpelu, hānai* the leader.

KM: Hmm, the *'ōpelu au'a* [the *'ōpelu* that guards the *ko'a*].

JH: Yeah, then you go. But who going make 'um. That's the style today. The old days, you make, somebody go make. Now, you make, everybody would go.

KM: Hmm. *Mahalo nui iā 'olua i kēia kama'ilio ana. Na'u nō e kākau kēia...* [Thank you both so much for talking with me. I'll go write this out...]

JH: Yeah.

KM: *...a ho'iho'i iā 'olua i ka mo'olelo.* [...and return the story to you.]

JH: Yeah. *Lawa* [enough].

GK: But our days was [pauses], some times we use coconut, *lā'au*, bamboo for put the canoe up. *Lona* [canoe rollers]. By the time you come with the skiff, we use 'um. But every time the boat *puka* [get a hole]. But the canoe, no problem.

JH: Yeah, the canoe.

KM: Where did your folks canoes go? Like in the picture you showed me earlier? Do you still have your family canoe?

JH: The canoe *pau*. Was heavy kind.

GK: Heavy.

JH: Because rough water eh. Heavy, and over here Hawaiians, big kind crew. My father guys...

KM: How big was the crew?

JH: Four. Big kind guys.

KM: And your *kūpuna, kālai* [carved] those *wa'a* [canoes]?

JH: Yeah, before. We *ma'a* [used to] rough water. Wide kind, heavy.

KM: Good for the waves yeah, and for carry the fish.

JH: My father, the paddle big, you know [gesturing the paddle size].

GK: [chuckles]

KM: Hoo!

JH: Big hand eh. And my father's paddle, I went cut 'um for make it smaller, I no can hold 'um.

KM: So the blade like was almost two feet across?

JH: Big kind paddle for *huki* that big canoe. Us, we no can *huki*. How do you *huki* that kind of canoe? [chuckles]

KM: [chuckling]

JH: For them, it was light.

KM: Yeah, that's what you said, Kapukini, he could *hāpai* [carry] the *wa'a* [canoe] by himself, yeah?

JH: He *hāpai* the canoe. He was big that's why, more then seven feet. When he stands by the canoe, the canoe looks small. He was big. Different breed that. You know the stone, they carry big kind [chuckles]. Today, kind no can.

KM: Yeah. You know, inside some places, by this area [pointing to proposed project area in Oneloa-'Ahalanui], if they have *ilina* [graves] or *iwi* [remains], do you think that that must be from the old people?

JH: Cave?

KM: Yeah, and even they make *pū 'o 'a* [above surface burial mounds]?

JH: Yeah, get, get.

KM: So *pono iā lākou ke waiho mālie?* [So should the leave that alone?]

JH: Yeah, they leave that.

KM: And the *'ohana* is all gone then?

JH: Gone.

KM: Like Kamakau and Kuahewa [Grant 2466], no more family here now?

JH: No more. When I came, nobody was. From what I remember when I was about six-seven years old. I never see nothing. Only guys come, go, come, go.

KM: And you said, almost all your life you've lived here?

JH: Yeah.

KM: Except for that couple of years during World War II when the military went *kīpaku* [kick] you folks out?

JH: Yeah. Only me was.

KM: So where did you live during that time, 'cause the Navy or some one blocked it off eh?

JH: Oh they blocked this whole Puna coast.

GK: We had one outpost right there [pointing to location].

KM: Oh, they had an outpost right by the parking area for the park now [in the vicinity of the old Pohoiki school lot]?

JH: Yeah, if they going invade, they were going come over here. Kapoho had a landing strip too. But they never come after the December 7th attack.

KM: So you folks had to go live *mauka*?

JH: Kapoho, my father was the camp police [for the old Kapoho plantation village]. He was the police.

KM: So you stayed down by Kapoho side?

GK: They only thing, we had to black out the window.

JH: Yeah, the windows.

KM: So for a couple of years, you couldn't live down here?

JH: Yeah. Then pau, I came and stayed, my Aunty stayed, and my brother guys, my sister. Always somebody stayed. I come and go, but always the family is here.

KM: Hmm. *Nui kou aloha i kēia 'āina?* [You have great love for this land eh?]

JH: *Nui ke aloha* [great love]...!

[end of Tape 1, side B; begin Tape 2, side A]

KM: [asked *kupuna* John if he knew of any old songs for the area]

JH: [answered — "*Manu 'Ō'ō*," which he thinks was originally written by Tutu Mānoa] ... I told you about the Makuakāne *wahine*, the one who speaks Hawaiian. The grandfather told me. He comes from that place.

GK: It's a good song

KM: *Kaulana 'o Pu'ulena e?* [Pu'ulena is famous, yeah?]

JH: *Kaulana* [famous].

KM: *I nā mo'olelo a me nā mele Hawai'i.* [In the stories and songs of Hawai'i.]

JH: Me, I think that mountain is for him. Underneath, get nice *lepo* [soil]. You've seen that mountain eh?

KM: *'Ae.*

JH: You go across the crater, has one mango tree. That's where the trail goes down. It goes down like this [gestures, turning along the slope].

KM: And below there, is where the *māla 'ai* [gardens] were for you folks?

JH: Inside there was something, Hawaiian herbs and what. Hidden kind stuff. *Lā'au* [medicinal plants], that the kind of *po'e* [people] that live over there. Before the Christian time. *Mamua, kahiko* [before, ancient] time.

KM: *Pehea kou mana'o, ua lohe paha 'oe, he heiau paha kēia 'āina 'o 'Ahalanui, Laepāo'o, me Oneloa paha?* [What do you think, did you perhaps hear about a temple in the lands of 'Ahalanui, Laepāo'o, or Oneloa?]

JH: No.

KM: *A 'ole* [no]?

JH: No. They get, but these old *po'e kahiko* [old people], when you talk to them, they don't talk. They tell, went *hala kēlā manawa* [that time passed], *hala* already. *Pau*, they stay on the Christian. But them two sides too eh. They tell *hala*. But they don't answer. Even my Aunty guys, they don't talk. So we don't know too much about this *heiau* [pointing towards Keahialaka].

KM: Hmm. That' one Mahina-akāka?

JH: Yeah, we don't know about the history. But plenty scientists went... [brief discussion about various archaeologists who have been to Pohoiki vicinity] ...Like over here, 500 years ago, the Hawaiians traveled to the other islands, 5000 miles like nothing. They travel, only looking at the sky.

KM: Hmm, *kilo hōkū* [observing the stars].

JH: Yeah, that's the real one. They smart. And how come the Mauna Kea guys they make over here? Must be the best place, the mountain guys, no. They study the sky, but these old guys, they knew already.

KM: The *kūpuna* over here, knew before.

JH: Hawai'i, they know. That's right.

KM: *I kou wā li'ili'i, a'ole 'oe kama'āina me kekāhi heiau ma kēlā 'ao'ao 'o 'Ahalanui...?* [So in your youth, you weren't familiar with a temple on that side, at 'Ahalanui...?]

JH: No more. Only Kapoho side, on the hill.

KM: *'Ae, Kūki'i* [yes, Kūki'i].

JH: I tell them, I don't know what kind of *heiau* that. Because the cinder cone before, the *heiau*, they used to dig, get plenty bones. So I wonder what that mountain is for. They put the bones.

KM: Hmm. *Kou po'e kūpuna ia ne'i, ua kanu lākou i nā ana i uka?* [your elders here, were they buried in the caves in the uplands?]

JH: No, over here [pointing to the Keahialaka cemetery].

KM: *I ka pā ilina* [in the cemetery]?

JH: Yeah, all in there.

KM: *A ua pono no kēia hānauna, ke waiho mālie...?* [And it's right for this generation to leave them alone...?

JH: Yeah, we no like no body touch, leave 'um alone.

KM: Oh, *mahalo nui.*

JH: Today, the *po'e lāhui* [various nationalities], they scared Hawaiian kind, they *maka'u*, they no touch [chuckles].

KM: Hmm, *mahope, o mu'umu'u* [bum-bye, crippled — gestures turning the hand in]

JH: [chuckles] *Mu'umu'u*! Even this house, if I don't stay, they don't come, they *maka'u* [afraid]. This old place, they don't like.

KM: *Aloha.*

JH: Leave it like this. You can only hear them talk, you imagine no. Nice the sound, no more that kind of *leo* [voice] now. Only I hear you talk today. You talk soft. Some times, ten guys behind, and you only hear soft voices. No more *'uwā* [roaring, loud conversation], that's the real old way. Today, only three guys talk, oh, the big noise.

KM: [chuckles] *Kakani* [noisy]!

JH: Hawaiian was soft, they no *hakakā* [fight], they don't *'ōlelo lapuwale* [talk dirty]. They don't fight, because humble.

KM: *Nā kūpuna, po'e ha'aha'a, aloha...* [The old people were humble, filled with *aloha...*]

JH: Yeah. *Aloha, pa'ani pila* [play music] or what. And us over here, my grandfather's days, I don't see *hakakā*, they don't fight, because the words, they don't *wala'au*. They use good words. No more swearing and that...

KM: *'Ae. Mahalo nui iā 'olua i kēia mo'olelo. Na'u nō i ho'iho'i i kēia lipine i ka hale a e kākau...* [Yes. Thank you both for sharing this history with me. I'll take this tape to my house, and transcribe it...]

JH: Yeah, *kākau* [write it], you look at the good. You take the good parts you like. I know the one you need already.

KM: Then I'll bring this back to you.

JH: You went go through this history already. You get good teacher, lucky.

KM: *Mahalo.*

GK: *Pono* [it good.]

JH: Old Hawaiians you go, it's the same thing. That's the old custom, no?

KM: Yeah.

JH: *Po'e* before, they different than today.

KM: *Pono no mākou, nā 'ōpio ke noho me nā kūpuna e kūkākūkā...* [It's important for us, the youth to sit with the elders and talk story...]

JH: Yeah, I think so. That's why my family, I try to teach them, no *hakakā* [fight].

KM: *'Ae, mahalo.* [tape off; end of interview]

While it was thought that the interview had reached an end, Uncle Hale *mā* continued reflecting on past times. It was during this conversation, that Uncle Hale shared what he had heard form his *kūpuna* about the ancient people of the Puna District (tape back on):

JH: ...That's why before, because my kūkū them never go in the war, only they know the history. Yeah, Kamehameha days, they don't know who's coming back.

KM: So you think before, the people who lived here, were the *po'e hana* [working people]?

JH: *Mahi 'ai* [agriculturists], yeah.

KM: Your *kūpuna* told you that the *ali'i* [kings] by-pass Puna?

JH: Yeah.

KM: Go to Kona, Hilo?

JH: Yeah. Puna, they by-pass. You don't hear anything about Puna.

KM: That's why, you'll enjoy this paper that I'm writing as a part of this *mo'olelo* [history] here. Has some *mo'olelo*, that the *kūpuna* would write in the Hawaiian newspapers like that.

JH: Good. Every time , I meet guys here, they see this house open here, they don't see this kind of place now. Everything is all bulldozed down.

KM: That's right.

JH: This is the last home. Me I stay, I don't like them to bulldoze the place, or cut down the trees.

KM: You'd also mentioned that the little warm pond back there, you'd opened it up. It was closed before.

JH: That's right.

GK: He made that.

JH: I went *hemo* that stone...

KM: *Pehea, i ka mo'olelo a kou po'e kūpuna, ua kama'ilio paha lākou i kekāhi mea e pili ana iā ka wahine o ka lua, 'o Pele paha?* [How about, in the stories of your elders, did they perhaps speak about the woman of the volcano, Pele?]

JH: They don't *wala'au* [speak about that] They no *wala'au*!

KM: Hmm. *Ai no lākou me ka ekalekia, e?* [They were a part of the church eh?]

JH: Yeah, they don't talk. But they respect the other one. They always tell me, "They got the same idea, different belief, but same idea. The two sides had good idea. But the other side [ancient Hawaiian ways], was more strict."

GK: That *ekalesia*, what year was it *pau*?

KM: By 1905, pau. You'll see in the write up, how Tūtū William Kama'u wrote about that. IT seemed like they were holding the services in the house here.

JH: Yeah, I think it was this house. That's what the old man Mānoa said. One minister, Kupihē, he lived in this room [pointing to the near shore side of the house], and one, Mānoa, stayed in that room [pointing to the *mauka* side of the house], when they come to this place. Was just like on temple. And the two guys, they stay on two side, they still get the other side [religion]. They respect the haole one too. "Same idea," they tell. Only the wala'au different.

GK: You know, you said about 1905, the *hale pule pau, popopo* [church was finished, rotted out] already.

KM: Yeah.

GK: I know had some buildings over there [pointing to the old school and church lot], I don't know what kind was.

JH: My sister had.

GK: Had some other buildings over there. [thinking] Who was that? Kaluna? Ahh, Kobayashi.

JH: Yeah, Kobayashi house.

KM: Oh, yes, I saw the name Kobayashi on the lease from the government on that lot in about 1939.

JH: They went lease that old house. It was just like one government house.

GK: They was staying over there. Was Kaluna and Kobayashi, family.

KM: So Kobayashi, *male Hawai'i* [married Hawaiian]?

GK: Yeah, married Kuamo'o girl.

KM: Ohh! So maybe when they got that, they went build a house over there.

GK: I think even in 1949, maybe '50, the building was still there yet.

JH: It was.

GK: And then Peter 'Iaukea was staying there with the wife and three children, I think. Then afterwards, they went move up to the mill.

JH: Yeah, in the 1950s, they stayed over there.

GK: I used to go fishing with him, the old man.

KM: 'Iaukea?

GK: 'Iaukea.

KM: Now, the mill wasn't running when you guys were alive eh?

GK: No, *pau.*

JH: Nineteen-o-three, the mill *pau.*

KM: Yeah. Rycroft had left about 1900.

JH: Yeah, the Brazil coffee went half price, here no can compete already. That's why he went move. Honolulu, they went buy land.

KM: Yeah, I found some information that speaks about this too. It's so good that you remember this history too...

JH: Kobayashi was pure Japanese, but the Kuamo'o was Hawaiian.

GK: So the next generation was Hawaiian *hapa.*

KM: *Maika'i* [good]. *Mahalo...* It's so good that you stayed here and took care of the land all this time.

JH: I take care. I'm weak now, I know what's going to happen... You know, the old people always told me "*Mālama ka 'āina*" [Take care of the land], that stuck in the head eh. I go work, but I come back here. Those kinds of words, no can remove.

KM: *'Ae. Inā mālama 'oe i ka 'āina, na ka 'āina i mālama iā 'oe.* [Yes. If you take care of the land, the land will take care of you.]

JH: Yeah, they tell me "*Ho 'omanawanui, mālama i ka 'āina*" [be patient, take care of the land]. Everybody move, nobody stay. When I first moved back here, no more two care in two weeks. Nobody. That's how was. Now, if those jobs come, bum-bye the people who are from the old families can have jobs, they can come home...

KM: *Mahalo, lawa paha kēia?* [Thank you , maybe this is enough]?

JH: *Lawa* [enough].

[end of interview]

Personal Release of Interview Records:
'Ahalanui, Laepāo'o and Oneloa Oral History Study
Prepared in conjunction with the proposed
A & O International Development (Puna, Hawai'i)

The interview referenced below was conducted by Kepā Maly (*Kumu Pono Associates*), under a contract with A & O International Corporation in conjunction with historical and archival documentary research as a part of a cultural assessment study for portions of the *ahupua'a* of 'Ahalanui, Laepāo'o, and Oneloa (the Puna study area).

Date of Recorded Interview: June 12, 1998 (with notes from discussion of June 5, 1998).

I, John Hale, participated in the above referenced oral history interview with Kepā Maly, and hereby give permission to Kepā Maly to include the released interview transcript in the study he is preparing (KPA Report HiPu15-063098). This permission is granted, subject to any restrictions listed below:

(a) Quotes from the interview(s) may be used as a part of the final report on historic and cultural sites and practices in the Puna study area, or reference may be made to the information in the interview(s). Copies of the interview records may be made available to A & O International Corporation, the County of Hawai'i, and the Department of Land and Natural Resource-State Historic Preservation Division.

Yes or no: yes

(b) The interview records may be referenced by Kepā Maly for scholarly publication.

Yes or no: yes

(c) The interview records may be housed in a library or historical Society collection for general public access.

Yes or no: yes

(d) Restrictions:

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Kepā Maly (Interviewer)

July 6, 1998
Date of Release

Personal Release of Interview Records:
'Ahalanui, Laepāo'o and Oneloa Oral History Study
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Date of Recorded Interview: June 12, 1998 (with notes from discussion of June 5, 1998).

I, Gabriel Kealoha, participated in the above referenced oral history interview with Kepā Maly, and hereby give permission to Kepā Maly to include the released interview transcript in the study he is preparing (KPA Report HiPu15-063098). This permission is granted, subject to any restrictions listed below:

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Yes or no: yes

(d) Restrictions:

Gabriel Kealoha (Interviewee)

Kepā Maly (Interviewer)

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7/23/98
Date of Release

Kahu*[18] *John "Kumukahi" Makuakāne
(With Violet Akamu Makuakāne and Joni Mae Makuakāne-Jarrell)
Oral history Interview of July 21st, 1998
at ʻŌpihikao with Kepā Maly

John "Kumukahi" Makuakāne (*Kahu*) was born in 1931, at Puʻukī (Kapoho uka), Puna. His father was Thomas K. Makuakāne, of ʻŌpihikao, and his mother was Hattie Makua-Makuakāne, who also had ties to ʻŌpihikao and neighboring lands in Puna.

While growing up, *Kahu* lived at several locations in Puna, including Kapoho, Pohoiki, Malama, ʻŌpihikao, and Kaueleau. For the first five years of his life, he was raised by his grandmother, and in the following years until he left Puna to join the military, he was raised with various *kūpuna* (people of his great- and grand-parent's generations), and other elders of his parents generation.

Kahu John Makuakāne
at the Kaueleau Cemetery, Puna

Throughout his early years, *Kahu* was surrounded by, and a participant in the native practices of the fishermen and agriculturists of Puna.

In his interview, *Kahu* describes the Hawaiian community of Puna, and their relationship with the lands extending from the Kaueleau to Kapoho vicinity. His personal recollections of planting and fishing customs, as experienced first-hand are an important contribution to the history of native Hawaiian land use in Puna

While some of Kahu's family on the Makuakāne line (Grant 1015 received through the genealogy of Emily Kālaiwaʻa Kahananui-Makuakāne), owned a portion of the land at ʻAhalanui, he does not personally remember ever staying there. The interview provides readers with important insights into residency and activities on the land between ca. 1935 to 1945. Importantly, Kahu's descriptions of subsistence practices—both on land and in the

[18] *Kahu* – a Hawaiian word for minister. Following a family tradition that reaches back to the 1850s, John "Kumukahi" Makuakāne is the *kahu* of the ʻŌpihikao Congregational Church.

Kapoho – ʻŌpihikao fisheries—adds corroborative documentation to the interviews of Arthur Lyman, John Hale, and Gabriel Kealoha.

When asked about development on the lands of ʻAhalanui-Oneloa and care of Hawaiian burials and other cultural resources, *Kahu* expressed the feelings that the families who are of the land, "are the rightful ones to say yes or no..." To him, he believes that the important thing is to have *aloha* and respect for the land and the people who have lived on the land for generations.

During the interview, Register Maps 1777, 1778, and 2191 were referenced when discussing various sites. *Figure 2* is an annotated map identifying various places of interest mentioned during the interview. Kahu gave his verbal permission for release of the interview excerpts and their incorporation into this study on October 10, 1998.

KM: *Aloha, mahalo nui!*

JM: *Aloha.*

KM: We're going to talk about your *ʻāina aloha, Puna*. Some of your recollections, the things that you remember as a child, and in growing up. Your family's history on this land here. Would you please share with me... and you were just telling me the story of your name, so you may have to share with me several names. But, could you share with me, your full name, Where you grew up, and where we are now?

JM: When I grew up, my full name was Pedro Kumukahi Makuakāne. I was born at Kapoho, Puʻukī. I was told that the reason they gave me that name, was because the lighthouse was there, and I am not sure, other than that, for the reason of my name. Then after high school, when I wanted to enter the service, I needed a birth certificate. When I applied for one, and it came and the name was not Pedro anymore, and there was no one born the day that I was registered. I was told I was born on November 26th, 1931. When we applied for the birth certificate, there was no Makuakāne born on that day [chuckling].

KM: Oh no!

JM: There was one that was born on November the 16th, 1931, and that baby's name was John Peter Cotano Makuakāne. So being that I was the only Makuakāne born in 1931, they assumed that that was me. So after that, my legal name became John Peter Cotano Makuakāne.

KM: *ʻAe* [yes], so you lost the Kumukahi, then, as far as the *palapala* [paper work] goes.

JM: Yes, right. When I came back here to Puna, most of my family was deceased; half of them call me Kumukahi, half of them call me Pedro, but never John. And even when I see friends now, they never refer to me as John, they always refer to me, either as Pedro or Kumukahi. And then I will know that that is a friend going way back.

KM: Hmm. That name stuck with you all through your school time, yeah?

JM: Yeah.

KM: You also mentioned, that at that time Puna was still isolated, when you were born, and there were only a couple of cars.

JM: Right. So that, probably was the reason that my name was changed. My Uncle John Hanohano was one of them that had a car. So I was told that when I was born and he was ready to go to Hilo, my mom gave him the information to register me at the Board of Health in Hilo. But not knowing that he changed the name. I am certain that my mom would not have given me that name and then called me under another name for eighteen years, under that and a different birth date. The year is the same, the month, except for the date. It's ten days different.

KM: Hmm. Do you have Spanish blood?

JM: My mother's mother, her second marriage was to a Spanish, Cotano was his last name... When I was growing up, I was raised by my grandma. Until I was about five or six years old, then she got sick, and I was sent back to my parents. That's the reason why that *'āina* [land] next to the 'Ōpihikao Church was given to me by my grandma. Then she only had life interest in that *'āina*.

KM: Who was your mother?

JM: Hattie Makuakāne.

KM: And her maiden name?

JM: Hattie Makua.

KM: Makua?

JM: Yeah.

KM: Ohh! And your papa?

JM: Thomas Ka'ōnohiokalā Makuakāne... He was born about 1901...

KM: Okay. When we look at these maps here...One of them is Register Map 2191 I'm just trying to see... [looking for Makuakāne family grant lands]. Yes, here's Makuakāne right next to the church. And then there's another Grant, 2600 here.

JM: Right.

KM: Are we on this land sort of in this area here [pointing to location of Grant 2600]?

JM: No, we're down here.

KM: Okay. [opening another map] This is Register Map 1778, by A.B. Loebenstein in 1895. Yes, see this is Grant...

JM: Ten-Twenty (1020).

VM: Uh-hmm. That's coming down Kamā'ili Road.

KM: Okay. These Grants with Makuakāne's name on them, go back to 1851 there abouts...

JM: [looking at Reg. Map 1777] And the other thing, you have here, the area from Kapoho out to Pohoiki eh?

KM: *'Ae.*

JM: And in there, there is another piece that the Makuakāne family had, yeah.

KM: Yes, that's interesting. This is Register Map No. 1777, it's the partner to the other map I gave you for this area, map No. 1778, by Loebenstein in 1895.

JM: Okay.

KM: This is 'Ahalanui. There were some houses, Kawaimaka and a few lots here, that the families got. Kahananui, Maunakea...

JM: Uh-hmm.

KM: ...was Maka'imoku's son. Maka'imoku (or Kamaka'imoku) got Grant 1001 in 1852. So Makuakāne had a house somewhere in here also?

JM: Well it was in the Pohoiki area.

KM: Okay, this is Pohoiki *ma'ane'i* [here]. [pointing to locations on map] Here's Uncle Hale's house.

JM: Right.

KM: This was Rycroft's house.

JM: Would you know more or less, where that Pū'āla'a pond is?

KM: *'Ae*! This is the old school and church lot at 'Ahalanui, which is now the County Park. So here is the park and spring right here.

JM: The house should be right around here somewhere [indicating on the *mauka* side of the old Government Road]. Right around here, I understand was about 30-acres that was a part of the Makuakāne Estate.

KM: Uh-hmm. Do you know if they lived there at one time also?

JM: My understanding is that my grandfather was married twice. This *'āina* he gave to the family of his first marriage. And then all this down in the 'Ōpihikao area came to the *'ohana* of the second marriage.

VM: See, his father is from the second marriage.

KM: Hmm.

JM: And this *'āina* over here, that we are staying on, is not Makuakāne, it came from my great grandmother's side, not from the Makuakāne side.

KM: [looking at Reg. Map 1778] I see some names here, like...

JM: Mokumaile.

KM: Mokumaile, *'ae*.

VM: Uh-hmm.

KM: So that is the *'ohana*?

VM: Yes. But this piece is like inside.

KM: Yes, it's within Grant 1359 to Mokumaile.

VM: See, Grant 1359, now we have all these spaces here.

JM: Uh-hmm, it's been all cut up.

KM: So this Mokumaile, is your *kupuna*?

JM: Yes.

KM: Now, coming back to ʻAhalanui.

JM: Uh-hmm.

KM: Where Makuakāne had *ʻāina* in here, this was originally awarded to Kahananui in Grant 1015. Do you recognize the name Kahananui or the name Kanaʻaukahi in your *ʻohana*?

JM: No, I don't. [see additional genealogical records below]

KM: Kahananui died some time around the 1880s. But his son, Daniela Kanaʻaukahi, gave a portion of this land to Mele Hale in June 1900.

JM: Hmm.

KM: But the family had once held a larger area as well. So your *ʻohana* had *ʻāina* over here though?

VM: Uh-hmm.

JM: Yes.

KM: Do they still have this *ʻāina*?

JM: No, they sold it to that firm that is doing that project.

KM: So A&O, with David Matsuura them?

JM: Yes. My understanding is that it was supposed to have been 30-acres. And it was right next to Pūʻālaʻa.

KM: *ʻAe.*

JM: The *mauka* side. And there is a small little shack there now. I think they built that; they still had the property when the shack was put up. My first cousin, Daniel Makuakāne.

KM: Oh yes, I remember him.

JM: He was the one that was handling the estate there...

KM: ...Hmm. Who was your grandpa?

JM: David.

VM: Kapuaaloha.

JM: David Kapuaaloha Makuakāne[19].

[19] Genealogical records compiled by Elizabeth Makuakāne (in the author's collection) provide the following documentation regarding the Makuakāne family's relationship to original grantees of land in ʻAhalanui. David Kapuaaloha Makuakāne was born in ca. 1848. His first wife (who died young), was Emily Kalāiwaʻa Kahananui. She was descended from two families who received land in the *ahupuaʻa* of ʻAhalanui. Kahananui received Grant 1015 (a portion of the land was retained by members of the Makukāne family until ca. 1989), and Kālaiwaʻa (or Kalauwaʻa), who received Grant 2982 which now makes up a portion of the County's ʻAhalanui Park.

KM: Did you ever visit any *'ohana* there? Did you stay down here at all with anybody when you were young?

JM: No. I never stayed there. Only visited here when my cousin *mā* [them], were cleaning this place.

KM: There's a name, Kawaimaka also. Do you recognize that name?

JM: No.

KM: Loebenstein's map shows their house here in the 1890s. You can see it here, an enclosed area.

JM: Yeah.

KM: Then in Pū'āla'a, this guy named Dickman, had a lease from Bishop Estate, and then he had *'āina kope* [coffee land] up in this area. [pointing to location on Reg. Map 1777]

JM: Oh wow!

KM: All the way up here. In fact, this is "Dickman's Coffee Patch" up here.

JM: Wow!

KM: So they were doing work up there. And the trail, you can see the old trail here.

JM: Uh-hmm.

KM: You can see Kīpaepae, the coconut grove and a spring *mauka* of here.

JM: Uh-hmm.

KM: Did you ever *holoholo* up there at all?

JM: No. No, I did not. Not too much that side. I was more this side [towards 'Ōpihikao].

KM: Yes, uh-hmm.

JM: We were over here and Kalapana side. My mama is from Kalapana.

KM: Makua?

JM: Uh-hmm.

JM-J: [looking at Reg. Map 1777] Here's Pu'ukī.

KM: Oh, *'ae*. This is were papa was born then. Now as a child, Puna, this area, were there a lot of families, or were most of the people your own relatives?

JM: No, there were different people. The Elias, the Kahaloas, Kumunui.

KM: Hailama Kahaloa?

JM: Yeah, Hailama's house was about 500 feet Kapoho-side of the Church on the mauka side of the road. [thinking] Not really that many families.

VM: Not many Hawaiian families, but there were the plantation families too.

JM: Oh yes, but they were further up. They were *mauka* at what we call Kaueleau. It's about three miles up from the beach. So no, there weren't too many families when I was growing up. But, I understand that at one time there were a lot of

people. Because, when you look at the history of my great grandfather from 1855 to right around 1870, around there, he had membership in the church, 500 people.

KM: *'Oia* [is that so]? At ʻŌpihikao?

JM: At ʻŌpihikao Church.

KM: Amazing! So your great grandfather?

JM: Yes.

KM: He was *kahu* down here at that time?

JM: Yes.

VM: Uh-hmm.

KM: Ahh, so you are carrying on a family tradition.

JM: Uh-hmm. Since we're talking about that, to me, I would like to say that my great grandfather... We don't have too many records of the church, it's beginnings, except for what we have at the Hawaiʻi Conference. Because of the walk of William Ellis. The time [1823], that he traveled all this *ʻāina*, right around the island.

KM: Yes.

JM: Outside from that, we did not have any written records of ʻŌpihikao until my great grandfather. I understand that he was one of the first educated Hawaiians in the area. So he started recording, and he became a deacon of the church, served the church. I am not sure what year it was, but at the *ʻaha* [meeting], of then, the Hawaiian Evangelical Association, that they ordained him as a *kahu* [minister]. He was not like the normal process of going through the college, or the seminary, but he was given that because of his outstanding work in the church here at ʻŌpihikao.

KM: Hmm.

JM: And 112 years or so later, I come along, and I got granted and ordained the same way. I was granted ordination through a resolution that was introduced by the Hawaiʻi Island Association. I just thought that I should share that.

KM: *ʻAe, mahalo!* It is beautiful to see that your family tradition is continued. You see Makuakāne here in the 1850s. They were the kahu with the church, and that history has continued all this time. And in between, I understand that Reverend William Kamaʻu was *ʻohana* as well?

JM: Uh-hmm, *ʻohana*.

KM: So you see this family tradition continuing. I'll pull out some of the communication that I've located in the archives. Your great grandfather, because he was educated and writing, I see letters that he wrote in support of people to get their *ʻāina*, so that they could get their grant records. [cf. Interior Department Land Files; May 15, 1895]

JM: Ohh!

KM: He was active in the community, helping other *kama'āina* so that they had a home. It's very interesting to see this history.

VM: Hmm. One of the things about the old days, was that the church had a lot of power. So they looked up to the *kahu.*

KM: *'Ae.*

VM: It was also the church that penalized them for whatever mistakes they made.

KM: You're right. You'll see some very interesting accounts in the study that I'm preparing for the *'āina* that you were just talking about, 'Ahalanui, in your grandfather's times, is that right?

JM: Yeah.

KM: That your grandpa somehow had this *'āina* in 'Ahalanui. I'm preparing this historical study on that area, because there is the proposed development project here.

JM: Uh-hmm.

KM: It's A & O-Oneloa Development.

JM: Uh-hmm.

KM: May I just ask you, and take care of this part of the conversation?

JM: Okay.

KM: Do you have some thoughts about development on this land here [pointing to Oneloa-'Ahalanui on Reg. Map 1777], and things that should be cared for? Or things that should be done to retain some of the qualities of the land?

JM: I have not really put too much thought into it.

KM: Yes.

JM: But, the *'ohana* that comes to our church, fall on the Hale side. I was asked to do the blessing for this, when they first came over several years ago. And because of the opposition of this, from them, I refused to do it. I asked that they would seek out somebody else because the members of the church, namely the Hale family, were not in favor of the development, for what ever reason. But, I myself, had not really looked into it as a good thing or are there any historic sites in there that we should protect... I have not done any of those things. I was just not into it of doing anything. It's because the owner of the *'āina*, of the area is not in favor.

JM: He used to be at Malama, up *mauka* side eh.

KM: Adeline?

JM: Pā. She used to be a Pā. Joe Mānoa, her grandfather, lived *mauka* at Malama.

KM: Ahh, by Pu'ulena side?

JM: Yes.

KM: They had their *'āina māla* [cultivated land] up there eh?

JM: Yes. So, in as far as that, I really have not thought about it. I have spoken with some who oppose it. I know him by, Keiki they call him.

KM: Oh, do you know Keikialoha Kekipi?

JM: Yes, I met him several times. He stopped when I was doing some work on my parents grave, here. My cousin and I, he was helping me to cement my *'ohana* graves. And he [Keikialoha] stopped by because he was, I think at that time, trying to preserve this, and trying to tell us that there is a possibility that if we don't record it or do anything about it, that developers could come in and they could destroy it.

KM: Hmm.

JM: So he was very interested if I could do a survey of the ʻŌpihikao graves and kind of draft up something to name them.

KM: Ahh to name each grave site?

JM: Yes, more or less to do that. That's how I first met him. He stayed there for many, many hours helping me. And that's how I first met him. And he spoke about what he is doing at Pūʻālaʻa. I think he has a lease right next to there eh.

KM: Hmm.

JM: From Bishop Estate. He was telling me about some of the things that they were doing over there. Other than that, no, I have not really kept up with it.

KM: Uh-hmm. Do you know if there is a Kekipi *'ohana* from Puna? That you recall?

JM: No, I don't.

KM: Hmm. You know, I spoke with Uncle Hale and your brother-in-law, I guess, Uncle Gabriel Kealoha?

JM: He's my brother-in-law, he married my sister, the one right below me.

KM: We had a really nice, nice time to talk story about the fishery and things here. And I asked them... See, with the Makuakāne parcel that they had in here, in 1929, a man by the name of George Kāne, he was from Kauaʻi, but his *kūpuna* were from here, from Puna and Kaʻū. And he wrote a series of articles in the Hawaiian newspaper Ka Hōkū o Hawaiʻi...do you remember that paper?

JM: Yes, right.

KM: He wrote about his "*Huakai Makaikai*," his site seeing journey to Hawaiʻi, the land of his grandmother *mā*. And one of the interesting things that he mentioned, was that after leaving Pūʻālaʻa, there was a *heiau* near the road side in ʻAhalanui. Did you ever hear anyone talk about that?

JM: No.

VM: The only one that I know of, is by where Billy Hale lives.

JM: Yes.

KM: Oh, Mahina-akāka, at Keahialaka.

JM: Yes, Keahialaka. And there was supposed to have been another burial cave just further down of Keahialaka, towards this side, on the *mauka* side of the road.

KM: *'Ae.*

JM: No, I have not heard of that. I'm not really familiar with any of this area, as far as that.

KM: Hmm. Do you have a general sense about care for old Hawaiian places, sites, and the land like that?

JM: Oh yes!

KM: What do you think?

JM: I think that it should be kept that way. They depended on what it is. Our problem is that in our generation, they [the elders] don't talk about things like that, so we don't understand too much about it. What I understand, and my own feeling comes, not from my *kūpuna*... But from my understanding now, what the younger generation is trying to do and preserve and why. I feel yes, there are some things that are very significant. Even as a Christian, we understand that some of the *heiau* were sacrificial *heiau*, and the Hawaiians had different things that they believed in. But I don't think that we should condemn that. We need to understand it first.

KM: Hmm. Your *kūpuna*...like today, "if you have faith the size of a mustard seed..." Well, your *kūpuna*, the *po'e kahiko* [ancient people], put that kind of faith in their *ho'omana* [worship] too eh?

JM: Yes, that why we need to understand that. I'm not going to say that 'because it's not on the belief of Christ, that it is wrong.' I cannot say that. Although I believe we have one God.

KM: Yes, that was their way.

JM: Yes, because they knew not...

KM: ...You'd said earlier, in your young time, the *kūpuna* didn't always talk and tell you about things that were going on. I don't understand how come they chose not to speak of those old things, but, *mahalo* that you are willing to take the time today. Because you know, if we don't know this history, where you came from... And that's why I want to talk about your childhood and your recollections. Like you were sharing earlier, a wonderful story about fishing, and how your papa would go down to get the *pūhi ūhā* [a variety of eel] and go then fishing. Those are wonderful stories that the children need to hear, because they can then learn about how you work on the land and ocean. Otherwise, our kids only know how to go to the refrigerator eh [smiling].

JM: And you've got to remember that before, they never had all these big trees that we have now. So the view, even though high, it was not obstructed at all. Even here, when I was growing up, none of these trees were here.

KM: Hmm. So, what was it like? What are some of your recollections as a child, living in Puna, working the land?

JM: Being raised and isolated in this small community, and because there was no real transportation, so we did not travel a lot. We Spent a lot of time in the area, we grew up knowing nothing except what was taught to us by our parents. When I look back, maybe at that time, we were taught number one, of the utmost importance in any Hawaiian home. In fact in all Hawaiian homes, that discipline

was the number one thing within the family. So we grew up that way. We do not question our *kūpuna*, our parents, or anyone...

...And as we got older, our responsibility was... As Hawaiians eat *poi*... I don't know why the *poi* today and the *poi* those days are so different. But our responsibility was to pound 100 pounds every Saturday.

KM: Hmm. Did you folks have *'āina, mauka*? Or where did your *kalo* [taro] come from?

JM: Oh, the *kalo* come from *mauka*, all in this *'a'ā* [clinker lava]. Only *hemo* [remove] the *pōhaku* [stones]. We take out the stones, cut all the *lau* [leaves] and put inside.

KM: So mulch the pukas eh?

JM: Yeah. And we get *'ama'u* [*Sadleria* ferns]...there was not too much *hāpu'u* [*Cibotium* ferns] down here, but we get *'ama'u*. We just cut a few, just to start out the plant, and then we knock a lot of the old *lau hala* [pandanus] trees. *Malo'o* [dry] then we cover the planting so the *mau'u* doesn't grow either. So that's how we *māla* [plant fields] down this side; on the *pōhaku*.

KM: So on the flats out here. And what, no More trees over head?

JM: No, no.

KM: So it was wide open then?

JM: It was all open. All these trees...there were a few mango trees, but none of these trees were here. This *'āina* over here, was all planted by us.

KM: I see. So your *'āina* here, your *kalo*, was all plentiful, and it grew good in the *'a'ā* like that?

JM: Oh yeah!

KM: How big would your root (corm) come?

JM: Well, it's not as big as you would have it up in where they have all plenty dirt, but they were good size, maybe three pound size. It grew pretty big.

KM: Wow! What kind of *kalo* was the good *kalo* that you folks grew out here?

JM: I don't recall the names. But I know that we used to plant *mana 'ulu, mana 'ele'ele, 'ōpelu* [thinking], I can't think of all the names.

KM: Hmm. But like the *mana 'ulu*, so you folks would eat a whitish, or yellow *poi*?

JM: Yes. See, the *mana 'ulu* always grow on one taro that has two *huli* [taro tops]. Most *kalo*, you have only one. But the *mana 'ulu*, most of it has two *huli* on it.

KM: Yes, that's what is said, that the *mana* means divisions like, branches?

JM: Yes.

KM: So your *kalo*, you folks would grow, cut the *'ama'u* like that and *kīpulu* [mulch] with *lau hala*, and that would keep what ever moisture in the ground, and you'd said that the *mau'u* [grasses] wouldn't grow?

JM: Right, it keeps the *mau'u* down. So once we plant, we don't even bother it until...well, like the old folks, they know whether it's nine month *huli*, or one year *huli*, what ever. And when ever it is ready to be harvested, they'd come back *huki* [pull]. And generally, we don't plant too much *kalo* down here [meaning near the shore and house lot area], because there was too much *lepo* [soil], and then, too much weeds. And that would be more work. So we go up *mauka* where it is all 'a'ā and that's where we plant.

KM: Oh that's so smart. Because you figure, if you come down where you get plenty *lepo*, and you're going to have more work. So you folks would seek out a more rocky area then?

JM: Uh-hmm. My mother's side family owned *'āina*, *mauka* side. My father's side is down this side. So my mother's side is *mauka*, and that's where we put the *huli*. And as I was saying earlier [before the interview], my father used to have his own business, cutting *lau hala*. That's what we do, we cut the *lau hala* and we plant too at that same time.

KM: Oh, so you could go *'ohi* [cut] *lau hala, mauka* here then too?

JM: Oh yes, this whole coast.

VM: They owned all the land.

KM: All this *'āina* here?

JM: Yes, all going up *mauka*, and over here, till down at the grave yard, and we used to own way down Kamā'ili side.

KM: So when he was out *'ohi lau hala* [harvesting pandanus], you folks would be planting *huli* also?

JM: That's right, certain places we do. See the planting is, you cannot plant too much one time, because then they come up all one time and you cannot use them all. So every month you plant so much and you go to a different place. With a little bit *lepo* over here, you put in five, fifteen, twenty, maybe thirty *huli*, and that's all you need.

KM: So there were planting pockets?

JM: Yes.

KM: And you staggered the planting times, so that way, all year round you had *kalo*?

JM: Yes.

KM: Oh, so *na'auao* [intelligent]!

JM: The Hawaiians, oh yeah!

KM: So what, people didn't come and...like you know now, guys plant *kalo* and the next thing you know, someone *'aihue* [steal] this. No more problems like that?

JM: Before, no. But later that came about...

KM: ...So you folks, with papa them, and your *kūpuna*, they would plant *kalo*...did they have *'uala* [sweet potatoes] down here too?

JM: Oh yes, plenty!

KM: So they planted *'uala*, *kalo*. Can you describe the process of when you would go out to *'ohi lau hala*? And tell me about the man from Kona who your papa sold the *lau hala* to.

JM: Well, we started out by him [Matsuyama] wanting the green *lau hala*. It's not growing into a tree yet, it was just the single plant. The young one. I would say that the leaf would be anywhere from six to ten feet long. We would cut it off and we would put it together, ten in each stack. We would tie it and put it together in the bundle, 2000 per bundle. That's how we would sell it and take it to Hilo. Then later, and I'm supposing, though I've never seen the process, but they would bleach it eh. They boil it and they bleach it and it would come white. That used to be very popular during the second World War.

KM: Yes, nice and white, like the Panama hats.

JM: Right. And then later on, he started ordering the dry *lau hala*. So then we picked the dry *lau hala*.

KM: Hmm. And you folks would gather *lau hala* all through... Your brother-in-law, Gabriel mentioned that... And he was born in 1928, so he is a couple of years older than you.

JM: Right.

KM: Did you go with papa out to this *'āina* at Oneloa like that from here, ʻŌpihikao, out to Pohoiki?

JM: No, I didn't go to the other side. It was mostly this side. From here, going towards Kamāʻili.

KM: Ahh, so you worked this *'āina*. Do you remember hearing that papa went over to that side to gather also?

JM: [thinking] No, I didn't hear that, but it could have been in the period that I was not here.

KM: Hmm. What were some of the other crops that your *'ohana* took care of? You've mentioned *kalo*, *'uala*, and of course, they were taking care of the *lau hala* as they gathered it. Did you folks clean the trees like that?

JM: Oh yes! This we do all the time. The first thing we do, the old folks know the good *lau hala*. So that, we have to climb the tree, strip and clean the tree. And we do that all over.

KM: Hmm. And you'd said that the *lau hala* was good for around your *huli* because it would keep the weeds down eh?

JM: Yes. Then, after you clean all of that... [end of Side A, begin Side B]

KM: [So did you always make mulch, or did you also burn] ...the rubbish like that, or did you always kind...?

JM: I don't recall burning at all. We used most for covering. And the more you put out, then it turns to *lepo* [soil] eh.

KM: *'Ae*.

JM: Several years later when we come back... The only grass that was easy to pull, easy to kill, is the *pua lele*, and it's easy for *huki* that. And that would be the only kind of plant that would come out where our *kalo* stay. And you know, it's one here, one there, so you don't even need to bother with it until you ready for *huki*.

KM: *'Ae*. So when you plant your *huli*, after you plant them, and you *kīpulu*, mulch 'um and cover it like that, *pau*, you don't need to do anything else? Or did you come back and turn the leaves?

JM: No, no, no. That's *pau* already, you let 'um go. That's why I said, you know, the Hawaiians here were smart, they're not going to plant in the *lepo* [chuckles], they go up there to the *'a'ā*. In later years, I guess when I was in intermediate, and going to high school, we did move up to Malama where Joe Mānoa lived and we planted five acres of *kalo*. That was another thing that my father did, and then sell to Pu'ueo Poi. That there, is totally different. There is work because the grass grew.

KM: Hmm. There was plenty of *lepo* up Pu'ulena side like that, yeah?

JM: Hoo, the *kalo* is different. Five *puka*, fill one bag.

KM: Wow! So big?

JM: Big! [gesture with hands 16 inch diameter]

KM: Oh, 10 to 15 pound kind.

JM: From one *puka*, I can not describe how many pounds you can get out of there. But certain parts, especially in the gulch, the water used to run. And I guess, it's really fertile over there. The water carries all the good kind *lepo* down, and it settles inside there. You get lost in there [gesturing the height of the *kalo* growth].

KM: So the *kalo* is more tall than you?

JM: Oh yes, definitely.

KM: You know the five gallon bucket size? One taro inside of one bucket, do you think?

JM: Kind of like that kind of size. Maybe a little smaller, but it is big! Big, big! I remember, and I've never seen *kalo* like that since. Before, nor after.

KM: Hmm. They also turned that area of Malama into sugar land too eh?

JM: Oh, we were behind of the sugar. There was sugar there already. Because of the sugar, we had the road for the plantation. They maintained the road.

KM: Yes. Let me pull out this other map, Register Map 2191. [looking at the map, getting bearings] Here, this is Pu'ulena here. You can see the railroad track.

JM: Right.

KM: Here's Malama.

JM: Okay.

KM: Where do you think you were? From the railroad, were you *makai* or...?

JM: No, *mauka*. I would say around here some where, we were further over from Pu'ulena.

KM: I see, so Kalapana side of Pu'ulena?

JM: Yes. I would assume, some where around here. The track would be down here yeah?

KM: Yes, that's the train track there.

JM: Well, almost half a mile *mauka* of the track.

KM: Oh. Did you folks walk this trail and come down? Is this how you came up to Malama, or did you folks have...?

JM: Oh, the plantation was already planting sugar, and they had roads all through there at that time, so we used to use those roads. Now, do you know where the Kuamo'o *'ohana* lived? Did you find them up there?

KM: Up here, I'm not sure, because the name isn't on here. But this is where The Hale family, Mele Hale, and her father John Kapukini had a place up here.

JM: Uh-hmm. Well, we were here [pointing to location on Reg. Map 2191].

KM: Okay. I know that Kuamo'o had one *hale* down here also, *makai*, by Keahialaka side?

JM: Right, it was further over, Kalapana side, right *mauka* of the road.

KM: [referencing Reg. Map 2191] I think it's this one here, in Malama.

JM: Yes. This is the beach road eh?

KM: Uh-hmm.

JM: Yes, that's the one that they used to own. I recall that. So we would be up here somewhere.

KM: Okay. [looking at Grant numbers on the map] This is Grant number 1887... I want to see if I can match the Grant number between *mauka* and *makai*. Oh, right here. You're right, in the exact location you were pointing to. This land was originally granted to Kamakau. And interestingly, there was a Kamakau who shared a Grant parcel with Kuahewa [Grant 2466], in the land of 'Ahalanui too.

JM: And the Kuamo'o were all over here too. They grew up here ['Ōpihikao vicinity]. I recall David Kuamo'o and his second marriage, their children, I know them real well. Even though they were a little younger than I, they grew up here.

KM: So this land at Malama, was a rich *'āina*, with the *kalo* eh?

JM: Oh yes. Of course, it was real, real cheap those days. You know, even $5.00 a bag, that was big bucks those days.

KM: Uh-hmm.

JM: It was big money in those days.

