

***ENVIRONMENTAL ASSESSMENT
FOR THE CONSTRUCTION OF
MILITARY HOUSING UNITS
AT PACIFIC MISSILE RANGE FACILITY
BARKING SANDS, KAUAI, HAWAII***

**Prepared for:
Pacific Division
Naval Facilities Engineering Command
Pearl Harbor, Hawaii**

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Honolulu, Hawaii**

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**ENVIRONMENTAL ASSESSMENT
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BARKING SANDS, KAUAI, HAWAII**

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Abstract: The **U.S.** Department of the Navy is proposing to construct from 13 to 34 family housing units at the Housing Area at Pacific Missile Range Facility, Barking Sands, Kauai. The housing is intended for military personnel assigned to the Range Facility on permanent duty. The housing will be mostly two bedroom, one-story duplex units, sharing primary distribution of utility services to the existing family housing in the same area. Site of the proposed housing is located mauka of and adjacent to the existing family housing units. The lot is currently unused and is covered by second growth coastal scrub forest.

At the time of this analysis, the population at PACMISRANFAC consisted of 595 civil service and contract employees and 207 military personnel. Permanent lodging facilities on base include 68 billets for single military personnel and 56 family housing units. The family housing units were built in 1969. According to a 1990 housing survey, approximately 23 families live off base. The purpose of the proposed housing project is to reduce the present deficit of housing units, estimated from the survey to be 38 units.

Alternatives to the proposed action include no-action, location of the project on an alternative site, construction of two-story duplexes rather than one-story duplexes, and the phased construction of the housing units, beginning with 13 units.

The site was investigated for flora, fauna, archaeology, land use hazards, and infrastructure impacts. No significant environmental impacts were identified with the project. Short-term construction related impacts can be mitigated through the use of accepted construction techniques as outlined by County of Kauai and State of Hawaii regulations. One candidate endangered plant species, the Ophioglossum concinnum, has known habitat near the site and was searched for but not found. Should the Ophioglossum subsequently be discovered on site, the **U.S.** Fish and Wildlife Service (**USFWS**) would be informally consulted regarding transplanting before plants are disturbed. No archaeological artifacts have been identified on the site; however, a monitoring program is recommended during any construction activity that will cause sub-surface disturbance. The monitoring archaeologist will have the authority to halt construction in the immediate area of a find until mitigative measures have been taken.

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CHAPTER 1

SUMMARY AND INTRODUCTION

1.1 IDENTIFICATION OF DOCUMENT

This document is an Environmental Assessment for an administrative action.

1.2 TITLE OF ACTION

Construction of Military Housing Units at the Pacific Missile Range Facility, Barking Sands, Kauai, Hawaii.

1.3 BRIEF DESCRIPTION OF ACTION

The U.S. Department of the Navy is proposing to construct from 13 to 34 family housing units at the Housing Area at Pacific Missile Range Facility, Barking Sands, Kauai. The housing is intended for military personnel assigned to the Range Facility on permanent duty. The housing will be primarily two-bedroom duplex units of one or two stories, sharing primary distribution of utility services to the existing family housing in the same area. Site of the proposed housing is located mauka of and adjacent to the existing family housing units. The site is unused and is covered by second growth coastal forest of primarily introduced species.

At the time of this study, the population at PACMISRANFAC consisted of 595 civil service and contract employees and 207 military personnel, of which 81 had families. There are 56 family housing units on base, which were built in 1969. According to a 1990 housing survey, the 222 military personnel then at PACMISRANFAC rated 101 housing units based on standard Navy "housing requirements factors" of 95 percent of eligible officers and 73.3 percent of eligible enlisted. Of this gross requirement, 56 reside in existing government quarters, six prefer living off-base, and one is voluntarily separated from his family. The net requirement is 38. The purpose of the proposed housing project is to reduce the deficit of housing units.

1.4 SUMMARY OF ADVERSE IMPACTS AND MITIGATION ACTIONS

- Possible minor construction impacts would be noise and dust; no mitigation actions required beyond normal procedures are required.
- U.S. Fish and Wildlife Service (USFWS) would be informally consulted should Ophioglossum plants be discovered on site.
- Archaeological remains, should they be discovered, would be treated in accordance with State and Navy policy.
- No adverse impacts to infrastructure are identified.

1.5 SUMMARY OF ALTERNATIVES CONSIDERED

- No action
- Alternative site across Tartar Drive and north of the proposed site
- Two-story duplexes, rather than one-story duplexes
- Phased construction of the units, beginning with an increment of 13 units

1.6 SIGNIFICANCE OF IMPACTS

The proposed action will not have any significant environmental effects, nor will it place any strain on PACMISRANFAC facilities or infrastructure. The proposed action would meet the current housing deficit on base and thus have a significant positive impact upon personnel morale among those separated from their dependents. The project would also help to relieve the tight private housing market in the surrounding area.

1.7 LIST OF AGENCIES AND PERSONS CONTACTED

Department of the Navy

- Ken Ando, Housing Branch, PACNAVFACENGCOM, Pearl Harbor
- Calvin Yamane, Utility Management, PACNAVFACENGCOM, Pearl Harbor
- George Teramoto, Water & Wastewater Section, Environmental Engineering Branch, PACNAVFACENGCOM, Pearl Harbor
- Christine Nonaka, PACMISRANFAC, Barking Sands
- Charlene Castor, PACMISRANFAC, Barking Sands
- Robert Inouye, PACMISRANFAC, Barking Sands
- Lt. David Jarrell, PACMISRANFAC, Barking Sands

Department of Education, State of Hawaii

- Marian Nakano, Administrative Offices, Kauai
- John Derby, Principal, Kekaha Elementary School

Kauai Electric Company

- Norman Takashiba

CHAPTER TWO PURPOSE AND NEED

2.1 BACKGROUND

Pacific Missile Range Facility (PACMISRANFAC) was established in 1958 as a mid-Pacific detachment of the Pacific Missile Test Center, Point Mugu, California, for the purpose of supporting missile programs in the Hawaiian Area. The facility provides major range services for training, tactics development, testing, and evaluation of air, surface, and subsurface weapons systems by Pacific Fleet users, other Department of Defense agencies, and foreign military forces.

PACMISRANFAC consists of several separate areas located on the Islands of Kauai, Oahu, Niihau, and the Midway Islands. The primary range support facilities are located on the Island of Kauai at Barking Sands. Barking Sands occupies a narrow strip of land on the west coast of Kauai. Several miles to the north of Barking Sands is a secondary facility located at Makaha Ridge. East of Barking Sands is the magazine area at the base of Kamokala Ridge. The facilities at Port Allen, approximately 16 miles southeast of Barking Sands, include a warehouse and a surface craft support area. The satellite stations include a frequency monitoring facility at Mauna Kapu on the island of Oahu and a Missile Impact Location Station on the Midway Islands. Radar facilities exist on Niihau and at Kokee Tracking Station, a few miles east of Makaha Ridge.

Barking Sands, the location of PACMISRANFAC headquarters, is a long narrow site, consisting of approximately 2,046 acres of land area, bordered on the west by the Pacific Ocean and on all other sides by agricultural and undeveloped land. The operational control, safety, display, and data recording facilities are located at this site. Other facilities include two tracking radars, one surveillance radar, high frequency transmitters and receivers, a launch complex for target and rockets, a calibration laboratory, a Post Operational Data Analysis and Display Facility, and a 6,000-foot airfield runway with associated support facilities. Housing quarters, personnel and community support facilities are situated in the southern end of Barking Sands near Kokole Point.

2.2 PURPOSE AND NEED

The current population at PACMISRANFAC consists of 595 civil service and contract employees and 207 military personnel. Permanent lodging facilities on base include 68 billets for single military personnel and 56 family housing units. The family housing units were built in 1969. According to a 1990 housing survey, the 222 military personnel then at PACMISRANFAC rated 101 housing units based on standard Navy "housing requirements factors" of 95 percent of eligible officers and 73.3 percent of eligible enlisted. Of this gross requirement, 56 reside in existing government quarters, six prefer living off-base, and one is voluntarily separated. The net requirement is 38. To prevent financial hardship, the range facility has a regulation that prohibits personnel in the ranks of E6 and below from bringing their dependents to Hawaii until they have procured housing.

At the time of this environmental study, there were 81 families at PACMISRANFAC, plus five involuntarily separated and three families "due-in," for a total demand of 89 housing units. Minus the **56** available units, **33** families needed quarters from other sources.

The closest off-station housing to PACMISRANFAC is in the town of Kekaha, about eight miles to the east, and beyond that in the town of Waimea. The area is primarily agricultural, with some tourist activity. Rental houses in the area tend to be small, old, and substandard. Rents in the area range from about **\$600 - \$700** for two-bedroom units, to **\$800- \$900** for three-bedroom units. At the time of this study, there were no rental listings on the market. As reported by PACMISRANFAC housing personnel, there may be an average of two rental listings on the market at any one time, but they are gone quickly because of the tight market for rental housing. The waiting list for housing has been running approximately **26** families, with the period of waiting from **20** to **24** months. At the time of the 1990 housing survey, **16** of the **23** families living off base reported that they were not suitably housed for reasons such as rent, condition of the house, or distance from the base.

The housing deficit is computed annually from the housing survey information. The computed 1990 deficit is **38**. As a result of DOD policy expressed in CNO message DTG **2301452** Oct 90, new housing can be programmed only to 90 percent of the computed deficit. Therefore, the programming limit is **34** units. In 1989, the computed deficit was **25** and in 1988, it was **13**.

It is clear that the availability of housing at PACMISRANFAC is a major concern for the living conditions and morale of personnel assigned to the facility. The purpose of the proposed housing project is to reduce the present deficit of **38** housing units.

CHAPTER 3 ALTERNATIVES

3.1 INTRODUCTION

Base loading at PACMISRANFAC is expected to remain constant over the foreseeable future. The factors in the civilian community that tend to make civilian housing unsuitable for military personnel assigned to PACMISRANFAC are projected to remain the same or become even more constraining. Community housing assets are likely to increase in price and decline in availability as a result of growing resort development. Competition for existing housing is projected to remain high, especially in the PMRF market area, "thus, military families at the Missile Facility will have a harder time finding suitable housing within the civilian community." (SMS Research, "PMRF Family Housing Market Study", Final Report, January 1991.) Alternatives for the number of housing units are based on meeting at least the minimum 1988 deficit of 13, or the maximum level of 34.

The proposed location for family housing on PACMISRANFAC is constrained by the operational character of the base, in which aviation and military launching activities in the northern, central, and extreme southern part of the base preclude housing. There is open space within the existing personnel support area located adjacent to the existing housing at Kokole Point. Therefore, no alternative housing locations are examined outside of the family housing area. The two locations considered, which can be used in whole or in part, or together for the maximum development alternative, are located on either side of Tartar Drive, makai of Sidewinder Road. Figures 1, 2, and 3 depict the location of the proposed site.

There are two alternative designs being considered for the housing project, two-story or one-story duplex units. Density will depend upon the ranks for which the structures are intended, with officer housing being between 2.5 to 5 units per acre, and enlisted personnel housing between 4 to 10 units per acre. Duplex units will be constructed in all cases to economize on development costs.

3.2 DESCRIPTION OF THE PROPOSED ACTION

The proposed action is to construct up to 34 family housing units at the Kokole Point Housing Area at Pacific Missile Range Facility, Barking Sands, Kauai. The housing is intended for military personnel assigned to the Range Facility on permanent duty. The housing will be mostly two bedroom, one-story duplex units, sharing primary distribution of utility services to the existing family housing in the same area. Site of the proposed housing is located mauka and adjacent of the existing family housing units. The lot is currently unused and is covered by second growth coastal forest.

LOCATION MAP Island of Kauai

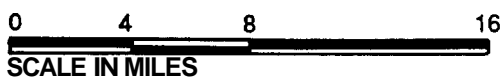
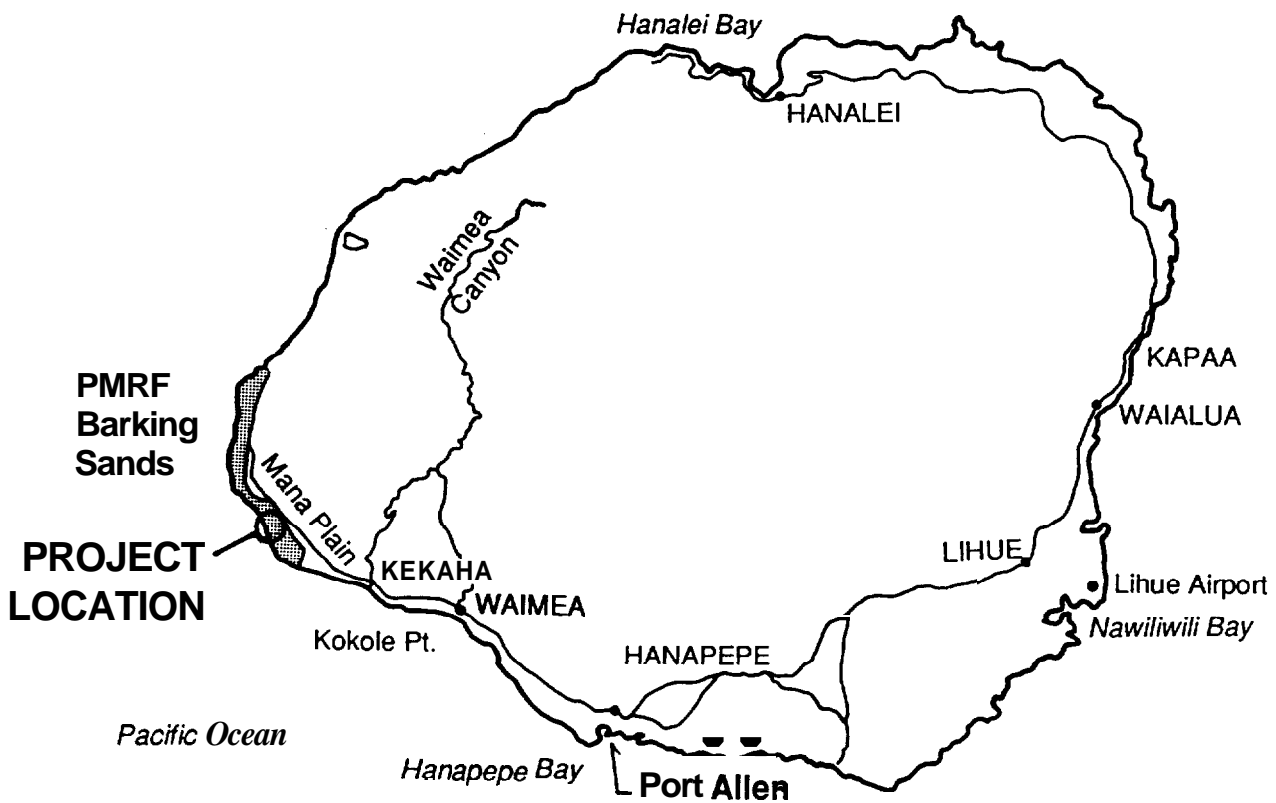
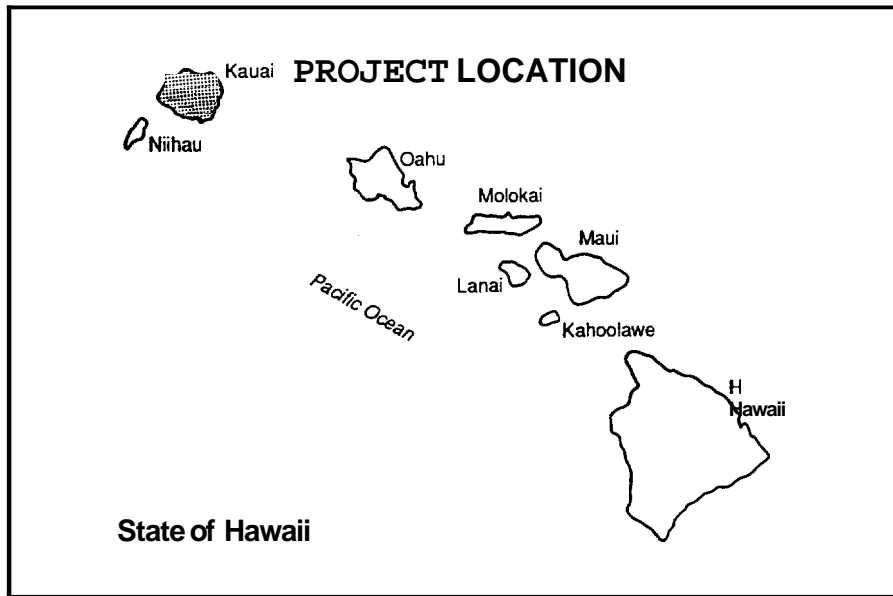


Fig. 1

PROPOSED HOUSING SITE

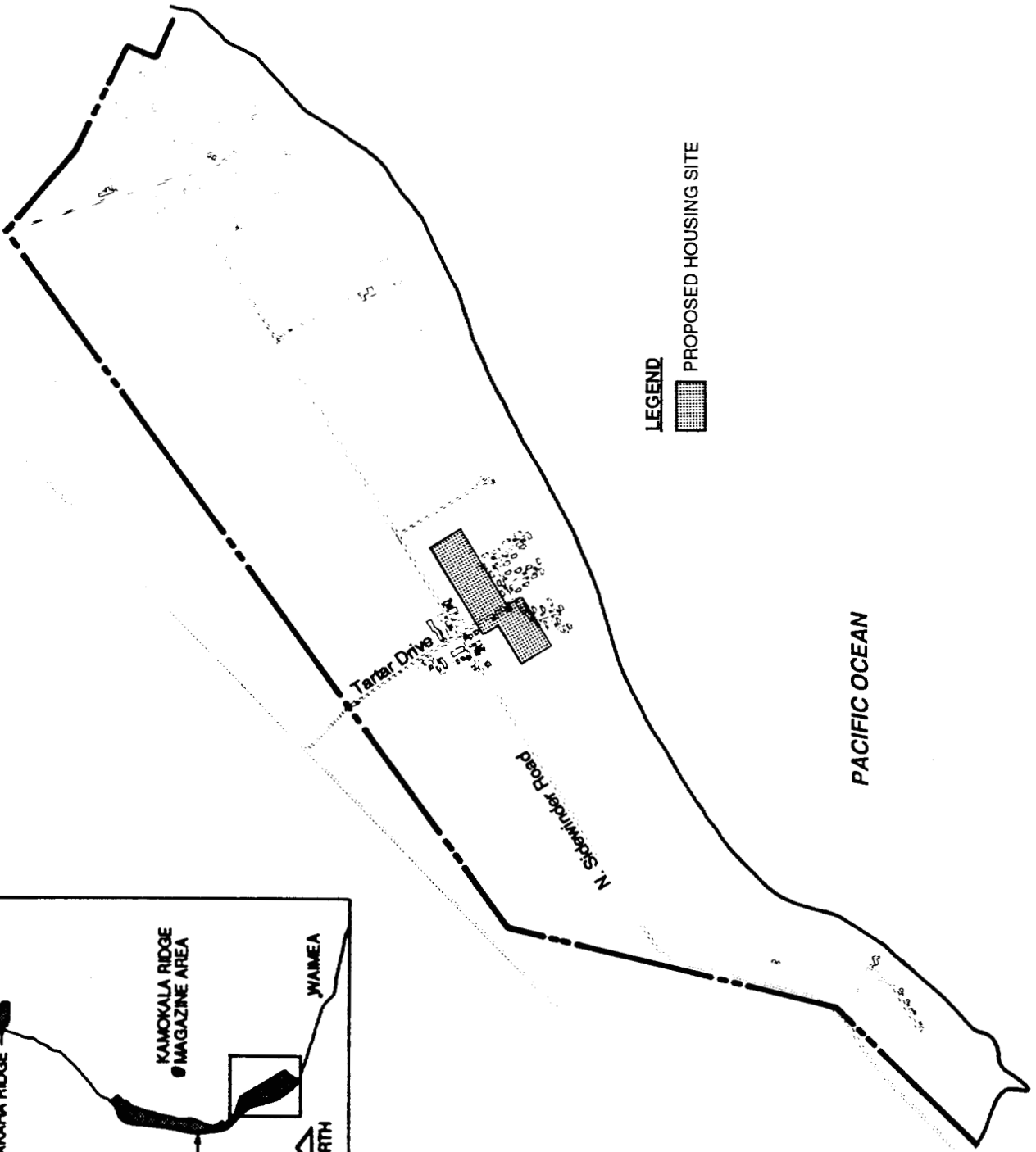
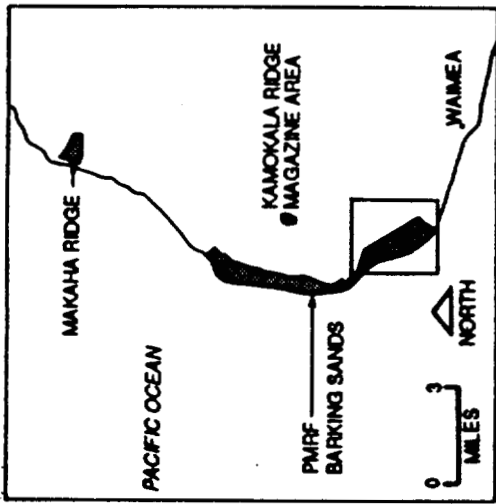


Fig. 2



CONCEPTUAL DEVELOPMENT PLAN

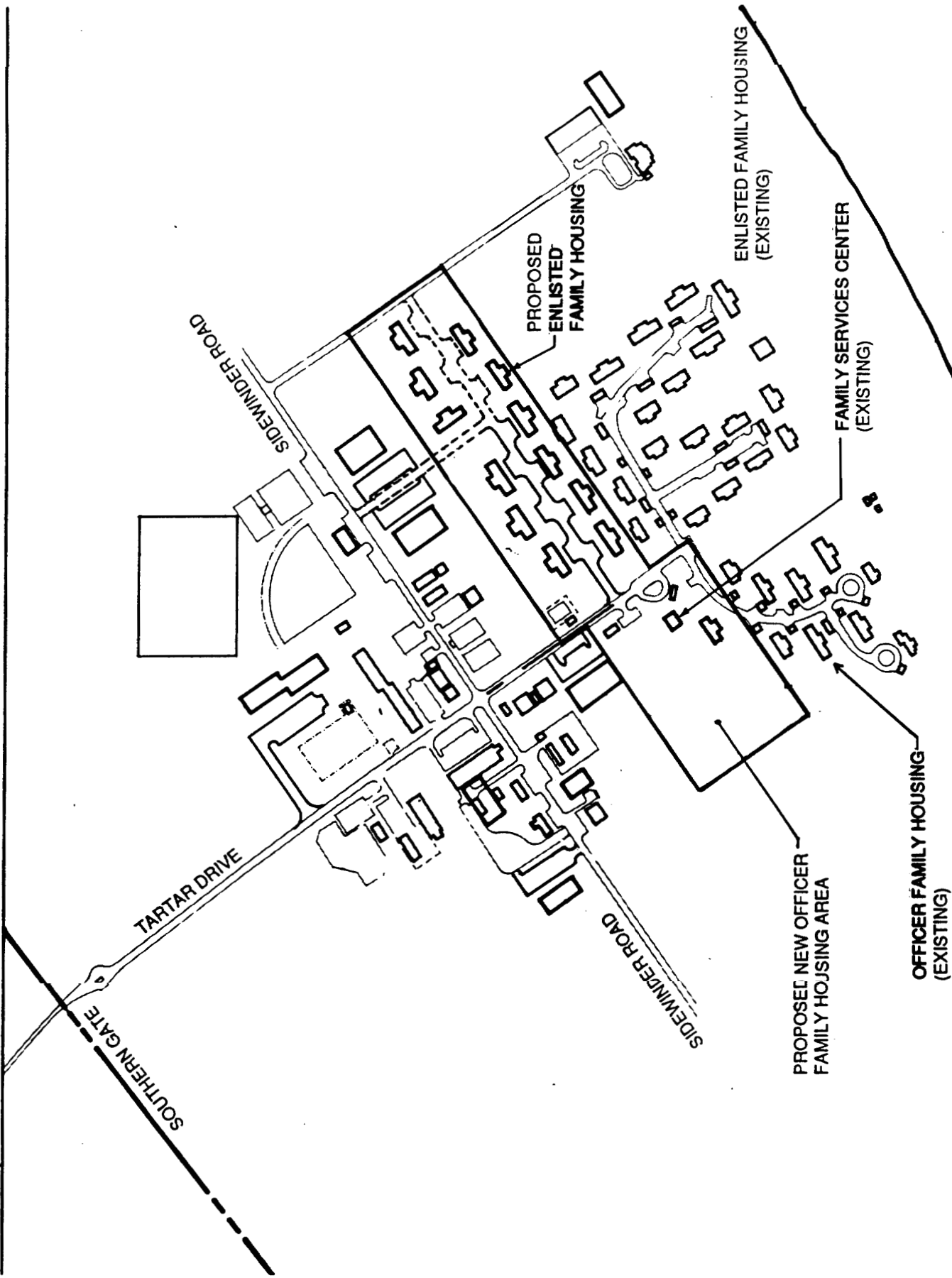


Fig. 3



3.3 DESCRIPTION OF ALTERNATIVES

3.3.1 Design Alternatives

The style of existing housing at PACMISRANFAC is one-story duplex, with detached car ports. Yards are relatively spacious. The proposed new units will be compatible in style with the existing units. They will be primarily two-bedroom structures, with some three-bedroom houses constructed for field grade officers in the 34- or 25-unit alternatives. In the 13-unit alternative, only two-bedroom, enlisted structures would be constructed. For the 34-unit alternative, at medium density and two stories, 1.6 to 2 acres would be necessary for officer housing requirements and about 3 acres for enlisted requirements. The less dense one-story alternative would require about 2.6 acres for the officers and 6.5 acres for the enlisted requirement. It is anticipated that the cost of the single-story alternative would be somewhat greater than that of the two-story alternative, because the latter allows greater sharing of costs for foundation, utilities, and common structural features among units.

3.3.2 Location Alternatives

For reasons discussed in Chapter 2, the only sites considered were located in the existing housing and personnel support area. The primary site is between Tartar Drive and the road to the new All Hands Club, on the makai side of Sidewinder Road. This site is approximately 10.5 acres and is adequate to house the entire 34 unit programming limit. However, since officer housing is located to the north side of Tartar Drive, eight units are proposed for construction on that side of the road. In the 25 unit alternative, only five officer units would be constructed north of Tartar Drive, and in the 13 unit alternative, no officer housing would be built. There is more than adequate space for the required number of officer units.

3.3.3 Program Alternatives

Three alternatives are proposed. The preferred alternative meets the full programmed construction need of 34 units, thereby eliminating the housing deficit. This is anticipated to cost approximately \$5,466,000 in FY 1993, based on costs to construct two-story duplex units. The program would construct eight officer units of two- and three-bedrooms and 26 enlisted units of two bedrooms.

The second alternative is to build 25 units, consisting of 5 officer and 20 enlisted units. The estimated cost is \$4,019,000. This alternative would fall short of meeting the housing programming limit by 9 units.

The third alternative is to build 13 enlisted, two-bedroom units. This would cost an estimated \$2,090,000 in FY 1993 dollars, and leave a deficit of 25 units. This is the present programmed MILCON Project, H-134, scheduled for FY 1994 funding. The project is being considered for earlier construction in FY 1993.

3.3.4 No-Action Alternative

The no-action alternative would not address the housing needs at PACMISRANFAC and would have a continued detrimental effect on morale, retention of military personnel in the service, and productivity. The monetary impact of the no-build alternative cannot be

determined, but would include the indirect costs associated with the lost productivity due to continued morale and personnel problems, continued payment of housing allowances to those residing off-base, and the continued payment of family separation allowances to those involuntarily separated from their families.

3.4 Summary

A phased alternative is possible, starting with the existing MILCON project and building over a period of several years to the 34 unit limit. This may be attractive from the programming perspective. However, it is likely to drive up total costs because of multiple mobilization expenses, and because of reduced sharing of infrastructure costs. While the no-action alternative is the least expensive from a capital outlay standpoint, the negative effects upon long-term base morale do not make it an attractive alternative. The full build out of all 34 units is seen as the best alternative for minimizing infrastructure installation expenses and for meeting existing and projected demands for adequate housing.

CHAPTER 4 EXISTING ENVIRONMENT

4.1 TOPOGRAPHY

Kauai is the fourth largest island in the State of Hawaii. It is 33 miles long and 25 miles wide and occupies 555 square miles (355,000 acres). The highest point on the island is Kawaikini Peak, which rises to 5,170 feet above sea level in the center of the island. The northern part of the island is characterized by high cliffs formed by wave action. Canyons, steep slopes, and the Alakai Swamp make access to the north and central part of the island difficult. Most potentially useable land consists of the lowlands on the perimeter of Kauai.

PACMISRANFAC's main base is located on a low lying coastal plain on the west coast of Kauai. It is bounded by the Pacific Ocean to the west, sugarcane fields and Kaunualii Highway to the east, sand dunes to the north, and Kokole Point to the south. The elevation varies from sea level to +25 feet over most of the base, with some dunes in the north rising to over 100 feet above sea level. The site of the proposed housing project consists of small dunes approximately 15 to 20 feet above mean sea level. The dunes are interspersed with low-lying areas approximately 10 to 12 feet above mean sea level.

4.2 GEOLOGY AND SOILS

4.2.1 Geology

Kauai is the oldest of the eight Hawaiian Islands. The island began as a large shield volcano similar to Mauna Loa on the island of Hawaii. Kauai's formation was probably completed before the end of the Pliocene Period. The rocks of the volcano are of the Waimea Canyon volcanic series, which is further classified into the Napali, Olokele, Haupu, and Makaweli formations.

PACMISRANFAC is located on the western side of Kauai in the geologic area known as the Mana Plain. The plain is composed of alluvium washed from the uplands, calcareous and earthy lagoon deposits, and calcareous beach and dune sands. On its inland edge, the lagoonal deposits are earthy, overlain by younger alluvium, and probably graded into older alluvium. On the seaward side, the deposits are mostly calcareous and probably graded into barrier beach deposits. Clay beds containing gypsum exist in some places.

The site of the proposed housing facility rests upon calcareous beach and dune sand deposits. The geology of the site is typical of such "back-shore" areas, with small dune rises and low spots.

4.2.2 Soils

A single soil classification applies to all of PACMISRANFAC. This is the Jaucus-Mokuleia association. The U.S. Soil Conservation Service (SCS) describes this association as unique to Kauai. It consists of excessively drained and well-drained soils in

dunes and on former beach areas. These soils are developed in coral or basaltic sand and are nearly level to moderately sloping.

The dominant soil found on the proposed housing site is Jaucus loamy fine sand (JfB) of the Jaucus series. This soil exhibits the following characteristics:

Suitability as a source of topsoil: poor--low available water capacity
Suitability as a source of roadfill: poor--unstable; highly erodible
Soil features affecting highway location: unstable slopes; erodible
Soil features affecting farm ponds: highly pervious; poor stability
Soil features affecting irrigation: low available water capacity; rapid intake rate
Soil features affecting foundations for low buildings: all features favorable
Degree and kind of limitations for septic tank filter fields: slight rapid permeability

SCS describes this soil as occurring on old beaches and on windblown sand. It is pale brown to very pale brown, sandy, and in some cases more than five feet deep. In many places, the surface layer is dark brown as a result of accumulated organic matter and alluvium. The soil is neutral to moderately alkaline throughout its profile. Permeability is rapid and runoff slow to very slow. Wind erosion is a severe hazard when vegetation has been removed.

This soil is suitable for pasture, recreational areas, wildlife habitat, sugarcane, and alfalfa. The natural vegetation consists of kiawe, koa-haole, bristly foxtail, bermuda grass, fingergrass, and Australian saltbush,

4.3 CLIMATE

Kauai has a mild, semi-tropical climate. Because of the marine influence and the prevailing northeast tradewinds, there is very little diurnal or seasonal variation in temperature. Greater variations in temperature are due primarily to change in elevation; however, temperatures do not reach freezing even at the highest areas in Kauai. Rainfall varies from about 20 inches per year on the leeward coast to about 400 inches at Mount Waialeale, the wettest spot in the world.

4.3.1 Precipitation

The coastal plain of western Kauai is one of the most arid regions in the State. Mean annual rainfall for the area over a 34-year period has been **22.9** inches, with three-fourths of this amount falling during the period of October through March. The northern sector of PACMISRANFAC is slightly wetter than the southern part with a median of 23 inches, compared to 18 inches on the south. Rainfall at the site of the proposed housing project measures approximately one inch per month in the spring, summer, and fall, and two to three inches a month in the winter.

4.3.2 Temperature

At PACMISRANFAC, long, dry, hot periods are common. The mean annual temperature range is 70° F to 78° F. The hottest temperature ever recorded on the Mana Plain is 95° F and the lowest recorded is 48° F.

4.3.3 Wind

The prevailing northeast tradewinds reach PACMISRANFAC from various directions due to the barrier effect of the mountains and cliff areas to the north and east. The tradewinds may come down from the mountains or around Mount Waialeale through Hanapepe, or around the Napali Coast, moving inland as they reach the Mana Plain. Diurnal wind patterns occur during calm weather, bringing sea breezes during the night to cool the warm air that has accumulated during the day. Strong winds also come from the south during the winter, when the islands are struck by low pressure systems known as Kona storms.

4.3.4 Limiting Conditions

The major limiting condition of the climate at PACMISRANFAC for agriculture is the low rainfall. In no month of the year does rainfall exceed evaporation. Irrigation is required for agriculture year-round.

4.4 HYDROLOGY AND DRAINAGE

4.4.1 Hydrology

PACMISRANFAC's groundwater system is comprised of three different but hydraulically connected aquifers. The aquifer in the basement rock of the Napali formation is typical of highly permeable basaltic aquifers elsewhere in Hawaii. Hydraulic conductivity is on the order of 1,000 feet/day and effective porosity is about 10 percent. The groundwater occurs as a brackish lens floating on sea water but is confined beneath the much less permeable sediments of the caprock. Nowhere at PACMISRANFAC does the basalt aquifer carry either potable or irrigation grade water. Salinity is high, in excess of 1,000 mg/l chloride.

The overlying sediments act as a caprock because of their low overall permeability, although individual layers, such as buried fossil coral reefs, may be as permeable as basalt. The hydraulic effect of these layers is local, however. The column of sediments is saturated but is not exploitable as an aquifer because of unfavorable hydraulic characteristics. The groundwater in it originates as seepage from the basalt aquifer, especially where the sediments are thin near the inner margin of the Mana Plain, from irrigation percolation and rainfall. To keep the water table below the root zone of sugarcane, thousands of feet of drainages have been excavated. The groundwater in the sediments is brackish.

The dune sand aquifer at PACMISRANFAC has a moderate hydraulic conductivity, probably 50 to 100 feet/day, and an effective porosity of about 20 percent. A basal lens of brackish groundwater floats on sea water. Recharge originates with storm rainfall and as seepage from the caprock sediments. Although the sand aquifer is exploitable, no groundwater of acceptable salinity seems to occur in it. Similarly, the salinity of the two lower aquifers eliminates them from consideration as sources of water for ordinary agriculture. The nearest fresh water sources are in the Napali formation at the inland edge of the coastal plain.

Nowhere at PACMISRANFAC does a source of either groundwater or surface water exist which is low enough in salinity to be used in agriculture. Both sources were found to be highly brackish.

4.4.2 Drainage

There is no natural drainage network at PACMISRANFAC because the sand is too permeable for rain water to accumulate and travel very far. Two drainage ditches traverse the base, carrying drainage water from Kekaha Sugar Plantation lands outside the facility. Pumps are required to lift the water from the alluvial plain to the slightly higher dune zone for passage to the sea.

The site contains a mixture of low lying areas where evidence of water accumulation during heavy rains is found. In addition, a large drainage ditch, a remnant of the vast drainage project undertaken by Kekaha Sugar in the 1930s, traverses the site from mauka to makai. The ditch is approximately six feet deep and restricted at both ends. It appears to function now as a sump following heavy rainfall. Drainage problems appear to exist following heavy extended rainfall. This is due to the saturation of the ground caused by the variable brackish water table under the site, which rises during extended wet periods and causes standing water for short periods of time.

4.5 EXISTING LAND USE

The site of the proposed housing project is located in the southern portion of the station, between the existing family housing area and the personnel support area. The area is currently undeveloped and covered with second growth coastal forest vegetation. The dwellings would be approximately three road miles away from the main operations area and five road miles from the rocket launch facilities in the northern support area. Residents of the proposed family housing would be within easy walking distance of recreational facilities and support facilities. Figures 4 and 5 portray existing and proposed land uses.

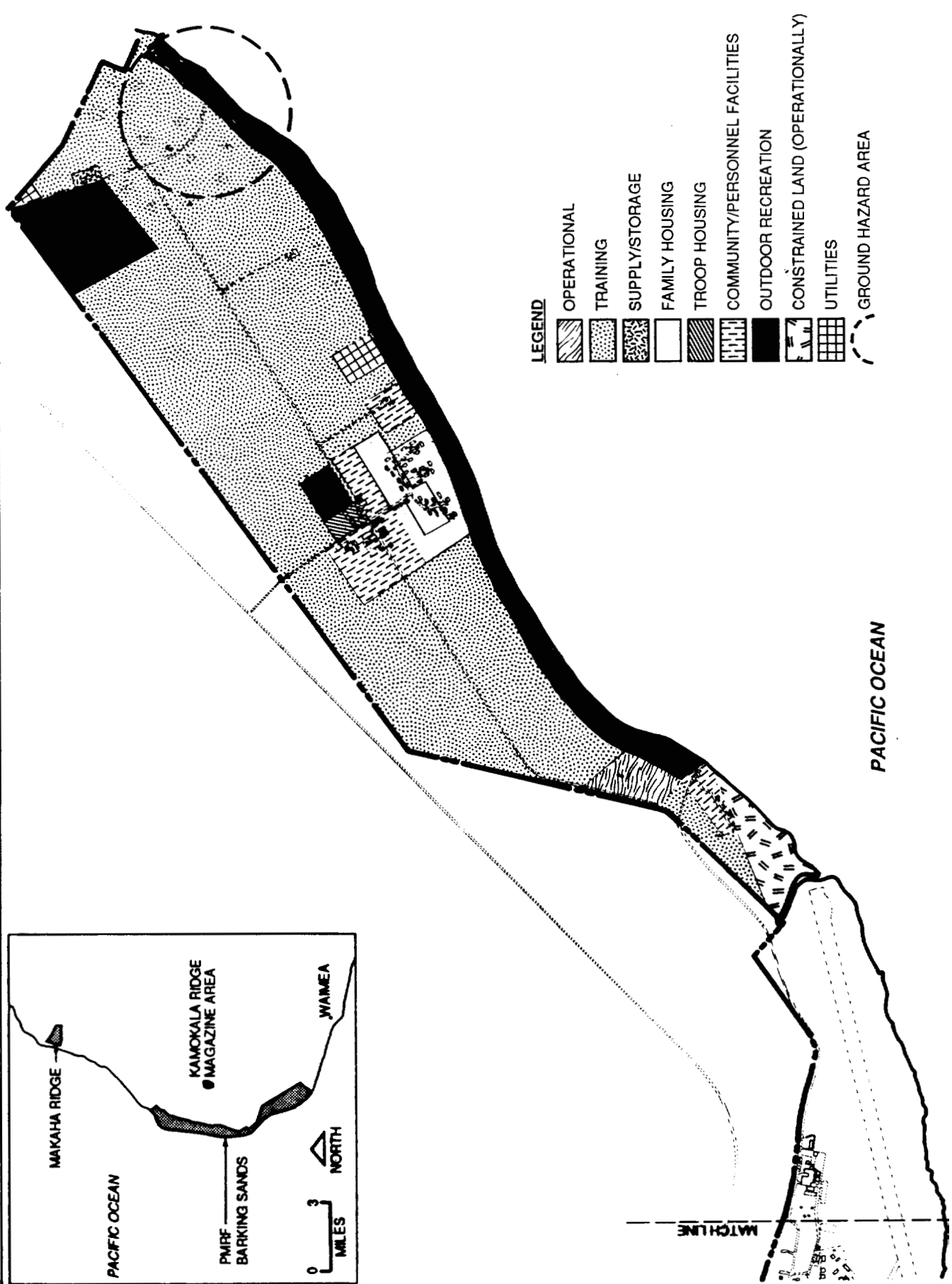
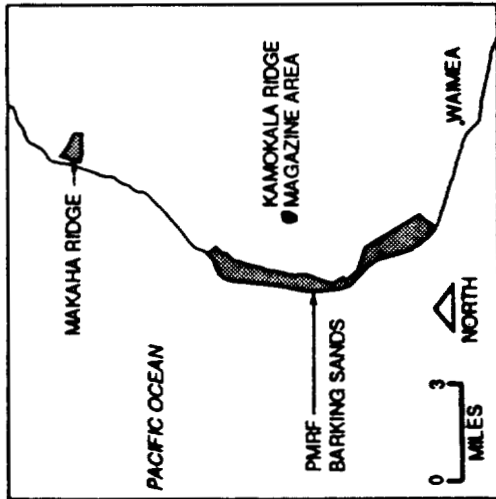
Adjacent land uses include the existing family housing on the makai side, basketball courts, the outdoor theater, and other recreational facilities on the mauka side, and the family services center on the north side.

