

FINAL
ARCHAEOLOGICAL INVENTORY SURVEY
TMK: (3) 1-3-09:POR. 005



KAUAEA AHUPUA'A, PUNA DISTRICT
ISLAND OF HAWAI'I

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SUMMARY

Haun & Associates conducted an archaeological inventory survey of a 309-acre portion of the 694.5-acre TMK: (3) 1-3-09:005 located in Kauaea Ahupua'a, Puna District, Island of Hawai'i. The objective of the survey was to comply with historic preservation regulatory review requirements of the Department of Land and Natural Resources-State Historic Preservation Division (DLNR-SHPD).

The survey identified six sites with ten features. The sites are comprised of four single feature sites and two feature complexes. The features consist of five roads, an enclosure, an enclosure with a ramp, a slab with a vertical metal post supporting a sign, a trail and a railroad grade. Feature function includes transportation (7), survey marker (1), triangulation station (1) and loading ramp (1). One site is probably prehistoric in age and 5 are historic.

In addition to the six sites, 20 caves and three overhangs were identified during the project. The caves consist of 8 vertical holes with chambers at the base, 8 caves in the bottoms of deep depressions, and 4 caves at the base of fissures. These natural features were carefully inspected during the project and no evidence of use or modification was found and they are designated as non-cultural features.

All six sites within the project area are assessed as significant for their information content. A trail was additionally assessed as culturally significant as a main, probably named transportation route. The mapping, written descriptions and photography at five of the six sites adequately documents them and no further work or preservation is recommended. The trail is recommended for preservation. Measures to protect this site would be detailed in a Site Preservation Plan prepared for DLNR-SHPD review and approval. Consultation with the Na Ala Hele is also recommended.

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INTRODUCTION

At the request of Sanford Service Center, Haun & Associates conducted an archaeological inventory Survey (AIS) of a 309 acre portion of the 694.5-acre TMK: (3) 1-3-09:005 located in Kauaea Ahupua'a, Puna District, Island of Hawai'i (Figures 1 and 2). The project area consists of Bishop Estate lands that are leased by Sanford Service Center. The objective of the project is to comply with historic preservation regulatory review requirements of the Department of Land and Natural Resources-State Historic Preservation Division (DLNR-SHPD), Hawai'i Administrative Rules, Title 13, DLNR, Subtitle 13, State Historic Preservation Rules, Chapters 276 and 284 (DLNR 2003). Sanford Service Center intends to expand the cinder mining operation within the parcel.

Haun & Associates conducted the survey fieldwork between November 26 and December 21, 2012 under the direction of Dr. Alan Haun. The field work portion of the project required 65 person days to complete. This final report presents the project scope of work, field methods, background information, survey findings, and site significance assessments with treatment recommendations.

Scope of Work

Based on DLNR-SHPD rules for inventory surveys the following specific tasks were determined to constitute an appropriate scope of work for the project:

1. Conduct background review and research of existing archaeological and historical documentary literature relating to the project area and its immediate vicinity--including examination of Land Commission Awards, *ahupua'a* records, historic maps, archival materials, archaeological reports, and other historical sources;
2. Conduct 100% pedestrian survey coverage of the project area;
3. Conduct detailed recording of all potentially significant sites including scale plan drawings, written descriptions, and photographs, as appropriate;
4. Conduct limited subsurface testing (manual excavation) at selected sites to determine feature function;
5. Analyze background research and field data; and
6. Prepare and submit Final Report.

Project Area Description

The project area consists of a 309-acre parcel located in the inland portion of Kauaea Ahupua'a between approximately 380 ft and 1,070 ft elevation. The project area is bordered to the north by the Leilani Estates subdivision and Keahialaka Ahupua'a, by Opihikao and Kaueleau Ahupua'a to the south, by undeveloped land to the west and by undeveloped land and a papaya farm to the east. An existing cinder quarry is located in the western portion of the parcel and the remaining portion is undeveloped. A dirt access road enters the project area along the southwestern side. An aerial view of the project area is presented in *Figure 3*.

There are two hills (*pu'u*) in the project area. Pu'u Kaliu is a 1,071 ft high hill located in the northwestern portion of the parcel. The cinder quarry is located on the slope flank of Pu'u Kaliu. The second *pu'u*, Pu'u Kepaka, is approximately 760 ft high and is located in the eastern portion of the parcel.

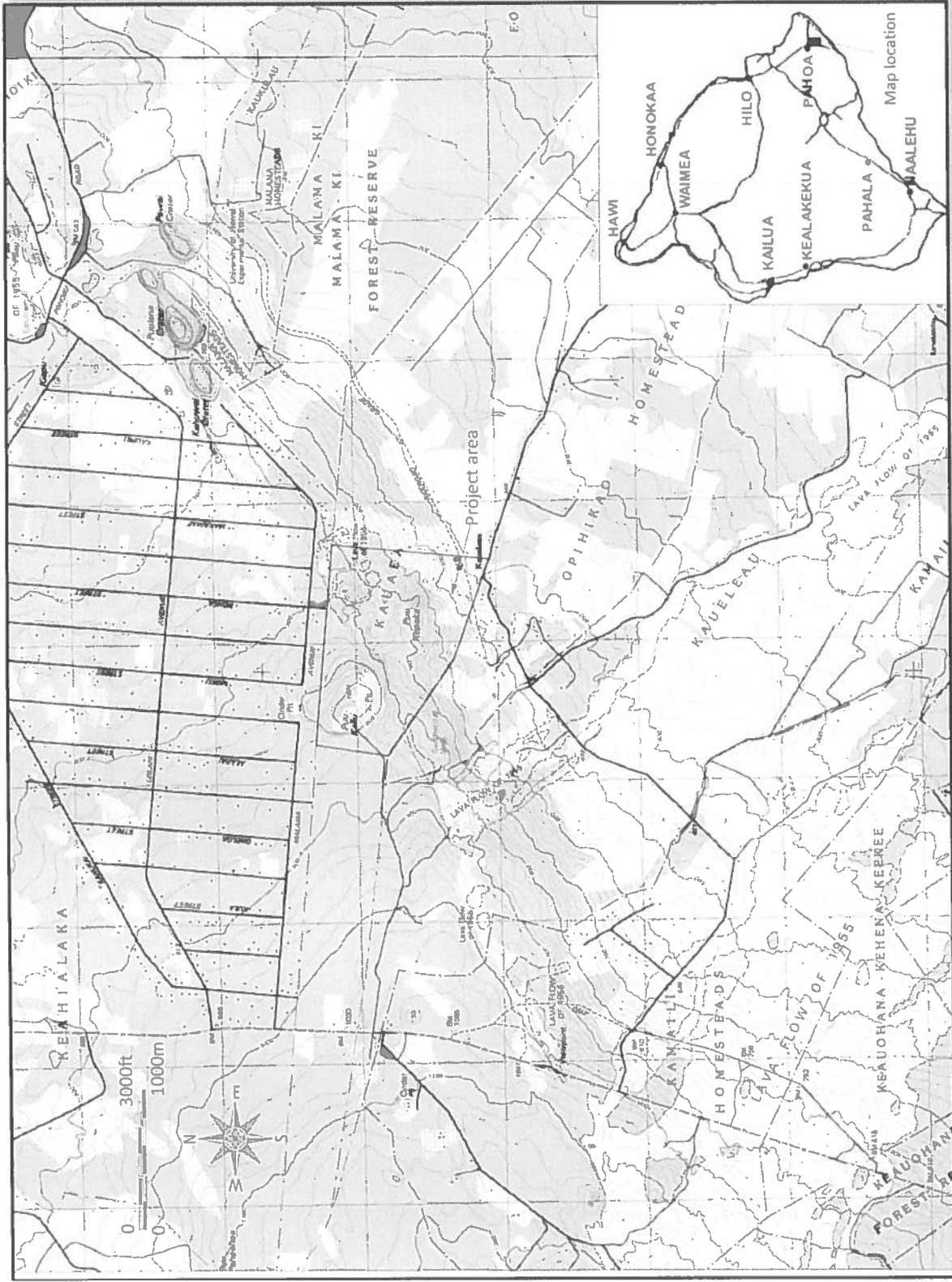


Figure 1. Portion of 1994 USGS Pahoehoe South Quadrangle showing project area

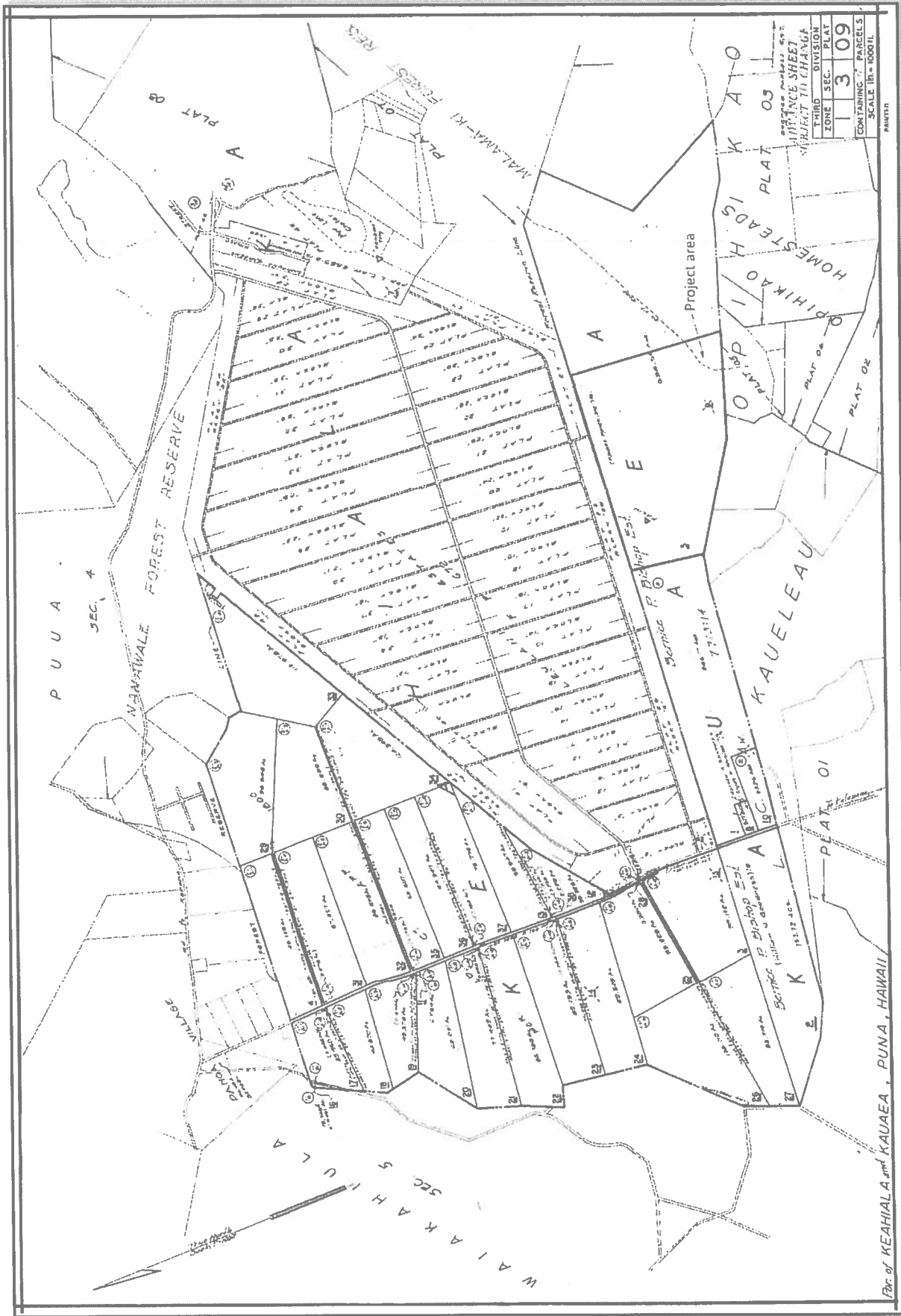


Figure 2. Tax Map Key 1-3-09 showing project area



Figure 3. Aerial view of project area (from Google earth)

The entire project area spans the East Rift Zone of the Kiluaea Volcano. Large portions of the project area have been disturbed by cinder mining and agricultural activities (Figure 4). Table 1 summarizes the disturbed areas and terrain types in the project area. The cinder quarry area comprises approximately 31-acres or 10% of the project area. This area includes an active cinder quarry (Figure 5) and areas that were previously disturbed by cinder mining (Figure 6). These areas have been excavated below the original ground surface and are vegetated with sparse grass and weeds.

Table 1. Areas of disturbance and terrain types in project area

Area	Acres within project area	% of project area	Ground surface visibility
Cinder quarry	31	10.0	Excellent
Impacted by sugarcane cultivation	66	21.0	Fair to good
Papaya farm	7	2.0	Excellent
1955 lava flow	13	4.0	Fair to good
High canopy forest	53	17.0	Fair to good
High canopy forest - Hazardous terrain	139	45.0	Fair
	309	100.0	

The southeastern portion of the project area was disturbed by historic and modern sugarcane cultivation. This area comprises 66-acres or 21% of the total parcel and is characterized by relatively flat, gently sloping terrain with introduced plant species including strawberry guava (*Psidium cattleianum*), Coster's curse (*Clidemia hirta*), lantana (*Lantana camara*), Miconia (*Miconia calvescens*), Hawaiian raspberry (*Rubus hawaiiensis*), avocado (*Persea americana*), coconut (*Cocos nucifera*), mango (*Mangifera indica*), red ginger (*Alpinia purpurata*), grasses and vines (Figure 7). The dense vegetation in this area resulted in fair to good ground surface visibility.

An active papaya (*Carica papaya*) farm is located in the southeast corner of the parcel, occupying 7-acres or 2% of the parcel (Figure 8). The ground surface visibility in the papaya farm is excellent. This area also was formerly used for sugarcane cultivation.

There is a U-shaped area in the northeastern portion of the project area that was covered by a 1955 lava flow from Kiluaea Volcano (13-acres, 4%). This area is vegetated with young *ohia* (*Metrosideros polymorpha*) trees, ferns and grasses with fair to good ground surface visibility (Figure 9).

The southwestern portion of the project area consists of a high canopy forest comprising 53-acres or 17% of the total project. The terrain in this area is relatively level with moderately thick vegetation dominated by strawberry guava and large *ohia* trees. Occasional fissures associated with the East Rift Zone are present in this area (Figure 10). Ground surface visibility in this area is fair to good.