KM: Yeah.

JM: And because of the way it grew, the work wasn't hard because it grew so fast too, that the grass never had a chance to keep up.

KM: Oh, so it shade over the weeds like that?

JM: It would shade, then *pau*. Just the beginning, maybe the first two three month, then after that, *pau*, the *kalo* would just cover everything. And what I notice different, the Hawaiian style, whether it's Hawaiian or whatever, today, they plant the *kalo* different. When they cultivate, they use machine and everything, but their *kalo*, they *kanu* [plant] single. Hawaiians, they all *kanu* double.

KM: Hmm.

JM: Two *huli* in each *puka*. Some, two or three. This is the way we plant. No less than two. I don't know the reason that they do that. So our *puka*, when time to harvest, is awesome, from one *puka*.

KM: So the *puka*, you think is about this big [gesturing]?

JM: Oh yes.

KM: About a foot and a half wide like that?

JM: Oh yes, when we dig, it's big. And generally we go with that flat *'ō'ō* [digging stick]. We soften the *lepo* and then we poke two inside. So when they come out, Hoo!

KM: So the lepo, you don't have to put any mulch or anything?

JM: Nothing, just soften the *lepo* and put the *huli* inside.

KM: How about up there, were trees growing over some of the area?

JM: Yes, mostly guava.

KM: Oh, guava.

JM: So we cut it all off. We had to pull the root. That was hard, and we had what was called the old stump puller. It was like and a-frame with a jack and chain. So we'd cut the tree short, and we'd chain it and we'd crank it. That's how we would *huki* the roots.

KM: So the guava was pretty big then?

JM: Yes.

KM: Did you hear that Rycroft used to have a Jelly factory down at Pohoiki side? They made...you know, where Rycroft's house was, had the old coffee mill?

JM: Yeah.

KM: And had closer by Uncle Hale's house, had the old...?

JM: I think that was before my time. I hear the name, Rycroft, but I never knew them.

KM: Yes, he died in 1909.

JM: Yes, I heard the name, and I heard some stories about that, but when the coffee mill... [thinking] I wonder if we lived in there for a while. You know, we lived all over the place. But for some reason, I can picture us spending a lot of time there. Either because we knew someone there, or we were there ourselves. And that old man Joe Mānoa is supposed to have one *'āina* right *mauka* of Hale *mā*.

KM: Uncle Hale says that he remembers... See, Uncle Hale was born in 1919. He remembers the old man Joe Mānoa them coming down and that they would stay

in the house there. He also mentioned *kūpuna* Kuamo'o and Kupihē staying down there at times.

JM: Yes, Mānoa was *mauka* of where Uncle Hale lives now. I think they used to have a house there or something. See, my brother, is married to Joe Mānoa's *mo 'opuna* [granddaughter].

KM: Ahh.

JM: My brother Sam, married to Adeline Pā. So that's why I recall that, because they used to come and spend time. I remember Joe so well, because he was one of the faithful pillars of our church.

KM: Hmm... ... How about your *lau hala*? Do you remember what you folks got in sale of that?

JM: [thinking] Yeah, I think he got $15.00 per thousand leaves. So 1000 leaves were $15.00. And I think my father would pay the work men $5.00 per thousand. And I think it was $2.00...If we were deep in the forest, *mauka*, he would pay $2.00 for them to bring it down to the road.

KM: Ohh! And what, had a truck on this road? Would someone come by with a truck along the *makai* road here?

JM: No, those days, my father bought an army truck. So those trucks, we would haul it home.

KM: Did you folks have to dry it out?

JM: No, no. It can not be burnt [by the sun]. Every time we harvest, we had to cover it. Because when they cook it, the color would be different where the sun hit it. So we had to take nice fresh green *lau hala*, so that when they cooked it, it would come out nice, white.

KM: Hmm. Now you'd mentioned earlier, that Matsuyama would come out here yeah? Did he stay here some times?

JM: He'd drive out on the weekends. He may have spent some time with us because we knew him so well. He was nice and an honest person to deal with. My work was...and that's why I say, I have mixed feelings about growing up. Because, a lot of times, I was kept home from school because the *lau hala* would be so far in the forest, the men did not want to...even for the $2.00 to haul it down, so I was the one to pack it down.

KM: And you don't get the money eh?

JM: No, no. That's right, exactly.

KM: [chuckles] Free labor.

JM: Yeah. But you know, funny that time. When you think about, we did not feel that way, that we should be paid.

KM: Hmm. It was different in your young time... ...We mentioned some of the crops that your *'ohana* cultivated earlier, did you folks gather *'awa*?

JM: Yes.

KM: Could you tell me a little about that?

JM: My uncle gathered *'awa*. I was living with him at that time.

KM: Who was that?

JM: John Hanohano. We would gather *'awa* about three miles up the road. But, I do not remember the price that he got. We used to go in the forest, and sometimes, when I think about that, my heart is *'eha* [sore]. To how, now they come and...of course, they're out to make money for the papaya. And these *'awa* roots before, I tell you, 500 pounds, one root. We used to dig.

KM: Gee!

JM: Huge, bag after bag, only one *kumu* [trunk]. And to see those bulldozers come in and just destroy that *'awa*.

KM: So even when they started the papaya, the forest *mauka* here, had *'awa*?

JM: Oh yes, *'awa*! Even though we take, we take so much and leave back so much.

KM: Hmm, so that was your style?

JM: Yeah.

KM: You would take some, but you would...

JM: We no *'oki* [cut] all. Say if you have a big stump like this [gestures, arm's width across].

K:M Arm's width across?

JM: Oh, even more big than that.

KM: Ohh!

JM: You leave back so much, so that it grows again. So we *'oki, 'oki, 'oki* [cut, cut, cut] all the roots already, so you leave some back. You take this, and what's left will keep growing, yeah.

KM: *'Ae*.

JM: And then, we used to take it home and cut it in about two inch blocks. Real small [gesturing], well, maybe three inch blocks, and we would dry it with that screens all out side.

KM: So out in the yard, in the open.

JM: Yes.

KM: So in a screen box, like drying fish?

JM: Yes, similar to that. And we dry it, during the day, we *hulihuli* [turn it periodically] eh. Then when we dry it, we bag it and my uncle would handle all the marketing.

KM: How long did it take you to dry out the blocks like that?

JM: [thinking] Maybe one week.

KM: What if *ua* [rain]?

JM: I don't recall... I'm very amazed at the amount of rain that we have now. Because I don't recall, when I was growing up, having this much rain [it was pouring outside during parts of the interview].

KM: For real, you don't remember this much rain here?

JM: No, not like what we're having now.

KM: Was the rain more in set seasons? Did you have rain...?

JM: No, not in set seasons like the way we have now. Raining now and then dry. I don't recall it to be that way.

KM: For real? That's what I was wondering, if you don't have a cover, and you put your *'awa* out to dry, and then rain in the afternoon, *pau*, all wet again.

JM: Yeah. I don't remember us covering it too. I don't think we had that much roof. I don't recall if we gather it, stack it up, or if it was less time.

KM: But it wasn't in one *pāpa'i* or *lānai* [sheltered drying house]?

JM: No, no, no.

KM: It was just wide open?

JM: Yeah.

KM: That is very important, what you described about how you folks would gather *'awa*. Your Uncle John Hanohano, you, and I guess some other men?

JM: Yes, my brothers, my cousins them.

KM: Was the main area that you gathered *'awa* from , your own *'āina*? Or did you have access to various areas?

JM: We had access to various areas. My Uncle John had in his property, and then the next, we got from my Uncle Solomon Makua, the property right *mauka* side. So there was an abundance of *'awa*. I don't recall going any place else. There was just an abundance of *'awa* there.

KM: So you didn't need to go down to Pohoiki or...?

JM: No, no, no. I never did. I don't recall going any place else.

KM: So your Uncle John was the one who handled the *'awa*. Was he driving the *'awa* into Hilo and shipping it?

JM: Yes, he had a dump truck. And he was also in the *lau hala* business like my father. But he had local weavers in Hilo. Different families in Hilo would order 1,000 2,000 leaves, or what ever. A lot of the Japanese families were weaving already at that time. So he had those local guys. My father would get as much as can, 20,000 leaves, 30,000 leaves a week.

KM: Oh, amazing.

JM: But he had one buyer eh. And that guy was the in between. He'd take it to Kona and then he would sell 'um. So for us, it was easy. Like my Uncle John would have to go to this house, then drive a mile to that house and deliver what ever they wanted. But in my father's case, he only worked with Matsuyama. Matsuyama would load his truck full, just for take home *lau hala*. Full his truck!

KM: Amazing. And your *'awa* was primarily *mauka* of here?

JM: *Mauka.*

KM: Do you recall where the *'awa* was going? Do you recall hearing about that at all?

JM: No. All I understand is that it was to make something like novocaine. I'm not sure whether it was here in our country or was it to Germany, or where ever.

KM: Well see, you mentioned Germany, and that was one of the big markets historically. And like Rycroft and Elderts them... Evidently Rycroft, from the historical records, that Pohoiki landing, when he bought the *'āina* at Pohoiki in around 1877, *'awa* was one of the big things for them also. They were shipping *'awa* out of the harbor there.

JM: I am almost certain that I heard...that's the place that I understand that they turned it into medicine of some sort. But I am not sure who was the in-between that he would deliver to.

KM: It's so interesting, it seems that all of the families here, their livelihood was primarily tied to working the land.

JM: Uh-hmm.

KM: They would *'ohi lau hala* [harvest pandanus], *kanu kalo, 'uala* [plant taro and sweet potatoes] like that.

JM: I don't recall anybody working anywhere else, but doing that.

KM: I see...

KM: Could you talk to me a little bit about the ocean, what it was to your family?

JM: My father, when he did *ulua* [crevalle or jack fish] fishing, he always used the *pūhi* [eel] as bait. He would send me down, from behind of our house, close to the church, my grandma's place. I would take a long bamboo stick, and he would have a long cord with the hook on it, with the bait, and I would stick it on the end of the bamboo and put it in the *pūhi* hole. And that was the *ūhā* [type of eel]. And after I got it in the hole, I'd pull the bamboo, and I'd go up and he'd stay on the land because the cord was long. And he would just hang on. He could tell when the *pūhi* was on.

KM: Oh, so the *pūhi 'ūhā* would take the bait like that?

JM: Yes, I'd just put it inside and leave it in the hole. Pull the stick back out, and I'd go back up. And the *pūhi 'ūhā*, was big [gestures], I mean when you talk about *pūhi 'ūhā* those days, it's big, like your *'ūhā* [thigh]!

KM: Oh, like your leg.

JM: Yeah, and that's probably the reason they call it *'ūhā*.

KM: Oh, maybe so.

JM: So he'd pull it out. See, my father eat *pūhi*, all the family eat. But I never could get around to it [chuckles].

KM: [laughing]

JM: I was just that odd-ball kid, I don't eat *poi* either, when I was growing up.

KM: *Aia*, what *'ai laiki* [eat rice]?

JM: Yeah. [chuckling]

Group: [laughing]

JM: Yeah, I had a hard time with *poi*. But anyway, when the *pūhi* bite, he drag the *pūhi* out, and he cut the tail off. Then he would dig out the center bone and put his big hook inside and tie the top to the hook so it wouldn't slip down. Then we would come in front of here. This is what we called Lae-'ō'io, the point over here. I suppose that would be because there were plenty *'ō'io* [bone fish] in those days.

Then, we could catch the other fish, something that I would call the rubbish fish. Something that he won't eat, *wela, kāpā* [other types of eels], and he'd split that in half and we would take a hammer and pound on it and tie a cord and throw it in as chum. We would pull it up, and we would do that for about five or ten minutes, then he would say, "How is it, warm?" I would think, "What are you talking about, warm?" Then he'd come over and feel it, "Ah, no, keep going." So we keep pounding. Then later on he come over feel, "Ahh! Here now." Then he'd tell us to stop. So he'd get his bait with his *aho* [line], and he would cowboy style [gestures swinging the bait line over his head], and throw the *pūhi* outside and drag it in [gestures hands pulling the line directly in front of him]. He'd do that one or two times, and then we'd see his hands go a different way. This way [gestures really pulling the line in, hands down at waste level], he pulling already. See, when he do that, it's like *kākele* [casting for *ulua*], when the hand goes side ways like that [gesturing], the *ulua* bite. He has *ulua* on his line.

Once, we caught one that was so big. My sister had come down and visit us, and her friend had a car. We didn't have a car yet, those days. And we had to go home, tell the guy to come down. We tied the rope to the car to pull the fish out.

KM: Wow! How big would you say that *ulua* was?

JM: My golly, if it wasn't close to 200 pounds. There was no way you could pull it up. And we pulled 80, over 100 pounds. The average weight that we used to catch was 60 to 80 pounds. That was the typical kind of size.

KM: And you said the *aho* was big eh?

JM: Oh yes, about the thickness of your small finger.

KM: So ulua was a big fish for this place here?

JM: All kinds, anything you want. Anything you wanted. When we wanted different kinds of fish. We wanted *manini, uouoa, āholehole*, or what ever we wanted, there were different places, and all we do is take the *'upena* [net], "Boy, let's go." We jump in the car. We wanted *manini*, most likely we go to Pohoiki. We wanted *āholehole*, we would go down to Kehena. One throw, we don't hemo the fish from the net. It is so full. We just pick up the net, carry the net in the bag, and go home. We take the fish out at home. Enough for us.

KM: One throw?

JM: Enough, that's it. You cannot eat it all. You got to salt, or *kaha* [cut] for dry. But only one *kā* [throw]. One throw and that's it. Every time we go. So the fish was plentiful.

KM: In your childhood time, you had access, you could go fish anywhere along this shore?

JM: Anywhere, anywhere.

KM: Did papa...you know, if papa went down to Pohoiki to go fish, did they *aloha* to the *'ohana* that was living down there, share some fish back?

JM: Oh yes. Yes. Always did that.

KM: You saw on the map [Reg. Map 1778], your little canoe landing?

JM: Right.

KM: Pā or Po'okea.

VM: Po'okea.

KM: Po'okea. Did papa or anyone still have canoes here when you were a child?

JM: Oh yes, plenty.

KM: Did they go out *lawai'a* [fish]?

JM: Oh yes. We go all the time.

KM: *'Ōpelu, 'ahi*?

JM: More was *'ōpelu, kawele'ā, 'ula'ula, 'ōpakapaka.*

KM: Oh, so you would also go deep out to the *ko'a* [fishing stations]?

JM: Yes.

KM: So did they have set areas where they knew the *i'a* [fish] would come?

JM: Yes, yes. *'Ōpelu*, there were two *ko'a* right outside of the canoe landing, and further up by what we call the old school house, that's another *ko'a.*

KM: Ahh, so you would mark form like various spots on the land, where your *ko'a* was?

JM: Yes. See, usually when we go out...Like I know where there was a good *'ula'ula ko'a* down in Kehena. You go out, look at Kumukahi, and then at the Kalapana point, and then there is a grave yard. So you line up those three, and you drop, guaranteed you get *'ula'ula.*

KM: For real? So that's how you would mark. You get far enough out, you see Kumukahi, and you look to Kalapana Point, and then you line up with the grave yard?

JM: Yeah. That's where you get the *'ula'ula.*

KM: Too good yeah. You know for your *'ōpelu* out here? What kind of *maunu*, bait did you use?

JM: The small red *ʻōpae* [shrimp]. We used to go to Keahialaka and we used to go over to Kapoho. And that was our job. If those who were going out for *ʻōpelu* wanted to go out, they'd always ask us. It was our job to go get the *ʻōpae*.

KM: So you would go get *ʻōpae ʻula* at Keahialaka, the pond not far from the *heiau* side?

JM: Right.

KM: And then Waiʻōpae at Kapoho?

JM: Yeah. Kapoho The ponds all over Waiʻōpae. You cannot even... What we gather from there, is not even different from any part of that, abundance. And you don't need too much. Because when you put inside that *palu* [bait] bag, the *ʻōpae* is alive yet. You take the *limu* [seaweed] and you put inside, and so the *ʻōpae* is still alive. So when they put it in the *palu* bag, and when they drop down... See, the way you do it with pumpkin, or the taro, or the other kind that they use today, they usually do it past the net. And then they *hemo* [release the bait].

KM: *ʻAe, huki* [yes, pull].

JM: Yes, and the *palu* bag open. But with the *ʻōpae*, you open ʻum way high above, because the *ʻōpae* swim. So when you open on the top, the *ʻōpelu* see, and the *ʻōpae* go down. All the way to the bottom of the net and go outside of the net. So the *ʻōpelu* chase ʻum all the way down to the bottom of the net, and *paʻa* [stuck]. Then you don't have to worry, you just *huki* [pull] your net up.

But, when I went the other style of *ʻōpelu* fishing, with the pumpkin and the taro, you have to pound on the canoe because the *ʻōpelu* like come back up eh. But with the *ʻōpae*, they go down to the net, because the *ʻōpae* stay underneath the net.

KM: Ahh, so when they pound the canoe, the *ʻōpelu* are afraid...?

JM: Yeah, they go down.

KM: Ahh!

JM: With *ʻōpae*, you don't have to do that. They automatically go down, and stay down.

KM: Now in Kona, like Kaʻūpūlehu, Kūkiʻo, Mahaiʻula like that...?

JM: Uh-hmm.

KM: They would also gather lepo [dirt], they'd put the *ʻōpae* in with dark *lepo* so it was like shadows in the water. Did you mix your *ʻōpae* here with anything? The *limu*?

JM: No, the *limu* was only to keep it alive.

KM: Just to keep it alive?

JM: Yeah.

KM: So you would go down to the pond, you *ʻohi ʻōpae*, and you'd get the limu from the pond?

JM: Yes.

KM: The green *limu*?

JM: Yes green, *limu.*

KM: So that *limu* is what you would gather when you get *'ōpae.*

JM: And then we put the *'ōpae* inside, she'd stay alive. And then, when you go out, they don't use that, they only put the *'ōpae* in the *palu* bag. The *'ōpae* no mix with nothing, just the *'ōpae.* And that's why they don't have to use too much because the *'ōpae* swim.

KM: Too good. And the *'ōpelu* plenty?

JM: Oh, plenty! Oh yes. How many canoes? Let's see. Joe Mānoa, Jack Kahana, my Uncle Hanohano, Hailama Kahaloa, at least six canoes. And everyone go out, they all get *'ōpelu*, except for this one person. Him, his canoe is always full up. Jack Kahana. Because he come in... I suppose you've heard of the *hāpai wa'a* [custom of division between those who help carry the canoes on shore].

KM: *'Ae.*

JM: Well, when the other canoes come in, they count what they give you. But when he come in his canoe, he just grab and throw the fish to you, he doesn't count. And his canoe always used to come in with more fish than any other canoe there.

KM: So you think he went out *hānai ko'a* [feed and care for the fishing station]?

JM: I don't think they had to *hānai.* I don't recall. Because, I guess it's not fished out like some of the other places. The fish are always there. And another thing, I've never noticed the water to be as rough as it is nowadays. We could go out almost any time...

KM: Hmm. Now, Hailama, I understand... I spoke with Arthur Lyman, yeah.

JM: Uh-hmm.

KM: And he said that Hailama had the last lease that they had down there for Wai'ōpae side. They leased him, I guess, the rights to gather *'ōpae 'ula.*

JM: Well you know, this is interesting that you bring this up, that there was a lease. We had never, at any time, known that we couldn't go there.

KM: So it was the custom, that you folks could go?

JM: We could just go! Even Keahialaka, Even though it was the Hales place, we would just go.

KM: But the *'ohana* you *aloha* eh? [greet one another and share the catch]

JM: Oh yes.

KM: And what, would you bring fish back it the canoe came in...?

JM: Well, like I said, this Uncle Jack was one of them. He always give, always give.

KM: Well, like you said, the *hāpai wa'a*, the *kōkua* [helpers] on the shore...

JM: That's what I mean, they get. As long as you touch the canoe, that's enough [chuckles]

Group: [laughing]

JM: You walk along side, you just hold the canoe, you going get fish. That's the way that it was. But you see, most of the canoe guys, they would count [how many fish they gave]. But with this Jack Kahana, he doesn't count, he just grab the fish and give it to you.

KM: I've heard stories from the *kūpuna* in the old times, about the *'aumakua lawai'a* [fisherman's god], when they give, you would always get back. Did you hear any stories like that?

JM: Oh yes! Yes, I always knew that. I always knew that. And when ever our *kūpuna* wanted to go fishing, they would always call on us, the young ones, they would take four of us young ones and two fishermen. We *hoe* [paddle] that's why. We do all the paddling. I can recall several times out there, rain, dark, they cannot see land marks. And in the morning, when you see, you're way past Kumukahi, way outside.

KM: Oh so you'd go out when it was still dark time?

JM: Oh yes, night time, we'd go out fish. The *'ōpelu* is day, but other fish like *kawele'ā* and some of the other fish we go for, are at night.

KM: Hmm. So what kind of fish would you go out for at night time?

JM: More, they would go for *kawele'ā*. I've never heard, or never known for us to get *'ū'ū* [menpachi]. We'd spear the *'ū'ū*, but we would never go hook *'ū'ū*.

KM: Day time?

JM: Day time, spear.

KM: So you'd go in the crevices like that?

JM: Yes. And remember, I was telling you about this guy from Kaua'i, Moke?

KM: Yes.

JM: I don't know his last name, but he was the one, that when he came from Kaua'i and somehow became friends with my father, he lived with us for a while. He was the one that introduced us to diving out in the deep.

KM: Hmm. So, you know your *'ōpelu*, you folks would go out...? Was it all fresh, or did you *kaula'i* [dry] and sell some?

JM: No, it was all for *'ohana*. I have never known them to go out and sell. They always go get their share. Some they dry. I guess, *'ōpelu* is season, yeah. They come only certain time of the year.

KM: And your *'upena* [net] was a round *'upena*?

JM: Round, what they call *poi* bowl kind.

KM: So there were two lines or something to let down and pull up?

JM: When you look at the Kona net and the Puna net, they are two different kinds. The Puna net is shallow and like a poi bowl. The Kona net is like a cone, real deep. That's because the *ko'a 'ōpelu* is shallow over here.

KM: Hmm.

JM: So I've worked both the Puna style and the Ka'ū and Kona style, their style is easier to hemo the *'ōpelu*. Because all you need to do, is pull the net inside the canoe and just open the underneath, and all the fish just come out.

KM: They drop out of the bottom.

JM: The Puna style, you've got to pull the whole net, and turn the net inside out to get the fish out. It does not come to a cone, and like how they tie the bottom where they have the led to take the net down. All they do is *hemo* that and underneath open and all the fish come out.

KM: Hmm. Before the interview, you'd also mentioned something about the ocean being like your folks *pahu hau* [refrigerator] eh?

JM: It was! It was. You know, we never knew probably, so we were never dependent on the *pahu hau*, the ice box or refrigerator. Because when ever we wanted the fish, it was right there, always there.

KM: So were your *kūpuna* and *mākua* careful about how they would gather? Not take so much that it was *pohō* and thrown away?

JM: Ohh! Never, never ever...we were taught never, ever to do that. And even now, I have a hard time, even though not much *'ōpihi*, I have a hard time picking small kind *'ōpihi*. Some guys tell me, "Why don't you take that, because if you don't take, somebody else will take?" But I have a hard time taking that. It has to be a certain size...

KM: ...Okay, now earlier, we were talking about the ocean and that you folks took for your time, what you needed. You'd mentioned that sometimes they get plenty fish, and that they *kaha* [cut some up], *kāpi* [salt] the fish or something. Where did your *pa'akai* come from?

JM: That we got from the store. We never had, the only time we got is if we would go down below Volcano.

KM: So 'Āpua, Keauhou, Kealakomo like that?

JM: Yeah. When we used to go there, we would gather the salt, and then we would bring home. But other than that, no.

KM: Uncle Hale and Uncle Gabriel mentioned that even like at Kapa'ahu side, they could make *pa'akai*.

JM: Yes, that's right, but not this side.

KM: Was there interaction between the families? Like if you had a good *'ōpelu* ... [end of Tape 1, Side B; begin Tape 2, side A]

[would you folks work together and exchange resources] ...much, or did you folks pretty much work within the *'ohana*?

JM: We pretty much worked within the *'ohana*, yeah. We would have the 'Ōpihikao group that goes out *'ōpelu* fishing here, and the Kalapana group that goes for *'ōpelu* at their canoe landing in Kalapana.

KM: *'Ae.* Did you folks pretty much, then... for your fishing, did you mostly stay here, or did you go down... Let's say, like you go down to Pohoiki or Maunakea's area at Oneloa, would you go *'ōpelu* fishing down there?

JM: No. No, we never needed to. The *ko'a* that we had here was more than enough for the six canoes that were here. During the season, they can go everyday, and they always get *'ōpelu.* But you know, because I did not them selling the *'ōpelu*, they really didn't need that much. So they really didn't go out that much. Because one time they go out, oh my golly, they've got enough *'ōpelu* to last you for months.

KM: So they got what they needed.

JM: Yeah. More than enough.

KM: Did they dry some for home use?

JM: Oh yes.

KM: So you folks would *kaula 'i* [dry] the *'ōpelu* like that?

JM: Yes. We always dried some.

KM: So there was a strong sense...this idea about access to the ocean, access to the uplands...

JM: Uh-hmm.

KM: *Lau hala, 'awa, kalo* like that. The relationship between working *mauka-makai.* When the ocean was *'ōkaikai*, or rough, down here, did you folks go up...?

JM: We go *mauka*, work. And because...I'm saying this because my grandfather owned almost all the properties here, but we have never had problems, in as far as I'm concerned. I don't care where we wanted to go. Go to the beach or if I saw an orange tree over there, and I wanted an orange, it was okay for us to go get it. But always in a respectful way that we take what we need only. If I'm not taking home, I'll just take one or two, enough for me to eat, and I go my way. We never had problems, yeah.

In our homes here, we never had doors. Certainly no locks, because there was no door. Our main house inside, was a two story building. The down stairs had a wide opening like this [pointing the entry way of his present house, a double-door entry]. But no door. And then it was our kitchen, our living room, and every thing was open...

KM: Hmm. I was just wondering, did you see your *kūpuna*...did any of them use *'awa*, or drink *'awa* for medicine or anything like that?

VM: [laughing]

JM: [laughs] Drink, yeah. Us, we had to go chew it for them. Potato and *'awa*, we used to go chew and spit in the bowl, and they used to make it for drink.

KM: What kind of potato, *'uala* [Hawaiian sweet potato]?

JM: Yeah.

KM: Hmm, so like *pūpū 'awa* for the taste?

JM: No, they make 'um for swipe.

Group: [laughing]

JM: And it's us, the kids that have to go chew it. The *'awa*, the same thing, till all numb, your mouth. And then, I used to see them enjoy themselves, sitting. And then when they get argument, they like stand up, they no can stand up. They like throw blows, no can! I've seen that.

KM: Amazing. So you folks were still chewing the *'awa* for your parents or *tūtū* them?

JM: Yeah, but I think when we were in high school, that all stopped already. Liquor was easy to get.

KM: Yeah, but young time?

JM: Young time, yeah.

KM: [pauses – thinking] Did you ever see your *kūpuna* go take *'awa* down to the ocean maybe, to give to manō or something like that?

JM: No. That I've never seen, but I know that I was told that our guardian was the shark. And I know I've heard that before us, they used to talk about how they took calabash, gourd eh. And when they'd see the big shark come towards the canoe, they'd throw the gourd out side so that the shark would go after the gourd rather than the canoe.

KM: The *manō* eh?

JM: Yeah.

KM: So they'd throw the *hue* or calabash inside the water, and he'd go after that?

JM: He go after that and he no bother you. I've heard that. But not when my time. But I've always heard, "Don't be scared of the shark. Don't worry about the shark, that's your guardian." I always heard that. We go diving and get plenty shark, but never thought anything about it...

KM: You know, you hear stories some times that the *kūpuna*, sometimes the *manō* would draw the schools of *i'a* [fish] to you like that. Did you see anything like that with the old man Kahana *mā*?

JM: Not, that I never saw.

KM: Yeah. So, you really *aloha* this *'āina*, yeah?

JM: Yes, very, very much so.

KM: In general, about development...and at least here, you folks have this āina, it's country. But like down at 'Ahalanui and Oneloa, of course, much of that land was bulldozed for papaya.

JM: Right.

KM: And in fact, I should tell you, that the area on the other map [Reg. Map 1777] where your *'ohana*, Makuakāne *mā* had some land in 'Ahalanui, there were names, Kuahewa and Kamakau, and Kahananui, were the three old grantees in 1852, there-abouts. That whole section of forest on the boundary between 'Ahalanui and Pū'āla'a, the project that A & O is proposing, that whole area is going to be preserved as is. In fact, you can still go inside the forest there and see

the walls, the *māla* or little garden plots. There is still *pia* growing. They are going to protect and preserve that area and the historic sites.

But in general...and you'd shared earlier that it's important to take care of the Hawaiian places and things like that, yeah?

JM: Uh-hmm.

KM: Do you have thoughts about *ilina* [burial sites]? I know that you are taking care of your family cemetery down here. When the *kūpuna* bury somebody, is that where they belong?

JM: [pauses – thinking] I would say that it should not be moved. I think that when they were buried in that particular area, that was their own area, or that was...I guess in the olden days, their graves were in their property. They don't have private cemeteries like we do now. The laws were not the same. So almost every *'āina* that you have, you will find graves, and that's how they did it.

KM: Hmm, yes. That was their style.

JM: Yes, that was their style of doing it at that time. I do not have any feelings about if it was to be removed, you need to then move it with the consent of course, of the *'ohana*, the family. If it's alright... Well, I feel that they are the rightful ones to say yes or no. If they say okay, then who am I on the side to say that it's not right.

KM: Right, so it should always go back to the *'ohana*?

JM: It should go back to the *'ohana*. That's where it belongs. I don't think that you can come in, just because you bought the *'āina* and you can just do what you like. I know it's yours, but there are certain things that are on that property that you shouldn't touch without giving respect to that person, at least to the *'ohana* to say.

We had a big problem too, even in our church, in bringing back Ōpūkaha'ia. We had mixed feeling about moving him from Cornwell over to Nāpo'opo'o. There were many mixed feeling about that. "He should remain over there." "No, this is his *'āina*, he should be brought back, his wish was to come home." So I feel the same. The *'ohana* said they want him over here, who are we to say "No!"?

KM: So if it's their descendants, their genealogy?

JM: Right.

VM: Uh-hmm.

JM: So if I had one grave over there, now I have in my yard here, I'm going to move it someplace, I'll put it in the front there. I'm not going to leave it there. I mean, it's nice to have it at that time, the most convenient place, or that was the proper place, that they felt at that time. But the time has changed, so if you ask me, there is nothing wrong with taking it.

KM: So you *aloha*, you always respect...?

JM: Right. Number one has to be, you have to have that *aloha*...

KM: ...So you're saying that the idea is, "You respect. You take care and *aloha* the *kūpuna* where they are." If the family agrees...

JM: Sometimes, you get mixed feelings in progress and development. I don't care for the kind that just comes in and pushes everything all over the place. The law helps us so much today, with respect to archaeology studies, yeah. They have to have that. And if they see anything they have to make a study of it before they can even move it or do anything with it. And yet, if it's of any significance, then they need to look at it, whether we are going to leave it , or remove it, or find out it is.

Like when I was building this land over here, the same thing. My neighbor had to pay $600.00 for and archaeology study, and the guy came over and looked at my place, and he told me... Well, I had all kinds of walls in here. And I had one wall back here that was my pig pen. Before, no more fence, so we build a wall. The guy tell me, "You no can move this." I tell him, "that was my pig pen." "Oh." Then he comes over here someplace, *makai* side of this house. It was cemented and had a rock pile, and he tell "Oh, this, I'll have to make study." Well that was my *hale li'ili'i* [outhouse] [chuckles].

Group: [laughing]

JM: I tell him, "Don't come over here tell me this kind of stuff, there's no *heiau*, there's nothing here." "What about this rock pile over here?" I said, "Well, over the years..." See, this was all *lepo* [soil] in the front here. "As we dig, the stone come out and we take and we make one pile. That's what it's from. It's not one *heiau*. We made that stone pile just to remove the stones."

KM: You know, that's very interesting, and it's logical, because the families live on the land, and these old *'āina*. Even down at 'Ahalanui and Oneloa like that, where the houses were.

JM: Uh-hmm.

KM: You see these nice mounds, nice clearing mounds. Some of them are well made.

JM: Uh-hmm.

KM: It's not just throw, throw.

VM: They just pile up the stones.

JM: See like I do the same thing here. And on my pile, I don't just throw the stones. The foundation, I make it look nice underneath, and we throw the stones, you know, we keep throwing them. Make the next wall. So we don't just take stones and throw.

KM: Hmm. So is that how your kūpuna were, you just learned that growing up?

JM: Yes, right!

KM: So you would make it nice and neat.

JM: Make it look nice, everything I do, I make a walk way, even if it's nothing, I put a face, and I make it look nice.

KM: Sure, you take pride in your work, and what you do...

JM: Uh-hmm...

KM: ...[discussing family lands in ʻŌpihikao vicinity] You were telling me too, there was a Catholic Church. We're here on Mokumaile's *ʻāina*, and we see...*Aia*! [looking at the map] This says Mauna...

VM: Kea.

KM: Yeah, Maunakea's [indicating – Maunakea's House]. See that house that's marked right there?

JM: Well, this property used to all be owned... This used to be the Kahana estate, Kahau, Hekekia [thinking]...

KM: See, there is another Grant in here, 1940 [awarded to Maua'e, situated in the ʻili of Pohoiki, *ahupua'a* of Kanane]. And this Grant, Number 1895, was awarded to Mohola, and then the Catholic Church is situated in this lot. [Bureau of Conveyances Liber 22:327 records that Mohola deeded his grant at Pohoiki, in Kanane to Louis Maigret of the Catholic Mission on December 5, 1866.]... Were the families in your time, mostly centered around here at ʻŌpihikao, and then down at Pohoiki side? Or were there people in between when you were a child?

JM: No, no in between. Only had this Kuamo'o in between

KM: Kuamo'o by Malama? [Grant 1887 awarded to Kamakau]

JM: Yeah, that side. That's the only one house that I remember, from here to Pohoiki. Except for that one at Keahialaka, that Hale had. And nothing again until you get down to Pohoiki.

Pohoiki, when I was growing up, there was really nobody there except for the Hales and Mānoa. That was the only two houses there.

KM: You'll be very interested, I've located some wonderful descriptive accounts, from the time of your great grandfather, with the church here. Even back to the 1840s. What was happening with the families here, and how the community was also changing... *ʻemi*, getting smaller.

JM: Uh-hmm...

JM: Yes. And as far as *ʻāina*, my wish is that...certainly, I respect the receiver, and hope that the receiver respects the giver as well. That this, what ever we have left here, would never be sold. This is my wish, to whom ever I leave it to.

KM: Yes. It is your heritage. There is a deep attachment to this land. How many generations have been here. At least you know that your great grandfather is here. Then you're the fourth generation on this same land. That's a long time.

VM: At least six generations.

KM: Yes, a long history.

JM: I know my grandma lived back here. Their house was on the top and we were raised right in the front here. Our house was...oh my golly, not one third of this building. That was our house [approximately 10 x 40].

KM: Yes, that's how it was in those days. They had enough room for sleeping like that, but most of the time, they were outside working all the time eh.

VM: Uh-hmm.

JM: Yeah. It was just for sleep, and then we had this small portion in the front of it that was our kitchen. And it was right on the ground. All they did was...our folks just put all *'ili 'ili* [water worn pebbles].

KM: On the floor?

JM: Yeah. We didn't have no board floor, it was all *'ili 'ili*. Right on the ground, just put *hāli 'i* [a mat covering] on it. And that's why we know the *pulume ni 'au* [coconut midrib broom], how good you can clean your place, real clean, and no even move the *'ili 'ili*.

VM: Uh-hmm, that's the best broom.

JM: That's the best broom to clean. It can even take out the match sticks inside there. Amazing!

KM: So it was walled around, but the floor was all *'ili 'ili* in the *hale*?

JM: Yeah. And then the house, that's why this place was known as the grass shack. Because all it was, was four posts in the corner, and it was all coconut leaves. And one frame with the window, glass window. And then metal roof.

KM: This was when you were very young?

JM: Yes, real, real young...

KM: ...Were *pipi* [cattle] still running on this *'āina*?

JM: Oh yes, my grandfather, maybe was actually a grand uncle, used to be the only one that owned *pipi* over here. That *pipi* roamed all the way from Kalapana to Kapoho. Nobody else owned *pipi*.

KM: How about Lyman side them?

JM: No, no more nothing.

KM: What was this grand uncle's name?

JM: Jack Hamili.

VM: And nobody stole the cattle.

JM: No, nobody stole anything in those days. And he had good mules too....

KM: Hmm. So the fishing and the land was good...?

JM: It's still good. It's still taking care of us.

KM: Do people still use *'ōpae* to go out for *'ōpelu*?

JM: No, that was outlawed in... I think late 1940s or early 1950s. It was outlawed that we can not use that anymore. So that's the reason I know of why we did not go *'ōpelu* fishing anymore. 'Cause we no *ma 'a* [not used to], like the Kona side, they *ma 'a* already, using the pumpkin, the taro, and the other baits. Here, we have never used that. Not that we cannot, but I guess they just didn't want to do it.

KM: Hmm. Did you hear your *makua* or anybody talk about the use of what they call "chop chop" now, or "make dog?"

JM: Right, the different names that they use. No. They just didn't want to fish without that *'ōpae*. That was their way.

KM: Yes, and it's sad, when you go throw in the *hauna* [stink, meat bait], your *ko'a* changes too.

JM: Right, it does. You bring in all of the different fish that you don't want. See, the sad thing about that is that a lot of fishermen that I see, that happens, then they bring up the fish and then they throw away. That is terrible. You know they catch all the fish, even the ones they don't want, on the *'upena* [net].

When you put inside the canoe...like our Puna side, with the *poi* bowl type of net, you don't have one pile like the Kona style. When you *hū* [pour the fish out of the net], it's the whole canoe. The net all *huli* inside, and we get all *'ōpelu* inside. So if they are still alive, and they're shaking, they take 'um and throw back what you don't like. But a lot of them don't do that. They bring 'um inside if you do the chop chop. Because with the *'ōpae*, you know, guaranteed, only *'ōpelu*. But when you start chop chop, you get all other kinds of fish go inside, that people don't care for. And then, they bring 'um in and just throw it all away. And that is bad!

Probably, the *kūpuna* knew about chop chop, they understand. But the Hawaiians, they no *'uha'uha* [waste]. Because food don't cry for you, you cry for it.

KM: *'Ae* [chuckles].

JM: So they never did that kind of stuff. So probably, as far as I know, and I can understand it, once the *'ōpae* was outlawed, *pau*.

VM: The *'ōpae* have disappeared. Same thing with the *'ōhua*, they came in seasons. You can go out and catch 'um by the bucket full. We'd go home and dry it, enough for the whole year. Then they made a law that you cannot catch that thing, it disappeared. You hardly see it.

JM: And yet, when we were growing, that was part of our food.

VM: *'Ae.*

JM: Every season, we have season for *'ōhua, moi li'i*, down the line, all different kinds. It was put there for us at different times. When the *'ōhua pau*, the *moi li'i* come, when the *moi li'i pau*, the *'oama* come. Right down the line. When that was *pau*, the *'ōpelu* was in season. So you always had.

KM: Hmm. So they were working the fishery year round, one to another?

JM: Right.

KM: That way the other fish can grow up again. You know, Arthur Lyman mentioned something very interesting. When you would go for *'ōpelu* with *'ōpae 'ula*, you can even eat the *ōpū* [stomach] eh?

JM: That's the best *palu* [a salted fish relish]. See the old folks never throw away. That's why even until today, when clean the *'ōpelu*, I like clean 'um. I like the *ake* [liver] [chuckles].

KM: *'Ae*. Just like you said, the *ōpū* like that, and when the *'ōpae* are inside, you can eat that.

JM: Oh yes.

KM: Arthur said that he wouldn't be surprised if one of the reasons people get sick when they do that and if they break the ake or something like that, is because when they put *hauna* in the water, the fish eat *hauna*.

JM: Uh-hmm.

KM: And then you get sick.

VM: Uh-hmm.

JM: Because even when...I have never seen dried *'ōpelu*, like the kind of *'ōpelu* we have here in Puna. Because when we *kaha* [cut] the *'ōpelu*, you see, you take the *pihapiha* [gills] eh.

KM: Hmm.

JM: Then you rub that all on the *'ōpelu*.

KM: Yes, red eh.

JM: Yes, it comes red! Oh, the good looking!

VM: And the *'ōpelu*, when it was dried before, it never got mildew. Now, when you dry the *'ōpelu*, you have to keep 'um in the freezer.

JM: We never had that.

KM: Yes, they don't dry 'um good now, when you go to the store.

JM: No, 'cause then they loose the weight.

KM: You're right.

JM: The drier it gets, the less the weight. So they want that wet weight, not the dry weight. It's totally different.

KM: I think you're right. Before, when you would *kaula'i* [dry], did you use the box, or did you just set it out?

JM: Right on the stone. See what we generally do, we used to have another warm spring, that was across the road. Right next to the road, maybe ten, fifteen feet away. And when the water is low, no more rain, we keep the water in the barrel, we keep it for drinking. The women folks would go down to this place, take their *pā kini* [tin basins] and put their water. That's where they would wash their clothes, and then they'd dry their clothes on the stone. And that's where they would *kaula'i* the fish too. They're sitting over there talking story, waiting for the clothes to dry, same time that the *'ōpelu* drying.

KM: Hmm. So it would dry fast on the stone?

JM: Yes, yes.

KM: So *'ono*, the *ōpū* with the *'ōpae* and stuff?

JM: That's guaranteed, every time, you clean, all the *ōpū* is saved. All the *ōpū*, because that's all *'ōpae*. No more *kāpulu* [dirty or contaminated bait] kind inside there. It's all clean with the *'ōpae*.

KM: Hmm. It's so interesting. It is smart, a simple way of life, not complicated, but the people lived well. They *aloha*, take care.

JM: They get *aloha* for everything that you have, everything that you see. That's where I think that was the biggest thing, to respect. Not just human beings, but everything around you.

KM: *Mahalo*. [pauses] Let me ask you a couple of questions. And if you prefer not to talk about it, that's okay too.

When you were young, did you hear any of your *kūpuna* still *'oli* [chant], call at the rising sun, or things like that?

JM: No.

KM: How about when *hala*, someone passes away? Would you hear *hō'uwē'uwē* [dirges]?

JM: Oh yes, yes.

KM: You'd hear that.

JM: Yes. My understanding is that they always had one chanter, and that always was my Aunt. You know when she comes, you're going to hear that. And to me, it was real scary, no. When you hear that, you no *ma'a* to that kind. You hear that, they understand what they are doing. For us kids, it was hard because we don't speak the language, so naturally we do not understand what they are saying. But you can hear uncle this, and aunty this, names and every thing that's coming out. Then I understood later, that this was just passing on the genealogy of the person. This is how they keep the family genealogy. Then whoever comes, they'd know the ties of the person.

KM: *'Ae*.

JM: Oh yes, that I heard.

KM: Hmm. We're sitting here, of course, in Puna. *Mauka*, you have Kali'u, Pu'ulena, Pu'ukī, down to Kapoho, to Waiapele, Kūki'i... [end of Side A; begin Side B]

...I realize. But the *kūpuna*, the old people had their beliefs. Did you hear your *kūpuna* talk at all, about the *pele*, the eruptions. Did you hear...or what was the feeling about volcano, eruptions? Did you go *holoholo* to see them?

JM: No, we never did. But on my mother's side, my mother's family, all the children were named after Pele. They have what they call the "dream names."

KM: Hmm. *Inoa pō*.

JM: Yes. So my mother was named Ke-li'i-wahine-o-Puna. My aunty's name was Hi'iaka-i-ka-poli-o-Pele. All were named after...there were twelve of them, only the four that were given such names lived. The rest all died.

KM: Oh, so the ones that were given the *inoa pō*, survived?

JM: Yes.

KM: The ones that they didn't give the names to, *hala* [died]?

JM: Yes. I guess, I would suppose because of my great grandfather being a *kahuna pule* [minister], some of these things were, as far as I know, when I came, my parents told me, "All that we *'oki* [cut], a long time ago." They *mālama* [keeping] of those things had past. But, it is our culture, our way of life, and it is hard to get away from it. Because they say "Don't sweep outside night time. No whistle. No throw *pōhaku*." I grew up with that kind eh. It was still with us, yet...

KM: ...Hmm. Thank you so much for sharing some of your recollections with me.

JM: I just thought I'd share some of those stories of my life, my time, and what happened to me and my family.

KM: *Mahalo!* [end of interview]

Personal Release of Interview Records:
'Ahalanui, Laepāo'o and Oneloa Oral History Study
Prepared in conjunction with the proposed
A & O International Development (Puna, Hawai'i)

The interview referenced below was conducted by Kepā Maly (*Kumu Pono Associates*), under a contract with A & O International Corporation in conjunction with historical and archival documentary research as a part of a cultural assessment study for portions of the *ahupua'a* of 'Ahalanui, Laepāo'o, and Oneloa (the Puna study area).

Date of Recorded Interview: July 21, 1998 (with notes from review of October 10, 1998).

I, John "Kumukahi" Makuakāne, participated in the above referenced oral history interview with Kepā Maly, and hereby give permission to Kepā Maly to include the released interview transcript in the study he is preparing (KPA Report HiPu15b-073198). This permission is granted, subject to any restrictions listed below:

(a) Quotes from the interview(s) may be used as a part of the final report on historic and cultural sites and practices in the Puna study area, or reference may be made to the information in the interview(s). Copies of the interview transcript (including maps and photographs – subject to restrictions) may be made available to A & O International Corporation, the County of Hawai'i, and the Department of Land and Natural Resource-State Historic Preservation Division and other appropriate review agencies.

Yes or no: yes

(b) The interview tape may be released for review by interested listeners.

Yes or no: NO

(c) The released interview transcript may be housed in the Hawaiian Collection of the University of Hawaii-Hilo, Mo'okini Library; public libraries; and Historical Society collections for review by the general public.

Yes or no: yes

(d) The interview records may be referenced by Kepā Maly for scholarly publication.

Yes or no: yes

(e) Restrictions:

John P.C. (Kumukahi) Makuakane
(Interviewee)

Address: 491 Makaala Cr.
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October 26, 1998
Date of Release

Kepā Maly
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Keikialoha Kekipi
Record of Limited Consultation
July 21, 1998 — Pū'āla'a, Puna
(notes prepared by Kepā Maly)

On July 21, 1998, from approximately 3:15 to 4:15 p.m., I met with Keikialoha Kekipi (Keikialoha) at Pū'āla'a, where he directs *Ho'oūlu Lāhui*, a cultural education program. The contact was initiated in an effort to ask Keikialoha to consider participating in an interview/consultation process, in order to record his thoughts and recommendations regarding the proposed A&O International-Oneloa Development project.

I first met Keikialoha in the 1970s, and knew that he was an active member of the Hawai'i Island Burial Council. More recently, I learned of his work in Puna through communications with David Matsuura; Marc Smith of the State Historic Preservation Division; staff of Cultural Surveys Hawai'i (CSH); Bob Lindsey of Kamehameha Schools/Bishop Estate; and area residents.

Being unable to obtain a phone number for Keikialoha, I sent a message to him July 8th, via one of the board members of *Ho'oūlu Lāhui*. Not hearing from Keikialoha, I sought him out and met with him at Pū'āla'a on July 21st. Keikialoha agreed to speak in person, regarding the 'Ahalanui-Oneloa vicinity, but stated that he would not participate in a recorded interview. Explaining this further, Keikialoha stated that he felt an interview in which he had participated on January 28, 1998, was improperly reported, and misrepresented the documentation given[20].