In terms of area, the dominant existing land use at PACMISRANFAC is the explosive safety and airfield clear zones which cover approximately 39 percent of the station. Facilities located within these two zones include ordnance storage magazines, ordnance and weapons operating and support buildings, runways, taxiways, and supporting structures.

Another major land use is outdoor recreation, which covers approximately 400 acres. About 85 percent of the outdoor recreation area is located in the southern half of the station, adjacent to family housing. Several times a year, these areas also serve as training sites for marine amphibious exercises.

Operational areas are located throughout the station. The rocket launch, DOE, and underground fuel storage areas are located to the north. In the central portion of the station is the Air Operations Area. Communication antenna fields and an auxiliary launching site are located to the south. Combined, the operational areas total approximately 335 acres.

EXISTING LAND USE

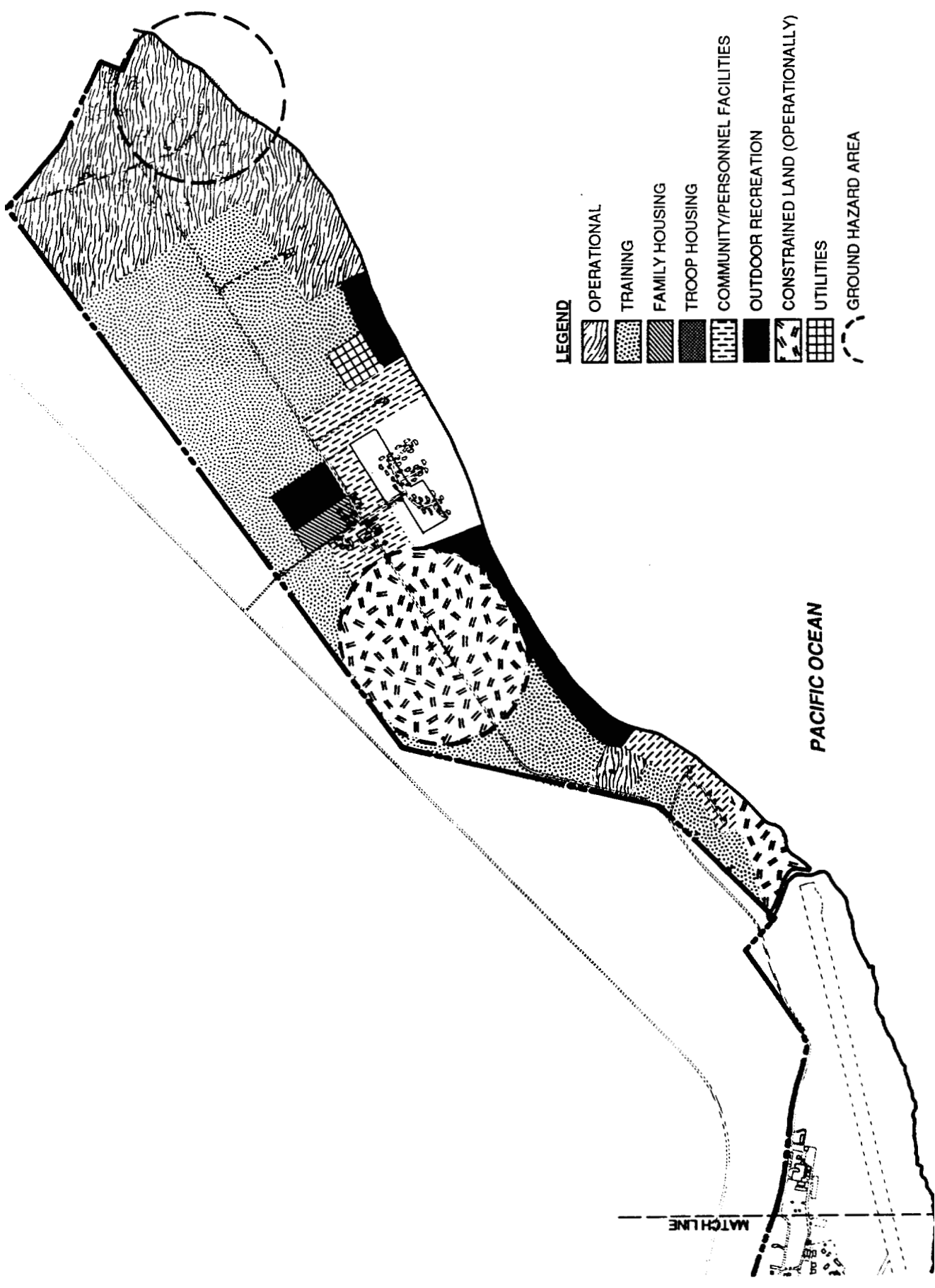


- LEGEND**
- OPERATIONAL
 - TRAINING
 - SUPPLY/STORAGE
 - FAMILY HOUSING
 - TROOP HOUSING
 - COMMUNITY/PERSONNEL FACILITIES
 - OUTDOOR RECREATION
 - CONSTRAINED LAND (OPERATIONALLY)
 - UTILITIES
 - GROUND HAZARD AREA



FIG. 4

PROPOSED LAND USE



- LEGEND**
- OPERATIONAL
 - TRAINING
 - FAMILY HOUSING
 - TROOP HOUSING
 - COMMUNITY/PERSONNEL FACILITIES
 - OUTDOOR RECREATION
 - CONSTRAINED LAND (OPERATIONALLY)
 - UTILITIES
 - GROUND HAZARD AREA



Supply and maintenance areas are located adjacent to the flight line in the main station and also adjacent to the Operations Area in the northern portion of the station. Acreages amount to 39 and 23 acres, respectively.

Administration and personnel support areas are located in the main station and the southern portion, respectively. These built-up areas lie on generally flat terrain and provide space for family housing, administration, bachelor housing, utilities, exchange retail, and morale, welfare, and recreation facilities.

The land at PACMISRANFAC is well utilized. In the main station area, most of the land is considered useable, since it is relatively flat and covered with vegetation ranging from grasses to koa haole. The main constraints are man-made. The principal environmental constraints consist of sand dune areas, tsunami inundation zones, and ecologically sensitive areas.

4.6 SOCIOECONOMIC ENVIRONMENT

PACMISRANFAC consists of approximately 2,046 acres in the main base area at Barking Sands along with two remote sites. The operational control, safety, display, and data recording facilities are located at the base. Other facilities at the main base include two tracking radars, one surveillance radar, R.F. transmitters and receivers, a launch complex for targets and rockets, a calibration laboratory, a Post Operational Data Analysis and Display Facility, and a 6,000-foot airfield with associated support facilities. Remote facilities include an ordnance storage facility and a tracking station at Makaha Ridge.

The current base loading at PACMISRANFAC consists of 595 civil service and contract employees and 207 military personnel. There are 68 billeting units for single military personnel and **56** family housing units on base. Twenty-three families are presently living in off-base housing. The current base population figure is not expected to change significantly in the foreseeable future.

The nearest community housing is approximately eight miles from the base in the town of Kekaha. Additional housing can be found beyond Kekaha in Waimea. Rental housing in the two towns tends to be small, old, and substandard. Rental rates range from **\$600** to **\$700** for two bedroom units to **\$800** to **\$900** for three-bedroom units. New housing development in the area is primarily intended for the tourist trade, with vacation rentals of **\$140** a night common.

Currently there are approximately **26** persons on the wait list for on-base housing. Wait times for base housing average from **20** to **24** months. To prevent financial hardship, PACMISRANFAC has a regulation that prohibits personnel in the ranks of **E6** and below from bringing their dependents to Hawaii until they have procured housing either on or off base. Until such time as these personnel find suitable housing, they must remain in the single-enlisted men's quarters.

A recent 1990 housing survey of all base personnel found 16 of the 23 families living off the station as reporting that they were not suitably housed. Reasons given included rent, condition of the house, and distance of the house from the base. The survey determined that there was a housing deficit of 38 units at PACMISRANFAC.

4.7 FLORA

The presence, populations, habitat, and distribution of flora at PMRF is well studied and documented. A field study conducted for this project is presented in Appendix B.

Flora on the site consists of second growth coastal forest with an understory of mixed native and exotic brush commonly found in that area of Kauai. Such habitats are very abundant on PACMISRANFAC. The predominant vegetation cover is a mixture of kiawe trees (Prosopis pallida) and koa-haole shrubs (Leucaena leucocephala), covering about **400** acres. Dodonaea-Nama shrubland, which covers about **100** acres, is the second major vegetation type and consists mainly of a'ali'i (Dodonaea viscosa), 'ilima lei (**Sida** spp.), Christmas berry (Schinus terebinthifolius), and lantana (Lantana camera).

The larger of the parcels on the proposed site consists of open to closed stands of kiawe trees, with a subcanopy of koa-haole shrubs. Where the kiawe canopy is less dense, lantana is present. Buffel grass (Cenchrus ciliaris) is the primary ground cover with localized profusion of green panicgrass (Panicum maximum var. trichoglume) and Guinea grass (P. maximum). The area near the unused drainage ditch supports two species of morning glory or koali (Ipomoea cairica, I. indica), chili pepper (Capsicum annuum), golden crownbeard (Verbesina encelioides), sourgrass (Digitaria insularis), klu (Acadia farnesiana), a'ali'i, and naupaka kahakai (Scaevola sericea).

The smaller parcel maintains patches of kiawe trees and buffel grass. The northeast corner of this parcel supports open Dodonaea scrub, along with golden crownbeard, Natal redtop (Rhynchelytrum repens), nama (Nama sanwicensis), naupaka kahakai, 'ihi (Portulaca pilosa), 'ilima (Sida fallax), and hunakai (Ipomoea imperata).

A category 1 candidate endangered species, the pololei fern (Ophioglossum concinnum), has been recorded in the both the southern and northern half of PMRF. This small fern lies dormant until after heavy rainfall. Two site studies were made between November and December **1990**; the latter was made after a heavy rainfall. No Ophioglossum ferns were located during either visit. None of the native species occurring on the project site are officially listed or proposed as threatened or endangered species.

4.8 FAUNA

Several studies have been conducted concerning animal species at PACMISRANFAC. A special field study was conducted for this project and is presented in Appendix C.

The PACMISRANFAC proposed housing development is presently covered in second growth forest with mixed native and exotic underbrush. Roadside habitat of mowed grass and residential lawns and yards also occur in close proximity to the property.

No evidence of rats or mice were found but these mammals likely occur on the property. One feral cat was seen. Black-tailed deer (Odocoileus henionus) are listed as "rarely found at PMRF" (TGI The Traverse Group Inc. **1988**). It is highly unlikely that deer utilize this particular site.

Records of the endemic and endangered Hawaiian Hoary Bat (Lasiurus cinereus semotus) are limited but the species is believed to be fairly common on Kauai (Tomich 1986; Kepler and Scott 1990).

The only new exotic species found was the Chestnut Mannikin (Lonchura malacca). This species is apparently localized but yet abundant at PACMISRANFAC. The only native species recorded was the migratory Pacific Golden Plover.

No unusual mammal activity was noted. No endangered species were recorded. The overall effect of the proposed development on the fauna in this region of the island should be minimal. Habitat of the sort found on this site is common at PACMISRANFAC. There is nothing from the perspective of the present fauna that makes this property unique or irreplaceable.

4.9 HISTORIC/ARCHAEOLOGICAL RESOURCES

A survey conducted in November 1990 by Archaeological Consultants of Hawaii found no significant historic, archaeological, or cultural sites in the area of the proposed housing project. A summary of the investigation is contained in Appendix D.

The purpose of the survey was to locate large subsurface sites such as extensive cultural deposits and large clusters of burials. Although the survey found no evidence of any large sites, it is possible that small sites such as individual subsurface burials may be present. Since many burials have been found on PACMISRANFAC, and most of these have been individual burials, this possibility must be regarded as significant. Due to the numerous burial finds, the Navy has drafted a specific Burial Treatment Plan to cover procedures to follow should subsequent sites be discovered at PACMISRANFAC, Barking Sands. It is recommended that a monitoring program be implemented during any construction activity that will cause subsurface disturbance. This should involve the presence on-site of an archaeologist during such ground disturbing activity. The monitoring archaeologist should have the authority to halt construction in the immediate area of a find until mitigative measures have been taken.

4.10 NATURAL HAZARDS AND CONSTRAINTS

4.10.1 Seismology

Except for the island of Hawaii, the Hawaiian Islands are not a highly seismic area. Even on Hawaii, most of the earthquakes are of volcanic rather than tectonic origin and rarely do major damage.

4.10.2 Wetlands

Portions of the area where PACMISRANFAC is now located were once a large marshland which was filled for agricultural purposes. The U.S. Fish and Wildlife Service (USFWS) classifies three areas on the base and one area immediately adjacent to the base as wetlands. The two sites on the coastline are classified as Marine System, Subtidal Subsystem, Reef Class, Coral Subclass, Subtidal. The major drainage ditch at the north end

of the base is classified as a Riverine System, Lower Perennial Subsystem, Open Water/Unknown Bottom Class, Permanent Non-Tidal, Excavated. The ditch at the southern end of the base is classified as a Palustrine System, Emergent Class, Persistent Subclass, Seasonal Non-Tidal, Excavated. There may be some tidal influence toward the mouth of either canal during high tide periods. The site of the proposed family housing contains no identified wetlands. See Figure 6.

4.10.3 Flood Hazard

The Flood Insurance Rate Map (1987) reveals that the majority of PACMISRANFAC lies within a potential flood prone area. See Figure 6.

In the past 25 years, several tsunamis have occurred at PACMISRANFAC. The most severe was in 1946, when wave runup reached an 11-foot elevation and inundated an area almost as far inland as Kaumualii Highway. In 1969, a storm wave swept 600 feet inland at Barking Sands and flooded several houses. Civil Defense maps of Barking Sands continue to designate the land 3,000 feet inland as an evacuation zone. The Flood Insurance Rate Map shows a flood line for a combination of tsunami, cyclonic storms surge, and storm wave runup effects. The proposed site for family housing lies outside of the special flood hazard area as shown on FIRM maps, but within the 3,000-foot evacuation zone. The proposed site is at an elevation ranging from 10 to 20 feet.

4.11 MAN-MADE HAZARDS AND CONSTRAINTS

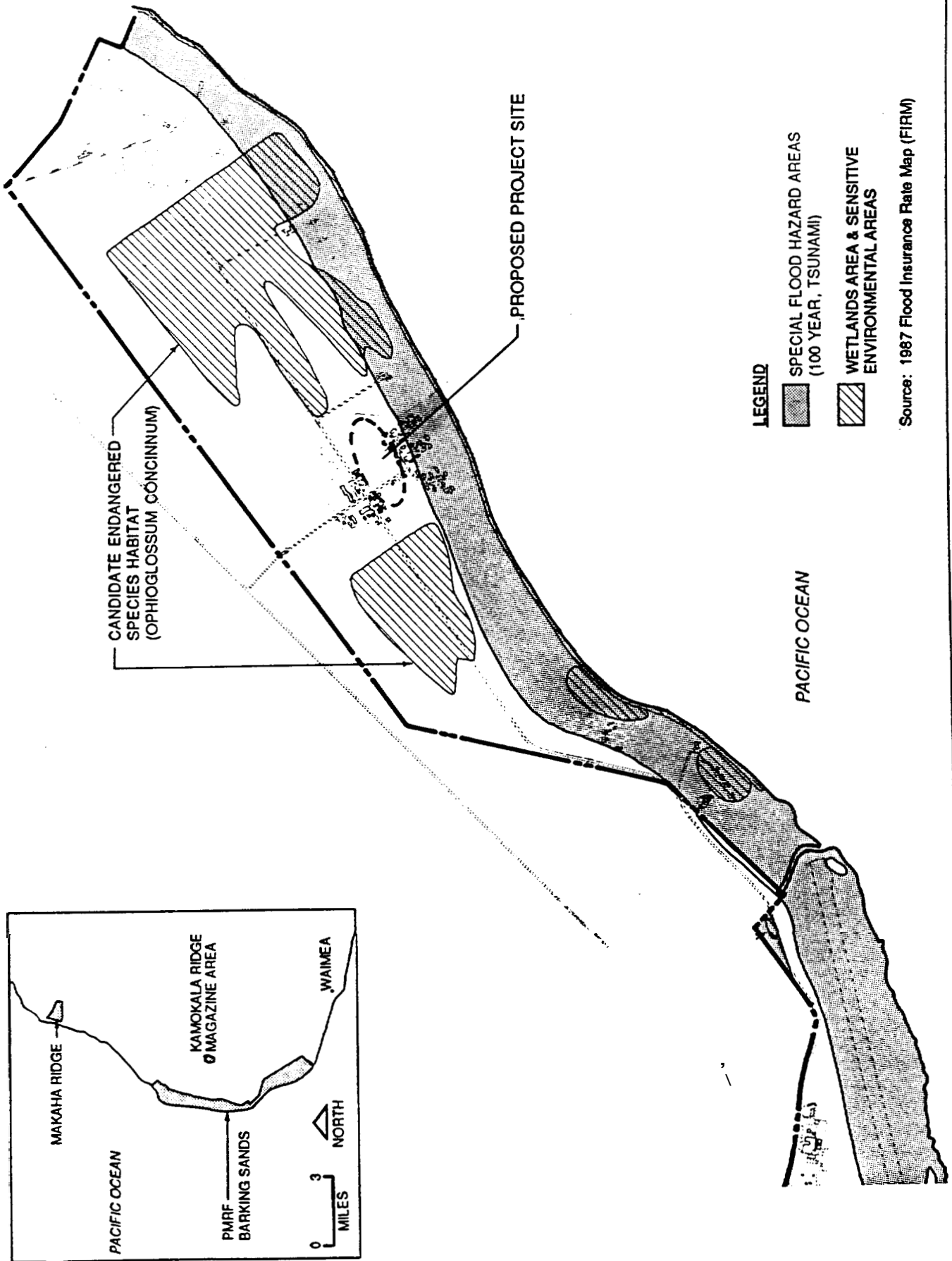
4.11.1 Electronic Clear Zones

The electronic interplay between Barking Sands and Makaha Ridge is part of an extremely complex range control system required for target control exercises, data gathering, and data transfer. Two components of this system, radars of various types and microwave channels, require land use considerations broader than their physical siting. In the case of microwave antennas, an unobstructed line-of-sight must be maintained between antennas. Radars also require an unobstructed path between the radar antenna and the object it is tracking. At PACMISRANFAC, these "look angles" are fairly fixed. Any proposed construction within these clear zones must be coordinated with the Commander PACMISRANFAC to ensure that operational "look angles" are not obstructed. The site of the proposed family housing lies outside of these identified clear zones.

4.11.2 Electromagnetic Interference (EMI)

EMI results from overlapping of adjacent uses of the frequency spectrum by different proximate EMI sources. It may also occur from interference or reflection caused by metal sided structures. Anecdotal accounts indicate that the supply warehouse, public works buildings, and aircraft maintenance hangar are causing interference to MPS 25 radar located at Range Control. Additional structures within this zone require careful consideration to prevent further interference. No EMI effects have been recorded at the existing family housing complex, located adjacent to the proposed project site.

FLOOD HAZARD AND WETLANDS AREAS



LEGEND

-  SPECIAL FLOOD HAZARD AREAS (100 YEAR, TSUNAMI)
-  WETLANDS AREA & SENSITIVE ENVIRONMENTAL AREAS

Source: 1987 Flood Insurance Rate Map (FIRM)



Fig. 6

4.11.3 Electromagnetic Radiation (EMR)

EMR zones designated around transmitter sites and tracking radars are required where high density electromagnetic power may constitute a hazard to personnel (HERP), ordnance (HERO), or fuels (HERF), or may interfere with non-military electronic equipment. There is no HERP issue related to the proposed housing site.

4.11.4 Explosives Safety Quantity Distance (ESQD) Requirements

Explosive hazard zones have been established by the Department of Defense (DOD) for various quantities and types of explosives. Since these zones increase in size as the TNT-equivalent quantity increases, it is desirable to limit the total quantity of explosives at any one location in order to meet the limits of the available safety areas. Minimum distances are prescribed for separating explosives from inhabited structures, public roads, and other explosives. These distances are called ESQD arcs and are proportional to the cube root of the TNT-equivalent quantity of explosives stored in the respective magazines.

The possibility of accidental detonation of explosives at ordnance operations and storage areas generally precludes the construction of inhabited buildings, standard structures, and recreational facilities within an ESQD arc. The outer portions of the arcs may be used for DOD runways, highways, open recreation for military personnel, and uninhabited storage facilities.

There are a number of sources of ESQD arcs at PACMISRANFAC. These include the magazine area at Kamokala Ridge, interim ordnance handling pad, Department of Energy (DOE) Launch Complex, PMRF missile launch area, ready service magazines, small arms/pyrotechnic magazine, and missile assembly/test building. In addition, the draft master plan for PACMISRANFAC HAWAREA identifies a potential location for three missile magazines approximately 1,500 feet northwest of the proposed family housing site. These magazines would produce an ESQD arc that would be about 750 feet northeast of Tartar Drive at its nearest point. The potential magazine site is one of three possible alternatives and is not being actively considered at this time. The proposed housing site is not within existing explosive safety quantity distances, nor within the ESQD arc that would be generated by the potential magazines.

4.11.5 Ground Hazard Area (GHA)

A ground hazard area is established to protect personnel on the ground from harm due to possible malfunctions and explosive detonations of rockets in the vicinity of the launch pad. Unauthorized personnel within this hazard area are required to leave during rocket launchings. Existing launch sites have GHAs with radii ranging up to 2,500 and 6,000 feet.

Future use of larger boosters will increase these arcs to 10,000 feet. Base security has authority to require evacuation of non-essential personnel from GHA's on-station. The site of the proposed project is not located within existing or proposed ground hazard areas.

4.11.6 Air Installations Compatible Use Zone (AICUZ)

An AICUZ study of PACMISRANFAC was completed in September 1979. The purpose of an AICUZ is to:

- Provide guidelines for preventing incompatible development in high noise exposure areas,
- Minimize public exposure to safety hazards associated with aircraft operations, and,
- Protect operational capabilities of the station from constraint by encroachment from adjacent incompatible land uses.

The **1979** AICUZ was reviewed in **1989** and remains applicable. Noise and Accident Potential Zones (**APZs**) identified in the AICUZ were also found to be still valid. Some land uses both on- and off-station are incompatible or potentially incompatible with aircraft noise or APZs delineated in the study.

The AICUZ was analyzed for its compatibilities with adjacent land uses. The land surrounding PACMISRANFAC is owned **by** the State of Hawaii and is used for public recreation (Polihale Beach Park) or leased for agriculture. The surrounding area is zoned by the County of Kauai as agricultural, preservation, or public facility. These uses are compatible with the AICUZ.

A review of on-station land uses indicates all existing facilities are generally sited in acceptable locations. There are no non-conforming facilities in areas where Ldn levels exceed 75 dbA. However, all structures located where the levels are in the **65** to 75 Ldn contour range should have a noise level reduction of **25** to **35 dbA**, if such structures are used for office, administration, industrial, or commercial purposes. The proposed housing site is located outside of the 65 Ldn noise contour and accident potential zones.

4.11.7 Small Arms Range Surface Danger Zone (SDZ)

PACMISRANFAC maintains an outdoor pistol range with six firing points in the northwestern portion of the station. This facility does not impact the proposed housing site.

4.11.8 Solid Waste and Hazardous Waste Management Units

There are a number of current and past Solid Waste Management Units (**SWMUs**) within the property of PACMISRANFAC, Barking Sands. Current and past SWMUs include seven landfills, two crash crew fire fighting pits, two incinerator sites, and two battery acid neutralization sites. In addition to the SWMUs, Hazardous Waste Management Units (**HWMUs**) exist in connection with the Ordnance Facility. Known SWMUs and HWMUs are shown in Figure 7. None of the known SWMUs or HWMUs are located on or near the proposed project site.

Based on available information, there have been no prior or current release of hazardous wastes or constituents into the environment at any of the SWMUs or at the HWMUs located at the Ordnance Facility. The hazardous waste management units at the Ordnance Facility connected with torpedo flushing contain treatment and storage areas for waste fuel are currently in an interim status awaiting a final Resource Conservation and Recovery Act (**RCRA**) permit.

SOLID AND HAZARDOUS WASTE MANAGEMENT UNITS

MARK	SWMU
L1	Landfill #1
L2	Landfill #2
L3	Landfill #3
L4	Landfill #4
L5	Landfill #5
L6	Landfill #6
L7	Landfill #7
FFP1	Fire Fighting Training Pit #1
FFP2	Fire Fighting Training Pit #2
I1	Incinerator #1
I2	Incinerator #2
BA1	Battery Acid Neutralization Unit #1
BA2	Battery Acid Neutralization Unit #2

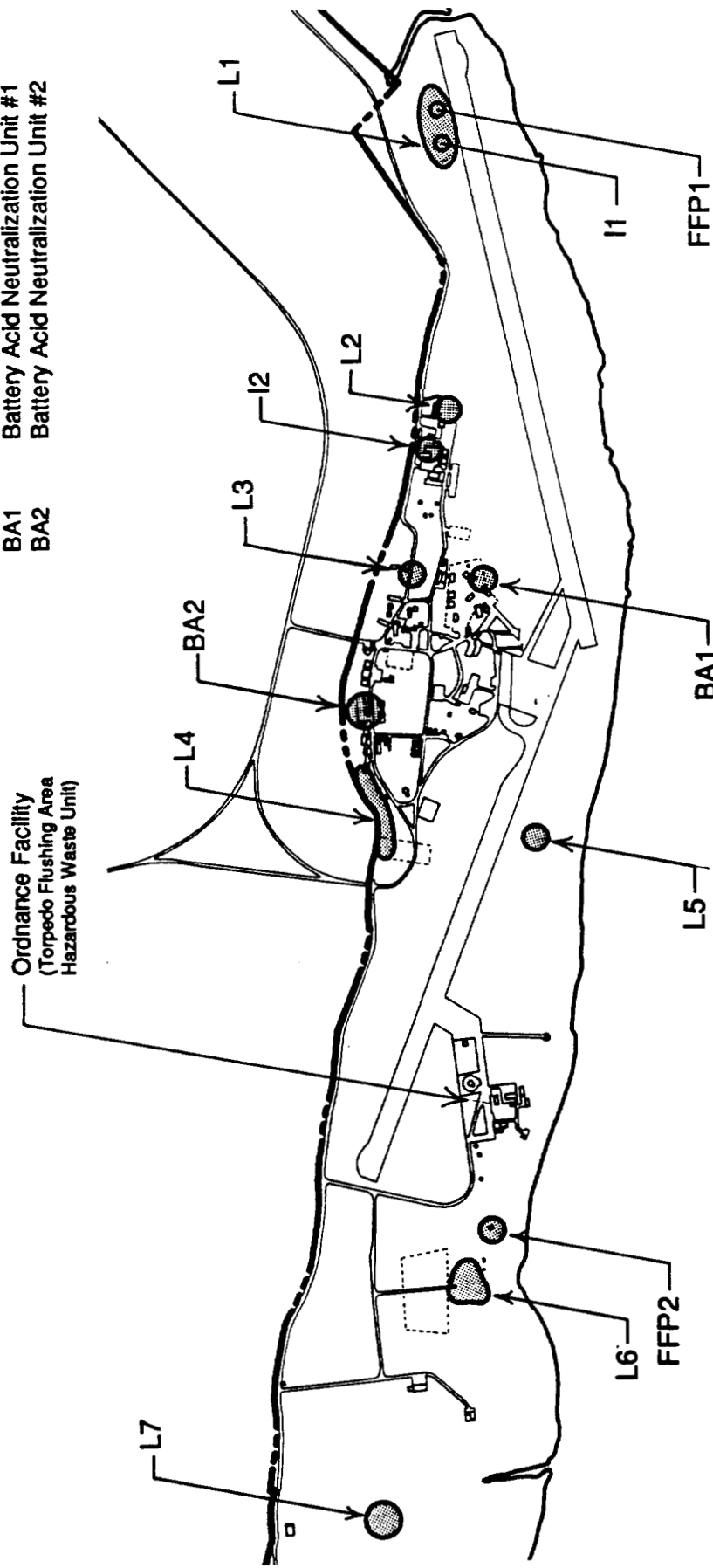


FIGURE 7



As part of the Department of Navy's Installation Restoration (IR) Program, all SWMUs and HWMUs are being investigated for evidence of and degree of contamination, if any. The results of the IR site investigations are not yet available, and remedial work, as needed, will proceed under the Navy cleanup program.

4.12 INFRASTRUCTURE

4.12.1 Roads

Two primary gates and a secondary gate control ingress and egress at PACMISRANFAC. The main station and northern area are serviced by the main gate. The southern gate serves the family housing and personnel support area. Both gates are open at all times. The northern gate, a secondary access, is opened only for the transportation of ordnance to and from Kamokala Ridge.

The interior road network generally consists of two-lane roads that are in good physical condition. The primary road from the Kokole Point Housing to the main base operations area is Sidewinder Road, an all-weather, two-lane asphalt road with standard lane widths. The current road system is adequate to accommodate lane expansion.

4.12.2 Electricity

Primary electrical power to the family housing portion of the base is supplied by a 12.5 KV feed system from Kauai Electric Company. The site of the proposed family housing is served by a 12.5 KV overhead primary power line. Electrical power to the site is adequate and can accommodate the proposed expansion.

4.12.3 Water

The water supply system for PACMISRANFAC main facility at Barking Sands originates from two sources: the Kauai Board of Water Supply and the Kekaha Sugar Company.

Water is provided to the southern area of the facility, including Kokole Point Housing, by the Kauai Board of Water Supply. This water is obtained from high level water tunnels and stored in the county's Paua Valley tank, where it is subsequently transmitted to Navy storage tanks at Kokole Point through approximately three miles of four-inch, asbestos-cement pipeline. An eight-inch main line, pressurized by a hydropneumatic system, distributes the water from the two 125,000 gallon Navy storage tanks to station facilities and housing.

The Mana well, owned and maintained by Kekaha Sugar Company, is the source of water for the main base and the northern area of PACMISRANFAC. Water is delivered from the Mana well, a high-level water tunnel located at Kamokala Ridge, to one 100,000 gallon and one 420,000 gallon storage tanks through approximately two miles of four-, six-, and eight-inch pipeline.

The quality of the water obtained from all sources and distributed on station is adequate. Monthly bacteriological analyses are conducted by the State Department of Health. The current water supply is adequate and can accommodate proposed station expansion.

4.12.4 Sewage

The proposed site is located approximately 1,000 feet from existing oxidation and leaching ponds used to treat sewage generated by the housing and personnel support areas. A sewage pump station moves wastewater into the oxidation pond, where secondary treatment is accomplished. From the oxidation pond, effluent flows into two leaching ponds, where it is dissipated by percolation and evaporation. The capacity of the pumping station is 202,000 gallons per day. The oxidation pond can process 54,000 gallons per day. Current flows are approximately 37,210 gallons per day. Sufficient excess capacity exists to accommodate the housing project.

4.12.5 Solid Waste

Solid waste is collected by a Navy Operations and Maintenance contractor and delivered to the Kauai County-operated landfill in Kekaha. These operation are sufficient to handle any increase in solid waste that would be produced at the proposed housing project.

CHAPTER FIVE ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

5.1 CONSTRUCTION IMPACTS

Construction will involve the removal of vegetation, grading, and building of housing units. Impacts would involve the creation of fugitive dust and noise. During construction of the proposed housing, necessary mitigative measures will be employed to reduce the effects of noise and dust on adjacent facilities. Mufflers will be used on all heavy earthmoving equipment and the equipment will be operated only during normal daylight hours. Dust will be controlled by dust screens and watering of bare or exposed ground. Erosion and sedimentation controls will be employed as necessary. An additional construction concern to be addressed would deal with the need (if any) for temporary housing for construction personnel during the building phase.

5.2 CHANGES IN TOPOGRAPHY

Grading will alter the current topography of the site. Presently the site contains several low depressions and slight sand hills. Elevation ranges from **10** to **20** feet above mean sea level. There is also a six- to ten-foot-wide ditch running mauka-makai through the site. Construction plans would call for the area to be made essentially level.

5.3 HYDROLOGY/DRAINAGE IMPACTS

Grading and leveling of the site would remove natural low areas. If the resulting grading level were to remain too low, standing water would be expected to continue to seep from higher areas during periods of sustained heavy rainfall. This could be a problem on the housing site were the water to collect around foundations. However, this can be mitigated by grading the site to decrease the opportunities for standing water accumulation on the site.

5.4 FLORA IMPACTS

None of the species found on the project site are listed as, or candidates for, endangered or threatened status. Given the abundant nature of the flora type and the relative small area of the site, removal of the vegetation would not constitute a significant adverse impact.

The ODhioalossum concinnum, a small perennial fern which is a candidate endangered species, has been found near the site. The habitat and plant communities associated with the Ophioalossum are not present on the proposed project site. Thorough searches were performed during dry and wet periods. However, should specimens of Ophioalossum be found on the site, the **USFWS** would be informally consulted before the plants are disturbed.

5.5 FAUNA IMPACTS

The change of habitat from a second growth coastal forest to a residential urban environment will alter the local populations of birds found at this site. Species which prefer cover (such as the ring-necked pheasant) may decline, while those which are better adapted to urban "backyard" habitats (such as the golden plover) should increase in number. The overall effect of the proposed development on the fauna is expected to be minimal. Habitat of the sort found on the site is common at PACMISRANFAC, Barking Sands.

5.6 ARCHAEOLOGICAL, HISTORIC AND CULTURAL RESOURCES IMPACTS

An archaeological survey was conducted in November 1990 by Archaeological Consultants of Hawaii revealed no cultural layers, materials, or sign of human burials. Although the survey found no evidence of any large sites, it is possible that small sites such as individual subsurface burials may be present. Since many burials have been found on PACMISRANFAC, and most of these have been individual burials, this possibility must be regarded as significant. It is therefore recommended that a monitoring program be implemented during any construction activity that will cause subsurface disturbance. This will involve the presence on-site of an archaeologist during such ground disturbing activities as grading and foundation excavation. The monitoring archaeologist will have the authority to halt construction in the immediate area of a find until appropriate mitigative measures have been taken. All actions will be taken in accordance with existing Navy and State of Hawaii rules, policies, and regulations pertaining to archaeological recovery.

5.7 AESTHETIC/VISUAL IMPACTS

Construction of the proposed housing project will mean replacing an area currently covered in second growth coastal forest with a landscaped urban environment and, as such, will cause an change in the community's visual setting. However, this change is not anticipated to be a significant visual impact because the site is situated amidst existing housing, stores, and community facilities. The proposed project will not impact the visual context of the area, nor will it impact any identified significant public view. As the environment and aesthetic aspects of the site are not unique to the PACMISRANFAC facility, nor do they encompass a large area, the impact will be local in extent.

5.8 AIR QUALITY IMPACTS

Air quality impacts of the proposed project are associated with fugitive dust generated during construction. Proper construction operation techniques would be adequate to mitigate these short-term impacts.

5.9 NOISE IMPACTS

Noise impacts of the proposed project are associated with equipment operation during construction of the housing facility. Properly muffled equipment operated during normal working hours should help mitigate this short-term impact.

5.10 HAZARDOUS WASTE MANAGEMENT IMPACTS

Hazardous waste management is generally associated with the construction of the facilities, and can include such items as paint, hydraulic fluid, or equipment lubricants. Contractors building naval facilities are required to remove and dispose of all hazardous wastes generated by construction off-site in a licensed, acceptable manner.

Hazardous wastes associated with base operations are located far enough away from the proposed housing structure as to have no potential for impact. The housing units themselves are anticipated to generate only municipal solid wastes.

5.11 MAN-MADE CONSTRAINTS

Man-made hazards and constraints are associated with base operations and include activities involving ordnance and explosives, aviation, electromagnetic interference, and training. All base operations involving these activities are located at a sufficient distance away from the proposed housing project and would have no impact upon inhabitants. Furthermore, the housing project is not anticipated to negatively impact the continuation of activities associated with these operations.

Specifically, the site is located outside of the **65** Ldn noise contour and accident potential zones (**APZs**) identified in the existing approved Air Installations Compatible Use Zone (AICUZ) for PACMISRANFAC. The site is also not within existing or proposed explosive safety quantity distances (**ESQDs**) or ground hazard areas (**GHAs**). The site lies outside the **ESQD** arcs generated by three potential magazines proposed by the draft PACMISRANFAC HAWAREA Master Plan.

5.12 TRAFFIC IMPACTS

The main road connecting the proposed housing site with the main base consists of two lanes and is in good condition. Using a full-build scenario, a 34-unit housing project consisting of two-bedroom units would be expected to generate an additional **68** automobiles on base (one car per spouse). However, as shift work normally reduces peak hour travel by 50 percent, and the additional assumption of only one base worker per family, peak hour demand on the roadway leading to the main base would not be expected to exceed 17 cars. This would have no impact upon existing capacities of the base road network.

In addition, construction workers traveling on public highways and roads would cause no significant traffic impacts.

5.13 ELECTRICAL IMPACTS

Electrical power is provided to PACMISRANFAC by the Citizens Utilities Company, a division of Kauai Electric. Service to the facility is provided through a system with a primary capacity of approximately 7,500 KVA, of which approximately 2,000 KVA is used. A separate electrical feed of **12.5** KV services the housing area from the main lines outside the base. This power would need to be stepped down through transformers to service individual

housing units. Approximately seven transformers would be anticipated. The additional 34 units would be expected to generate a peak demand load of 272 kw on top of the existing peak demand load of 438 kw. This is well within the current capacity of the system and would have no impact.