The remaining 139-acres (45%) are comprised of a high canopy forest with hazardous terrain. This area is characterized by an extremely uneven ground surface that is bisected by narrow ridges and deep fissures and channels. Examples of the terrain are presented in Figures 11 and 12. The vegetation in this area consists of strawberry guava, African tulip (*Spathodea campanulata*), albizia (*Falcataria moluccana*), avocado, autograph tree (*Clusia rosea*), bamboo (*Bambusa spp.*), bamboo orchid (*Arundina graminifolia*), Coster's curse, gunpowder tree (*Trema orientalis*), Hawaiian raspberry, kukui (*Aleurites moluccana*), *ohia*, paper mulberry (*Broussonetia papyrifera*), staghorn fern, (*Dicranopteris linearis*), *ti* (*Cordyline fruticosa*), *uluhe* (*Dicranopteris linearis*), grasses and vines. Ground surface visibility in this area is fair.

Sato *et al.* (1973) indicates that there are six soil types present within the project area (Table 2 and Figure 13). These are either comprised of surface lava flows or thin rocky and stony muck soils over

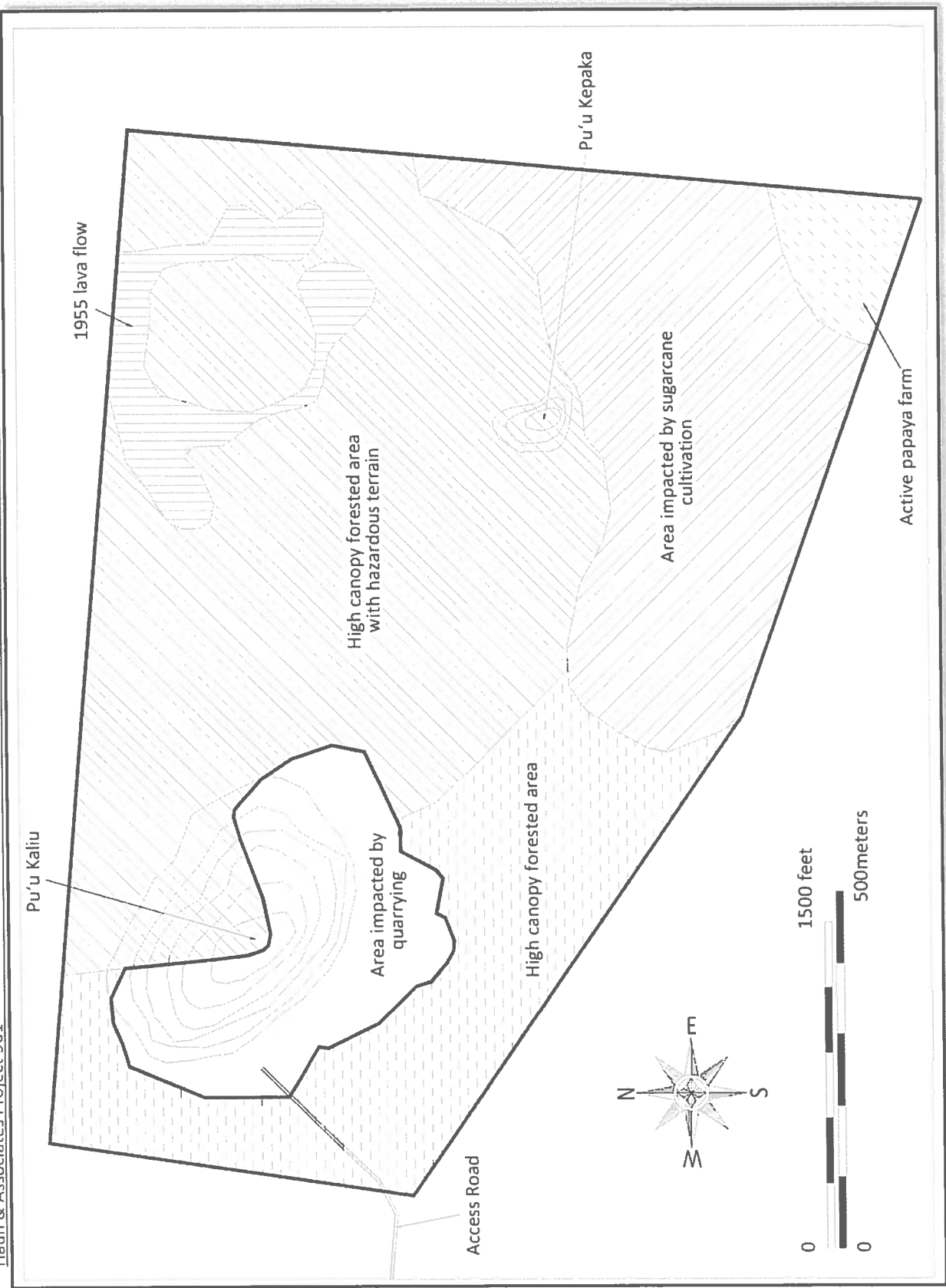


Figure 4. Areas of disturbance and terrain types within project area



Figure 5. Active cinder quarry, view to northwest



Figure 6. Abandoned cinder quarry, view to east-southeast



Figure 7. Area impacted by sugarcane cultivation



Figure 8. Papaya farm, view to northeast



Figure 9. 1955 lava flow area, view to east



Figure 10. Fissure within High Canopy Forest area, view to east



Figure 11. Deep fissure within High Canopy Forest with hazardous terrain, view to north



Figure 12. Terrain with High Canopy Forest with hazardous terrain, view to northeast



Figure 13. Soil types present within the project area

lava substrates. These soils are typically suitable for watershed, woodlands and native forest, with none particularly suited for cultivation.

Table 2. Soil Types in the project area

Soil designation*	Soil name	Acres within project area	% of project area	Location with project area	Soil use
rMAD	Malama extremely stony muck (3-15% slopes)	175	56.7	Majority of eastern two-thirds	Woodland, pasture and orchards
rPAE	Papai extremely stony muck (3-25% slopes)	91	29.4	Majority of western one-third	Woodland
rLV	Aa lava	33	10.6	NE and SW corners	Watershed
rPOE	Opihikao extremely rocky muck (3-25% slopes)	6	1.8	SE corner	Native forest or pasture
rKFD	Keaukaha extremely rocky muck (6-20% slopes)	4	1.2	NW corner	Native forest or pasture
rLW	Pahoehoe lava	1	0.3	SE corner and north-central	Watershed
Total		309	100.0		

* - from Sato et al. (1973)

The majority of the parcel is comprised of Malama extremely stony muck on 3-15% slopes (rMAD), occupying most of the eastern two-thirds of the project, or 175-acres (56.7%). According to Sato et al., "This soil overlies relatively young a'a lava flows on the windward side of Kiluaea Crater" (1973:37). This soil is characterized by a 3" thick layer of very dark brown extremely stony muck over the a'a lava substrate. It evidences a rapid permeability, a very slow runoff and a slight erosion hazard and is classified as suitable primarily for woodlands with smaller areas in pasture and orchards.

Papai extremely stony muck on 3-25% slopes (rPAE) occupies most of the western one-third of the project area (91 acres, 29.4%). This soil is similar to the Malama soil consisting of an 8 inch thick layer of very dark brown extremely stony muck over a fragmental a'a lava substrate (*ibid* 1973:46). This soil has a rapid permeability, a slow runoff and a slight erosion hazard and is classified as suitable primarily for woodlands.

There are isolated areas of surface lava (rLV) located in the northeast and southwest portion of the parcel (33 acres, 10.6%). The lava is a miscellaneous land type with little vegetation, "except for mosses, lichens, ferns and a few small ohia trees" (*ibid* 1973:34). The area of a'a lava in the northeastern portion of the parcel corresponds to the 1955 lava flow from Kiluaea Volcano. It is characterized as a "mass of clinkery, hard, glassy, sharp pieces piled in tumbled heaps" (*ibid* 1973:34) and is classified as suitable for watershed.

A small area of Opihikao extremely rocky muck on 3-25% slopes (rPOE) is located in the southeastern corner of the parcel (6 acres, 1.8%). This area roughly corresponds to the location of the papaya farm discussed above. This soil consists of a 3" thick layer of very dark brown muck over a pahoehoe lava substrate (*ibid* 1973:43). It evidences a rapid permeability, slow runoff and slight erosion hazard with rock outcrops present over 30-50% of the area. It primarily is vegetated with native forest with cleared areas suitable for pasture.

There is a small area of Keaukaha extremely rocky muck on 6-20% slopes (rKFD) in the northwestern corner of the project area. This soil is similar to the Opihikao soil and consists of a surface layer of dark brown muck (8") over pahoehoe bedrock (*ibid* 1973:27). The Keaukaha soil has rock outcrops

over 25% of the surface, has a rapid permeability, a medium runoff and a slight erosion hazard. It also is primarily in native forest with cleared areas suitable for pasture.

There are two small areas of pahoehoe lava (rLW, 1-acre, 0.3%) located in the southeastern corner of the parcel and along the northern project area boundary in the center of the parcel. This is also a miscellaneous land type with little or no soil or vegetation with the exception of mosses and lichens. According to Sato *et al.*, "This lava has a billowy, glassy surface that is relatively smooth. In some areas however, the surface is rough and broken, and there are hummocks and pressure domes" (1973:34). It is classified as suitable for watershed.

The project area has been inundated by lava flows from Kilauea Volcano that date to as early as 1,500 years ago (*Figure 14* and *Table 3*). The most recent flow was deposited in 1955 and comprises 15 acres of the project area (5%). The flow is located in the northeastern portion of the parcel (designated as a "p5" flow by Wolfe and Morris 2001). This flow is U-shaped and surrounds an area of lava deposited 750-1500 years ago. The current condition of this flow is depicted in *Figure 9*.

Table 3. Lava flows in the project area

Lava flow designation*	Lava flow age	Acres within project area	% of project area	Location with project area
p5	AD 1955	15	5	Northeast corner of parcel
p5	AD 1790	3	1	North-central area and along south boundary
pc40	450-750 years old	62	20	Pu'u Kaliu
p40	450-750 years old	210	68	Majority of parcel
pc3	750-1500 years old	12	4	Pu'u Kepaka
pc3	750-1500 years old	6	2	Northeast corner of parcel
Total		309	100	

* - from Wolfe and Morris 2001

There are two small lava flows associated with a 1790 eruption (p5), located along the northern boundary in the central portion of the parcel, and along the south boundary in the southwestern portion. The 1790 flow occupies 3 acres or 1% of the project area. The flow along the north boundary corresponds to an area of pahoehoe lava (see *Figure 13*) and the flow along the south boundary corresponds to an area of a'a lava.

The majority of the project area is characterized by lava flows that date from 450-750 years ago comprising 272 acres (88%). The Pu'u Kaliu area is designated as "pc4-0" by Wolfe and Morris (2001) and encompasses 62 acres (20%). This flow roughly corresponds to the Papai extremely stony muck soil area discussed above. The remaining 210 acres (68%) are designated as "p40" and correspond to the Malama extremely stony muck soil area.

The oldest flows in the parcel date from 750 to 1,500 years ago (pc3) and are located in two areas. A 12-acre (4%) area corresponds to the Pu'u Kepaka area (see *Figure 1*) indicating that this smaller hill pre-dates Pu'u Kaliu. The second area is situated in the northeastern corner of the parcel and is surrounded by the 1955 flow. It is 6 acres in area and comprises 2% of the project area.

In addition to the sites documented during the survey, 20 caves and three overhangs were identified. These features were carefully examined and no evidence of cultural use or modification was evident resulting in their designation as non-cultural features.

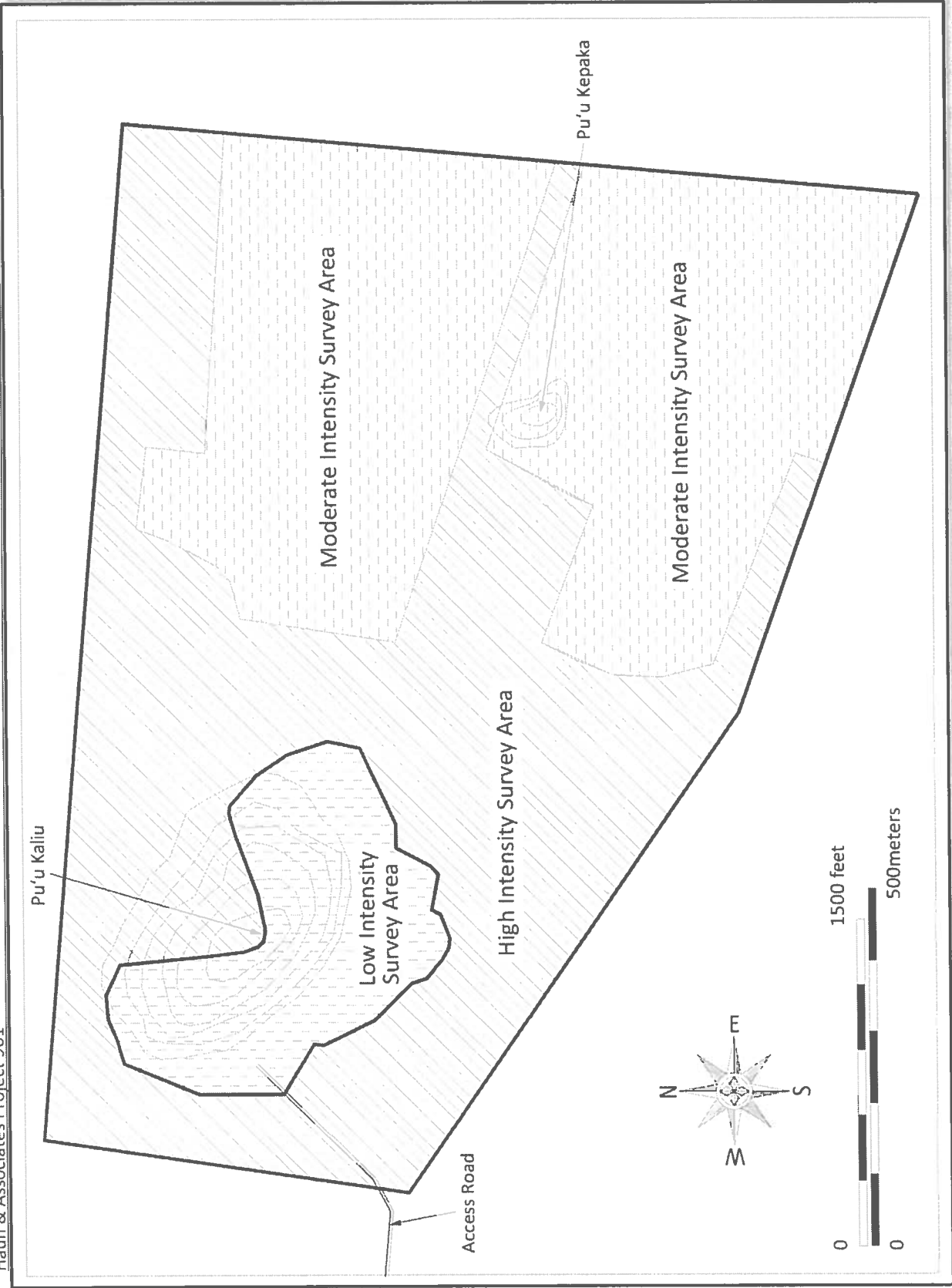


Figure 15. Low, Moderate and High Intensity survey areas within project area

Methods

The project area was subjected to a 100% variable intensity inventory survey based the survey findings as the work progressed and it became apparent that some areas lacked sites. Nearly half of the project area (146-acres or 47%) was subjected to a high intensity survey with the surveyors spaced at 10 m intervals (*Figure 15*). The cinder quarry area (31-acres, 10%) was subjected to a low intensity survey which consisted of a non-systematic vehicular and pedestrian examination of this disturbed area. The remaining 132-acres (43%) was subjected to a moderate intensity survey with the surveyors spaced at 30 to 50 m intervals.