Following our conversation, I drafted some notes, paraphrasing key comments, historical observations, and recommendations regarding the proposed development. Those notes were mailed to Keikialoha on July 27th, asking him to review them, make any comments or revisions, and to consider allowing me to include them as a summary of his concerns regarding the proposed project. The communication was retransmitted on August 14th, 1998. But because I did not hear back from Keikialoha, or receive his permission to include the paraphrased summary notes in this study, the documentation is not cited here.

[20] The interview mentioned by Keikialoha was conducted by T. Devereux and D. Borthwick of Cultural Surveys Hawaii (CSH), and is reported in an "Archaeological Inventory Survey for Two Proposed Hawaii County Parks, Ahalanui and Pohoiki, Puna Hawaii Island" (Devereux, Borthwick and Hammatt; March 1998). Doug Borthwick reports that Mr. John Hale was the primary interviewee. At the time of this writing, the CSH report is still under review by DLNR-SHPD, and not formally released (pers comm. D. Borthwick; July 23, 1998.)

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APPENDIX G

SOCIOECONOMIC IMPACT ASSESSMENT: ONELOA ONSEN AND SPORTS RETREAT

by:

Ron Terry, Ph.D.

SOCIOECONOMIC IMPACT ASSESSMENT

ONELOA ONSEN AND SPORTS RETREAT

Prepared July 1998
for A&O International Corp.
by Ron Terry, Ph.D., Keaau, Hawaii

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1 INTRODUCTION

1.1 Purpose of Report

A range of adverse and beneficial social impacts is generally associated with projects that develop resort facilities in rural areas. There is a possibility of losses of farmland, pressure on formerly uncrowded recreational or resource areas, increase in traffic and noise, and unwelcome changes in the character of a community. However, these impacts may not occur, or they may be offset by economic benefits, including: growth in jobs, income, government revenues; larger and more accessible markets for local products; and economic diversification, which in turn spin off positive social impacts. Other social benefits such as improved recreational facilities and community diversification may also result.

The purpose of this report is to identify such impacts for the Oneloa Onsen and Sports Retreat ("The Project") and to develop mitigation measures to eliminate or reduce adverse impacts.

1.2 Project Description

This analysis will consider two basic alternatives: Project and No-Project. The description of the Project Alternative has been supplied by A & O International Corp. ("A&O") in the Environmental Impact Statement Notice of Preparation (EISPN) published in the May 8, 1998 edition of the *OEQC Environmental Notice*.

This report assumes no responsibility for ensuring that the various elements that comprise the Project are accurately described by A&O, likely to occur, or even realistic to develop. It is our understanding that a Hawaii County Development Agreement (DA) will be formulated simultaneously with the EIS process in order to ensure congruence between the description of key various project elements and mitigation measures in the EIS and the corresponding items that are approved for action by the Hawaii County Council.

The reader may refer to the main EIS for a full description of the Project. A summary of its elements follows:

- *Sports and health complex with onsen ponds*. This facility would offer exercise and sports facilities, a 50-meter swimming pool and diving platforms, seven tennis courts (including one championship course), a track and field complex meeting international standards, a baseball field, garden jogging path, equestrian facilities, and numerous other features. The therapy and wellness facilities include consultation, examination, and treatment rooms, exercise area, men's and women's locker rooms, and a hydro-therapy area equipped with whirlpool tanks and therapeutic pools. A unique attraction are the natural geothermally warmed ponds that will serve as *onsen* (Japanese-style) spa ponds.
- *Boutique lodge*. The lodge would consist of 40 all-suite single-story units, thatched in Hawaiian style and situated on an artificial lagoon. The hotel will also include meeting

facilities, onsen baths, swimming pools, snack bar and restaurant, an artificial lagoon, and a two-story lobby and restaurant.

- *Chalets*. The 125-unit chalets will provide owner-occupied or longer-term rental accommodations. Each detached unit, approximately 2,500 square feet in size, will include a kitchen, living space, dining space, bedrooms, and outdoor recreation area such as a private pool or garden terrace.
- *Beach club*. With the proposed realignment of the Kalapana-Kapoho Road, the beach club will have open access to the shoreline areas. The beach club will include recreational and exercise facilities (locker rooms, weight lifting, tennis courts, sand volleyball court, swimming pool, Jacuzzi), restaurant and pool-side snack bar, and meeting facilities. The beach club will also include 30 thatched-roof bungalow suites and a lobby. The site will be lushly landscaped to provide a colorful tropical ambience, and to buffer the side fronting the realigned Kalapana-Kapoho Road.
- *Golf facilities*. One public 18-hole golf course, driving range, and clubhouse facilities including a two-level, 30,000 square foot complex with a pro shop, restaurant, bar, and meeting facilities.
- *Restaurant and retail complex*. The restaurant and retail center, approximately 15,000 square feet in floor area, will be located along the realigned Kalapana-Kapoho Road. The design will reflect a quaint village style intended to serve guests, visitors passing through the area, and surrounding residents. The center will include a restaurant, fast food outlet, service station, convenience store, and a variety of retail establishments.
- *Agricultural, Open Space, and Trails*. Agricultural, open space and trail uses are planned to integrate with the sports and health components of the development. An orchard area will be established within an agricultural easement along the *mauka* perimeter of the Site. In addition to providing agricultural products for sale, the orchard will function as a buffer from surrounding land uses and provide a linkage to the open spaces on the site. The golf course irrigation system will also service the orchard and other agricultural areas. Awa, a traditional Hawaiian medicinal plant that was historically grown in the area, will be cultivated in the understory of the native forest. Herbal products will be cultivated on-site to complement the wellness and therapy programs. A riding academy on the mauka end of the project site will provide equestrian facilities complete with stables, feed and equipment areas, tack area, paddock, dressage area, and manager's quarters. A trail system will meander through the trees for use by pedestrians, bikers, and horse riders. The trail system will provide access to the cultural and archaeological interpretive features along the northeast portion of the project site, and continue through the native forest area and *makai* portions of the project site, and finally connect to the Kapoho-Kalapana Road to complete a loop. Trails through the forest will provide a cool, peaceful, and educational experience. An interpretive program, including signs to identify and explain the native plants and archaeological sites, will be strategically placed within the forest area.

Related to the above resort features is a realignment of the Kapoho-Kalapana Road (County Highway 137) to higher elevations that would avoid a section of the road currently inundated at high tide (see main EIS for map). The Applicant will improve the existing Kapoho-Kalapana Road corridor for use as a bikeway.

"No-Project" Alternative

State environmental impact assessment laws require examination of a "No-Project" alternative in the EIS. While this report recognizes this requirement, the impacts of not building the project are simply the absence of the impacts - both beneficial and adverse - associated with the project. There is therefore no explicit discussion of No-Project impacts in individual sections that deal with individual resources.

1.3 Definition of Study Region

The Project is located in the Puna District of the Island of Hawaii. More specifically, it occupies 494 acres in the *ahupua`a* (traditional Hawaiian land division) of Oneloa, Laepao`o, and Ahalanui. The reader is referred to the main EIS for general and detailed maps of the site. For the purposes of this report, the term **project site** will refer to only the area proposed to be an actual part of the development. The term **study area** will be used to refer to the area of Puna in which the Project is located; i.e., between and including Kapoho, Pahoa, and Opihikao, and centered on Pohoiki. The boundaries are treated as approximate, in order to adapt to the resources or characteristics under discussion. For many resources, the entire District of Puna serves as the study area. For others, we refer to Lower Puna - or Puna Makai, which encompasses the areas with elevations below 1,500 feet east of Keaau. Where important to distinguish precise geographical areas, they are specified.

1.4 Methodology, Data Sources and Consultants

1.4.1 Issues Studied

Social and economic impacts vary greatly depending on the type of project and environmental setting. Of interest in this study are effects on the following:

- Quantity and distribution of population
- Community cohesion and sense of community
- Public services such as police, fire, emergency medical, and schools
- Effects on local businesses, agriculture, churches, and community activities
- Recreational activities
- Highway safety for bicyclists and pedestrians
- Employment
- Government revenues and expenditures
- Indirect and induced economic benefits

Impacts to Hawaiian culture have been addressed in a study conducted separately for this EIS by Kepa Maly.

1.4.2 Consultants

Dr. Ron Terry of GeoMetrician Associates in Kea`au was responsible for the social impact analysis. The economic impact analysis was conducted for the author by Dr. Hossein Khaleighi of Honolulu. Dr. Khaleighi's report is attached in its entirety to the social impact assessment, and is summarized in appropriate sections which follow.

1.4.3 Published Data

Data and descriptions concerning the design and operation of the project were supplied by A&O. Demographic, social and economic information of a quantitative nature was obtained from U.S. Census data, the *Hawaii State Data Book* and the *Hawaii County Data Book* for various years, and publications of the Hawaii State Department of Labor and Industrial Relations, and the Hawaii Visitors Bureau.

A number of other published studies including Environmental Assessments, Environmental Impact Statements, surveys and regional plans were consulted for data, ideas and opinions concerning the impact of tourism in rural areas of Hawaii. These sources are cited individually in the text.

1.4.4 Community Consultation

Statements concerning community opinions of the special character of Puna are taken from previous and ongoing work the author has done in Puna, including approximately a dozen environmental assessments over the last five years, which involved more than 20 meetings with the community. The author also consulted informally with various individuals and agency officials to gain further understanding about community perception of environmental effects from the project. Formal public input on the project is expected at a public hearing which is expected to be held after announcement of the availability of the Draft EIS. This report will be supplemented and modified accordingly at that time.

2 EXISTING CONDITIONS

2.1 Population and Settlement Patterns

2.1.1 Population

The population of the Big Island in general has been growing rapidly since 1970, largely as a function of increasing economic opportunities associated with tourism growth. Puna has shared in this growth, although for somewhat different reasons. Table 2.1 depicts recent population growth for Hawaii County and the South Hilo and Puna Districts.

Table 2.1
U.S. Census of Population Trends

	1960	1970	1980	1990
Hawaii County	61,332	63,468	92,053	120,317
South Hilo	31,553	33,915	42,278	44,639
Puna	5,030	5,154	11,751	20,781

Sources: U.S. Bureau of the Census: "1990 Census of Population. General Population Characteristics," 1990 CP-1-13; Hawaii County Data Book.

The average daily visitor count on the Big Island expanded from about 3,500 in 1970, to 8,000 in 1980, to almost 20,000 by 1995, a nearly six-fold increase in two decades. Although the early efforts at attracting tourists were divided equally between East and West Hawaii, Table 2.2 illustrates that actual growth in hotel and condo rooms occurred in West Hawaii (first Kona and later Kohala).

Table 2.2
Visitor Accommodation Units, 1960-1994

	1960	1970	1980	1990	1994
East Hawaii	249	1,204	1,957	1,411	1,246
West Hawaii	288	2,180	4,222	7,423	8,107

Sources: Hawaii County Data Book, var. years. Hawaii State Data Book, var years.

The visitor industry supplies jobs, a surplus of which induces in-migration and thus increases the resident population. The year 1965, when the Mauna Kea Beach Hotel opened and brought with it 775 jobs, inaugurated the era of large-scale resorts. By 1982 there were over a thousand jobs available at South Kohala resorts, a figure which grew to 4,000 by 1990 and to almost 5,000 by 1997 (Hawaii County Data Book, var. years). Continued expansion of resorts during the next two decades is likely. The *Hawaii County Data Book 1995* (Table 7.14) lists almost 3,600 new planned units.

A large and ever-increasing component of the de facto population (the average number of people present on any given day) is composed of visitors. In 1980, the de facto population of Hawaii County was 98,700 - approximately 5,500 (7.2 percent) greater than the resident population. By 1990, the de facto population had increased to 135,100 - approximately 15,000 (12 percent) greater than the resident population (Source: 1993 Hawaii County Data Book: Tables 2 and 106). An increasing number of tourists rent cars on the Big Island. Over time, greater absolute numbers and larger proportions of motorists are visitors.

The Lower Puna area, well-populated by Hawaiians before 1800, was nearly abandoned in the 19th century. Cattle raising and agriculture dominated land use in Puna in the late 1800s (Puna Community Development Plan Technical Report [PCDP] Community Management Associates 1992:10). At Pohoiki itself, the entrepreneur Robert Rycroft had settled in 1877 and soon began a series of ventures including `awa shipping, an `ohi`a sawmill, and a coffee plantation. Despite such economic ventures here and in other parts of Puna, the population in Puna remained the lowest of any district on the island, reaching a nadir of 834 in 1890 (Ibid.:10).

The advent of plantation sugar in Puna in about 1900 spawned villages full of immigrant laborers, and Puna's population began to slowly grow. The 1990 U.S. Census of Population counted 20,781 inhabitants in the Puna District (U.S. Census Bureau: STF1a CD-ROM). The rapid rate of growth experienced in Puna during the 1980s (76.8 percent) has probably slowed somewhat, but it is likely that Puna is home to at least 25,000 people in 1998. The steady growth is in part attributable to the ready availability of inexpensive building lots and rental housing within a reasonably close distance to Hilo, the major source of jobs and government services.

Although no data on visitor numbers and/or de facto population in Puna are available, the relatively small inventory of visitor rooms - basically the sum of several dozen bed-and-breakfast operations - would indicate that visitors are a minor component in the daily population (although many day visits and pass-throughs occur).

2.1.2 Settlement Patterns

The island of Hawaii is still a dominantly rural area, with great tracts of open space used for farms or ranches. Large areas of wilderness are also present, including the majority of the land in the Puna District.

Population in Puna is mainly widely dispersed in the so-called "substandard subdivisions," not clustered within towns or villages. The only true town in the study area is Pahoa, which has about 1,000 inhabitants, but over three dozen stores and service establishments, by far the majority of storefront businesses in Lower Puna. There was formerly a small village at Kapoho, but this was destroyed in the 1960 eruption of Kilauea volcano. Major subdivisions are Hawaiian Paradise Park (the most populous subdivision with over 4,000 residents but virtually no commercial or industrial land use), Orchidland, Ainaloa, Hawaiian Beaches-Hawaiian Shores, Leilani Estates, and Nanawale Estates. Several smaller residential/ agricultural or agricultural subdivisions are also present.

The project site contains no homes, nor indeed any active land use, and there are only a few homes and park directly bordering the site. The most prominent subdivisions (where most residents live) within five miles of the proposed project, and the number of lots in each, are as follows: Nanawale Estates (4,289), Leilani Estates (2,266), Kalapana Seaview Estates (693), Kapoho Vacationland (489), Kehena Beach Estates (199), Kapoho Beach Lots (185), Waawaa (177), and Lanipuna Gardens (118 lots). Most lots in these subdivisions are vacant; residential occupancy rates vary from less than 5 percent to over 50 percent. Various residential and agricultural lots are also present scattered throughout other parts of the study area. Most germane to the Project is the small settlement at Opihikao, 5 miles west along the coastal road, and other individual homes along or near the coastal road near Pohoiki and Ahalanui.

As indicated earlier, the majority of storefront businesses, community facilities and schools are centralized in the town of Pahoa. Among public use or commercial facilities, only beach parks and churches are distributed widely in correspondence with the population.

2.2 Economy

[Note: This section and Section 3.1 are largely summaries of a separate report, The Economic Impact of the Oneloa Onsen and Sports Retreat, which is appended to this report. Readers interested in methodology, sources, or further detail are referred to the full report.]

State Economy

Hawaii's economy is based on tourism, construction, services, military expenditures and agriculture. The Gross State Product increased at an annual rate of 3.9 percent during the 1970s and at 3.2 percent during the 1980s in real terms (adjusted for inflation). Largely responsible was the related growth in tourism and foreign investment. Direct visitor-related spending increased at an average rate of 14 percent per year during this period. Foreign investment grew from less than $150 million in 1985 to more than $2.7 billion in 1989. However, there has been little or no growth in tourism during the 1990s, and a sharp decline in foreign investment. In 1995, direct visitor spending contributed about $11.4 billion to the Gross State Product - nearly the same as 1991. The collapse of the Japan "bubble" economy in the early 1990s ushered in an era of stagnant foreign investment averaging less than $1 billion per year between 1992 and 1994. Not surprisingly, the rate of growth in the Gross State Product after 1990 has been only 0.38 percent annually in real terms.

Per capita income followed suit. It increased at an average rate of 1.6 percent per year during the 1970s and at an average annual rate of 1.9 percent during the 1980s, then it fell as the GSP growth rate declined. During 1990-96, the average annual rate of per capita income was minus 0.65 percent in real terms. This means that in 1996, people in Hawaii were worse-off compared with 1990.

Hawaii County Economy

The economy of the Big Island, historically based on agriculture but now more dependent on tourism, has not yet recovered from the statewide slump that began in 1991. In addition to drops in tourism and foreign investment, the sugar industry began its rapid collapse after a century of dominating the islands's economy. Growth rates declined from double digits in the late 1980s to 2.6 percent in the period from 1990-1994.

Since 1991, visitor number increases in West Hawaii have contributed to a small degree of recovery, although investors leery of the hotel/condo glut of the last five years have been slow to implement further ventures. The *Four Seasons*, which opened in 1997, was the first major new hotel to open in nearly five years. Direct flights from Japan to Kona began in 1996, and have subsequently increased in number. Economic diversification in West Hawaii is evidenced by technology industries centered on the Natural Energy Laboratory-Hawaii and astronomical base facilities in Waimea, diversified agriculture, and services.

East Hawaii's economy presents a different picture. With the domino-like failure of the sugar plantations, roughly a thousand former workers were left with few economic options. Almost 60,000 acres were taken out of production. The closing of Ka`u Sugar in 1996 marked the end of the sugar plantation era on the Big Island.

Today, County and State government, the University of Hawaii at Hilo, several astronomy bases, and diversified agriculture anchor the economy. Timber operations - particularly those using fiber trees - are being developed on former sugar lands. Ranching continues to be a major industry, with over $20 million in annual sales. East Hawaii is noted for its lush tropical agriculture: anthurium, papaya, orchid, foliage, banana, and ginger, among others. While such farms may sometimes be lucrative, the constant battle against invading pests has sapped much of the profit from these ventures.

Puna Economy

The economic structure of the Puna District has changed greatly since the era when sugar cane plantations dominated the landscape. The *Technical Reference Report, Puna Community Development Plan* (Community Management Associates, Inc. 1992) showed that in 1980, 36.3 percent of the Puna population were in the labor force. Of the total, 15.4 percent were managerial, 21.6 percent were involved in technical, sales, or administrative work, 13.0 percent were in service occupations, 15.8 percent in farming, forestry, or fishing, 15.1 percent in precision production, crafts, or repair work, and 6.2 percent were operators, fabricators, or laborers. Government workers made up 19.0 percent of the total, self-employed workers were 14.6 percent, and the remainder, 65.9 percent, were private wage and salary workers. Puna had and continues to have a diverse economy, even if many of the jobs are actually situated in Hilo. In contrast with former years, small businesses employ more workers than any large concerns.

In the direct study area (Pohoiki), papaya farming and fishing are the major economic

activities. Between 1988 and 1997, papaya on Big Island has consistently yielded approximately $13 million annually in economic returns from about 250 farms harvesting more than 2,000 acres (Source: Hawaii County Data Book, var. years, Hawaii County Research and Development Department).

Fishermen from Puna and to some extent from around the island make frequent use of the Pohoiki Small Boat Launch, as it is the only launching facility in the district. In 1996, 82 commercial fishing licenses were held by fishermen using this landing - an increase of more than 30 percent since 1994. In the fiscal years 1994-1996, the value of the catch has consistently exceeded $1.0 million/year. The major component of the catch is tuna on handline, with trolling, bottom handline, dive and other catch types accounting for less than 10 percent of the value. During the 1980s and 1990s, the Puna catch accounted for between 15 and 20 percent by weight of various commercial pelagic fish (especially ahi, ono, and swordfish) caught in the entire state of Hawaii. (Sources: Puna Community Development Plan Technical Report [PCDP-Tech] Community Management Associates 1992; Commercial Fish Landings by Island, State of Hawaii, var. years [Hawaii State Department of Land and Natural Resources, Division of Aquatic Resources]; Hawaii County Data Book, var. years [Hawaii County Research and Development Department]; State of Hawaii Data Book, var. years [Hawaii State Department of Business, Tourism and Economic Development])

Unemployment

Unemployment rates in the last five years in Hawaii County have been high, varying between 8 and 11 percent for most of the period. Each month between April and August 1997 (inclusive), the unemployment rate was above 10 percent. As of March 1998, the rate for Hawaii County was 8.3 percent, and that for the state of the whole is 5.5 percent (Source: Hawaii Department of Labor and Industrial Relations monthly reports). In East Hawaii, the situation is worse than these statistics reveal, since West Hawaii accounts for many of the jobs and has a tighter labor market than East Hawaii. In addition, many Puna residents are not eligible for unemployment compensation and/or are discouraged and not actively seeking work. It is generally agreed by residents and agency officials that the lack of employment is a severe problem in Puna, a district with many residents and few sources of employment.

2.3 Socioeconomic

Table 2.3 illustrates selected socioeconomic characteristics of the population on the Island of Hawaii, in the Pahoa-Kalapana (Puna District), South Hilo and North Kona.

The socioeconomic distinction between agricultural, traditional East Hawaii and modern, tourism-based West Hawaii is well illustrated by census statistics for South Hilo or Pahoa-Kalapana versus North Kona. East Hawaii exhibits lower incomes, a more ethnically diverse population, and larger proportions of disabled, elderly, poorly educated, non-working and impoverished individuals. Household incomes, home prices, and rents are lower in East Hawaii. The visitor industry in West Hawaii has attracted workers and entrepreneurs from not only the state of Hawaii, but also the mainland U.S. and around the world. Sharing the

economic benefits of tourism jobs with East Hawaii - at more of a disadvantage than ever because of the collapse sugar - is hindered by the great distances and poor road connections

between the two ends of the island. Nevertheless, as many as 25 percent of West Hawaii hotel workers commute from Hamakua, Hilo and even Puna (CRI/Datametrics 1989)

The study area displays many of the characteristics of a disadvantaged region in its census statistics (Table 2.3). The median family income in 1989 in the Pahoa-Kalapana Division was less than 60 percent of that of the County as a whole. Over 30 percent of individuals had income below the poverty level, a rate over a twice as great as Hawaii County.

Table 2.3
Selected Socioeconomic Characteristics, by Districts

CHARACTERISTIC	GEOGRAPHIC AREAS			
	Hawaii Island	South Hilo	North Kona	Pahoa-Kalapana
Total Population	120,317	39,737	22,284	6,745
Pct. Caucasian	39.9	26.7	58.9	45.0
Pct. Asian	37.8	59.4	21.9	27.7
Pct. Hawaiian	19.2	12.6	16.4	22.0
Pct. Under 18 Years	28.7	27.2	26.4	33.4
Median Age	34.3	35.2	34.7	32.0
Pct. Over 65 Years	12.6	13.5	10.1	11.1
Pct. 10-64 Years With Work Disability/Mobility/Self Care Limit.	13.0	19.9	9.5	22.6
Pct. Do Not Speak English Well	7.7	12.9	12.1	8.5
Pct. Over 25 Years With High School Diploma	77.7	78.4	86.0	75.1
Pct. Over 16 Years in Labor Force	64.2	62.1	70.7	57.3
Median Household Income	$33,186	$29,967	$35,364	$18,360
Pct. in Poverty	14.2	14.3	9.4	32.1
Pct. Lived in Hawaii 1985 & 1990	35.1	91.4	73.1	85.8
Pct. Owner Occupied Housing	61.1	62.6	55.1	71.3
Median Contract Rent Value	$428	$371	$644	$419
Median Home Price	$113,000	$110,700	$211,900	$68,300

Source: U.S. Bureau of the Census: "1990 Census of Population. General Population Characteristics," 1990 CP-1-13 and "1990 Census of Population. Housing, Summary Population and Housing Characteristics," 1990 CPH-1-

13. Note: Asian percentage includes non-Hawaiian Pacific Islanders.

About 25 percent of those age 25 years or over have less than a high school education, and 16 percent have a work disability, compared to 22.3 percent and 9.6 percent, respectively, for the County as a whole.

Many of Puna's problems are related to the rudimentary infrastructure of its sprawling subdivisions, which was well-suited for speculation but inadequate to serve the needs of the low and middle income families who have come to occupy the district. Other problems often cited by Puna residents are typical of disadvantaged communities: crime, unemployment, and lack of public amenities such as recreational facilities.

The population of Lower Puna has certain characteristics that would suggest a greater than average demand for recreational facilities. The median age for the Kalapana-to-Hawaiian Beaches area is 31.4, as compared to 34.3 for Hawaii County and 35.2 for the Hilo District. Contributing to this low median age (the lowest of all areas in the county) is the proportion of the population under 16, which is at 30.9% as compared to 25.9% for Hawaii County as a whole (Sources: U.S. Census Bureau: 1990 Census of Population; electronic files STF1a and STF3a).

2.4 Community Identity and Cohesion

Less amenable to quantification but vitally important to an accurate characterization of the social fabric of an area are a series of concepts that comprise social well-being and community cohesion. Included are characteristics such as the following:

- Community and regional character or spirit;
- Community decision-making processes and local power structures;
- Socio-economic harmony or polarization;
- Codes of conduct among and between various social and ethnic groups; and
- Relationship with visitors and tourist industry.

The Big Island has a rich, multi-ethnic history that has helped to create a strong sense of community identity evinced in both the people and the landscape. Many native Hawaiian traditions, including cuisine, *luau* and *pa`ina* (ceremonial feasts), music and dance have been enthusiastically embraced by later arrivals. Native Hawaiian culture is strong and growing in influence. In addition, many traditions of the Japanese, Chinese, Filipino, Portuguese and Korean immigrant plantation workers have also been perpetuated. Such enduring phenomena as burial societies, lending organizations, religious groups and labor movements evolved from the everyday life of such ethnic groups in the plantation camps (Lind 1938; Crane 1992; Manicas 1993).

This heritage continues. Most long-time Hawaii (*kama`aina*) families trace their roots to such beginnings and share many deep and wide-ranging bonds. Newer residents of the area, particularly those from the mainland, do not share such links. Nevertheless, the celebration of this heritage in such events as hula festivals, plantation days and rodeos is enthusiastically supported by old-timer and newcomer alike. There is also a deep concern for preserving and

restoring historic sites. Many Hawaiian activists (e.g., Trask 1984), however, make a distinction between the cultural preservation interests of residents of Hawaiian heritage, as opposed to generic "locals".

The sense of community is experiencing ever-more rapid change as new residents (and their values) from outside the Big Island are gradually incorporated. *Kama`aina* residents often express a longing for the old days and a fear of being disenfranchised. Many towns and villages (particularly in West Hawaii) have been transformed from charming local settlements into bustling visitor and residential communities with numerous wealthy, transplanted mainlanders whose influence in community affairs is not related to their family connection to the land. The discontent with development in rural areas reaches its peak among Hawaiian activists, who equate it with colonization of Hawaiian people and suppression (or even genocide) of the Hawaiian culture.

Community Identity in Puna and Pohoiki Area

In the words of historian June Gutmanis:

> "Puna's history has been a rich one, with many twists and turns. The first events in that history relate to a supernatural being named `Ai La`au or Forest Eater. True to his name, he frequently started fires that "ate" the lands between his home in Kilauea and the shores of lower Puna. At a time when `Ai La`au was away from his home, the foreign woman, Pele, with many members of her family, arrived on the island and took over his home in the volcano. `Ai La`au never returned. From that time, Pele's sports competitions, her angry confrontations with Puna residents and her tumultuous love affairs became the principal themes of stories told about Puna. Many place names are memorials to these events, and numerous lava formations area said to contain the spirits of those whom she covered with lava in her anger" (CMA 1992:1)

Puna has a special flavor - some would say a split personality - that is the product the deep cultural roots and ongoing culture of native Hawaiians juxtaposed with the sugar plantation culture and the recent, but more dominant, influence of thousands of immigrants from the mainland. To some extent the contrasting facets are separated geographically.

Certain out-of-the-way locations in Lower Puna, particularly Kalapana and Opihikao, retained Hawaiian settlement patterns, majority Hawaiian populations, and a picturesque landscape that evoked the 19th century. The core of this area - Kalapana - was devastated by the eruption of Kilauea from 1983 to the present.

Puna was nearly depopulated by 1890, but soon after coffee plantations (and later, with much greater influence, sugar cane plantations) took hold. The Olaa Sugar Company centered in Keaau and the Puna Sugar Company in Kapoho both began in 1899. Thousands of immigrants laborers built Keaau, Pahoa and Kapoho into typical plantation communities with a distinctive early 20th century streetscape reminiscent of earlier Old West boomtowns, which has been well preserved in Pahoa.

The final influence in Puna was the development of dozens of subdivisions that eventually comprised over 50,000 residential lots. At first simply thought of as vehicles for land speculation and technically classed within the Agricultural District, they slowly began to attract a distinct assortment of residents: mainland retirees, recluses and eccentrics; guava, papaya, and flower farmers; local families seeking an inexpensive homestead; and "guerilla farmers" who took advantage of the dense cover of forest and ferns, the warm, humid climate, and utter lack of law enforcement to cultivate marijuana ; and finally, commuters with jobs in Hilo. Unlike the residents of wealthy resort areas, many of these mainland immigrants in this group are low-income, an example of a relatively recent phenomenon in mainland immigrants to Hawaii (Crane 1992: 38). The subdivisions nearest to Hilo are becoming bedroom communities for Hilo commuters who increasingly demand upgraded services, including roads and utilities, which has to some extent integrated the district with Hilo. Substantial portions of subdivisions such as Hawaiian Paradise Park now have at least the rudiments of urban infrastructure: paved roads, electricity, cable television, and County water lines. Residents, the utility companies and the County are developing orderly plans to complete this. More remote subdivisions retain the backwoods atmosphere of the early subdivision era. Residents often have divided opinions concerning the benefits of infrastructure "improvements."

The study area has elements of all three of these historical aspects, in that it is an area important area of Hawaiian settlement and land use, played an important role in 19th and 20th century agriculture, and is surrounded by typical "modern" Puna subdivisions.

2.5 Outdoor Recreational Resources

About a dozen County parks in Puna feature ballfields, an Olympic-size swimming pool, basketball courts, playgrounds, and other activities. State and federal parks offer hiking and camping. However, outdoor recreation in the study area itself is mostly confined to coastal activities, since few parks or other public areas offering other activities exist outside Pahoa. Important activities include shore fishing, snorkeling and spear fishing, boat fishing, shellfish and limu (seaweed) gathering, sunbathing, picnicking, surfing and body boarding. Swimming offshore is too dangerous for most people and is usually undertaken instead in sheltered tidepools and anchialine ponds - some of which are geothermally heated.

Before 1990, the Puna coastline was well endowed with parks, mostly in the vicinity of Kalapana. But between 1989 and May 1990, lava flows covered an area of approximately 30 square miles, destroying nearly 200 residences and other structures. The flows also filled in the Kalapana oceanfront area, and moved the shoreline as much as 0.75 mile makai (County of Hawaii 1992). Lava flows inundated three Hawaii County parks in the vicinity of Kalapana-Kaimu: Harry K. Brown Park, Kalapana Beach Park, and Kalapana Black Sands Beach. All of these parks were located near Kalapana in the vicinity of Kaimu Bay. These three parks were buried under 50 to 75 feet of lava. Approximately 50 acres of county land were destroyed, including nearly 28 acres of beachfront property with 1.35 miles of shoreline (County of Hawaii, 1992). The area was renowned for scenic beauty and provided recreation, relaxation, and meeting-places for thousands of island residents and tourists annually. All of

the parks were directly accessible by county road and had electricity, telephones, and potable water. Adequate parking was available at each park, and all were supported, maintained, and patrolled by the County of Hawaii Department of Parks and Recreation (DPR) (County of Hawaii, 1992).

The disaster left only one County beach park in Puna - Isaac Hale Beach Park at Pohoiki. The harbor there was soon inundated with beachgoers who were in conflict with the main function as a boat launching area for commercial fishermen. Subsequently, the County has obtained several million dollars from the Federal Emergency Management Agency (FEMA) to improve and expand Isaac Hale Beach Park and to develop an additional park centered around a lawn and half-acre swimming pond at Ahalanui. Both these parks are located in the vicinity of the Project. Ahalanui County Park borders the northeast edge of the Project, and Isaac Hale is located less than 0.3 miles away from the southwest border of the Project.

2.6 Public Services, Community Centers, Local Business and Agriculture

Fire, Police and Emergency Services

Fire and emergency service is provided by the Hawaii County Fire Department. A full-time station is located in Pahoa, which operates with a round-the-clock with a crew of firefighters and Mobile Intensive Care Technicians (MICT). In Hawaii County, about 80 percent of calls are related to emergency medical services, and 20 percent or less for building, brush, and vehicle fires (Source: Hawaii County Fire Department Annual Reports).

The Hawaii County Police Department provides all police services for the island. Round-the-clock police stations to service the area are located in Keaau. A police substation is located in Pahoa.

Schools

The area is served by the Pahoa Elementary, Pahoa Intermediate, and Pahoa High Schools, which area located on the same campus in Pahoa, approximately six miles from the site.

Churches and Community Centers

The nearest church is approximately five miles away in Opihikao. Pahoa has a number of churches. No community or other public centers are near the project. The nearest center is in Nanawale Estates, about five miles from the site. Most public meetings and activities that take place in this area of Puna are conducted at the Pahoa Neighborhood Center.

Local Businesses and Agriculture

Aside from agriculturally-related endeavors, local businesses in the study area are mostly concentrated in Pahoa. Pahoa supports one of the very few village centers in Hawaii that has maintained its "village-scape" while successfully accommodating the needs of businesses

focused on local residents. This achievement is all the more remarkable in light of the Puna District's low per capita income and endemic economic problems. Scattered through the study area are hundreds of large and small farms. Major crops are flowers, foliage, papayas, macadamia nut, and other tropical fruits. Although the project site at one time was farmed in papaya and could be farmed again, there are no active leases.

2.7 Travel Patterns for Pedestrians and Bicycles

Conditions in the Puna District are not generally favorable for widespread pedestrian or bicycle use. Population is spread widely, rainfall is heavy and frequent, and major roads generally do not have sidewalks or bicycle lanes. Despite these obstacles, many Puna residents through choice or necessity walk and/or bicycle as part of their regular travel patterns. In comparison to other town in the rural districts of the island (e.g., Honokaa, Keaau, or Naalehu), Pahoa is a highly pedestrian town. Walking for exercise or relaxation is common in the quieter roads of the rural subdivisions. Coastal areas, particularly those near the project which have parks and surfing areas, also experience fairly high concentrations of pedestrians.

The *Bike Plan Hawaii* (HDOT 1994) serves as the guide for implementation of bikeways for the State of Hawaii. According to this plan, "future proposed bike routes" are planned for the Kapoho-Kalapana Road, State Highway 130, and the Pahoa-Kapoho Road, i.e., for all major public roads in the area except the Pahoa-Pohoiki Road. A bike route is defined as "Any street or highway so designated, for the shared use of bicycles and motor vehicles or pedestrians or both." Designating bike routes encourage signage, shoulder improvements, motorist awareness, and in some cases, separate lanes. The steadily increasing use of the Kapoho-Kalapana Road by recreational bicyclists, including some tourists, is evidence of the growing appropriateness of this designation.

3 IMPACTS AND MITIGATION MEASURES

This section is organized to discuss impacts and mitigation by socioeconomic category. Within each category, impacts are divided into temporary and permanent. After each discussion of impacts, the implications of alternatives are analyzed, and finally, proposed mitigation measures are presented. The order of discussion is slightly altered from that used in Chapter 2 to allow a clearer chain of causation to be presented.

3.1 Economic Impacts

[Note: This section and Section 2.2 are largely summaries of a separate report, The Economic Impact of the Oneloa Onsen and Sports Retreat, which is appended to this report. Readers interested in methodology, sources, or further detail are referred to the full report.]

In overview, the economic impacts of the project are the provision of a large number of direct temporary and permanent jobs, which in turn fosters indirect and induced jobs and income, and a substantial benefit-to-cost ratio for County and State revenues versus expenditures. As these impacts are all beneficial, no mitigation is proposed.

3.1.1 Temporary (Construction) Impacts

Employment and Income

The first phase of the project involves two years of land development and construction. Construction is expected to cost $81.64 million, and the developers estimate that this will require 1,089 workers averaged over the two-year period. Based on studies of similar projects, it is estimated that the construction phase will contribute $32.6 million to the local economy, or $16.3 million per year.

The project would also generate indirect and induced employment and income. Indirect jobs are those created by the local companies as a result of the project activities in the local economy. For example, the resort will purchase construction materials and services from local businesses, that will in turn require workers to fill this demand. Induced jobs, which occur because of the consumption expenditures of project workers, will also be created. The tendency of new investments to cause a large, rippling effect through the economy is known as the multiplier effect, and it typically ends up generating two to three times as many jobs as those produced directly. According to the calculations made for projects of this nature in Hawaii, it is estimated that indirect and induced jobs would total approximately 2,253 jobs during the two year construction period. Therefore, the total number of jobs that would be generated by the project in Puna, the rest of the Big Island, and to a lesser extent, throughout the state and the nation, is 3,342.

These direct, indirect, and induced jobs would contribute to a total income of $29.9 million annually for the two years of construction.

Government Fiscal Impact

Fiscal impact refers to the changes in government budget that occur as a result of the project. The main fiscal goal of government is to maintain a balanced budget. The estimates presented here are derived from application of average revenue and cost models, utilizing visitor spending data from the Hawaii Visitors Bureau and visitor applicable constituents of the state operating budget.

State revenues from the construction phase of the project will be derived from general excise tax, materials tax, conveyance tax, and income tax. During construction, about $6.8 million per year in total state revenues would be produced. Very little state expenditure will occur because of construction itself, and therefore these tax revenues can essentially be considered a one-time gain.

Construction itself will not markedly affect the County's revenues or expenditures.

3.1.2 Permanent Impacts

Employment and Income

After construction, the developers estimate that approximately 410 full time, permanent direct jobs will be created. Multiplier effects would generate an additional 704 indirect and induced jobs, for a total of 1,114 jobs.

These direct, indirect, and induced jobs would contribute to an additional income of $14.8 million annually during the lifetime of the resort.

Government Fiscal Impact

State revenue during operation would be derived from general excise tax, hotel room tax, and income tax. It is expected that approximately $2.58 million annually would be generated annually.

State expenditures would occur during operation because visitors would require services supplied by State government; e.g., State parks, airports, etc. The State estimates that it spends $936 annually per visitor-year (the total number of visitor years in any specific area is the total of the daily visitor counts for a year divided by the number of days in a year). With an expected daily visitor count of 366, the State would expend about $342,000. Comparing revenues to expenditures yields a benefit/cost ratio of about 7.6.

The County will also derive revenue from the operation of the resort, in the form of real property taxes, its 44.8% share of the T.A.T. (Transient Accommodation Tax or room tax), and to a lesser extent, state/federal grants and other taxes. Total expected annual revenues would be approximately $1.16 million.

The County estimates that it expends about $591 per visitor-year, for a total expenditure of $216,000. Comparing revenues to expenditures yields a benefit/cost ratio of about 5.4.

Table 3.1 summarizes economic impacts of the project.

Table 3.1
Annual Economic Impacts, Oneloa Onsen and Sports Retreat

	JOBS	INCOME	FISCAL			
			STATE		COUNTY	
			Expenditures	Revenue	Expenditures	Revenue
Temporary (Construction)	3,342	$29.9 M	0	$3.4 M	0	0
Permanent (Operation)	1,114	$14.8 M	$0.342 M	$2.58 M	$0.22 M	$1.16 M
			Benefit/Cost Ratio: 7.6		*Benefit/Cost Ratio: 5.4*	

Note: Jobs include direct, indirect, and induced jobs.

3.2 Population and Settlement Patterns

Background

Population change is often the basis of broader social impacts. Any substantial increase or decrease in population will engender a wide range of adverse and beneficial impacts to housing, social conditions and public services.

Nearly all population projections undertaken by the State and County agencies assume continued growth in all of the Big Island, including the Puna District. The State and County have developed several population projections to help prepare and plan for expected population growth. One that is often cited and relied upon was developed in 1997 by the Hawaii State Department of Business, Economic Development and Tourism (DBEDT).

Table 3.2
Hawaii DBEDT 1997 Population Projections/History

POPULATION	HAWAII COUNTY	STATE OF HAWAII
1980 Resident	92,900	968,500
1980 De facto	99,300	1,055,400
1985 Resident	105,900	1,039,700
1985 De facto	112,500	1,138,000
1990 Resident	121,500	1,112,900
1990 De facto	136,500	1,257,000
1995 Resident	137,200	1,179,200
1995 De facto	149,700	1,287,100
2000 Resident	149,600	1,238,500
2000 De facto	165,900	1,372,800
2005 Resident	160,600	1,304,000
2005 De facto	181,900	1,463,000
2010 Resident	173,900	1,366,700
2010 De facto	200,400	1,548,600
2015 Resident	189,100	1,430,500
2015 De facto	220,900	1,633,300
2020 Resident	205,400	1,494,100
2020 De facto	243,300	1,720,200

Note: 1980 and 1990 figures are from U.S. Census.

These state projections do not include figures on a district-by-district basis. The only published report that provides such detail is that of the Hawaii County General Plan (Hawaii County Planning Department 1989). The population projections to the year 2005 developed for the General Plan were derived from an econometric model designed to account for the relationship between employment and population. Three series were projected, A-C, based on ascending magnitude of economic activity. The following table summarizes the projections from the General Plan.

Table 3.3
Hawaii County General Plan Population Projections, Year 2005

AREA	GP-SER. A	GP-SER. B	GP-SER. C
South Hilo	44,115	55,335	65,790
Puna	39,790	49,910	59,340
Hawaii County	173,000	217,000	258,000

Source: Hawaii County General Plan, 1987. Note: Series A based on modest economic growth, Series C based on vigorous growth, Series B is midway.

It should be noted that population projections more recent than that used for the General Plan estimate far lower numbers for Hawaii County. For example, note the difference between DBEDT's 2005 projection for resident population (160,600) and the General Plan numbers (173,000-258,000). However, most planners feel that the prediction that Puna's population will total about 90 percent of South Hilo's (as compared to less than 50 percent in the 1990 census) may well be borne out by the year 2005.

3.2.1 Temporary (Construction) Impacts and Mitigation Measures

No firm construction schedule has been developed for the project. One estimate is that it will begin in the year 2001 and be complete after two years. During peak periods, over five hundred workers may be employed on the project. According to data from the Hawaii Department of Labor and Industrial Relation's (HDLIR) *Labor Force Data Book*, a construction labor force of between approximately 2,000 and 4,000 is present in Hawaii County. Many reside in the districts of South Hilo and Puna,, i.e., within commuting distance of the Project. As discussed in Section 2.2, unemployment rates have for some years generally exceeded 8 percent in Hawaii County. Construction is one of the sectors most often affected. The labor force necessary to fill jobs created by construction can be expected to already be in place. Although workers on the project could conceivably migrate from other areas of Hawaii or the U.S., population growth associated with this would likely be negligible.

3.2.2 Permanent

The total increase in resident population would be the sum of three components: new residents of the Chalets; employees of the resort who choose to relocate to Lower Puna as a direct result

of job availability at the project; and those who choose to relocate to Lower Puna as an indirect result of the resort. This last category could include, for example, relatives of Chalet residents, retired people who were drawn to settle in the area because of the ambience and amenities of the resort, and those whose jobs are indirectly dependent upon income generated by the resort.

Chalet "Residents"

It is recognized that the Chalets would probably house a mixture of occupants: persons who could be classified as hotel guests; second or vacation home owners who visited seasonally or occasionally; short-term vacation renters; corporate guests; and more or less permanent residents. The precise mix of occupants is difficult to predict. For the purposes of analyzing the maximum possible population increase - these distinctions will not be employed, and all occupation will be treated as "permanent,". Although it is likely that many if not most occupants will be short-term, this assumption accounts for all of additional "bodies" that will be added to Puna's population, an important fact for the experience of everyday life of Puna residents.

If all 125 Chalet units are built, and County average of 3.15 residents per household obtained (calculation based on data from the 1990 U.S. Census of Population), approximately 400 new "residents" could be added to this area of Lower Puna. This figure assumes full build-out and 100 percent occupancy of the units, and may be considered an "extreme-case" scenario.

New Residents Drawn to Puna for Employment

As discussed in Section 3.1, the permanent operation of the project could offer full-time employment to as many as 410 people. Another more than 700 indirect and induced jobs would also be produced. Indirect and induced jobs - e.g., wholesaler employees, travel agents, schoolteachers, government workers - may be distributed throughout the region, state, and even nation. For purposes of this analysis, it is assumed that no more than 300 of these positions would represent employment in the Lower Puna area. The total number of new, permanent jobs would be roughly 700.

The workforce of the Pahoa-Kalapana Division - which is just a portion of Lower Puna - is approximately 2,000, based on an adult population of about 4,000, and a workforce participation of something over 50 percent (see Table 2.3) . Assuming 10 percent unemployment, there are at least 200 active job seekers in the area. However, not all of these individuals would desire and/or be qualified for the type of jobs offered at the resort. There is an even larger pool of candidates for Project jobs among Puna residents who work in Hilo but would prefer a closer job, residents from other areas of Lower Puna (e.g., Ainaloa, Hawaiian Paradise Park and Orchid Land subdivision), and even residents from other areas of East Hawaii, where unemployment is also high. Considering the large, underemployed labor force at and near the study area, there is little doubt that jobs could easily be filled by "local" residents, although a certain number of project employees, particularly managers and those with unusual skills (e.g., a golf professional) would come from outside the region.

Some employees who did not already live in Lower Puna might choose to relocate to Lower Puna for convenience of commuting, as those traveling from outside the area would face a one-way commute of at least 20 miles. It is this fraction of the total workforce generated by the workforce that could add to the number of households, and thus the population, of Lower Puna. There is sufficient uncertainty in all the variables that would influence this figure that no reliable estimate can really be given. However, the given the chronic unemployment of the region and the large workforce within easy commuting distance, it seems unlikely that any substantial population increase would occur as a result of in-migration to Puna by job-seekers and their families. A figure of 100 new residents is offered here.

Indirect Residents

The number of new residents drawn to the area for indirect reasons related to the increased quality of life offered by the project (as occurs at Disney World, for example) is expected to be negligible. For the purposes of calculating an extreme-case scenario, a figure of 20 new residents attributable to indirect reasons is used.

Total Population Increase

Summing these three components yields a figure of just over 500 new residents, most of whom would most likely be short-term occupants of the Chalets. It is this additional population component that will require local services, add traffic to roadways, and represent a market for local businesses. To put this figure in context, however, it represents an increase of about 7 percent of the 1990 Pahoa-Kalapana population of 6,745, and 2-3 percent of what is projected in the General Plan for this area by the year 2005 (see Table 3.3).

3.3 Socioeconomic

3.3.1 Impacts and Mitigation Measures

In the sense of the term used here, socioeconomic effects have to do with raising or lowering the study area's status with respect to various measures such as poverty rates, educational achievement, disability status, etc. Because the project has the potential to supply a large number of jobs to this high unemployment region, the socioeconomic effects would be essentially beneficial. In addition, the potential for providing public recreational, educational and alternative health facilities count as a substantial benefit in this disadvantaged region.

Proposed Mitigation Measures

No mitigation measures are necessary for these beneficial impacts.

3.4 Community Identity and Cohesion

Opinions are quite variable concerning the effect of tourism related developments in rural, traditional areas. Several social thinkers (e.g., Kelly 1974 for Hawaii; MacNaught 1982 for

Pacific islands; Duffield and Long 1981 for Scotland) maintain that the urbanization and class differentiation of the local population that accompany the growth of tourism foster racial and social tensions, leading to increased crime, violence and family problems. In Hawaii, Hawaiian activists have voiced the concern that given the limited land base and the intimate association of natural and cultural attributes in Hawaii, resort development constitutes a violation of Hawaiian culture and detracts from both the physical and cultural health of Hawaiians (Trask 1986).