5.14 WATER IMPACTS

Potable water to PACMISRANFAC is supplied by Kekaha Sugar Company and the Kauai Board of Water Supply. Neither system imposes a water usage ceiling, and either could supply the entire base water demand, although if demand on either source were to exceed 25 million gallons per year the Navy is asked to notify the supplier. Currently there is no method to measure the amount of water being used by the existing housing area. However, average per capita consumption of water for family households is generally estimated to be 175 gallons per capita per day (gpcd). Given that figure, with 34 units averaging 3.5 persons per unit, the proposed project would generate a demand for 20,825 gal/day.

5.15 SEWER IMPACTS

Current wastewater treatment for the existing housing facilities is handled by an oxidation pond and leaching ponds. Wastewater is pumped through a pumping station to these ponds. The oxidation pond has a capacity to handle 54,000 gal/day. The pumping station has a design capacity to process 202,000 gal/day. Average flows recorded in 1988 were 37,320 gal/day of wastewater processed through the pumping station into the ponds. An additional 34 units, with an estimated 3.5 persons per unit producing 120 gallons per capita per day, would be expected to generate 14,280 gal/day. Total wastewater processed would be expected to be approximately 52,000 gal/day, within the current capacity of the system.

5.16 HOUSING IMPACTS

Construction of 34 additional units would alleviate the wait for on base housing. With 34 units all individuals currently on the wait list could be served. This would facilitate service members' reunions with dependents and have a positive impact upon morale. In addition, construction of the units would free up 12 units of off-base housing in what is now a very tight housing market. It is anticipated that the extra units constructed over and above the wait list requirements would **also** be filled **by** personnel currently living off-base. The construction of the proposed housing units is anticipated to be undertaken by local labor from Kauai. Therefore, no temporary housing needs are expected.

5.17 MEDICAL SERVICES IMPACTS

Medical facilities serving PACMISRANFAC consist of an on-base dispensary, Kauai Veteran Memorial Hospital in Waimea, and the Garden Island Medical Group in Waimea and Elelee. Kauai Veteran Memorial Hospital is a state facility providing 24-hour emergency room care. The Garden Island Medical Group operates daytime clinics. The on-base dispensary provides both daytime clinic service and a 24-hour corpsman. Ambulance service is provided

by base personnel. Additional demand for medical services as a result of the proposed project would not have an adverse impact upon the provision of adequate medical care.

5.18 FIRE PROTECTION IMPACTS

Fire protection is provided by base personnel associated with the flight line crash crew. The proposed housing project would not be expected to negatively impact their ability to provide adequate fire protection service to PACMISRANFAC.

5.19 POLICE PROTECTION IMPACTS

Police protection and enforcement are provided by base security personnel. The proposed housing project would not be expected to negatively impact their ability to provide adequate police protection service to PACMISRANFAC.

5.20 SCHOOL SERVICES IMPACTS

Local public schools in the area consist of Kekaha Elementary School (K-6), Waimea Elementary and Middle School (1-8), and Waimea High School (9-12). One private school, St. Theresa's Catholic School in Kekaha, provides additional elementary education opportunities.

Approximately 12 families wait listed for the proposed housing project live off base; their children already utilizing the local school system. Of the 14 remaining on the wait list, one could expect approximately 21 children, most likely in ages infant to elementary. Given the number of elementary schools, and as the local schools have been experiencing recent declines in enrollment, the additional school age children are not anticipated to have an adverse effect upon the local schools.

5.21 SUMMARY

5.21.1 Indirect Effects and their Significance

Construction of the proposed housing project would have no adverse impacts upon the environment or upon existing base operations. Positive impacts would include more available housing in the civilian sector and an increase in morale due to reunion with dependents. Construction of the 34-unit facility would also facilitate any future expansion of PACMISRANFAC operations.

5.21.2 Possible Conflicts Between the Proposed Action and the Objectives of Federal, State, and Local Land Use Policies, Plans and Controls

5.21.2.1 National Environmental Policy Act

This document has been prepared in compliance with the National Environmental Policy Act (NEPA) of 1972, and the Council of Environmental Quality Regulations.

5.21.2.2 National Historic Preservation Act

The project is being carried out in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended, and 36 CFR 800 (implementing regulations). Section 106 requires Federal agencies to consider the effects of their actions on historic properties. The review process is designed to identify and evaluate historic properties, to assess the effects of the proposed action on the properties, and, if applicable, to find ways to mitigate adverse effects. Section 106 applies not only to those properties listed on the National Register of Historic Places, but also to properties that meet specified eligibility criteria. This could include properties that have not been listed and even those that have not yet been discovered, especially in the case of archaeology. In Hawaii, Section 106 review is carried out by the Department of Land and Natural Resources. No archaeological artifacts have been identified on the site; however, a monitoring program is recommended during any construction activity that will cause sub-surface disturbance. The monitoring archaeologist will have the authority to halt construction in the immediate area of a find until mitigative measures have been taken.

5.21.2.3 Hawaii Coastal Zone Management (CZM) Program

The National Coastal Zone Management Act of 1972 (P.L. 92-583), as amended (P.L. 94-370) requires Federal agencies to conduct their planning, management, development, and regulatory activities in a manner consistent with the State of Hawaii's CZM programs. The "coastal zone" of Hawaii includes all non-federal property within the state, including offshore islands and the submerged lands and waters extending seaward to a distance of three (3) nautical miles. The Office of State Planning, as the lead agency of the CZM Program, is responsible for conducting federal consistency review for the following:

1. Federal activities
2. Activities requiring a federal license or permit
3. Federal assistance to local governments

The review to establish consistency with CZM policies as stated in E.O. 78-37, is conducted as specified in 15 CFR Part 930. The proposed action is consistent with the objectives and policies of the CZM Program, and contains no "spillover" effect on non-Federal lands. Therefore, no Hawaii Coastal Zone Management Program Consistency Certification is required.

5.21.2.4 PACMISRANFAC HAWAREA Master Plan

Under the updated Master Plan for the Pacific Missile Range Facility, the project site land use is designated for family housing. Hence the project is in compliance with the PACMISRANFAC HAWAREA Master Plan.

5.21.3 Environmental Effects of Alternatives

Environmental effects of the proposed alternative are expected to be minimal. No significant adverse effects upon the environment have been identified. Phasing of the proposed housing project would not create a discernible difference upon environmental impacts, as the entire site would need to be cleared for construction of the minimum 13 unit phase. Relocation of the site to the north side of the road would not alter the environmental

impacts associated with vegetation clearing, other than the possible presence of the Ophioglossum fern.

5.21.4 Energy Requirements and Conservation Potential of Various Alternatives

Short-term energy requirements would be lowest for the no-action alternative and highest for those alternatives requiring more units to be built. However, the immediate energy savings from the no-action alternative would eventually be consumed by transportation-related fuel use from continued commuting from off-base housing to on-base employment, as well as from dependents commuting to perform shopping and other support-related activities. The highest immediate energy consumption would be associated with the construction of the proposed **34** units. In addition to construction-related energy, the additional consumption would be related to the increased population caused by more military dependent families coming to Kauai.

For any of the proposed alternatives, energy requirements would be relatively minor during the construction phase. Equipment used for grading, clearing, and preparation of the site would consume insignificant amounts of petroleum products. Upon construction, electrical demand during the peak load hour would be estimated to increase by **272** kw. However, island wide, only that portion of demand associated with new, rather than relocated, demand represents growth in energy use.

5.21.5 Irreversible and Irrecoverable Resource Commitments

The proposed project would involve the irretrievable **loss** of fiscal resources, as well as labor and materials expended during construction. The vacant site at PACMISRANFAC would be lost to future alternative uses.

5.21.6 Short-Term Use Versus Long-Term Productivity

The site of the proposed housing project is currently unused second growth coastal forest. As such, it is productive only in its capacity as a habitat for some common bird species found in the area and as open space. Construction of the project will cause the site to lose its ability to serve in these capacities.

Other short-term gains would include the increased employment opportunities for construction labor associated with the project, and the resulting economic gain these increased opportunities would bring the surrounding communities. Short-term losses would include the construction disruption to the environment surrounding the site.

Long-term impacts would include greater availability of on-base housing, resulting in shorter wait times, and an easing of the pressure upon the local civilian market. Reunion of base personnel with dependents would have an improving impact upon morale. A greater supply of overall base housing would also make future plans for PACMISRANFAC more flexible.

5.21.7 Urban Quality, Historic and Cultural Resources, and the Design of the Built Environment

Construction of the proposed project would result in the clearing of all natural vegetation on the site and its replacement with up to **34** units of family housing and landscaping. These units would be of designs compatible with the adjacent housing complex. No historic or cultural resources were identified during surveys of the site.

5.21.8 Cumulative Impacts

The proposed construction of **34** units for family housing causes no significant cumulative adverse impacts. The Ophioglossum concinnum has not been determined to exist upon the site. However, should it be discovered, the USFWS would be informally consulted. No archaeological artifacts have been identified on the site; however, a monitoring program is recommended during any construction activity that will cause sub-surface disturbance. The monitoring archaeologist will have the authority to halt construction in the immediate area of a find until mitigative measures have been taken. There are no animals listed on, or candidates for, threatened or endangered status. No impacts to the area's road network or utility service are anticipated due to the development of the project.

The master plan for PACMISRANFAC HAWAREA identifies a potential location for three missile magazines to be located approximately **1,500** feet from the proposed family housing site. The potential site is one of three possible alternatives, and is not being actively considered at this time. The family housing site is well outside the **ESQD** arc that would be generated by the potential magazines.

5.21.9 Means of Mitigating Potentially Adverse Effects

No potentially adverse effects as a result of this proposed project were identified. Construction impacts can be mitigated through the use of proper and approved construction techniques. Should the Ophioglossum be discovered it would be moved and replanted in another compatible area. Should historic or culturally important finds be identified during the construction phase, work would stop until such finds could be thoroughly examined and their significance determined.

5.21.10 Adverse Environmental Effects Which Cannot be Avoided/Unresolved Issues

The proposed construction of housing units on the PACMISRANFAC site is not anticipated to produce any adverse environmental effects requiring mitigation. Impacts are anticipated to be short-term in nature, related to construction, and easily mitigated through the use of accepted construction techniques as outlined by County of Kauai and State of Hawaii regulations. No unresolved issues were identified connected with this project.

**CHAPTER SIX
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EXECUTIVE SUMMARY
PMRF FAMILY HOUSING MARKET STUDY DRAFT FINAL REPORT

EXECUTIVE SUMMARY

The Pacific Missile Range Facility (PMRF) in Kekaha, Kauai is located on the west side of the island in an area known as Barking Sands. The facility is bordered on the west by the Pacific Ocean and on all other sides by agriculture and undeveloped land.

In September 1990, the Department of the Navy, Pacific Division, Naval Facilities Engineering Command contracted SMS Research to conduct the Housing Market Analysis for PMRF. The following are the highlights of the study based on primary research conducted among Kauai residents by SMS Research, primary research conducted among military personnel by the Naval Facilities Engineering Command, Housing Division, and secondary research conducted by SMS Research and Locations Inc.

MARKET AREA DESCRIPTION

- The Market Area for the Pacific Missile Range Facility (PMRF) covers the southern coast of the island of Kauai. The PMRF Housing Market Area is oriented north-northwest of the range facility to incorporate Kokee Satellite & Missile Tracking Station and one of the two major population centers in the region -- Lihue.
- The rapid expansion of the area and accompanying increased land values have made the community extremely attractive for housing expansion. Recent improvements in sewer and water delivery systems have also encouraged residential and commercial construction. There are currently 15 developments in Kauai (including the Pacific Missile Range Facility), of which 11 are within the boundaries of the **PMRF** Market Area.
- Despite these developments, competition for available housing in the county is still high. In addition, almost 40 percent of the county's land is publicly owned (the State of Hawaii owns 38 percent of the land, Federal government one percent and the County of Kauai less than one percent) which make urban development a lengthy and uncertain process.
- Although 60 percent of Kauai land is under private ownership, only a small percentage of that is buildable. Zoning restrictions and affordable housing requirements make it increasingly difficult and less attractive for those with buildable land to develop residential housing. Moreover, government concerns about the lack of adequate infrastructure such as roads, water, and sewage treatment will likely place greater restrictions on the building industry, and have a negative impact on housing development on the island.

- o Over the past 20 years Kauai has experienced rapid population growth. In the PMRF Market Area, however, the population is growing at a slower rate than in other areas of Kauai. Over the next five years, this trend is expected to change due to the expected increase in housing units being built in the market area. The increase in units will cause the population to shift away from the other parts of Kauai and into the PMRF Market Area. Currently, population in the market area is increasing by three to four percent per year and the estimated 1995 population is 37,577 persons.
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- o The Household Growth Rate of an area is the true barometer of the demand for housing. Even during periods of static population growth, the number of households can increase through the general aging of the population, young adults leaving home, and through separations and divorce.
 - o In all areas of the PMRF Housing Market Area, the household formation rate is higher than the population growth rate. By 1995, there will be almost 22,000 households on Kauai, and nearly 16,000 of those households will be in the PMRF market area.
 - o The increasing household growth rate indicates that competition for existing housing will remain high on the island, and will be even stronger in the PMRF Market Area. Thus, military families at the missile facility will have a harder time finding suitable housing within the civilian community.
 - o In addition to the projected increase in civilian population and households, the staffing at PMRF is also expected to increase. Current estimates of staffing at PMRF indicate that total military personnel will increase by about 11 percent and the number of military personnel requiring family housing will increase by more than 25 percent over the next five years.
 - o Hawaii is one of the top states in the nation in terms of the high cost of living. Therefore, income and affordability become critical issues in defining the future military capture rate of civilian housing.

SUPPLY CONDITIONS

- o There are currently 56 military family units at PMRF, including 16 two bedroom units, 25 three bedroom units, and 15 four bedroom units. All units were built in 1968 and were recently cited as being well-designed and in good condition.
- o All military family units are occupied, and there are 26 families on the waiting list. At the present time, there are no new construction projects authorized for the PMRF.

- o There are three government assistance programs for low-income Kauai renter households: (1) State rental housing projects offer a total of 296 low-income units on Kauai, (2) State rent supplement programs offer a maximum \$160 (for the Hawaii Housing Authority program) and \$175 (for the Housing Finance and Development Corporation program) per month, per unit for qualified households, and (3) Federal Section 8 vouchers pay the difference between 30 percent of the family's gross monthly income and the fair market rental value of the housing unit.

In addition, the state (HulaMae) and federal governments (Farmer's Home Administration) offer low interest loans and minimal down payments to qualified households. Eligibility for the state program requires Hawaii residency, The state and County of Kauai also sponsor affordable housing projects for families earning below 120 percent of the area median income.

- o At the current time, it is estimated that there are 16,228 resident housing units on Kauai. Of those, approximately 72 percent or 11,674 units are in the PMRF market area. About 1,800 of the resident housing units are located within near proximity to the PMRF in Waimea or Kekaha. An additional 3,900 units are located on the fringe of the market area in Lihue. It is estimated that there is currently an excess demand for nearly 2,200 units in the PMRF market area.
- o Along with the excess demand, there is also a high incidence of substandard living units in the PMRF Market Area. It is estimated that there are 2,900 units (780 owned, 2,220 rented) that could be classified as "unsuitable" based on their size, structural condition, location, and area infrastructure.
- o Kauai residential building activity reached a record level of 908 units in 1989 -- this represented a 24 percent increase over 1988. However, strong building activity over the past several years has, for the most part, been limited to single family homes. In 1989, there were 857 single family and 51 multi-family units authorized.
- o The number of new housing units on Kauai could increase by nearly 3,600 units by 1995 if all of the planned residential project are completed. Of which, approximately 2,700 housing units are planned for the PMRF market area. Although there is the potential for a large supply of new units coming on the market in future years, these numbers must be put in the proper perspective. The resident population on Kauai is estimated to grow from 54,100 (estimate) in 1990 to 61,100 by 1995, an increase of 7,000. This growth should result in a corresponding increase of approximately 2,500 households, from the current 19,321 households to 21,821. Assuming all of these households will require dwelling units, annual demand should increase by about 500 units per year till 1995. Furthermore, this number does not include the current pent-up demand which is estimated to be for nearly 3,600 units. Thus, housing needs on Kauai and in the PMRF market area are not likely to be satisfied by 1995.

- o Residential vacancy rates for the combined Neighbor Islands (Maui, island of Hawaii, and Kauai) have historically been relatively low. In particular, between 1970 and 1988 residential vacancy rates have ranged from a low of three percent to a high of seven percent. The vacancy rate in 1988 was 3.7 percent.
- o The Kauai real estate market (sales activity and prices) has finally begun to show clearer signs of peaking after very heated activity since 1987. Through the first ten months of 1990, Kauai single family and condominium resales were down 3.9 percent compared to the same period a year ago. This is still very healthy considering, both, how far prices have risen and how low inventory levels have fallen over the past several years.
- o However, overall market conditions appear to be softening. One indicator we are watching closely is the relationship between active listings and pending sales. It appears that this past February marked the low point for Kauai single family and condominium listings. Since that time, there has been a sharp increase -- single family and condominium listings have increased about 42.6 percent. During the same time period, single family and condominium pending sales have declined about 57 percent.
- o These trends of increasing supply and decreasing demand are indicative of a market in transition. This is the whole idea of the interaction between supply, demand, and prices in a marketplace. Thus, if the past is any guide, we should expect to see island-wide sales prices fluctuate in a band of plus-or-minus 10 percent from present levels (averaging approximately \$305,000 for market area single family homes and \$180,000 for market area condominiums) over the next several years. This will be associated with an increase in the time a typical home takes to **sell as** overall market conditions return to more "normal" levels.
- o An important trend in the 1990s will be the effort to build a significant number of affordable housing units on Kauai. These developments are necessary not only for the existing pent-up demand for housing, but also for future economic growth. Housing has become a critical consideration for long-term residents hoping to be able to stay in Hawaii and Kauai as well as for newcomers looking to move and work here. To build affordable units, buyers must be willing to accept smaller homes on smaller lots and multi-family units. This will be a major theme in Hawaii and Kauai in the coming decade as it is in any market where demand constantly outstrips available supply.
- o The availability of mortgage funds in Hawaii remains very good. Owner occupant financing is readily available to qualified households. FHA/VA funding is still abundant. However, price levels for many homes are above the current maximum FHA/VA loan amounts. Thus, buyers without large enough down payments may find homeownership very difficult. Non-owner occupant financing is also readily available, but underwriting criteria are getting stricter because of concerns over stabilizing or slightly declining property values.

- o The Kauai residential rental market remains relatively tight despite rising inventory levels. New construction in recent years has fallen far short of the demands of a rapidly growing population and visitor industry. This has caused rents to rise dramatically over the past several years -- rental rates over the past 6 months range from \$994 to \$1,261 for single family homes and from \$550 to \$1,263 condominium units. However, increasing inventory levels, new housing construction and stabilizing rents are likely to result in a return to more "normal" rental market conditions in the not-so-distant future. Of particular note is the following statement from Larry Stewart of Century 21, Lihue: "Rental markets within near proximity to major resort destinations should remain strong as the number of people employed by the visitor industry continues to climb." Nevertheless, a more balanced market, which is likely to be characterized by increased availabilities and stable rents, can be expected over the next several years.
- o It is projected that the housing stock in the PMRF Market Area will increase by 14.8 percent over the next five years -- from 11,674 in 1990 to 13,400 in 1995. It is estimated that owned units will account for most of the increase (71%).

DEMAND CONDITIONS

- o Due to the high cost of buying a home in Hawaii and the short length of stay of military personnel at PMRF, it is unlikely that military families will enter into home ownership.
- o In 1995, most of the demand in the PMRF civilian housing market will be for rental units. It is estimated that there will be a deficit of 1,750 rental units (46 percent studio to two bedroom, 54 percent three and four bedroom).
- o Rental housing, aside from being unavailable, is unaffordable to many military families. Smaller units (studio and one bedroom) are affordable to enlisted personnel ranking E-5 or above. Two bedroom units are affordable only to officers O-4 or above, and units larger than two-bedrooms are affordable only to the highest ranking officers.
- o The civilian housing capture rate for military families in 1995 is less than one half of one percent.

CONCLUSIONS

- o These facts all add up to the conclusion that the civilian housing market cannot provide affordable and suitable housing for military personnel five years down the line. At minimum, the military housing deficit in 1995 will be for 20 housing units. The following table summarizes the military housing deficit:

Table i-1

Bedroom size	Officer Deficit	Enlisted Deficit	Total Deficit
Studio to two bedroom	2	17	19
Three or four bedroom	1	0	1
Total	3	17	20

BOTANICAL SURVEY

BOTANICAL SURVEY
PROPOSED FAMILY HOUSING SITE
PACIFIC MISSILE RANGE FACILITY
BARKING SANDS, ISLAND OF KAUA'I

by

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December 1990

INTRODUCTION

The proposed family housing site consists of two parcels located adjacent to the existing Pacific Missile Range Facility (PMRF) family housing on Tartar Drive. The larger of the two parcels is approximately 25.7 acres and is located south of Tartar Drive. Enlisted family housing (10.1 acres) and F-20 family housing (15.6 acres) are proposed for this parcel. The smaller parcel, ±5.5 acres, is located north of Tartar Drive and also includes the existing Child Care Center and bus shelter; officer family housing is proposed for this parcel.

Ophioglossum concinnum, a Category 1 candidate endangered species, has been recorded from the nearby Dodonaea-Nama shrubland. **It** is a small, inconspicuous fern which lies dormant until the rainy season begins, at which time **it** produces one to two sterile fronds and one fertile, spore-bearing frond.

Field studies of the proposed family housing site were made on 07 November 1990 to 1) describe the general vegetation type, 2) inventory the flora, and 3) search for threatened and endangered plants. **An** additional visit was also made on 18 December 1990, about three weeks after a heavy rain of 5 inches had fallen, to check for the presence of Ophioglossum on the housing site.

SURVEY METHODS

Prior to undertaking the field studies, a search was made of the pertinent literature to familiarize the principal investigator with other botanical studies conducted on PMRF. Topographic maps were examined to determine terrain characteristics, access, boundaries and reference points. Access was from Tartar Drive and from behind the existing housing facility.

A walk-through survey method was used. Areas most likely to harbor the Ophioglossum fern, as the patches of Dodonaea shrubs and open sandy areas, were more intensively examined. Notes were made on plant associations and distribution, substrate types, topography, exposure, etc. Plant identifications were made in the field; plants which could not be positively determined were collected for later identification in the herbarium and for comparison with the recent taxonomic literature.

DESCRIPTION OF THE VEGETATION

There have been two studies which have described the biological resources found on PMRF (Botanical Consultants 1985; The Traverse Group, Inc. 1988). Two major and several minor vegetation types were recognized in the studies. The predominant cover at PMRF is a mixture of kiawe trees (Prosopis pallida) and koa-haole shrubs (Leucaena leucocephala); this covers about 400 acres. The second major vegetation type is the Dodonaea-Nama shrubland which covers about 100 acres. The candidate endangered Ophioglossum fern is associated with this vegetation type.

On the proposed family housing site, the larger of the two parcels is covered by rather dense kiawe/koa-haole scrub. The smaller parcel supports patches of Dodonaea shrubs and scattered kiawe trees. A more detailed description of the vegetation follows. A list of all those vascular plants inventoried during the field studies is presented at the end of the report.

25.7-Acre Parcel

Vegetation on this parcel consists of open to closed stands of kiawe trees, 25 to 35 ft. tall, with a subcanopy layer of koa-haole shrubs, 6 to 12 ft. tall. Where the kiawe trees are more open, that is, canopy cover is 60% or less, lantana (Lantana camara) forms a dense, prickly thicket. Ground cover consists primarily of buffel grass (Cenchrus ciliaris), although, in places,

green panicgrass (Panicum maximum var. trichoglume) and Guinea grass (P. maximum) may be locally abundant.

A drainage ditch no longer in use, dry and overgrown with koa-haole shrubs runs through the parcel. Because of the past disturbance around this ditch, there are few kiawe trees and the open koa-haole scrub supports a number of other species as two species of morning-glory or koali (Ipomoea cairica, I. indica), chili pepper (Capsicum annuum), golden crownbeard (Verbesina encelioides), sourgrass (Digitaria insularis), and klu (Acacia farnesiana). A few shrubs of a'ali'i (Dodonaea viscosa) and naupaka kahakai (Scaevola sericea) are also found along the ditch area.

5.5-Acre Parcel

About half of this parcel has been graded and is periodically mowed. Buffelgrass provides the major ground cover but patches of bare soil and coralline rubble are frequent.

Where the parcel borders the existing family housing, there is a strip of kiawe trees with a dense cover of buffel grass beneath.

On the northeast corner of the parcel, is an open Dodonaea scrub on loose sand. Other species found here include golden crownbeard, Natal redtop (Rhynchelytrum repens), nama (Nama sandwicensis), naupaka kahakai, "ihi (Portulaca pilosa), 'ilima (Sida fallax), and hunakai (Ipomoea imperata). A few trees of kiawe are also scattered along the fringes of this scrub. Much of the area has been disturbed by off-road vehicles and bare areas of sand cover about 50%.

THREATENED AND ENDANGERED SPECIES

Ophioglossum concinnum, the pololei fern, is a Category 1 candidate endangered species (U. S. Fish and Wildlife Service 1990).

This diminutive fern is associated with the Dodonaea-Nama shrubland on the southern half of PMRF. On the northern half of the facility, it has been found within an old cemetery area and near the proposed Exoatmospheric Discrimination Experiment (EDX) site (Advanced Sciences, Inc. 1990). These two populations were inspected during the December visit. The largest concentration of plants is found within the cemetery area and on the northern part of the facility is associated with open, grassy areas covered with Bermuda grass (Cynodon dactylon) and 'ihi (R. Inouye, Environmental Engineer PMRF-BS, pers. comm.).

Because Ophioglossum has been observed in the Dodonaea-Nama shrublands which lie near the proposed family housing site, an intensive search was made for the fern during the field studies. The 07 November studies were made prior to any heavy rains. Random samplings of the sand around each of the Dodonaea shrubs to locate rhizomes of the Ophioglossum fern were made. No ferns were found. Later in December, after heavy rains had fallen, a second visit to areas with Dodonaea shrubs was made. No Ophioglossum ferns were found.

DISCUSSION AND RECOMMENDATIONS

Vegetation on the proposed family housing site consists primarily of a kiawe/koa-haole scrub on the larger 25.7-acre parcel; a smaller area with koa-haole scrub and some Dodonaea shrubs is found near an old drainage ditch. On the smaller parcel by the Child Care Center, about one-half of the parcel is periodically mowed. One-quarter of the parcel is covered by dense kiawe and buffel grass. The remaining area supports an open Dodonaea scrub. An intensive search was made for Ophioglossum concinnum, a Category 1 candidate endangered species known from PMRF. No plants of the Ophioglossum fern were found on the site proposed for development.

The proposed project is not expected to have a significant negative impact on the botanical resources of the facility. The vegetation on the site proposed for development is dominated primarily by introduced plants as kiawe, koa-haole, buffel grass, lantana, etc. The native plants found on the project site occur elsewhere in greater numbers on other parts of PMRF and on areas adjacent to PMRF, especially north of the facility at Polihale. None of the native species occurring on the project site are officially listed threatened and endangered species; nor are any proposed or candidate for such status.

It is recommended that native and Polynesian-introduced species be used for landscaping common areas. These plants are adapted to the environmental conditions on PMRF and would require less water and no addition of top soil in most cases. Some natives suggested for landscaping are naupaka kahakai, a'ali'i, naio (Myoporum sandwicense), pohinahina or beach vitex (Mex rotundifolia), 'ohai (Sesbania tomentosa), the native caper or maiapilo (Capparis sandwichiana), and ~~WIMI~~ (Erythrina sandwicensis). Plants of Polynesian introduction include coconut (Cocos nucifera), milo (Thespesia populnea), and kou (Cordia subcordata).

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PLANT SPECIES LIST -- PMRF Family Housing Site

Following is a checklist of all those vascular plant species inventoried during the field studies. Plant families are arranged alphabetically within each of two groups: Monocots and Dicots. The taxonomy and nomenclature of the flowering plants are in accordance with Wagner et al. (1990). In most cases, common English and/or Hawaiian names follow St. John (1973) or Porter (1972).

For each species, the following information is provided:

1. Scientific name with author citation.
2. Common English and/or Hawaiian name, when known.
3. Biogeographic status. The following symbols are used:
 - = endemic = native only to the Hawaiian Islands
 - I = indigenous = native to the islands and also to one or more other geographic area(s)
 - X = introduced or alien = all those plants brought to the islands intentionally or accidentally after Western contact (1778); not native.

<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>STATUS</u>
MONOCOTS		
POACEAE (Grass Family)		
Cenchrus ciliaris L.	buffel grass	X
Cynodon dactylon (L.) Pers.	Bermuda grass, manienie	X
Digitaria insularis (L.) Mez. ex Ekman	sourgrass	X
Eragrostis tenella (L.) P. Beauv. ex Roem. & Schult.	lovegrass	X
Panicum maximum Jacq.	Guinea grass	X
Panicum maximum var. trichoglume Eyles ex Robyns	green panicgrass	X
Rhynchelytrum repens (Willd.) Hubb.	Natal redtop	X
DICOTS		
AMARANTHACEAE (Amaranth Family)		
Amaranthus spinosus L.	spiny amaranth, pakai kuku	X
ANACARDIACEAE (Mango Family)		
Schinus terebinthifolius Raddi	Christmas berry	X
ASTERACEAE (Sunflower Family)		
Verbesina encelioides (Cav.) Benth. & Hook.	golden crownbeard	X
CARICACEAE (Papaya Family)		
Carica papaya L.	papaya, rika	X
CONVOLVULACEAE (Morning-glory Family)		
Ipomoea cairica (L.) Sweet	koali	X?
Ipomoea imperata (Vahl) Griseb.	hunakai	1
Ipomoea indica (J. Burm.) Merr.	koali-'awania	1
FABACEAE (Pea Family)		
Acacia farnesiana (L.) Wald	klu	X
Leucaena leucocephala (Lam.) de Wald	koa-haole	X
Prosopis pallida (Humb. & Bonpl. ex Wald) Kunth	kiawe	X
GOODENIACEAE (Goodenia Family)		
Scaevola sericea Vahl	naupaka kahakai	I

<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>STATUS</u>
HYDROPHYLLACEAE (Waterleaf Family) Nama sandwicensis A. Gray	nama	E
MALVACEAE (Mallow Family) Sida fallax Walp.	ima	I
PORTULACACEAE (Purslane Family) Portulaca pilosa L.	'ihi	X
SAPINDACEAE (Soapberry Family) Dodonea viscosa Jacq.	a'ali'i	I
SOLANACEAE (Nightshade Family) Capsicum annuum L.	chili pepper, nioi	X
STERCULIACEAE (Cacao Family) Waltheria indica L.	'uhaloa, hi'aloa	I?
VERBENACEAE (Verbena Family) Lantana camara L.	lantana, lakana	X

FIELD SURVEY OF THE AVIFAUNA AND FERAL MAMMALS

FIELD SURVEY OF THE AVIFAUNA AND FERAL MAMMALS
AT A PROPOSED HOUSING SITE AT THE PACIFIC MISSILE
RANGE FACILITY, BARKING SANDS, KAUAI

Prepared for
Belt Collins and Associates
by

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2 November 1990

INTRODUCTION

The purpose of this report is to summarize the findings of a one day (30 October 1990) bird and mammal field survey at Pacific Missile Range Facility (PMRF), Barking Sands, Kauai (see Fig.1 for actual location of property surveyed). **Also** included are references to pertinent literature as well as unpublished faunal reports from similar habitat at PMRF. and elsewhere in Kauai.

The objectives of the field survey were to:

- 1- Document what bird and mammal species occur on the property or may likely occur given the habitats available.
- 2- Provide some baseline data on the relative abundance of each species.
- 3- Determine the presence or likely occurrence of any native fauna particularly any that are considered "Endangered" or "Threatened". If such occur or may likely be found on the property proposed for development identify what features of the habitat may be important for these species.
- 4- Determine if this property contains any special or unique habitats that if lost or altered by development might result in a significant negative impact on the fauna in this region of the island.

GENERAL SITE DESCRIPTION

The PMRF proposed housing development site (Fig.1) is presently covered in second growth forest dominated by Kiawe (Prosopis pallida) with an understory of mixed native and exotic brush. A'ali'i (Dodonaea viscosa), 'Ilima Lei (Sida spp.), Christmas Berry (Schinus terebinthifolius) and Lantana (Lantana camara) are some of the most common species. Road-side habitat of mowed grass and residential lawns and yards also occur in close proximity to the property.

Weather during the field survey was clear and warm. Winds were from NE at 5 mph.

STUDY METHODS

A walk-through of accessible sections of the site was made in order to view a representative sample of the available habitats. Field observations were made with the aid of binoculars and by listening for vocalizations. These observations were concentrated during the peak bird activity periods of early morning and late afternoon. Attention was also paid to the presence of tracks and scats as indicators of bird and mammal activity.

At various locations, during the walk-through, census (count) stations were established where all birds seen or heard over a

period of eight minutes were tallied. Observations of birds made between these census stations were also recorded. These data provide the basis for the relative abundance estimates given in this report. Published and unpublished reports of birds known from similar habitat elsewhere on PMRF and on Kauai were also consulted in order to acquire a more complete picture of the possible species that might occur in the area (Pratt et al. 1987; TGI 1988; Bruner 1988, 1990a, 1990b, 1990c, 1990d; Hawaii Audubon Society 1989). Observations of feral mammals were limited to visual sightings and evidence in the form of scats and tracks. No attempts were made to trap mammals in order to obtain data on their relative abundance and distribution.

Scientific names used herein follow those given in the most recent American Ornithologist's Union Check-list (A.O.U. 1983), Hawaii's Birds (Hawaii Audubon Society 1989); A field guide to the birds of Hawaii and the Tropical Pacific (Pratt et al. 1987); Mammals species of the World (Honacki et al. 1982) and Hawaiian Coastal Plants (Merlin 1980).

RESULTS AND DISCUSSION

Resident Endemic (Native) Land and Waterbirds:

No endemic waterbirds were recorded. However, endemic and endangered waterbirds do occur at PMRF but not at this locality (TGI 1988). The endemic Pueo or Short-eared Owl (Asio flammeus sandwicensis) is active during the day and forages over open fields

as well as coastal forest and thus could potentially be found at PMRF. None were observed on this survey.

Migratory Indigenous (Native) Birds:

Seven Pacific Golden Plover (Pluvialis fulva) were found along roadsides and on lawns in and near the property. Plover prefer open areas such as mud flats, fields and lawns. Johnson et al. (1981), Bruner (1983) and Johnson et al. (1989) have shown plover are extremely site-faithful (returning each year to the same spot and maintaining this behavior throughout their life time). Plover also establish foraging territories which they defend vigorously. Such behavior makes it possible to acquire a fairly good estimate of the abundance of plover in any one area. These populations likewise remain relatively stable over many years (Johnson et al. 1989). The **only** other migratory species which may occur on or near the property is the Ruddy Turnstone (Arenaria interpres). This species also forages on lawns as well as along the shoreline.

Resident Indigenous (Native) WATERBIRDS:

The Black-crowned Night Heron (Nycticorax nycticorax) is the only species in this category. This bird occurs at PMRF and may occasionally rest in the trees at this locality. No night heron were recorded on the survey.

Resident Indigenous (Native) Seabirds:

The Wedge-tailed Shearwater (Puffinus pacificus) is known to nest at PMRF but not at this particular spot. Laysan Albatross (Diomedea immutabilis) also occur at the facility during the winter months. No seabirds were recorded during this survey. Newell's Shearwater (Puffinus newelli) may fly over the property as it goes back and forth between its nesting burrows in the mountains and the open sea where it forages.

Exotic (Introduced) Birds:

Table One lists a total of 14 exotic species found on the survey. Data from surveys in similar habitat elsewhere on PMRF and Kauai (Bruner 1988, 1990a, 1990b, 1990c, 1990d) and information provided in Pratt et al. (1987), TGI (1988), Hawaii Audubon Society (1989) suggest the following to occur on or near this site: Japanese Bush-warbler (Cettia diphone), Eurasian Skylark (Alauda arvensis), Barn Owl (~~Sc~~ Tyto alba), Ring-necked Pheasant (Phasianus colchicus), Western Meadowlark (Sturnella neglecta) and Hwamei (Garrulax canorus). Java Sparrow (Padda oryzivora) has also recently become established in the Princeville area (Hawaii Audubon Society 1989) and is likely spread to other lowland and urban habitats on the island. It would not be unexpected to eventually find this highly urban bird at PMRF.

Feral Mammals:

No evidence of rats or mice were found but these ubiquitous mammals likely do occur on the property. No trapping was conducted in order to assess the relative abundance of mammals at this site. One feral (?) cat was seen. Black-tailed Deer (Odocoileus henionus) are listed by TGI (1988) as "rarely found at PMRF." It is highly unlikely that deer utilize this particular site.

Records of the endemic and endangered Hawaiian Hoary Bat (Lasiurus cinereus semotus) are limited but the species is believed to be fairly common on Kauai (Tomich 1986; Kepler and Scott 1990). The ecology of this native bat is poorly understood.

CONCLUSIONS

A brief field survey can at best provide only a limited perspective of the wildlife present in any given area. Not all species will necessarily be observed and information on their use of the site must be sketched together from brief observations, available literature and unpublished reports. The number of species and the relative abundance of each species may vary throughout the year due to food resources and reproductive success. Species which are migratory will quite obviously be a part of the faunal picture only at certain times during the year. Exotic species sometimes prosper for a time only to later disappear or become a less significant part of the ecosystem (Williams 1987; Moulton et al. 1990). Thus only long term studies can provide a comprehensive

view of the bird and mammal populations in a particular area. However, when brief field studies are coupled with data gathered from other similar habitats the value of the conclusions drawn are significantly increased.

The following are some general conclusions related to birds and mammals on this property:

- 1- This relatively small property provides a limited range of habitats which are utilized by the typical assemblage of exotic species of birds one would expect at this elevation and in this type of environment on Kauai. However, some species typically found in this habitat were not recorded. This could have been due to the fact that the survey was too brief or that their numbers are so low that they went undetected or a combination of these and other factors. Species not accounted for on this survey but recorded on an earlier visit to PMRF (Bruner 1990d) include: Ring-necked Pheasant, Western Meadowlark and Hwamei. The only new exotic species found on this survey was the Chestnut Mannikin (Lonchura malacca). This species is apparently localized but yet abundant at PMRF.

- 2- The only native species recorded was the migratory Pacific Golden Plover. This bird is easily the most abundant shore-bird in Hawaii. Their use of lawns and roadsides makes them an exceptionally visible component of the environment. Their site-faithfulness and territoriality have been extensively studied (Johnson et al. 1981, 1989).

- 3- The change of habitat from a second growth coastal forest to a residential urban environment will alter the local populations of exotic birds found at this site. Species which prefer cover may decline while those which are better adapted to urban "backyard" habitats should increase in number. The opening up of the property and the creation of lawns will undoubtedly result in some increase in the population of wintering Pacific Golden Plover found at this site in subsequent years.
- 4- In order to obtain more definitive data on mammals, a trapping program would be required. No unusual mammal activity was noted. No endangered species were recorded.
- 5- The overall effect of the proposed development on the fauna in this region of the island should be minimal. Habitat of the sort found on this site is common at PMRF. There is nothing from the perspective of the present fauna that makes this property unique or irreplaceable.

Acknowledgements

Robert Inouye and his staff graciously provided assistance in accessing the site as well as information about the property and surrounding areas that are important to wildlife.