Table 4 summarizes the survey areas. The high intensity survey area consists of the entire high canopy forest area (53-acres), and portions of the area impacted by sugarcane cultivation, the 1955 lava flow, and the high canopy forest with hazardous terrain area. The moderate intensity survey area consists of the entire papaya farm area (7-acre), and portions of the area impacted by sugarcane cultivation, the 1955 lava flow and the high canopy forest with hazardous terrain area.

Table 4. Variable intensity survey areas in project area

Area	Acres within project area	% of project area	High Intensity		Moderate Intensity		Low Intensity	
			Acres	% of area	Acres	% of area	Acres	% of area
Cinder quarry	31	10					31	100
Impacted by sugarcane cultivation	66	21	9	14	57	86		
Papaya farm	7	2			7	100		
1955 lava flow	13	4	6	46	7	54		
High canopy forest	53	17	53	100				
High canopy forest - Hazardous terrain	139	45	78	56	61	44		
	309	100	146		132		31	

In the 66-acre area impacted by sugarcane cultivation, 9-acres (14%) of the area was subjected to high intensity survey. The remaining 57 acres (86%) were examined with a moderate intensity survey. The 13-acre 1955 lava flow was surveyed with a combination of high intensity survey (6-acres, 46%) and a moderate intensity survey (7 acres, 54%). More than half (78 acres, 56%) of the 139-acre high canopy forest with hazardous terrain was subjected to a high intensity survey. The remainder of the area (61 acres, 44%) was covered using a moderate intensity survey.

With the exception of a survey marker on top of Pu'u Kaliu, all of the sites in the project area are located in the high canopy forest in the southwestern portion of the parcel and in the area impacted by sugarcane cultivation.

The identified sites were subjected to detailed recording consisting of mapping, preparing standardized site and feature forms, and photographic documentation. Archaeological features were flagged with pink and blue flagging tape and their locations geo-referenced with the assistance of a Garmin Global Positioning System (GPS) Model 60-series device using the NAD 83 datum. The accuracy of the GPS device for a single point is +/- 3-5 meters. This accuracy is increased to approximately 2-3 meters by recording multiple geo-reference points, including property corners and overlying the plotted points on a scaled map using AutoCAD software. No subsurface testing was undertaken during the survey and no cultural remains were recovered for analysis.

ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

Historical Documentary Research

The project area is situated in the *ahupua'a* of Kauaea in Puna District (*Figure 16*). There is little mention of Kauaea in Hawaiian traditional and legendary accounts. Crozier and Barrere (1971) note that in Puna few pre-missionary traditions and legends survived because of intensive mission work by Reverend Titus Coan between 1835 and the 1870s. Emory *et al.* (1959) suggest that Puna's traditional history is difficult to follow because of the dominating influence of the ruling families in the neighboring districts of Hilo and Ka'u. Handy and Handy (1972:542) state that Hawaiian traditions suggest that Puna "was once Hawaii's richest agricultural region and that it is only in relatively recent time that volcanic eruption has destroyed much of its best land".

According to Kamakau (1961), Hua'a was the chief of Puna when it was seized by 'Umi-a-Liloa, unifying his control over the Island of Hawaii'i. Hua'a was killed during a battle with one of 'Umi's warrior sons, Pi'i-mai-wa'a, at Kuolo in Kea'au. Kalani'opu'u unified his control over Hawaii Island when he gained control of Ka'u and Puna following Alapa'i's defeat in a battle at Mahinaakaka. During Kalani'opu'u's rule, the Puna chief, I-maka-koloa, attempted a rebellion and seized the valuable products of the district including 'o'o and *mamo* bird features, hogs, fine mats made from pandanus blossoms and from young pandanus leaves, gray tapa cloth, and tapa cloth made from *mamaki* bark.

Following the death of Kalani'opu'u, in 1782, a dispute over ascendancy ensued culminating in the battle of Moku'ohai (Kamakau 1961, Kuykendall 1938). Following the battle, control over the island was divided between Keoua Ku'ahulu'ula, who held Ka'u and a portion of Puna; Keawema'uhili, who controlled the remainder of Puna, Hilo, and southern Hamakua; and Kamehameha, who controlled northern Hamakua, Kohala, and Kona. A feud between Keoua and Keawema'uhili in 1785 resulted in Keawema'uhili's death and the expansion of Keoua's territory, including the unification of Puna. The island was finally re-unified in 1791 when Kamehameha killed Keoua at Kawaihae. In 1790, a lava flow extended diagonally across Kaueleau from the northeast above Opihikao to the coast at Kamaili (Wolfe and Morris 2001).

Early historic accounts document that Puna was well populated and intensively cultivated. In 1823, Ellis (1963) traveled along the coast to Kaimu, where he reported a sandy beach and village with an estimated 725 occupants. At Kaimu, there were plantations and groves of coconuts and *kou*. Ellis estimated that the population of Kaimu and nearby villages was approximately 2,000. Ellis described a village at Kamaili surrounded by plantations where they were given taro and potatoes. Other crops noted by Ellis in Puna included bananas and sugar cane.

The following summarizes Burtchard (1994) discussion of Puna's later history. Prior to the 1870s, foreign influence in Puna primarily was limited to missionaries. In the late 1870s, Robert Rycroft moved to Pohoiki and built a home, wharf, sawmill, jail and courthouse. He later began growing coffee in the area and built a coffee mill. In the mid-1880s, the government began selling land in Puna for homesteads. Most of the homestead land was acquired for coffee cultivation in the 1890s.

The Waihona 'Aina (2000) Mahele Database; which is a compilation of data from the Indices of Awards (Indices 1929), Native Register (NR n.d.), Native Testimony (NT n.d.), Foreign Register (FR n.d.) and Foreign Testimony (FT n.d.); indicates that only one Land Commission Award (LCA) was awarded in Kauaea. LCA 7713*H was awarded to Victoria Kamamalu, Kuhina Nui of the Hawaiian Islands between 1855 and 1863. This LCA is depicted on *Figure 17*, a map of Kauaea Ahupua'a by D.B Lyman. This figure is a tracing of the original Lyman map, which belonged to Princess Ruth Keelikolani, made by E. Baldwin in February 1882. According to the map, Kauaea encompassed 2,449 and $\frac{3}{4}$ acres.

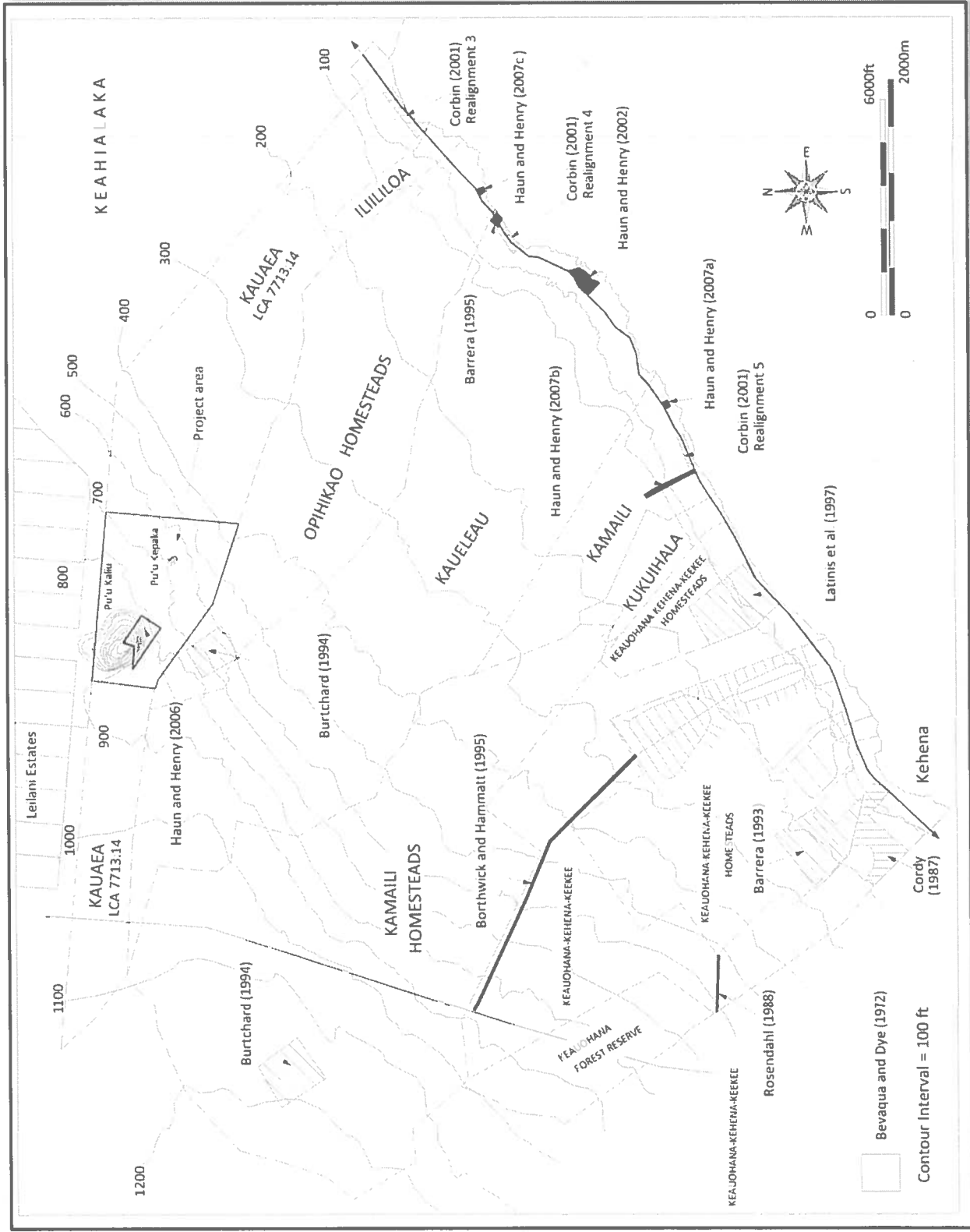


Figure 16. Ahupua'a boundaries and previous archaeological work

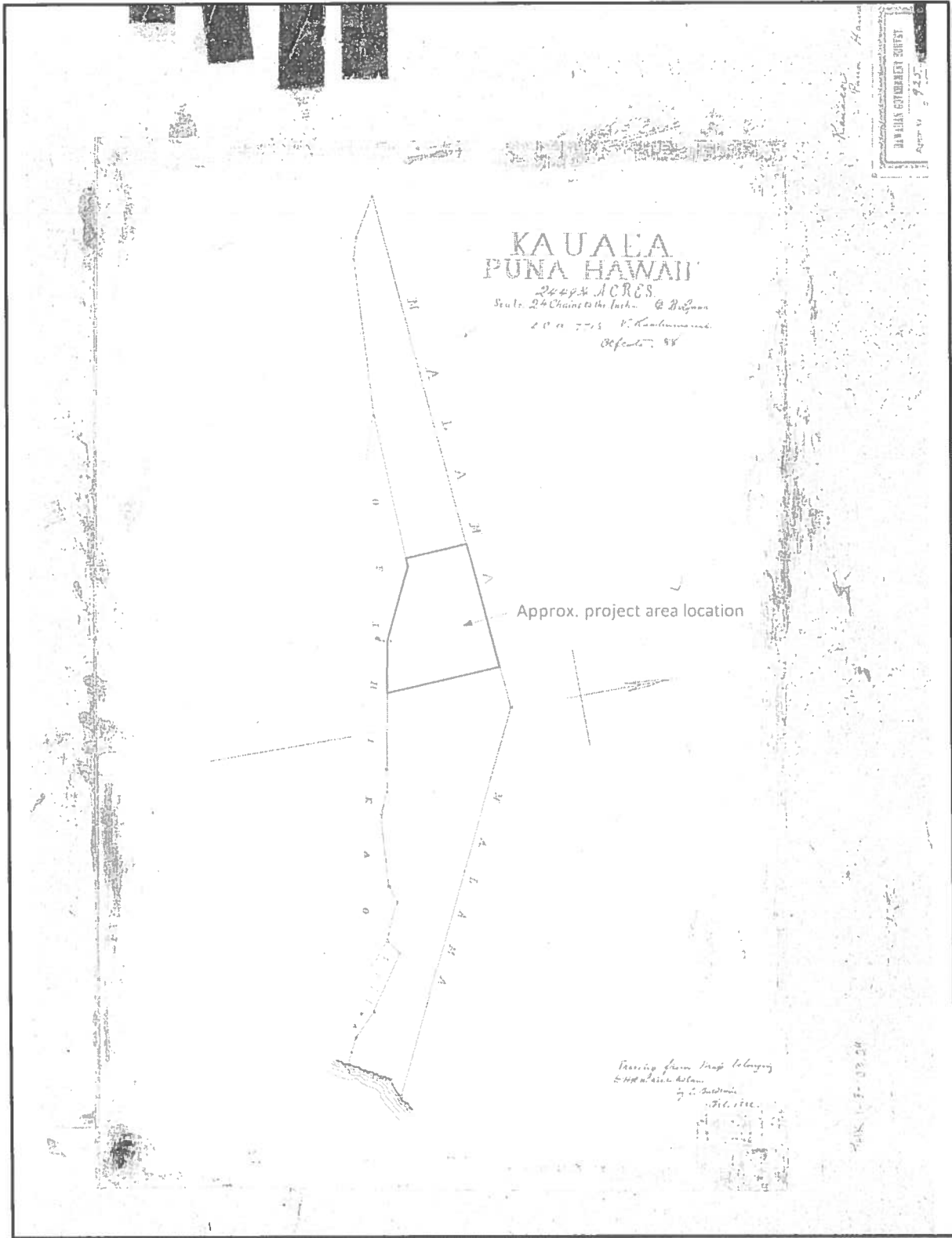


Figure 17. 1882 tracing of Lyman's Map of Kauaee Ahupua'a showing LCA 7713.