In opposition to this argument was a study in Hawaii by Knox (1979) that indicated social tensions were not especially exacerbated by tourism and that residents generally perceived visitor interaction in a positive light. The issue is complex in that undesirable social trends such as drug use, suicide, child abuse, teen pregnancies, and divorce are common in communities throughout the U.S., whether they are urban or rural, rich or poor, white or non-white, or increasing or declining in population.

3.4.1 Temporary (Construction) Impacts and Mitigation Measures

Construction would disrupt traffic, produce dust and noise, and create a general sense of change that may appear negative and disturbing. Although the residents of the region are accustomed to some heavy machinery, noise, dust and smoke associated with agriculture, the impacts of construction may still be disturbing. It is at this time that the reality of the project may first come home to some residents, and they may feel anxious. Many, however, may also have the opportunity to be employed during construction, which may yield positive socioeconomic effects and allay concerns about change.

3.4.2 Permanent Impacts and Mitigation Measures

Impacts

Discussions of the author with Puna residents and letters to the editor in the Op-Ed pages of the *Hawaii Tribune Herald* have revealed that opinions are divided on the effects of the resort. The question of whether the character of Puna and its community identity and cohesion will be adversely altered is problematic and not really capable of resolution within the scope of an EIS. This is because different people have quite distinct conceptions of what is essential and what is not for keeping this character. The points presented below illustrate diverse points of view that have been expressed to the author concerning the project; they are presented in no particular order and with no assumption of equal weight.

- "All the jobs that the resort will provide will be a benefit that far outweighs any bad effects on local lifestyle."
- "Having alternative healing, local medicinal plants and Hawaiian cultural practices as part of the resort experience will help preserve what is special about Puna".
- "All resorts are basically incompatible with the rural character of the Puna district."

- "Golf courses are undesirable land use which may pollute the land and ocean. We don't need any in Puna."
- "Even Ka'u has two golf courses. It would be nice to not have to travel out of the district just to play golf."
- "Puna needs agriculture, not resorts."
- "Rich newcomers will not fit in well in Puna. They will dominate the local scene and try to get rid of local customs, like cockfighting."
- "Puna needs something new and positive."
- "Increasing traffic and more mainland-style driving will ruin the laid-back feeling of the area."
- "The resort will not blend into the Puna scene and will stick out like a sore thumb."
- "Once they approve this resort, many more will follow."

It should be emphasized that these statements are not quotes from individuals, but rather, an attempt at representative composites of attitudes expressed to the author. Again, I wish to state that the public hearing scheduled for the project will provide a much-needed form of soliciting specific, formal input on the proposal. It is hoped that this will help identify whether a consensus exists regarding the community impacts of the Project. If appropriate, mitigation measures could then be developed.

3.5 Outdoor Recreation

3.5.1 Temporary (Construction) Impacts and Mitigation Measures

Very minor temporary impacts to outdoor recreation will occur during construction as a result of inconvenient access to recreational areas, including Pohoiki. It is recommended that any construction with the potential to disrupt traffic on either the Pahoa-Pohoiki or Kapoho-Kalapana Roads be scheduled with sensitivity to recreational and cultural events such as surfing meets, festivals, and other events.

3.5.2 Permanent Impacts and Mitigation Measures

The project will potentially increase the recreational diversity of the area substantially by providing facilities for golf, equestrian, and other sports. Benefit to the community will largely depend upon the degree to which these facilities are open to the public.

ECONOMIC IMPACT OF ONELOA ONSEN

&

SPORTS RETREAT

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May 23, 1998

ECONOMIC CONDITIONS OF THE STATE OF HAWAII

Sugar was the mainstay of the Hawaii economy for about a century. In 1972, the sugar industry accounted for 5,550 agricultural jobs. During the 1980s, the sugar industry started to lose its economic ground in Hawaii. Between 1980 and 1994, the value of sugar production decreased by 58.3 percent. As the sugar industry gradually disappeared, Hawaii economy has moved toward tourism (Hawaii Data Book 1996).

In the early 1970s, tourism began to assume dominance of Hawaii's economy. This was the time when the first Boeing 747 landed at the Honolulu airport, beginning the jumbo-jet mass tourism. In 1970, the number of visitors was about 1.7 million, and in 1975 this number increased to 2.8 million. During this 5-year period, tourism growth rate reached its all time high of about 62 percent.

From 1975 onward, tourism started to grow at a decreasing rate. The visitor count increased but the rate of growth, although positive, began to decline until late 1980s. Table 1 shows that between 1970 and 1990 (10-year period), the number of visitors has continued to increase. In 1990, tourism rejuvenated by growing at 7.4 percent, reaching nearly 7 million visitors.

In 1990's the visitor count reached its peak. Since then, the number of visitors has never approached the 1990's count. In fact, the annual growth rate began to show a negative sign. Between 1990 to 1996, the average annual tourism growth rate was minus 0.4 percent (Table 1).

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Table 1: Visitor Count 1970-1996

Year	Visitors staying overnight or longer	Average number of visitors present	5-Year Tourism Growth Rate	1-Year Tourism Growth Rate
	5-Year Exhibit			
1970	1,746,970	36,943	-	-
1975	2,829,105	66,308	61.9%	10.1%
1980	3,934,504	96,497	39.1%	6.8%
1985	4,884,110	116,700	24.1%	4.4%
1990	6,971,180	162,070	42.7%	7.4%
1995	6,629,180	158,070	-4.9%	-1.0%
1990-1996 Growth rate==>			**-2.1%**	**-0.4%**
	1-Year Exhibit			
1991	6,873,890	157,590		-1.4%
1992	6,513,880	153,390		-5.2%
1993	6,124,230	148,750		-6.0%
1994	6,430,300	159,200		5.0%
1995	6,629,180	158,070		3.1%
1996	6,823,130	158,870		2.9%

Source: Hawaii Data Book, 1996.

Tourism continues to play a major role in the Hawaii economy making major contribution to the Gross State Product. Table 2 shows the visitor related expenditures. During 1970-1990, direct visitor-related spending increased at an average rate of 14 percent per year.

After 1991, both the visitor count and spending dropped. For example, in 1994, visitors spent $11 billion during their stay in Hawaii. This is the same amount as in the peak of 1991 in current dollars, and a bit less in 1982 dollar (constant dollars). This clearly depicts the decline of the tourism in Hawaii during the 1990s.

Table 2: Direct Visitor-Related Expenditures, 1970-1995

Year	Visitor-related expenditures ($ million)	Visitor-related Expenditure Growth Rate	Year	Visitor-related expenditures ($ million)	Visitor-related Expenditure Growth Rate
1970	699	-	1983	4,197	5.6%
1971	819	17.2%	1984	4,792	14.2%
1972	964	17.6%	1985	5,437	13.4%
1973	1,163	20.7%	1986	6,296	15.8%
1974	1,383	18.8%	1987	7,129	13.2%
1975	1,523	10.1%	1988	8,814	23.6%
1976	1,818	19.4%	1989	9,613	9.1%
1977	2,027	11.5%	1990	10,109	5.2%
1978	2,358	16.3%	1991	11,040	9.2%
1979	2,792	18.4%	1992	10,020	-9.2%
1980	3,175	13.7%	1993	9,125	-8.9%
1981	3,500	10.2%	1994	11,036	20.9%
1982	3,975	13.6%	1995	11,486	4.1%

Source: Hawaii Data Book, 1996.

The Growth Rate of the State Economy

Economic growth is the most important element of the health of any modern economy. A healthy economy requires a sustain growth in order to maintain and enhance the well-being of its citizens.

The economy of Hawaii grew considerably during the 1970s and 1980s. The Gross State Product increased at an annual rate of 3.9 percent during the 1970s and at 3.2 percent during the 1980s in real term (adjusted for the inflation rate). But after 1990 the rate of growth dropped and the Gross State Product grew only at an average annual rate of only 0.38 percent in real terms (Table 3).

The per capita income, which measures income per individual, followed suit. It increased at an average rate of 1.6 percent per year during the 1970s and at an average annual rate of 1.9 percent during the 1980s, then it fell as the GSP growth rate declined. During 1990-96, the average annual rate of per capita income was minus 0.65 percent in real term. This means in 1996, the people in Hawaii were worse-off compared with that of 1990 (Table 3).

Table 3: Gross State Product and Per Capita GSP, 1970 - 1996

Year	Gross State Product		Per Capita GSP	
	Millions of Current dollar	Millions of 1982 dollar	Current dollar	1982 dollar
1970	4,414.00	9,324.60	5,721	12,085
1972	5,305.40	10,464.50	6,405	12,634
1974	6,901.70	10,948.50	7,951	12,613
1976	7,933.40	11,746.40	8,774	12,991
1978	9,627.60	12,482.90	10,334	13,399
1980	12,225.70	13,690.50	12,623	14,136
1982	13,691.00	13,691.00	13,776	13,776
1984	15,826.50	14,637.30	15,397	14,240
1986	18,483.00	16,170.60	17,573	15,374
1988	22,324.00	17,745.70	20,674	16,434
1990	27,033.60	19,227.30	24,297	17,281
1992	30,259.60	19,322.80	26,363	16,835
1994	31,965.30	19,400.10	27,259	16,544
1996	33,509.10	19,665.00	28,308	16,613
1990-96 Avg. Growth Rate=>		**0.38%**		**-0.65%**

Source: Hawaii Data Book, 1996.

Table 4 shows the employment status and the unemployment rate of the state. Employment was gradually growing throughout the 1980s. The unemployment rate was 6.7 percent in 1982 which was below national average. The rate declined to 5.6 percent in 1984, and 4.8 percent in 1986. It decreased to as low as 2.8 percent in 1990, which was lower than national level. Then, from 1991 onward, the rate has begun to rise due to the economic recession in Hawaii. In 1996, the unemployment rate was 6.4 percent. This is more than twice as high as the level of unemployment 1990. The main reasons for the downturn of Hawaii's economic are two fold: a) stagnation of tourism; b) decline of foreign investment.

Table 4: Employment Status of the Civilian Labor Force 1980 - 1996

Year	Civilian labor force	Civilian employment	Unemployed	
			Number	Percent
1982	461,000	430,000	31,000	6.7
1984	472,000	445,000	27,000	5.6
1986	492,000	468,000	24,000	4.8
1988	518,000	502,000	16,000	3.2
1990	542,000	527,000	15,000	2.8
1992	584,050	557,450	26,650	4.6
1994	580,150	545,000	35,150	6.1
1996	590,900	553,200	37,700	6.4

Source: Hawaii State Department of Labor and Industrial Relations, Labor Force Data Book, and Internet site http://www.hawaii.gov/workforce/index.html

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Foreign Investment

The economy of a small island such as Hawaii is highly dependent on trade, because Hawaii lacks most of the needed resources to produce goods and services. Therefore, imports are essential in sustaining the modern standard of living. All the petroleum consumed in Hawaii, for example, is imported. In 1990, Hawaii imported goods and services for a total of $10.9 billion.

Imports of goods and services are the leakage from and exports (including tourism) are injection to the economy. Thus any economy needs to export as much as its imports in order to maintain balance of trade.

In 1992, Hawaii imported a total of $11.8 billion and only exported about $1.6 billion. One can observe that the import is 7 times higher than the export in Hawaii. This has created a large gap between the value of the imports and the value of exports (Table 5).

Table 5: Exports and Imports 1990 - 1992

Year	Imports ($ Million)	Exports ($ Million)	Import/Export Ratio
1990	10,926	1,562	7
1991	11,329	1,589	7
1992	11,780	1,635	7

Source: Hawaii Data Book, 1996.

With tourism in decline, Hawaii should look into other alternative sources to stimulate its economy, creating more employment and income. The main source of economic growth is investment, which through the multiplier effect would increase economic activity more than the initial capital. A sustained increase of capital flow is needed to maintain the growth of economy over time. This would in term rise business activities leading to higher employment level and income.

Investment can either be direct or indirect. A direct investment refers to capital inflow into the productive enterprise. An indirect investment is the money invested in financial instruments such as a portfolio of shares.

Foreign Investment is an inflow of capital in to a domestic economy by *foreign individuals* or companies. It has the same effect as domestic investment in the economy. It injects capital into the domestic economy, propelling economic growth leading to more job opportunities and higher income. Thus, one can conclude that foreign investment has the same impacts as domestic capital in the economy.

The Impact of Foreign Investment

The local capital invested in Hawaii is relatively limited. Foreign Investment has played a major role in the development and growth of Hawaii economy. Recent studies show that foreigners have made many major investments in Hawaii, especially in the hotel industry. In 1991, for example, 66 percent of the hotel rooms in the state were owned by foreign investors (mostly Japanese). In Hawaii county, as much as 70 percent of the hotels were foreign-owned in the same year (almost all of them by Japanese investors).

Table 6 shows the relationship between foreign investment and economic growth in Hawaii. The Table reveals that Gross State Product (GSP) has a direct relation with foreign investment. As foreign capital increases, the GSP rises and vise versa. During 1989-1994, foreign investment in the state averaged more than $ 1.6 billion per year.

Table 6: Gross State Product and Foreign Investment (1985 - 1996)

Year	Gross State Product		Foreign Investment	
	Amount (1,000)	Growth Rate	Amount (1,000)	Growth Rate
1985	$17,140	-	$140,224	-
1986	$18,483	8%	$1,150,354	720%
1987	$20,027	8%	$1,306,025	14%
1988	$22,324	11%	$1,866,563	43%
1989	$24,575	10%	$2,723,450	46%
1990	$27,034	10%	$1,990,530	-27%
1991	$28,614	6%	$2,614,475	31%
1992	$30,260	6%	$671,952	-74%
1993	$31,172	3%	$1,027,491	53%
1994	$31,965	3%	$981,145	-5%
1995	$32,724	2%	NA	-
1996	$33,509	2%	NA	-

Source: Hawaii Data Book, 1996

Between 1988 and 1991, the foreign capital inflow to Hawaii was at its peak. During this period, foreigners invested an average annual amount of $2.3 billion, while the Gross State Product grew at nearly 9 percent per year. Then, during the following three years (1992-95), the average yearly foreign investment fell below billion dollars and Hawaii's economic growth, during this period, declined to less than 4 percent per year.

Most foreigners invested in hotels, construction, restaurants, agriculture, science, and education. These investments boosted development plans and fueled the Hawaii's economic growth. The inflow of foreign capital has generated a significant number of jobs for the local people and has increased the state income. Foreign investment has further created opportunities for the local businesses to compete in the world market, helping them to be more efficient.

Thus, foreign investment has accelerated the economic growth and created new jobs and income in Hawaii. It has also helped the Hawaii business community to become more efficient by competing in the international Market.

THE ECONOMY OF HAWAII COUNTY

The county of Hawaii is commonly known as the Big Island. Its 4,038 square miles makes it almost twice as big as all the other Hawaiian islands combined. With its 137,500 inhabitants (1995 survey), Hawaii county has become the second most populated of the four counties in the state. For the past 25 years, the economy of Hawaii county has relied on agriculture, mainly sugar, macadamia nut, and coffee.

The County has not yet recovered from a slump that began with the Persian Gulf War of 1991, when tourism fell off dramatically and sugar plantations closed. Visitor numbers increases in West Hawaii have contributed to a small degree of recovery, although investors leery of the hotel/condo glut of the last five years have been slow to implement further ventures. The Four Seasons, which opened in 1997, was the first major new hotel to open in nearly five years. Direct flights from Japan to

Kona began in 1996, and have subsequently increased in number. Economic diversification in West Hawaii is evidenced by technology industries centered on the Natural Energy Laboratory-Hawaii and astronomical base facilities in Waimea, diversified agriculture, and services.

The Growth Rate of the Hawaii County Economy

In the past, Hawaii County experienced considerable economic growth for several years. Between 1985-90, total income grew at an average annual rate of 10.8 percent and per capita income grew at about 8.3 percent.

Table 7: Total Income, Personal Income and Employment Status of the Civilian Labor Force in Hawaii 1985 - 1997

Year	Total Income (Million)	Per Capita Income	Total Disposable Income	Per Capita Income	Unemployment Rate, (Percent)
1985	$1,167	$10,782			8.5
1986	$1,293	$11,760			7.5
1987	$1,378	$12,177			5.8
1988	$1,507	$13,066			4.9
1989	$1,705	$14,448			3.9
1990	$1,948	$16,039			4.0
1991	$2,098	$16,632	$1,757	$13,920	4.5
1992	$2,232	$17,168	$1,846	$14,031	8.1
1993	$2,340	$17,573	$2,120	$15,643	7.5
1994	$2,412	$17,798	$2,222	$16,251	10.8
1995	NA	NA	$1,897	$13,707	10.2
1996	NA	NA	NA	NA	9.9

Source: Hawaii County Data Book, 1996.

The last few years, the pace of economic growth has decreased. During 1990-94, per capita income grew at an average of only 2.6 percent per year. During the same period, the county's total income increased at an average rate of 5.5 percent annually.

In 1995, the disposable income in Hawaii county dropped to below that of 1994. The county's total disposable income decreased by 14.6 percent, while the population increased. This had a notable effect on the welfare of the community, pushing down the per capita disposable income by 15.7 percent.

The unemployment rate is inversely related to economic performance. As the economic activity increases the unemployment rate fall and vice versa. During late 1980s, when the Hawaii county economy was at its peak, unemployment was at its lowest (Table 7). In 1989, the unemployment rate fell to its all time low of 3.9 percent. Then, in 1992, as the economy entered into recession, the unemployment rate began to rise. Between 1994-96, the unemployment rate was about 10 percent, which is relatively high. One has to note that the rate does not take into account the discouraged unemployed individuals (those who do not actively seeking job) and those who left the Island in the hopes of finding job elsewhere.

The declining trends of income and employment in the Big Island suggest that the county should encourage investors to bring capital to the Island. The capital inflow to the Island would translate not only to more jobs and income, but also help the county to increase its tax revenue.

The Role of Sugar industry in Hawaii County

From the mid -19 century until early 1990s, sugar played a major role in the economy of Hawaii county. In the early 1980's, the sugar industry contributed more than all the other crops combined to the Big Island economy.

In late 1980's, however, the sugar industry started to decline. By early 1990's, sugar lost its economic ground in the Island. With the domino-like failure of the sugar plantations, roughly a thousand former workers were left with few economic options. Almost 60,000 acres were taken out of production. The closing of Ka`u Sugar in 1996 marked the end of the sugar plantation era on the Big Island. This has led the Island to search for other viable sources of employment and income.

Construction Industry in Hawaii County

A sustained increase of tourism during the late 1970's demanded the expansion of hotels and resorts on the Big Island. This resulted in an *upswing of the construction industry which continued to grow* throughout the 1980's reaching its peak in 1991. Since then, construction activity has begun to decline, causing the jobs to disappear. In 1996, there were only 4,000 construction jobs which is about 31 percent decrease compare to that of 1991 (Construction in Hawaii 1997, Bank of Hawaii).

Table 8 shows the value of building permits and construction completed between 1985-96. The value of construction permits issued in 1996 totaled $215 million compared to $408 million in 1991--- a decrease of 47 percent.

Table 8:Construction Authorization and Completion; Hawaii County, (1985 – 1996)

Year	Total Authorized (1,000)	Total Completed (1,000)	Completed Construction Growth Rate
1985	$132,734	$81,102	-
1986	$250,493	$95,769	18%
1987	$187,186	$124,800	30%
1988	$199,785	$162,756	30%
1989	$359,027	$191,675	18%
1990	$494,218	$350,810	83%
1991	$408,222	$354,342	1%
1992	$418,749	$258,329	-27%
1993	$273,421	$247,609	-4%
1994	$205,137	$221,774	-10%
1995	$290,033	$222,250	0%
1996	$215,489	$186,121	-16%

Source: Bank of Hawaii, Construction in Hawaii. 1997.

In 1991, the value of the finished building totaled $354 million, which was the industry's peak. Sine then, there has been a sustained decline afterward. In 1996, the value of construction completed fell to $186 million. This is about 48 percent less than that of 1991. Certainly, the construction industry in Hawaii has severely stagnated over the past few years, pushing this industry into its lowest level.

Economic Conditions in Puna

Puna is situated on the East Coast of the Big Island. Between 1990 and 1995, the average annual growth rate of population was about 5.9

percent. Currently, Puna is the second most populated district of Hawaii county, hosting 28,000 inhabitants. Throughout the 1980s, people in Puna worked in agriculture, crafts, and repairs.

The economic structure of the Puna District has changed greatly since the era when sugar cane plantations dominated the landscape. The Technical Reference Report, Puna Community Development Plan (Community Management Associates, Inc. 1992) shows 36.3 percent of the Puna population were in the labor force in 1980. Of the total, 15.4 percent were managerial, 21.6 percent were involved in technical, sales, or administrative work, and 13.0 percent were in service occupations. Farming and fishing accounted for 15.8 percent and precision crafts hired 15.1 percent of the labor force. About 6.2 percent were operators, fabricators, or laborers.

Government workers made up 19.0 percent of the total, self-employed workers were 14.6 percent, and the remainder, 65.9 percent, were private wage and salary workers. Puna had and continues to have a diverse economy, even if many of the jobs are situated in Hilo. In contrast with former years, small businesses employ more workers than any large concerns.

When Puna Sugar company shutdowned in the 1980's, a distinct part of the labor in Puna tried to find job in Hilo. Other sugar workers straggled to establish their own business. They mostly engaged in small home business, construction, and maintenance. Some people who lost their job in the sugar company have attempted to enter to agriculture and alternative crop production.

ECONOMIC IMPACT OF ONELOA ONSEN
&
SPORTS RETREAT

For the past several years, the state economy has been deepening in recession with no visible sign of immediate future recovery. The economy of Hawaii county appears to be even worse. The demise of the sugar industry caused massive unemployment which has led plantation workers to lose their jobs and income. The reason is that the other farming industries were not strong enough to absorb the sugar farmers.

As mentioned above, the construction industry in the county of Hawaii has also significantly declined. In 1991, the builders employed 5,800 workers, whereas there were only 4,000 people working in the construction industry in 1996. The industry has lost about 1,400 jobs over a 5-year period. One can surmise that the construction industry is actually in depression because it has lost 31 percent of its employment in a 5-year period.

The disappearance of sugar industry and notable decline of construction industry together with the slowdown of tourism have reduced the welfare of the community. Thus, the county should be in search of new investors to stimulate the economy, creating more jobs and income, especially in the construction industry and tourism.

This project represents a large new investment to the county of Hawaii. It will significantly contribute to the economy of the state in general and

the Big Island in particular. This resort project will inject $81.6 million worth of financial capital into the Hawaii county economy.

This development will create construction jobs and income at first. When it becomes operational, it will create demand for tourism workers and professionals. The operation phase would not only help increase employment but also would raise income over the lifetime of the project. In addition, this project will increase government revenues, through income tax payments, general excise tax and other taxes.

Methodology

This study utilizes data and information (secondary source) published by various state and county agencies. The hotel occupancy rates are collected from PKF Hawaii. The Tax Foundation of Hawaii's publications are used to estimate the government tax revenues and expenditures. The costs and employment information were provided by the resort developer. A series of Tables are produced using various issues of Hawaii Data Book (i.e. 1992-96) and the 1996 County of Hawaii Data Book.

The quantitative models are developed to estimate the economic impact of the project on both the economy and government. This study uses the Input-Output (I/O) model constructed by Department of Business and Economic Development and Tourism (DBEDT) in 1997. The Input-Output model measures the contribution of each economic sector to Hawaii's economy. The model also shows the relationships among various sectors of the economy. The I/O model, for example, measures the

degree and extent to which the construction industry in Hawaii stimulates the related industries through its increased demand for construction materials and labor. It calculates what is called "Multiplier" which measures the ripple effect of the construction industry in the entire economy.

This study adopts the 1997 DBEDT estimated multipliers for the various sectors as follows:

a) The output multiplier measures the changes in total output in response to a $1 dollar change in final demand.

b) The income multiplier measures the effect of a $1 dollar change in final demand for total household income.

c) The employment multiplier calculates the impact of one newly created job in total employment of the economy.

Employment and Income

This section focuses on the impact of the project on employment and income. It estimates the projected changes of employment and income resulting from this development.

The project will increase construction jobs and tourism related jobs. During the first two years of building and land development, the project would mostly need construction workers. After construction completion,

the resort will enter into the operation phase. This is a long-term phase, creating permanent tourism related jobs and professional positions.

Employment created and income generated by this development fall under three categories:

a) direct,
b) indirect, and
c) induced.

Direct Impacts on Employment and Income

Direct employment is defined as on-site jobs that are generated as a direct result of the project. These positions include construction workers in the first 2 years and the permanent resort operational jobs.

Direct income are gained by those who are directly employed by the resort. It includes wages and salaries paid to the construction workers and operational employees of the project.

Direct Employment

The direct employment is computed based on similar resorts projects in the state. During the construction period, this project is expected to create 1,089 full-time construction jobs. After the construction, the operational employment is estimated to generate about 410 full-time permanent tourism related employment.

Direct Income

In the 2-year construction period, the project's total direct income contribution in the form of wages and salaries will be $32.6 million. Therefore, the payroll of the construction employees working on the project would be $16.3 million per year.

After the completion of the resort construction, the project will have a sustained demand for tourism related workers and professionals. This would generate permanent income during the operation of the resort. The estimated direct income (wages and salaries) will be about $8.2 million annually (Table 10).

Indirect and Induced Effects on Employment and Income

Indirect employment refers to the jobs that are created by the local companies as a result of the project activities in the local economy. The resort will purchase construction materials and services from local businesses. These local companies in turn would demand to have more workers, creating more jobs in the community.

The project will also create other job opportunities called "Induced Employment". These jobs are created due to the consumption expenditures of the project workers and professionals.

The newly created employment both indirect and induced would generate income. The income that would be earned as wages and salaries by the indirect and induced employees.

Indirect employment

According to the DBEDT's latest input-output model, every new full-time job in the construction industry generates 2.07 additional full-time jobs caused by the multiplier effect. Hence, during the construction, the direct employment of 1,089 jobs would create additional 2,253 full-time indirect employment.

After the construction phase, the resort operational activity would also contribute to the permanent indirect and induced employment. Utilizing the DBEDT's estimated multipliers, the resort would create 704 additional permanent indirect and induced employment.

Indirect Income

As shown in Table 11, the direct income of $32.6 million during the construction will contribute additional $27.1 million in the from of indirect and induced income to the economy. During operation, the project is expected to generate permanent indirect income amounting to $6.6 million annually.

Table 9: Employment Generated during Project Construction

Facility	Multi-plier	Construction Cost, (1,000)	Direct /1 Employment
Boutique Hotel		$14,560	194
Sports / Spa Complex		$11,700	156
Beach Club		$7,020	94
9 Hole Cinder Golf Course / Clubhouse		$3,600	48
Chalets Site 1		$30,000	400
Chalets Site 2		$4,500	60
Equestrian Center		$960	13
Retail / Restaurant / Fast Food		$900	12
18 Hole Champion Golf Course / Club House		$5,400	72
Chalet Site 3		$1,500	20
Chalet Site 4		$1,500	20
Total Direct Employment		$81,640	1089
Indirect/Induced Multiplier	2.07		
Total Indirect Induced Employment			2253
Total Employment			3342
Total Payroll		$32,656,000	

1/ Based on an annual earnings of $30,000 for construction workers, assuming that 40% of the construction costs goes to labor.

Table 10: Employment Created During Project Operation

Facility	Direct Employment	Multi-plier	Indir./Induc. Emplyment	Total Employment
Restaurant	50	1.59	80	130
Lode / Chalets	100	2.10	210	310
Sports Complex	50	1.21	61	111
Clubhouse / Restaurant	50	1.69	85	135
Golf Course (9 Hole)	30	1.67	50	80
Golf Course (18 Hole)	30	1.67	50	80
Clubhouse / Restaurant	50	1.69	85	135
Equestrian	10	1.69	17	27
Nursery	20	1.67	33	53
Agricultural Products	20	1.74	35	55
Total Employment (Direct/Indirect/Induced)	410		704	1114
Total Payroll	$8,200,000			

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Total Employment and Income

As mentioned, the project will have a positive impact on employment and income of both the state and the Big Island. During the 2-year construction phase, the total employment (i.e. direct, indirect, and induced) is estimated to be 3,342 new full-time positions. This development is also projected to create an annual total of 1,114 permanent jobs as long as it stays in operation.

During the 2-year construction activity, a total income of $59.8 million will be generated (i.e. direct, indirect, and induced). Then, during the operation phase, the resort would contribute an annual total of $14.8 million income during its lifetime (Tables 11 & 12).

Table 11: Total Income Generation During Construction Phase

Activitiy	During Resort Construction (two years)			
	Direct Income	Multiplie	Indirect/Induced Income	Total Dir, Indir, + Induced Income
Resort as a Total	$32,656,000	0.83	$27,104,480	$59,760,480

Table 12: Total Income Generation During Operation

Activity	During Resort Operation (per year)			
	Total Income	Multi-plier	Indirect/Induced Income	Total Dir, Indir, + Induced Income
Resort as a Total	$8,200,000	0.81	$6,642,000	$14,842,000

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Direct, Indirect, and Induced Effects on Output

The increase of direct state output generated by the project includes the construction costs of the resort which are $81.6 million initial investment. An additional $169 million indirect and induced output will be generated as a result of the multiplier effect. Based on $ 81.6 million initial capital, using the state multiplier (2.07), this project would increase the state output by $251 million (Table 13).

Table 13: Total Output Generated upon Completion

Activitiy	During Resort Construction (two years)			
	Direct Output	Multiplier	Indirect/Induced Output	Total Dir, Indir, + Induced Output
Resort as a Total	$81,640,000	2.07	$168,994,800	$250,634,800

Government FISCAL IMPACT

Fiscal impact refers to the changes in government budget that occur as a result of the project. The main fiscal goal of government is to maintain a balanced budget.

This section analyzes the economic impact of the resort on the government budget. Attempts will be made to estimate the revenues gained and expenditures incurred by the government due to the project.

Methodology

For the purpose of calculating the fiscal impact of the development on the government budget, the project activities are broken-down as follows:

a) Impacts of construction phase, and
b) Impacts of operation phase.

The estimated revenues are dependent on the projected construction costs. The construction related revenues to the government are derived from taxes on construction materials, income tax, general excise tax, and conveyance tax.

The operation phase will become a sustained tax revenue source for the government over the lifetime of the resort. The fiscal revenues will mostly be generated through income tax paid by the resort employees. Hence, the operation revenues are considered to be rather conservative. It is further assumed that there would not be any significant in-migration to the state as a result of this project.

The fiscal impact analysis measurement method used in this study is the modified version of the average revenue and cost models. The analysis also utilizes visitor spending data from the Hawaii Visitors Bureau and Visitor-Applicable Constituents of the state operating budget.

Per capita estimates of revenues uses the average revenue approach. These estimates include all sources of revenues such as taxes and user fees. Revenues are calculated based on the assumption that the resort employs its workers mostly from the local residents.

The average cost approach is utilized to estimate the per capita expenditure. These expenditures are: operational spending, debt service expenses, maintenance costs, and cash capital expenditures.

The nature of above estimates tend to be conservative. This is based on the fact that economies of scale in the production of government services is not accounted for in the average cost estimation method.

The State Fiscal Impacts

Table 14 below shows the additional tax revenues the state would collect as a result of the project construction. The various construction related taxes would generate a total revenue of about $6.8 million for the state.

Table 14: Projected State Revenue from Construction ($1000)

Tax Type	Estimated Const. cost	Estimated Total Payroll	Rate (%)	Amount
Construction of Oneloa resort				
General Excise Tax	$81,640		4.17	$3,404
Materials	$81,640		0.13	$106
Conveyance Tax	$81,640		0.05	$41
Income Tax		$94,702	3.40	$3,220
Total Taxes/Construction				$6,771

1/ John Zapytocky, Fiscal Impact Assessment, Maini'owali Residential Community EIS 1991.
2/ As projected in Oneloa Master Plan Development.

During operation, the state will be collecting tax revenues on the sustainable bases. Table 15 shows the government will increase its fiscal revenues by about $2.58 million per year.

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Table 15: Projected State Revenue from Operation

Source	Amount ($)
Operation/Excise Tax on Revenues	$1,312,000
Hotel Room Tax /1	$532,436
On Resort Residents	
Income Tax /2	$451,000
Visitors	
General Excise Tax /3	$289,043.30
Total State Revenue/Operation	**$2,584,479**

1/ Based on 1998 approved 7.25 percent hotel room tax rate and the 44.8 percent share of county room tax revenue, (State Dept. of Taxation).
2/ Uses the total payroll of $8,200,000 at a tax burden of 5.5%.
3/ Based on 133,590 visitor days with an average daily expenditure of $300 at a tax rate of 4%, less item (1) above, (Visitor Expenditure Survey).

Table 16: State Operating Expenditures

	Total	Per Resident	Per Visitor
General Government	$480,513,684	$406	$0
Public Safety	$187,380,537	$158	$158
Highways	$125,105,363	$106	$106
Natural Resources	$42,560,066	$36	$36
Health & Sanitation	$186,709,663	$158	$158
Hospitals & Institutions	$331,924,139	$280	$0
Public Welfare	$831,575,136	$703	$0
Education	$1,432,753,165	$1,210	$0
Recreation	$37,985,204	$32	$32
Utilities & Other Enterprises	$286,438,191	$242	$0
Debt Service	$460,257,657	$389	$0
Retirement & Pension	$275,167,612	$232	$0
Employee's Health & Hospital Insur.	$621,594	$1	$0
Unemployment Compensation	$243,984,694	$206	$0
Grants-In-Aid to Counties	$2,375,471	$2	$0
Urban Redevelopment & Housing	$142,609,444	$120	$0
Miscellaneous	$112,759,900	$95	$0
Cash Capital Improvements	$455,369,454	$385	$385
Total	$5,636,090,974	$4,761	$874
Adjusted Total (1998$) /1		$5,098	$936
1996 Resident Population	1,183,723		

1/ Based on Honolulu inflation rates of 2.5% 1994, 2.2% 1995, 1.5% 1996, and 0.7% 1997.
Source: Tax Foundation of Hawaii, Annual Report of the Comptroller 1994.

Each visitor would cost the state $936 annually. With an average of 366 visitors, shown in Table 17, the project would incur the state an additional expenditure of $338,588 per year.

Table 17: State Expenditure due to Oneloa Resort

On Resort Visitors /1	366
Cost Per Visitor	$936
Expenditure	**$342,243**

1/ Average occupancy rate of 81 percent.
Source: County of Hawaii Data Book, 1996.

The project would generate a fiscal revenue of $2.58 million annually (Table 18). The new annual expenditure attributable to the project is expected to be $342.24 thousand. This would result in additional (net of expenditure) fiscal revenues of $2.24 million per year. Thus, the ratio of tax revenues to government expenditure is 7.6. The government also will gain a one-time tax revenues of $6.8 million from the construction.

Table 18: State Revenue and Expenditure Due to Oneloa Resort

New Annual Tax Revenues	$2,584,479
New Annual Government Expenditures	$342,243
New Additional Net Revenues per Year	**$2,242,236**
Revenue/Expenditure Ratio	7.6
One-Time Additional Net Revenue from Construction	$6,771,215

The Hawaii County Fiscal Impacts

The county government will incur some costs due to the existence of the project, but Hawaii County also would gain tax revenues from this development. Attempts are made to estimate the County's costs and benefits as a result of the project.

Table 19 shows the details of the Hawaii county operating expenditures. Each visitor would impose cost on the county. The visitor county expenditures are estimated in the last column of the Table.

Table 19: Hawaii County Operating Expenditures

	Total	Per Resident	Per Visitor
General Government	$15,888,000	$116	-
Public Safety	$50,583,000	$368	$368
Highways	$4,766,000	$35	$35
Health & Sanitation	$9,781,000	$71	$71
Public Welfare	$11,233,000	$82	-
Public Schools	$290,000	$2	-
Recreation	$9,587,000	$70	$70
Interest	$6,459,000	$47	-
Bond Redemption	$4,923,000	$36	-
Pension and Retirement	$14,024,000	$102	-
Mass Transit	$1,088,000	$8	$8
Miscellaneous	$11,543,000	$84	-
Cash Capital Improvements	$3,193,000	$23	-
Total	$143,358,000	$1,044	$552
Adjusted Total (1998$) /1		$1,118	$591
1995 Resident Population		137,291	

1/ Based on Hawaii inflation rates of 2.5% 1994, 2.2% 1995, 1.5% 1996, and 0.7% 1997.
Source: Tax Foundation of Hawaii, Government in Hawaii, 1995.

The project would increase the county expenditures. The 1998 inflation-adjusted annual county total expenditures are $591 per visitor. The increase of the county expenditure due to the project is estimated in Table 20. The county would incur additional costs, amounting to $216,031 per year as a result of the operation of the project.

Table 20: County Expenditure Due to Oneloa Resort (Year)

On Resort Visitors /1	366
Cost Per Visitor	$591
Expenditure	**$216,031**

1/ Average occupancy rate of 81 percent.
Source: County of Hawaii Data Book, 1996.

The main source of the county revenues is real property taxes, followed by state/federal grants and other taxes. The county receives 78 percent of the Transient Accommodation Tax (TAT), which is hotel room tax. This year, however, the state has lowered the county share of TAT to 44.8 percent. Therefore, in order to have better estimates, this study applies 44.8 percent to project the TAT share of Hawaii county.

Table 21 shows the county annual tax revenues from the project operation. The project would primarily contribute to the county revenue by its real property tax. The county revenue would increase by the amount of $727,400, which is the project property taxes.

The county government would also receive 44.8 percent share of TAT collection from the state. The project will contribute an additional $432,122 to the county revenue. Therefore, the county revenue will be enhanced by the total amount of $1.16 million per year.

Table 21: Projected County Tax Revenues From Operation

Parameter	Amount ($)
Boutique Hotel /1	$123,760
Chalets /1	$318,750
Other Commercial Buildings /1	$115,090
2 Golf Courses & Land Improvement /2	$169,800
Total Propety Tax Revenues	$727,400
County Hotel Room Tax Revenue Share /3	$432,122
Total County Revenue	**$1,159,522**

1/ The hotel, chalets and other commercial buildings are taxed at $8.50 per $1,000 of assessed value. (County of Hawaii, Real Property Tax Office)

2/ The golf courses and land improvement are taxed at $10 per $1,000 of assessed value.

3/ Based on 1998 approved 7.25 percent hotel room tax rate and the 44.8 percent share of county hotel room tax revenue, (State Department of Taxation).

As indicated above, this project would increase both the county expenditure and tax revenue. The projected net county revenue is present in Table 22. The tax contributions of the resort are 5.4 times greater than the costs imposed on the county government. Thus, the county of Hawaii will gain a total net benefit of $943,491 per year as a result of the operation of the project.

Table 22: Projected County Revenue and Expenditure Due to Oneloa Resort

New Annual Tax Revenues	$1,159,522
New Annual Government Expenditures	$216,031
New Additional Net Revenues per Year	**$943,491**
Revenue/Expenditure Ratio	**5.4**

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APPENDIX H

PRELIMINARY ENGINEERING REPORT FOR ROADWAY AND DRAINAGE FOR THE ONELOA ONSEN AND SPORTS RETREAT

by:

Okahara & Associates, Inc.

Preliminary Engineering Report for Roadway and Drainage

for the

ONELOA ONSEN & SPORTS RETREAT

May 1999

Okahara & Associates, Inc.
ENGINEERING CONSULTANTS

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INTRODUCTION

This report describes the preliminary engineering for the proposed Oneloa Onsen & Sports Complex project. Included in this report is the overall traffic issues of the area, the preliminary design of the new roadways, the initial investigation of onsite and offsite drainage that will affect this project, and evacuation issues. Information contained henceforth is extremely preliminary, and is subject to revision as more accurate information becomes available.

PROJECT LOCATION

The project site is located on the eastern side of the Island of Hawaii, Puna District, Laepao'o, and is identified by Tax Map Key (3) 1-4-02:13. It is bounded by Kapoho-Kalapana Road (Red Cinder Road) to the southeast, Pahoa-Pohoiki Road (Mango Tree Road) to the southwest, and undeveloped land to the northeast and northwest (see Figures 1 & 2).

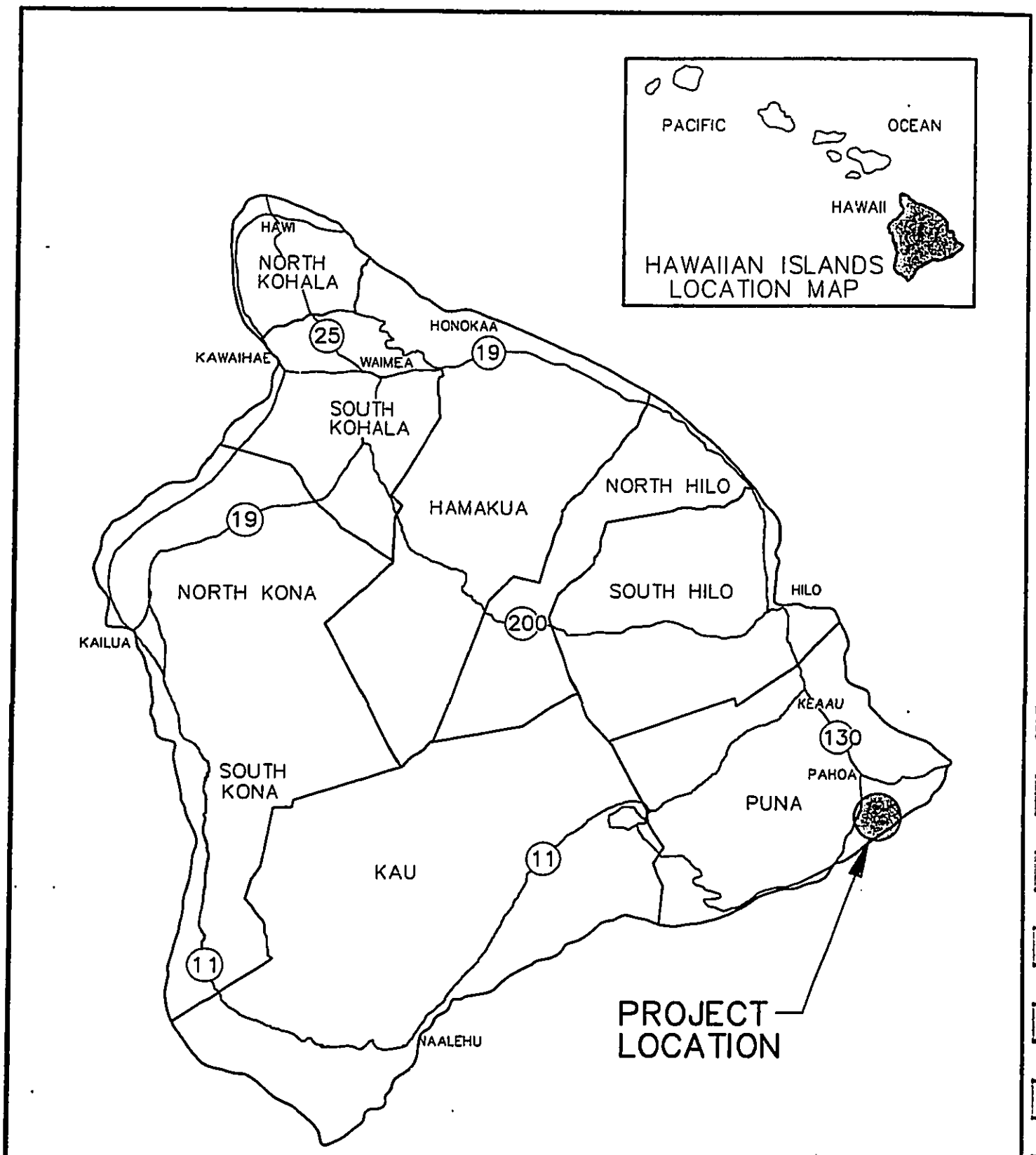
PROJECT CLIMATE

The climate of the Island of Hawaii is greatly influenced by the topography of the land, which is dominated by Mauna Loa (13,653 ft. summit elevation) and Mauna Kea (13,796 ft. summit elevation). Along the windward slopes, mean annual rainfall increases from approximately 100 inches along the coast, to over 300 inches at elevations of 2,000 to 3,000 feet, and then declines to about 15 inches at the summits of Mauna Loa and Mauna Kea (see Figure 3). The proposed project will experience a mean annual rainfall of approximately 100 inches.

SOIL TYPES

Eight soil types as defined by the Soil Conservation Service's "Soil Survey of Island of Hawaii, State of Hawaii" are found within the project site and its approximate drainage basin, and are described below (see Figure 4).

Cinder Land (rCL) - This is a miscellaneous land type consisting of cinders, pumice and ash. These materials are black, red, yellow, brown, or variegated, and show little evidence of soil development. Characteristics of this soil type include very rapid permeability, high erodibility, and moderate compressibility. This series has a hydrological soil classification "A".