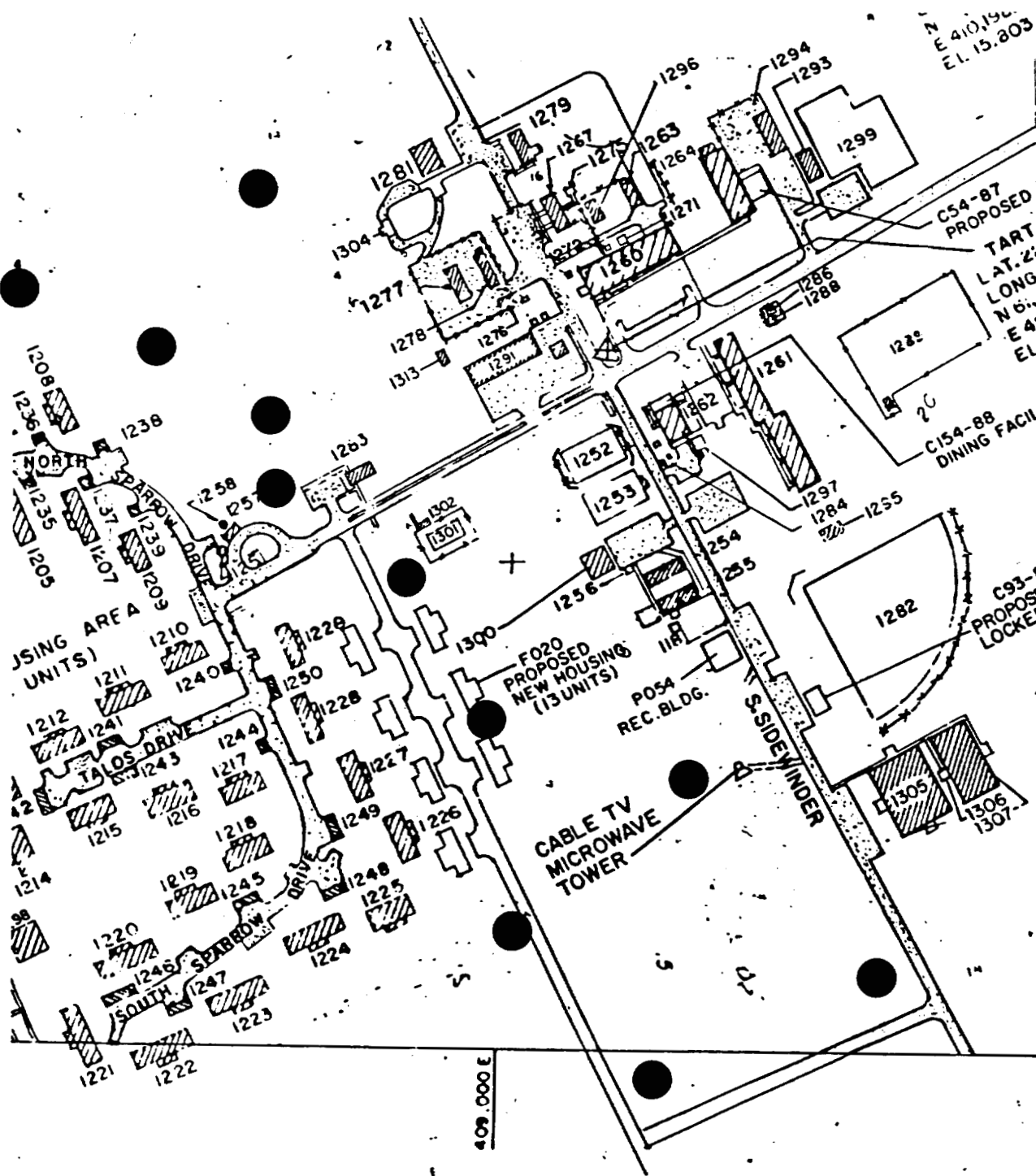


Fig. 1. Location of survey site with census stations marked by solid circles.

Table 1

Exotic birds recorded at PMRF, Kauai

COMMON NAME	SCIENTIFIC NAME	RELATIVE ABUNDANCE*
Feral Chicken	<u>Gallus gallus</u>	R = 4
Cattle Egret	<u>Bubulcus ibis</u>	R = 1
Spotted Dove	<u>Streptopelia chinensis</u>	C = 6
Zebra Dove	<u>Geopelia striata</u>	Ø = 10
Common Myna	<u>Acridotheres tristis</u>	C = 8
Northern Cardinal	<u>Cardinalis cardinalis</u>	U = 2
Red-crested Cardinal	<u>Paroaria coronata</u>	C = 5
Northern Mockingbird	<u>Mimus polyglottos</u>	R = 6
White-rumped Shama	<u>Copsychus malabaricus</u>	U = 2
Japanese White-eye	<u>Zosterops japonicus</u>	A = 14
Nutmeg Mannikin	<u>Lonchura punctulata</u>	U = 4
Chestnut Mannikin	<u>Lonchura malacca</u>	A = 15
House Finch	<u>Carpodacus mexicanus</u>	C = 7
House Sparrow	<u>Passer domesticus</u>	U = 4

* (see page 11 for key to symbols)

KEY TO TABLE 1

Relative abundance = number of times observed during survey
or average number on eight minute counts.

A = abundant (ave. 10+)

C = common (ave. 5-10)

U = uncommon (ave. less than 5)

R = recorded (seen or heard at times other than on 8 min. counts.
number which follows is the total number seen or heard over
the duration of the survey).

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ARCHAEOLOGICAL STUDY

**ARCHAEOLOGICAL SUBSURFACE TESTING RESULTS
FOR THE PROPOSED FAMILY HOUSING PROJECT AREA,
PACIFIC MISSILE RANGE FACILITY, BARKING SANDS,
ISLAND OF KAUAL, TMK 1-2-02:13, POR.25
REVISED OCTOBER 1991**

**Sponsored By: U.S. Navy and Belt Collins and Associates
680 Ala Moana Blvd., Suite 200
Honolulu, Hawaii 96814**

Contract Number: N62742-89-D-0007 Amendment 6

Principle Investigator: Joseph Kennedy M.A.

**Prepared By: Archaeological Consultants of Hawaii Inc.
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continued

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ABSTRACT

A surface and sub-surface survey was made of an area of 15.6 acres in the southern portion of the Pacific Missile Range Facility (PMRF) at Barking Sands, Kaua'i, Hawai'i. A family housing development is proposed for the area. Thirty-one randomly located test trenches were dug in the area. The purpose of the sub-surface testing was to locate and identify the nature and size of large subsurface sites. Many burial sites have previously been discovered in the northern section of the PMRF but there are no records of any being discovered in the southern section, where the project area is located.

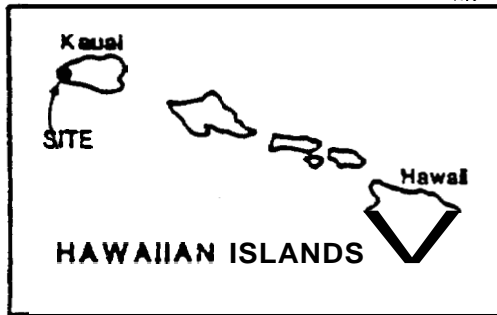
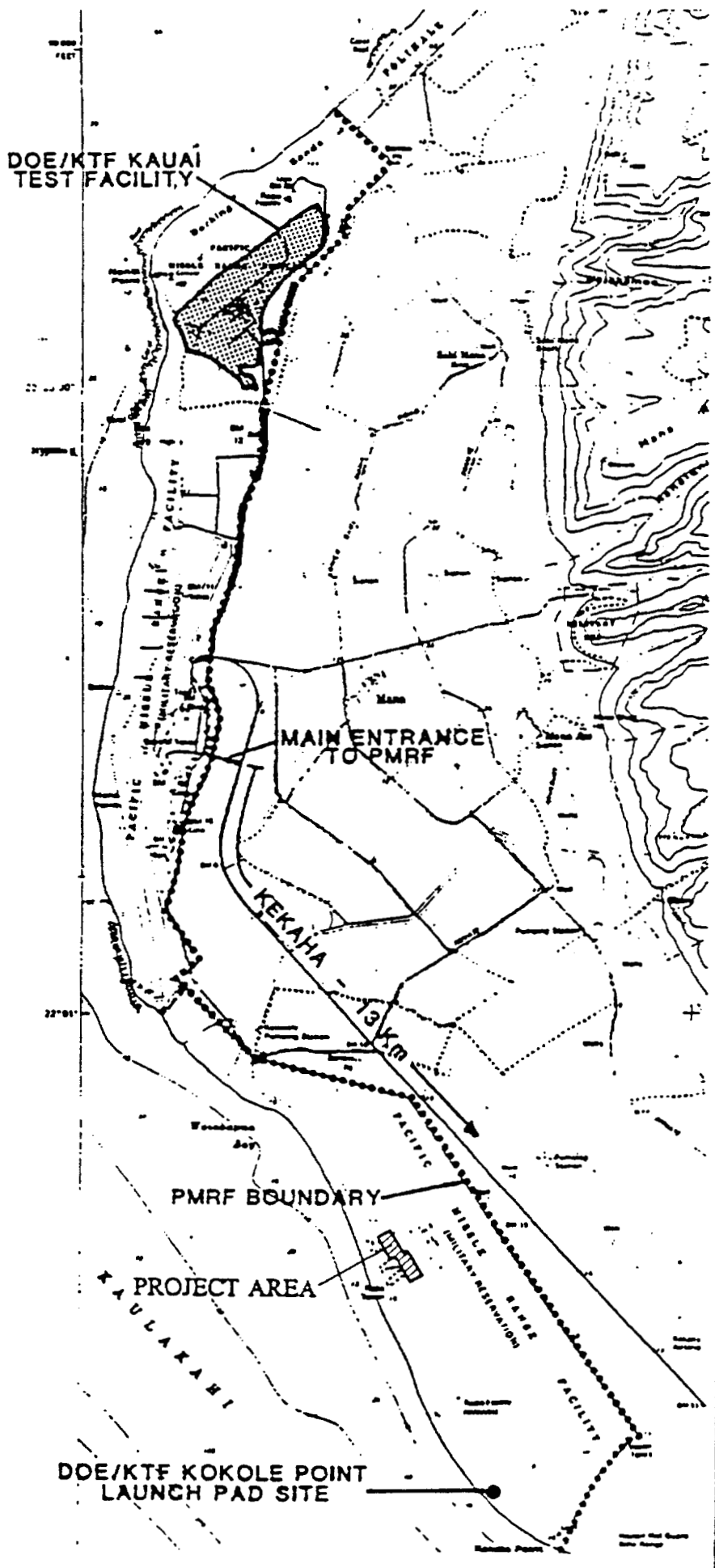
The sub-surface testing revealed no evidence of cultural materials save for some military ordinance which was buried in 1957. It is proposed that this lack of cultural materials supports an hypothesis that this southern section of the PMRF was not used to the same extent as the northern section in prehistoric or protohistoric times. A historic drainage ditch has been identified and described. Any adverse effect upon this ditch has been mitigated by this survey and report. However, because the survey was not designed to determine the presence or absence of small sub-surface sites, the possibility of such sites as individual burials being present cannot be discounted. For this reason, and because such burials are commonly found in sandy strand areas in Hawai'i, it is recommended that a monitoring program be implemented during construction activities which involve sub-surface disturbance.

INTRODUCTION

The United States Navy has proposed several future improvements at the Pacific Missile Range Facility (PMRF) at Barking Sands, island of Kauai. Under a contract with Belt Collins and Associates, Archaeological Consultants of Hawaii Inc. has conducted a surface survey and sub-surface testing of the affected area.

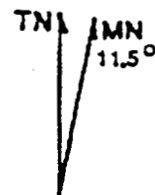
The location of the project site is shown in Figures 1 and 2. The Barking Sands Pacific Missile Range Facility is located on the west coast of the island of Kauai, in the ahupua'a of Waimea, district of Kona, Kauai County, Hawaii. The property is shown on the Hawaii Tax Map Key (TMX) as parcel TMK 1-2-02:13 and the western portion of TMK 1-2-02:25. The project site is located at 22 00 00 N, 159 46 15 W, and at UTM coordinates 2433000mN, 420000mE.

The project site is located in the southern section of the PMRF approximately 200 meters inland from the beach. The project area lies to the west of Sidewinder St. and to the east of Sparrow Dr. and is divided into two sections by Tarter St. The section north of Tarter St. is approximately

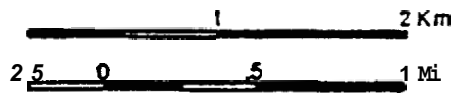


EXPLANATION

- DOE/KTF - DEPARTMENT OF ENERGY/
KAUAI TEST FACILITY
- PMRF BOUNDARY



SCALE

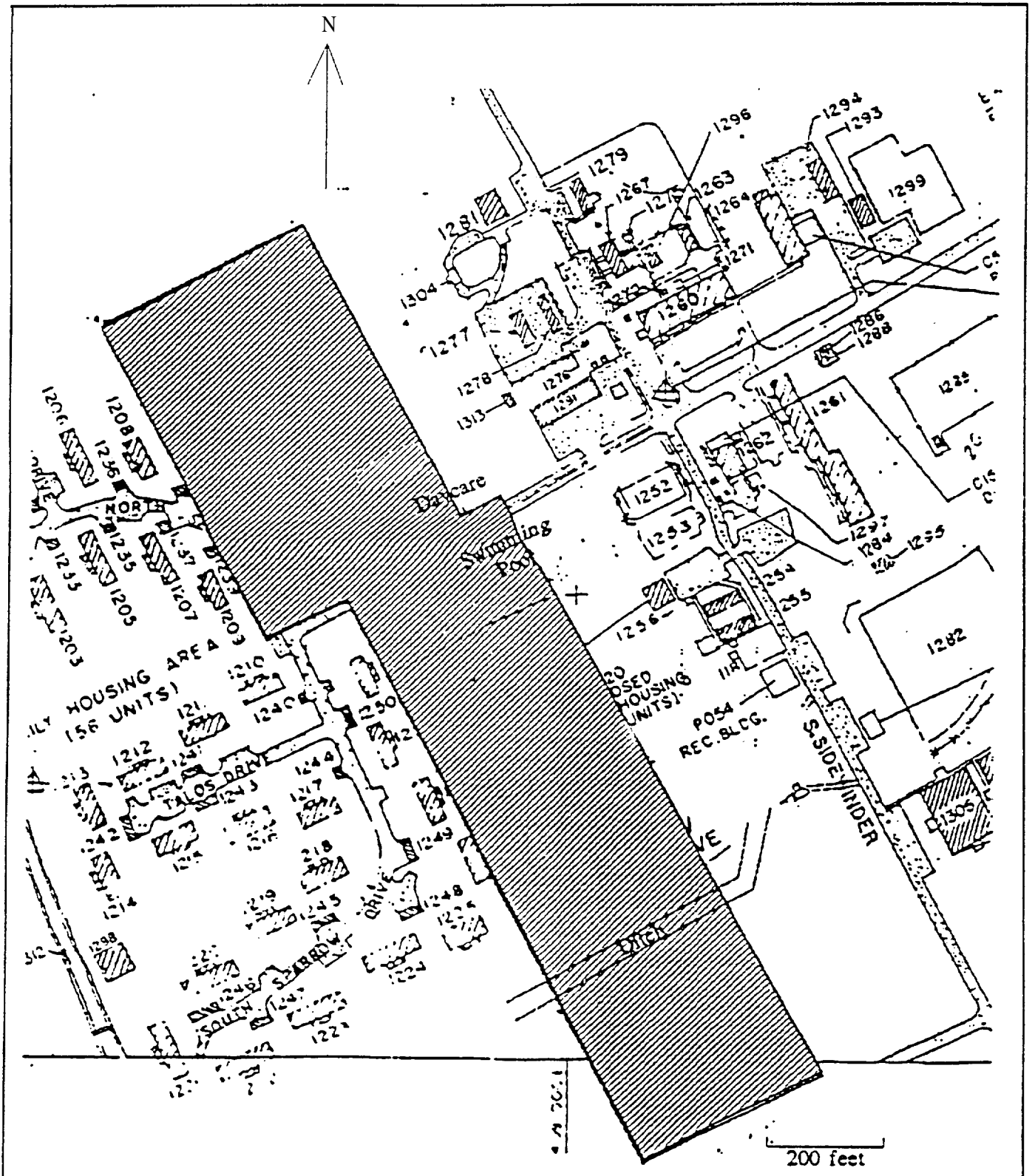


**FIGURE 1
PROJECT
LOCATION
MAP**

U.S. DEPARTMENT OF ENERGY/
KAUAI TEST FACILITY (DOE/KTF)
U.S. NAVY PACIFIC MISSILE
RANGE FACILITY, BARKING
SANDS, ISLAND (COUNTY) OF
KAUAI, DISTRICT OF KONA,
AHUPUA'A OF WAIMEA, HAWAII
TAX MAP KEY (TMK) 1-2-02,
PARCEL 13

MODIFIED FROM
ADVANCED SCIENCES INC.
1990

FIGURE 2
PROJECT SITE



Archaeological Consultants of Hawaii, Inc.

5.5 acres in area and the section south of Tarter St. approximately 10.1 acres.

The purpose of this survey was to conduct an archaeological sub-surface survey of the entire area potentially effected by the subject construction project. The primary emphasis of the testing was to locate and identify the nature and size of any large subsurface sites such as extensive cultural deposits and large clusters of burials.

Fieldwork was conducted by a two member crew (consisting of a permanent field supervisor and rotating field assistants), together with a backhoe operator, between November 26 and 28 and on December 27 and 28, 1990. Altogether, 80 person/hours were involved not including the backhoe operator's person hours. The work was supervised in the field by James Powell, B.A.; field assistants were Mark Barelllo B.A. and John A. P. Kruse. The field notes for the survey are on file at the Pupukea office of Archaeological Consultants of Hawaii Inc.

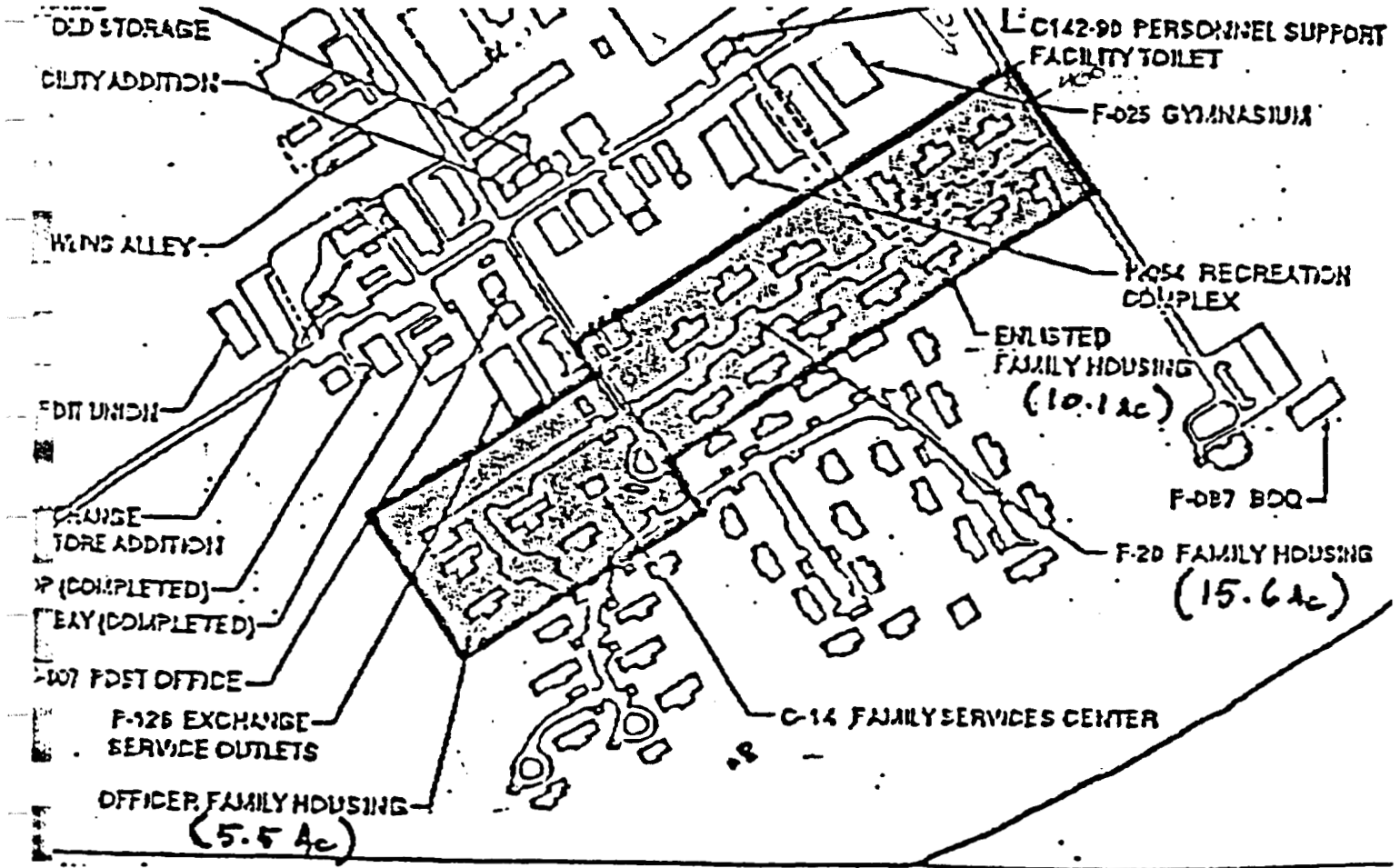
The proposed improvements to the project area consist of the development of a family housing area. This will involve the construction of low rise residential units throughout the area, a family services center, parking areas, and access roads (see Fig.3).

PHYSICAL SETTING

The PMRF is located on the coastal margins of the Mana plain stretching along the beach from **Kokole** Point in the south to Polihale State Park in the north. The major portion of the Mana plain consists of calcareous sand deposited by wave action, while the inland or eastern margin of the plain is made up of terrestrial alluvium. Old sea cliffs border the eastern edge of the plain. Most of the plain, away from the coastal margins, was formerly marshland and lakes until it was drained in stages between 1875 and 1960. Only very small areas of marsh still remain. The area occupied by the PMRF was thus formerly part of a large sand spit, 10 miles long, stretching from Polihale in the north to Xekaha in the south and separated from the ridges and valleys of western Kauai by the marshland and lakes.

The plain is generally flat with elevations below 5 meters. Along the coastal margins, however, sand dunes up to 30 meters high are present. Within the PMRF, these dunes are generally less than 5 meters in elevation, except in the most northern part of the facility, where the dunes reach greater elevations.

FIGURE 3
MAP OF PROPOSED DEVELOPMENTS



The high mountains bordering the plain on its north-east have a dominant influence on its climate. These mountains shelter the Mana plain from the north-east trade winds. As a result winds are generally light and variable. The plain is also in the rain shadow of these mountains resulting in an annual rainfall of only 50 cm (20 inches) per year. The majority of this rain results from winter, kona storms occurring between November and March. Average maximum temperatures range from 78 degrees in January to 87 degrees in August. Average minimum temperatures range from 60 degrees in January to 66 degrees in August.

The undisturbed soils throughout the PMRF are classified as Jaucas loamy fine sand (U.S. Department of Agriculture 1972:49). These are excessively drained, calcareous soils which have developed in wind and water deposited sands. Typically a 30cm thick C1 horizon of light yellowish-brown loamy sand overlays a C2 horizon of pale brown sand between 15cm and 75cm thick and a C3 horizon of very pale brown sand. The sand is loose on the surface but subsurface cemented laminae up to 10cm thick are present in the profile. The vegetation of the PMRF is dominated by exotic species. The natural vegetation of the area probably consisted mainly of pili grass covering the sand dunes with species such as naupaka (Scaevola sericea), 'ilima (Sida fallax), ihi (Portulaca cyanosperma), and Pa'u-o-hi'iaka (Jacquemontia sandwicensis) present along the strand.

The project area, itself, is now covered by low scrub with kiawe (Prosopis pallida), the dominant species. Other species present are lantana (Lantana camara), koa-haole (Leucaena alauca) and naupaka. The area is relatively level with a few natural depressions 30cm to 50cm deep and a few dune like mounds 1 to 2 meters high. A modern, unmaintained drainage ditch crosses the property in an east-west direction from near the cable TV microwave tower across to the south of the houses on South Sparrow Drive and on to the ocean. This ditch is approximately 6 meters across and 3 meters deep and densely vegetated. The section of the project area north of Tarter St. has been cleared and graded except for a stand of trees which parallels the western boundary. The section on the south side of Tarter St. is thickly wooded in its northern part with kiawe trees reaching 10m in height but is largely cleared in its southern part.

Along the coast, there are coral reefs at Polihale, north of the facility, Nohilli Point in the northern section, and just south of Mana Point in the central section of the facility. These reefs would have supported marine resources which could have been utilized by ancient Hawaiians. There are no reefs along the coastline adjacent to the southern section of the PMRF where the project area is located.

HISTORY AND PREVIOUS ARCEAEOLOGICAL SURVEYS

Advanced Sciences Inc. (1990) has presented a comprehensive review of both the history of the area and previous archaeological surveys in the vicinity. Figure 4 shows the location of known archaeological resources located within and in the vicinity of the PMRF. Table 1 lists these resources.

A major ancient burial ground is identified on an undated U.S. Navy map as existing in the northern quarter, or the Nohili area, of the PMRF (Advanced Sciences Inc.). The extent of this site is shown in Figure 4 (site #14). Its' boundaries extend from a point on the shoreline approximately 400m south of Nohili ditch, to the Polihale State Park on the northeast. The inland edge of the dunes at Barking Sands demarcates the approximate eastern boundary of the burial ground. Four other burial sites are identified on the navy map (Fig.4 sites #16,17,18,19). They are located in the central section of the PMRF within 1.5km either side of Mana Point. The most southerly site (#19) is approximately 2km to the north of the project area.

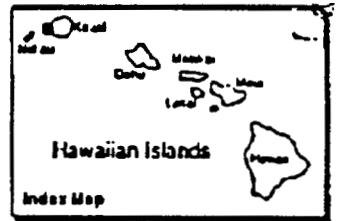
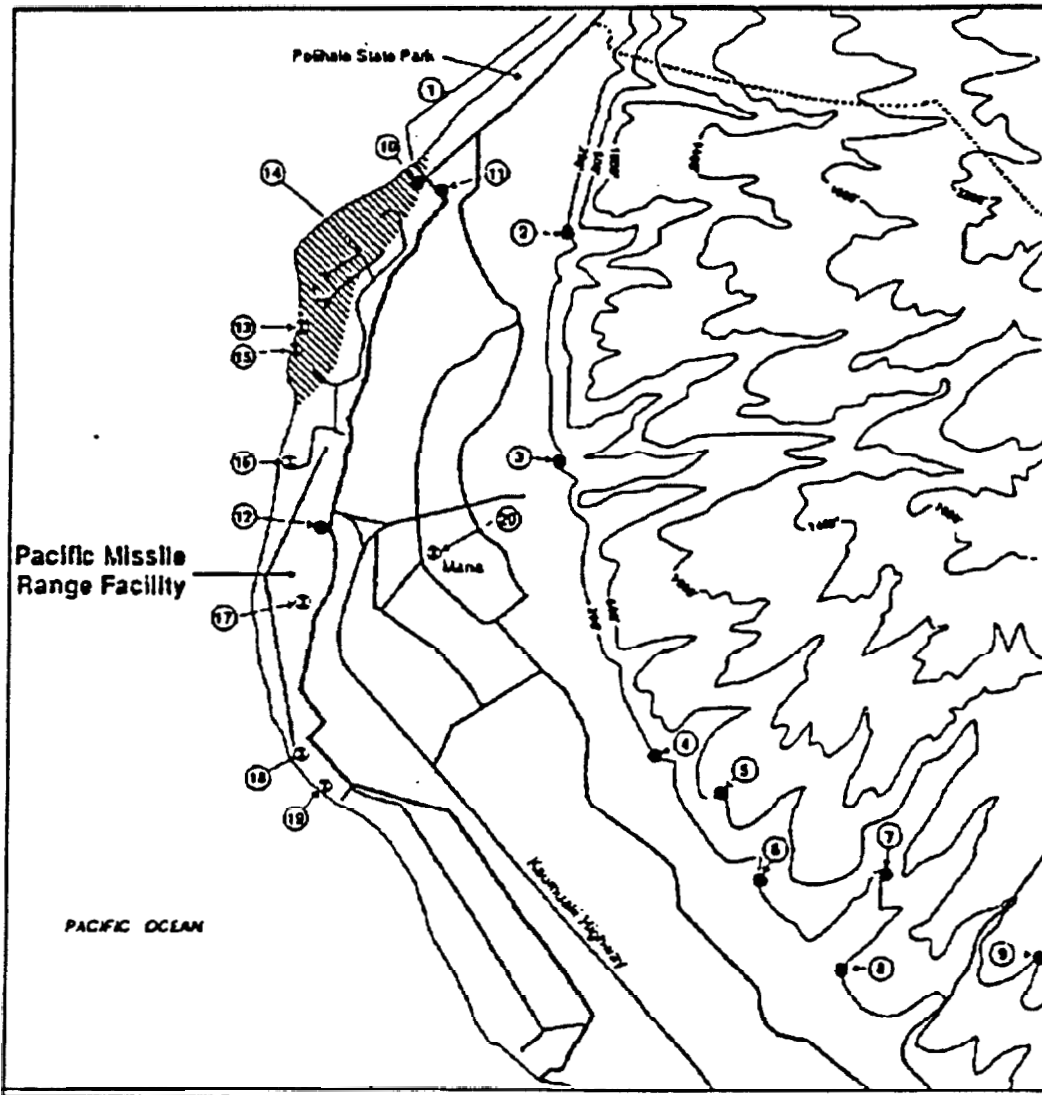
State Historic Preservation Deapartment (SHPD) file #50-30-05-09 and and a site located by Gonzalez with a SHPD number pending were identified as the only possible habitation sites within the PMRF boundries (Fig.4 sites #11 & 13 respectively). They are both in the Nohili area, site #13 being within the ancient burial ground marked on the Navy map (site #14) and site #11 being located just outside it. A heiau, has also been recorded within the boundaries of this same burial ground and is shown as Figure 4, site #10 (SHPD file #50-30-05-08). Kikuchi observed two small pits (Fig.4 site #15) in the south wall of the Nohili Ditch in the northern section of the facility (Advanced Sciences Inc.).

In addition, other camp sites and burials have been identified in the sand dunes immediately north of the PMRF, where Polihale State Park is now located (SHPD file #50-30-01-07).

No archaeological resources have been identified in the southern section of the facility where the project site is located.

A review of the Department of Land and Natural Resources (DLNR) State Historic Preservation Division (SHPD) archaeological files indicated that no archaeological surveys have been conducted in the southern section of the facility. There has been no previous surveys of the subject property and no previously recorded sites on the subject property.

McMahon (1988 a, b) conducted two field surveys just outside the boundary of the PMRF, one at Kawaiele, a mile



EXPLANATION:

- RECORDED SITE
- KNOWN UNRECORDED SITE
- ▨ ANCIENT BURIAL GROUND AS PER U.S. NAVY MAP

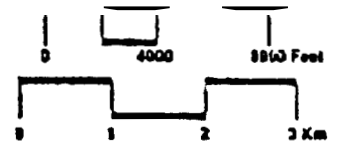


Figure 4
PMRF & Vicinity:
Archaeological
Resources

CONFIDENTIAL USE MAP-
NOT FOR PUBLIC DISCLOSURE OR
DISTRIBUTION from
 Advanced Sciences Inc.
 1990

Table 1

PMRF and Vicinity: Archaeological Resources

Recorded Archaeological Resources

1. Dune Burials and Camps
Reference: Bennett 1931; SHPO Hawaii Files #50-30-01-07
2. Kapula Heiau (Religious site); estimated location
Reference: Bennett 1931; SHPO Hawaii Files #50-30-03-06
3. Kahelu Heiau (Religious site); estimated location
Reference: Bennett 1931; SHPO Hawaii Files #50-30-05-10
4. Hoonenuu Heiau (Religious site); On State Register of Historic Places
Reference: Bennett 1931; SHPO Hawaii Files #50-30-03-12
5. Burial or Habitation Caves - estimated location
Reference: Bennett 1931; SHPO Hawaii Files #05-30-05-13
6. Two Heiaus (Unnamed - Religious sites); estimated location
Reference: Bennett 1931; SHPO Hawaii Files #50-30-05-14
7. Hauola Heiau (Religious site); On State & Federal Register of Historic Places
Reference: Bennett 1931; SHPO Hawaii Files #50-30-05-16
8. House Sites and Taro Terraces
Reference: Bennett 1931; SHPO Hawaii Files #50-30-05-14; Sinofo 1978
9. Burial Caves - estimated location
Reference: Bennett 1931; SHPO Hawaii Files #50-30-05-17
10. Elokuna Heiau (Religious site); estimated location
Reference: Bennett 1931; Luomala 1951; SHPO Hawaii Files #50-30-05-09
11. Hawaiian House Sites (Habitation); estimated location of destroyed site
Reference: Bennett 1931; SHPO Hawaii Files #50-30-05-09
12. Historic Japanese Cemetery
Reference: Cleeland 1976; SHPO Hawaii Files #50-30-05-616; The Traverse Group Inc. 1988
13. Burial Site/Beach Encampment - Habitation Area
Reference: Gonzalez, 2-90; SHPO Hawaii HSS # Pending

Unrecorded Archaeological Sites

14. "Major Ancient Burial Ground" at PMRF
Reference: U.S. Department of the Navy, Archaeological Map Files, no date
15. Subsurface Ash/Sand Strata Indicative of Previous Human Occupation in the Nohihi Area
Reference: Kikuchi 1979
16. Burial Site
Reference: U.S. Department of the Navy, Archaeological Map, no date. Location confirmed by C. Kagawa 7/89
17. Numerous Bones Found During (1960s) Construction of B-105
Reference: U.S. Department of the Navy, Archaeological Map, no date
18. Burial Site
Reference: U.S. Department of the Navy, Archaeological Map, no date. Location confirmed by K. Del Aire 2/90
19. Burial Site
Reference: U.S. Department of the Navy, Archaeological Map, no date. Location confirmed by C. Kagawa 7/89
20. Townsite of Mana (Historic Village)
Reference: Lydia Smith, Kekaha Sugar Co., March 1990

north of the project area and one about a mile south of the project area. No findings were reported as a result of these surveys. Bennett (1931) noted the existence of many house sites, burials and heiau in the cliffs and valleys bordering the eastern edge of the Mana plain. Survey maps from 1875 and 1891 indicate the existence of two settlements, Moelola and Keanapuka, just south of Nohili Point (Jay 1875 and Imlay 1891). Kikuchi (1987) has identified three former aquaculture pondfields situated just outside the northern and central sections of the present boundary of the PMRF on the Mana plain, Kolo Pond near Polihale covered 11 acres, Nohili Pond 179 acres, and Kawaiaeli Pond 77 acres.

Ethnographic reports by Handy and Handy (1972) and Pukui (1983) indicate that wet taro farming was undertaken in the northern end of the Mana marsh.

The Mana marsh was also used as a transport route by ancient Hawaiians. Accounts by Von Holt (1985) and John Kruse (pers. comm. 1990), whose families were among the first European settlers in the area, indicate that Hawaiians bringing taro by canoe from the Na Pali Coast area would come ashore at Polihale, transport both canoes and cargo across the sand spit, and continue their journey to Kekaha and Waimea on the lagoon. With afternoon sea breezes at their backs, the canoes would enjoy smooth sailing on the lagoon and avoid adverse currents found between Nohili Point, Mana Point, and Kokole Point in the Kaulakahi Channel.

A review of Indices of Quiet Titles (Land Commission Awards or LCA's) showed that there were no awards in the vicinity of the project area.

The first Crown lease in the Mana area was granted in the mid 1850's to Archibald Archer. Von Holt (1985: 77) describes riding through "... a big swamp, almost an inland sea..." to get to Waialele beach. She also indicates that around 1875 her father, Valdemar Knudsen, who had taken over the lease from Archer "... finally got the half-finished Waiele ditch dug through and led the bulk of the water off" (Von Holt 1985: 78). Previous to this the swamp must have stretched further south than the present southern boundary of the PMRF since Von Holt (1985: 77) reports that "Hawaiians going by canoe from Mana to Waimea ... would tie their canoes to the coconut trees on the bank of this tremendous swamp" when they wanted to see her father at Waiawa, which is more than 5km south of the project area.

The 1891 survey map shows ditches draining the marshlands at Waiele, Waiawa and Kekaha (Imlay 1891). The map however does not show the extent of the Marshland and lakes around the PMRF. The ditches which are shown on the 1891 map do not appear on the 1875 survey map (Jay 1875). This supports Von Holt's account of the swamp being partially

drained about this time. A 1912 USGCS topographic map which was surveyed in 1910 shows the three ponds described by Kikuchi (1987) with some surrounding marshland and the Waiele ditch. It seems that the marshlands are much smaller than those described by Von Holt (1985). A 1944 Territorial Highway Department map of Kauai shows Waiele pond but not the ones at Kolo and Nohili (Territorial Highway Department 1944). The 1965 USGS map, which was based on aerial photos taken in 1959-60, shows that all three ponds and nearly all the marshland had been drained (U.S. Geological Survey 1965). Thus it appears that the ponds and marshlands were drained in stages starting around 1875 when much of the marshland was drained, between 1910 and 1944 Kolo and Nohili ponds may have been drained and by 1960 Waiele pond and the remaining marshland had disappeared,

After the partial draining, the drained land was used to grow tobacco, sisal, rice and finally sugar cane (Advanced Sciences Inc. 1990).

A 1903 Territorial survey map showing land use shows the PMRF area dedicated to cattle grazing with rice growing around the Mana area and sugar cane closer to the foothills in the east (Wall 1903). A 1921 Territorial Survey Map shows the coastal strand designated as pastoral land and indicates that the area had been cleared of kiawe (Advanced Sciences Inc. 1990). In 1941 the area was transferred to the U.S. War Department and has been used as a military base since that time.

In the project area itself, two modern buildings, a covered bus stop with turnaround and a section of North Sparrow Drive occupy small portions of the project area. The buildings house the on-base day care center and a swimming pool. A 4 inch sewer line passes through the southern end of the project area. The northern part of the southern section has recently been graded and planted with lawn grass and a sprinkler irrigation system has been installed.

In review, ethnographic and archaeological evidence suggests substantial use of the coastal and adjacent areas now occupied by the northern and central sections of the PMRF by Hawaiians during the pre-contact and early historic period. There is no archaeological evidence, however, of use of the area now occupied by the southern section of the facility.

The lack of known archaeological resources in this section of the facility could be partly explained by the fact that no previous archaeological surveys have been undertaken in this section of the facility. However, if there are cultural materials in this area, it is surprising that some have not already been discovered and recorded during construction activities in this area, **as has** happened in the

northern and central sections of the facility.

An alternative hypothesis explaining this lack of evidence in the southern section of the facility is that this area was not used by the Hawaiians to the same extent as the coastal areas to its' north. There are a number of facts which support this hypothesis. The northern section of the facility lays astride an ancient transport route where canoes were hauled from the ocean and carried across the sand spit to the marsh. In contrast, the southern section was well away from this route connecting the settlements along the Na Pall Coast with those in the area of Waimea and Kekaha.