Figure 18 is a portion of Loebenstein's 1895 Hawaii Government Survey map of Puna from Pohoiki to Kehena. The boundary of Kauaea Ahupua'a on this map appears to be inaccurate, depicting it as slightly wider in the project area vicinity than it appears on later maps. This map depicts a network of transportation routes that extended through this portion of Puna. Three of the routes were labeled as roads by Loebenstein and the remainder depicted as trails. The three roads consist of the Government Road that parallels the shoreline, Puna Road located in Kaiahiku and Keahialaka Ahupua'a, and Rycroft's Road in Pohoiki.

The main transportation routes were the Government Road following the coast and the Kehena Trail, located further inland paralleling the shoreline. A series of inland-seaward trails and roads connect the main transportation routes, providing access from mountain communities to the sea. Several of the trails are listed as ancient in origin including the Kipapaia Trail in Kamaili, and the Kauaea Trail located in Kauaea Ahupua'a.

Figure 19 is a close-up of the 1895 Loebenstein map showing the project area vicinity. The Kehena Trail extends through the southwestern corner of the parcel in an east-west direction. A house belonging to "Kaaukai" is located on the north side of the trail and a coconut tree is located to the east of the house.

The ancient Kauaea Trail originates at a coconut grove and community named Kikiikii seaward of the project area (see *Figure 18*). The trail enters the project area at the southeast corner and extends inland, roughly paralleling the southern side of project area on the boundary between Kauaea and Opihikao. It appears to terminate in the forest at the base of Pu'u Kaliu. Houses owned by "Elia" and "Maluo" are located to the southwest of the Kauaea Trail, just outside the project area.

Figure 19 also indicates that in 1895, most of the northeastern portion of the project area, on the "Slope of Kaliu" was "Good coffee land". An area listed as "Thin woods on clinkers" is surrounded by the "Good coffee land" along the northern project area boundary.

Pu'u Kaliu has been in use as a triangulation station to map the displacement of Kilauea Volcano's south flank from as early as 1896 (Swanson *et al.* 1976). A series of triangulation surveys used Pu'u Kaliu, among other volcanic summits to track the horizontal ground displacement over time, within the Kilauea Rift Zones (*ibid.*:8). These surveys were conducted in 1896 and 1949 by the U.S Coast and Geodetic Survey, in 1958 and 1961 by the U.S. Geological Survey, and in 1970 and 1971 by personnel from the Hawaiian Volcano Observatory. The data from the earliest study was obtained in 1896, but was not triangulated until 1914. A sign marking the data point is present on the summit of Pu'u Kaliu. The sign was found to be in good condition in 1967 (pers. comm., Robert Shrai, Island Survey). The sign was located during the project and has been designated as Site 29727 (discussed in detail in Findings section).

A September 30, 1908 article in the Hilo Tribune described the effects of a violent earthquake in the Puna District that opened cracks throughout the region, destroyed homes and stone walls, and damaged a school house in coastal Kauaea. This school house is depicted in *Figure 18*.

Gerritt P. Wider and I (A. Gartley) just came through Puna from the Volcano on horseback, and saw many evidences of the earthquake which were of interest. We left the Volcano on Keauhou trail, passing the line of small craters Panau, Panau-iki, Kapaahu, Kalapana, Pahoa, Kapoho and to Hilo. At the crater of Makaopuhi tons of material have been shaken down from the vertical banks into the mauka pit below. Some smoke was issuing from the bottom of the mauka pali and quite large deposits of sulphur have formed. The shake must have been very heavy in Puna. At Kapaahu a crack about a foot wide opened for about 500 feet, extending mauka from the sea. At

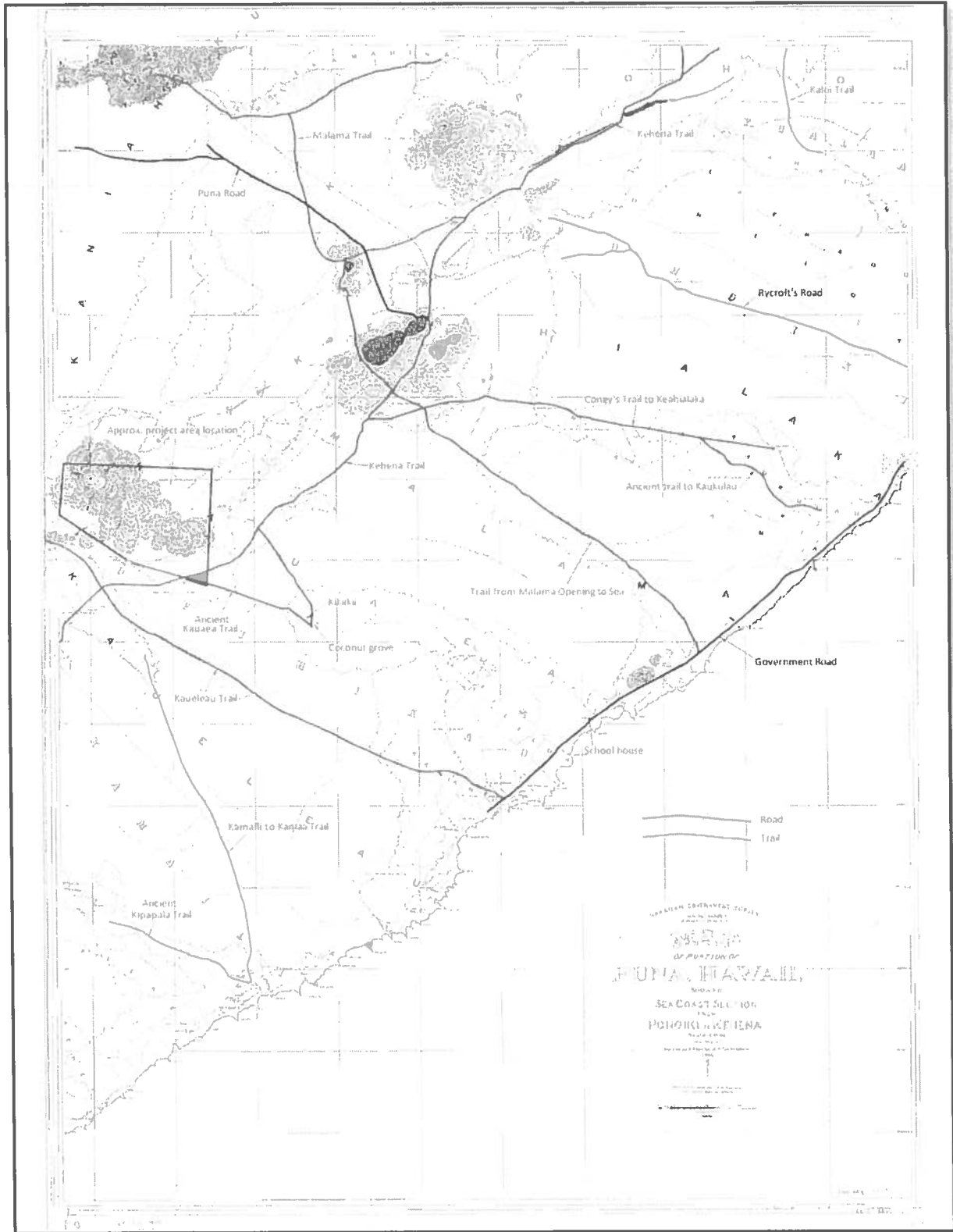


Figure 18. Loebenstein's 1895 Hawaii Government Survey Map of Puna from Pohoiki to Kehena

Kalapana the old '68 crack, which opened when the Puna coast sunk, opened about twelve inches more, and about a quarter mile back of this crack toward Kau a new crack has opened, extending from pali to pali and several hundred feet long. Some say there was a small crack before one or two inches wide, but it is now twelve to eighteen inches wide. At Kahena it is reported that a strip of the pali (about 100 feet high) along the coast, some 50 feet wide and half a mile long, split off and dropped into the sea, and a new crack has opened parallel with the front of the pali 50 feet back and over two miles long. Three houses and many water tanks were overturned in Kalapana and nearly every stone wall was thrown down. On the trail from Kalapana to Kahena the walls on the mauka side of the road suffered, those on the makai side being left intact. The schoolhouse at Kauaea was either overturned or badly set off its foundation (USGS.gov website).

The Ola'a Sugar Company was founded in 1899 by B.F. Dillingham, Lorrin A. Thurston, Alfred W. Carter, Samuel M. Damon, and Wm. H. Shipman. The plantation was to become one of the largest in the state. According to the Hawaii Sugarcane Plantation Archives:

With a \$5,000,000 investment, the promoters purchased 16,000 acres in fee simple land and nearly 7,000 acres in long leasehold from W.H. Shipman. They also purchased 90% of the stock in the adjacent Puna Plantation, adding another 11,000 acres to the holdings. Ola'a Sugar Company began as one of Hawaii's largest sugar plantations with much of its acreage covered in trees.

The task of setting up the plantation was enormous. Before 1900, coffee was the chief agricultural crop in the area. Over 6,000 acres of coffee trees were owned by approximately 200 independent coffee planters and 6 incorporated companies. The coffee trees were uprooted to make way for cane. Ohia forests had to be cleared, field rock piled, land plowed by mules or dug up by hand with a pick, quarters for laborers and staff had to be built, the mill constructed, and the first cane planted.

The cane was transported to the mill by fluming and by railroad. Although Ola'a Sugar Company had 72 miles of flumes, it had no dependable water source for their operation. The railroad was relied upon for delivery of 60% of the cane. In addition to its own standard gauge 35 miles of railway track, the company ran cars over the Consolidated Railway tracks to bring its cane in from more distant fields. The history of Ola'a Sugar Company is closely connected with the southern branches of the Hawaii Consolidated Railway Co. because they were interdependent from the start. The cane fields were in four widely separated areas cut off from each other by stretches of barren lava. The railroad was therefore vital to the plantation, which in turn helped support the railroad. When a tidal wave on April 1, 1946 destroyed much of the Hawaii Consolidated Railway Company's tracks, it ceased operations. The plantation was then forced to convert to trucks in order to transport sugar and molasses to the Hilo wharf.

Fortunately, under the management of Wm. L.S. Williams, a major road-building program had been started in 1939 for the purpose of eliminating the portable track. He started the plantation on its way to modernization by laying a network of 500 miles of roads for hauling cane. Since 1948, all the cane hauling has been by truck (Hawaii Sugarcane Plantation Archives).

By the end of the 1940s, Ola'a Sugar Company was deeply in debt, owing American Factors, Ltd (AMFAC) \$2,000,000. The debt was the result of insect epidemics, volcanic eruptions and drop in sugar prices. By 1953, the company was \$4,100,000 in debt and in 1959 it was decided that the plantation

would sell some of its 35,700-acres to offset the debt. In 1960, the company changed its name to the Puna Sugar Company, primarily because it was thought a name change would give the company a new start. Apparently this strategy worked because in 1963 the company had its best year ever with a 36% increase in profits. The company was debt free for the first time in its history by 1966, and in 1969 the Puna Sugar Company was purchased outright by AMFAC. The company closed in 1982 following cancelation of government subsidies and tax breaks and the introduction of high fructose corn syrup, a cheap low-cost substitute for sugar.

Figure 20 is a portion of Walter E. Wall's 1915 Hawaii Territory Survey Map of Puna Homestead Subdivisions and Government Tracts. This map indicates that formal roads in the area had been expanded since 1895, connecting the town of Pahoia with coastal communities. Despite this expansion, many of the trails depicted on the 1895 map appear to have still been in use in 1915. This map also depicts the Hilo Railroad lines to the east of Pahoia with a line extending as far south as Kapoho Ahupua'a.

By the late 1920s, concern over forest depletion and watershed maintenance lead to the creation of forest reserves in the Puna District. *Figure 21* is portion of Wall's 1927 Hawaii Territory Survey Map of Puna, Keauohana and Malama-Iki Forest Reserves. This map indicates that few new roads had been built since the 1915 map. It also shows that fewer trails were being utilized in 1927.

Figure 21 also indicates that the railroad lines, used to transport sugar cane were expanded since 1915. One line extended from Pahoia town into the *ahupua'a* of Waiakahiula and Keahialaka. The rail line that formerly terminated in Kapoho (see *Figure 21*) was expanded to the east as far as Kaueleau Ahupua'a. This section of track passed through the southeastern corner of the present project area.

Figure 22 is a close-up of Wall's 1927 map showing the project area vicinity. As discussed above, a portion of the railroad line extended into the project area. This rail line roughly follows the path of the Kehena Trail depicted on *Figures 18-20*, suggesting that railroad utilized the pre-existing transportation route. The rail line was identified during the present project and was documented as Site 29728 that is discussed the Findings section. *Figure 22* also depicts a trail that enters the project area along its southern side, roughly paralleling the inland portion of this boundary. This trail may represent an inland extension of the Kaueleau Trail as depicted on *Figure 18* and *Figure 20*.

The Kauaea School discussed above is also depicted on Wall's 1915 (see *Figure 20*) and 1927 maps of the area (see *Figure 21*). This indicates that the school was re-built following the 1908 earthquake and used until at least 1927.

Handy and Handy (1972) citing oral historical sources, indicate that in the 1930s there were homesteading areas in the *ahupua'a* of 'Opihikao, Kaueleau, Kamaili, Ke'eke'e, Kehena, and Keauohana, in the general vicinity of the project area. Dry land taro was grown throughout the inland portions of these *ahupua'a*. A particular taro cultivation method, *pa-hala*, is described for the area from Kalapana to Kamaili.

The method involved excavating a hole in a'a lava in a pandanus grove. The hole was then filled with weeds, which were allowed to rot for six weeks or more. A taro cutting (*huli*) was wrapped in pandanus leaves and planted in the hole. After the cutting produced three or four leaves, the pandanus branches were cut to provide sunlight and the taro plant was covered with pandanus leaves. After the pandanus leaves were sufficiently dry, the leaves were burned reducing them ash that provided nourishment to the taro plant, which grew tall enough to hide a man beneath the leaves.