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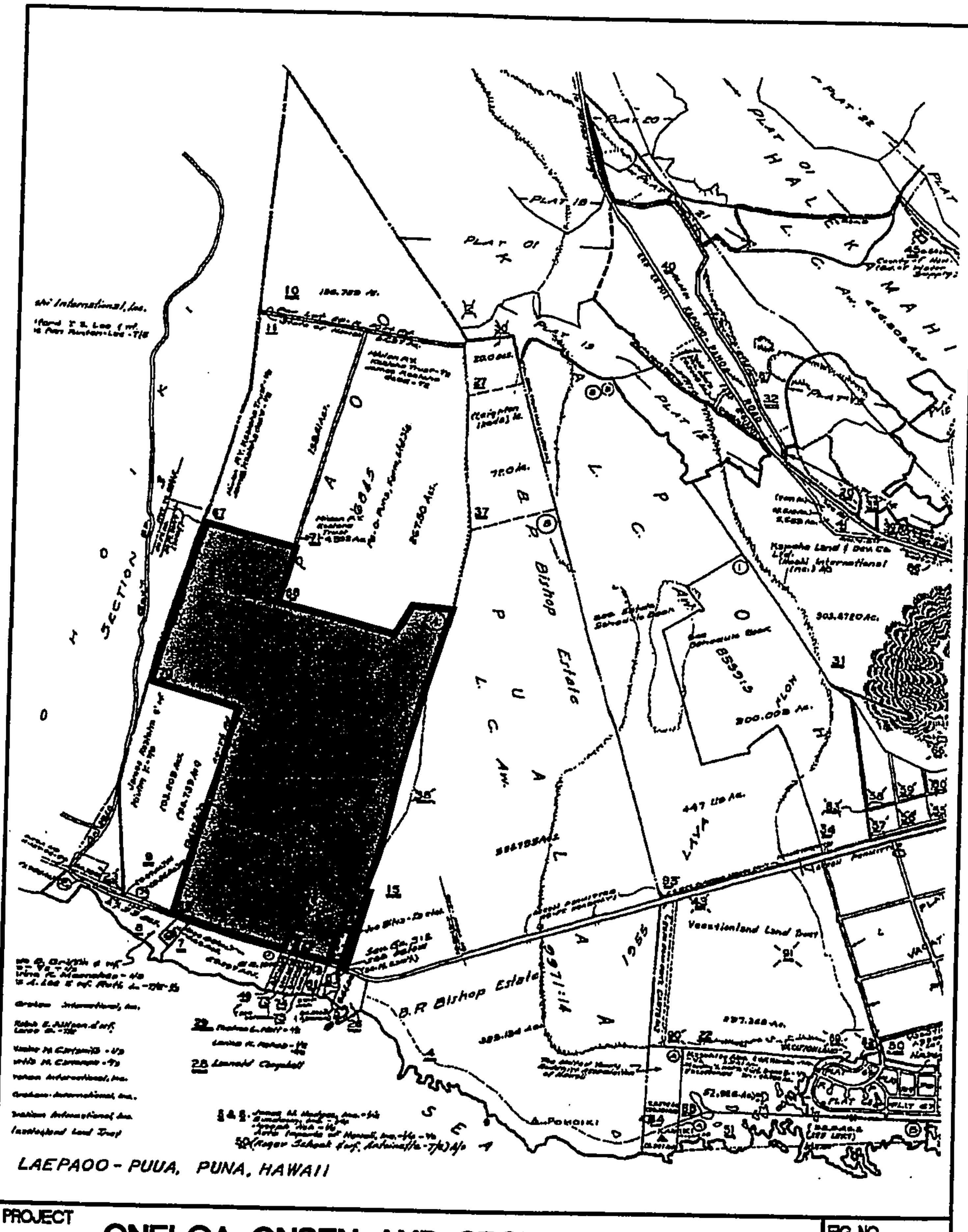
PROJECT: ONELOA ONSEN AND SPORTS RETREAT		FIG. NO. 1
TITLE: ISLAND MAP	DATE: 3/99	



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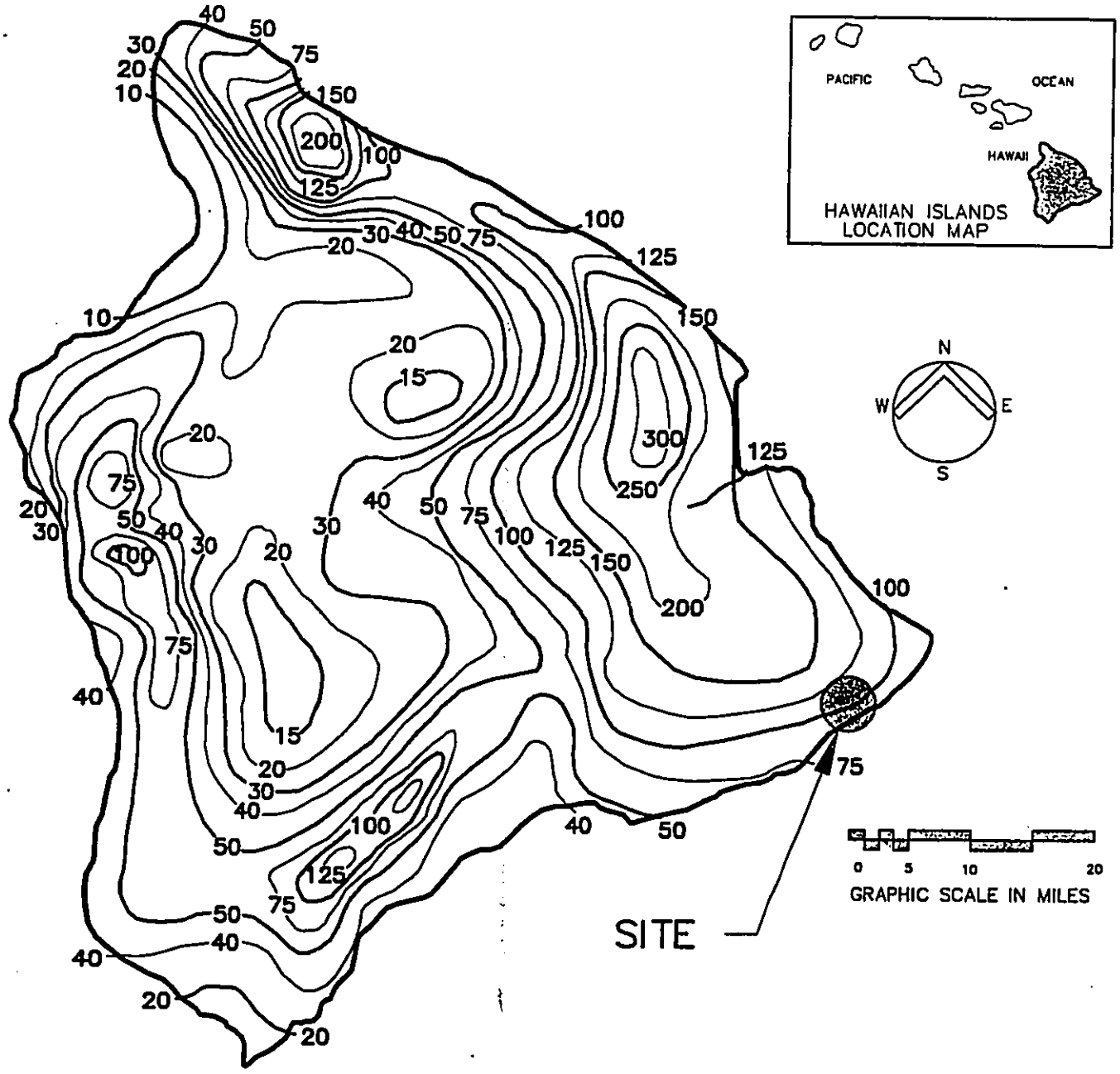
PROJECT	ONELOA ONSEN AND SPORTS RETREAT		FIG. NO.
TITLE	T.M.K. MAP	DATE 3/99	2



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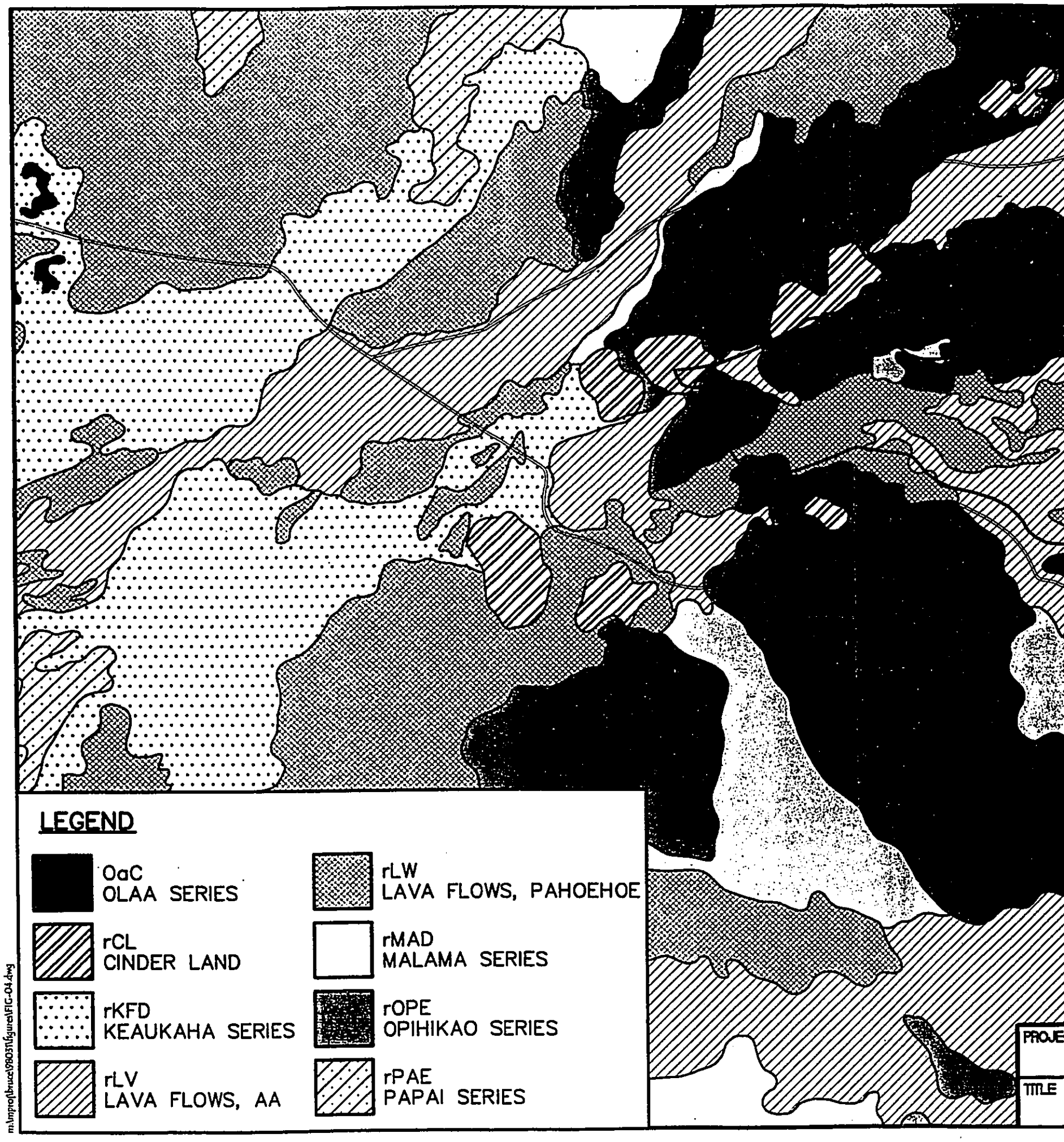
PROJECT: ONELOA ONSEN AND SPORTS RETREAT		FIG. NO. 3
TITLE: MEAN ANNUAL RAINFALL (INCHES)	DATE: 3/99	


LEGEND
OaC
OLAA SERIES
rCL
CINDER LAND
rKFD
KEAUKAHA SERIES
rLV
LAVA FLOWS, AA
rLW
LAVA FLOWS, PAHOEHOE
rMAD
MALAMA SERIES
rOPE
OPIHIKAO SERIES
rPAE
PAPAI SERIES
PROJE
TITLE
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PROJECT		FIG. NO.
ONELOA ONSEN AND SPORTS RETREAT		4
TITLE	DATE	
SOIL MAP	3/99	

Keaukaha Series (rKFD) - This series consists of a thin layer of undulating organic soil which follows the topography of the underlying pahoehoe lava. A typical section of this soil type shows an 8-inch layer of strongly acidic dark brown muck, followed by the pahoehoe lava. The soil above the lava is rapidly permeable, while the lava itself is very slowly permeable, although water moves rapidly through cracks and crevices. Rock outcrops are found in about twenty-five percent (25%) of the area, and the natural vegetation consists of ohia, tree fern, uluhe fern, and guava. This series has a hydrological soil classification "D".

Lava Flows, Aa (rLV) - Aa lava is a mass of clinkery, hard, glassy, sharp pieces piled in tumbled heaps. This series has practically no soil covering and is bare of vegetation except for mosses, lichens, ferns, and a few small ohia trees. This series has a hydrologic soil classification "D".

Lava Flows, Pahoehoe (rLW) - Pahoehoe lava has a billowy, glassy, and relatively smooth surface, although in some areas, the surface is rough and broken. Typically, this series has no soil covering and is bare of vegetation except for mosses and lichen, however, ohia trees, ohelo berry, and alii do exist in cracks and crevices in areas of higher rainfall. This series has a hydrologic soil classification "D".

Malama Series (rMAD) - This series consists of well-drained, thin, extremely stony organic soils over Aa lava. A typical section of this soil type shows a 3-inch layer of strongly acidic, dark brown extremely stony muck, underlain by fragmental Aa lava. Natural vegetation consists of guava, waiwe, mango, hala, noni apple, and ohia. Characteristic of this series include rapid permeability, very slow runoff, and slight erodibility. This series had a hydrologic soil classification "A".

Olaa Series (OaC) - This series consists of well drained silty clay loams that formed in volcanic ash. A typical section of this soil type shows a 16-inch thick layer of very dark brown silty clay loam, followed by a 9-inch layer of dark brown, extremely stony silty clay loam, underlain by Aa lava. Natural vegetation consists of ohia, tree fern, guava and hilograss. Characteristic of this series include rapid permeability, very slow runoff, and slight erodibility. This series had a hydrologic soil classification "A".

Opihikao Series (rOPE) - This series consists of a thin layer of well drained organic soil over pahoehoe bedrock. A typical section of this soil type shows an 3-inch layer of strongly acidic, very dark brown muck, followed by the pahoehoe lava. The soil above the lava is rapidly permeable, while the lava itself is very slowly permeable, although water moves rapidly through cracks and crevices. Rock outcrops are found in about thirty to fifty percent (30%-50%) of the area, and the natural vegetation consists of ohia, waiwe, and guava. This series has a hydrological soil classification "D".

Papai Series (rPAE) - This series consists of well-drained, thin, extremely stony organic soils over fragmental Aa lava. A typical section of this soil type shows a 8-inch layer of slightly acidic, very

dark brown extremely stony muck, underlain by fragmental Aa lava. Natural vegetation consists of guava, tree fern, uluhe fern, and ohia. Characteristic of this series include rapid permeability, very slow runoff, and slight erodibility. This series had a hydrologic soil classification "A".

PROJECT DESCRIPTION

The proposed project encompasses approximately 494 acres which will house an eighteen hole golf course, an equestrian center, a sports/spa complex, a lodge, a beach club, retail establishments, and single family housing facilities. Also included as part of this project is improvements to the county road bordering the parcel (see Figure 5).

TRAFFIC CONSIDERATIONS

A traffic analysis was conducted by Julian Ng, Incorporated in August of 1998 (see APPENDIX A). It performs an analysis of the impact that the project will have on the general traffic circulation of the area. It was used to help determine what could be developed in the project that would minimize the need to improve the existing public roads in the area.

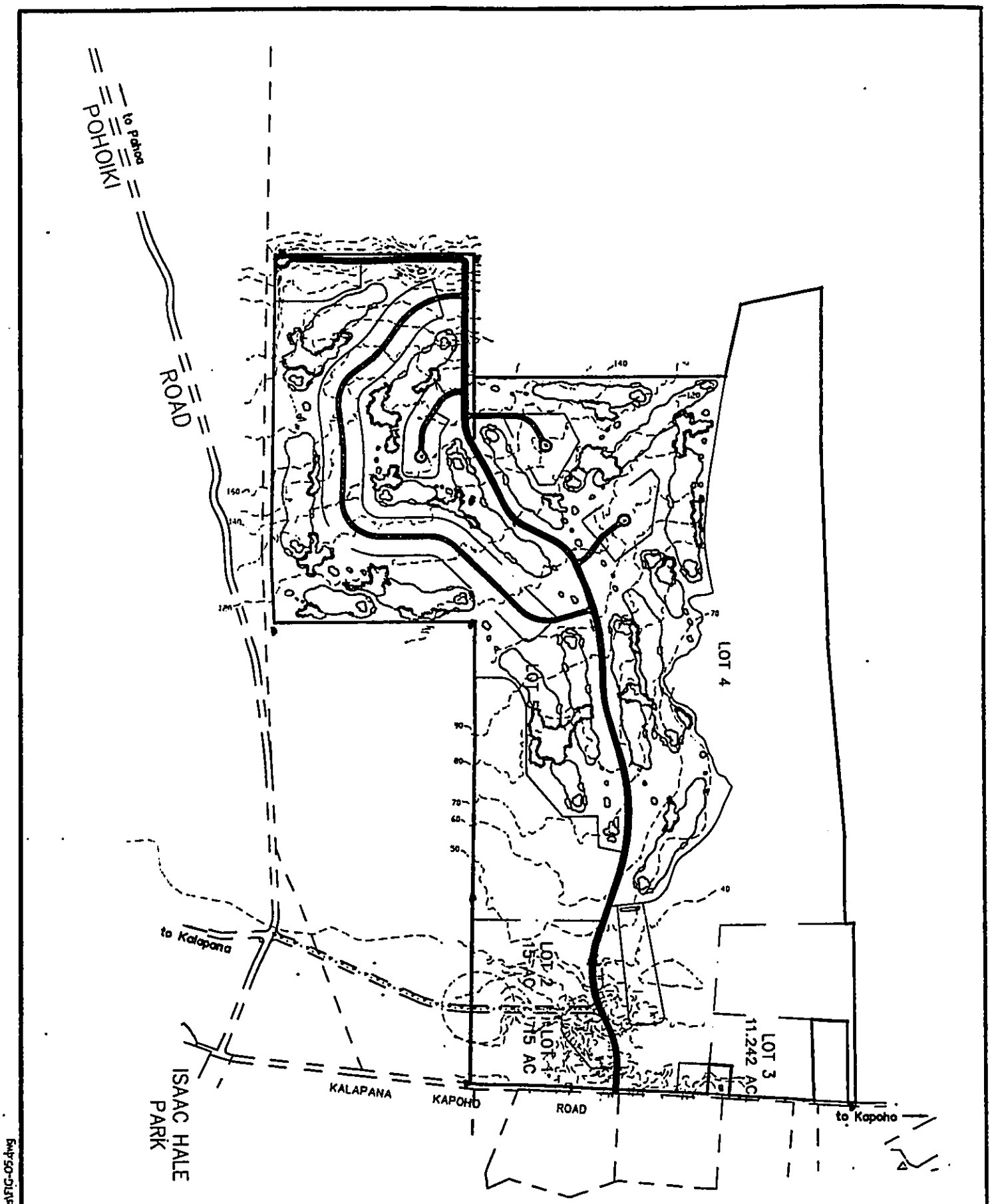
Currently the project site is accessible from two main public roads, the Pahoa-Kapoho Road (Hwy 132) and the Pahoa-Pohoiki Road also or Mango Tree Road. Both roads connect to the coastal road known as the Kapoho-Kalapana Road or Red Cinder Road which has the private access to the project site. All non-local traffic enters this general area through the Pahoa Bypass (Hwy 130) and Pahoa-Kapoho Road junction near Pahoa Town (see Figure 6). It should be noted here that these roads, though are designated using the State numbers, are County owned roads.

It is anticipated that there will be no improvements to these roads except for a portion of the Kapoho-Kalapana Road or Red Cinder Road which is discussed below. It will also be proposed that the Mango Tree Road be made a one-way road going inland from the coast.

PAHOA BYPASS AND THE PAHOA-KAPOHO HWY

It is anticipated that the Pahoa-Kapoho Highway will experience an increase of about 160 vehicles during the AM peak hour and 135 vehicles during the PM peak hour. This is in the East bound direction. The West bound direction should experience a comparable increase in traffic volume (see Exhibits 3 & 4 of the traffic analysis in APPENDIX A of this report).

The level of service (LOS) for both the Pahoa Bypass and the Pahoa-Kapoho Hwy is B without the project and C with the project. Also the LOS for the junction of these two highways are as follows:



m:\mpro\bruce\980311\figures\FIG-05.dwg

PROJECT: ONELOA ONSEN AND SPORTS RETREAT		FIG. NO. 5
TITLE: SITE PLAN	DATE: 3/99	

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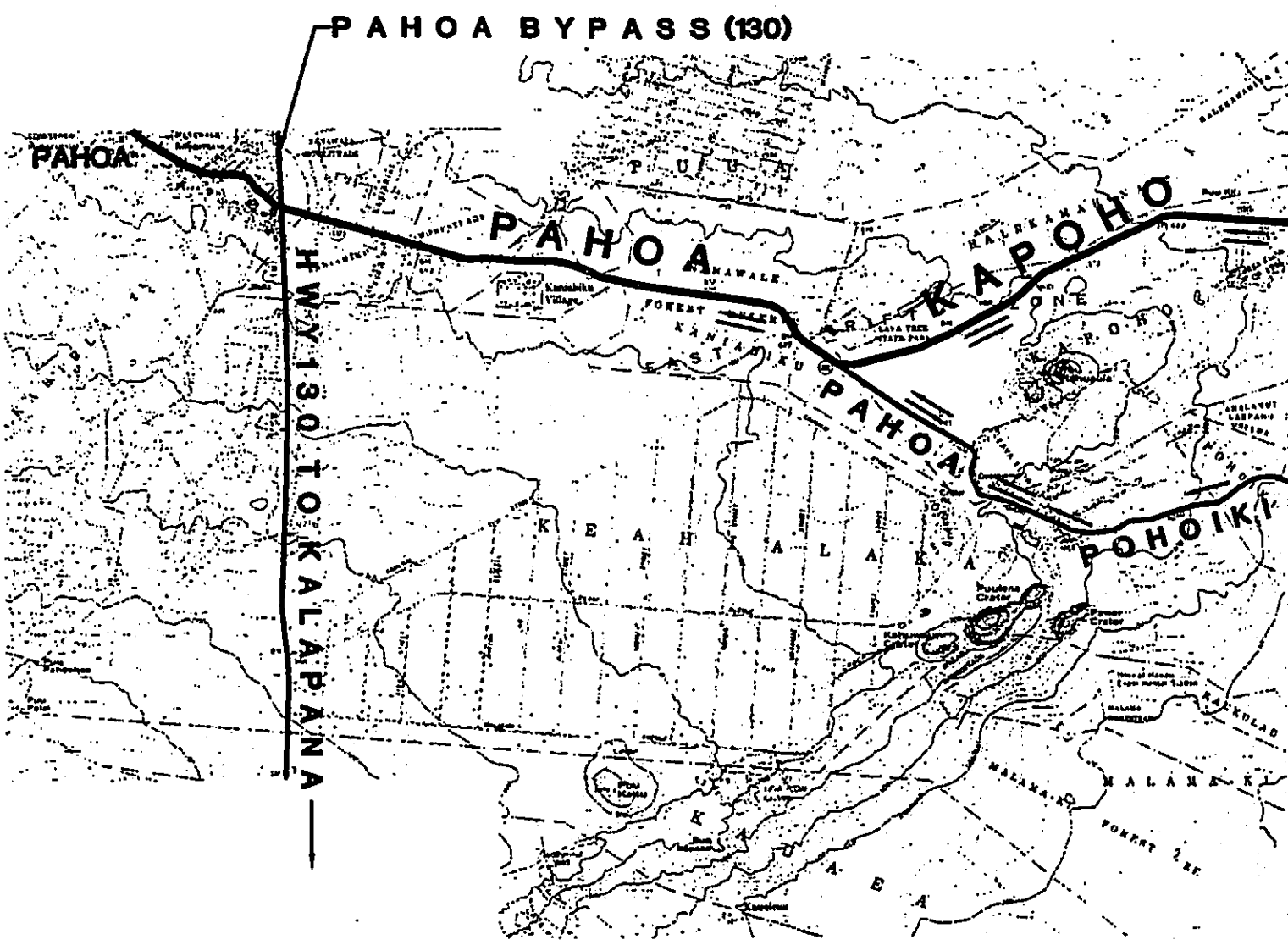

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PROJEC

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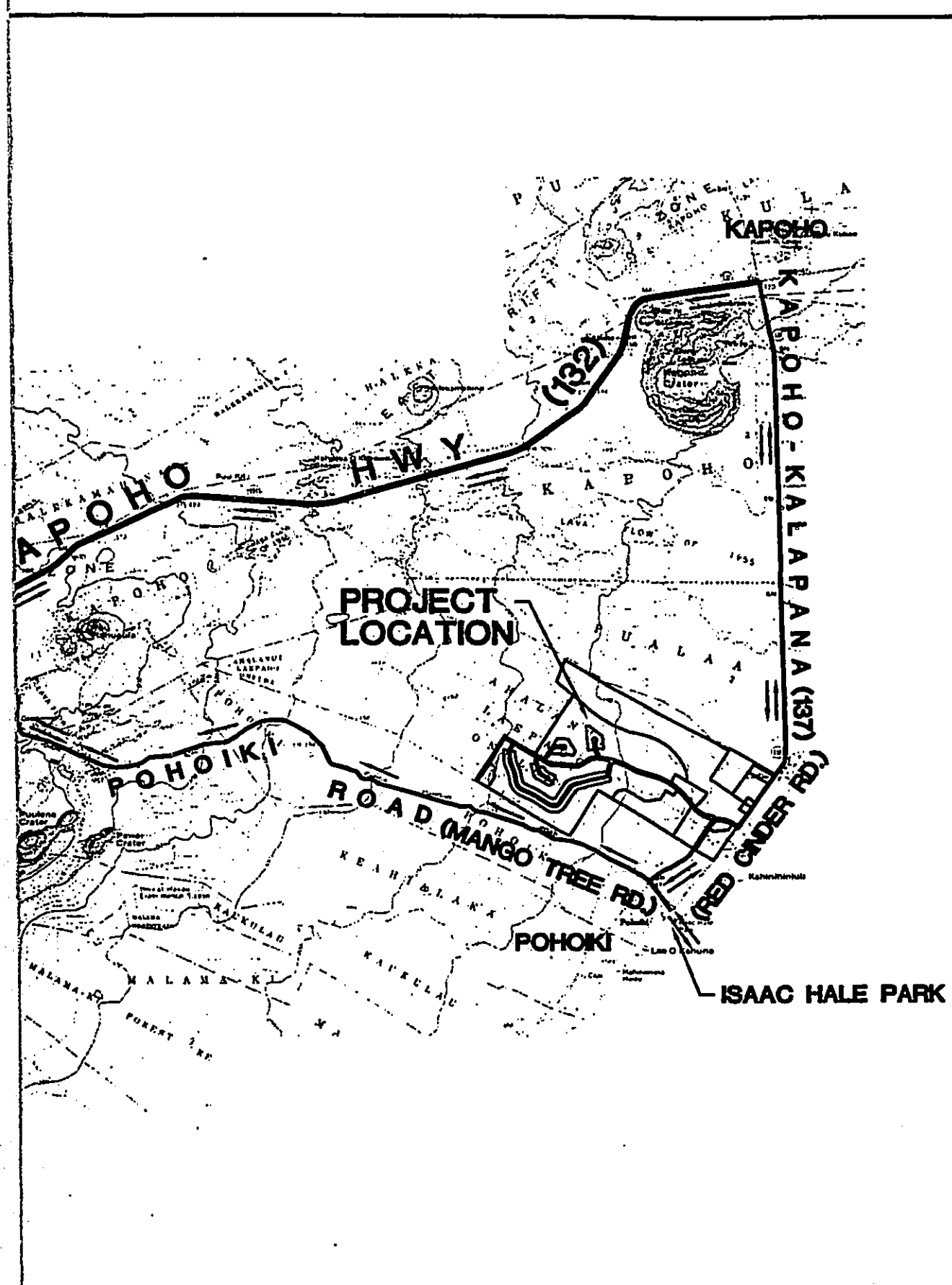


PROJECT	ONELOA ONSEN AND SPORTS RETREAT		FIG. NO. 6
TITLE	OVERALL ROADWAY PLAN	DATE 3/99	

Unsignalized intersection LOS	from Pahoa	from Kapoho
AM Peak Hour		
2005 traffic assignment (without project)	B	B
2005 traffic assignment (with project)	B	C
PM Peak Hour		
2005 traffic assignment (without project)	C	C
2005 traffic assignment (with project)	D	D

This means that with the project, the traffic volumes are under the capacity of these highways. Additionally, no major impacts are anticipated at the intersection of the Pahoa-Kapoho Road and the Kapoho-Kalapana Beach Road.

RED CINDER ROAD

It is estimated that the increase in the traffic on the Red Cinder Road will be slightly less than the Pahoa-Kapoho Road. This is enough, however, to necessitate improvements to approximately 3860 feet of the Red Cinder Road that is very substandard. The improvements are described in the ROADWAY DESIGN section of this report.

Also, the portion of this road from the project entrance to the Isaac Hale Park will be abandoned due to the flooding which occurs during high tide. The County of Hawaii Parks and Recreation is planning to build a beach park in this area. It is unknown at this time what the size or layout of this facility will be.

MANGO TREE ROAD

It has been discussed with the County of Hawaii's Department of Public Works that the Mango Tree Road be made one-way towards inland from Pohoiki. This road is very substandard and consequently very dangerous. However, because of its historical significance, a proposal to straighten its horizontal alignment for instance will likely cause serious public resistance (it would mean cutting down the mango trees that are on both sides of the road). The rationale for changing it to one-way include:

- safer evacuation route
- wider travel way
- lower speeds going uphill
- more control of vehicle going uphill
- convenience for fisherman to transport to the markets

- convenience for beach users to go home

Although it may be a longer distance to get to the Isaac Hale Park from Pahoa for example, it should not represent a significant increase in travel time. However, the overall increase in safety will probably be significant. It is unknown at this time where the one-way section will end but consideration should be given to resident's who live on this road.

DISCUSSION

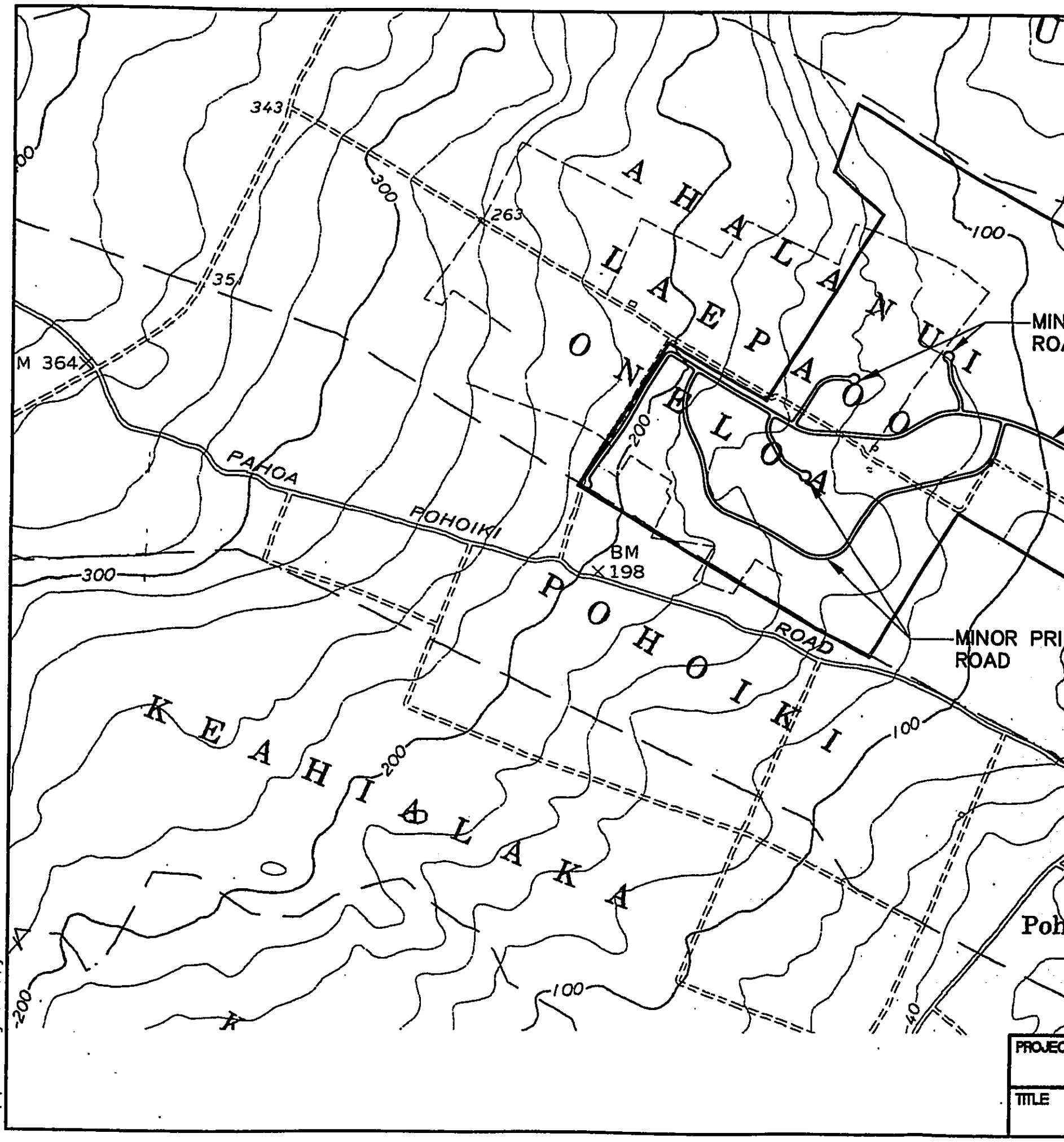
The traffic generated by the project will be directed to use the Pahoa-Kapoho route. All traffic to this area will be forced to use this route should the one-way on the Pahoa-Pohoiki Road be implemented. The outbound traffic from this project will be directed to use the Pahoa-Kapoho route to go back while the local users of the area will likely choose the Pahoa-Pohoiki Road.

ROADWAY DESIGN

There are four different types of roadways within this project, and all were designed with a different set of criteria. The four different roadways are: red cinder road; sixty-foot county road; major private road; and minor private road (see Figure 7). Each is described in detail below.

RED CINDER ROAD

The existing Kapoho-Kalapana Beach Road, borders the Southeast side of the parcel. It is made of a cinder pavement that varies in width (approximately 12 feet or so). The proposed improvements to this road include repaving and widening to accommodate ten foot lanes and two foot shoulders (total width of 24 feet, see Figure 8). The total length of this improvement is approximately 3860 feet, from the terminus of the County's wider pavement portion of the roadway, to the existing road entering the parcel as shown on Figure 7. This wider pavement section has 11-foot lanes, no paved shoulders, and an 80-foot right-of-way. There are gravel shoulders that vary in width. Although the 3860-foot portion is County Road, the proposed improvements are not up to County of Hawaii Standards. This was done to keep the feel of this road as rural as possible, while improving it's safety and capacity. If this road is to be improved to full Hawaii County Standards (60 foot right-of-way), vehement community opposition is expected. Also, some retaining walls may be necessary since the R.O.W. is only 30 feet in some parts and adjustment to the vertical alignment will likely be required.


343
300
263
100
35
M 364
AHALANUI
LAEPAOO
ONELOA
200
PAHOA
POHOIKI
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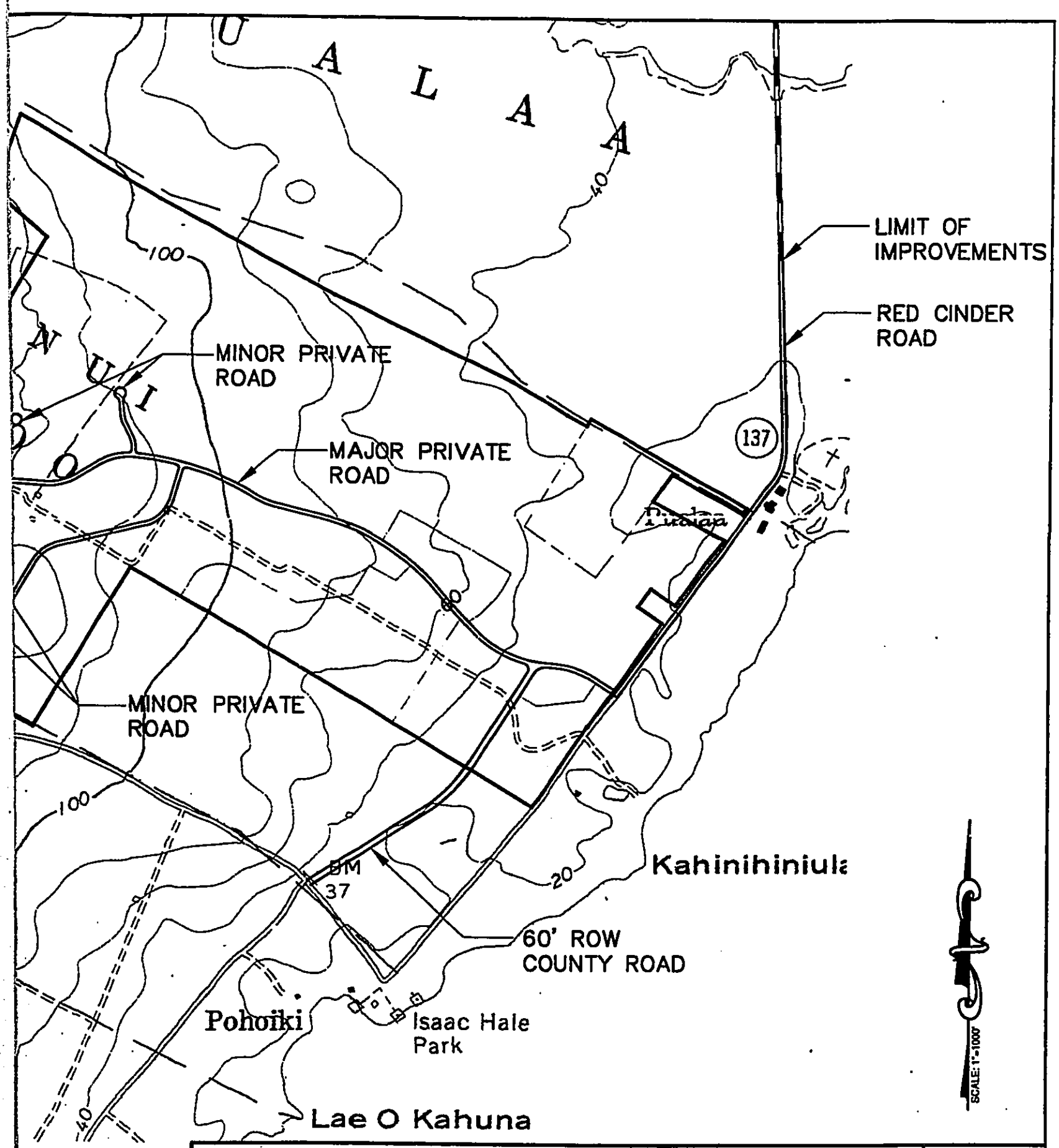
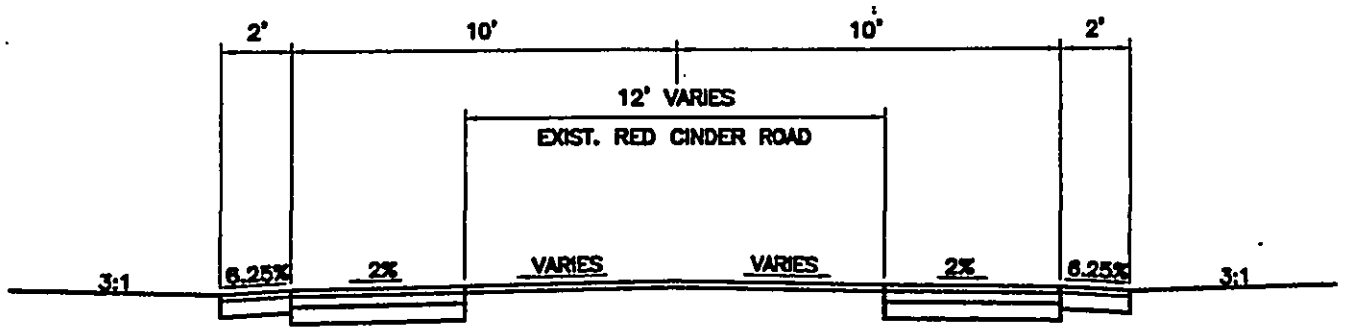


PROJECT: ONELOA ONSEN AND SPORTS RETREAT		FIG. NO. 7
TITLE: ROADWAY PLAN	DATE: 3/99	



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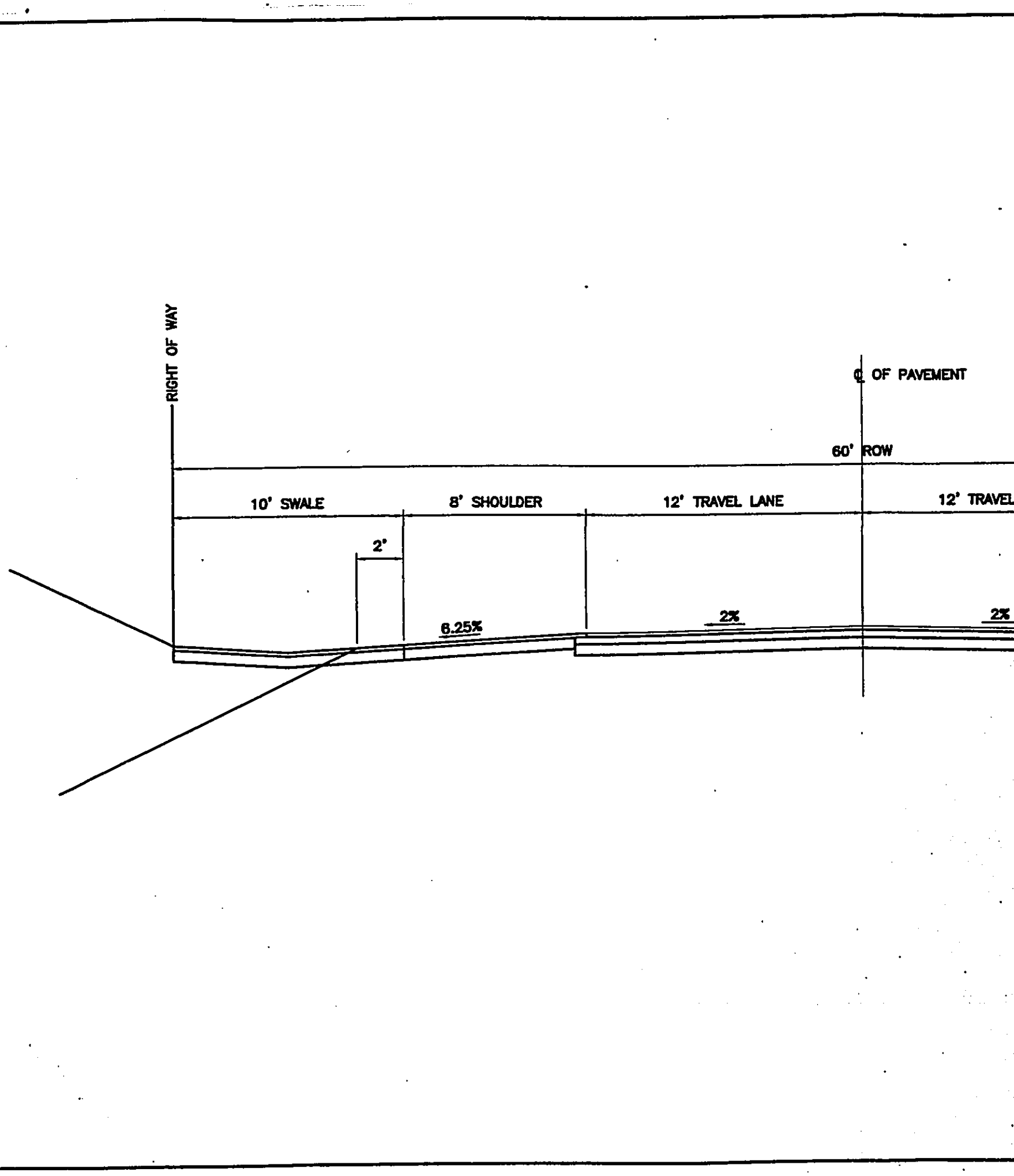
PROJECT: ONELOA ONSEN AND SPORTS RETREAT		FIG. NO. 8
TITLE: RED CINDER RD - TYP. SECTION	DATE: 3/99	



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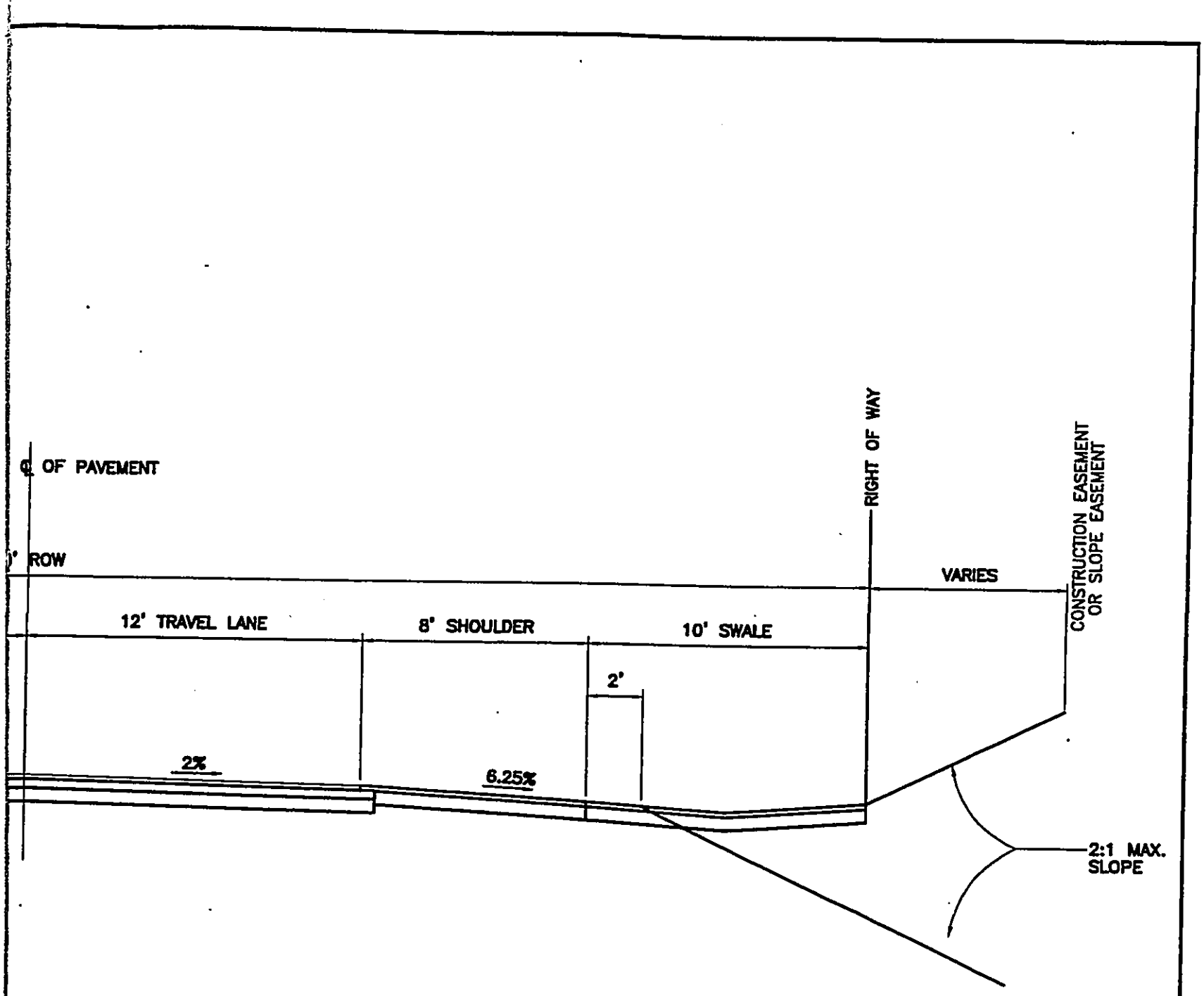
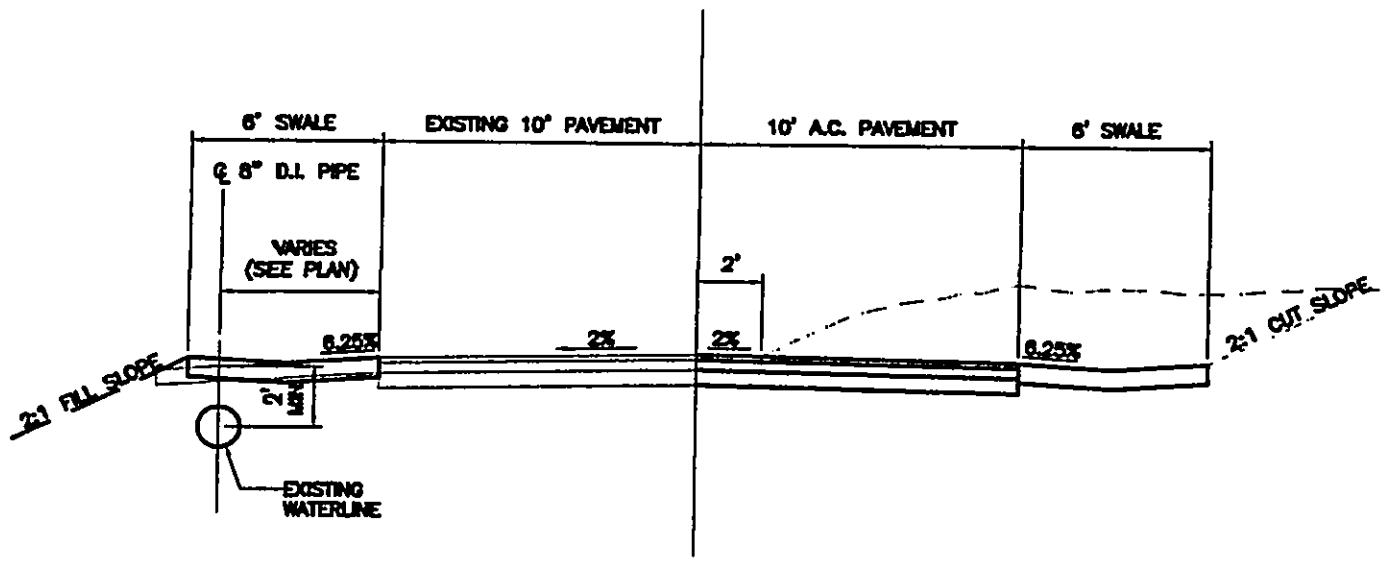
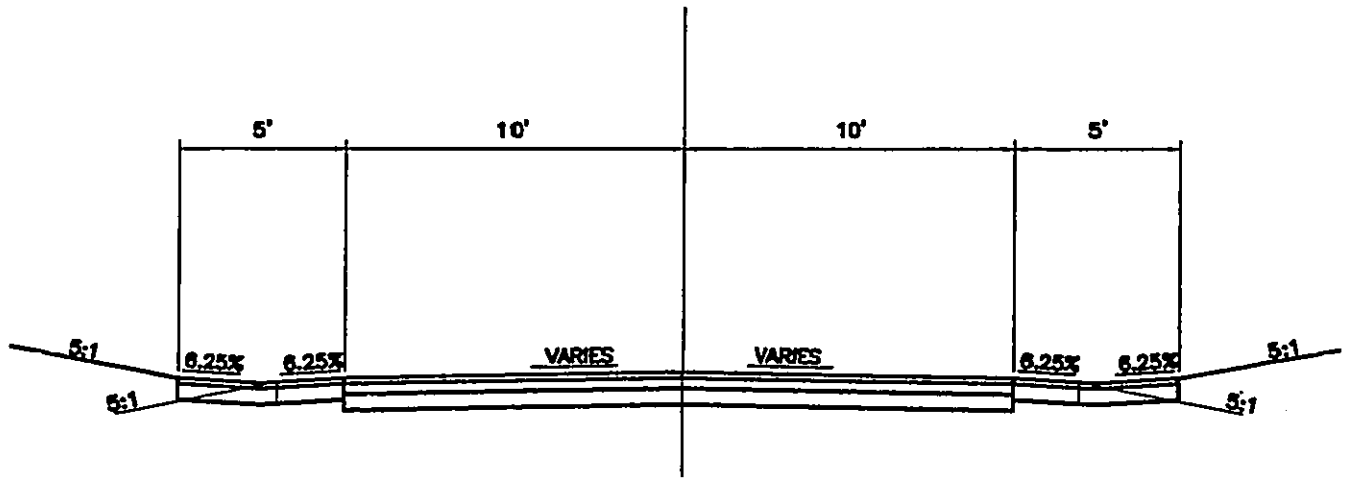


PROJECT		FIG. NO.
ONELOA ONSEN AND SPORTS RETREAT		9
TITLE	DATE	
60' COUNTY RD - TYP. SECT.	3/99	



m:\mpro\bruce\9803\figures\FIG-10.dwg

PROJECT: ONELOA ONSEN AND SPORTS RETREAT		FIG. NO. 10
TITLE: MAJOR PRIVATE RD - TYP. SECT.	DATE: 3/99	



m:\mproj\bruce\98031\figures\FIG-11.dwg

PROJECT	ONELOA ONSEN AND SPORTS RETREAT		FIG. NO. 11
TITLE	MINOR PRIVATE RD - TYP. SECT.	DATE 3/99	

SIXTY-FOOT COUNTY RIGHT-OF-WAY ROAD

At the end of the improvements to Red Cinder Road, it is proposed that a new County Road along the existing waterline service road be constructed as shown on Figure 7. This new County Road, which would be constructed with a 60' R.O.W., would then turn southwesterly and connect to the Mango Tree Road. The existing Red Cinder Road between this new connection point and Isaac Hale Park would be converted into a bicycle/walking path. The purpose for this conversion is because that portion of Red Cinder Road is within the flood inundation zone as designated by F.E.M.A. Because this portion of the road is new, it is proposed to construct it to full County Standards which include 12-foot lanes, 8-foot paved shoulders, and 10-foot paved swales in cut areas(see Figure 9). The road alignment was designed using County of Hawaii Standards and the following criteria:

a) Design Speed: 30 mph
b) Operating/Posted Speed: 25 mph
c) No superelevation
d) Minimum radius: 431 feet
e) Minimum stopping sight distance: 200 feet
f) Maximum k value: 167
g) Stop controls at Red Cinder Road/County Road intersection, County Road/Private Road intersection, and County Road/Pohoiki Road intersection

The roadway alignment as shown on Figure 7 meets or exceeds all criteria listed above, and will therefore provide safe and comfortable travel for the community.