In addition, marine resources would have been much more plentiful in the northern and central sections due to the presence of coral reefs at Nohili Point, Waiele, and Polihale (see U.S. Geological Survey 1983 Makaha Point, Hawaii and Kekaha, Hawaii quadrangles). Coral Reefs along the shoreline provide food such as algae, seaweeds, shellfish, fish and sea urchins. Sandy coastlines without reefs do not support the above food sources because the continually shifting sandy bottom does not provide a suitable substrate for these plants and animals. Fish are not as common along sandy shores because of the lower amounts of food available for them there. The southern section of the PMRF would have been depauperate in these resources because *of* its sandy coastline.

There is other evidence which supports the hypothesis that the northern parts of the PMRF were used more intensively. The presence of fish ponds and taro cultivation in the areas of the marsh adjacent to the northern and central sections of the facility has been detailed. **No** accounts of similar activities occurring in the southern section of the marsh were found. Early historic maps (Imlay 1891 and Jay 1875) show settlements in the northern section of the facility but none in the south.

A number of archaeological sites (SHPD file #50-30-05-12, 50-30-05-13 & 50-30-05-14), three heiau and one burial or habitation cave, are located along the foothills directly opposite across the plain from the project area (approx 2 1/2km) (see Fig.4 sites #4, 5, & 6). Even though a large marsh originally separated these sites from the strand where the project area is located it is possible that the people using these sites may have used the project area for burials and or habitation. However the fact remains that resources were limited in this area compared to the areas further north in the PMRF.

The archaeological review indicates that the project site is located on dunes which have been disturbed. Dunes are known to have been favored burial sites for the pre-European contact Hawaiians. No human burials were

encountered during subsurface testing at this project site, although human bones have been found in the dunes along this coast and a large burial ground has been identified by the U.S. Navy to the north of the project site (see figure 4). The environment of the project site and its vicinity did not favor agriculture or aquaculture. It is unlikely that habitation sites, other than modern, will be found in this area .

METHODOLOGY

A surface survey was conducted on the first day by two people. The project area was divided into two sections for the purposes of this survey, the area north of Tarter Rd. and the area south of the road. The northern section was covered in sweeps on a bearing of 320 to 140 degrees. Because the area has been cleared and graded, the sweep lines were spaced 8 meters apart. No sites were observed. The southern section of the project area was swept on the same bearing but the sweep lines were spaced 5 meters because the vegetation was more dense here. One possible site was found in the south-west corner of the project area and was given a temporary site number, PMRF ACH#1. Its' location is shown in Figure 6.

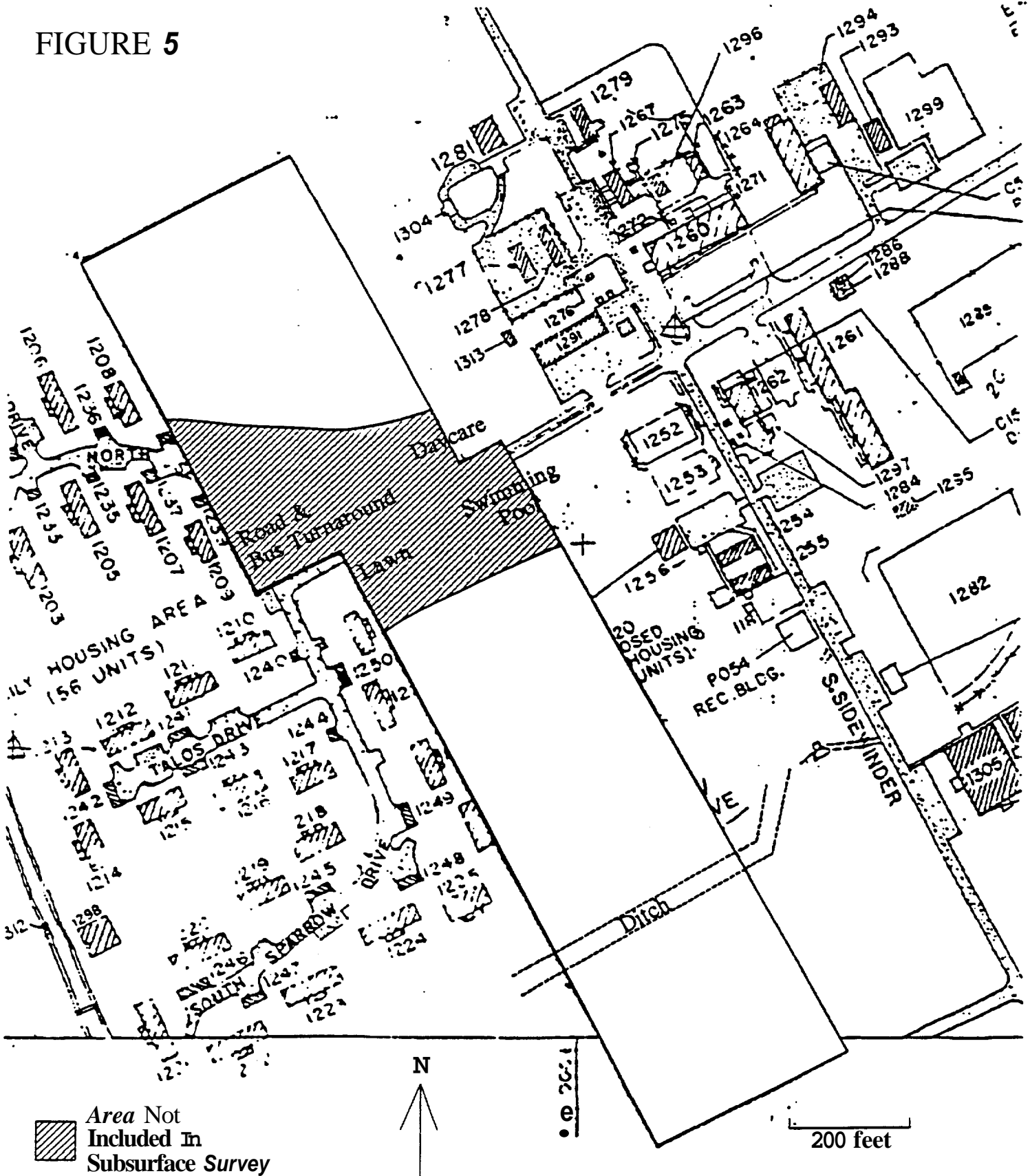
This site consisted of 8 pieces of cemented sand in a somewhat elliptical pattern on the top of a small sand dune 5 meters long, 3 meters wide and 1 meter high. A sketch of the site is shown in Figure 7.

A total of 31 test trenches were excavated across the subject property with a Case 600 backhoe equipped with a 22 inch (56cm) bucket. All the earth excavated was screened through 6mm (1/4") screens and the sift inspected. The scope of work required 25 test trenches to be dug. The distribution of these 25 trenches was determined randomly using a random number table with the numbers being used to identify squares delineated by a grid placed over a map of the project area. The grid squares measured 40ft (13m) on a side. In the field, the location of the selected squares was determined using a tape and the trenches were dug wherever was most practical within the squares. Trench 23 was purposely placed through a mound that was considered to be a possible site (PMRF ACH#1). The excavation of this mound is a representative sample for similar mounds located within the project site.

Before determining the trench locations, several areas were considered to be excluded from the sub-surface survey. These areas have been shown in Figure 5. The south-western corner of the northern section of the project area was excluded from the sub-surface survey because it was covered by a paved road and a bus turn around and waiting shed. The

AREA OF SUBSURFACE SURVEY

FIGURE 5



TRENCH LOCATION MAP
 ARCHAEOLOGICAL CONSULTANTS OF HAWAII, INC
 JANUARY 1991

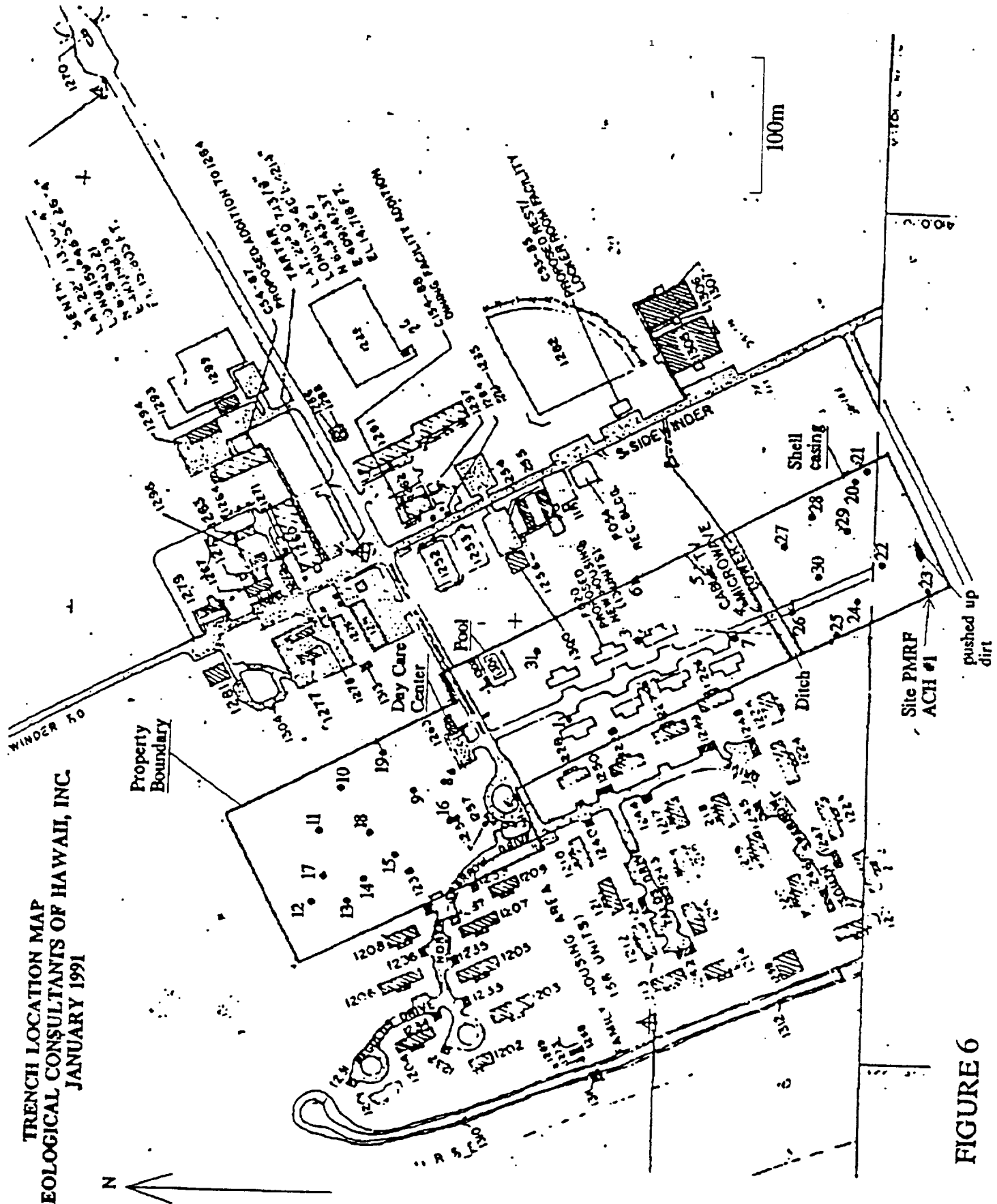


FIGURE 6

south-east corner of the northern section was excluded because it is the site of an existing day care center. The northern part of the southern section was excluded because an existing swimming pool is located there and the remaining area has recently been turned into a lawn with irrigation piping laid below the surface. These areas were not going to be disturbed during the proposed development. An extra six trenches were dug as there was some spare time at the end of the job. These were located in the southern part of the southern section of the project area as it was easier to dig there since there were not as many large trees as in the northern part. The trenches ranged in length between 5ft (1.6m) and 16ft (5.25m) and in depth between 5ft (1.6m) and 6ft (2m).

Both sides of the ditch which crosses the project area were examined (figure 5). No cultural material was exposed, nor was an intrusive pit present. It is very likely that this is the intermittently flowing drainage ditch, located on a contemporary 1:62,500 topographical map, which crosses the dunes running from the Mana Plain to the ocean (USGS 1983). This ditch was undoubtedly constructed during the draining of the Mana Plain while it was still a marsh, either at the end of the eighteenth century or at the beginning of the nineteenth century. In the strictest sense, this ditch is a historic site for it is over 50 years old. This ditch is located and described in the text and was subject to an examination for cultural materials. Thus, if this ditch is disturbed during construction activities at this site, any adverse effect upon it will be mitigated.

RESULTS

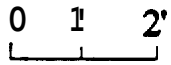
Only two trenches (#'s 6 & 20) yielded any artifacts, Military ordinance was found 15cm to 30cm below the surface (layer 1) in trench 20. The ordinance consisted of shell casings for 85mm mortars, A scrap book kept by a security guard at the base (C. Cutbreath pers.comm.) indicates that these cases were buried in 1957. Work was suspended on this trench upon discovery of the ordinance.

A fire pit along with a piece of lumber with nails and concrete attached was found in layer 3, 40cm below the surface in trench 6. This feature was classed as modern because the condition of the lumber indicated it was less than 50 years old and thus is not historically significant.

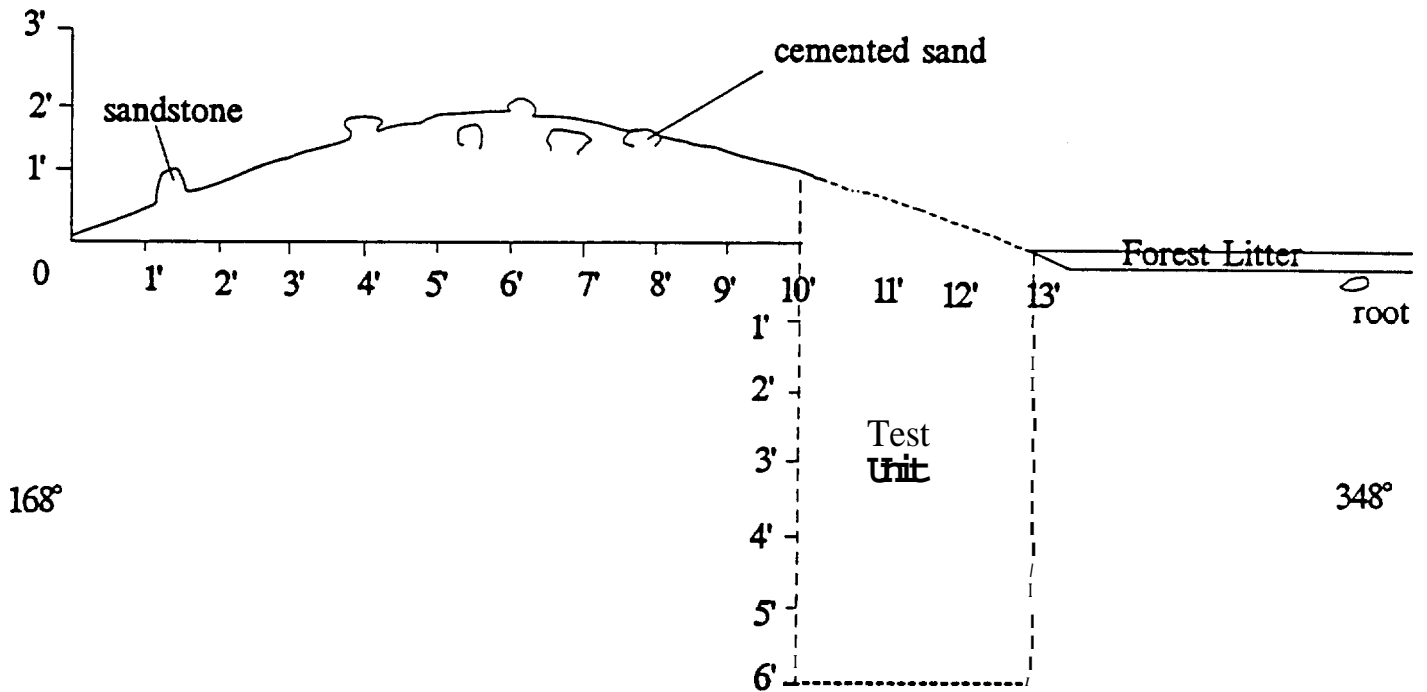
Profiles of all trenches are presented in appendix A. These are schematic profiles based on notes and representative profiles recorded in the field. The soil profiles of the 31 trenches can be classified in three groups. Tree roots were found in all trenches at varying depths.

FIGURE 7 PROFILE & PLAN OF TRENCH 23 & SITE PMRF ACH #1

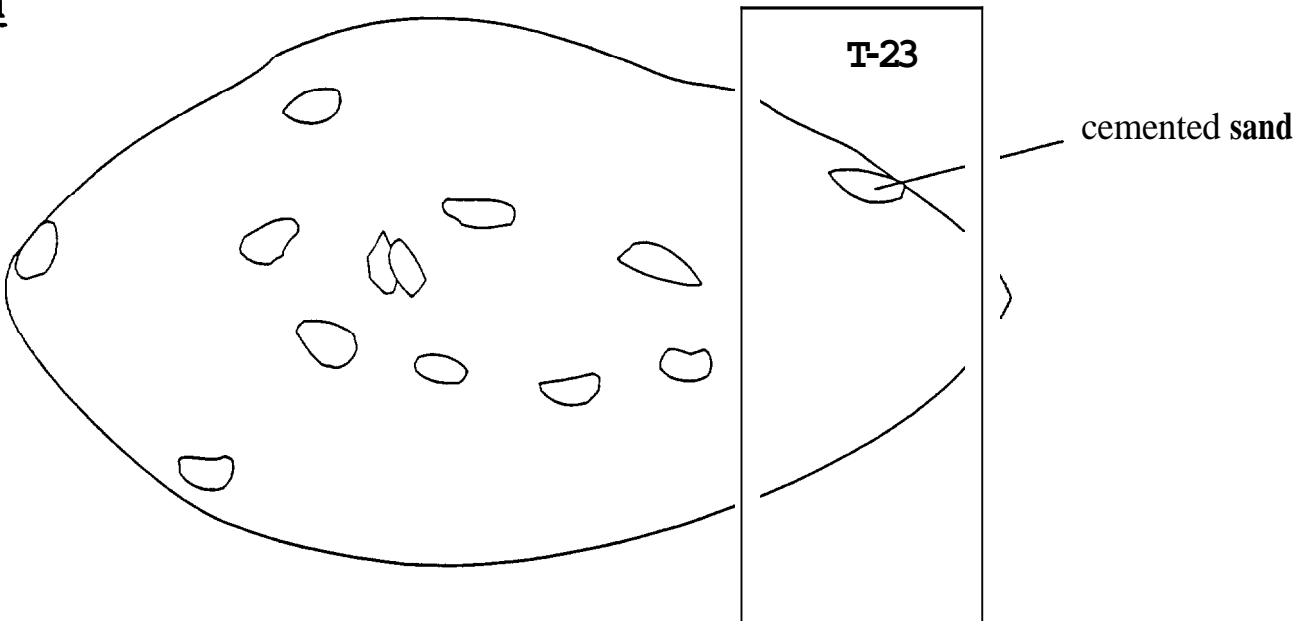
Site PMRF ACH #1
Trench #23



Profile



Plan



Trenches 1-7 exhibit two distinct deposits. The soil sequences in these profiles are consistent with the Jaucas loamy fine sand, 0 to 8% slopes, soil classification of Foote et al. (1972:49). The upper layer is a dark grayish brown loamy fine sand (10 YR 4/2), averaging 25cm (10") in thickness (Layer 1). Foote et al. (1972:49) note of this deposit:

"This soil occurs on old beaches and windblown sand deposits in the western and southern parts of Kauai"

The second layer is a light yellowish brown sand (10 YR 6/4), averaging 90cm (35") thick (Layer 2). This sand is unconsolidated, nonsticky and nonplastic. This sand was deposited by aeolian processes. At a depth of 130cm (51") and more, the sand becomes cemented (Layer 3). This cement is likely to be carbonate based.

Trenches 8-31 (excepting 16 & 29) exhibited only one layer of light yellowish brown sand (10 YR 6/4). This is the same deposit identified as layer 2 in trenches 1-7. In some trenches the sand is cemented at 100cm-125cm (39"-49") below the surface. The overlaying loamy layer characteristic of trenches 1-7 has probably been removed when the area was graded.

Trenches 16 and 29 were distinctive, for they contained a layer of red loam (2.5 YR 4/8) about 20cm thick. This red loam has undoubtedly been mechanically placed above the sand.

Trench 23, which was dug into the northern end of site #1, revealed no evidence of disturbance of the natural profile. The lack of stratigraphic disturbance may indicate that this deposit is not cultural, but is a remnant of the formerly more extensive dune system in this area. The presence of dunes within the PMRF has been noted above (page 4). The cemented blocks on the surface of the mounds have probably been mechanically dumped there. These blocks originate from the cemented sand found at depth across this site. The excavation of site #1 is a representative sample for similar mounds located across the project site, for it allows the nature of these features to be ascertained.

Cultural artifacts were found in only two trenches (#'s 6 & 20). The red loam present at the surface at trenches 16 and 29 has probably been placed here since the PMRF was constructed. The remaining stratigraphy across this site is consistent with the Jaucas series identified by Foote et al. (1972:49), and is a product of aeolian processes and subsurface cementation of sand.

CONCLUSIONS AND RECOMMENDATIONS

The stratigraphic profiles displayed in trenches 1-7, which are located in the northern portion of the southern part of the project area, are close to that of the typical Jaucas loamy fine sand profile as described by Foote et al. (1972: 49) in which the surface layer is loamy fine sand and the lower layers are sand. The surface layer of loamy fine sand is absent in the profiles of the other trenches probably due to the fact that the areas in which these trenches are located have been cleared and in some areas, graded.

No cultural layers or materials were discovered in any of the profiles, although modern artifacts were found in trenches 6 and 20. A historic ditch was found, although any adverse effect upon it has been mitigated by this survey and report. No sign of human burials was found. It is our opinion that ACH site #1 is not an archaeological or historical site. The dune appears natural, many other similar mounds were present in the project area and many of these were also tested and no cultural materials found. The trench cut in the northern side of the site showed no evidence of disturbance or cultural materials. The pieces of cemented sand on the surface seem to have come from the layer of cemented sand that is evident in many of the trench profiles at a depth of over 100cm (39"). These pieces of cemented sand may well have been eroded to the surface, or unearthed during the excavation of the nearby sewer trench.

The purpose of this survey was to locate large subsurface sites such as extensive cultural deposits and large clusters of burials. Given the spacing of the test trenches, there is a possibility that small sites such as a camp site or a small cluster of burials may have been missed.

Although this survey has found no evidence of any large sites it is possible that small sites such as individual subsurface burials may be present. Since many burials have been found on PMRF, and most of these have been individual burials (pers. comm. Robert Hommon), this possibility must be regarded as significant. It is therefore recommended that a monitoring program be implemented during any construction activity that will cause sub-surface disturbance. This should involve the presence on site of an archaeologist during such ground disturbing activity. The monitoring archaeologist should have the authority to halt construction in the immediate area of a find until mitigative measures have been taken.

The failure of this survey to find any indication of prehistoric use may support the hypothesis that this area was not utilized to the same extent as the northern part of the Mana Plain.

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- Wall, W.
1903 Hawaii Territory Survey, Kauai, Hawaiian Islands.
 On file at Hamilton Library, University of Hawaii at
 Manoa.

Archaeological Consultants of Hawaii, Inc.
59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

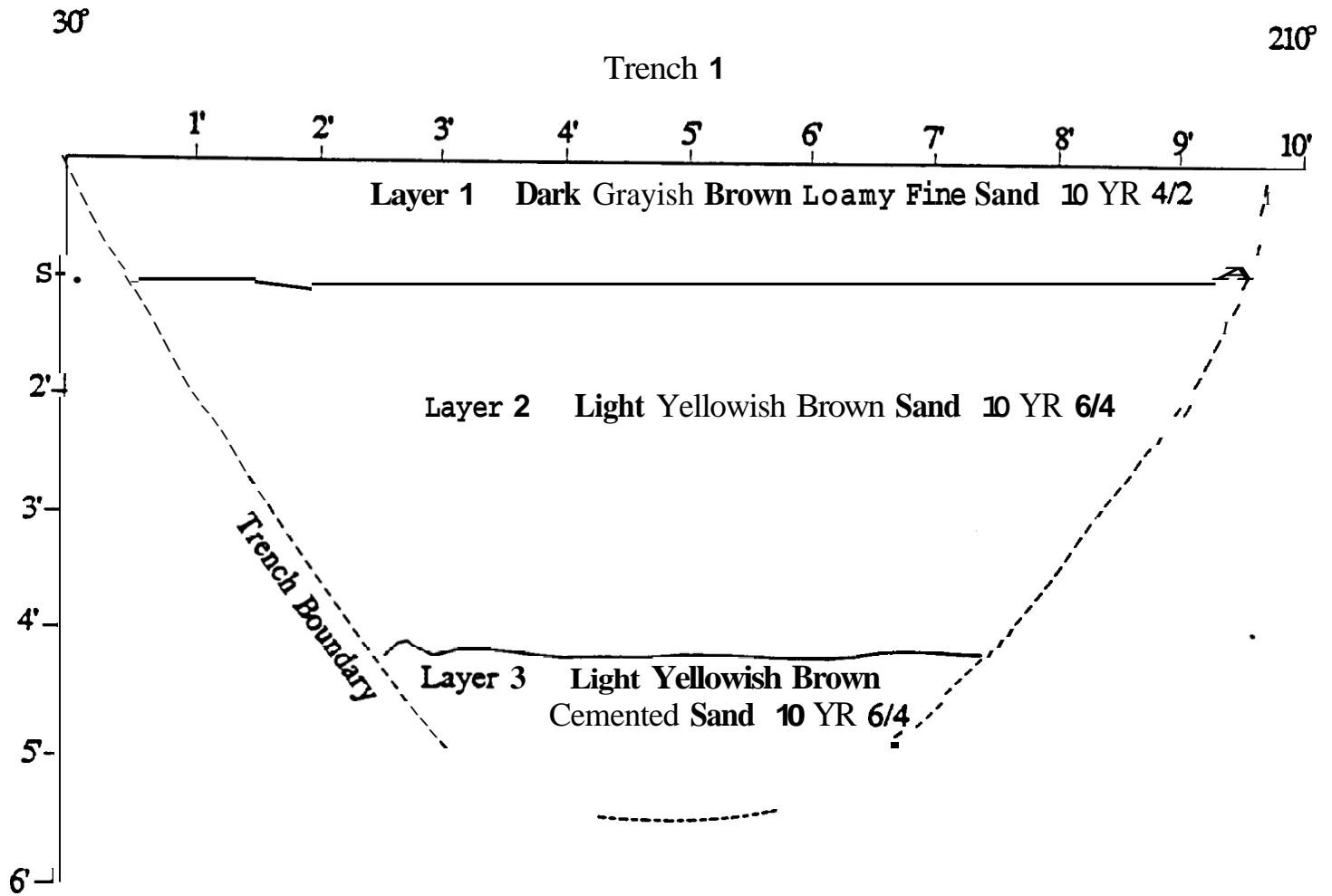


Figure A-1

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59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT' AREA
BARKING SANDS, KAUAI

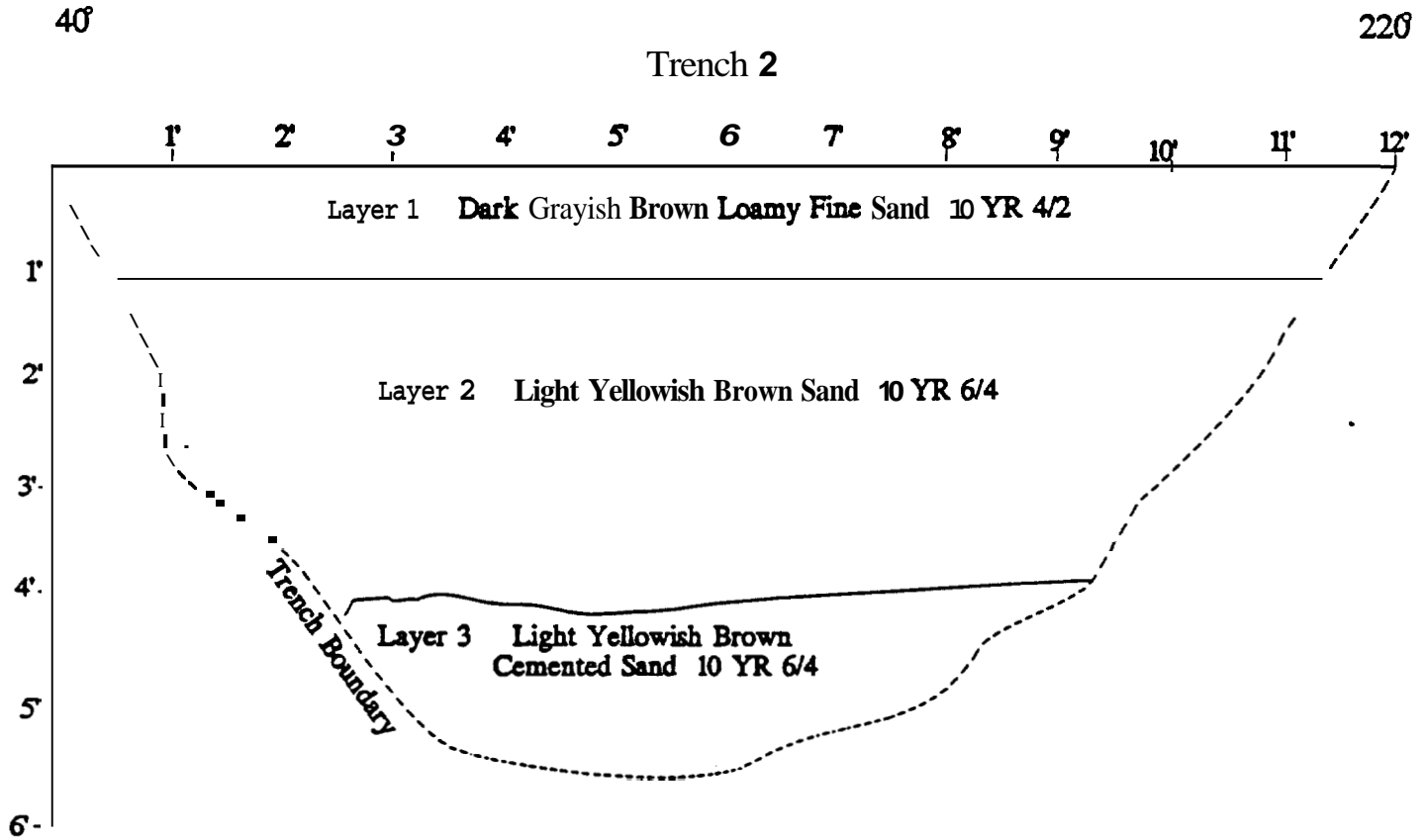


Figure A-2

Archaeological Consultants of Hawaii, Inc.
59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

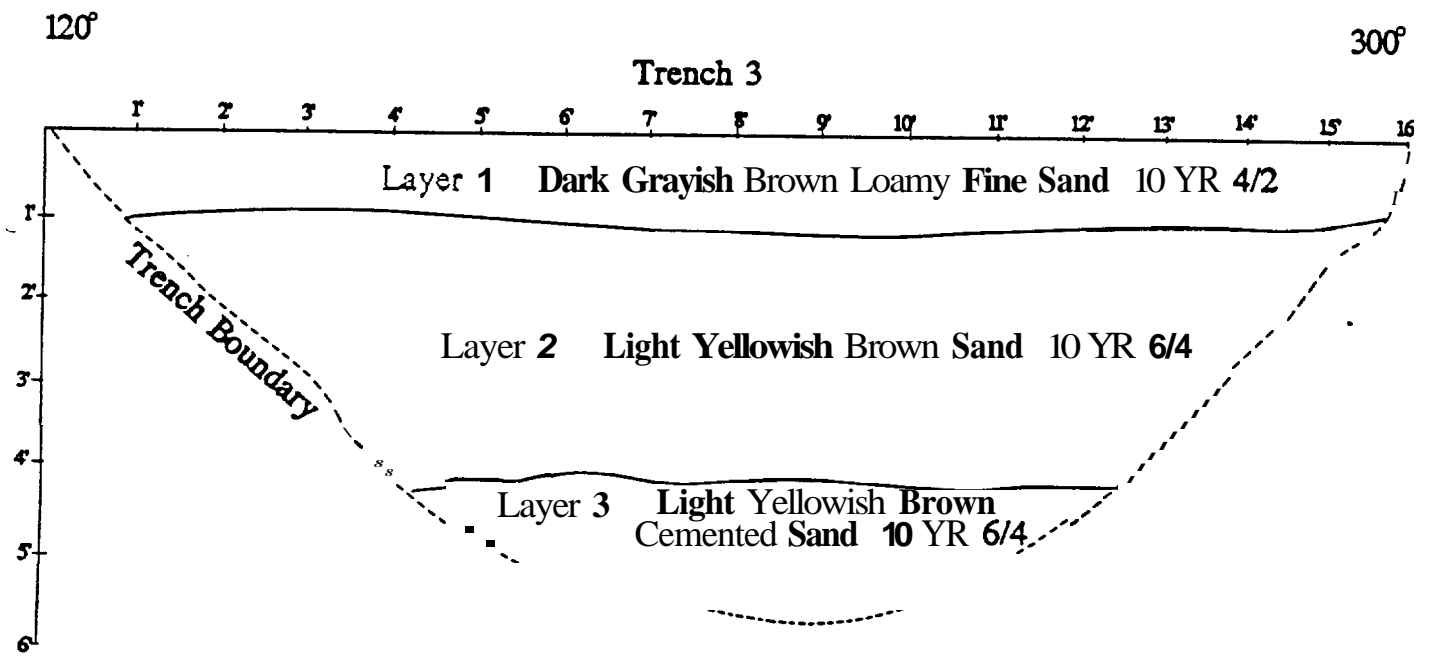


Figure A-3

Archaeological Consultants of Hawaii, Inc.
59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

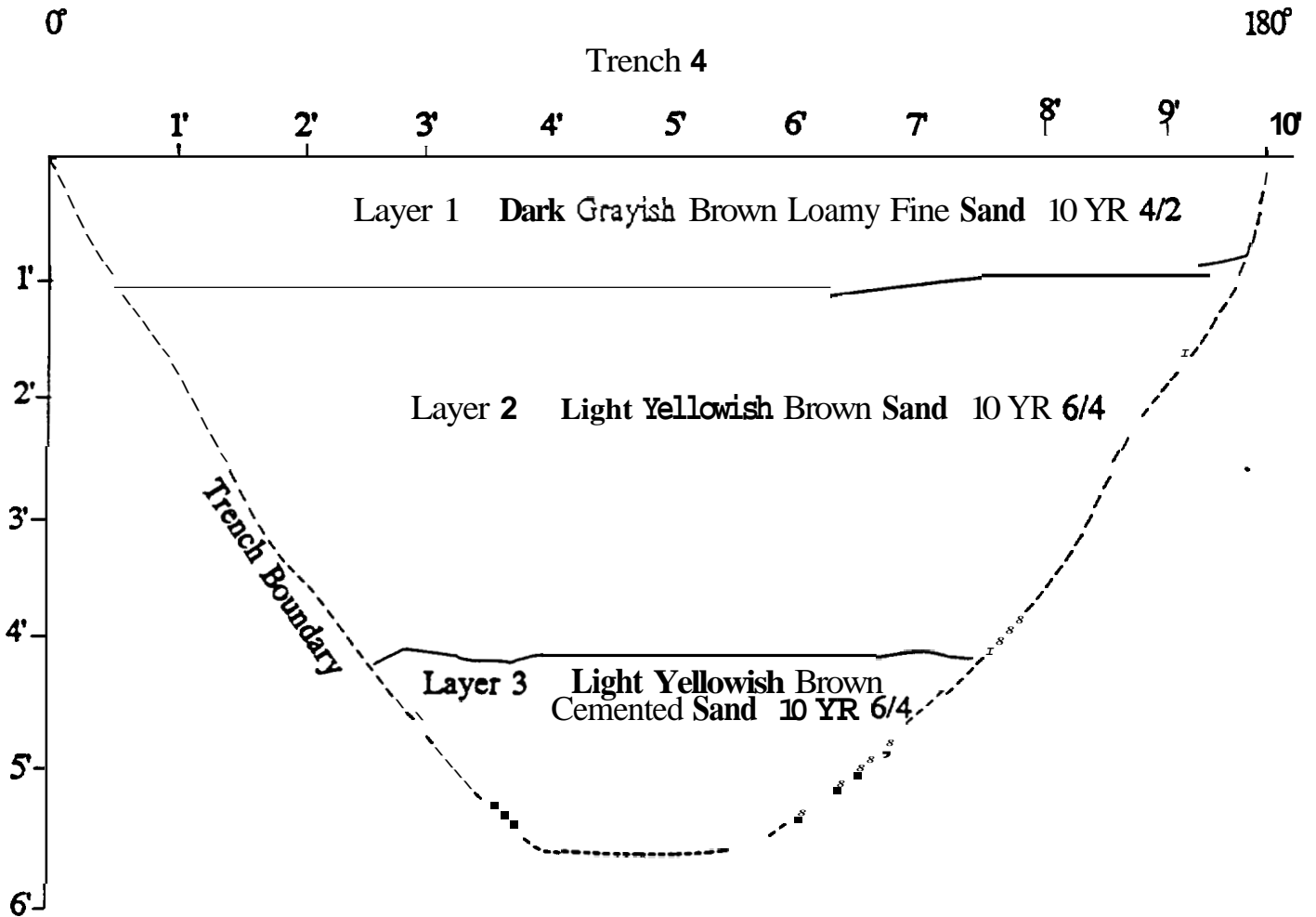


Figure A-4

Archaeological Consultants of Hawaii, Inc.
59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

120°

300°

Trench 5

1'

2'

3

4'

5'

6

7

8'

Layer 1 ~~Dark Grayish~~ Brown Loamy Fine Sand 10 YR 4/2

Layer 2 Light Yellowish Brown Sand 10 YR 6/4

Layer 3 Light Yellowish Brown
Cemented Sand 10 YR 6/4

Trench Boundary

1

2

3

4'

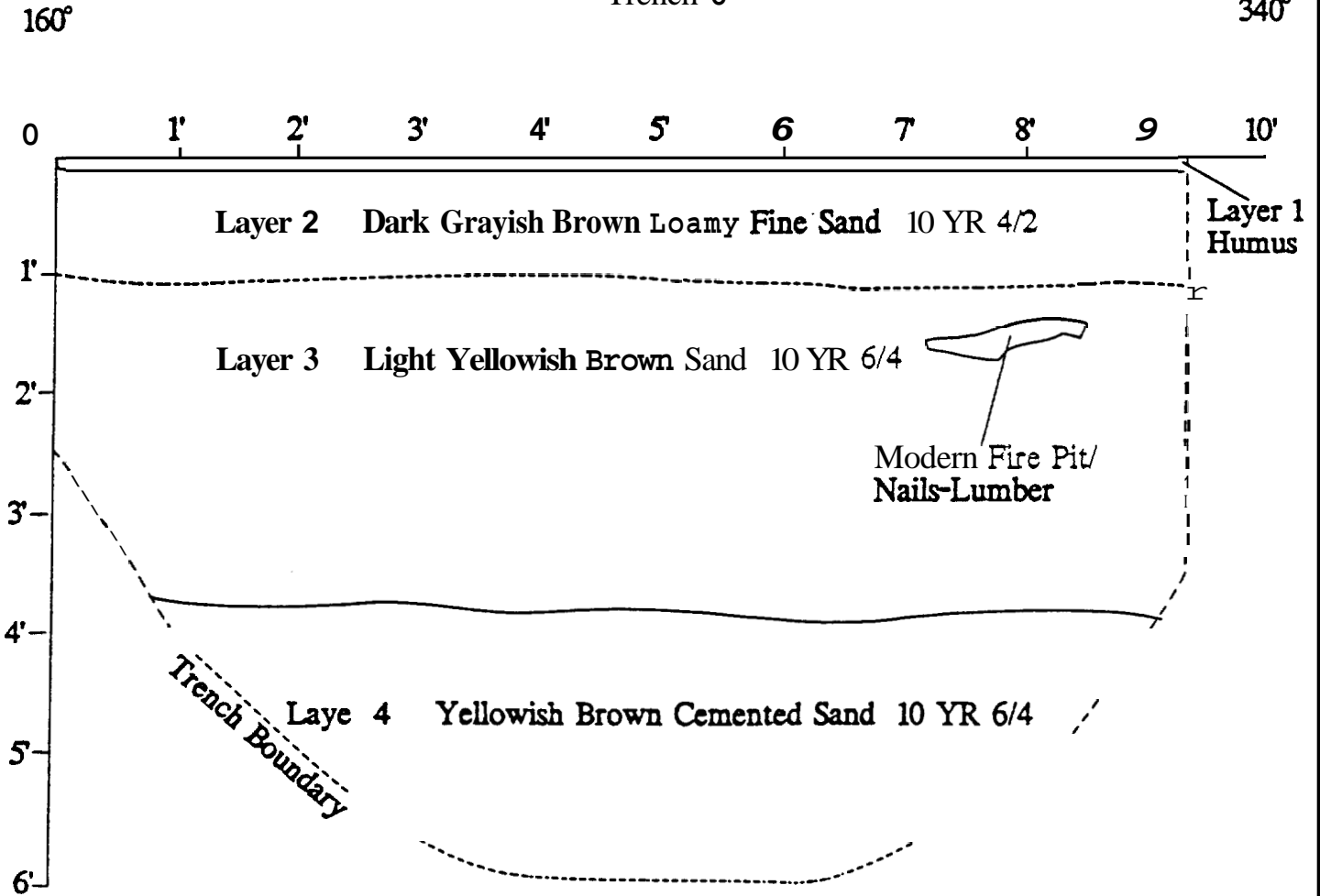
5'

6

Figure A-5

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 59-624 Pupukea Rd.
 Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

Trench 6



This trench is in a depression in which water and plant material have collected.