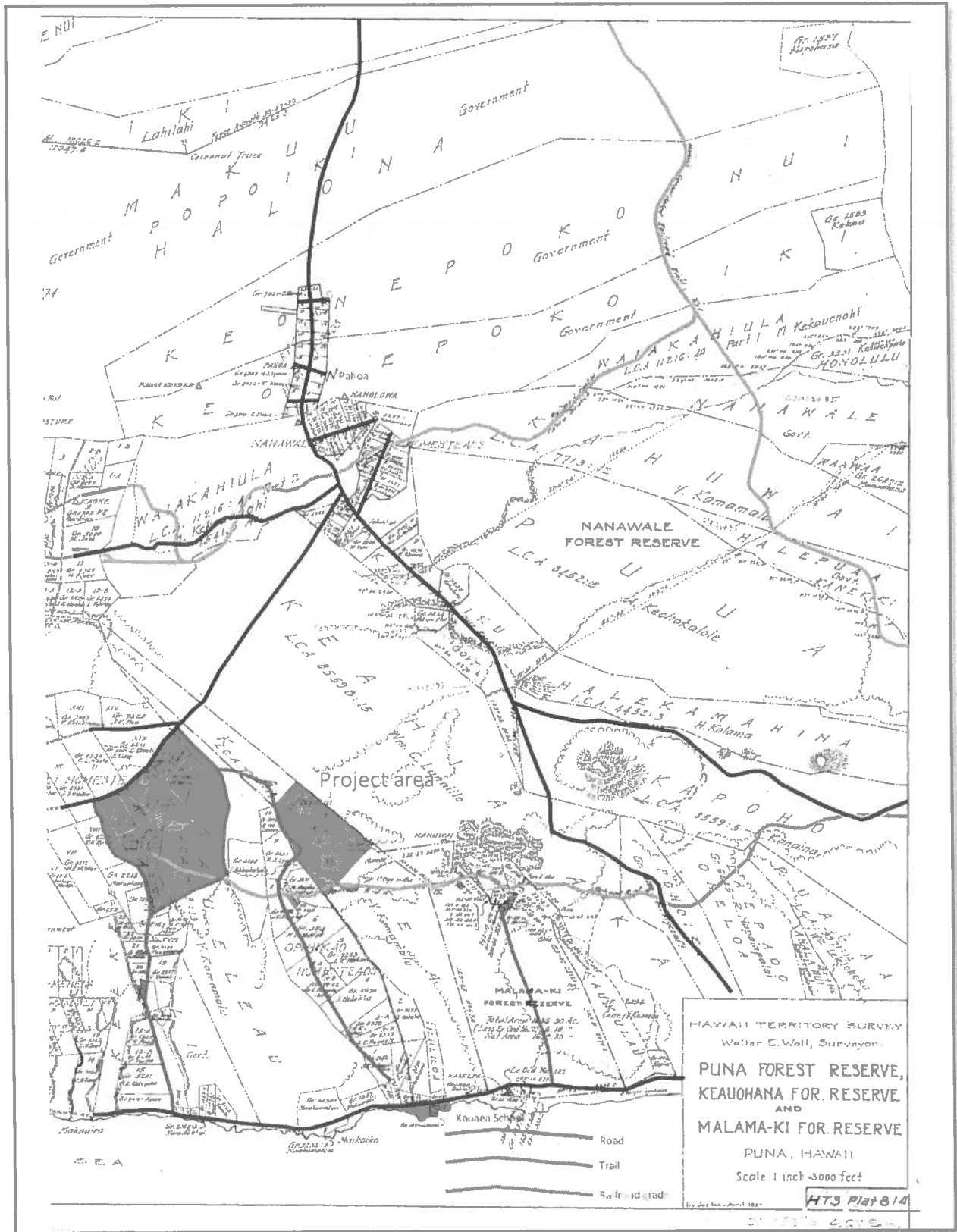


Figure 21. Portion of Wall's 1927 Hawaii Government Survey Map of Puna, Keauohana and Malama-iki Forest Reserve

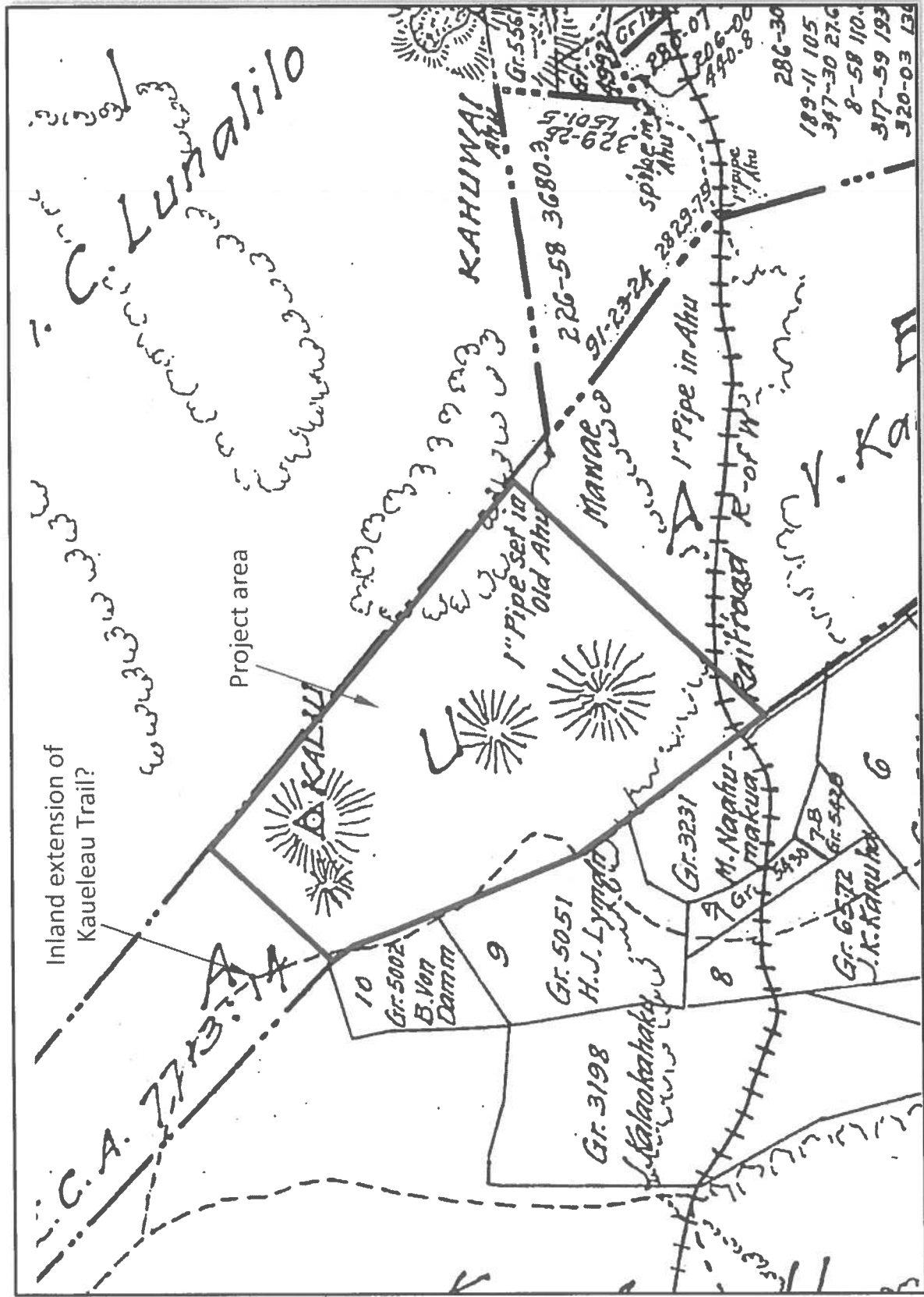


Figure 22. Close-up of Wall's 1927 map showing project area vicinity

Figure 23 is a 1965 aerial photograph of the project area vicinity. It depicts the Site 29728 railroad grade that extends through the southeastern corner of the parcel. The area to the south of the railroad line appears to be cultivated in formal fields, and the area to the north has been cleared of trees. A linear cleared swath extends through the central portion of the parcel in a northeast by southwest direction.

Portions of the present project area have been used as a cinder mine. The cinder mining activity has been in operation by Sanford Service Center since 1987. Cinder mining was also undertaken along the northern slopes of Pu'u Kaliu, outside the project area to the north. Cinders mined from this area were used to create the Leilani Estates subdivision, founded in 1964 (lelaniestates.org).

An interview with a local resident of the project area vicinity was conducted by Haun & Associates Project Supervisor Shawn Fackler during the project. Mr. Kahaloa was born in 1959 and raised near the project area. During the interview he stated, "I used all that area [from his house up to Pu'u Kaliu and Kepaka] as my playground as a kid". He explained that the vegetation used to be mainly guava and it was easy to venture all the way up to either *pu'u*. The only cultural resource in the project area that he could remember is the Site 29726, Feature A enclosure (discussed in Findings section). He originally thought the structure might have been a World War II era feature, but now thinks it is related to sugarcane cultivation in the area.

Mr. Kahaloa began leasing land and running his papaya farm in the southeastern portion of the project area approximately 25 years ago. He explained that a cherry orchid previously grew on the land where his papaya farm is now, but that he could not remember who ran it. He did indicate that a ranch [name unknown] grazed cattle in the area *mauka* of his farm up to the Leilani Estates area for at least 30 years before he began growing papaya. He also indicated that the ranch routinely used tractors in its later years to clear vegetation for grazing cattle and also confirmed that the wooden posts observed during the survey along the old sugar cane railroad grade were part of a cattle chute built within the past 50 years.

Mr. Kahaloa recalled that, "the land *mauka* of the road used to be sugarcane fields all the way up to the tops of the *pu'us*. They [field workers] used donkeys and carts to harvest the cane but then stopped all together when the railroad stopped running." Kahaloa also mentioned that his grandmother told him that taro used to grow in the fields before the introduction of sugar cane.

Another informant interview was conducted with Emily Naeole-Beason by telephone on February 4, 2013. She is 56 years old and has lived in Opihikao her entire life. Her parents and grandparents also lived in Opihikao. She is very familiar with the project area. Her granddaughter is named after the cinder cone Pu'u Kaliu that dominates the western half of the area and is referenced in a *hula* performed by her daughter. She was not aware of any traditional activities or resources in the area. She recalled that sugar cane was once grown in the vicinity.



Figure 23. 1965 aerial photograph showing project area vicinity

Previous Archaeological Research

A search of the DLNR-SHPD archaeological report database and other sources identified 16 archaeological projects between Kauaea and Kehena. *Figure 16* shows the project locations and *Table 5* summarizes the projects. Not included in the figure or table are the studies by Stokes (Stokes and Dye 1991), which focused on major sites, primarily *heiau* throughout Hawaii Island and a survey of east Hawaii by Hudson (1932).

Stokes (Stokes and Dye 1991), relying in part on the earlier observations of Thrum, reported fourteen *heiau* in Puna of which three were destroyed at the time of Stokes fieldwork in 1906. Several of the *heiau* were reported to be agricultural temples. Hudson (1932) reported 32 sites along the coast between Kapoho and Kaimu including the Hilo-Puna Trail, habitation platforms and enclosures, water sources (cave and well), windbreak shelters, and four *heiau*: Mahina'akaka Heiau at Keahialaka, Kalepa at Kalepa Point, "Old" Wahaula Heiau at Kamaili, and Kumakaula at Ke'eke'e.

The surveys in *Table 5* cover more than 650 acres of Puna between sea level and 1,540 ft elevation. Cultural remains identified by the surveys consist of 113 sites with nearly 940 features. To aid in reconstructing settlement patterns, features were quantified by probable age and function, and the studies are ordered by elevation. Traditional Hawaiian features were categorized as habitation, agricultural, burial (including possible burials), ritual, and trail. Features not assignable to these categories were categorized as miscellaneous. Traditional sites in this category include petroglyphs, *holua* slides, water sources, and *ahu*. Density values are given for sites, features, and habitation and agricultural features.

Overall, the studies have identified more than 76 habitation features, 314 agricultural features, 269 burials, 7 ritual features, and 18 trails. The large number of burials includes several historic cemeteries. Other historic features were not segregated by function. The majority of the historic features are walls and roads. None of the studies processed radiocarbon dates.

A 15-acre portion of the present 309-acre project area was previously examined by Haun and Henry (2006). The majority of the Haun and Henry (2006) study area (c. 95%) was comprised of the cinder quarry area, with a narrow (10-30 m wide) disturbed vegetated band present around the southwest and west sides. No sites or features were present.

McEldowney (1979) primarily used historic documentary evidence to develop a land use and settlement pattern model for the windward Hilo area that is probably applicable to most of Puna. The model consists of five elevation-defined zones: Coastal Settlement, Upland Agricultural, Lower Forest, Rainforest, and Sub-Alpine or Montane. The Coastal Settlement Zone extended approximately 0.5 miles inland from the shoreline between sea level and 50 ft elevation. The zone was the most densely populated with both permanent and temporary habitations, high status chiefly residences, and *heiau*. Settlements were concentrated at Hilo Bay and sheltered bays and coves. Also present were fishponds and gardens where breadfruit, coconut, *kukui*, banana, *wauke*, sugar cane, sweet potato, and wet and dryland taro were cultivated. The ocean provided fish and other marine resources.

The Upland Agricultural Zone was situated between approximately 50 ft and 1,500 ft elevation. Settlement in the zone consisted of scattered residences among economically beneficial trees and agricultural plots of dryland taro and bananas. Lava tubes were utilized for shelter. A pattern of shifting cultivation is believed to have converted the original forest cover to parkland of grass and scattered groves of trees. Wetland cultivation of taro occurred along streams.