MAJOR PRIVATE ROAD

The major private road will begin at the turn of the proposed County Road, forming a T-intersection, and will follow the alignment of the existing waterline service road as shown on Figure 7. Construction of this road will overlay the existing service road, add an additional 10-foot lane, 2-foot shoulders in fill conditions, and 6-foot swales in cut conditions (see Figure 10). Although this is a private road, the road alignment was checked using County of Hawaii Standards and the following criteria:

a) Design Speed: 30 mph
b) Operating/Posted Speed: 25 mph
c) No superelevation
d) Minimum radius: 431 feet
e) Minimum stopping sight distance: 200 feet
f) Maximum k value: 167

The roadway alignment as shown on Figure 7 falls short on the minimum radius requirements, and therefore, according to County standards, superelevation is needed. The existing service road

alignment prevents realigning or superelevating the roadway, so thus, this requirement cannot be met. However, this is a private roadway, and the existing minimum radius is only 31 feet short of the required radius, therefore, it is the opinion of the engineer that this is satisfactory. Possible solutions to improve this situation include warning signage, or reducing the speed at the substandard curves.

MINOR PRIVATE ROAD

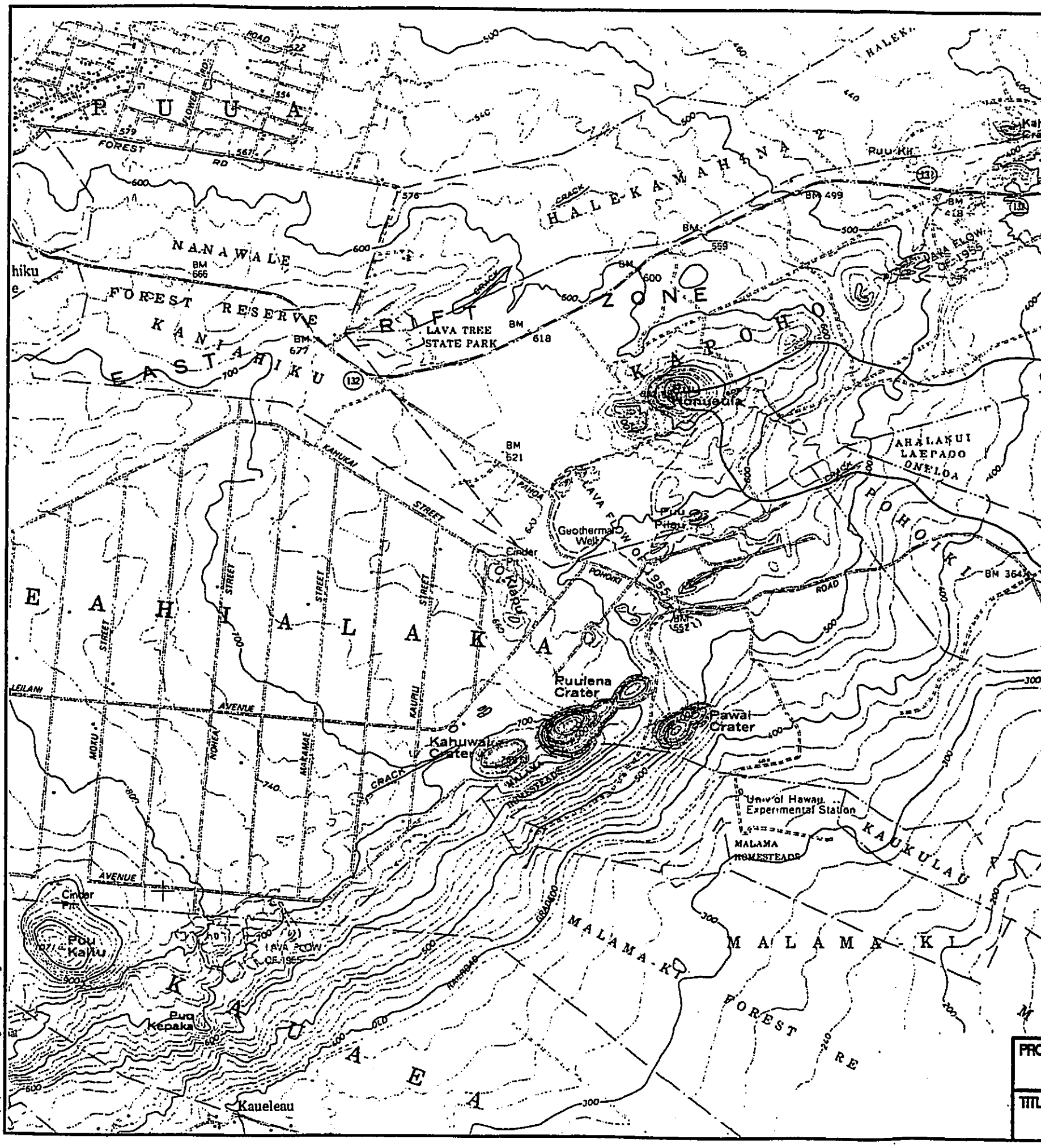
Four minor private road are proposed throughout the site. Three of the roads are cul-de-sacs off the major private road, and the other forms a loop with the major private road (see Figure 7). Construction of this road will include 10-foot lanes, 2-foot shoulders in fill conditions, and 5-foot swales in cut conditions (see Figure 11). Although this is a private road, the road alignment was checked using County of Hawaii Standards and the following criteria:

a) Design Speed: 25 mph (20 mph for cul-de-sacs)
b) Operating/Posted Speed: 20 mph (15mph)
c) No superelevation
d) Minimum radius: 289 feet (179 feet)
e) Minimum stopping sight distance: 163 feet (125 feet)
f) Maximum k value: 167

The roadway alignment as shown on Figure 7 meets all the criteria listed above except for the minimum sight distance requirement. Along the inside of a few of the horizontal curves, the line of sight needed to achieve the sight distance required falls outside of the roadway itself. Therefore, a ten-foot strip on the inside of these curves will need to be reserved for line of sight purposes. Within this strip, nothing of significant height (no more than a couple of feet) can be stored, built, or planted.

MANGO TREE ROAD

The existing Mango Tree Road is not being upgraded at this time accept for changes in the signing and striping should the one-way traffic pattern be implemented.



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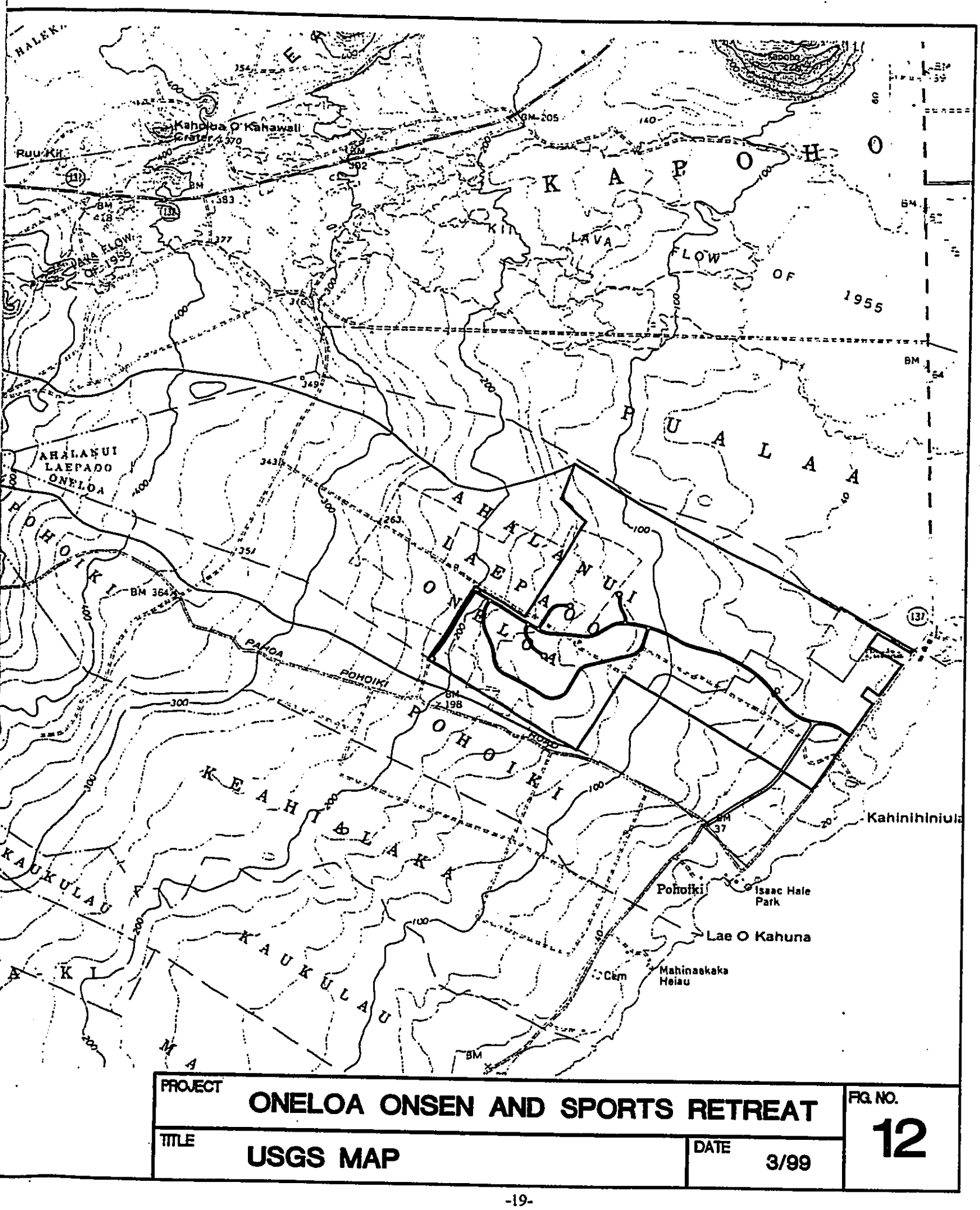


PROJECT: ONELOA ONSEN AND SPORTS RETREAT		FIG. NO. 12
TITLE: USGS MAP	DATE: 3/99	

PRELIMINARY DRAINAGE

OFFSITE DRAINAGE

The offsite drainage area affecting the project encompasses approximately 1.3 square miles mauka of the site (see Figure 12). The soil types within this area are described previously, and are classified as type "A" and type "D" soils. However, it is the opinion of the engineer that the type "D" soils, although quite impervious, contain many cracks and crevices that will allow the runoff to percolate into the ground, and were therefore considered type "A" soils (hydrologically) in this study. It is believed that treating them as type "D" soils would produce very conservative values, and in turn would create an over-design of the drainage structures.

Runoff Calculation

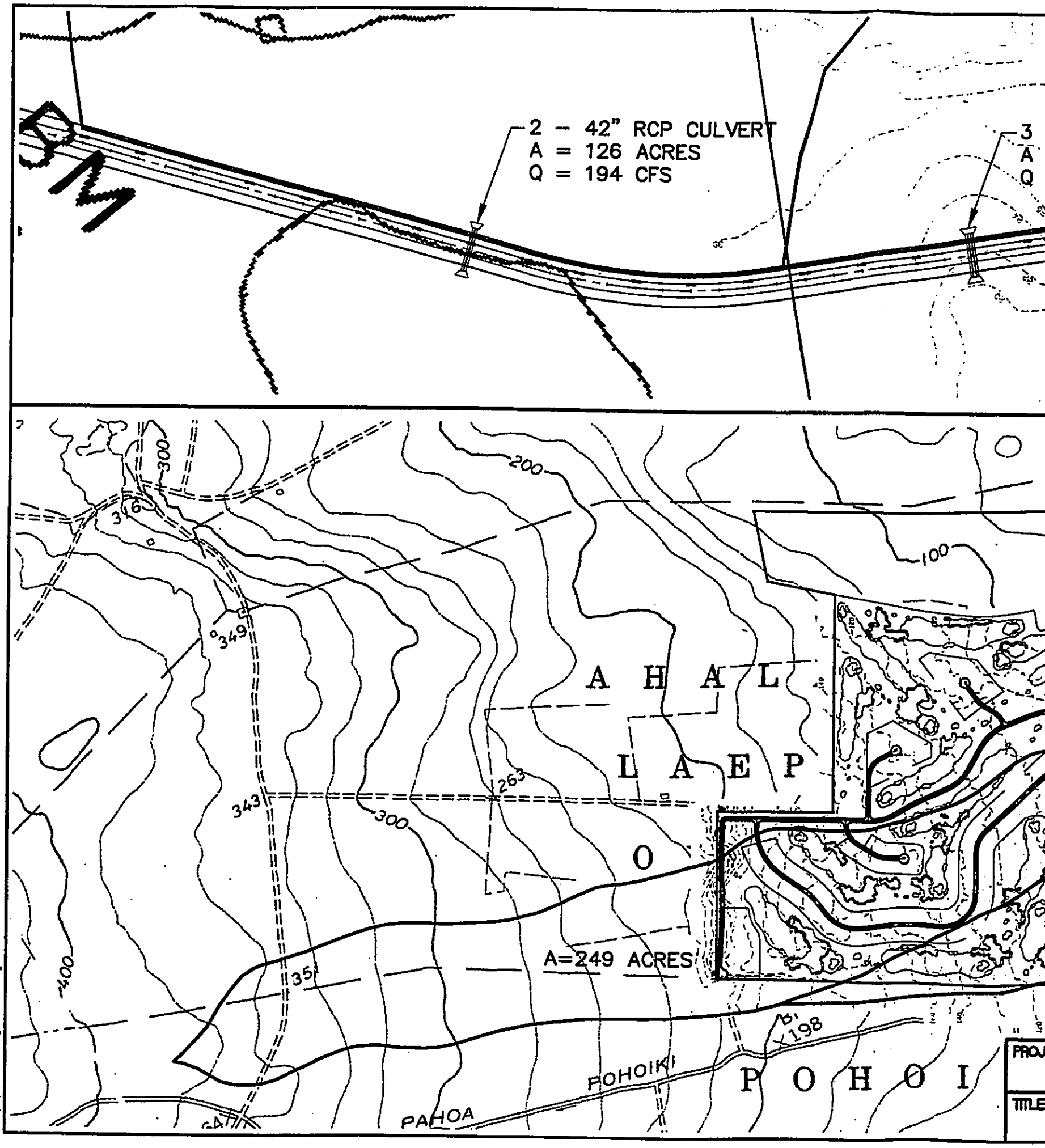
HYDROCALC® Hydrology by Dodson & Associates, Inc. was used to estimate the amount of runoff produced from the 1.3 square miles of area. This program produces identical results as the HEC-1 program using the same input data. Within the program, the Soil Conservation Service Curve Number Method was used for loss computations, and the Soil Conservation Service Dimensionless Unitgraph was used for unit hydrograph computations. With an approximate watershed lag of 1.0 hours and a negligible amount of impervious cover, the computed peak runoff was 962 cfs. This is for a 100 year storm and enters along the entire length of the West border and part of the South border. Much of it will go through the northern part of the development where there will be little or no improvements and continue to flow as before.

Discussion

Close examination of the USGS map as shown on Figure 12 shows no prominent natural drainage channel along the northwest boundary of the project. The contours do show possible small waterways along the middle northwest border (encroaching into the golf course and the open space), however, the majority of the runoff encroachments seems to be very shallow and undefined. More information is needed to design the drainage structures that will be capable of routing this estimated 962 cfs of runoff. However, it is recommended that some type of man-made stream or channel be used to route this flow through the golf course, creating a "natural" water hazard.

ONSITE DRAINAGE

Development of this project will increase the amount of runoff produced by this parcel. County standards dictate that the amount of runoff leaving the site shall not increase because of


2 – 42" RCP CULVERT
A = 126 ACRES
Q = 194 CFS
3
A
Q
300
200
100
316
349
343
263
300
400
351
A H A L
L A E P
O
A=249 ACRES
198
POHOIKI
PAHOA
P O H O I
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TITLE
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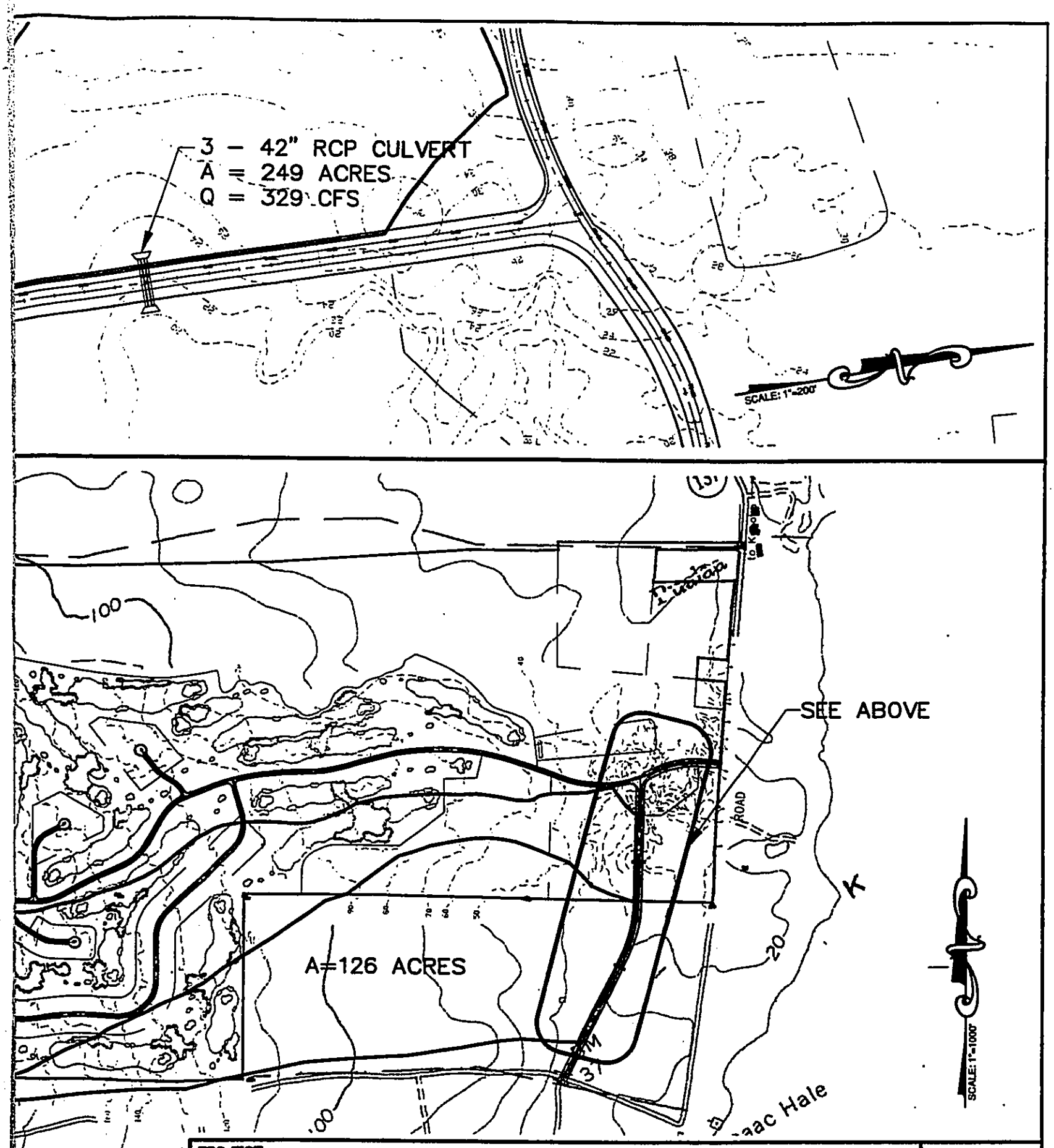

PROJECT: ONELOA ONSEN AND SPORTS RETREAT		FIG. NO. 13
TITLE: ONSITE CULVERTS	DATE: 3/99	

development. Therefore, this section of the report will: calculate the increase in runoff; give preliminary means of disposing the excess runoff; and locate possible culverts. Please note again that this is an initial investigation only, and the results are preliminary at best.

Pre-Development

The site encompasses approximately 494 acres. The soil types within this area are described previously, and are classified as type "A" and type "D" soils. However, it is the opinion of the engineer that the type "D" soils, although quite impervious, contain many cracks and crevices that will allow the runoff to percolate into the ground, and were therefore considered type "A" soils (hydrologically) in this study. It is believed that treating them as type "D" soils would produce very conservative values, and in turn would create an over-design of the drainage structures. HYDROCALC® Hydrology by Dodson & Associates, Inc. was used to estimate the amount of runoff produced by the parcel. This program produces identical results as the HEC-1 program using the same input data. Within the program, the Soil Conservation Service Curve Number Method was used for loss computations, and the Soil Conservation Service Dimensionless Unitgraph was used for unit hydrograph computations. With an approximate watershed lag of 0.6 hours and 0.7% of impervious cover, the computed peak runoff was 745 cfs.

Post-Development

Development of this project will add impervious material to this parcel. The roads, sports facilities, retail facilities, beach club, lodge, and the chalets will add an estimated 57 acres of impervious material to the site. Therefore, HYDROCALC® Hydrology was employed using the same information as the pre-development condition, except the amount of impervious material was increased to 12.1%, to produce an estimated peak runoff of 934 cfs.

Discussion

The difference between pre- and post-development runoff is 189 cfs. The proposed golf course produces a situation where a lot of this excess runoff could be retained onsite in ponds and detention basins, however, the hydrologic functions of these facilities are not known at this point. The other solution is the use of drywells, which can inject up to six (6) cfs of runoff each. Therefore, with the amount of runoff detained by the ponds and detention basins unknown, it is proposed to install 32 drywells onsite to dispose of the excess runoff. With more information, the amount of drywells necessary may decrease.

Onsite Culverts

Routing of the runoff through the golf course as much as possible will minimize the amount of culverts needed onsite. A few small culverts will be needed on the private roads, however, they

will be designed and placed when more detailed information is available (the cost of these culverts are expected to be minimal, and should be a trade off for the extra drywells). At this point, two culverts will be preliminarily sized and placed. Both will be on the county road at approximate stations 7+00 and 16+00 (see Figure 13).

The culvert at station 7+00 has an approximate drainage area of 249 acres. Since limited information is available at this time of the extent of the development, the pre-development condition will be used to calculate the required size of this culvert. This is justified because, as stated earlier, development of this parcel requires all excess runoff to be disposed of onsite. Furthermore, since this culvert is located near the low end of the site, it assumed that most of the excess runoff has already been disposed of. So therefore, the existing and future peak runoff amounts at this location should be very similar. HYDROCALC® Hydrology was again used, resulting in a calculated peak flow of 329 cfs. It is therefore recommended to install a 3 barrel 42" RCP culvert at this point to convey this flow. This system will have a headwater depth of 7.7 feet at the design flow, and an approximate capacity of 427 cfs.

The culvert at station 16+00 has an approximate drainage area of 126 acres. Using the same assumptions as above, HYDROCALC® Hydrology calculated a peak flow of 194 cfs. It is therefore recommended to install a 2 barrel 42" RCP culvert at this point to convey this flow. This system will have a headwater depth of 6.7 feet at the design flow, and an approximate capacity of 285 cfs.

EMERGENCY EVACUATION

In the event of a warning from Hawaii County Civil Defense or when it is apparent that there is danger in which evacuation becomes necessary, there needs to be a way or several ways for the area's residents and visitors to move to safety as quickly as possible. The usual reasons for evacuation are tsunamis and lava flows. These will usually allow some amount of time for evacuation. Hurricanes may also pose a threat though technology has allowed for a fair amount of warning time. There will likely be no warning for an earthquake. Regardless of the reason, the estimated time to evacuate the area is as follows (based on a design year of 2005):

1) Without the project 15 minutes
2) With the project 34 minutes
3) With the project 20 minutes, utilizing the project's upper regions for some of the evacuation.

The estimated vehicles to be evacuated is as follows:

1) Without the project 255

2) With the project 720
3) With the project 410, utilizing the project's upper regions for some of the evacuation.

See the evacuation analysis in APPENDIX C. With 3), the upper area of the project is above the tsunami zone as shown on Figure 14 and can therefore be used as a refuge. Since much of the evacuees could go to this area, it would facilitate a more rapid flow of traffic considering the increase in population due to the project.

CONCLUSION

The proposed traffic scheme and roadway design as stated above will provide more safe and comfortable driving conditions. Since there will be an increase in traffic to the area, some road improvements will be required to part of Red Cinder Road. This along with the one-way of the Mango Tree Road should allow for this safer driving. Hawaii County Standards were followed in most cases (a few horizontal curves are not superelevated), and sufficient sight distance is provided at all locations. The drainage structures explained above will dispose of and convey the storm runoff that affects the project. However, information and data at this point is very limited, therefore the cost and location and number of drainage structures are subject to change. For emergency evacuation, utilizing the project's upper regions provides another route to safety and allows a more rapid flow of traffic on the existing roads towards inland and safety.

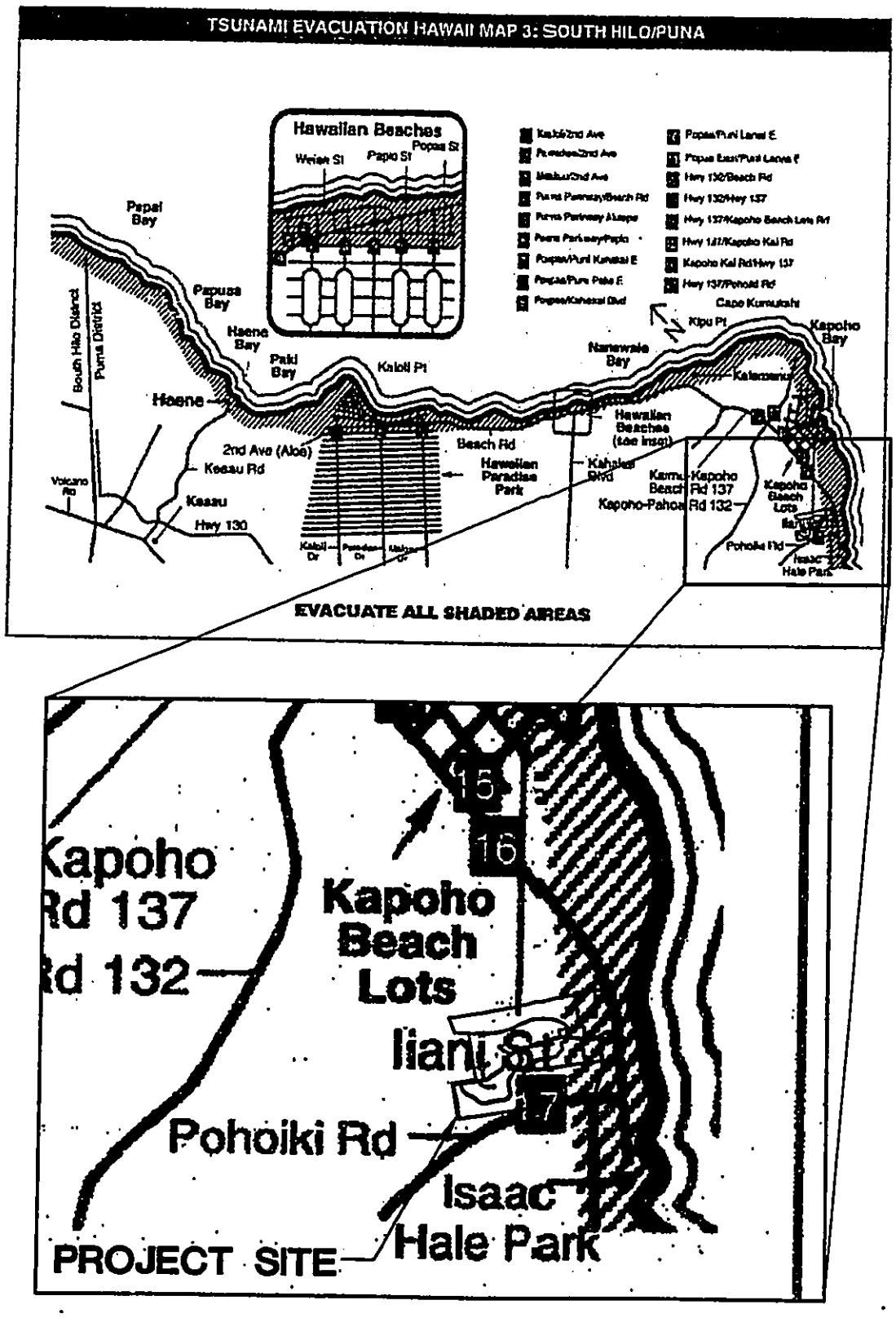

IMAGE TAKEN FROM THE OCTOBER 1998-1999 TELEPHONE DIRECTORY

PROJECT		FIG. NO.
ONELOA ONSEN AND SPORTS RETREAT		14
TITLE: TSUNAMI ZONES	DATE: 5/99	

m:\mproj\bruce\98035\figures\FIG-14.dwg

APPENDIX A

TRAFFIC ANALYSIS

Julian Ng, Incorporated
P. O. Box 816 Kaneohe, Hawaii 96744-0816

Facsimile Transmittal

phone: (808) 236-4325
fax: (808) 235-8869

Date: July 28, 1998

To: Mr. Bruce Meyers
Okahara & Associates, Inc. **@ Fax #:** (808) 961-5529

From: Julian Ng

Re: Onelua Onsen and Sports Retreat This is Sheet 1 of 4

Attached: draft Exhibits 2, 3, and 4

Message: Attached exhibits showing traffic data, future traffic without project, future traffic with project for your information.

As discussed, the analyses done so far are without the benefit of a site visit and many assumptions have been made. We are planning a site visit on Saturday, August 1.

Please note, in comparing Exhibits 3 and 4, the large relative increase in traffic along the Pahoa-Kapoho Road and along the beach road due to the project. However, the volumes even with the project are well under capacity on the Pahoa Bypass (Highway 130) and the Pahoa-Kapoho Road (Highway 132). On the Kapoho-Kalapana Beach Road, we have computed capacity based on two 9-foot lanes, no shoulders, on level terrain with no opportunities for passing (minimum conditions for two-lane roadway). Estimated conditions are:

volume/capacity ratio, LOS	without project	with project
Pahoa Bypass, north of HWY 132		
AM Peak Hour	0.18 B	0.23 C
PM Peak Hour	0.19 B	0.24 C
Pahoa-Kapoho Road, east of HWY 130		
AM Peak Hour	0.20 B	0.31 C
PM Peak Hour	0.27 C	0.38 C
Kapoho-Kalapana Beach Road, south of HWY 132		
AM Peak Hour	0.09 B	0.31 C
PM Peak Hour	0.14 B	0.38 D

The Level of Service (LOS) D condition with the project may be justification for improvements (rural condition, desirable LOS B, minimum LOS C). If the roadway is less than two lanes, improvement will be needed.

While we have not yet done an analysis of the intersection of the Pahoa-Kapoho Road and the Kapoho-Kalapana Beach Road, we do not expect any problems there. A separate right turn lane (eastbound to southbound) would be the only improvement that may be needed.

At the intersection of Pahoa Bypass and Pahoa-Kapoho Road, we have estimated turn volumes for existing and future conditions. Assuming a separate lane for right turns from the stopped approaches of the Pahoa-Kapoho Road, existing LOS B (AM) and C (PM) conditions would not change with future (without project) traffic. The addition of project traffic, however, changes conditions to LOS C (AM) and LOS E (PM). The addition of another lane so that separate lanes are provided for each movement (left turn, through, right turn) would adequately mitigate conditions (LOS C and better).

An additional recommendation would be the conversion of the Pohoiki Road to one-way maukabound operation.

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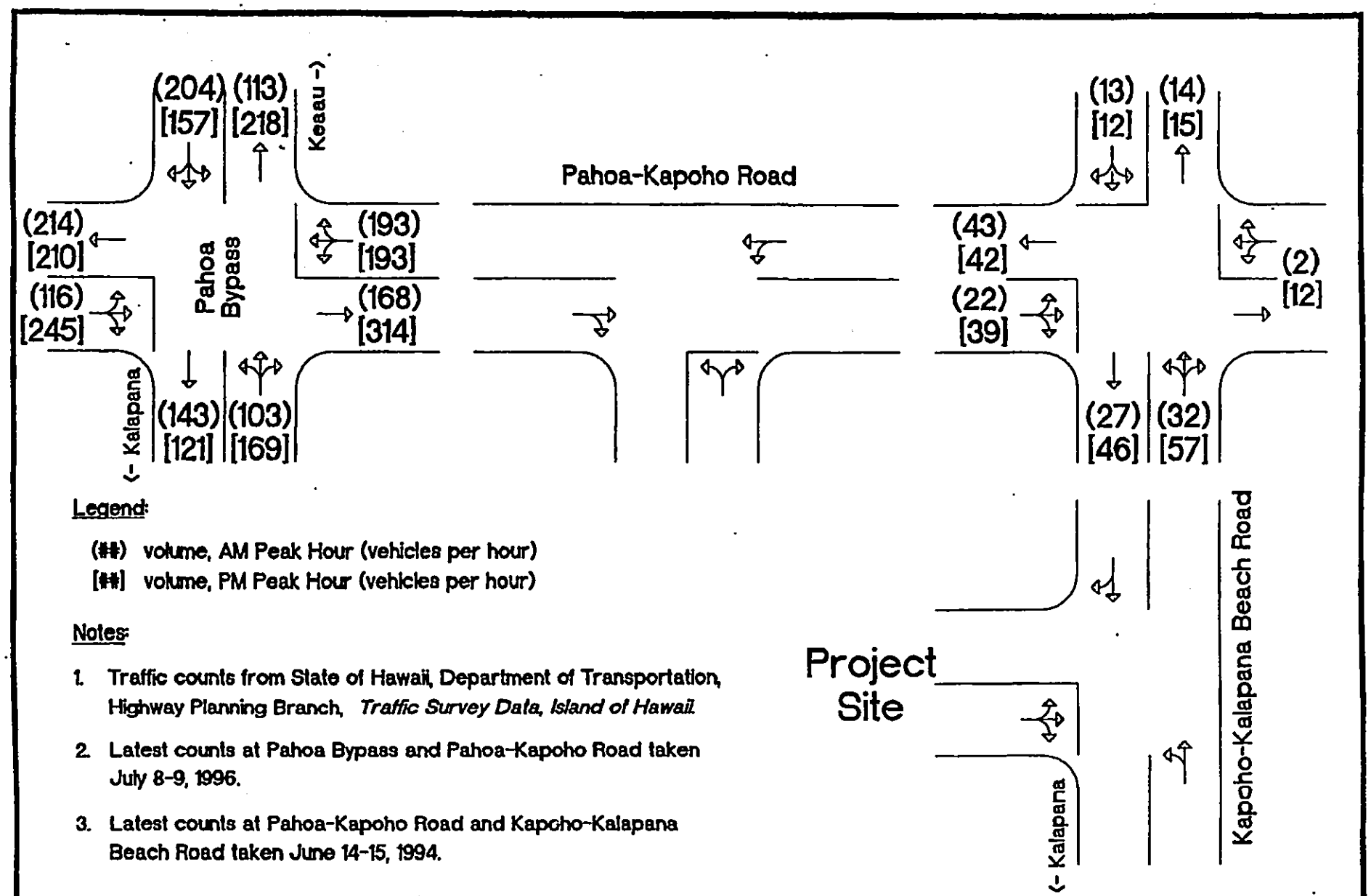
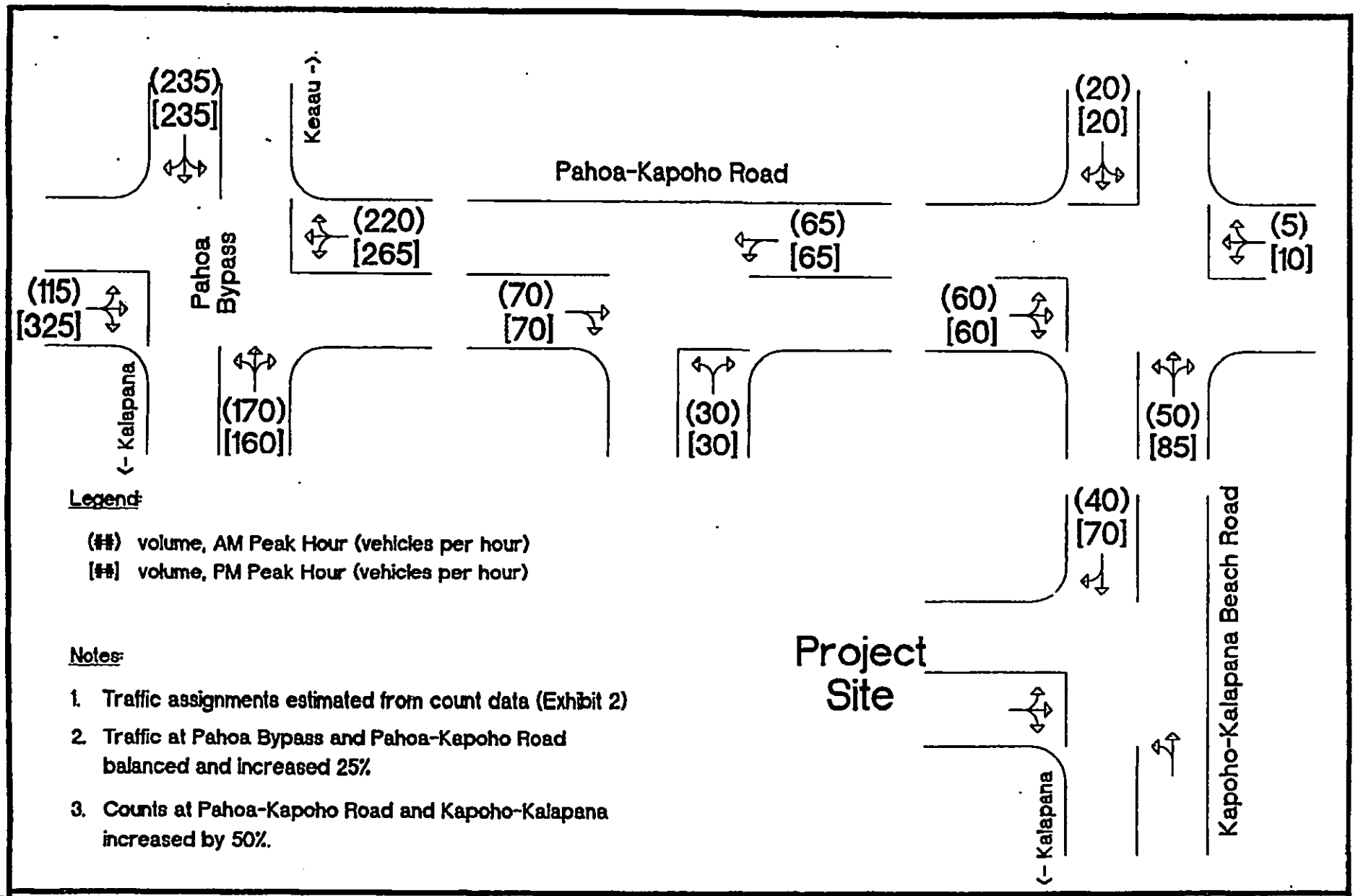


Traffic Assessment Oneloa Onsen and Sports Retreat Pohoiki, Puna, Hawaii	Peak Hourly Volumes Latest Traffic Counts	Exhibit 2
	prepared by: Julian Ng, Inc. July, 1998	Not to Scale



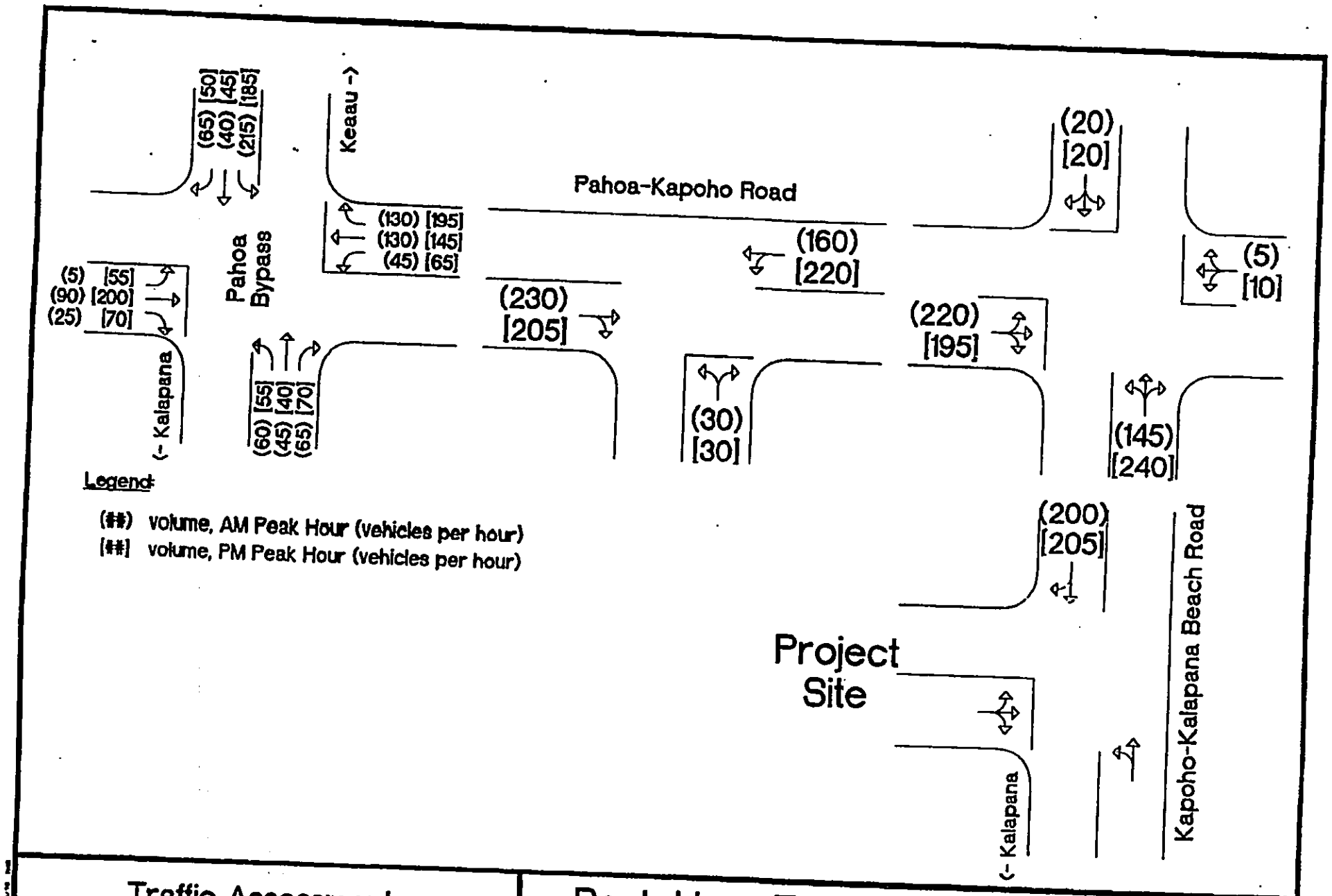
Legend:

(##) volume, AM Peak Hour (vehicles per hour)
[##] volume, PM Peak Hour (vehicles per hour)

Notes:

1. Traffic assignments estimated from count data (Exhibit 2)
2. Traffic at Pahoa Bypass and Pahoa-Kapoho Road balanced and increased 25%
3. Counts at Pahoa-Kapoho Road and Kapoho-Kalapana increased by 50%.