Figure A-6

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59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

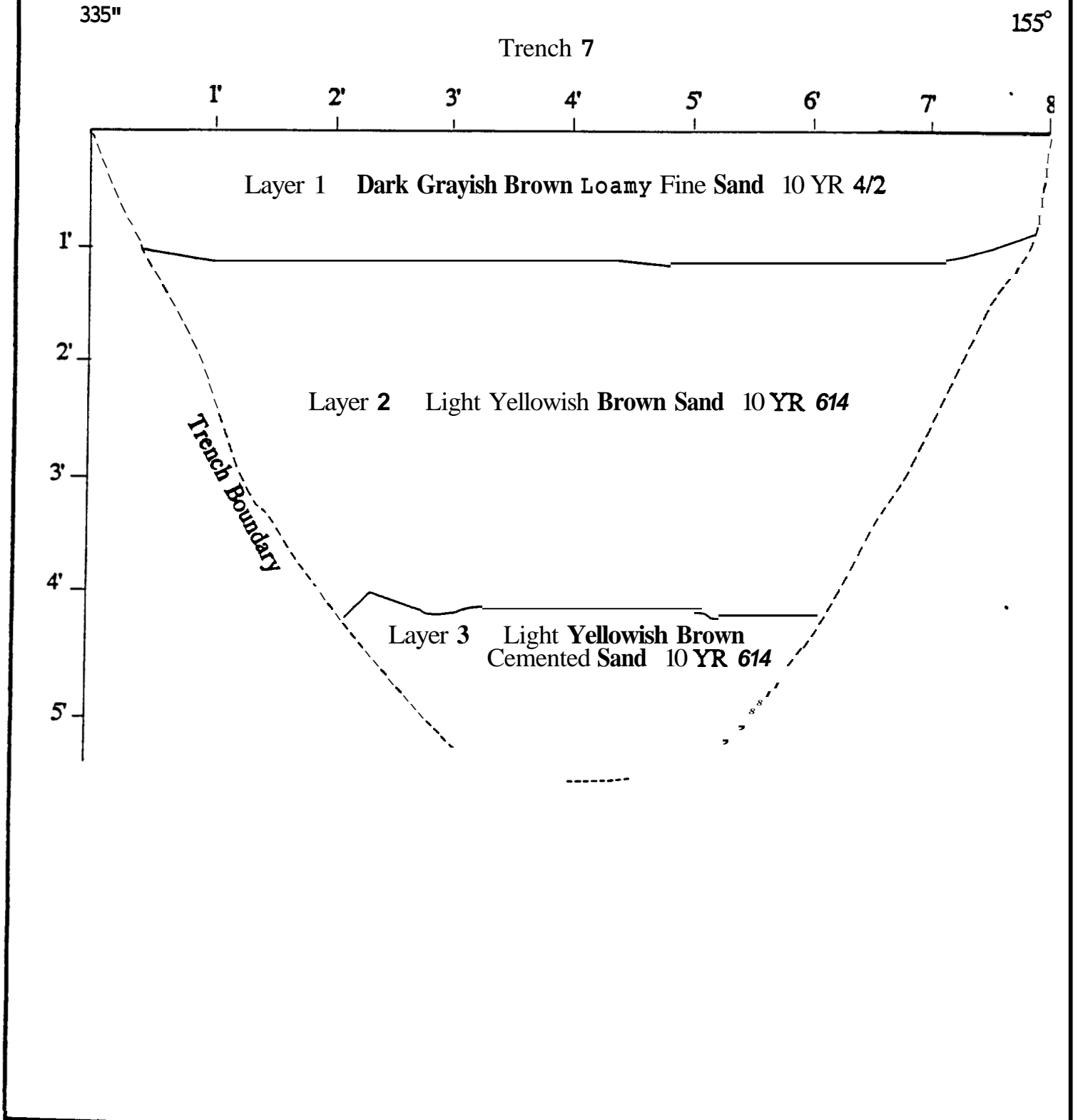


Figure A-7

Archaeological Consultants of Hawaii, Inc.
59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

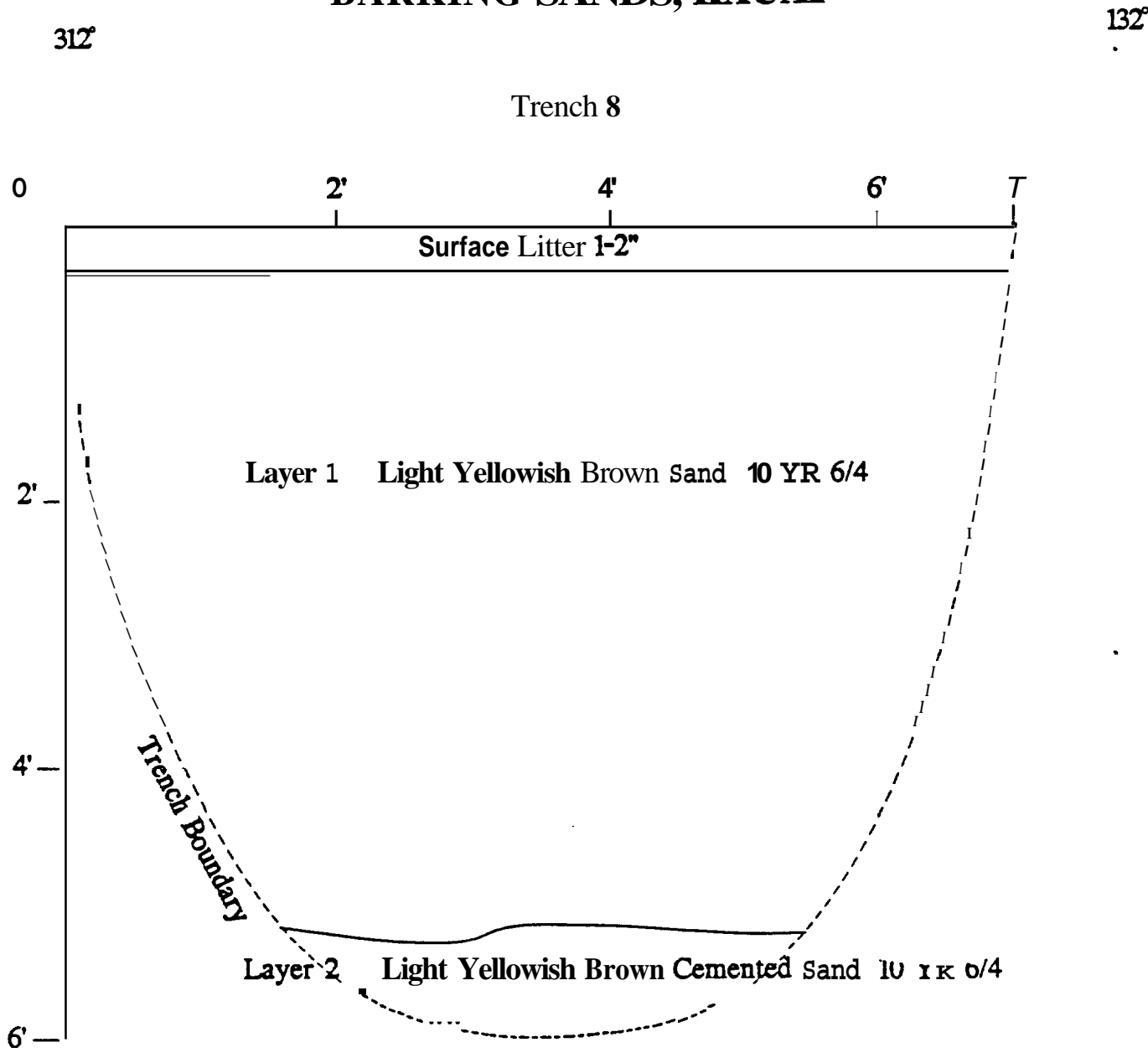


Figure A-8

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59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

230°

50°

Trench 9

0

2

4'

6'

T

Surface Litter 1-2"

2'

Layer 1 Light Yellowish Brown Sand 10 YR 6/4

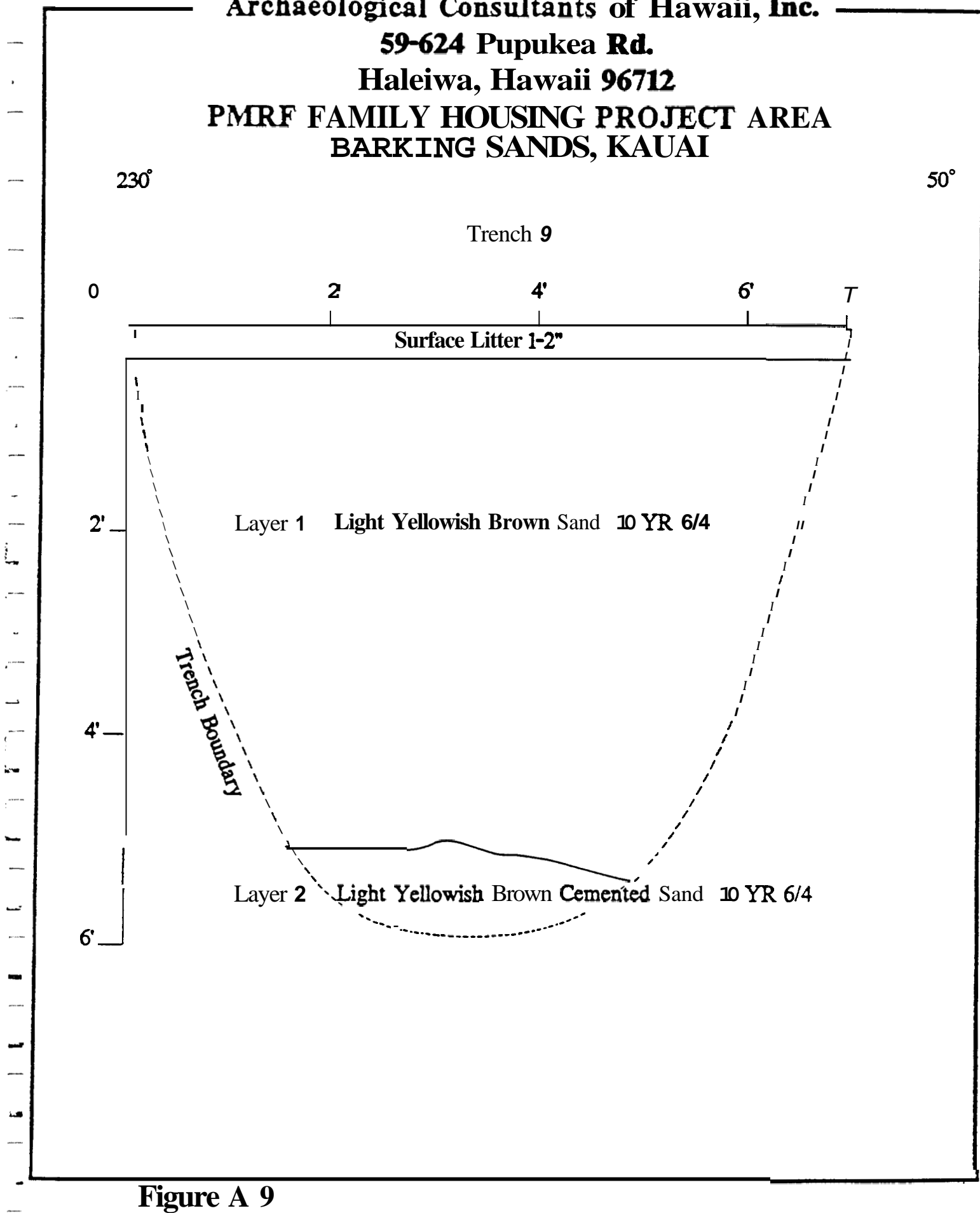
4'

Trench Boundary

6'

Layer 2 Light Yellowish Brown Cemented Sand 10 YR 6/4

Figure A 9



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59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

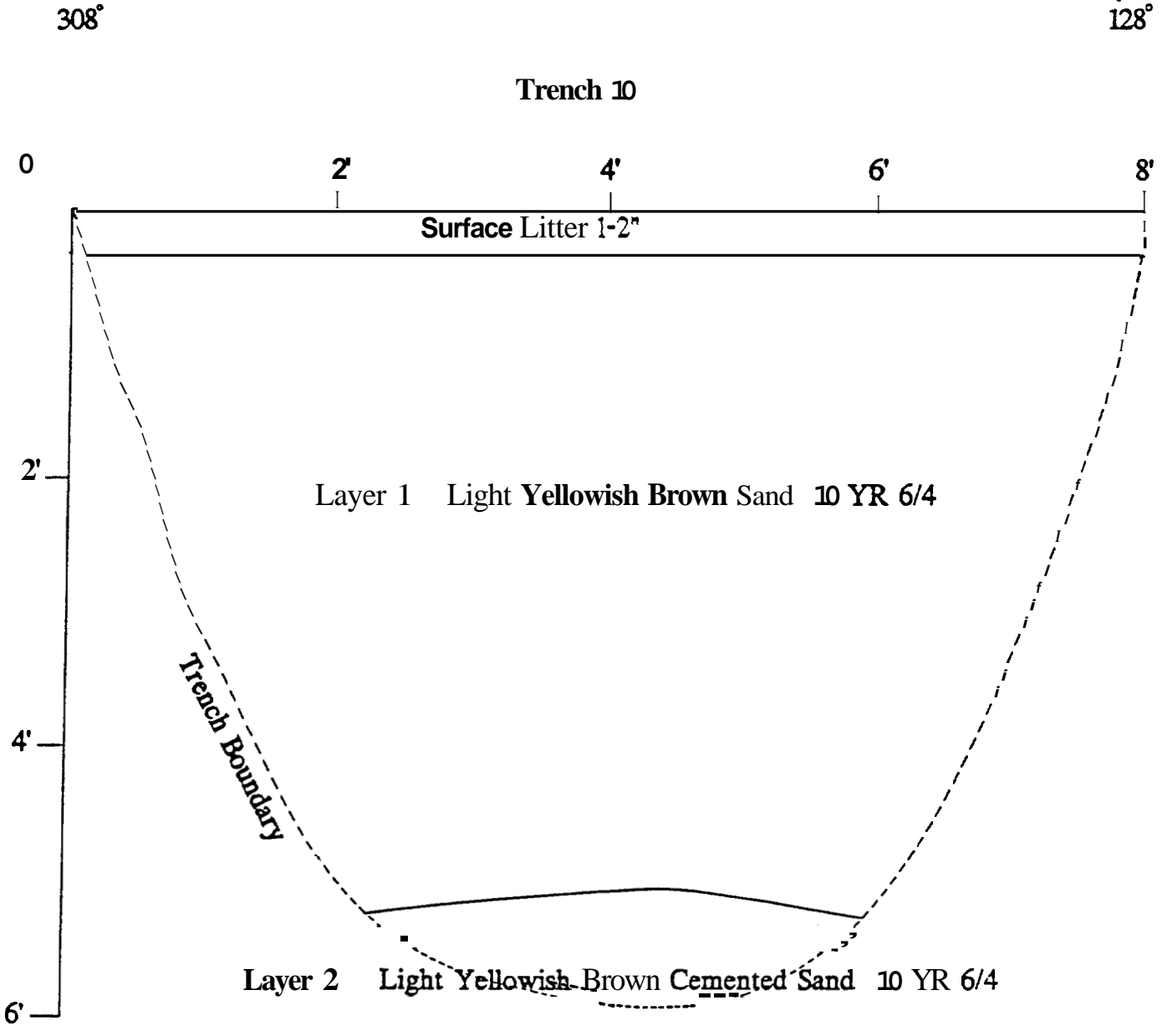


Figure A-10

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59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

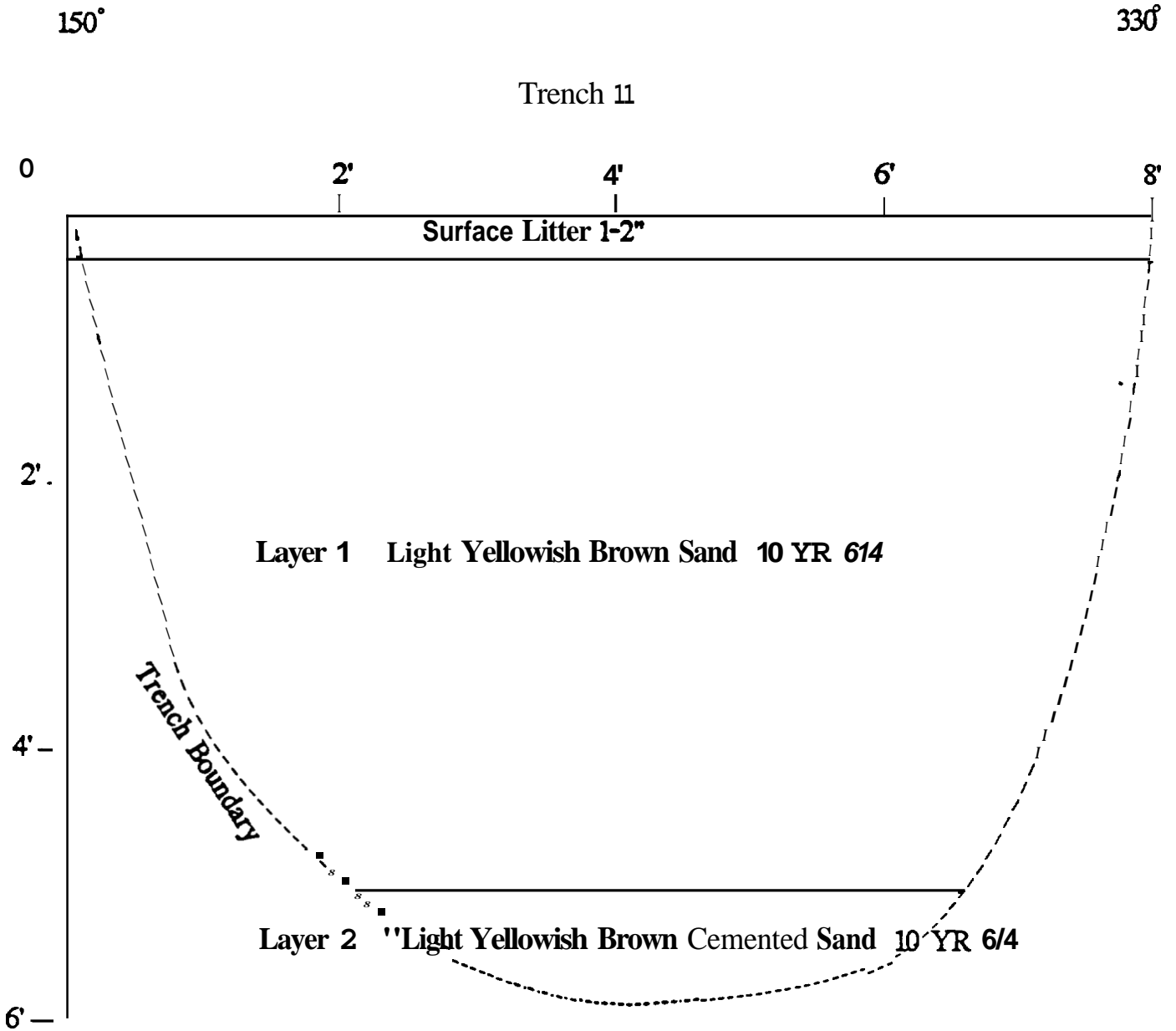


Figure A-11

Archaeological Consultants of Hawaii, Inc.
59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

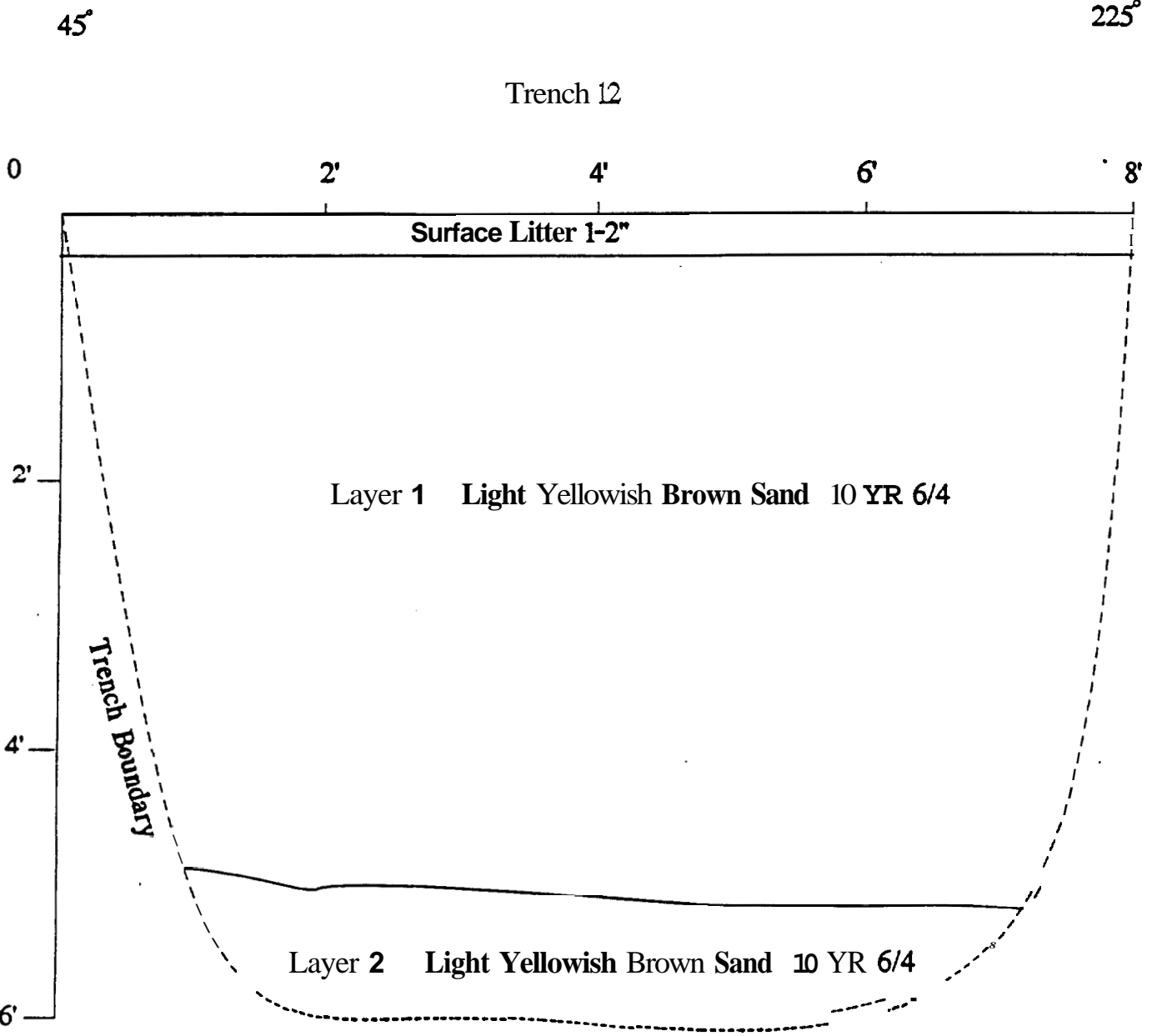


Figure A-12

Archaeological Consultants of Hawaii, Inc.
59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

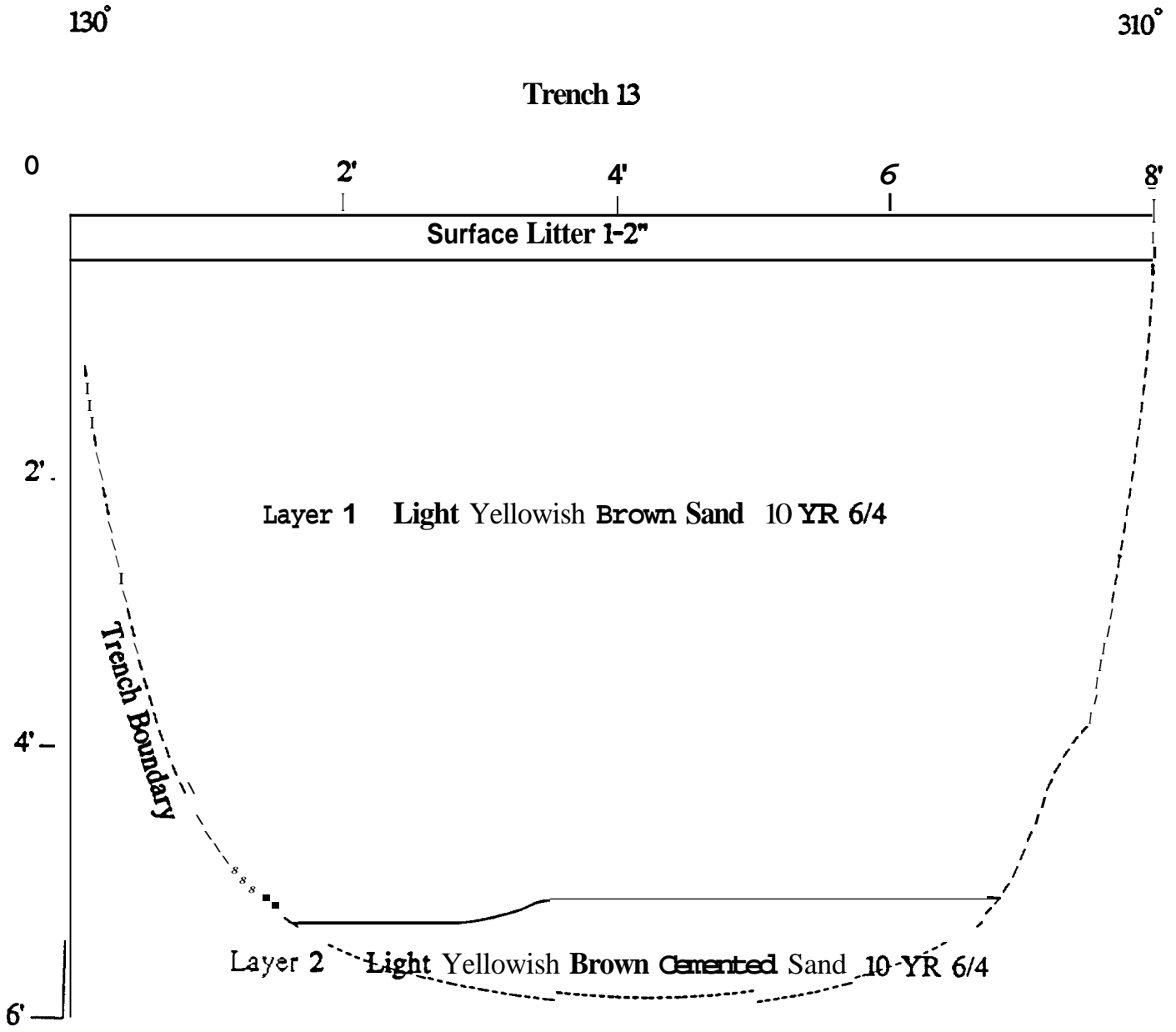


Figure A-13

Archaeological Consultants of Hawaii, Inc.
59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

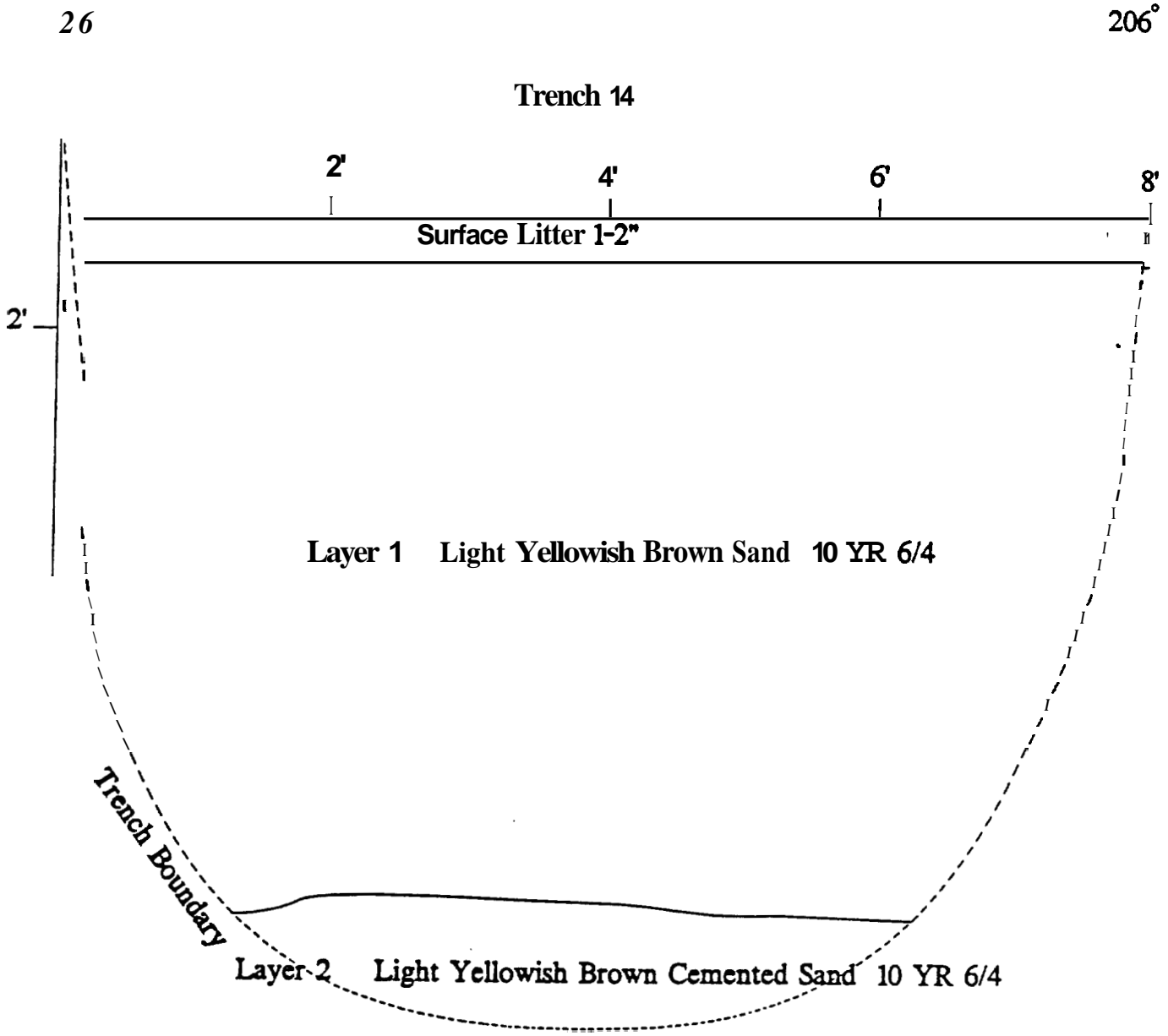


Figure A-14

Archaeological Consultants of Hawaii, Inc.
59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

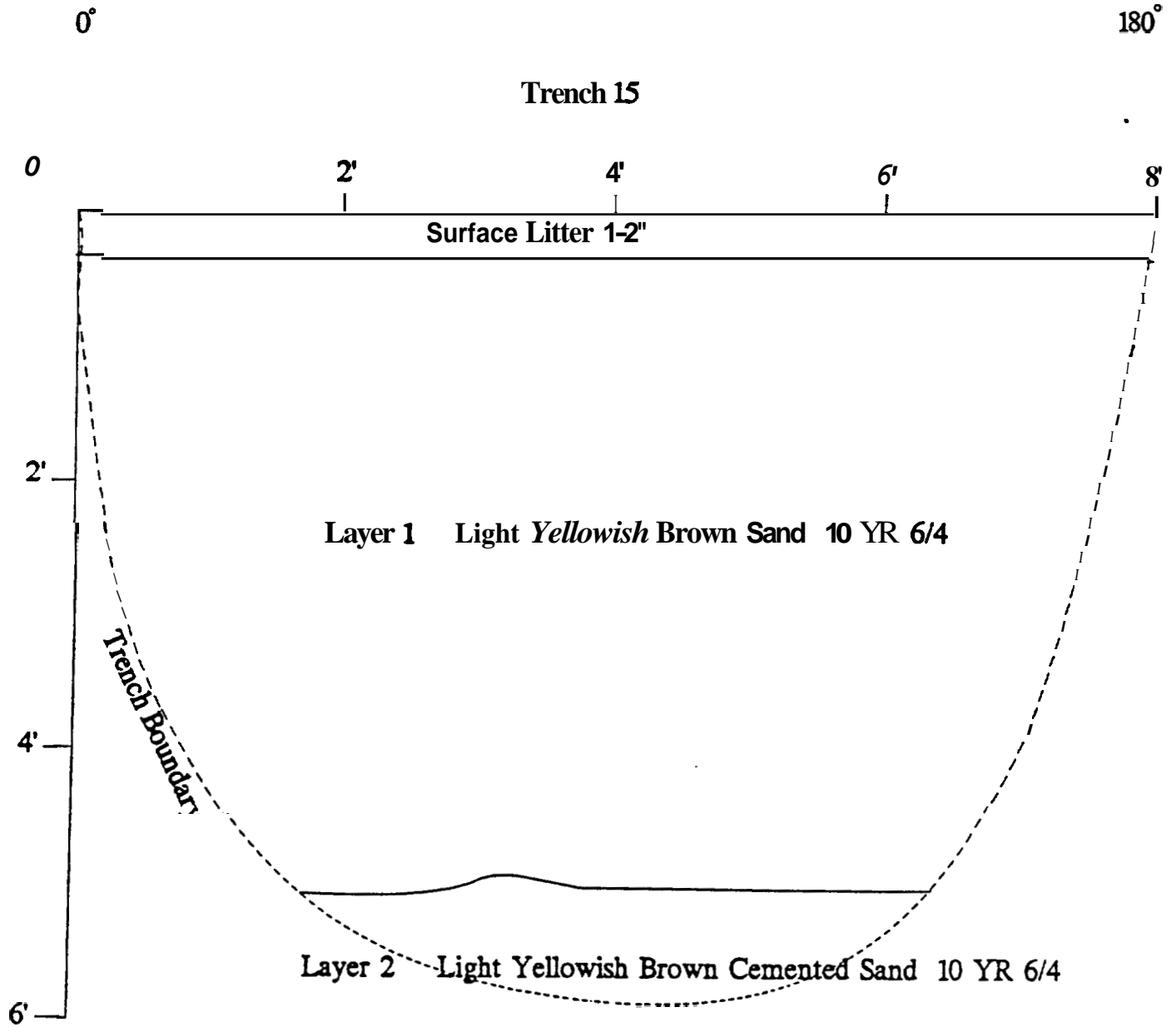


Figure A-15

Archaeological Consultants of Hawaii, Inc.
59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

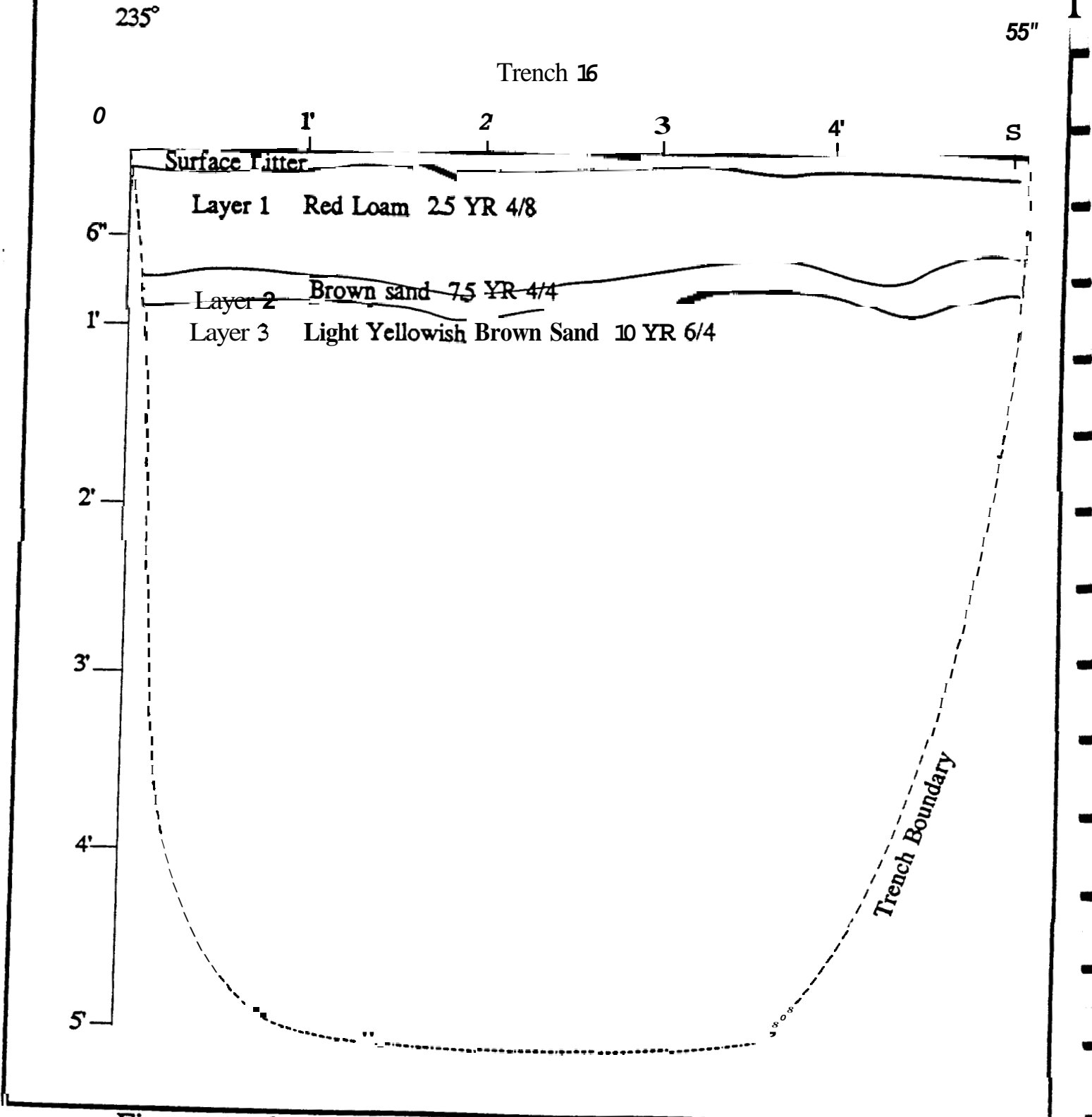


Figure A-16

Archaeological Consultants of Hawaii, Inc.
59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