Table 5. Previous archaeological work

Author	Land	Study Type*	Elevation	Acreage	No. of sites	Sites/ acre	No. of Feas.	Feas/ acre	Hab Feas.	Hab Feas/ acre	Ag Feas.	Ag Feas/ acre	Burial Feas.	Ritual Feas.	Trail	Misc.	Historic Feas.	Comment
Haun and Henry (2007c)	Opihikao	IN	10-25	1	2	2.00	2	2.00									2	
Corbin (2001)	Kamaili, Kauaea, Kaualeau	IN	20-40	5.3	1	0.19	40	7.55			40	7.55	1					
Bevaqua and Dye (1972)	Kapoho-kalapana	RN	20-40	151	48	0.32	426	2.82	61	0.40	many		156	3	5	188	7	Feature totals estimated, most not quantified in report; misc. incl. 165 petroglyphs
Haun and Henry (2007a)	Kamaili	IN	20-38	1	*		*											* = Identified portion of trail initially identified by Bevaqua and Dye (1972)
Haun and Henry (2007b)	Kamaili	IN	30-115	4.274	5	1.17	10	2.34									10	
Barrera (1995)	Kaualeau	DR	35-40	3	3	1.00	9	3.00	2	0.67							7	
Haun and Henry (2002)	Kaualeau	IN	80-100	7	0	0.00												
Cordy (1987)	Keauohana	RN	80-250	39	15	0.38	92	2.36			20	0.51	63		4		5	
Latinis, Moore and Kennedy (1997)	Keekee	IN	100-300	94	6	0.06	128	1.36	3	0.03	88	0.94	24	3	4	2	4	
Barrera (1993)	Keauohana	RN	120-300	66	1	0.02	167	2.53	5	0.08	150	2.27	3				9	
Borthwick and Hammett (1995)	Kamaili, Keekee, Kehena, Keauohana	AS	280-860	9.99	0													
MLK Rosendahl (1988)	Keauohana and Kehena	FI	540-620	1.7	0													
Burtchard (1994)	various	RN	650-1200	247	34	0.14	65	0.26	5	0.02	16	0.06	22	1	5	8	11	
Haun and Henry (2006)	Kauaea	AS	780-1050	15	0													
Bonk (1989, 1990)	Kaimu, Makuu, Kaoho, Kehena, Kaapahu and Maimaili	RN/ MON	1480-1540	10	0													
	Total/Average			655.26	113	0.53	939	2.69	76	0.20	314	2.27	269	7	18	198	55	

IN = Inventory Survey, RN = Reconnaissance Survey, DR = Data Recovery, AS = Archaeological Assessment

The Lower Forest Zone ranged from 1,500 ft to 2,500 ft elevation. Timber and other forest resources such as medicinal plants, *olona*, and birds were gathered from the zone. Site types consisted of temporary habitations, trails, shrines, and minor agricultural features in forest clearings and along streams. Sites in the Rainforest Zone (2,500-5,000 ft elevation) and Subalpine or Montane Zone (5,000-9,000 ft) were limited to trails and associated temporary habitations. These zones were used for intra-island travel and gathering of valued resources including hardwoods, birds, and stone for tool making.

PROJECT EXPECTATIONS

Based on historic documentary research and previous archaeological work, the prehistoric use of the project area, located in McEldowney's (1979) Upland Forest Zone, would likely consist of agricultural features and lava tubes used for temporary habitation and burial. Habitation and ceremonial sites would be rare. Interviews with longtime residents of the area indicate that portions of the project area have been used for cattle ranching and the cultivation of sugarcane. These historic activities potentially obliterated pre-existing prehistoric sites. The relatively recent lava flows within the project area may have also destroyed early sites.

The remains of historic sites are likely to be encountered. These sites would likely date to the 1900s and would consist of roads, cattle walls and fences, railroad lines, historic houses and sites associated with ranching and sugarcane cultivation.

FINDINGS

The survey identified six sites with ten features. The sites are comprised of four single feature sites and two feature complexes. The features consist of five roads, an enclosure, an enclosure with a ramp, a slab with a vertical metal post supporting a sign, a trail and a railroad grade. Feature function includes transportation (7), survey marker (1), triangulation station (1) and loading ramp (1). One site is probably prehistoric in age and 5 are historic. The sites are summarized in *Table 6* and their locations are presented in *Figure 24*.

Table 6. Summary of Sites

SIHP Site No.	Formal Type	Function	Age	No. of Features	Formal Type						Function			Haun & Associates Temp. Site No.	
					Road	Enclosure	Enclosure with ramp	Slab with sign	Trail	Railroad Grade	Transportation	Survey marker	Triangulation station		Loading ramp
29723	Trail	Transportation	Prehistoric	1					1		1				1
29724	Complex	Transportation	Historic	4	4						4				4, 6, 7, 13
29725	Enclosure	Survey Marker	Historic	1		1						1			8
29726	Complex	Loading ramp, Transportation	Historic	2	1		1				1			1	10
29727	Slab with sign	Triangulation station	Historic	1				1					1		16
29728	Railroad grade	Transportation	Historic	1						1	1				17
Total				10	5	1	1	1	1	1	7	1	1	1	

In addition to the six sites, 20 caves and three overhangs were identified during the project (see *Figure 24* and *Table 7*). The 20 caves consist of 8 vertical shafts with chambers at the base, 8 caves at the base of deep depressions, and 4 caves at the base of fissures. The 3 overhangs include 2 located on the side of fissures and 1 located on the side of a surface outcrop. The majority of these features are located in the southwestern portion of the parcel (n=18). Of the five remaining features, two are located along the northern slopes of Pu'u Kaliu and three are situated in the northwestern portion of the parcel. These natural features were thoroughly inspected during the project and no evidence of cultural use or modification was present, resulting in their designation as non-cultural features.

Site 29723

Site 29723 is a trail located in the southwestern corner of the project area. The trail is comprised of a cleared path through an area of uneven rocky terrain (*Figure 25*). The trail originates along the southwestern project boundary at approximately 855 ft elevation. It extends downhill in an easterly direction for 91 m where it becomes indiscernible at approximately 845 ft elevation. The area outside the parcel to the west has been disturbed and no evidence of the trail was observed there.

A 4.5 m long section of the trail was mapped (see *Figure 25*). The cleared area varies in width from 0.55 to 1.0 m. Linear piles of cobbles and small boulders, cleared from the trail have been placed along each side. These linear piles are 0.4 to 0.6 m wide and 0.15 to 0.4 m in height. The stones are moss-

Site 29724

Site 29724 is a complex of four road segments (Features A-D) located in the south-central portion of project area. The overall extent of the road network is depicted in *Figure 24*. The road segments have a combined length of 3,251 ft (991 m) and range in elevation from 790 ft at the northern end to 555 ft at the southern end.

The **Feature A** road appears to represent the main segment of the complex, with the Feature B-D road segments branching off of it. Feature A originates along the southern project area boundary at approximately 645 ft elevation. It extends upslope in a north-northwesterly direction for 1,880 ft (573 m) where it becomes indiscernible at approximately 790 ft elevation. The area outside the parcel to the south has been disturbed and no evidence of the road was observed there.

A section of the southern portion of Feature A is depicted in *Figure 26*. The road extends through a dense strawberry guava forest and is 13 to 16.5 feet (c. 4.0 to 5.0 m) wide. The surface of the road is comprised of soil cleared of stones and is bordered along the sides by discontinuous berms of soil and stones. These berms are linear and range in height from 10 to 20 inches (0.25 to 0.5 m). No cultural remains are present in association with the feature.

The **Feature B** road extends to the west from the Feature A road at 645 ft elevation. This road segment has an overall length of 620 ft (189 m). The road extends to the west from Feature A for 26 ft (8 m) and then angles to the south for 92 ft (28 m). It then turns to the south and extends in this direction for 502 ft (153 m) where it terminates along the southern project area boundary at approximately 580 ft elevation. No evidence of the road is present outside the parcel.

The Feature B road is comprised of a cleared path that extends through a dense strawberry guava forest that slopes to the south. It ranges in width from 10 to 13 ft (3.0 to 4.0 m). *Figure 27* depicts a section of the Feature B road where a causeway constructed over a low swale. The causeway is built of stacked cobbles and small boulders and is 17 ft long (north-south) and 10 ft (3.1 m) wide. The sides of the causeway vary in height from 12 to 16 inches (30.5 to 40.5 m). A section of displaced railroad rail is located on the surface of the Feature B road, 164 ft (50 m) to the north of the causeway. No other cultural remains are present.

The **Feature C** road extends to the northwest from Feature A at approximately 675 ft elevation. This road has an overall length of 626 ft (191 m). The road extends to the northwest from Feature A for 141 ft (43 m), then turns in a roughly west-southwesterly direction for 485 ft (148 m) where it becomes indiscernible at approximately 719 ft elevation. *Figure 28* depicts a section of the road.

The Feature C road is narrower than the other features, ranging in width from 4.5 to 11.5 ft (1.4 to 3.5 m), following the contour of a south sloping a ridge. It appears that portions of the bank on the upslope (north) side of the road has been excavated into the slope, evidenced by a vertical cut that ranges in height from 19 to 70 inches (0.48 to 1.8 m) above the surface of the road cut. A linear berm of sloping soil and stones is located below the road on the southern side. This berm is 16 to 52 inches (40.5 to 1.3 m) wide and 36 to 59 inches (0.9 to 1.5 m) in height. No cultural remains are present at the feature.

The **Feature D** road extends in a northerly direction from the Feature A road at approximately 700 ft elevation. This road continues in this direction for 125 ft (38 m) where it becomes indiscernible at approximately 715 ft elevation. *Figure 29* depicts a section of the Feature D road. It is 13 to 17.5 ft (4 to 5.3 m) wide and is comprised of a soil surface bordered along each side by low berms of soil and stones. These berms vary in width from 23 to 53 inches (0.58 to 1.35 m) and 4 to 28 inches (0.1 to 0.7 m) in height. The surface of the road is soil that slopes gently to the south. No cultural remains are present.