Traffic Assessment Oneloa Onsen and Sports Retreat Pohoiki, Puna, Hawaii	Peak Hour Traffic Assignments Base Case (no project traffic)	Exhibit 3
	prepared by: Julian Ng, Inc. July, 1998	Not to Scale



Traffic Assessment Oneloa Onsen and Sports Retreat Pohoiki, Puna, Hawaii	Peak Hour Traffic Assignments Future Condition with Project	Exhibit 4
	prepared by: Julian Ng, Inc. July, 1998	Not to Scale

98031f

Julian Ng, Incorporated
P. O. Box 816 Kaneohe, Hawaii 96744-0816
phone: (808) 236-4325
fax: (808) 235-8869

Facsimile Transmittal

Date: August 14, 1998

To: Mr. Bruce Meyers
Okahara & Associates, Inc. @ Fax #: (808) 961-5529

From: Julian Ng

Re: Pohoiki Golf Course Development This is Sheet 1 of 1

Message:

Good news! With the reduction of traffic generated by the project due the downsizing of the golf course from 27 to 18 holes and the "YIELD" signs that are already in place for right turns from the Pahoa Bypass to the Pahoa-Kapoho Road, we can show Level of Service D or better conditions for the AM and PM peak hours for single lane approaches (shared by left turns, throughs, and right turns) on both sides of the Pahoa-Kapoho Road at the Pahoa Bypass, for 100% of the project traffic in year 2005.

Unsignalized intersection LOS (HWY 132 @ HWY 130)	from Pahoa	from Kapoho
AM Peak Hour		
1996 traffic estimate	B	B
2005 traffic assignment (without project)	B	B
2005 traffic assignment (with project)	B	C
PM Peak Hour		
1996 traffic estimate	B	B
2005 traffic assignment (without project)	C	C
2005 traffic assignment (with project)	D	D

Certain assumptions were made as to the other origin/destination of project traffic. One-tenth of the traffic generated in the peak hours (which includes employees) was assumed to be from/to the area west of the intersection and therefore would not affect the intersection. The distribution for the AM Peak Hour was estimated to be:

	entering	exiting
local (Nanawale, etc.)	10%	10%
from/to Keaau direction	70%	60%
from/to Pahoa	20%	30%
from/to Kalapana	0%	0%

The distribution for PM peak hour traffic would be the opposite (enter/exit).

For your information, if we had used 27 holes of golf course, the intersection conditions in the PM peak hour would be LOS E. Reduction of project traffic to 92% would be needed to reduce the project impact to show LOS D at the intersection.

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APPENDIX B

COST ESTIMATE

PRELIMINARY CONSTRUCTION COST ESTIMATE

ONELOA ONSEN & SPORTS RETREAT

OA Job No. 98031

Date: 3/06/98

ITEM NO.	DESCRIPTION	QUANTITY	UNIT		UNIT COST		TOTAL COST
1	Excavation / Embankment	46300	C.Y.	$	50.00	$	2,315,000.00
2	2" AC Pavement	86332	S.Y.	$	12.00	$	1,035,984.00
3	4" Base Course	38593	S.Y.	$	11.00	$	424,523.00
4	6" Subbase Course	71512	S.Y.	$	12.00	$	858,144.00
5	Erosion Control	1	L.S.	$	100,000.00	$	100,000.00
5	Traffic Control, Pavement Markers & Striping, and Traffic Signs	1	L.S.	$	120,000.00	$	120,000.00
6	Drainage Structures Including Drywells, Inlet Structures, Drainage Pipes, and Culverts	1	L.S.	$	432,000.00	$	432,000.00
SUBTOTAL						$	5,285,651.00
15% CONTINGENCY						$	792,847.65
GRAND TOTAL						**$**	***6,078,498.65***
SAY						**$**	**6,078,500.00**

APPENDIX C

EVACUATION ANALYSIS

96003
98031

Julian Ng, Incorporated
P. O. Box 816 Kaneohe, Hawaii 96744-0816

Facsimile Transmittal

phone: (808) 236-4325
fax: (808) 235-8869

Date: April 28, 1999

To: Mr. Bruce Meyers
Okahara & Associates, Inc. **@ Fax #:** (808) 961-5529

From: Julian Ng

Re: Mohouli Street Extension
Onelua Onsen and Sports Retreat This is Sheet 1 of 2

Attached:

copy of September 28, 1998 fax to you showing ADTs to use (2000 and 2020)

Message:

For the Onelua project, estimates of the time needed to evacuate the Pohoiki area (in case of tsunami threat), as requested:

Assumptions:

Estimated number of vehicles to be evacuated:		3 x the peak hour volume
Roadway capacities: (one direction)	Pahoa-Kapoho Road	900 vehicles per hour
	Kapoho-Kalapana Road (1)	660 vehicles per hour
	Kapoho-Kalapana Road (2)	900 vehicles per hour
	Mango Tree Road (3)	360 vehicles per hour

(1) existing condition
(2) with improved roadway
(3) assuming one-way maukabound operation, at one vehicle/ten seconds

In terms of daily traffic, the estimated number of vehicles to be evacuated is approximately one-third of the daily traffic (assuming that the peak hour volume is 11% of daily, 3 times the peak hour would be 33% of daily).

	No. of vehicles to be evaculated	available capacity	time needed to evacuate
Future condition, without project	255	1,020	15 minutes
Future condition, with project	720	1,260	34 minutes
Future condition, with project (4)	410	1,260	20 minutes

(4) assuming 1/3 of project traffic to be evacuated (a portion of the project is assumed to be out of the tsunami zone and could provide alternative refuge)

FAXBM428.DOC: Completed @: _____ M, HST Date: April 28, 1999

APPENDIX I

PRELIMINARY ENGINEERING REPORT FOR WATER SYSTEM FOR THE ONELOA ONSEN AND SPORTS RETREAT

by:

Okahara & Associates, Inc.

Okahara & Associates, Inc.
ENGINEERING CONSULTANTS

civil • mechanical • structural
engineering

PRELIMINARY ENGINEERING REPORT FOR WATER SYSTEM

February 1, 1999

INTRODUCTION

This report is a preliminary engineering investigation of the water system requirements for this project. This report is arranged to discuss the following topics:

- Description of Existing Water System
- Estimated Water Demand for Project
- Fire Flow Requirements
- Proposed Off-Site Reservoir
- On-Site Water Distribution

SUMMARY OF FINDINGS

The findings and recommendations for improvements of the existing water system are based on an investigation of the best available information from various resources. Hydraulic calculations were performed using the WaterCad® Version 1.5 program developed by Haestad Methods, Inc.

The following summary provides a concise description of the results of this study.

1. The project will be served by the County's Pahoa-Kapoho water system.
2. The estimated water demand for the project results in an Average Daily Consumption of 159,770 gallons; a Maximum Daily Consumption of 239,655 gallons; and a Peak Hourly Consumption of 33,285 gallons.
3. A new 300,000 gallon reservoir will be required to provide the necessary water storage requirements for this project.
4. An existing section of approximately 5,000 linear feet of 6-inch pipe will not provide the necessary fire flow for the project site.
5. By locating the proposed reservoir downstream of the 6-inch pipe, the necessary fire flow will be realized.

6. The overflow elevation of the proposed reservoir will match the hydraulic characteristics of the existing 254 feet elevation PRV station located alongside the Pahoa-Pohoiki Road. This PRV station will then be disconnected or isolated from the water system. Matching the hydraulics will result in the hydraulic conditions downstream of the PRV station to remain the same.

7. The on-site distribution system will be designed to accommodate the necessary fire flow and will be arranged in a loop as much as possible.

8. The project water system will be designed and constructed to meet the Department of Water Supply standards.

9. The estimated construction cost for the off-site 0.30 MG reservoir will be $1,120,000.00.

10. The estimated construction cost for the on-site (project site) water distribution system will be $663,000.00.

DESCRIPTION OF EXISTING WATER SYSTEM

The project site is located in an area served by the County's Pahoa-Kapoho water system. (See map insert). Water source for this system comes from deep wells at the Department of Water Supply's Keonepoko and Pahoa well sites. Both sources have good quality water with chloride content between 4 to 27 ppm.

Water is withdrawn from the wells by pumps and subsequently pumped to nearby water storage reservoirs. Water is then distributed to the various water users via a network of water mains and additional reservoirs. Deep well source and reservoir descriptions are as follows:

I. WATER SOURCES FOR PAHOA-KAPOHO WATER SYSTEM

A. Keonepoko Deep Well

1.	Location:	Keonepoko-Nui Well and Reservoir Site (TMK: 1-5-08:8)
2.	Pump Capacity:	700 gpm
3.	Pump Head:	640 feet
4.	Pump Type:	Vertical turbine, open lineshaft

5. Motor: 150 hp, vertical, hollow shaft, 1750 rpm, 460 volts, 3 phase, 60 hz.

This deep well pump discharges to the on-site 0.50 MG reservoir. A second deep well pump is currently in construction at the site. This new pump will have similar pumping characteristics as the existing pump. Construction is being funded by the Department of Hawaiian Home Lands in conjunction with their Makuu Subdivision development.

B. Pahoa Deep Wells

1. Location: Pahoa Well Site (TMK: 1-5-03:40)

2. Pahoa Deep Well Pump No. 1 Characteristics

   a. Pump Capacity: 200 gpm

   b. Pump Head: 860 feet

   c. Pump Type: Submersible, vertical turbine

   d. Motor: 60 hp, submersible, vertical, 3550 rpm, 440 volts, 3 phase, 60 hz.

3. Pahoa Deep Well Pump No. 2 Characteristics

   a. Pump Capacity: 350 gpm

   b. Pump Head: 855 feet

   c. Pump Type: Submersible, vertical turbine

   d. Motor: 125 hp, submersible, vertical, 3450 rpm, 440 volts, 3 phase, 60 hz.

These two deep well pumps discharges into the 0.30 MG Pahoa Reservoir No.1 located approximately 4,200 feet away.

C. Kapoho Infiltration Gallery

1. Location: Near Kapoho Crater (TMK: 1-4-91:11)

2. Kapoho Pump No. 1 Characteristics

a. Pump Capacity: 100 gpm

b. Pump Head: 390 feet

c. Pump Type: Vertical turbine, booster

d. Motor: 20 hp, vertical, 1750 rpm, 240 volts, 3 phase, 60 hz.

3. Kapoho Pump No. 2 Characteristics

a. Pump Capacity: 100 gpm

b. Pump Head: 390 feet

c. Pump Type: Vertical turbine, booster

d. Motor: 20 hp, vertical, 1750 rpm, 240 volts, 3 phase, 60 hz.

These two pumps are designed to discharge into the 0.10 MG Kapoho reservoir. Due to the high chloride levels being pumped from the infiltration gallery, these pumps are normally not in operation.

II. WATER STORAGE RESERVOIRS FOR THE PAHOA-KAPOHO WATER SYSTEM

A. Keonepoko Reservoir

1. Location: Keonepoko-Nui Well and Reservoir Site (TMK: 1-5-08:8)

2. Size: 500,000 gallons

3. Type: Reinforced concrete

4. Overflow Elevation: 623.00 feet MSL (mean sea level)

5. Floor Elevation: 605.00 feet MSL

6. Supply: Water is supplied to this reservoir from the Keonepoko deep well. A future deep well (pump outfitting currently in construction) will also supply this reservoir.

B. Pahoa Reservoir No. 1

1. Location: Off of Kalapana Road (TMK: 1-3-09:11)

2. Size: 300,000 gallons

3. Type: Reinforced concrete

4. Overflow elevation: 844.00 feet MSL

5. Floor Elevation: 829.00 feet MSL

6. Supply: Water is supplied to this reservoir from the Pahoa deep well pumps or from the Keonepoko reservoir via booster pumps at the Keonepoko site.

C. Pahoa Reservoir No. 2

1. Location: Off of Old Government Road to Pahoa Solid Waste Transfer Station (TMK: 1-5-08:6)

2. Size: 300,000 gallons

3. Type: Reinforced concrete

4. Overflow Elevation: 727.33 feet MSL

5. Floor Elevation: 712.00 feet MSL

6. Supply: Water is supplied to this reservoir from the Pahoa Reservoir No. 1.

D. Lanipuna Gardens Reservoir

1. Location: Lanipuna Gardens Reservoir Site (TMK: 1-3-45:39)

2. Size: 100,000 gallons

3. Type: Reinforced concrete

4. Overflow elevation: 733.50 feet MSL

5. Floor Elevation: 720.00 feet MSL

6. Supply: Water is supplied to this reservoir from the Pahoa Reservoir No. 1.

E. Kapoho Reservoir

1. Location: Near Kapoho Crater (TMK: 1-4-91:10)

2. Size: 100,000 gallons

3. Type: Reinforced concrete

4. Overflow Elevation: 374.30 feet MSL

5. Floor Elevation: 360.00 feet MSL

6. Supply: Water is supplied to this reservoir from the Lanipuna Gardens Reservoir.

With respect to the existing water system, the project site is situated between the Lanipuna Gardens reservoir and the Kapoho reservoir. As such, water demand for the project will be drawn from these existing reservoirs first.

ESTIMATED WATER DEMAND FOR PROJECT

As described elsewhere in this environmental impact statement, the project consists of six components:

- Sports and health spa complex with onsen ponds
- Boutique hotel
- Chalets
- Beach club
- 18-hole golf course
- Restaurant and retail complex

The total number of units is 195. The average day consumption (ADC) is 400 gallons per unit, or a total of 78,000 gallons per day. This project is expected to employ a maximum of 410 employees. It is assumed the maximum number of (transient) guests on any particular day will equal to 100. From the U.S. Geological Survey Circular 1004, Estimated Use of Water in the United States in 1985, for Hawaii, the water consumption per capita day for employees and guests is 45 gallons and 13.2 gallons, respectively. Therefore, the total average day water consumption for employees and guests will be 18,450 gallons and 1,320 gallons, respectively.

Some design components will require additional water consumption due to the type of amenities they will provide. Amenities include water-related recreation, saunas, jaccuzzies, restaurants, etc.

The design components would include:

- Boutique hotel
- Sports complex
- Spa complex
- Beach club
- 18 hole cinder golf clubhouse
- Equestrian center
- Restaurant/Fast Food

The average day water consumption to supply the amenities for these design components would be 58,000 gallon. This is based on an ADC of 1,000 gallons per acre.

An on-site sewage treatment plant will be situation on a one acre site. Water requirements for this facility will be 4,000 gallons per acre or 4,000 gallons ADC.

The total average day consumption for this project would be 159,770 gallons. A summary of the ADC is shown below.

DESIGN COMPONENT	LAND AREA (ACRES)	UNITS	AVERAGE DAILY CONSUMPTION (ADC)	TOTAL ADC
Boutique Hotel		40	400 gals/unit	16,000 gals.
	15		1,000 gals/acre	15,000 gals.
Sports Complex	12		1,000 gals/acre	12,000 gals.
Spa Complex	10		1,000 gals/acre	10,000 gals.
Beach Club		30	400 gals/unit	12,000 gals.
	12		1,000 gals/acre	12,000 gals.
18 Hole Cinder Golf Clubhouse	4		1,000 gals/acre	4,000 gals.
Chalet Site 1		100	400 gals/unit	40,000 gals.
Chalet Site 2		15	400 gals/unit	6,000 gals.
Chalet Site 3		5	400 gals/unit	2,000 gals.
Chalet Site 4		5	400 gals/unit	2,000 gals.
Equestrian Center	3.5		1,000 gals/acre	3,500 gals.
Restaurant/Fast Food	1.5		1,000 gals/acre	1,500 gals.
Sewage Treatment Plant	1		4,000 gals/acre	4,000 gals.
410 Employees			45 gals/employee	18,450 gals.
100 Guests			13.2 gals/guest	1,320 gals.
			TOTAL ADC	159,770 gals.

For Hawaii County, the maximum daily demand is 1.5 times the ADC. The peak hour demand is 5 times the hourly rate for the ADC. Therefore, the maximum daily demand will be 239,655 gallons per day and the peak hour demand will be 33,285 gallons per hour.

FIRE FLOW REQUIREMENTS

The required fire flow for this type of land use is provided by the Department of Water Supply's Water System Standards. Fire flow of 2,000 gpm shall be required for the project site. Enough fire flow storage in the water storage reservoirs will be required to accommodate a two hour fire event. Therefore, at least 240,000 gallons of fire flow storage will be required.

The existing water system at the project site is arranged such that if a fire event occurs, fire flow will be supplied by both the 0.10 MG Lanipuna Gardens Reservoir and the 0.10 MG Kapoho Reservoir. However, due to a 5,000 linear feet section of 6-inch ductile iron pipe (DIP) along the Pahoa-Pohoiki Road, the pressure drop will be too great and the required fire flow will not be realized.

PROPOSED OFF-SITE RESERVOIR

An off-site reservoir is recommended to provide the solution to the inadequate fire flow. This reservoir would be located downstream of the 6-inch DIP section and be situated to supply the 0.10 MG Kapoho Reservoir. The proposed reservoir would hydraulically match the existing 254 feet elevation PRV station on the 8-inch water main along the Pahoa-Pohoiki Road. (Lower PRV).

During any fire condition at the project site, the fire flow will then be primarily from the proposed reservoir and the Kapoho reservoir.

Sizing the Off-Site Reservoir. The recommended guidelines in the Department of Water Supply's Water System Standards are followed to determine the reservoir capacity. According to the DWS standards, the reservoir capacity should accommodate the greater of the following conditions.

1. Meet maximum day consumption. Reservoir full at the beginning of the 24-hour period with no source input to the reservoir.

2. Meet maximum day rate plus fire flow for duration of fire. Reservoir 3/4 full at start of fire, with credit for incoming flow from pumps, one maximum size pump out of service.

The DWS standards also states,

> "Where there are two or more reservoirs serving the same system, the design shall be made on the basis of combined protection provided by all facilities available."

Of the two reservoir sizing conditions, condition two would govern. Taking condition number two in consideration, the size of the proposed reservoir would be 300,000 gallons. The following calculations show,

Fire Flow Storage: 2000 gpm x 60 min/hr x 2 hr duration = 240,000 gals.

Maximum Day Storage for 2 hr. Fire Duration:
(239,655 gallons (max. day)/24 hrs/day) x 2 hr duration
= 19,971.25 gals., say 20,000 gals.
Therefore, 240,000 + 20,000 = 260,000 gals. capacity required.

Since the Kapoho reservoir would be serving the project area, as well as the proposed reservoir, their combined capacity of 300,000 gallons when three-quarters full would be more than adequate during a fire event. Furthermore, the proposed reservoir would receive credit for incoming flow from the Lanipuna Gardens reservoir.

Locating the Off-Site Reservoir. Locating the reservoir is a matter of accessibility, achieving the proper hydraulic characteristics, and economics. It is proposed to locate the reservoir as shown on Figure 1. The tax map key for the parcel is 1-4-02:10 and is privately owned. Access to the parcel is from a gravel road off of the Pahoa-Pohoiki Road. The reservoir site must be "set in" from the parcel's front boundary line. The exact location depending upon the ground elevation to achieve the proper reservoir overflow elevation. A new driveway to the reservoir site will be required.

The reservoir will match the discharge pressure setting of the 254 feet elevation PRV station alongside the Pahoa-Pohoiki Road. (See Figure 1 and Figure 2).

PRV elevation = 254.0 feet
Discharge pressure setting = 80 psi
Equivalent reservoir overflow elevation = 254 + (80 x 2.31)
= 438.8 feet, say 440 feet.

Therefore, the reservoir overflow elevation will be set at 440 feet and existing hydraulic conditions downstream of the PRV will not change.

Off-Site Reservoir Supply. The supply for the proposed reservoir will be from the Lanipuna Gardens Reservoir. A separate 8-inch DIP influent line will be needed for a gravity feed to the proposed reservoir. This 8-inch influent line will connect to the existing 8-inch water main at the Pahoa-Pohoiki Road and aligned to follow the reservoir site access road. Approximately 3,750 linear feet of pipe will be required.

To control the reservoir water levels, a Department of Water Supply standard design reservoir level control valve station will be employed. A float similar to the CF1-C1 Float Control, manufactured by the Cla-Val Company, will be installed within the reservoir. This float will control the hydraulically-operated control valve(s) to open or close at pre-determined water levels. The control valve will also maintain a certain minimum back pressure to avoid "robbing" the water system of the recommended minimum pressure.

Off-Site Reservoir Discharge. A separate 8-inch DIP effluent line will be installed to provide a gravity feed to the project site and other existing and future water services. The 8-inch effluent line will connect to the 8-inch water main at the Pahoa-Pohoiki Road just downstream of the proposed 8-inch influent line connection. The alignment will also follow the reservoir site access road and will likewise be approximately 3,750 linear feet in length.

The existing 254 feet elevation PRV station will no longer be required and may be disconnected from the water system. It should be noted that any service laterals located below the 260 feet elevation may experience a water pressure greater than 80 psi, which is the highest pressure recommended by the Uniform Plumbing Code. These services with high water pressure may be outfitted with pressure regulating valves to reduce pressure to an acceptable value. Water meters with high water pressure rating will be necessary where required at lower elevations.

ON-SITE WATER DISTRIBUTION

On-site water mains will be sized to accommodate the required fire flow. The water main alignment will follow the on-site road pattern and will be looped where possible. (See Figure 3). Water service will be from the on-site water mains. On-site fire hydrants will be provided and spaced as recommended in the DWS standards.

CONSTRUCTION COST ESTIMATE FOR PROJECT WATER SYSTEM IMPROVEMENTS

The following cost estimate breakdown is provided in two parts. First, the cost estimate for the off-site 0.30 MG reservoir including site work at the reservoir site, access road to the reservoir site, 8-inch influent and effluent water lines, and appurtenances are furnished. Second, the cost estimate for the on-site (project site) water distribution system, including water mains, valves, fittings, fire hydrant assemblies, service laterals, and appurtenances are furnished.

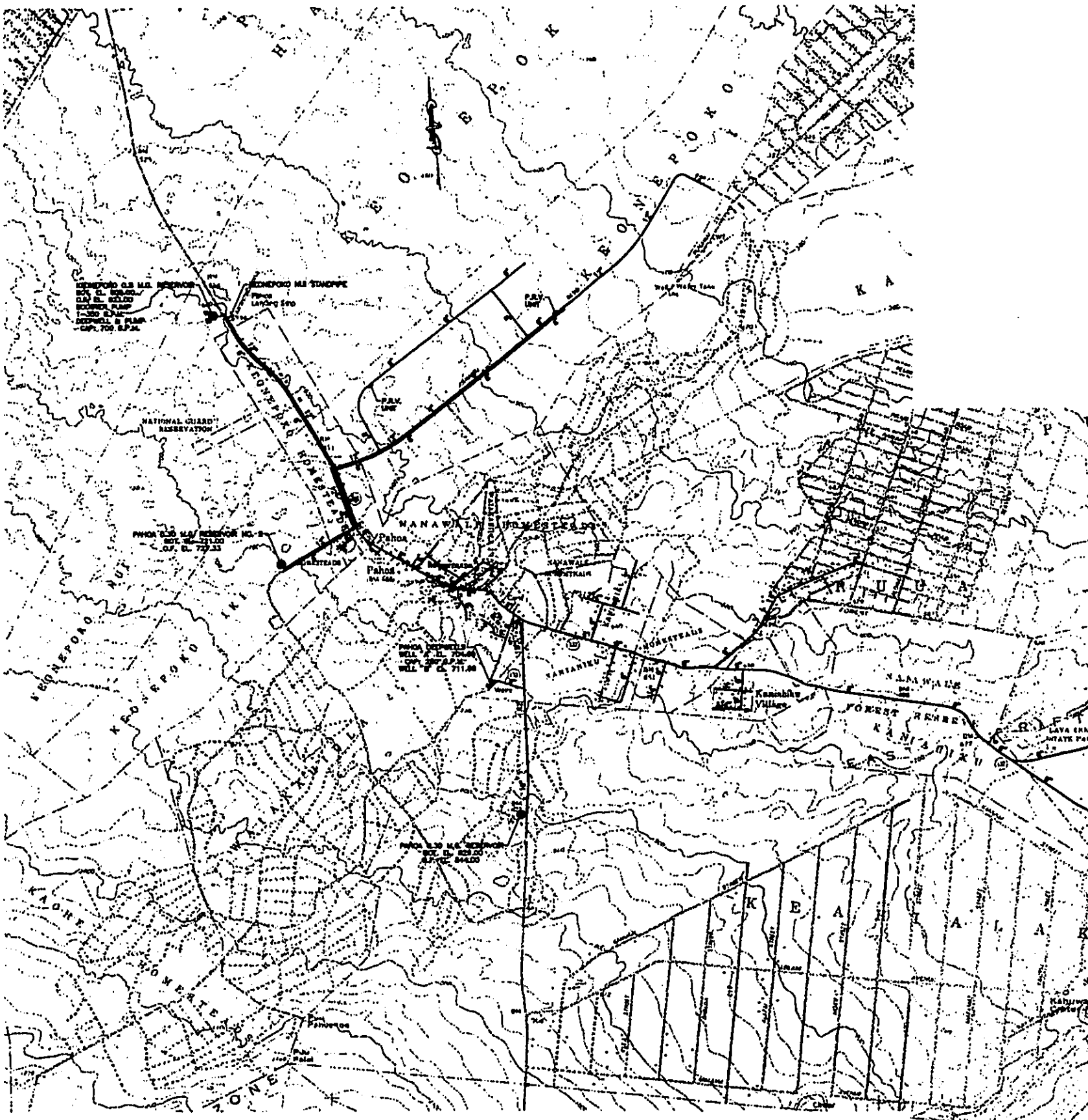
The cost estimates are for planning purposes only and must be revised when detailed construction plans are available.

Cost Estimate for Off-Site 0.30 MG Reservoir

Item	Qty	Description	Total Cost
1.	L.S.	Clearing and grubbing of reservoir site and access road, inclusive of material disposal	$ 20,000.00
2.	L.S.	Excavation and embankment for access road	$109,500.00
3.	L.S.	Grading for reservoir site	$ 45,000.00
4.	L.S.	Structural excavation for reservoir	$ 12,000.00
5.	L.S.	Asphaltic concrete pavement for access road	$ 60,000.00
6.	L.S.	Asphaltic concrete pavement for reservoir site	$ 16,000.00
7.	L.S.	Drainage structures, culverts and appurtenances at reservoir site and access road.	$ 36,000.00
8.	L.S.	6-ft high chain link fence at reservoir site	$ 19,000.00
9.	L.S.	0.30 MG reservoir and appurtenances	$225,000.00
10.	L.S.	8-inch ductile iron pipe influent line, in place complete	$187,500.00
11.	L.S.	8-inch ductile iron pipe effluent line, in place complete	$187,500.00
12.	L.S.	Reservoir water level control valve station	$ 21,000.00
13.	L.S.	Reservoir site facility piping, in place complete	$ 29,000.00
14.	L.S.	Reservoir water level recorder and appurtenances	$ 3,500.00
		Subtotal	$ 971,000.00
		Contingencies (15%)	$ 145,650.00
		Total	$1,116,650.00
		Rounded	$1,120,000.00

Cost Estimate for On-Site Water Distribution

Item	Qty	Description	Total Cost
1.	L.S.	8-inch ductile iron pipe, in place complete	$ 380,000.00
2.	L.S.	Fire hydrant assemblies	$ 62,400.00
3.	L.S.	Service laterals, inclusive of water meters, valves, fittings, meter boxes, and appurtenances	$ 85,000.00
4.	L.S.	8-inch water main gate valves, valve boxes, ARV units and boxes, cleanout units and boxes	$ 48,800.00
Subtotal			$ 576,200.00
Contingencies (15%)			$ 86,430.00
Total			$ 662,630.00
Rounded			$ 663,000.00

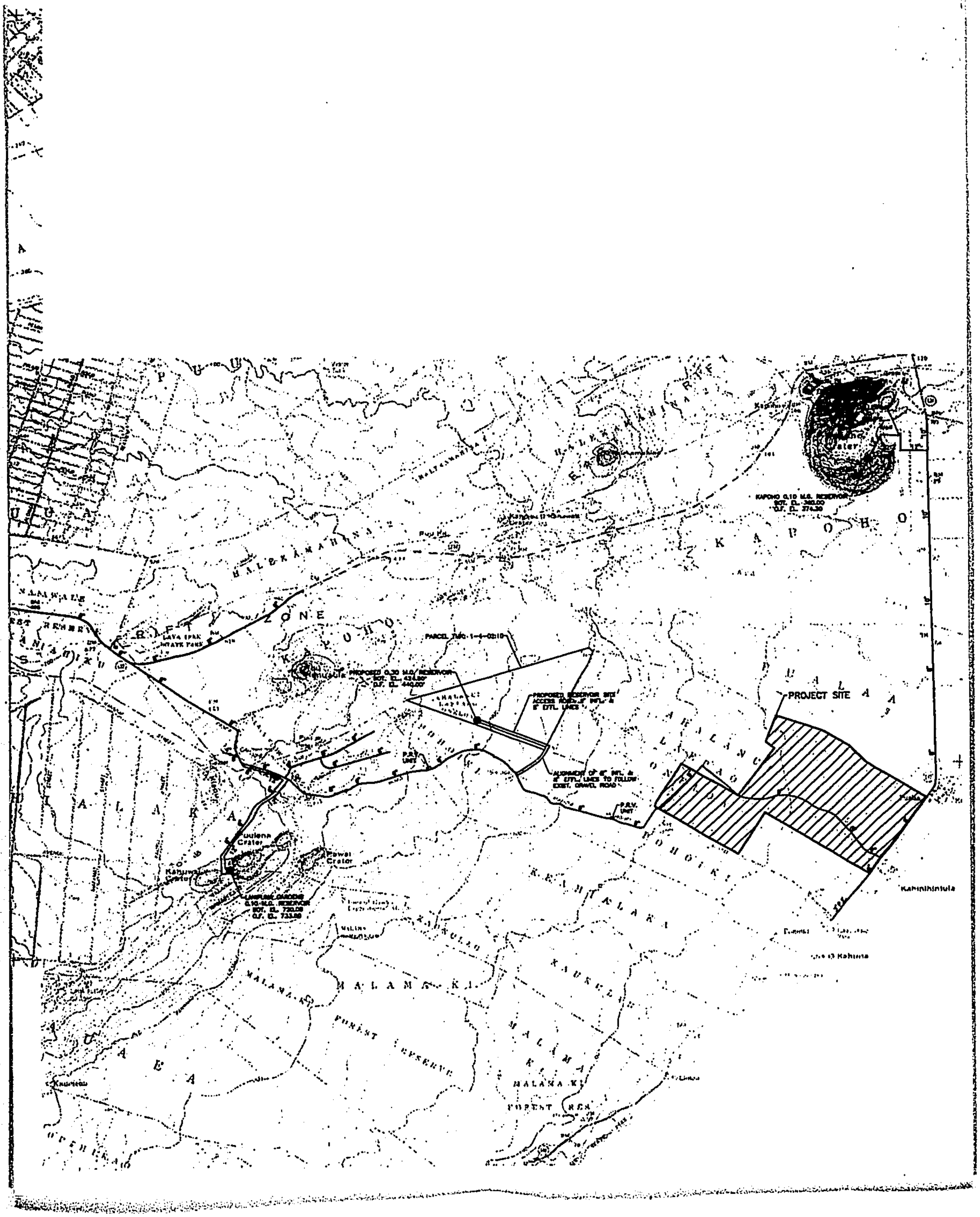


PAHOA - KAPOHO WATER SYSTEM

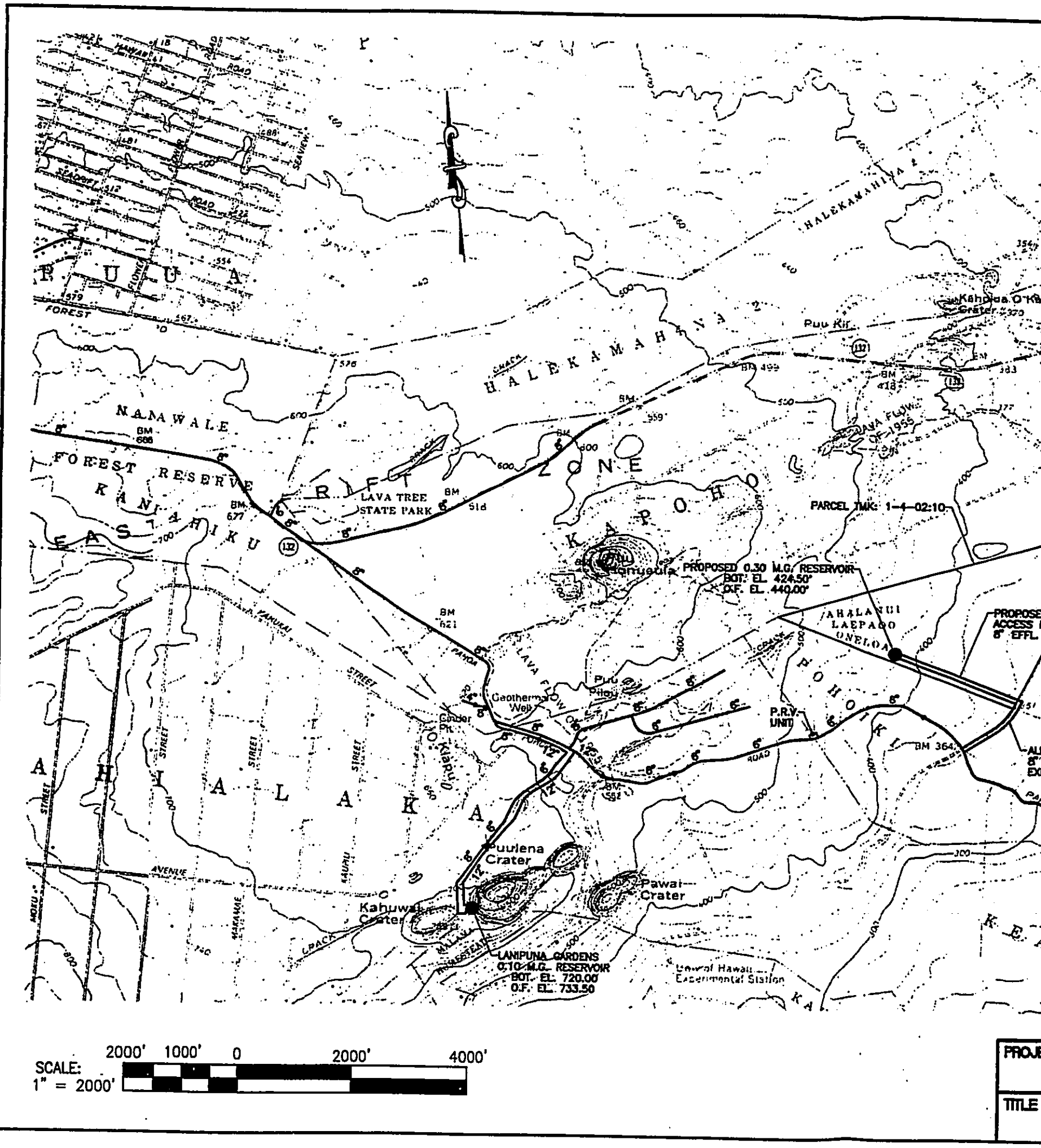
SCALE: 1" =2000'

SCALE: 1" = 2000'

2000' 1000' 0 2000' 4000'


PROJECT SITE
KAPOHO
RIFT ZONE
PARCEL TMK: 1-4-02:10
PROPOSED 0.30 M.G. RESERVOIR
BOT. EL. 424.00'
O.F. EL. 440.00'
PROPOSED RESERVOIR SITE ACCESS ROAD, 8" INFL. & 8" EFFL. LINES
ALIGNMENT OF 8" INFL. & 8" EFFL. LINES TO FOLLOW EXIST. GRAVEL ROAD
P.R.V. UNIT
KAPOHO 0.10 M.G. RESERVOIR
BOT. EL. 360.00
O.F. EL. 374.30
LANIPUNI GARDENS 0.10 M.G. RESERVOIR
BOT. EL. 720.00
O.F. EL. 733.00
Puulena Crater
Kahuwai Crater
Pawai Crater
Kahinihiniula
Kahuna
MALAMA-KI
FOREST RESERVE
KAUELEAU
PUUA
HALAKAA
OPIHIKAO
KEAHIALAKA
POHOIKI
PUALAA

DOCUMENT CAPTURED AS RECEIVED



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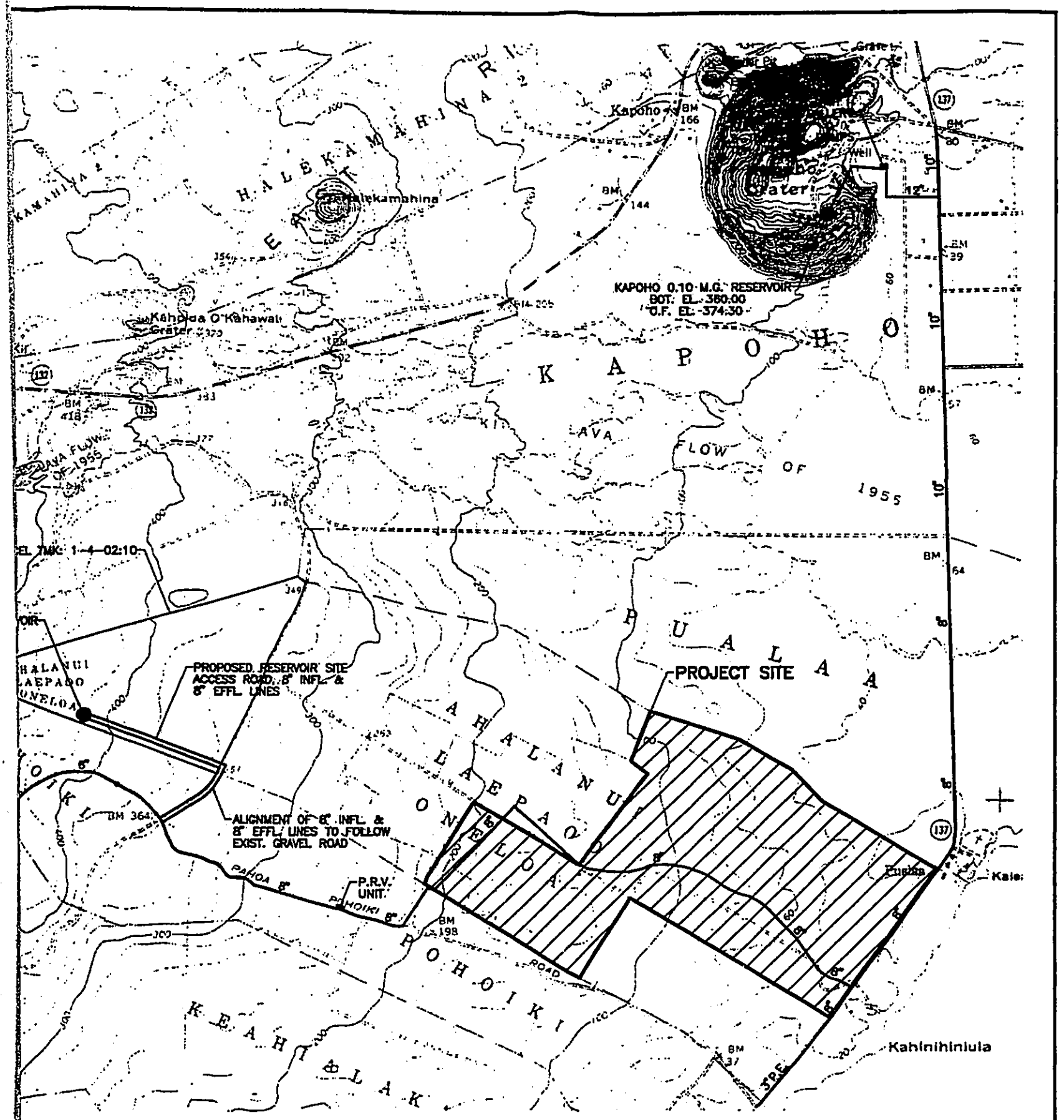
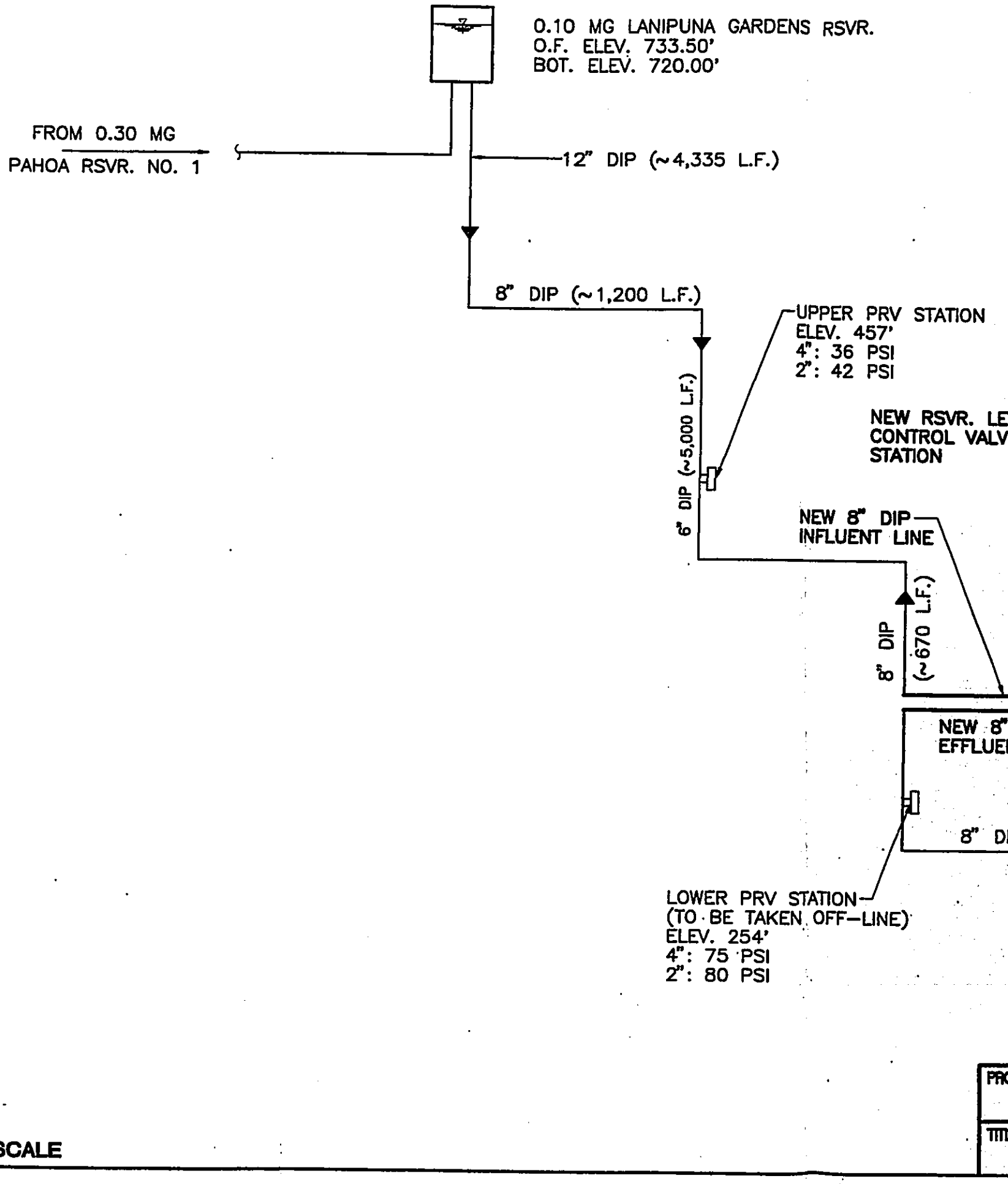
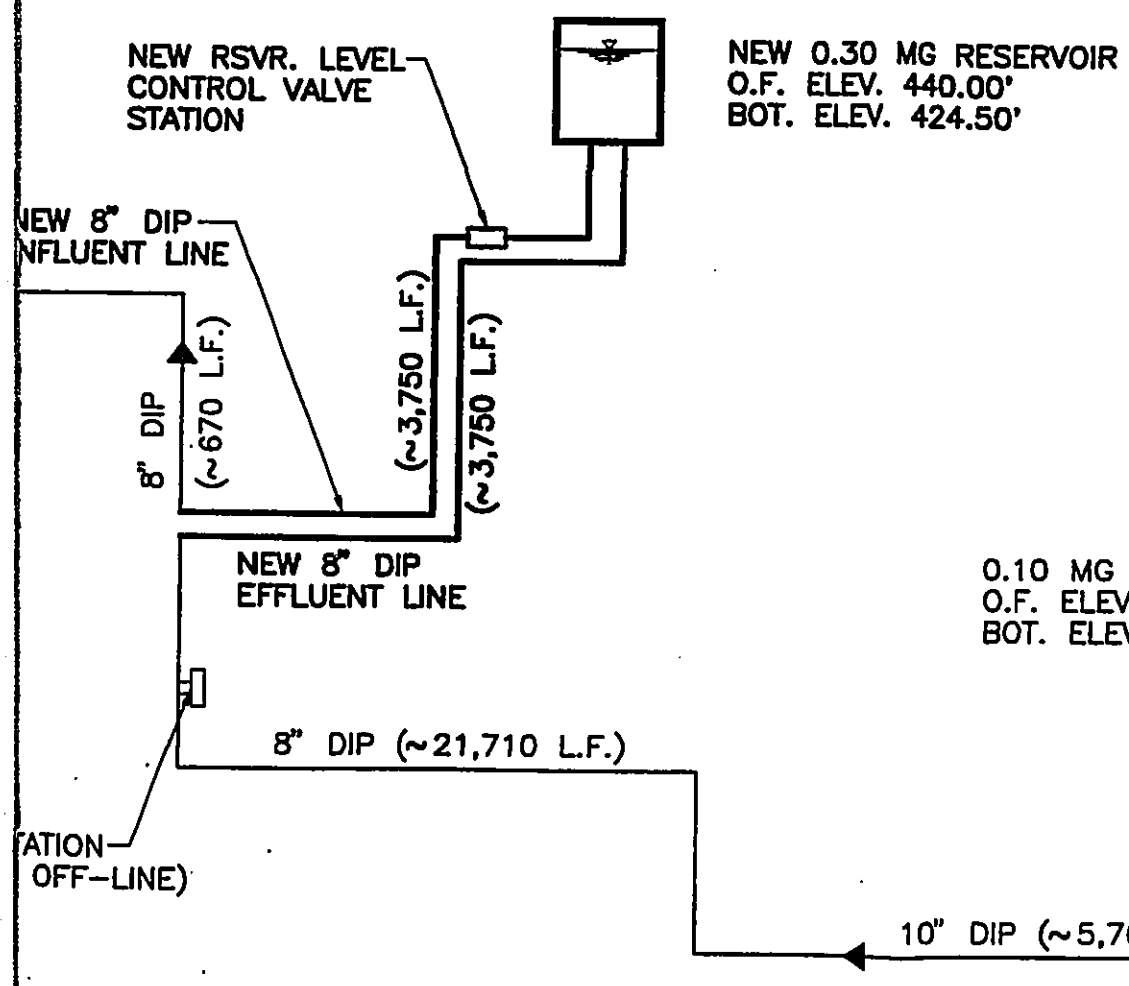