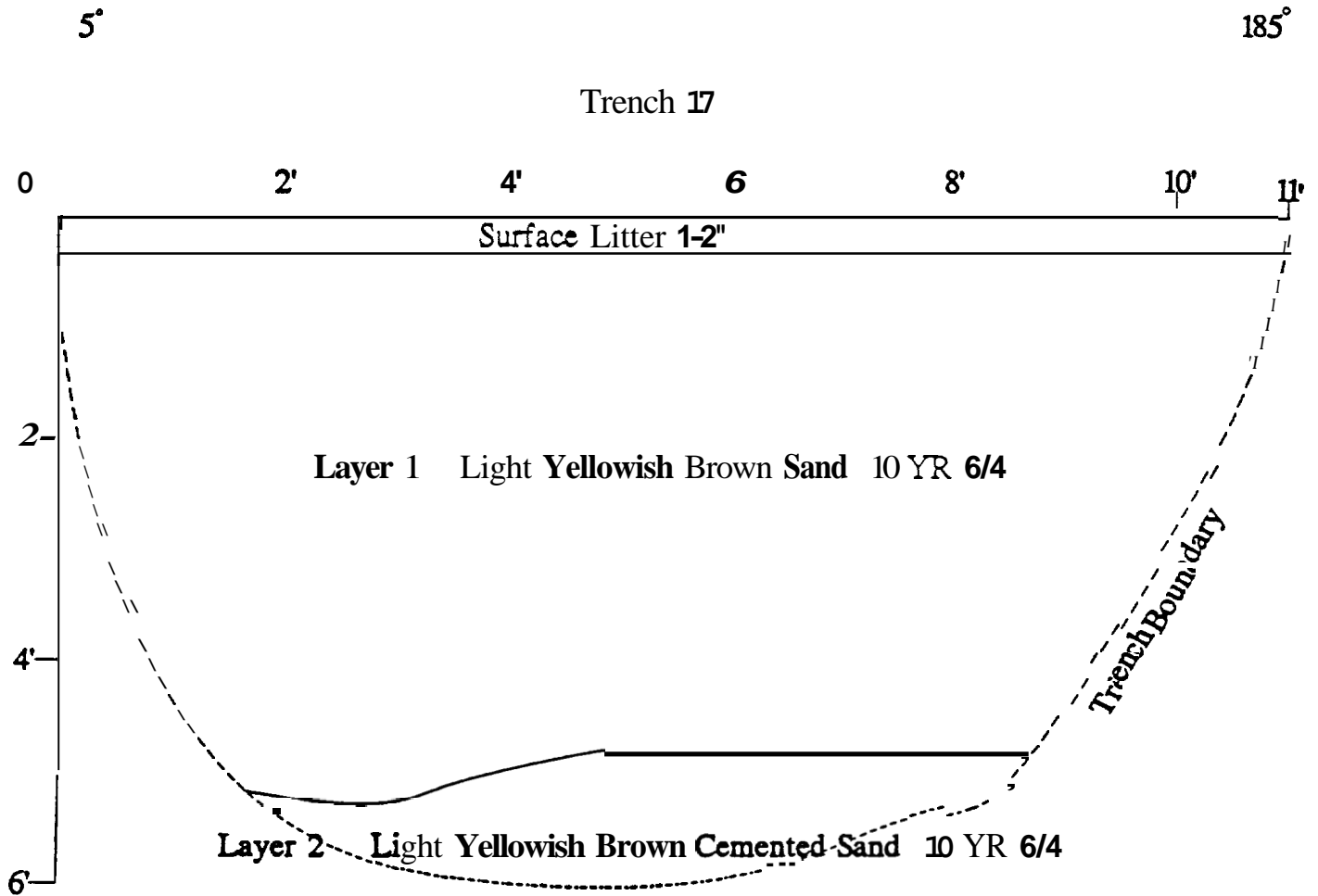


Figure A-17

Archaeological Consultants of Hawaii, Inc.
59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

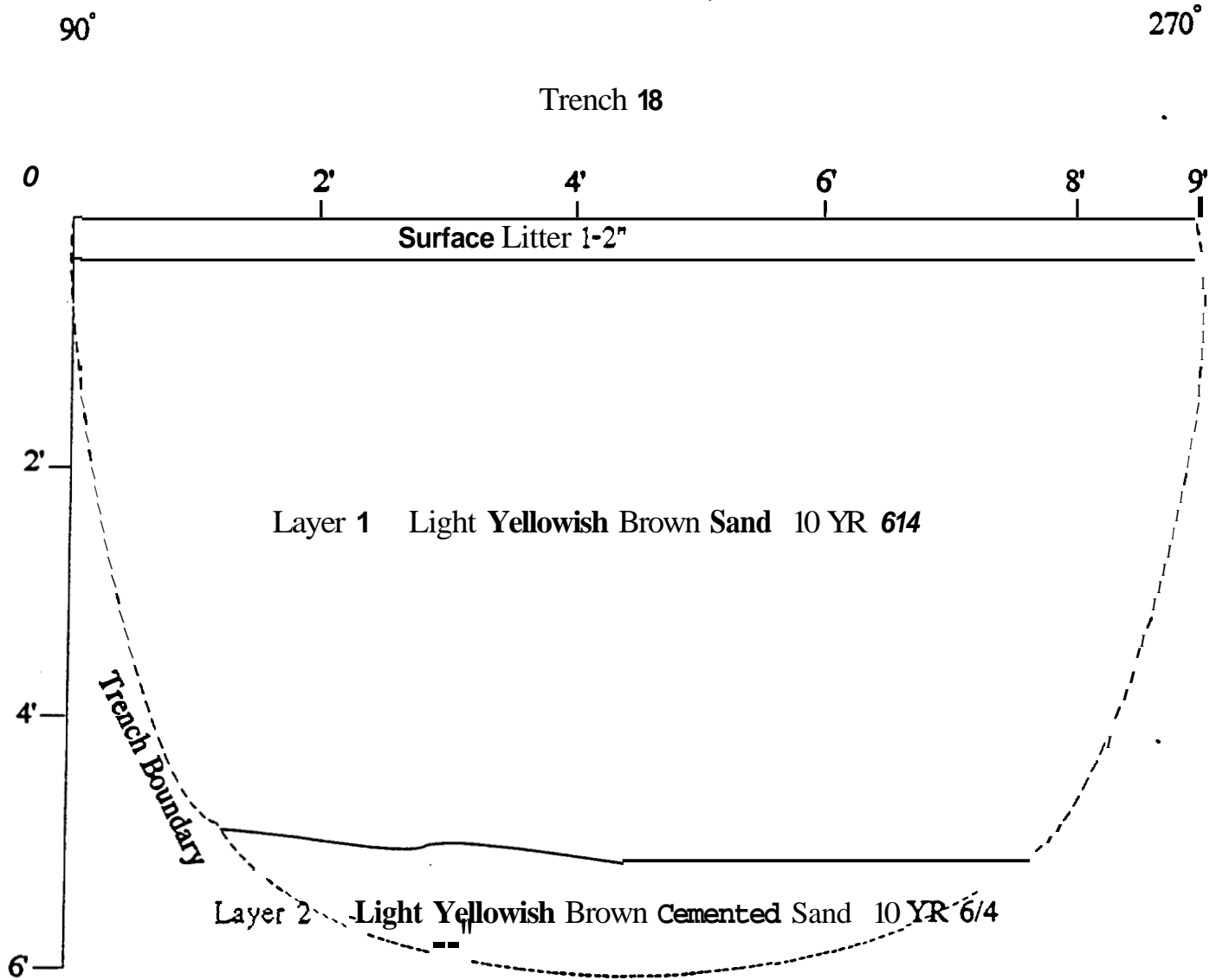


Figure A-18

Archaeological Consultants of Hawaii, Inc.
59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

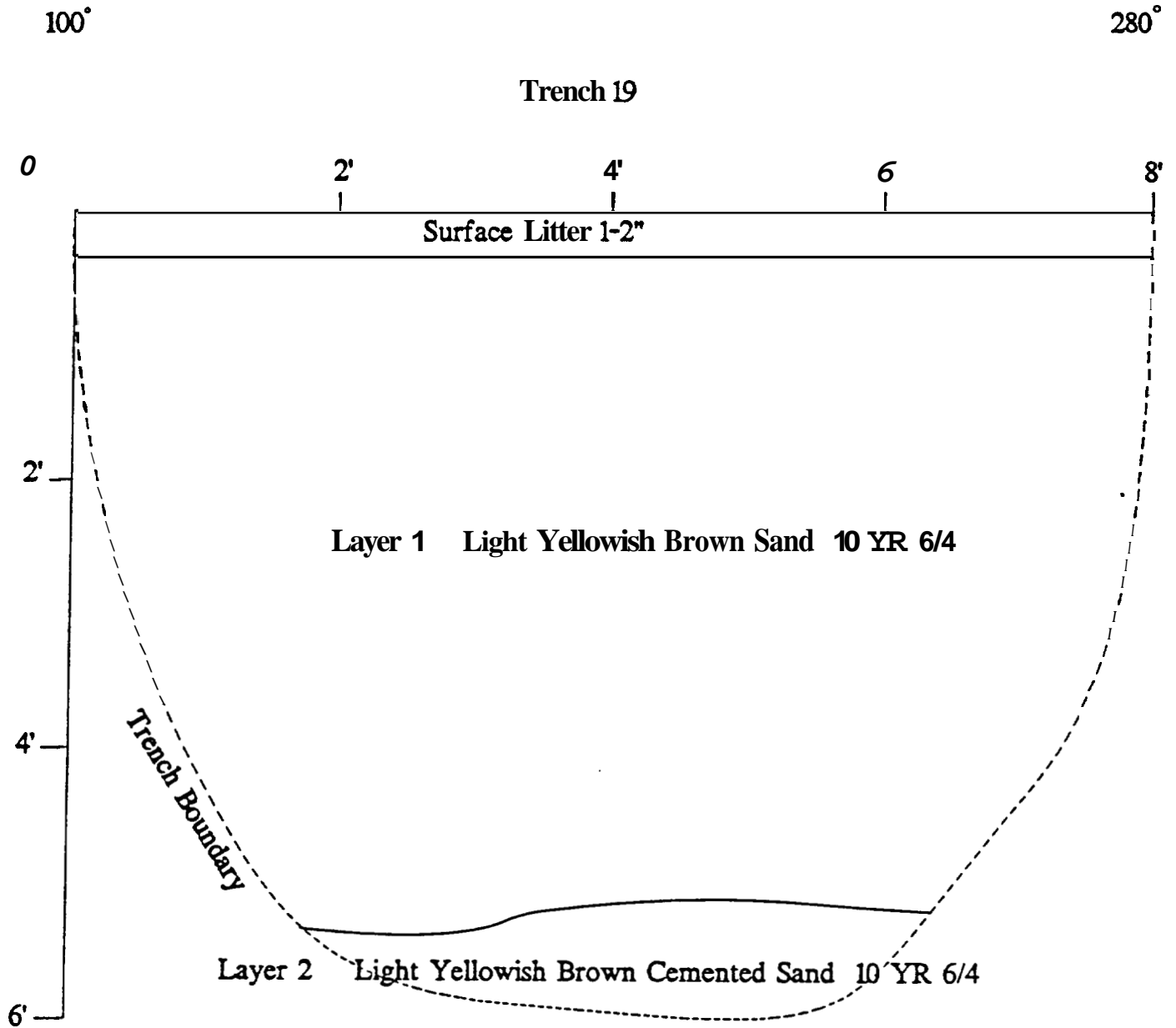


Figure A-19

Archaeological Consultants of Hawaii, Inc.
59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

Trench 20

Trench #20 was begun but had to be discontinued due to the presence of mortar shell casings

Figure A-20

Archaeological Consultants of Hawaii, Inc.
59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARIUNG SANDS, KAUAI

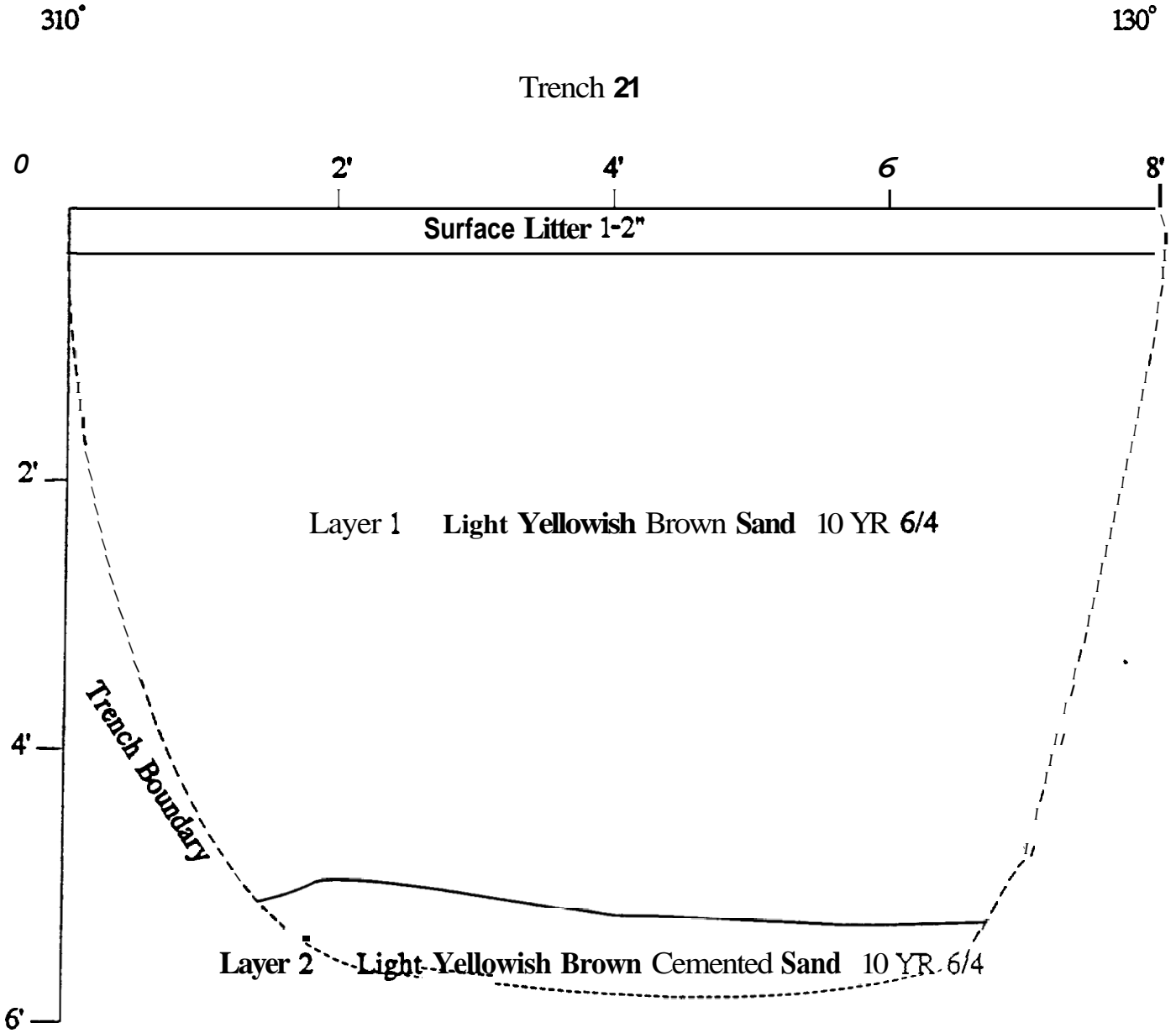


Figure A-21

Archaeological Consultants of Hawaii, Inc.

59-624 Pupukea Rd.

Haleiwa, Hawaii 96712

**PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI**

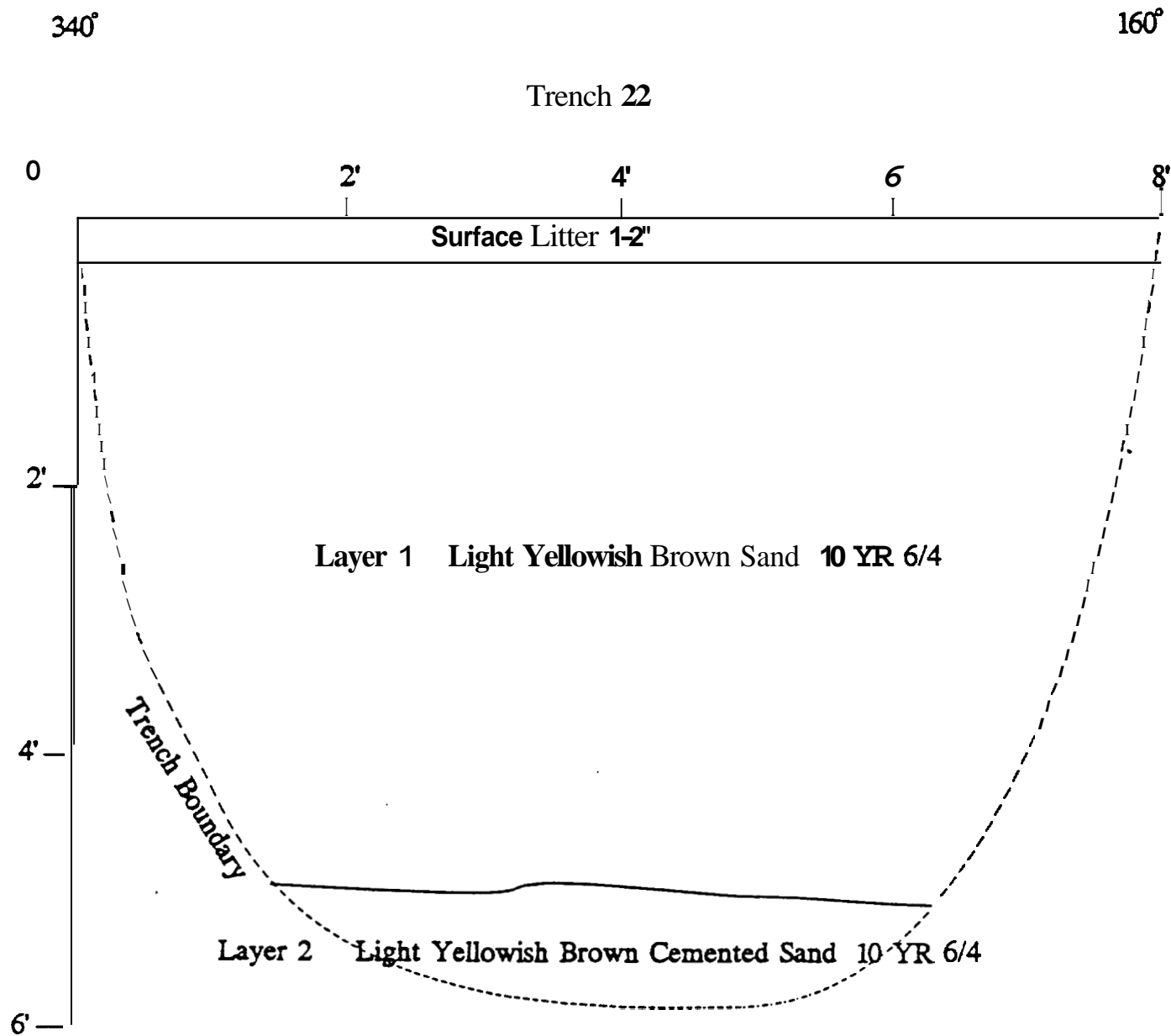


Figure A-22

Archaeological Consultants of Hawaii, Inc.
59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

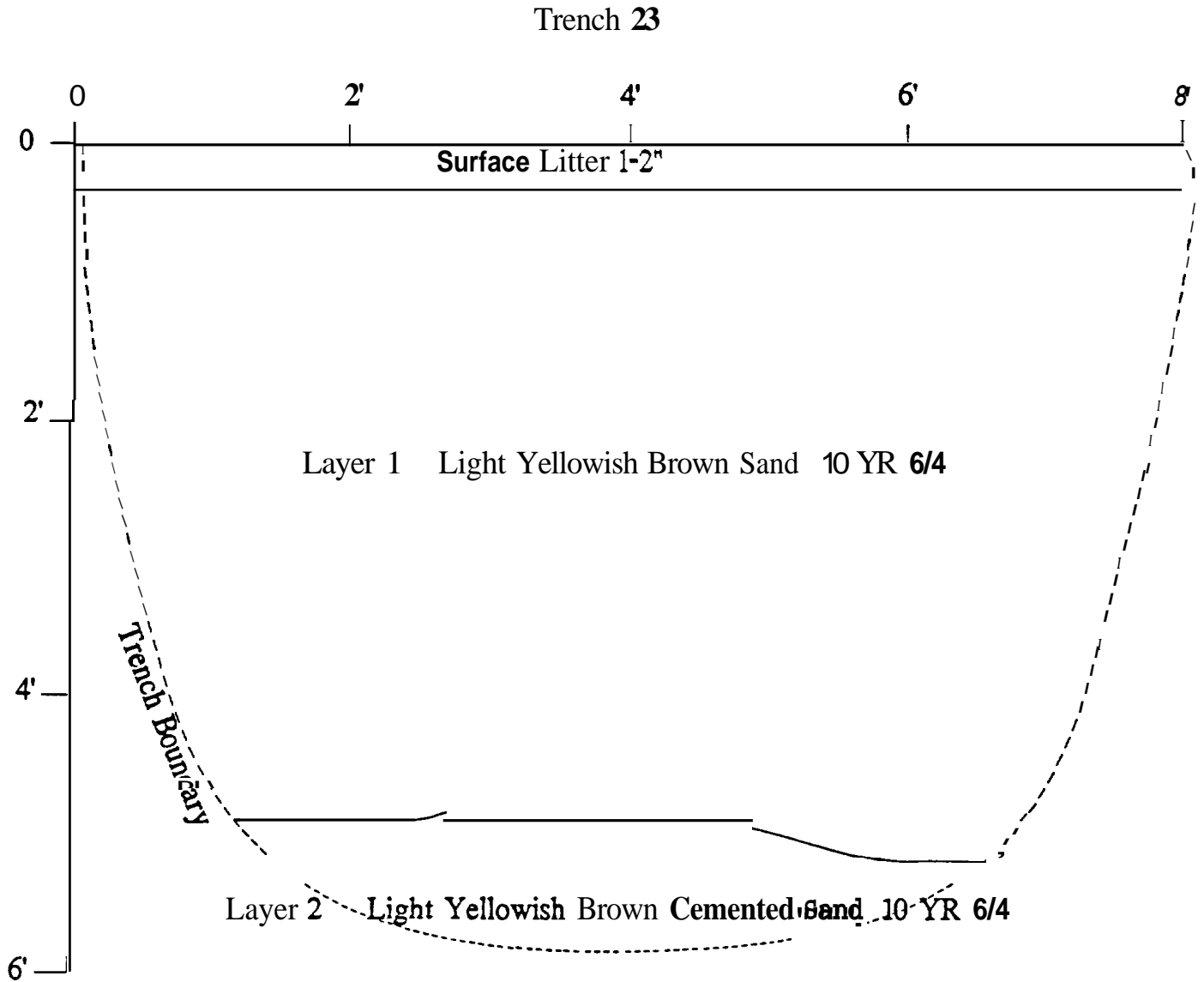


Figure A-23

Archaeological Consultants of Hawaii, Inc.
59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

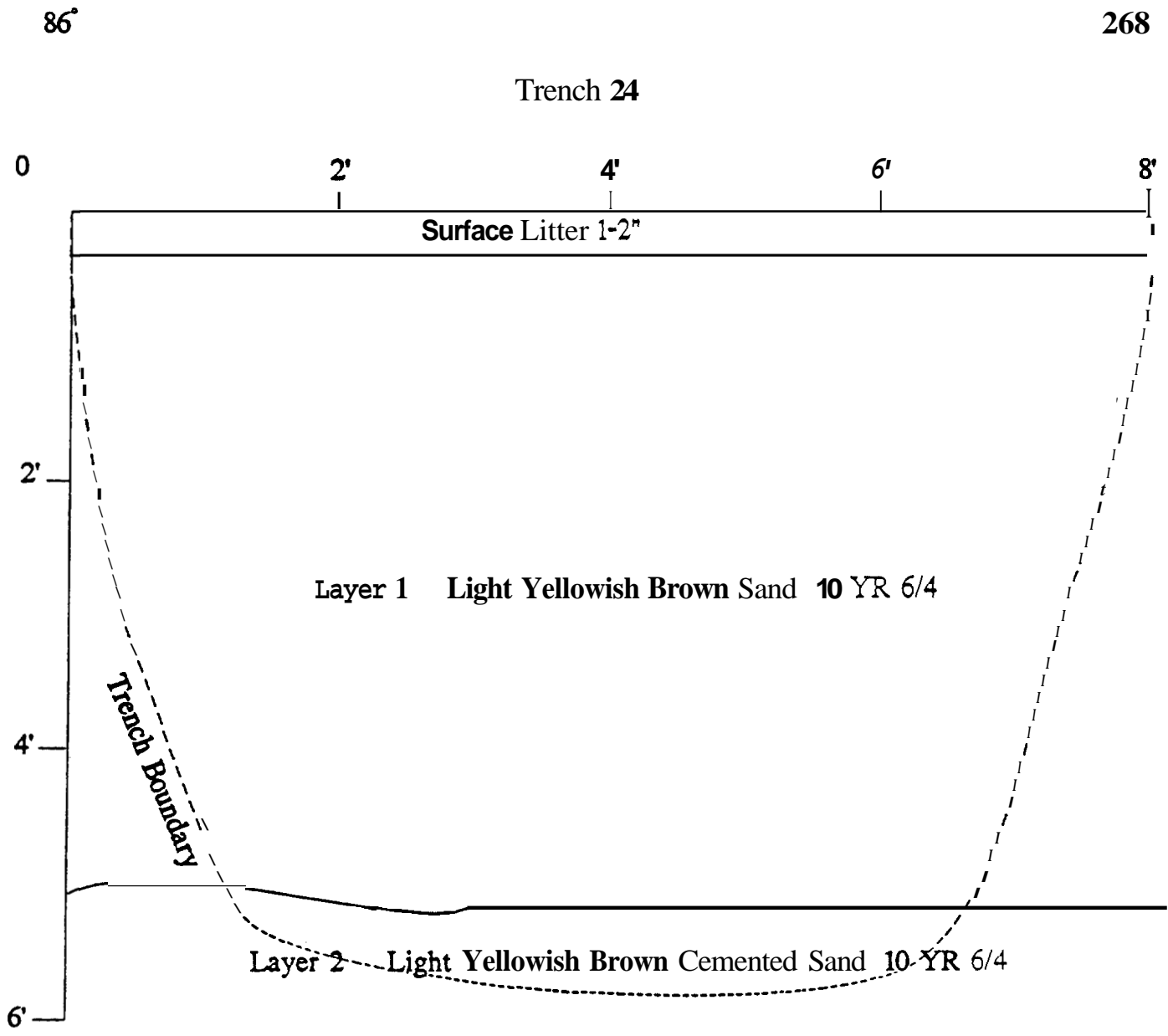


Figure A-24

Archaeological Consultants of Hawaii, Inc.
59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

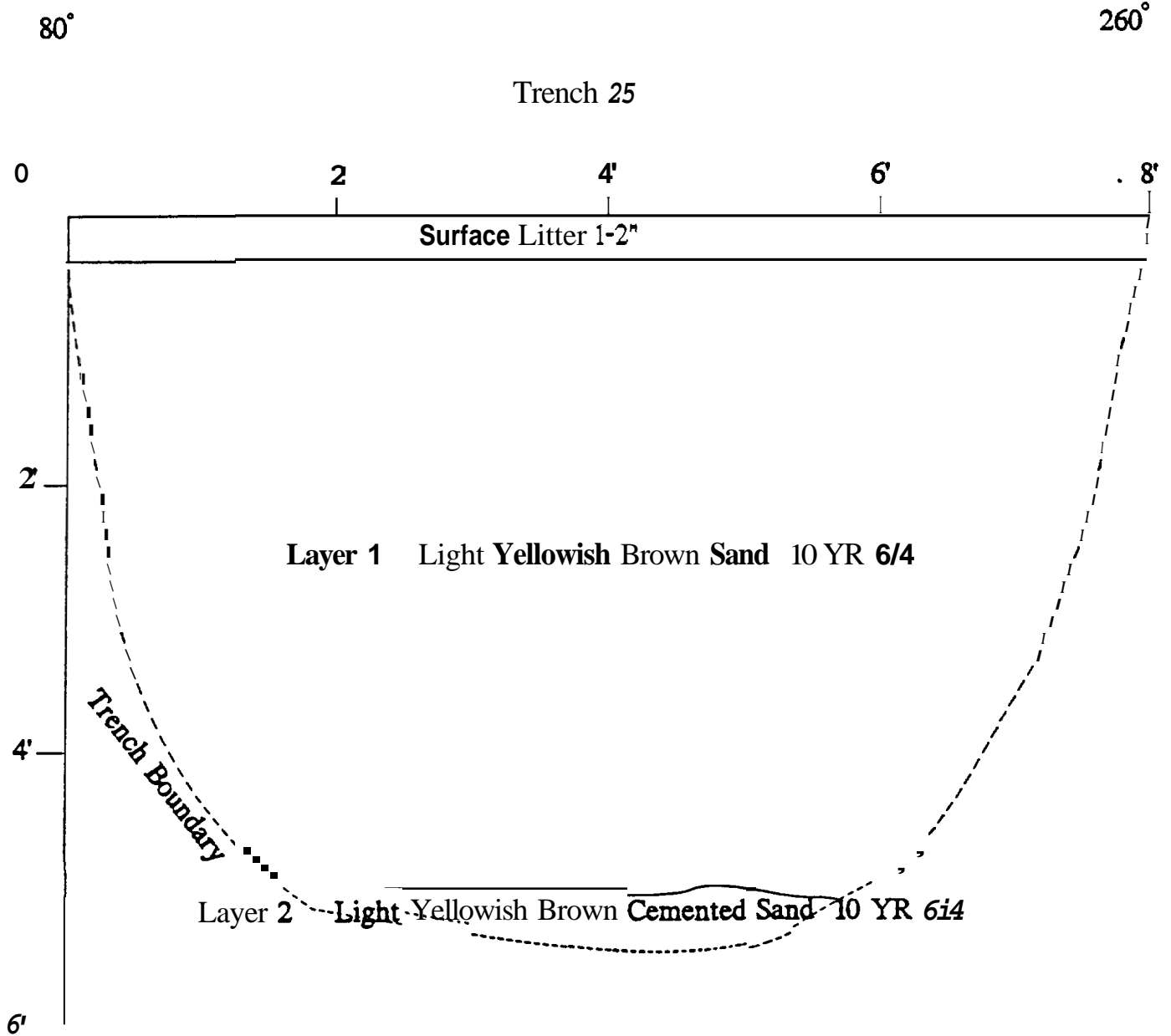


Figure A-25

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59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

24f

Trench 26

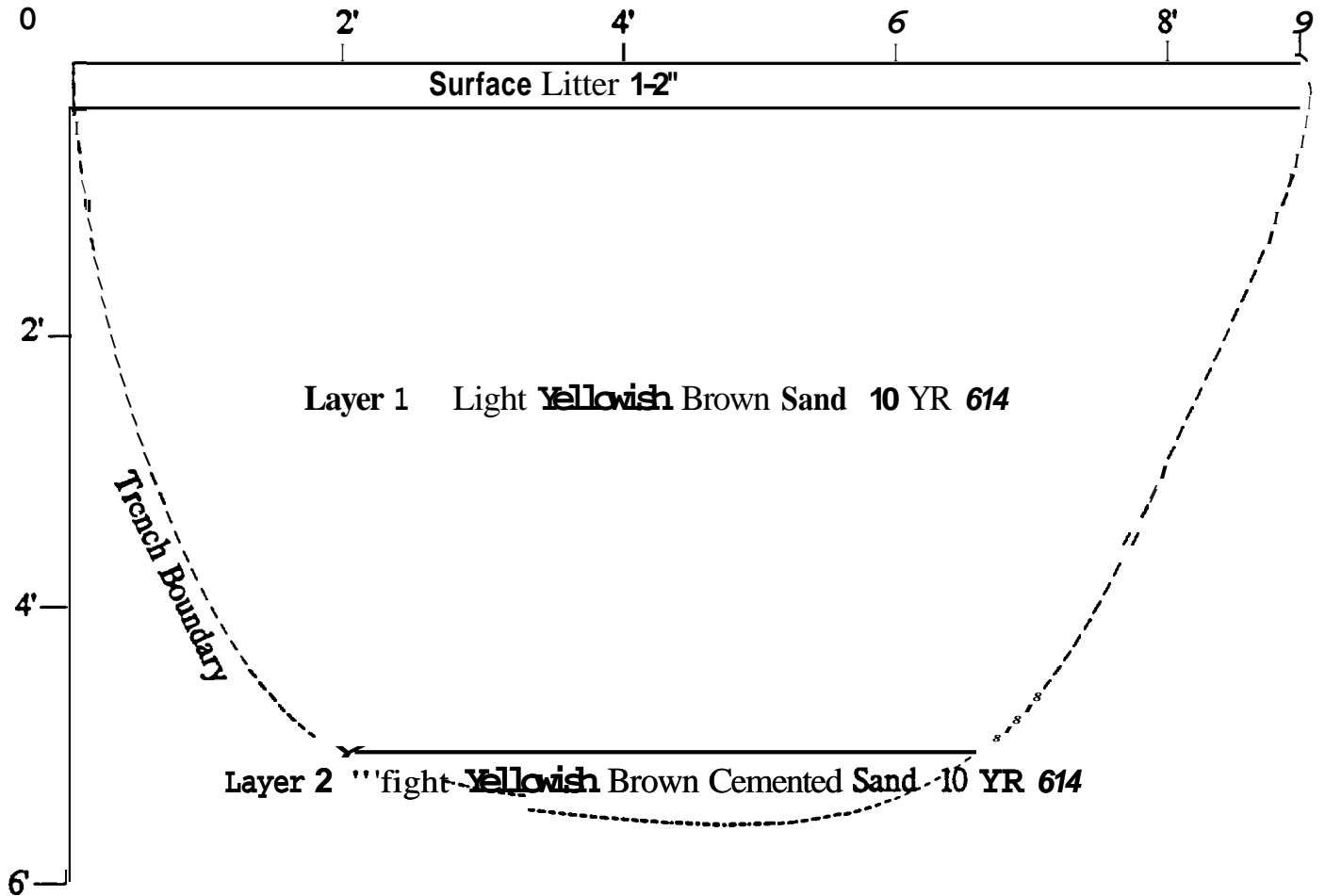


Figure A-26

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59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

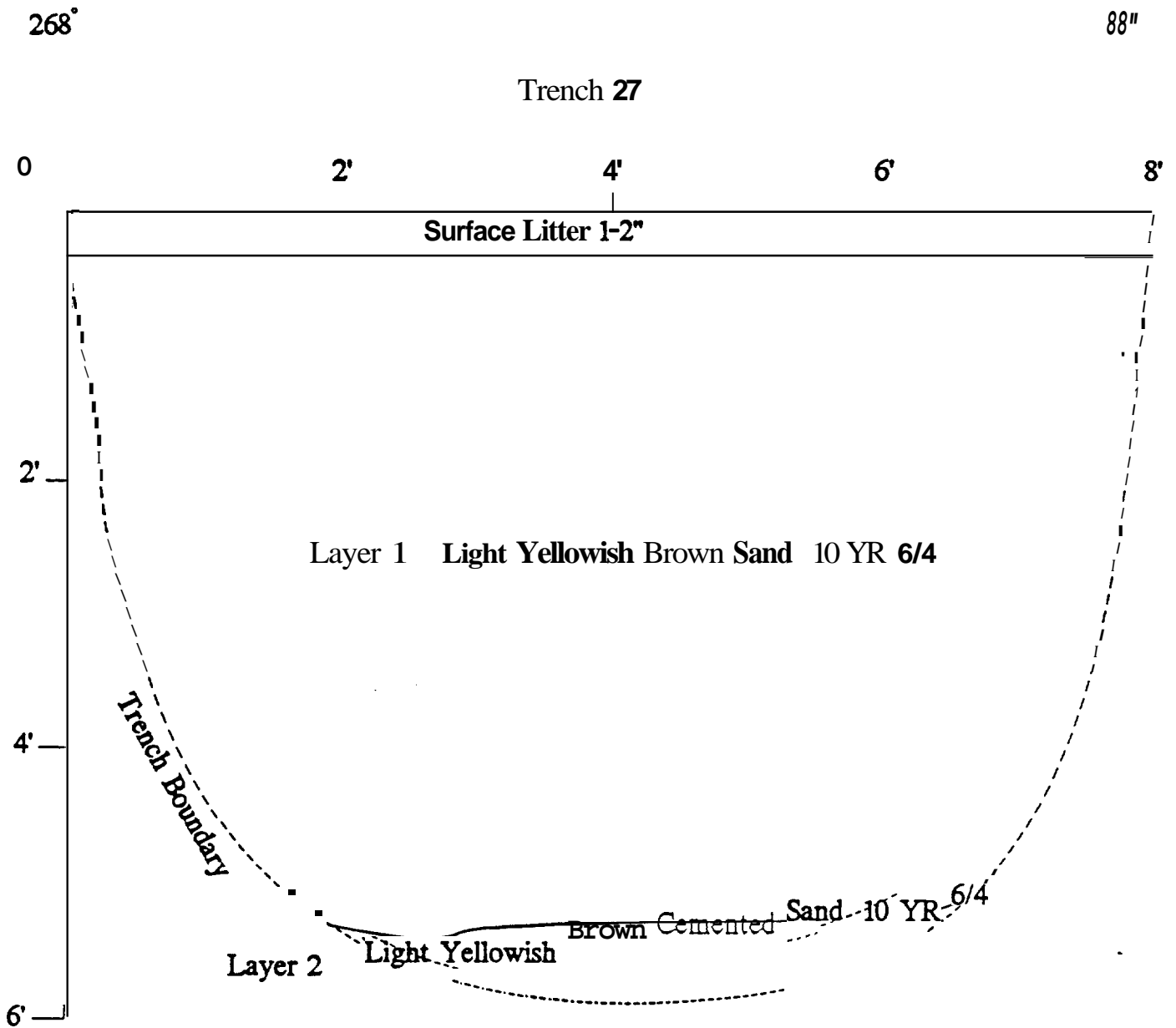


Figure A-27

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Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