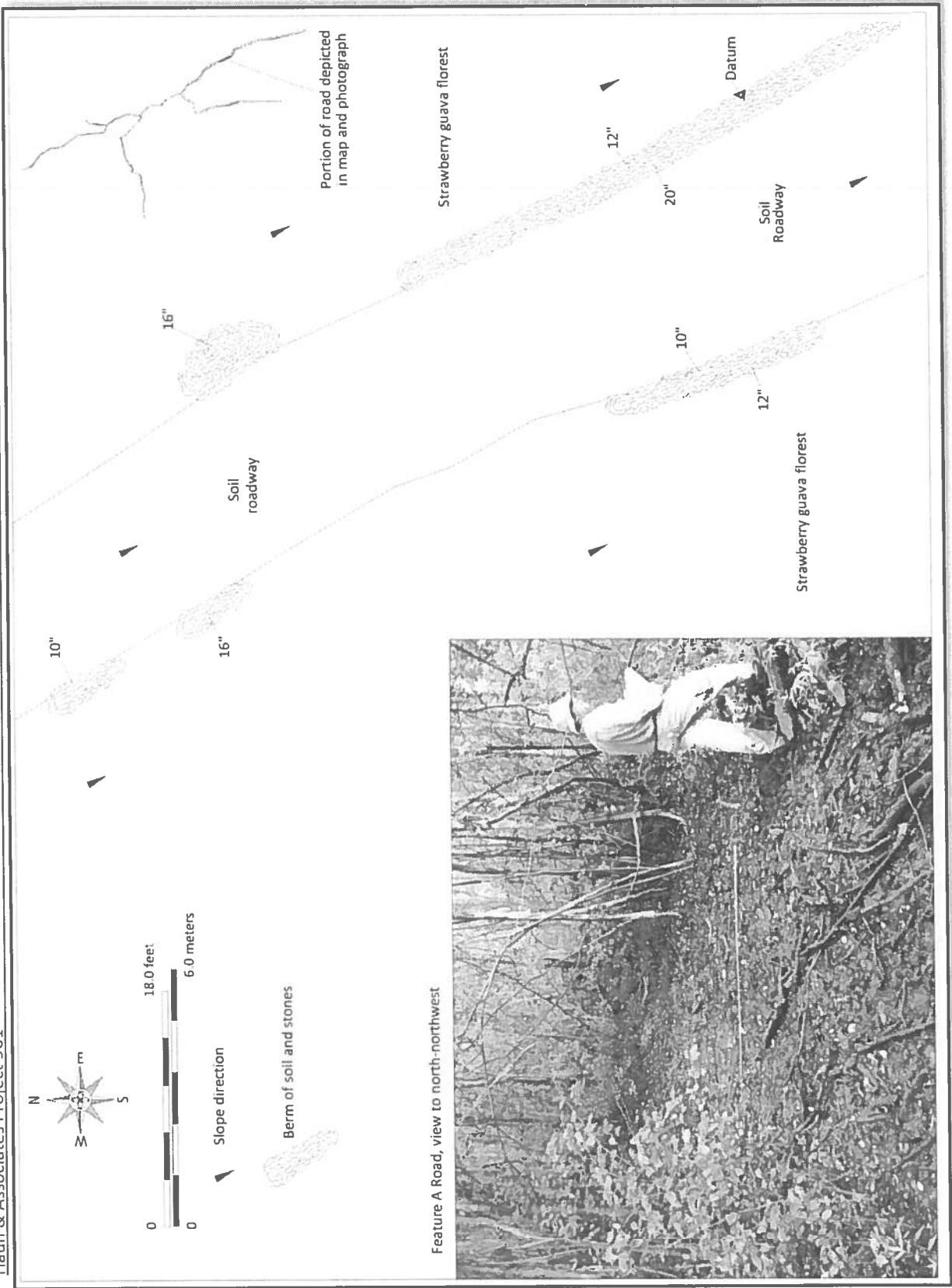


Figure 26. Site 29724, Feature A plan map and photograph

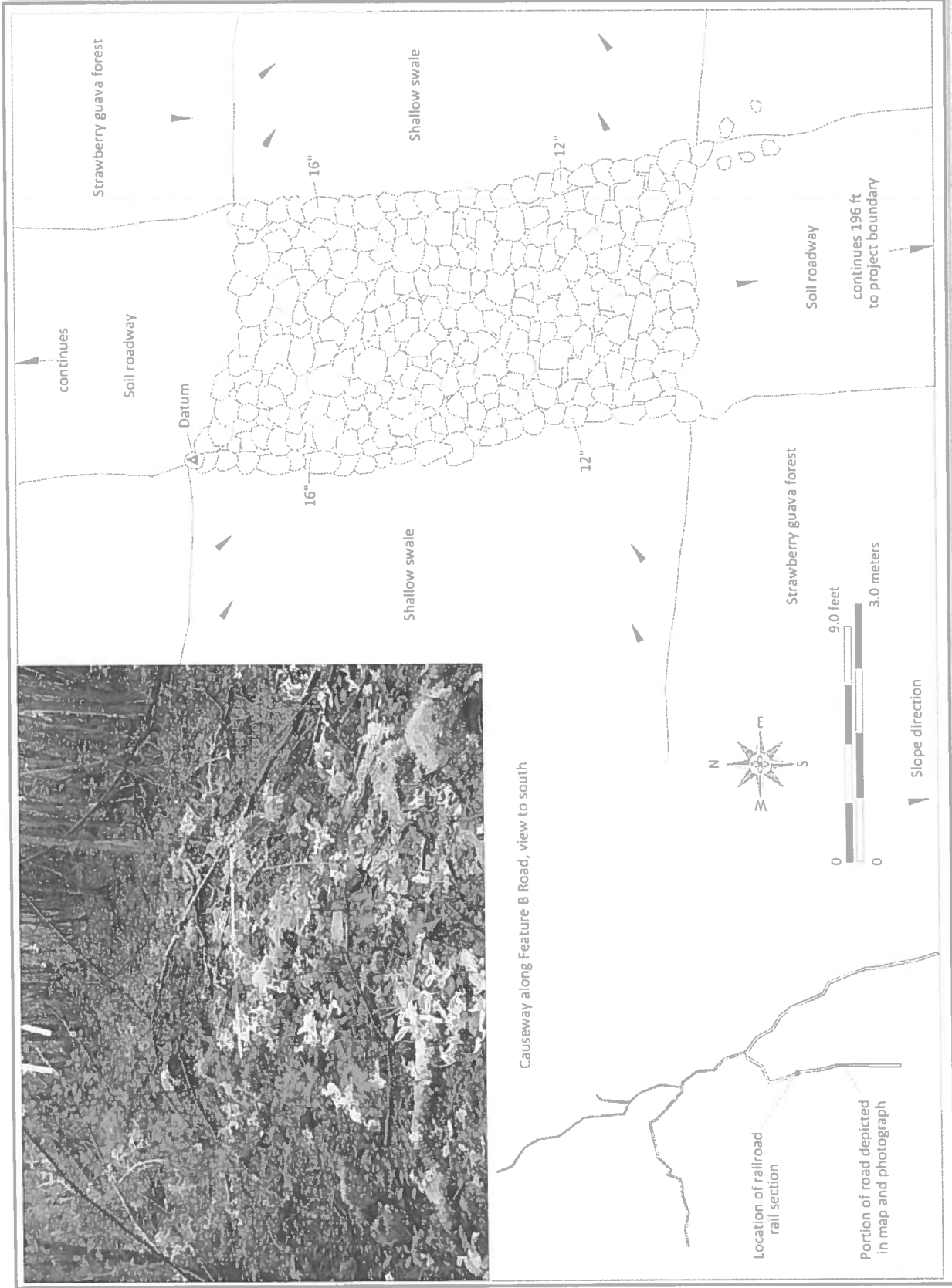


Figure 27. Site 29724, Feature B plan map and photograph

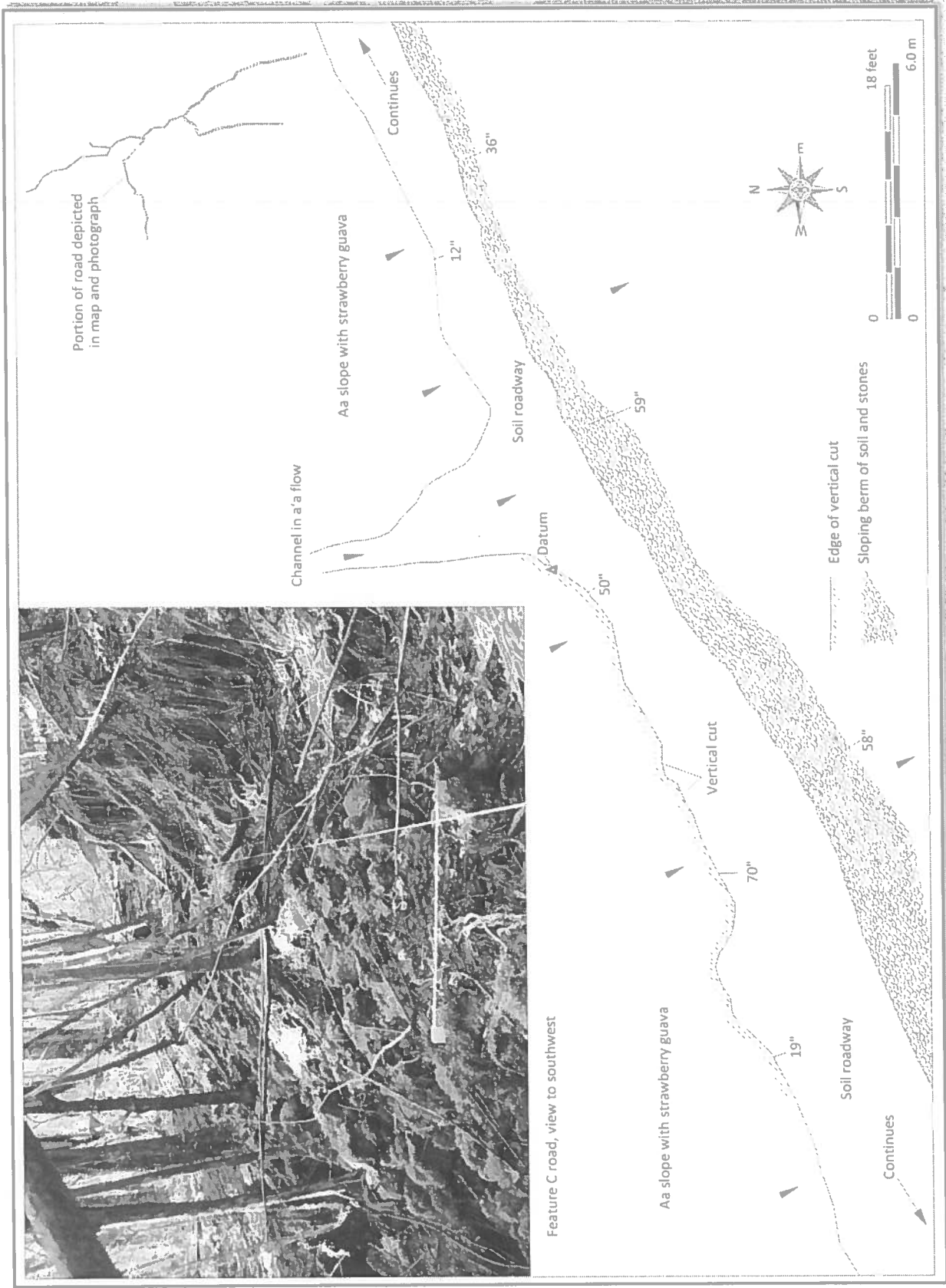


Figure 28. Site 29724, Feature C plan map and photograph

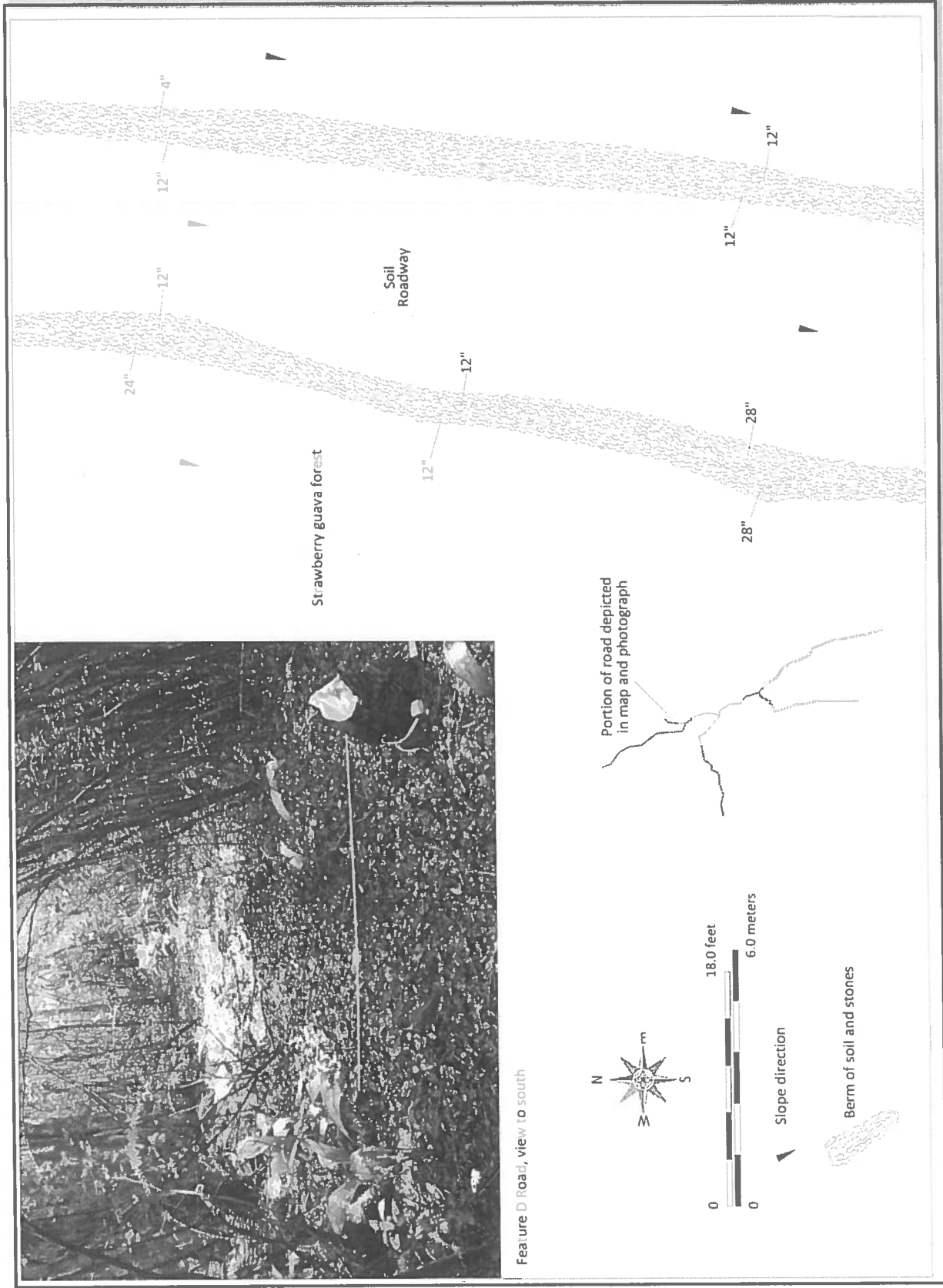


Figure 29. Site 29724, Feature D plan map and photograph

Site 29724 is interpreted as a network of historic roads features that likely functioned to transport sugarcane from the fields to the Site 29728 railroad grade (discussed below). The displaced rail noted at Feature B suggests that this road section may have been a spur line off the main rail line. The width of the Feature A, B and D roads would have been wide enough to have accommodated a truck; however, the Feature C road is only 4.5 to 11.5 ft wide, suggesting the cane may have been moved from the fields in this area to the main Feature A road in carts, or possibly a temporary railroad spur. Site 29724 is altered and in poor to fair condition. It is assessed as significant for its information content.

Site 29725

Site 29725 is a small roughly circular-shaped enclosure located in the southwestern portion of the project area at approximately 870 ft elevation. The site is situated on a small knoll with a level soil surface on the southeast side of the access road into the parcel. The enclosure is 47 ½" (1.21 m) long (east-west) and 42 ¾" (1.09 m) wide, built of stacked cobbles and small boulders that are covered in thick moss (*Figures 30 and 31*). The walls of the enclosure are one to two courses wide (7 ½ to 13" or 0.19 to 0.33 m) and two to three courses in height (11 ¾ to 17 ¾" or 0.3 to 0.45 m).

The interior of the enclosure is comprised of a thick root mat with no cultural remains present. A 1 ½" galvanized metal pipe extends vertically out of the ground in the center of the enclosure. The pipe is 3 ¾" (0.1 m) in height.

Site 29725 is interpreted as an historic survey marker base on its formal type and the presence of the vertical metal pipe. The moss accumulation on the stones suggests that the structure is historic in age. The site is unaltered, in good condition and is assessed as significant for its information content.

Site 29726

Site 29726 is a complex of two features located along the eastern project area boundary at approximately 545 ft elevation. The features consist of an enclosure with an attached ramp (Feature A) and a road (Feature B). *Figure 32* illustrates the Feature A enclosure and a portion of the Feature B road. The entire extent of Feature B is depicted in *Figure 24*.

Feature A is a U-shaped enclosure located in an area of level soil with a ramp extending from the north wall. The enclosure portion is 12' 2" long (3.7 m) and 10' 8" to 12' 2" (3.3 to 3.7 m) wide, open to the south-southwest. The walls of the feature are constructed of stacked and faced cobbles and small boulders. The walls range in width from 23" (0.57 m) to 25" (0.63 m) and slope down from north to south. The northern end of the enclosure walls are 41 to 55" (1.05 to 1.4 m) in height, tapering down to 12" (0.3 m) at the southern end (*Figure 33*). The interior of the enclosure is comprised of level soil with no cultural remains.

The ramp portion of the feature extends from the north side of the enclosure (*Figure 34*). The ramp is 9' 8" to 15' 2" long (3.0 to 4.65 m) and 7' to 8' 2" (2.15 to 2.5 m) wide. The sides of the ramp are built of stacked and faced cobbles and small boulders and the surface is roughly paved with cobbles (*Figure 35*). An 'ohia tree is growing out of the surface of the ramp in the southeastern corner. The southwest end of the ramp, adjacent to the enclosure is 49 to 51" (1.24 to 1.29 m) high. The ramp slopes down to the northwest to heights ranging from 4 to 32" (0.1 to 0.81 m). A raised outcrop is located adjacent to the northwest end of the ramp. No cultural remains are present on or adjacent to the structure.