PROJECT	ONELOA ONSEN AND SPORTS RETREAT		FIG. NO. 1
TITLE	PROPOSED 0.30 MG RESERVOIR ARRANGEMENT	DATE	-/-/99

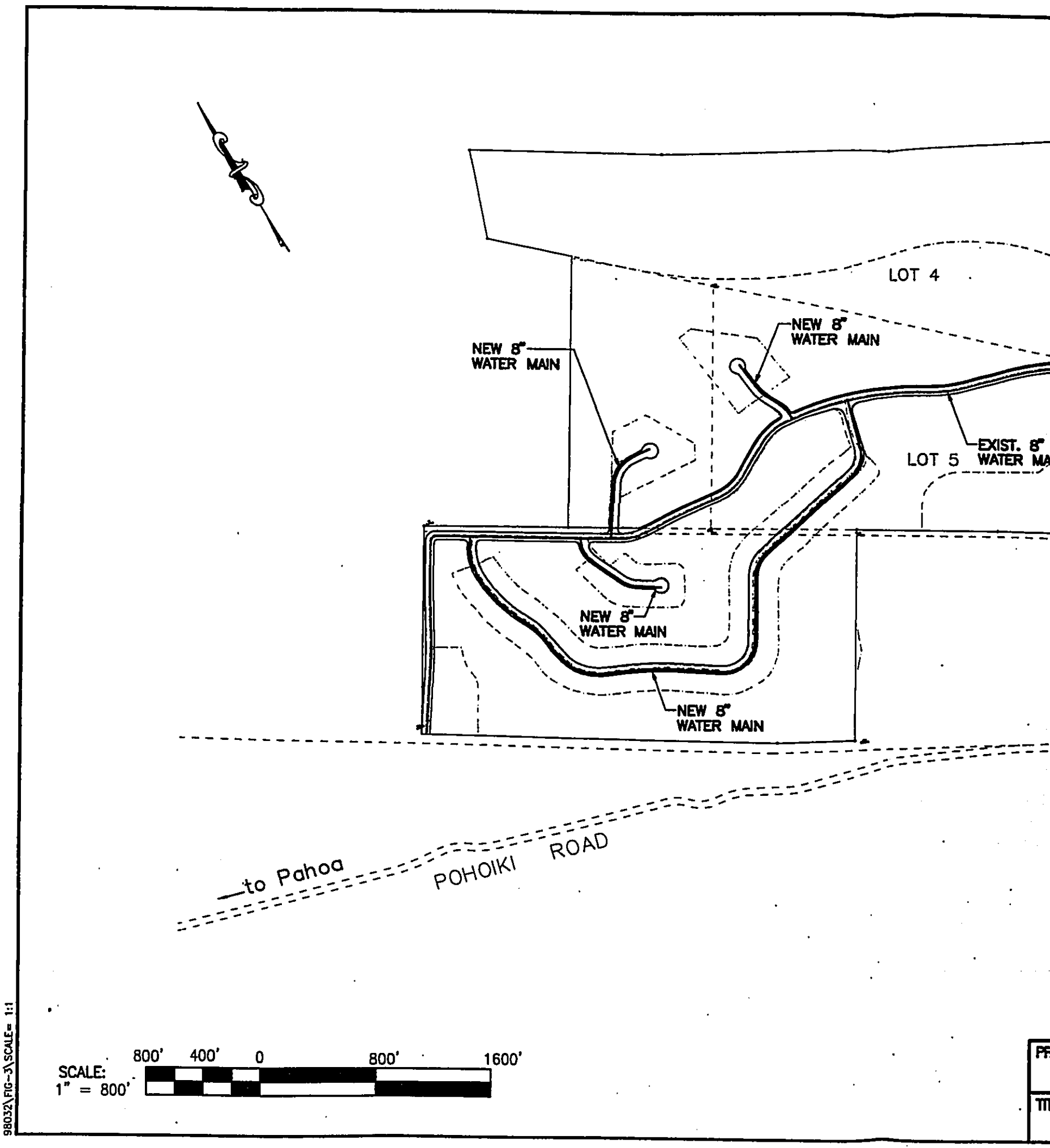

0.10 MG LANIPUNA GARDENS RSVR.
O.F. ELEV. 733.50'
BOT. ELEV. 720.00'
FROM 0.30 MG
PAHOA RSVR. NO. 1
12" DIP (~4,335 L.F.)
8" DIP (~1,200 L.F.)
6" DIP (~5,000 L.F.)
UPPER PRV STATION
ELEV. 457'
4": 36 PSI
2": 42 PSI
NEW RSVR. LE
CONTROL VALV
STATION
NEW 8" DIP
INFLUENT LINE
8" DIP
(~670 L.F.)
NEW 8"
EFFLUE
8" DI
LOWER PRV STATION
(TO BE TAKEN OFF-LINE)
ELEV. 254'
4": 75 PSI
2": 80 PSI
98032\FIG-2\SCALE= 1:1
NOT TO SCALE

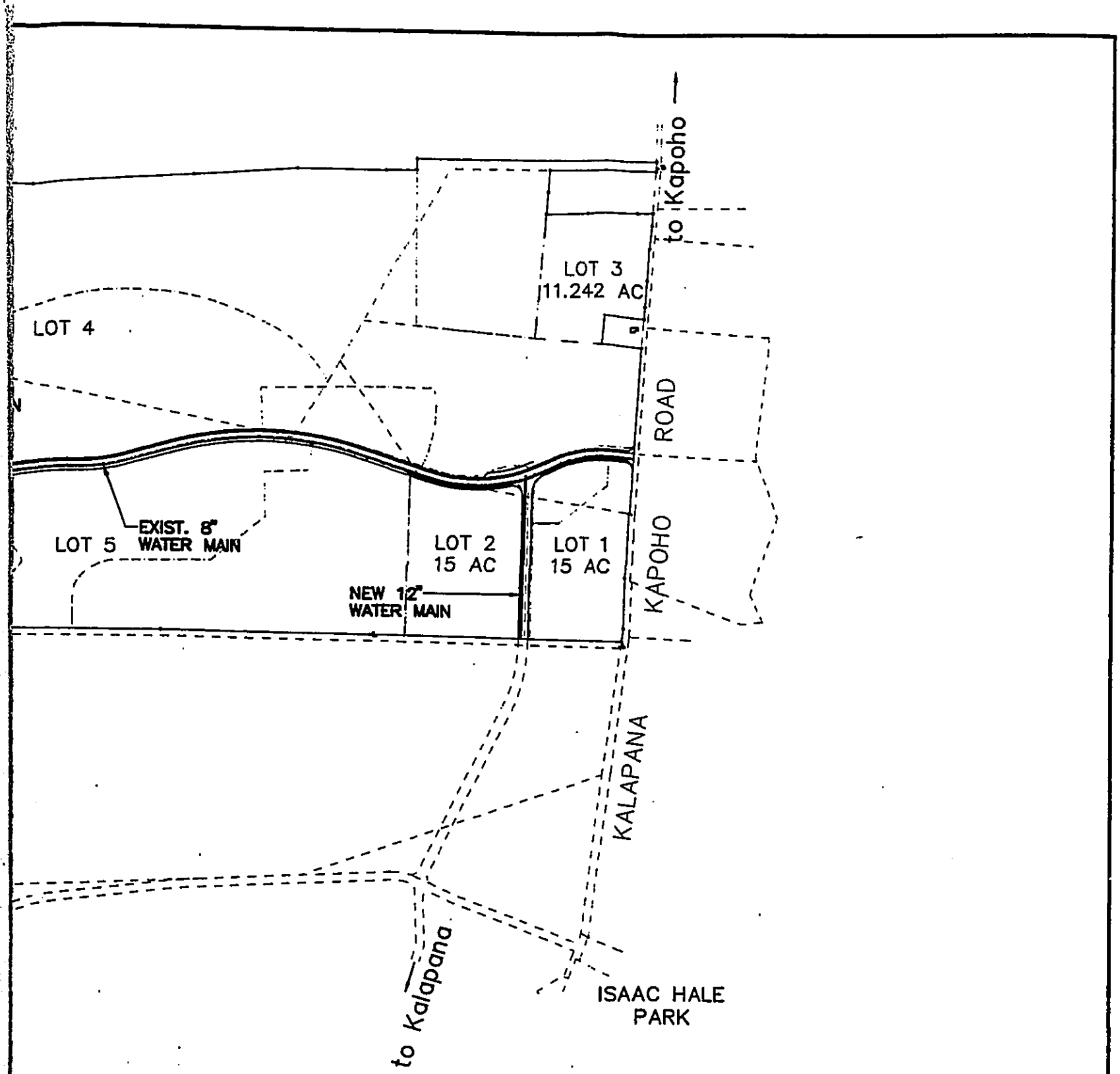
RSVR.

PPER PRV STATION
LEV. 457'
": 36 PSI
": 42 PSI



PROJECT: ONELOA ONSEN AND SPORTS RETREAT		FIG. NO. 2
TITLE: SCHEMATIC DIAGRAM - PROPOSED 0.30 MG RESERVOIR	DATE: -/-/99	

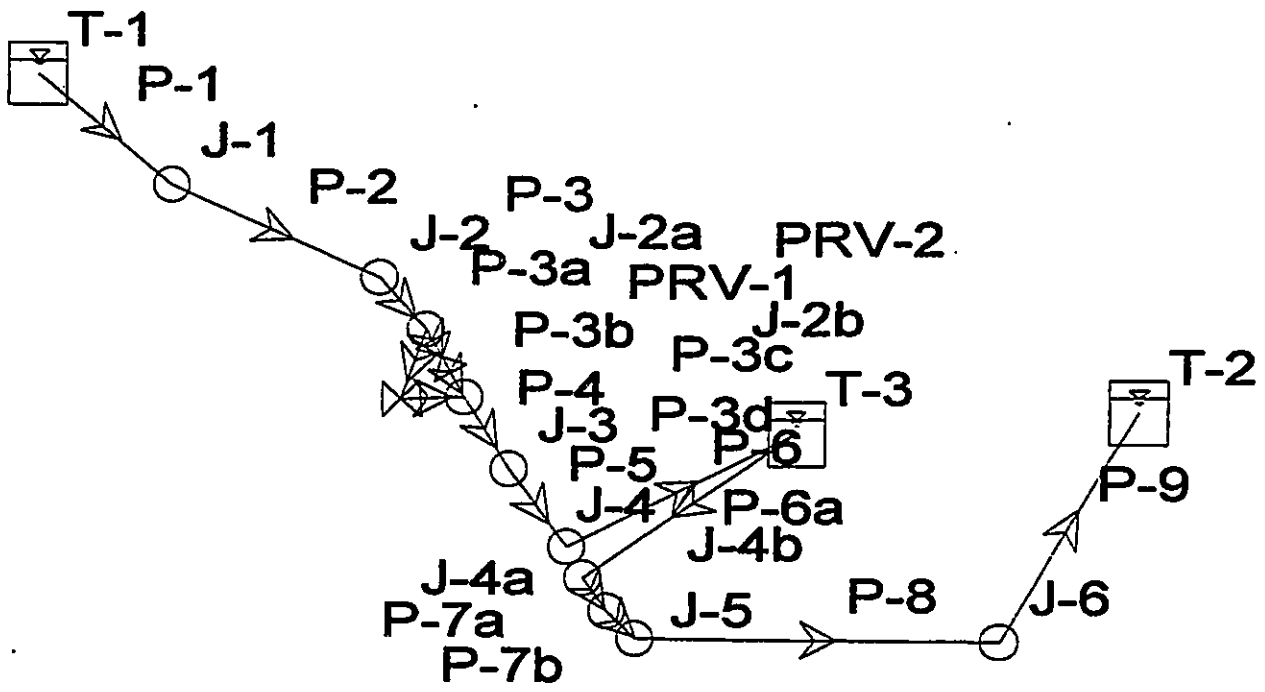

LOT 4
NEW 8"
WATER MAIN
NEW 8"
WATER MAIN
EXIST. 8"
LOT 5 WATER MA
NEW 8"
WATER MAIN
NEW 8"
WATER MAIN
to Pahoa
POHOIKI ROAD
800' 400' 0 800' 1600'
SCALE:
1" = 800'
98032\FIG-3\SCALE= 1:1



PROJECT: ONELOA ONSEN AND SPORTS RETREAT		FIG. NO. 3
TITLE: PROPOSED ON-SITE WATER DISTRIBUTION	DATE: -/-/99	

HYDRAULIC CALCULATIONS
FOR
MAXIMUM DAILY FLOW

Steady State Analysis



Analysis Results
Steady State Analysis

Project Title: Off-Site Water System Requirements
Project Engineer: TERRANCE NAGO
Project Date: 11/25/98
Comments: Oneloa Onsen and Sports Retreat

Hydraulic Analysis Summary			
Analysis	Steady State	Demand Scenario	Default-Maximum Day
Friction Method	Hazen-Williams Formula	Accuracy	0.001000
Trials	40		

Liquid Characteristics			
Liquid	Water at 20C(68F)	Specific Gravity	1.00
Kinematic Viscosity	0.108e-4 ft²/s		

Network Inventory			
Number of Pipes	15	Number of Reservoirs	0
Number of Junctions	10	Number of Tanks	3
Number of Pumps	0	Number of Valves	2
- Constant Power:	0	- FCV's:	0
- One Point (Design Point):	0	- PBV's:	0
- Standard (3 Point):	0	- PRV's:	2
- Standard Extended:	0	- PSV's:	0
- Custom Extended:	0	- TCV's:	0

HYDRAULIC STATUS:

Hydraulic status for steady-state conditons

Balanced	Trials = 10, Accuracy = 0.000004
Flow Supplied	661.03 gpm
Flow Demanded	346.43 gpm
Flow Stored	314.60 gpm
T-1	Tank: Emptying
T-2	Tank: Filling
T-3	Tank: Filling
PRV-1	PRV: Active, Setting = 36.00 psi
PRV-2	PRV: Active, Setting = 42.00 psi

Steady State Analysis
Tank Report

Node Label	Base Elevation (ft)	Minimum Level (ft)	Initial Level (ft)	Maximum Level (ft)	Inactive Volume (ft^3)	Tank Diameter (ft)	Tank Inflow (gpm)	Current Status	Hydraulic Grade (ft)	Tank Level (ft)
T-1	720.00	0.00	13.50	13.50	0.00	35.00	-661.03	Draining	733.50	13.50
T-2	360.00	0.00	14.30	14.30	0.00	35.00	101.92	Filling	374.30	14.30
T-3	424.50	0.00	15.50	15.50	0.00	58.67	212.68	Filling	440.00	15.50

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Minor Loss	Initial Status	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)
P-1	4,335.00	12	Ductile Iron	130.0	0.00	Open	Open	661.03	733.50	728.36	5.14
P-2	1,200.00	8	Ductile Iron	130.0	0.05	Open	Open	601.03	728.36	719.75	8.61
P-3	2,666.00	6	Ductile Iron	130.0	0.00	Open	Open	601.03	719.75	642.19	77.56
P-8	5,702.00	10	Ductile Iron	130.0	0.00	Open	Open	221.92	376.60	374.42	2.18
P-9	3,200.00	12	Ductile Iron	130.0	0.03	Open	Open	101.92	374.42	374.30	0.12
P-5	670.00	8	Ductile Iron	130.0	0.00	Open	Open	601.03	471.68	466.87	4.80
P-6	3,750.00	8	Ductile Iron	130.0	0.00	Open	Open	601.03	466.87	440.00	26.87
P-3c	10.00	2	Copper	135.0	0.00	Open	Open	286.96	642.19	627.63	14.56
P-3a	10.00	4	Ductile Iron	130.0	0.05	Open	Open	314.07	642.19	641.51	0.68
P-4	2,333.00	6	Ductile Iron	130.0	0.03	Open	Open	601.03	539.57	471.68	67.89
P-3b	10.00	4	Ductile Iron	130.0	0.05	Open	Open	314.07	540.25	539.57	0.68
P-3d	10.00	2	Copper	135.0	0.00	Open	Open	286.96	554.12	539.57	14.56
P-6a	3,750.00	8	Ductile Iron	130.0	0.00	Open	Open	-388.35	428.02	440.00	11.98
P-7a	13,003.00	8	Ductile Iron	130.0	0.00	Open	Open	388.35	428.02	386.48	41.54
P-7b	8,707.00	8	Ductile Iron	130.0	0.00	Open	Open	221.92	386.48	376.60	9.88

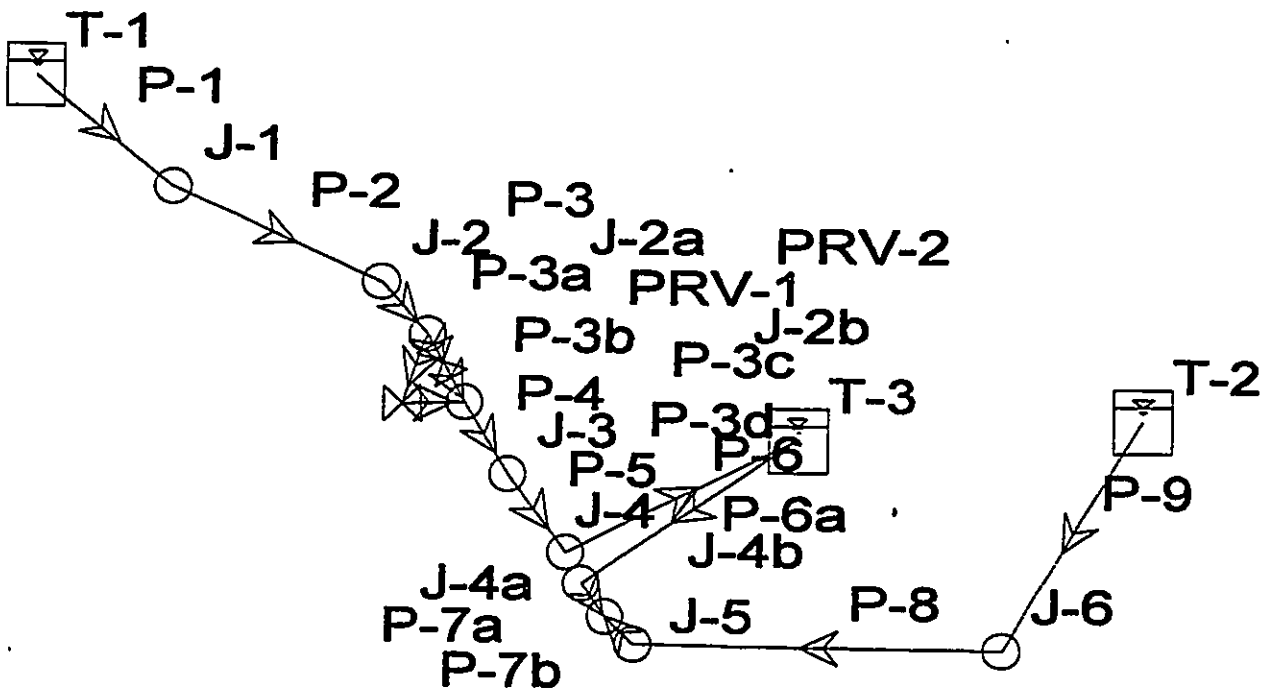
Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-1	550.00	Demand	60.00	Fixed	60.00	728.36	77.13
J-2	523.64	Demand	0.00	Fixed	0.00	719.75	84.80
J-5	56.40	Demand	0.00	Fixed	0.00	376.60	138.47
J-6	44.80	Demand	120.00	Fixed	120.00	374.42	142.54
J-3	376.50	Demand	0.00	Fixed	0.00	471.68	41.16
J-4	357.00	Demand	0.00	Fixed	0.00	466.87	47.51
J-2a	457.00	Demand	0.00	Fixed	0.00	642.19	80.08
J-2b	457.00	Demand	0.00	Fixed	0.00	539.57	35.71
J-4a	357.00	Demand	0.00	Fixed	0.00	428.02	30.71
J-4b	55.00	Demand	166.43	Fixed	166.43	386.48	143.34

OKAHARA AND ASSOC., INC.
37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666

HYDRAULIC CALCULATIONS
FOR
FIRE FLOW EVENT

Steady State Analysis



Analysis Results
Steady State Analysis

Project Title:	Off-Site Water System Requirements
Project Engineer:	TERRANCE NAGO
Project Date:	11/25/98
Comments:	Oneloa Onsen and Sports Retreat

Hydraulic Analysis Summary

Analysis	Steady State	Demand Scenario	Default-Maximum Day
Friction Method	Hazen-Williams Formula	Accuracy	0.001000
Trials	40		

Liquid Characteristics

Liquid	Water at 20C(68F)	Specific Gravity	1.00
Kinematic Viscosity	0.108e-4 ft²/s		

Network Inventory

Number of Pipes	15	Number of Reservoirs	0
Number of Junctions	10	Number of Tanks	3
Number of Pumps	0	Number of Valves	2
- Constant Power:	0	- FCV's:	0
- One Point (Design Point):	0	- PBV's:	0
- Standard (3 Point):	0	- PRV's:	2
- Standard Extended:	0	- PSV's:	0
- Custom Extended:	0	- TCV's:	0

HYDRAULIC STATUS:

Hydraulic status for steady-state conditons

Balanced	Trials = 9, Accuracy = 0.000798
Flow Supplied	2,346.43 gpm
Flow Demanded	2,346.43 gpm
Flow Stored	0.00 gpm
T-1	Tank: Emptying
T-2	Tank: Emptying
T-3	Tank: Emptying
PRV-1	PRV: Active, Setting = 36.00 psi
PRV-2	PRV: Active, Setting = 42.00 psi

Steady State Analysis
Tank Report

Node Label	Base Elevation (ft)	Minimum Level (ft)	Initial Level (ft)	Maximum Level (ft)	Inactive Volume (ft^3)	Tank Diameter (ft)	Tank Inflow (gpm)	Current Status	Hydraulic Grade (ft)	Tank Level (ft)
T-1	720.00	0.00	13.50	13.50	0.00	35.00	-661.03	Draining	733.50	13.50
T-2	360.00	0.00	14.30	14.30	0.00	35.00	-1,255.96	Draining	374.30	14.30
T-3	424.50	0.00	15.50	15.50	0.00	58.67	-429.44	Draining	440.00	15.50

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Minor Loss	Initial Status	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)
P-1	4,335.00	12	Ductile Iron	130.0	0.00	Open	Open	661.03	733.50	728.36	5.14
P-2	1,200.00	8	Ductile Iron	130.0	0.05	Open	Open	601.03	728.36	719.75	8.61
P-3	2,666.00	6	Ductile Iron	130.0	0.00	Open	Open	601.03	719.75	642.19	77.56
P-8	5,702.00	10	Ductile Iron	130.0	0.00	Open	Open	-1,135.96	317.09	361.85	44.76
P-9	3,200.00	12	Ductile Iron	130.0	0.03	Open	Open	-1,255.96	361.85	374.30	12.45
P-5	670.00	8	Ductile Iron	130.0	0.00	Open	Open	601.03	471.68	466.87	4.80
P-6	3,750.00	8	Ductile Iron	130.0	0.00	Open	Open	601.03	466.87	440.00	26.87
P-3c	10.00	2	Copper	135.0	0.00	Open	Open	286.96	642.19	627.63	14.56
P-3a	10.00	4	Ductile Iron	130.0	0.05	Open	Open	314.07	642.19	641.51	0.68
P-4	2,333.00	6	Ductile Iron	130.0	0.03	Open	Open	601.03	539.57	471.68	67.89
P-3b	10.00	4	Ductile Iron	130.0	0.05	Open	Open	314.07	540.25	539.57	0.68
P-3d	10.00	2	Copper	135.0	0.00	Open	Open	286.96	554.12	539.57	14.56
P-6a	3,750.00	8	Ductile Iron	130.0	0.00	Open	Open	-1,030.47	367.14	440.00	72.86
P-7a	13,003.00	8	Ductile Iron	130.0	0.00	Open	Open	1,030.47	367.14	114.49	252.65
P-7b	8,707.00	8	Ductile Iron	130.0	0.00	Open	Open	-1,135.96	114.49	317.09	202.60

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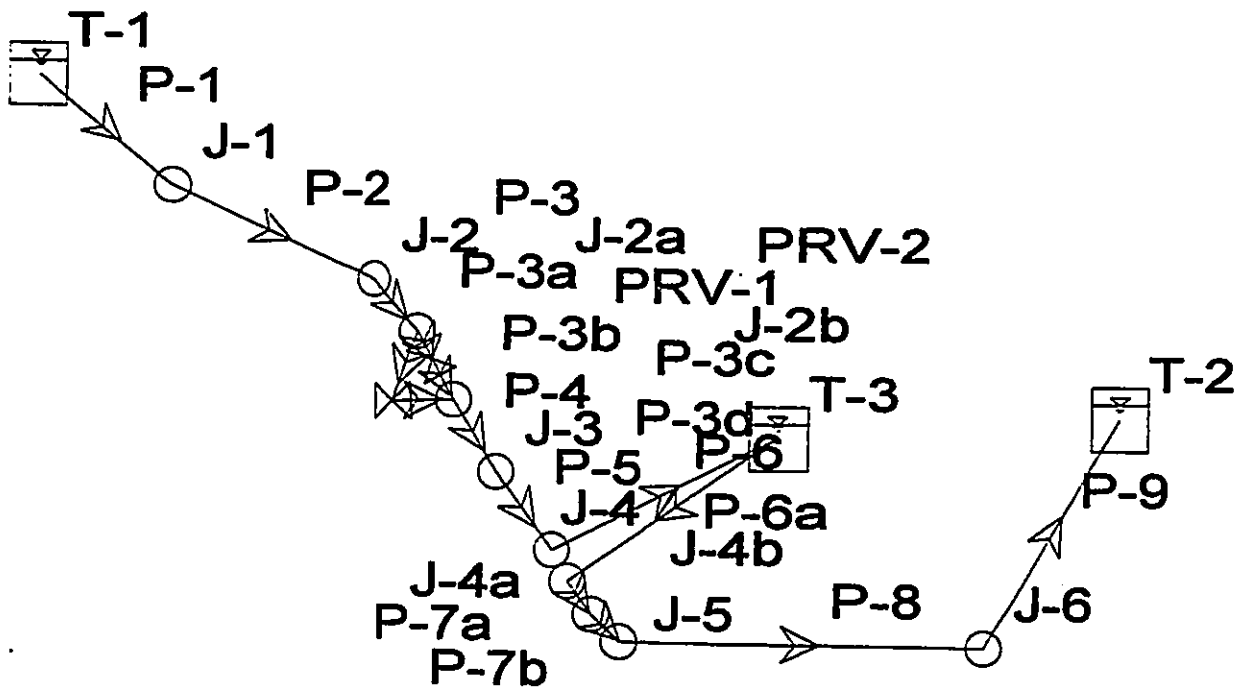
Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-1	550.00	Demand	60.00	Fixed	60.00	728.36	77.13
J-2	523.64	Demand	0.00	Fixed	0.00	719.75	84.80
J-5	56.40	Demand	0.00	Fixed	0.00	317.09	112.73
J-6	44.80	Demand	120.00	Fixed	120.00	361.85	137.10
J-3	376.50	Demand	0.00	Fixed	0.00	471.68	41.16
J-4	357.00	Demand	0.00	Fixed	0.00	466.87	47.51
J-2a	457.00	Demand	0.00	Fixed	0.00	642.19	80.08
J-2b	457.00	Demand	0.00	Fixed	0.00	539.57	35.71
J-4a	357.00	Demand	0.00	Fixed	0.00	367.14	4.38
J-4b	55.00	Demand	2,166.43	Fixed	2,166.43	114.49	25.72

HYDRAULIC CALCULATIONS
FOR
AVERAGE DAILY FLOW

Steady State Analysis



HYDRAULIC STATUS:

Hydraulic status for steady-state conditons

Balanced	Trials = 10, Accuracy = 0.000004
Flow Supplied	661.03 gpm
Flow Demanded	290.95 gpm
Flow Stored	370.08 gpm
T-1	Tank: Emptying
T-2	Tank: Filling
T-3	Tank: Filling
PRV-1	PRV: Active, Setting = 36.00 psi
PRV-2	PRV: Active, Setting = 42.00 psi

Analysis Results
Steady State Analysis

Project Title:	Off-Site Water System Requirements
Project Engineer:	TERRANCE NAGO
Project Date:	11/25/98
Comments:	Oneloa Onsen and Sports Retreat

Hydraulic Analysis Summary

Analysis	Steady State	Demand Scenario	Default-Maximum Day
Friction Method	Hazen-Williams Formula	Accuracy	0.001000
Trials	40		

Liquid Characteristics

Liquid	Water at 20C(68F)	Specific Gravity	1.00
Kinematic Viscosity	0.108e-4 ft²/s		

Network Inventory

Number of Pipes	15	Number of Reservoirs	0
Number of Junctions	10	Number of Tanks	3
Number of Pumps	0	Number of Valves	2
- Constant Power:	0	- FCV's:	0
- One Point (Design Point):	0	- PBV's:	0
- Standard (3 Point):	0	- PRV's:	2
- Standard Extended:	0	- PSV's:	0
- Custom Extended:	0	- TCV's:	0

Steady State Analysis
Tank Report

Node Label	Base Elevation (ft)	Minimum Level (ft)	Initial Level (ft)	Maximum Level (ft)	Inactive Volume (ft^3)	Tank Diameter (ft)	Tank Inflow (gpm)	Current Status	Hydraulic Grade (ft)	Tank Level (ft)
T-1	720.00	0.00	13.50	13.50	0.00	35.00	-661.03	Draining	733.50	13.50
T-2	360.00	0.00	14.30	14.30	0.00	35.00	140.41	Filling	374.30	14.30
T-3	424.50	0.00	15.50	15.50	0.00	58.67	229.67	Filling	440.00	15.50

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Minor Loss	Initial Status	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)
P-1	4,335.00	12	Ductile Iron	130.0	0.00	Open	Open	661.03	733.50	728.36	5.14
P-2	1,200.00	8	Ductile Iron	130.0	0.05	Open	Open	601.03	728.36	719.75	8.61
P-3	2,666.00	6	Ductile Iron	130.0	0.00	Open	Open	601.03	719.75	642.19	77.56
P-8	5,702.00	10	Ductile Iron	130.0	0.00	Open	Open	260.41	377.45	374.52	2.93
P-9	3,200.00	12	Ductile Iron	130.0	0.03	Open	Open	140.41	374.52	374.30	0.22
P-5	670.00	8	Ductile Iron	130.0	0.00	Open	Open	601.03	471.68	466.87	4.80
P-6	3,750.00	8	Ductile Iron	130.0	0.00	Open	Open	601.03	466.87	440.00	26.87
P-3c	10.00	2	Copper	135.0	0.00	Open	Open	286.96	642.19	627.63	14.56
P-3a	10.00	4	Ductile Iron	130.0	0.05	Open	Open	314.07	642.19	641.51	0.68
P-4	2,333.00	6	Ductile Iron	130.0	0.03	Open	Open	601.03	539.57	471.68	67.89
P-3b	10.00	4	Ductile Iron	130.0	0.05	Open	Open	314.07	540.25	539.57	0.68
P-3d	10.00	2	Copper	135.0	0.00	Open	Open	286.96	554.12	539.57	14.56
P-6a	3,750.00	8	Ductile Iron	130.0	0.00	Open	Open	-371.36	428.97	440.00	11.03
P-7a	13,003.00	8	Ductile Iron	130.0	0.00	Open	Open	371.36	428.97	390.73	38.24
P-7b	8,707.00	8	Ductile Iron	130.0	0.00	Open	Open	260.41	390.73	377.45	13.28

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-1	550.00	Demand	60.00	Fixed	60.00	728.36	77.13
J-2	523.64	Demand	0.00	Fixed	0.00	719.75	84.80
J-5	56.40	Demand	0.00	Fixed	0.00	377.45	138.83
J-6	44.80	Demand	120.00	Fixed	120.00	374.52	142.58
J-3	376.50	Demand	0.00	Fixed	0.00	471.68	41.16
J-4	357.00	Demand	0.00	Fixed	0.00	466.87	47.51
J-2a	457.00	Demand	0.00	Fixed	0.00	642.19	80.08
J-2b	457.00	Demand	0.00	Fixed	0.00	539.57	35.71
J-4a	357.00	Demand	0.00	Fixed	0.00	428.97	31.12
J-4b	55.00	Demand	110.95	Fixed	110.95	390.73	145.18

HYDRAULIC CALCULATIONS
FOR
PEAK HOUR FLOW

HYDRAULIC STATUS:

Hydraulic status for steady-state conditons

Balanced	Trials = 10, Accuracy = 0.000004
Flow Supplied	888.86 gpm
Flow Demanded	734.75 gpm
Flow Stored	154.11 gpm
T-1	Tank: Emptying
T-2	Tank: Emptying
T-3	Tank: Filling
PRV-1	PRV: Active, Setting = 36.00 psi
PRV-2	PRV: Active, Setting = 42.00 psi

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Steady State Analysis
Tank Report

Node Label	Base Elevation (ft)	Minimum Level (ft)	Initial Level (ft)	Maximum Level (ft)	Inactive Volume (ft^3)	Tank Diameter (ft)	Tank Inflow (gpm)	Current Status	Hydraulic Grade (ft)	Tank Level (ft)
T-1	720.00	0.00	13.50	13.50	0.00	35.00	-661.03	Draining	733.50	13.50
T-2	360.00	0.00	14.30	14.30	0.00	35.00	-227.83	Draining	374.30	14.30
T-3	424.50	0.00	15.50	15.50	0.00	58.67	154.11	Filling	440.00	15.50

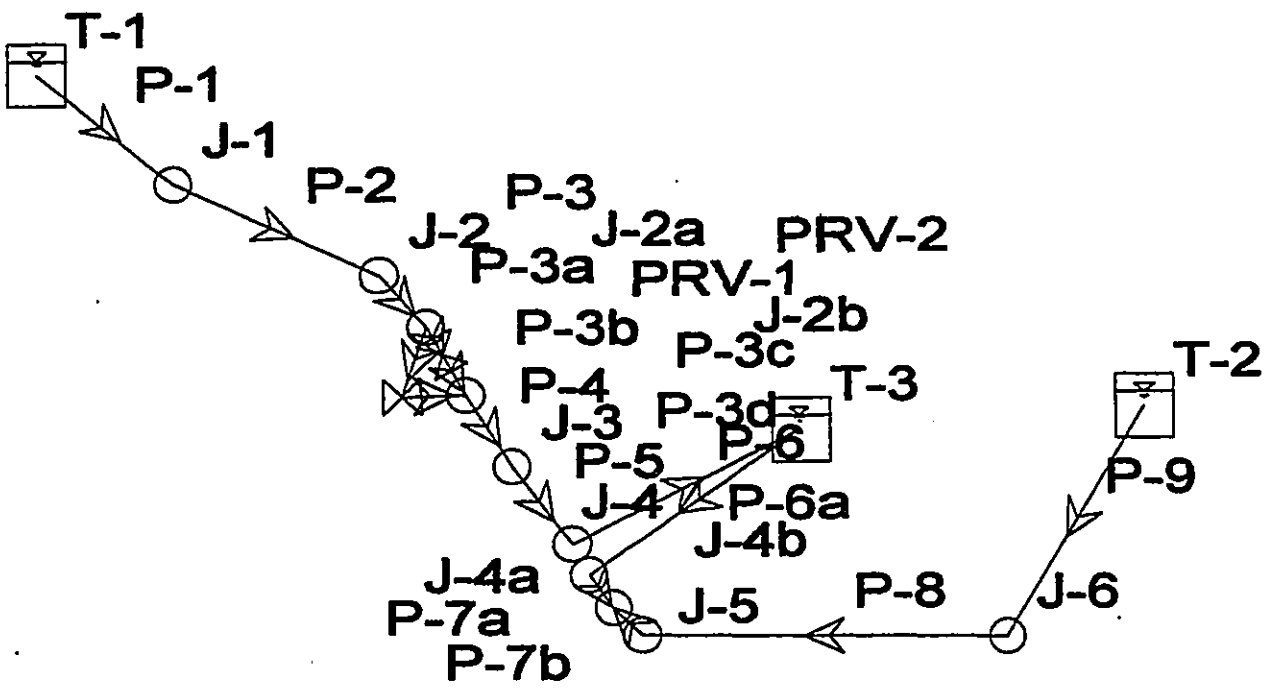
Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Minor Loss	Initial Status	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)
P-1	4,335.00	12	Ductile Iron	130.0	0.00	Open	Open	661.03	733.50	728.36	5.14
P-2	1,200.00	8	Ductile Iron	130.0	0.05	Open	Open	601.03	728.36	719.75	8.61
P-3	2,686.00	6	Ductile Iron	130.0	0.00	Open	Open	601.03	719.75	642.19	77.56
P-8	5,702.00	10	Ductile Iron	130.0	0.00	Open	Open	-107.83	373.20	373.77	0.57
P-9	3,200.00	12	Ductile Iron	130.0	0.03	Open	Open	-227.83	373.77	374.30	0.53
P-5	670.00	8	Ductile Iron	130.0	0.00	Open	Open	601.03	471.68	466.87	4.80
P-6	3,750.00	8	Ductile Iron	130.0	0.00	Open	Open	601.03	466.87	440.00	26.87
P-3c	10.00	2	Copper	135.0	0.00	Open	Open	286.96	642.19	627.63	14.56
P-3a	10.00	4	Ductile Iron	130.0	0.05	Open	Open	314.07	642.19	641.51	0.68
P-4	2,333.00	6	Ductile Iron	130.0	0.03	Open	Open	601.03	539.57	471.68	67.89
P-3b	10.00	4	Ductile Iron	130.0	0.05	Open	Open	314.07	540.25	539.57	0.68
P-3d	10.00	2	Copper	135.0	0.00	Open	Open	286.96	554.12	539.57	14.56
P-6a	3,750.00	8	Ductile Iron	130.0	0.00	Open	Open	-446.92	424.46	440.00	15.54
P-7a	13,003.00	8	Ductile Iron	130.0	0.00	Open	Open	446.92	424.46	370.60	53.87
P-7b	8,707.00	8	Ductile Iron	130.0	0.00	Open	Open	-107.83	370.60	373.20	2.60

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-1	550.00	Demand	60.00	Fixed	60.00	728.36	77.13
J-2	523.64	Demand	0.00	Fixed	0.00	719.75	84.80
J-5	56.40	Demand	0.00	Fixed	0.00	373.20	136.99
J-6	44.80	Demand	120.00	Fixed	120.00	373.77	142.26
J-3	376.50	Demand	0.00	Fixed	0.00	471.68	41.16
J-4	357.00	Demand	0.00	Fixed	0.00	466.87	47.51
J-2a	457.00	Demand	0.00	Fixed	0.00	642.19	80.08
J-2b	457.00	Demand	0.00	Fixed	0.00	539.57	35.71
J-4a	357.00	Demand	0.00	Fixed	0.00	424.46	29.17
J-4b	55.00	Demand	554.75	Fixed	554.75	370.60	136.47

Steady State Analysis



Analysis Results
Steady State Analysis

Project Title:	Off-Site Water System Requirements
Project Engineer:	TERRANCE NAGO
Project Date:	11/25/98
Comments:	Oneloa Onsen and Sports Retreat

Hydraulic Analysis Summary

Analysis	Steady State	Demand Scenario	Default-Maximum Day
Friction Method	Hazen-Williams Formula	Accuracy	0.001000
Trials	40		

Liquid Characteristics

Liquid	Water at 20C(68F)	Specific Gravity	1.00
Kinematic Viscosity	0.108e-4 ft²/s		

Network Inventory

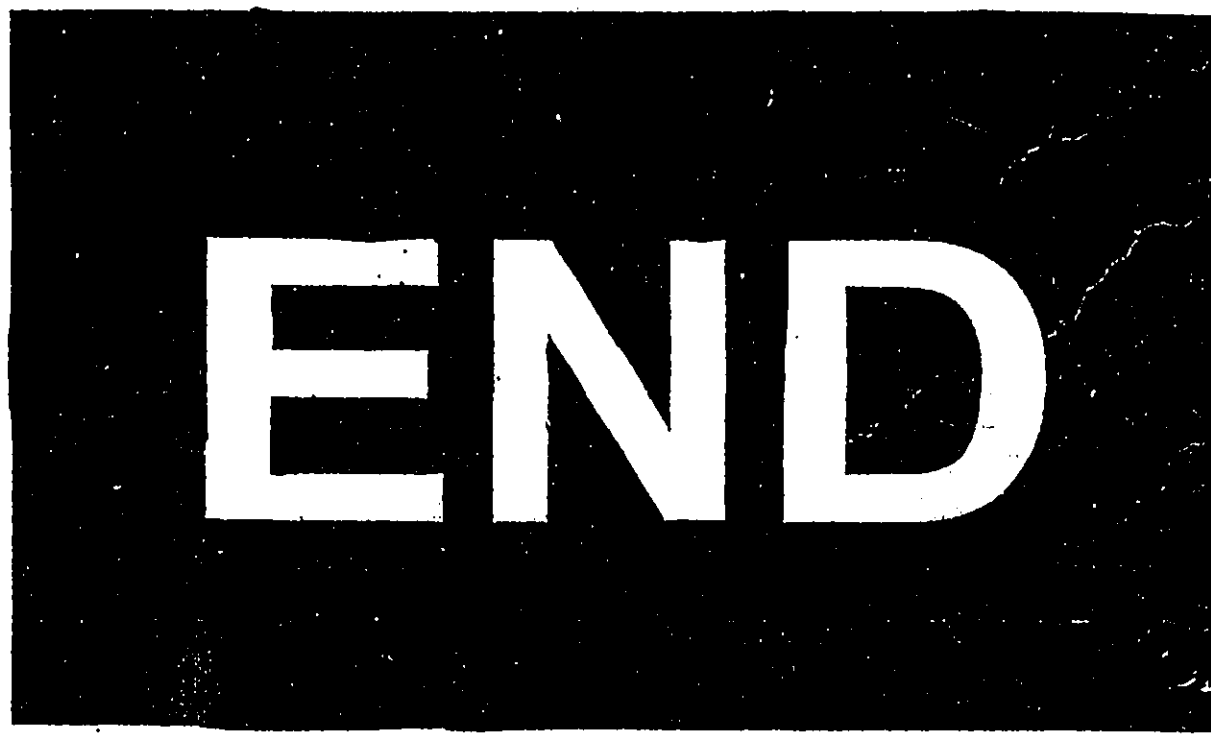
Number of Pipes	15	Number of Reservoirs	0
Number of Junctions	10	Number of Tanks	3
Number of Pumps	0	Number of Valves	2
- Constant Power:	0	- FCV's:	0
- One Point (Design Point):	0	- PBV's:	0
- Standard (3 Point):	0	- PRV's:	2
- Standard Extended:	0	- PSV's:	0
- Custom Extended:	0	- TCV's:	0

Junctions @ 0.00 hr

Label	Constituent (mg/l)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)	Pressure Head (ft)
J-1	0.0	728.36	77.13	60.00	178.36
J-2	0.0	719.75	84.80	0.00	196.11
J-2a	0.0	642.19	80.08	0.00	185.19
J-2b	0.0	539.57	35.71	0.00	82.57
J-3	0.0	471.68	41.16	0.00	95.18
J-4b	0.0	370.60	136.47	554.75	315.60
J-4a	0.0	424.46	29.17	0.00	67.46
J-4	0.0	466.87	47.51	0.00	109.87
J-5	0.0	373.20	136.99	0.00	316.80
J-6	0.0	373.77	142.26	120.00	328.97

Tanks @ 0.00 hr

Label	Constituent (mg/l)	Hydraulic Grade (ft)	Tank Level (ft)	Pressure (psi)	Percent Full (%)	Current Storage Volume (ft³)	Tank Inflow (gpm)	Tank Outflow (gpm)	Status
T-1	0.0	733.50	13.50	0.00	100.0	12,988.52	N/A	661.03	Draining
T-2	0.0	374.30	14.30	0.00	100.0	13,758.20	N/A	227.83	Draining
T-3	0.0	440.00	15.50	0.00	100.0	41,903.83	154.11	N/A	Filling



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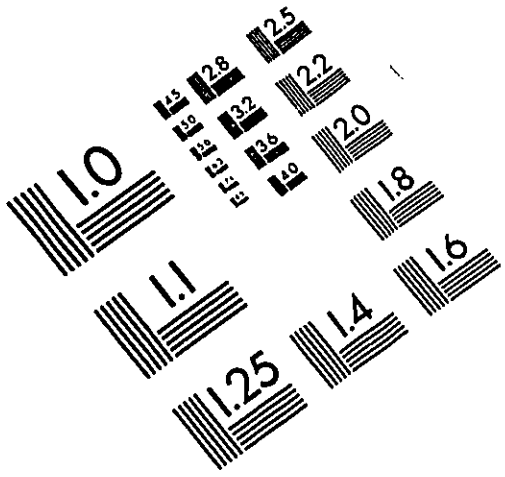
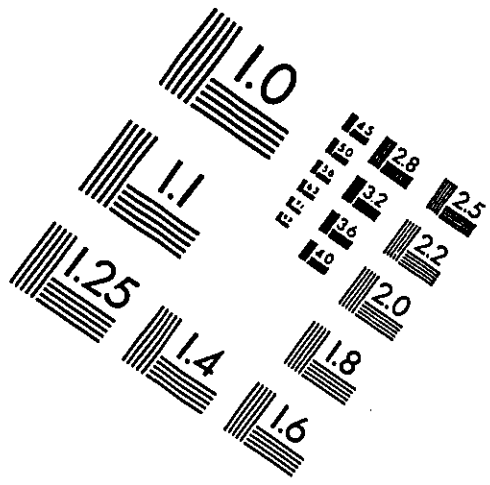
2007
DATE

SIGNATURE OF OPERATOR

TOP



Film Identification



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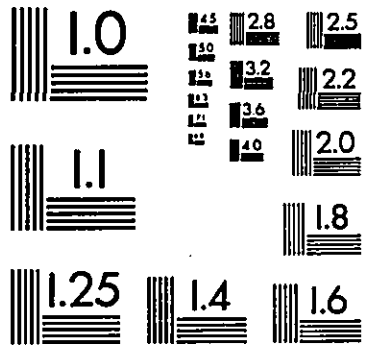
PRECISION[SM] RESOLUTION TARGETS

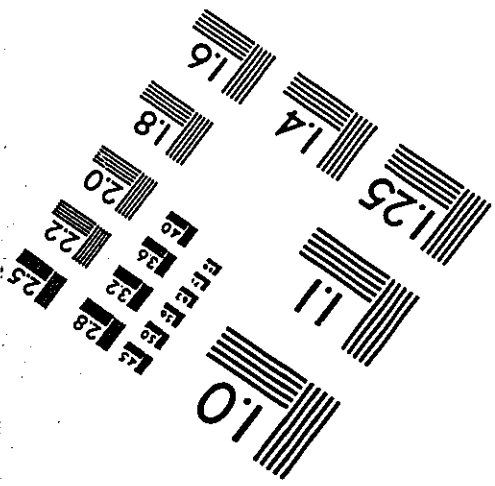


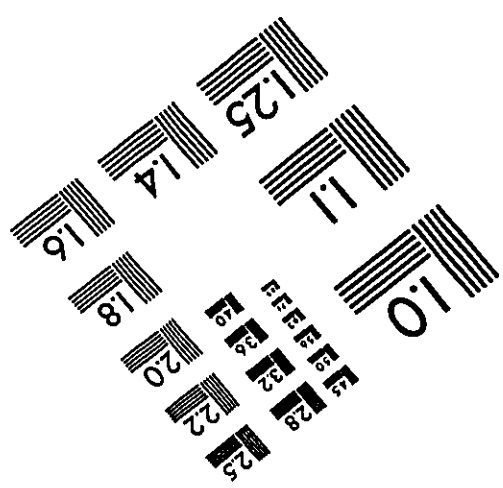
LEFT

RIGHT

150 MM

6 ″





PA-3 8½″x11″ PAPER PRINTED GENERAL TARGET

DENSITY TARGET