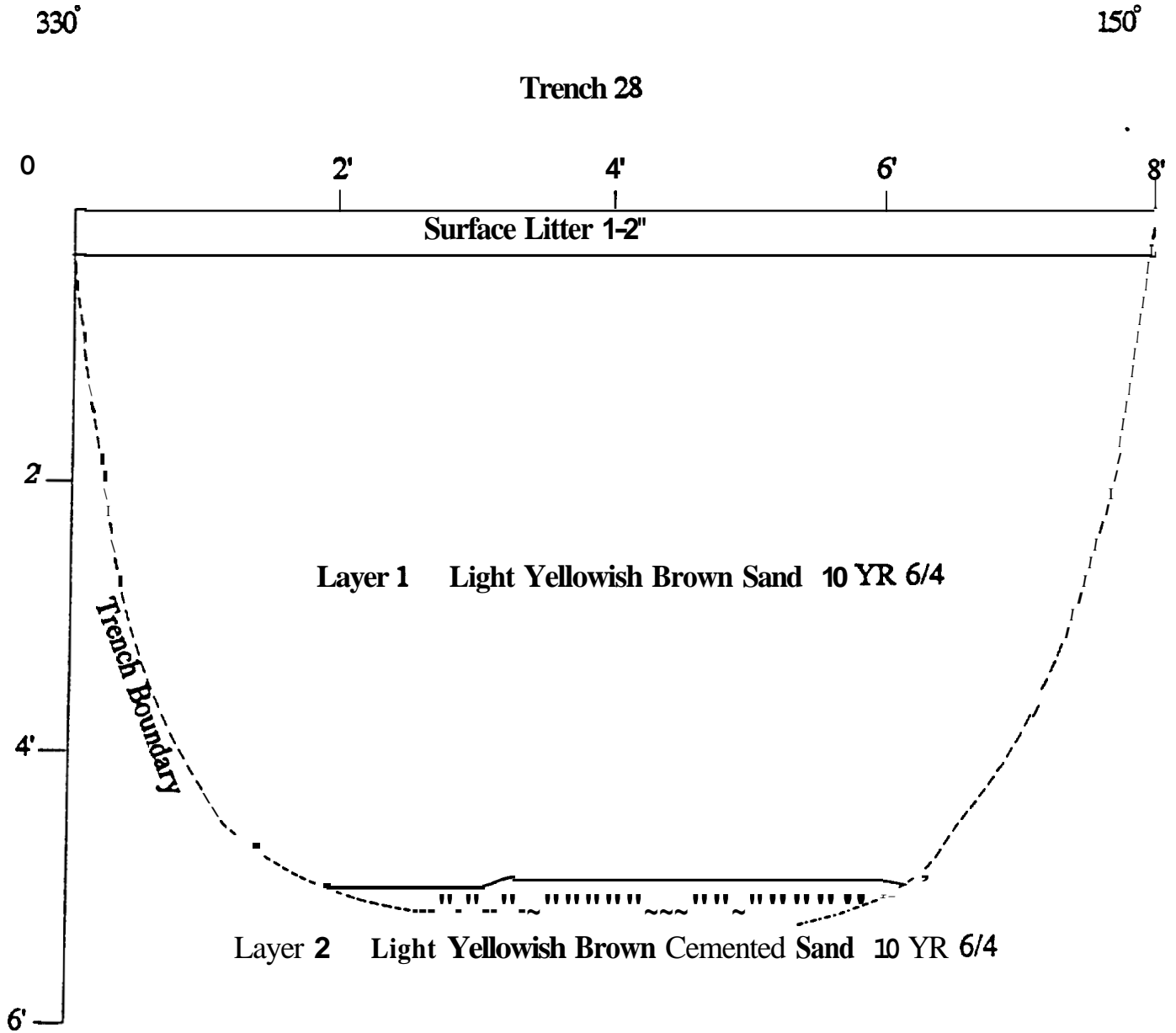


Figure A-28

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59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

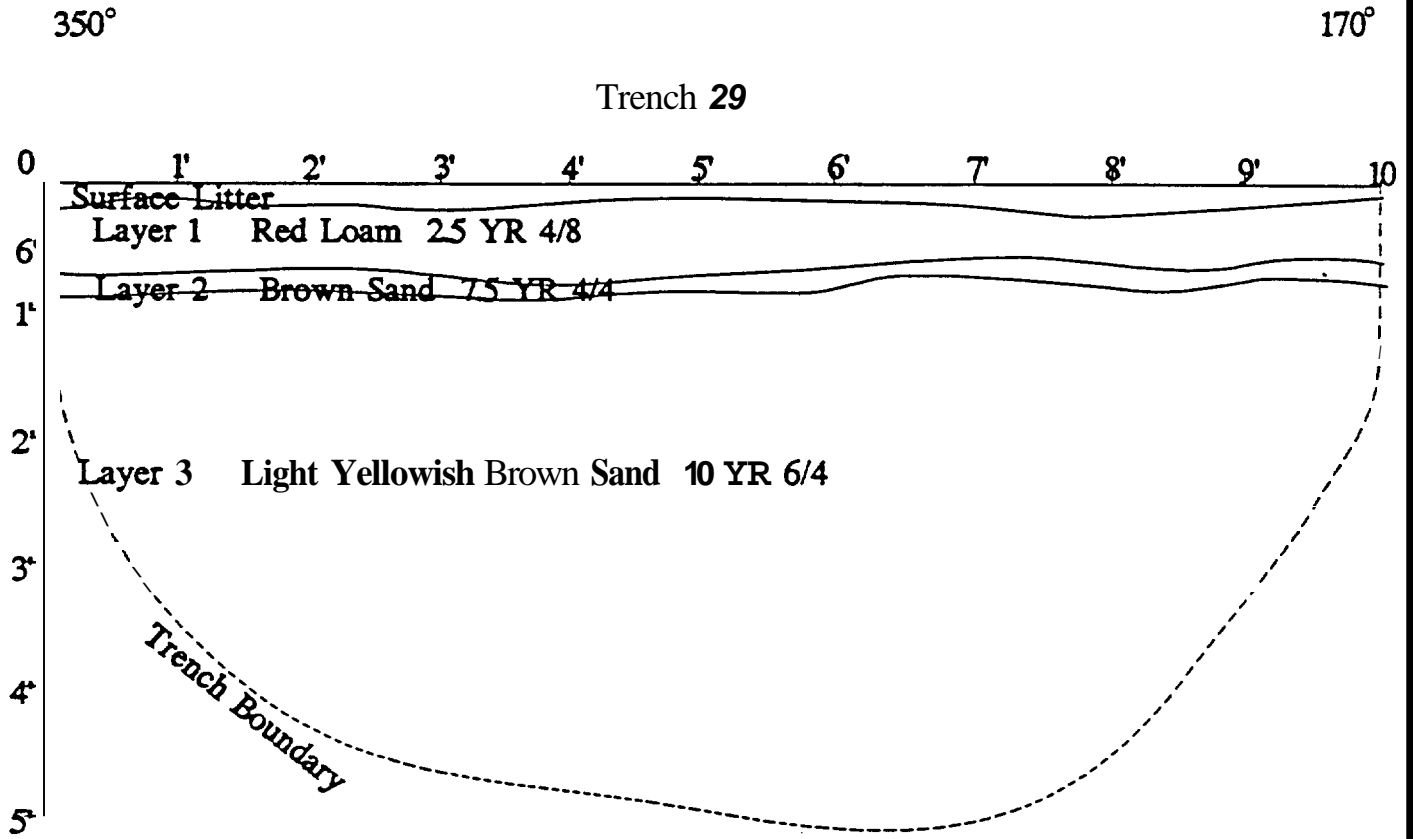


Figure A-29

Archaeological Consultants of Hawaii, Inc.
59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

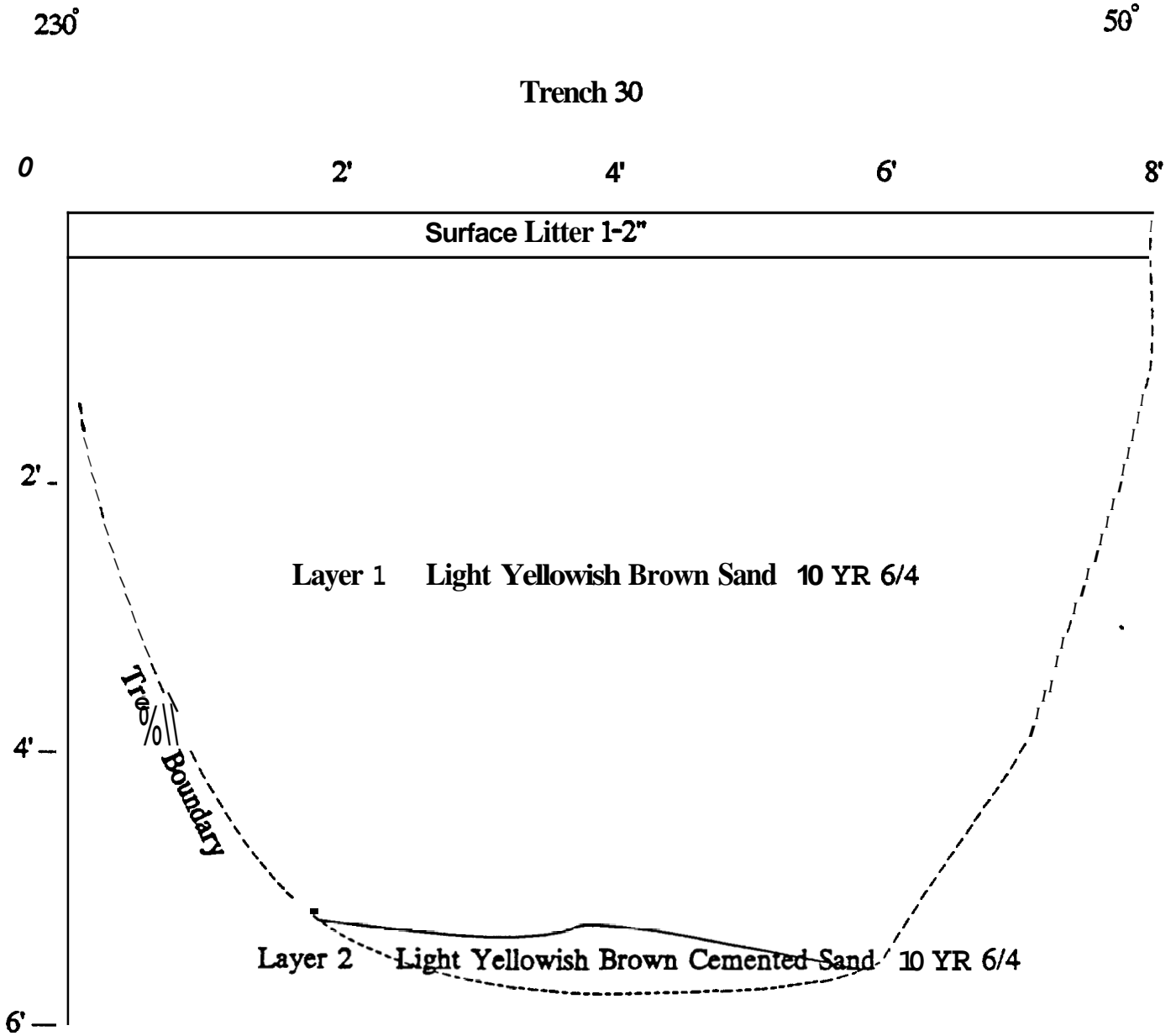


Figure A-30

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59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
PMRF FAMILY HOUSING PROJECT AREA
BARKING SANDS, KAUAI

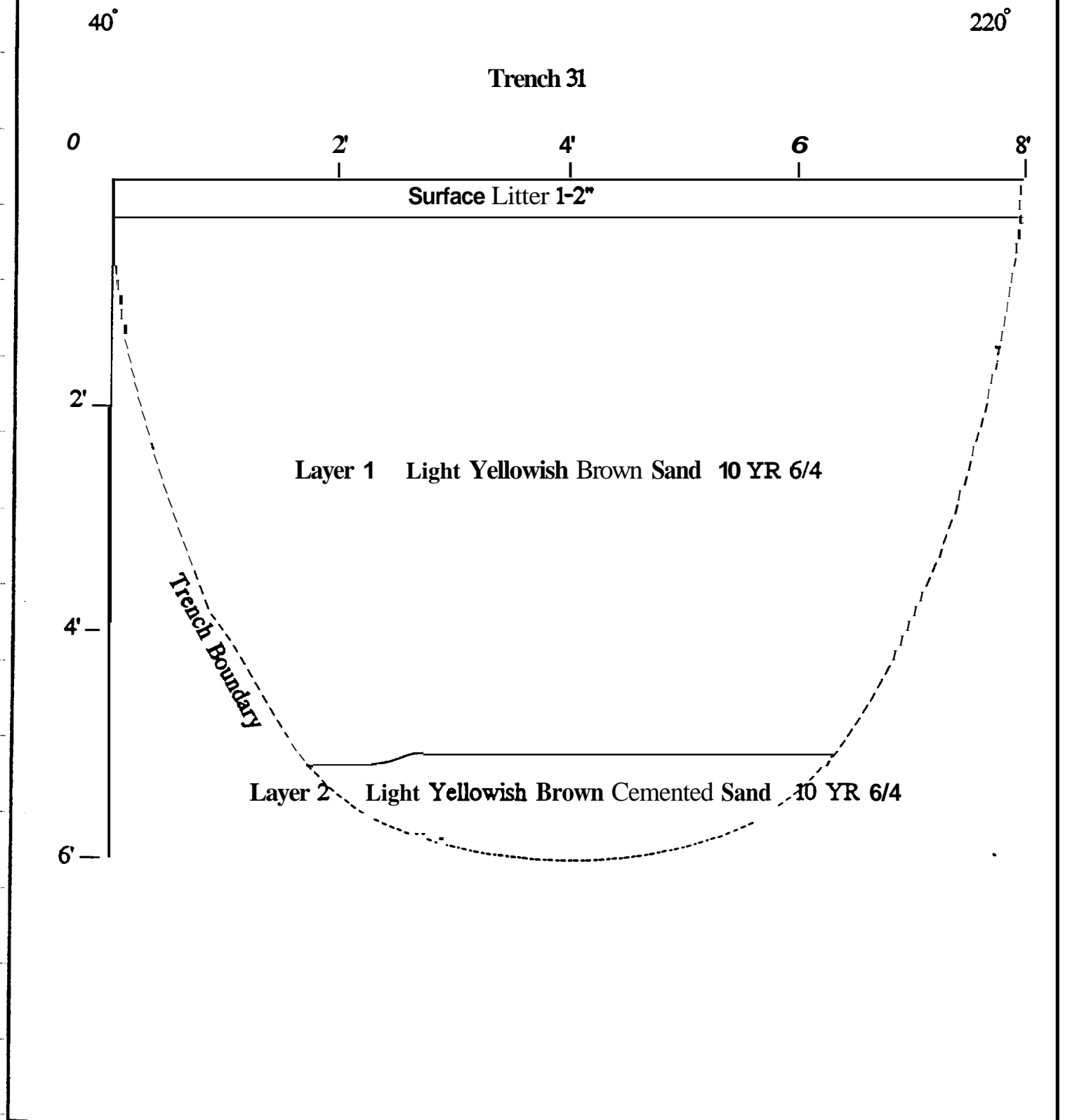


Figure A-31

APPENDIX B

SCOPE OF WORK

SCOPE OF WORK FOR SUB-SURFACE ARCHAEOLOGICAL SURVEY OF
PACIFIC MISSILE RANGE FACILITY (PMRF) FAMILY HOUSING PROJECT AREA

BACKGROUND

This scope of work calls for sub-surface archaeological survey of the project area of the Family Housing Project at Pacific Missile Range Facility (PMRF), Kauai, Hawaii. Most of the project area, about 15.6 acres in extent, has been cleared and graded in the recent past. No archaeological resources or other historic properties are known to exist in or adjacent to the project area. However, buried archaeological sites, including human burials and cultural deposits, are known to exist in various locations throughout PMRF.

SPECIFIC SERVICES

The Consultant shall conduct an archaeological sub-surface survey of the entire Area of Potential Effect (APE) of the subject construction project. The survey shall include at least twenty-five test trenches, each measuring at least three feet long, at least five feet deep, and wide enough to allow the archaeologist to closely inspect the trench faces. The recommended method of trench excavation is by backhoe or similar equipment. An alternate method (such as hand-shoveling) may be used if it can be shown to be as efficient and appropriate for the field conditions as backhoe excavation.

The trenches shall be distributed so as to yield a representative sample of the entire project area. The primary purpose of the testing is to locate and identify the nature and size of large subsurface sites such as extensive cultural deposits and large clusters of burials. The design and conduct of the survey shall take into account previous development and other ground disturbance in the area, as well as the extent and nature of the subject projects' ground-disturbance. The exact distribution of sub-surface test units shall be determined by the Consultant on the basis of the results of the surface survey, the analysis of the variables discussed above and current archaeological principles and practices.

Records kept for each excavation unit shall be in accordance with current professional standards and shall include, at a minimum, location, depth, sediment profile, indications of disturbance, and cultural evidence.

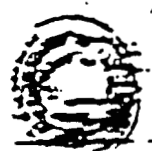
The conduct and results of the survey shall satisfy the requirements of Section 106 of the National Historic Preservation Act of 1966, as amended and its implementing regulations, 36 CFR Part 800. The report of the survey shall include the information listed in the Outline for Preliminary and Final Reports (Enclosure 1), though it need not be presented in the order and format shown. The survey report shall provide information of sufficient quality and quantity to support consultation with the Hawaii State Historic Preservation Officer and the Advisory Council on Historic Preservation. The survey report shall include recommendations regarding the eligibility of identified historic properties for listing in the National Register of Historic Places as well as

and recommendations regarding the management of historic resources in the construction project area. These recommendations shall be explicitly supported by specific data. An example of recommended management actions would be the archaeological monitoring of ground-disturbing activities in particular areas where significant archaeological deposits are likely.

Should human remains be encountered during any survey, subsurface investigation work shall stop and the Consultant shall notify the PMRF Environmental Engineer immediately. No excavation of human remains (other than clearing to confirm that the remains are definitely human) shall proceed without the consent of the PMRF Environmental Engineer. The Consultant shall, following identification of the remains as human, take reasonable precautions to ensure that the remains are preserved in place until such time as their final disposition can be determined in conjunction with the planned construction projects. The Consultant shall ensure that each location of human remains left in place is marked on the ground and indicated on a scale map so that they can be found again easily. The marker on the ground shall be sturdy enough to be in place and visible for at least five years. Human remains will be moved during the subject survey only with the approval of the PMRF Environmental Engineer and only if there is a reasonable expectation that the remains would be affected before construction if they were not moved.

If necessary, and with the approval of PACNAVFACENGCOM, laboratory analysis beyond the level normally expected during subsurface survey, as well as analysis of one radiocarbon specimen will be conducted by the Consultant on a reimbursable basis. No more than eight hours of human remains recovery will be conducted by the Consultant on a reimbursable basis.

END OF APPENDIX B



RECEIVED

DEC 5 1991

BELT, COLLINS & ASSOCIATES



DEPUTIES

KEITH W. AHUE
MANABU TAGOMORI
DANT. KOCHI

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION

33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

AQUACULTURE DEVELOPMENT
PROGRAM
AQUATIC RESOURCES
CONSERVATION AND
ENVIRONMENTAL AFFAIRS
CONSERVATION AND
RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
PROGRAM
UNO MANAGEMENT
STATE PARKS
WATER RESOURCE MANAGEMENT

REF: HP-JLE

DEC 2 1991

Mark R. Willey
Environmental Planner
Belt Collins & Associates
680 Ala Moana Boulevard, Suite 200
Honolulu, Hawaii 96813

LOG NO: 4153
DOC NO: 1734W

Dear Mr. Willey:

SUBJECT: National Historic Preservation Act Compliance -- Revisions to (Kennedy April 25, 1991. Archaeological Subsurface Testing Results for the Proposed Family Housing Project Area, TMK: 1-2-02-13, Por. 25.) Pacific Missile Range Facility, Barking Sands, Waimea, Kauai

Thank you for your letter of November 12, 1991, submitting this revised report for our review. The changes, however, have opened up a set of new questions, and we need some further information before we can agree with a "no effect" determination.

The report now indicates that the ditch was an historic site. Thus, descriptive information and a significance evaluation is needed.

The numerous mounds found are now called natural dunes (pp. 19). One was tested (ACH site #1) and so documented in the report. Bdt this is not a very large sample of these dunes, which clearly might contain sites (e.g., burials, habitation remnants). The report's conclusions indicate that "many of these [dunes] were also tested and no cultural materials found" (p. 19); however, it is not clear in the text of the report which trenches were in dune remnants, how many dune remnants were tested, and how representative this sample was. This information is critical for determining that the testing of the dunes was a representative sample.

These two matters need resolution. We ask that either a supplemental report of a page or two be submitted covering these items (in report format, not a letter responding to the items), or the report be revised slightly again.

If you have any questions regarding this review, please contact Ms. Nancy McMahon our staff archaeologist handling the County of Kaua'i at 587-0006.

Very truly yours,

WILLIAM W. PATY, Chairperson and
State Historic Preservation Officer

NM:jle

cc: R. Hommon, U.S. Navy

**SUPPLEMENT TO ARCHAEOLOGICAL TESTING
RESULTS FOR THE PROPOSED FAMILY HOUSING
PROJECT AREA, PACIFIC MISSILE RANGE FACILITY,
BARKING SANDS, ISLAND OF KAUAI,**

**TMK: 1-2-02-33, POR. 25
REVISED OCTOBER 1991
DECEMBER 1991**

**SPONSORED BY: U.S. NAVY AND BELT COLLINS AND ASSOCIATES
680 ALA MOANA BLVD., SUITE 200
HONOLULU, HAWAII 96814**

CONTRACT NUMBER: N67742-89-D-0007 AMENDMENT 6

PRINCIPLE INVESTIGATOR: JOSEPH KENNEDY, M.A.

**PREPARED BY: ARCHAEOLOGICAL CONSULTANTS OF HAWAII
JOSEPH KENNEDY, M.A.
59-624 PUPUKEA RD.
HALEIWA, HAWAII 96712**

SUPPLEMENT TO ARCHAEOLOGICAL TESTING RESULTS FOR THE PROPOSED
FAMILY HOUSING PROJECT AREA, PACIFIC MISSILE RANGE FACILITY,
BARKING SANDS, ISLAM) OF KAUAI, TMK 1-2-02:13, POR. 25
REVISED OCTOBER 1991.

INTRODUCTION

This supplement to the original subsurface testing report was requested by Ms. N McMahon of the State Historic Preservation Division in order that a "no effect" determination can be agreed upon for construction activities proposed for this location (refer to Appendix A). For information concerning the Physical Setting, History and Previous Archaeology, Methodology, Results, Conclusions and Recommendations, refer to Kennedy 1991.

HISTORIC DRAINAGE DITCH

A drainage ditch which traverses the subject property is depicted on a current USGS topographical map of this area (USGS 1983) (see map 1). This ditch was examined during the surface survey at this site. It was found to be overgrown with vegetation and gave the impression to the field crew that it had fallen out of use. No historic cultural materials were present in the ditch, nor was an intrusive pit present. The ditch crosses the property in an east-west direction from near the cable TV microwave tower to the south of houses on Sparrow Drive. The ditch is 6m across, 3m deep, and approximately 100m long on the subject property (it extends off property).

As suggested in the original report this ditch was constructed during the draining of the Mana Marsh (Kennedy 1991:16). Belt Collins and Associates state that this ditch was built by Kekaha Sugar around 1935 (pers. comm.). The ditch has been blocked by the construction of Sidewinder Road and the base boundary. Towards the sea, or makai, the ditch has been shut off by the construction of the current housing. This ditch no longer flows into the sea, nor does it drain the Mana Plain.

Since this ditch has been described and historically documented, it is evaluated to be no longer significant (NLS) (refer to Table 1). Any adverse effects upon this ditch as a result of construction activities in this area are mitigated.

TESTING OF MOUNDS

On the subject property there were a number of low dune-like mounds, up to 2m high. It is necessary to distinguish

between different types of low dune.

Low mounds of sand were scattered across the site in areas which had not been leveled. These low mounds were considered to be naturally occurring dunes. 31 trenches were excavated within the subject property. A number of these trenches tested at least two dozen of these low dunes (surface topography is not represented in the trench profiles, Kennedy 1991: Appendix A). The subsurface testing confirmed that these were natural, undisturbed dunes. These are not significant historic sites (refer to Table 1).

A number of low dunes had accumulated around the base of trees on the subject project. This type of dune was not tested for the sand deposit is younger than the object it accumulated around. These mounds are naturally occurring, recently deposited, dunes. These dunes are evaluated to be not significant (refer to Table 1).

In addition to these features, a number of low dunes with blocks of cemented sand embedded in the surface were discovered in the southwestern corner of the project area. These mounds with blocks averaged 4m long, 2.5m wide, and 0.60m high. At the time of their initial discovery these mounds with cemented blocks were believed to have been created by the dumping of backfill excavated during the construction of a sewer line nearby. It was decided to test one of these mounds in order to determine if the interpretation of them was correct. The testing of this mound was considered to be a sufficient sample in order to determine the nature of similar mounds found in this corner of the subject property. The mound which was tested was designated as ACH site #1 (Kennedy 1991:18). The excavations of this mound did not discover any historical artifacts. The stratigraphy in the trench did not seem to have been disturbed (see Figure 1: reproduced from Kennedy 1991:17). The profile was dominated by loose light yellowish-brown sand. However the presence of cemented, light yellowish-brown sand at the surface needed explanation.

The stratigraphy in most of the trenches dug at this site (Kennedy 1991: Appendix A) contained a layer of light yellowish-brown sand underlain by a cemented layer of this sand. The low mounds, one of which was labelled ACH site #1 and subject to subsurface testing, had blocks of this cemented sand at the surface. The revised report concluded that these mounds were either natural or cultural features: "These pieces of cemented sand may well have been eroded to the surface, or unearthed during the excavation of the nearby sewer trench." (Kennedy 1991:19). It is likely that these blocks were placed here mechanically, probably during the construction of a sewer line. This type of mound, with cemented blocks, is probably a modern feature, and has been evaluated to be not significant (refer to Table 1).

CONCLUSIONS

The archaeological investigations documented in this supplementary report have shown that the dunes and low mounds located on the subject property are not significant historic sites (NS). The historic ditch has been evaluated to be no longer significant (NLS).

This supplementary report was requested by SHPD in order to clarify the results of inventory survey and subsurface testing at the site of a proposed housing project at the Pacific Missile Range Facility, on the island of Kauai. The reader should refer to the original report for the recommendations for archaeological monitoring during construction activities at this location.

BIBLIOGRAPHY

Kennedy, J

1991 Archaeological Subsurface Testing Results For
The Proposed Family Housing Project Area,
Pacific Missile Range Facility, Barking Sands,
Island of Kauai, TMK 1-2-02:13, Por.25.
Revised October 1991.

U.S. Geological Survey

1983 Kekaha, island of Kauai. 7.5 minute series,
1:62 500.

Table 1: Significant Criterion Evaluation

Feature	Significance Criterion
Drainage Ditch	No Longer Significant
Low Dunes	Not Significant
Low Dunes around trees	Not Significant
Low Dunes with cemented blocks	Not Significant

MAP I: AREA OF SUBSURFACE SURVEY

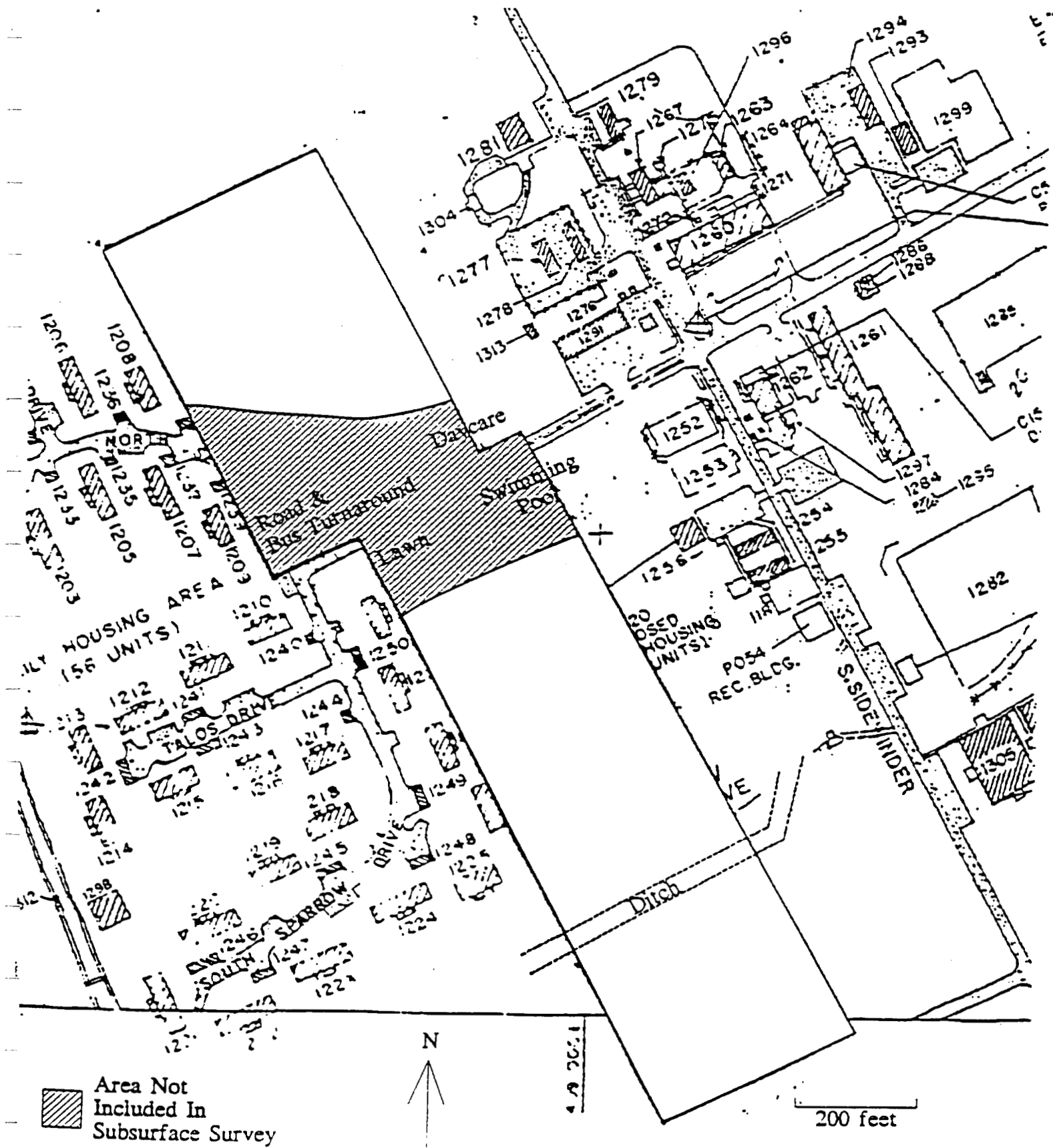
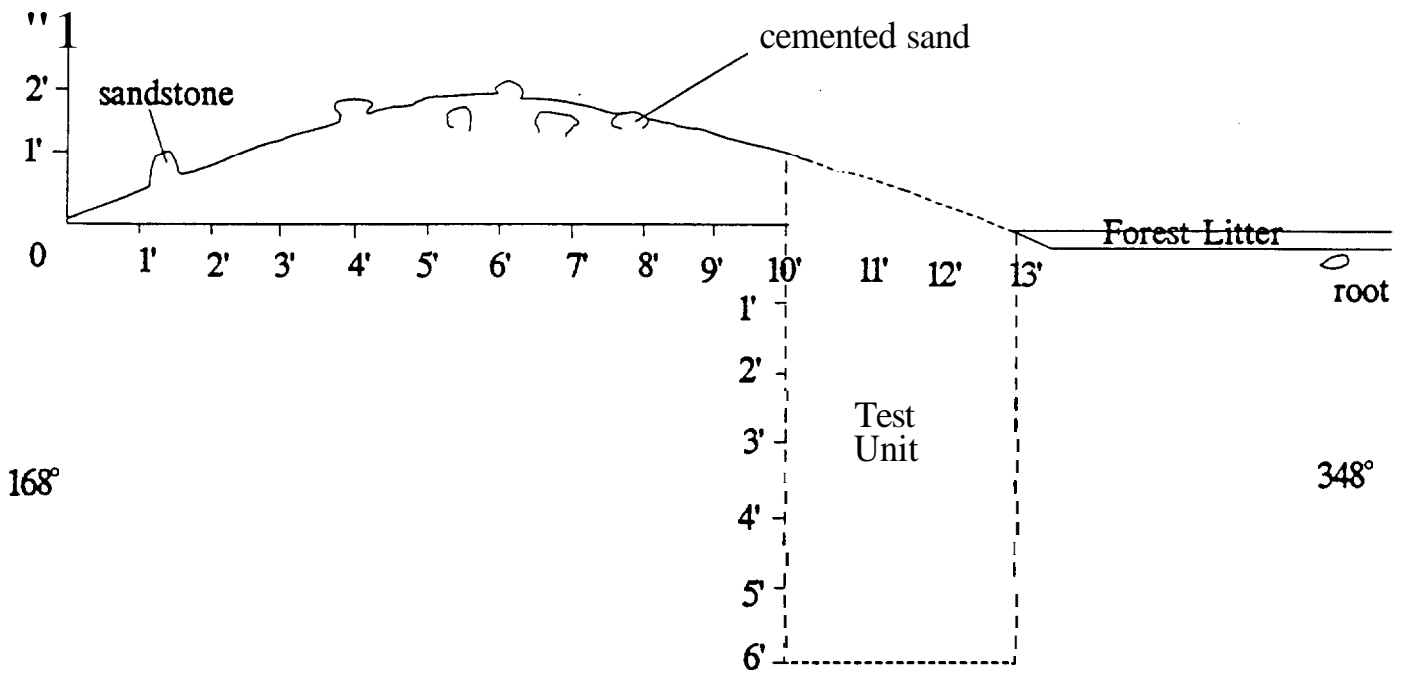


FIGURE 1 PROFILE & PLAN OF TRENCH 23 & SITE PMRF ACH #1

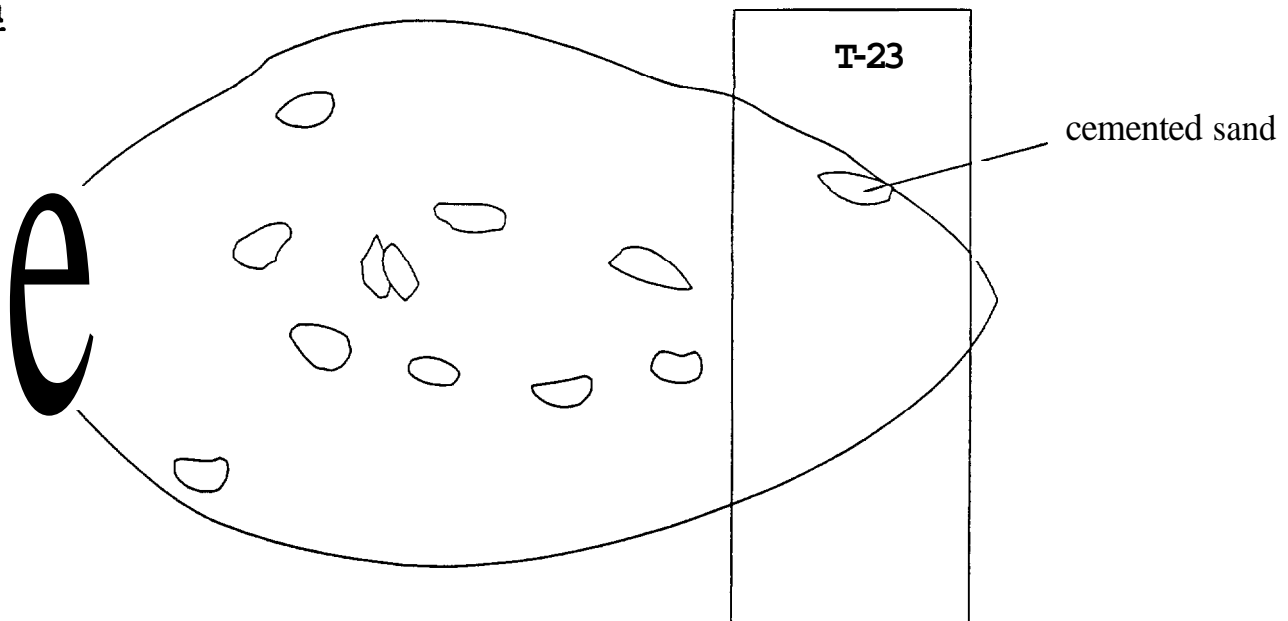
Site PMRF ACH #1
Trench #23

0 1' 2'

Profile



Plan



JOHN WAIHEE
GOVERNOR OF HAWAII



WILLIAM W. PATY, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES

KEITH W. AHUE
MANABU TAGOMORI
DAN T. KOCHI

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION

33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES FORESTRY AND WILDLIFE HISTORIC PRESERVATION PROGRAM
LAND MANAGEMENT STATE PARKS
WATER RESOURCE MANAGEMENT

REF: HP-JLE

JAN 15 1992

Mark R. Willey
Environmental Planner
Belt Collins & Associates
680 Ala Moana Boulevard, Suite 200
Honolulu, Hawaii 96813

LOG NO: 4462
DOC NO: 1768W

Dear Mr. Willey:

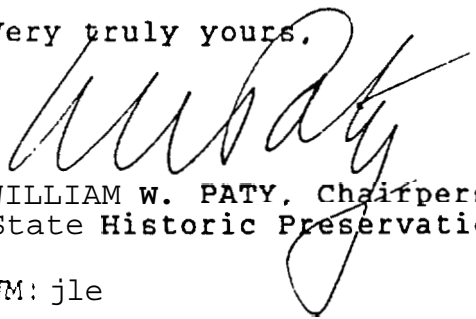
SUBJECT: National Historic Preservation Act Compliance --
Revision #2 to (Kennedy October 1991. Supplement to
Archaeological Subsurface Testing Results for the
Proposed Family Housing Project Area, TMK: 1-2-02-13,
Por. 25.)
Pacific Missile Range Facility,
Barking Sands, Waimea, Kauai

Thank you for your submitting the above supplement.

The report now indicates that the ditch is no longer significant.
The numerous mounds found are now called natural dunes and
man-made dunes. One was tested (ACH site #1) and so documented in
the report. Therefore, we can now concur the proposed project
will have "no effect".

If you have any questions please contact Ms. Nancy McMahon at
587-0006.

Very truly yours,


WILLIAM W. PATY, Chairperson and
State Historic Preservation Officer

NM: jle

cc: R. Hommon, U.S. Navy
J. Kennedy, Archaeological Consultants Hawaii