The **Feature B** road is situated adjacent to Feature A to the east. The road is 488' (148 m), long and ranges between 500 and 530 ft elevation – see *Figure 24*). The northern end of the road terminates

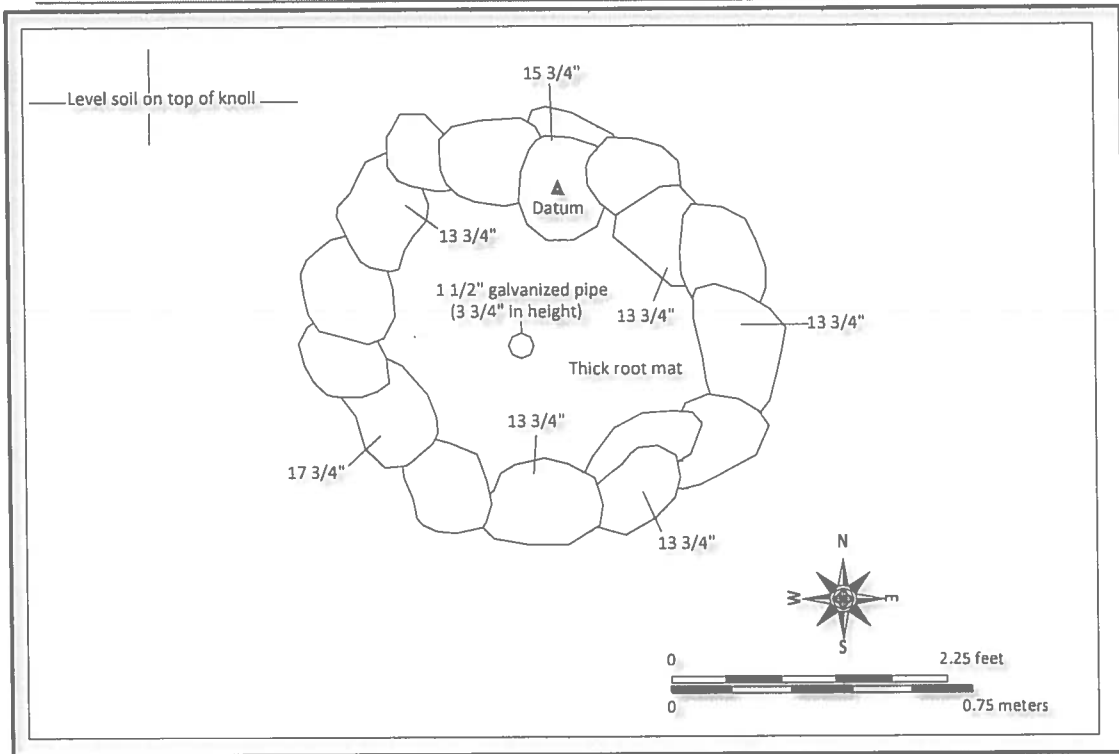


Figure 30. Site 29725 plan map



Figure 31. Site 29725 circular enclosure, view to north



Figure 33. Site 29726, enclosure portion of Feature A, view to northeast



Figure 34. Site 29726, enclosure and ramp portions of enclosure, view to southeast



Figure 35. Site 29726, ramp portion of Feature A, view to southwest



Figure 36. Site 29726, Feature B road, view to north

131 ft (40 m) to the north of the Feature A enclosure. The southern end extends outside the project area, angling to the south-southeast. The road is 10 to 13' (3.0 to 4.0 m) wide and has been excavated into the sloping terrain (*Figure 36*). The surface of the road is 55 to 59" (1.39 to 1.5m) below the surrounding ground surface. The clear glass base of a jug is present on the surface of the road directly east of Feature A. "Hilo Brewery LTD" is embossed on the base. No other cultural remains are present.

Site 29726 was probably associated with sugarcane cultivation in the project area. The Feature A structure likely functioned as a loading ramp based on its shape. The ramp was likely used to load material, potentially sugarcane onto a vehicle parked in the U-shaped enclosure. The interior width of the enclosure is only 7' 7" (2.3 m) potentially indicating that it was too narrow to accommodate a truck, and that horse drawn carts were used. The adjacent Feature B road functioned as the transportation route. It is likely that the southern portion of the road continued downhill outside the parcel, eventually intersecting the Site 29728 railroad (discussed below). The site is in fair to good condition and is unaltered. It is assessed as significant for its information content.

Site 29727

Site 29727 consists of a concrete slab located on the summit of Pu'u Kaliu in the western portion of the project area. According to the USGS quadrangle map (see *Figure 1*) the summit is 1,071 ft in elevation. The top of the *pu'u* is level and is densely vegetated with strawberry guava. The slab is 67" (1.7 m) square and 4" (0.1 m) thick (*Figure 37*). There is a trapezoidal concrete pier on top of the slab that is 16" (0.4 m) square at the base, 10" (0.25 m) square at the top and 24" (0.61 m) in height (*Figure 38*). The pier is positioned over a recessed area in the slab that is 8" (0.2 m) square and 4" deep (0.1 m) on each side.

A 2" (0.05 m) diameter metal pipe extends out of the top of the pier, attached to a 2 ½" (0.06 m) metal threaded metal flange. The pipe is 7'8" (2.4 m) in height above the flange and has a metal sign on top comprised of four rectangular fins welded to the side of the pipe (*Figure 39*). Each fin is 3' (0.92 m) long and 9 ½" (0.24 m) wide and each has seven 1 ½" holes along the sides. The upper portion of the sign and the post is painted red with the lower portion painted white. No cultural remains are present.

Site 29727 is a triangulation station that is used to track the horizontal displacement of the south flank of Kilauea over time. The Pu'u Kaliu summit has been used for this purpose since as early 1896. The Site 29727 sign has been in existence since prior to 1967 when it was found to be in good condition during an examination by the United States Geologic Survey (pers. comm. Robert Shrai, Island Survey, Inc.). The site is unaltered and in fair condition. It is assessed as significant for its information content.

Site 29728

Site 29728 is a section of abandoned railroad grade that extends through the southeastern corner of the project area, roughly paralleling the 480 ft elevation contour. The portion of the site within the project area is 787 ft (230 m) in length. It enters the parcel along the eastern project boundary and extends 626 ft (191 m) to the southwest, then curves to the south-southwest for an additional 161 ft (49 m) where it exits the project area along the southern boundary.

A 108 ft long (33 m) long section of the railroad grade is depicted in *Figure 40*. The site is comprised of the main railroad grade that is bordered along the northwest side by a raised level bench and on the southeast by a steep slope above the papaya farm. The main railroad grade is comprised of a linear, level soil area that is 28.5 ft (8.7 m) to 34 ft (10.5 m) wide (*Figure 41*). The raised level bench is 12'

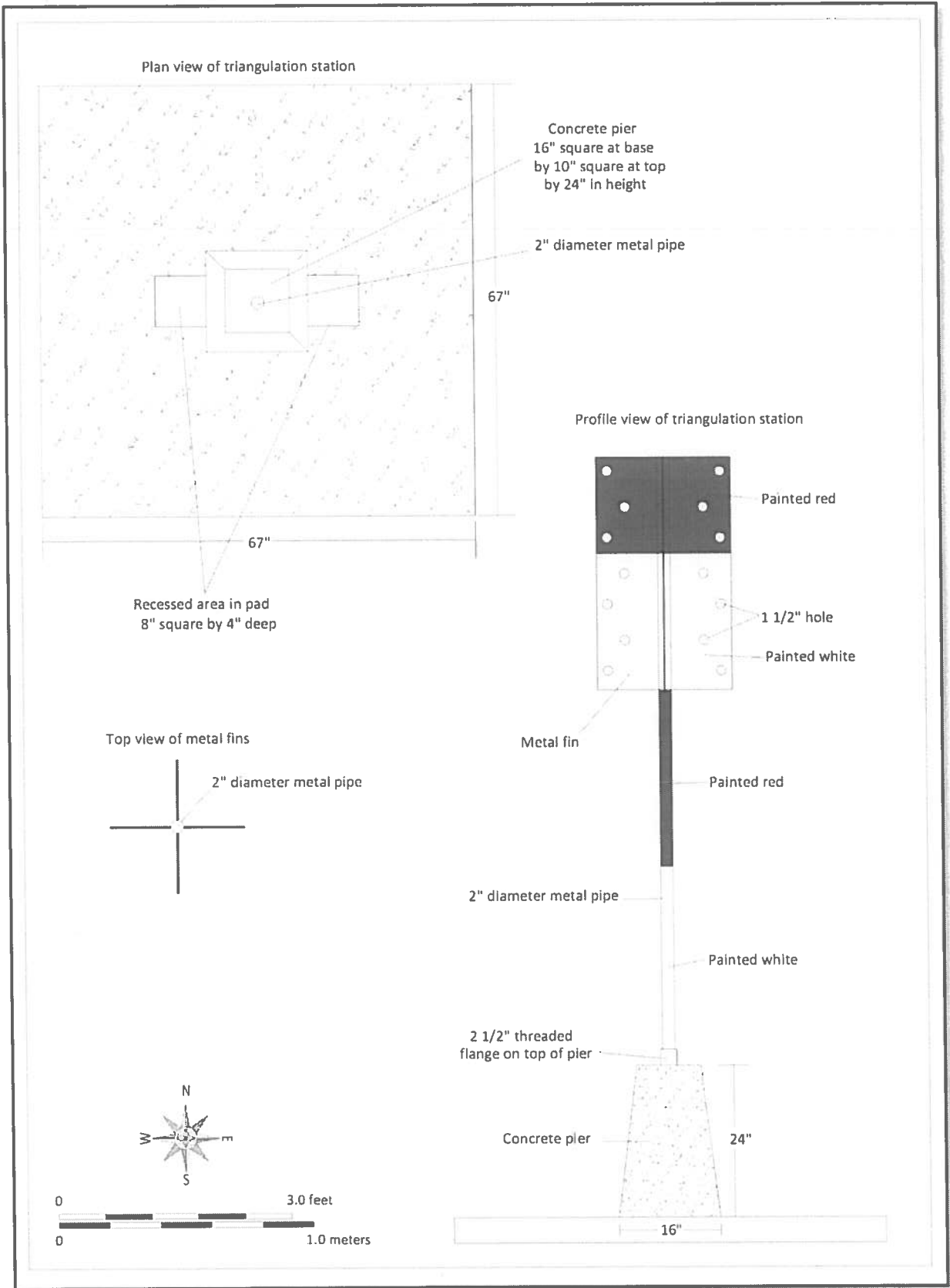


Figure 37. Site 29727 plan map



Figure 38. Site 29727, concrete slab and sign, view to north

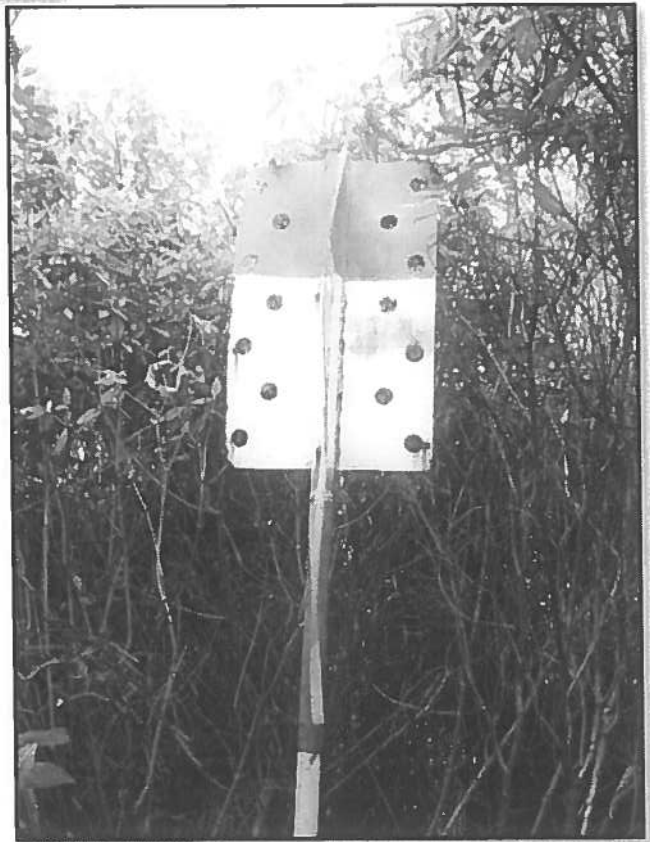


Figure 39. Site 29727, close-up of sign, view to north



Figure 41. Site 29728 railroad grade, view to east



Figure 42. Site 29728, raised bench and wooden posts, view to north

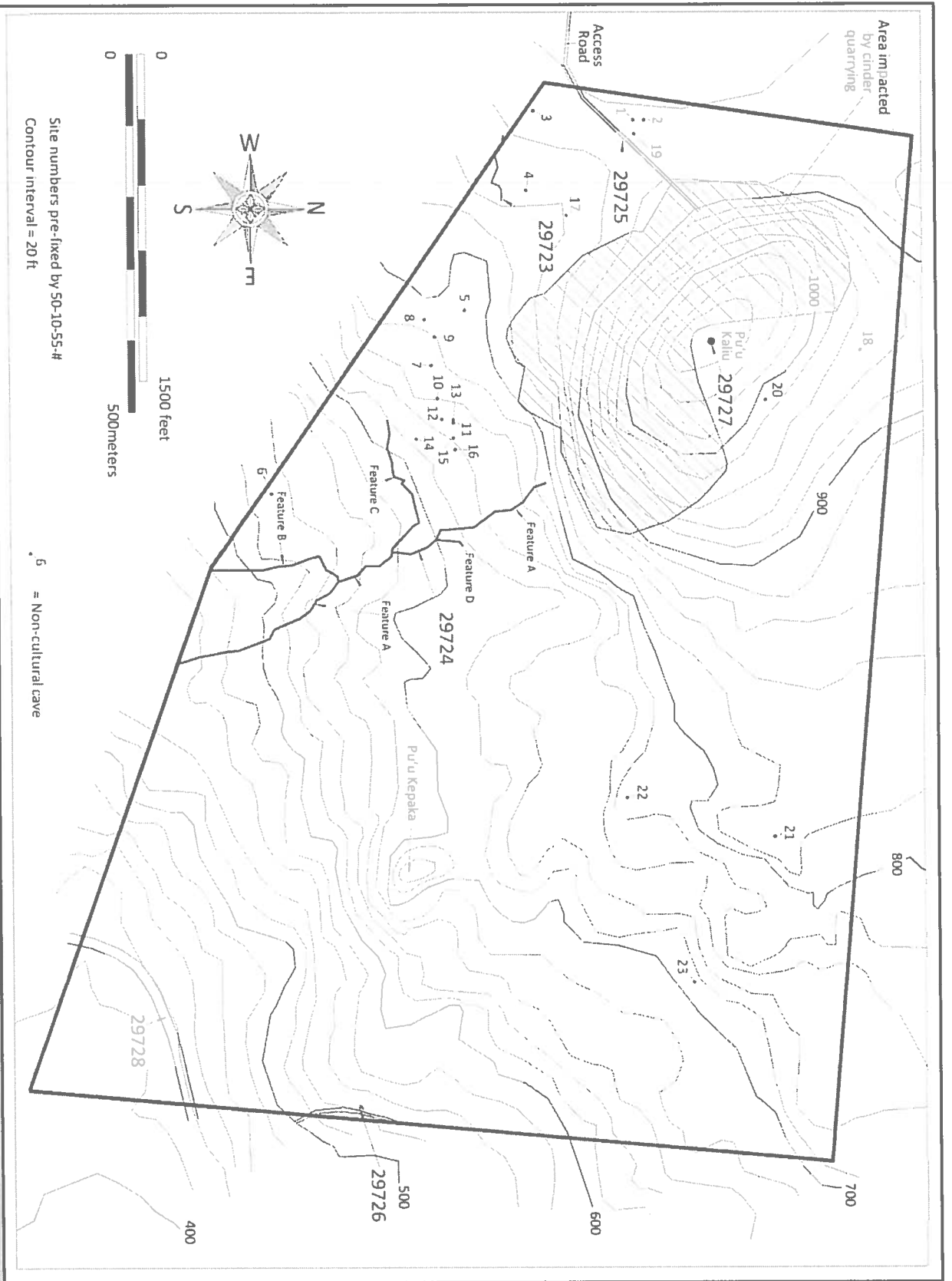


Figure 24. Site location map

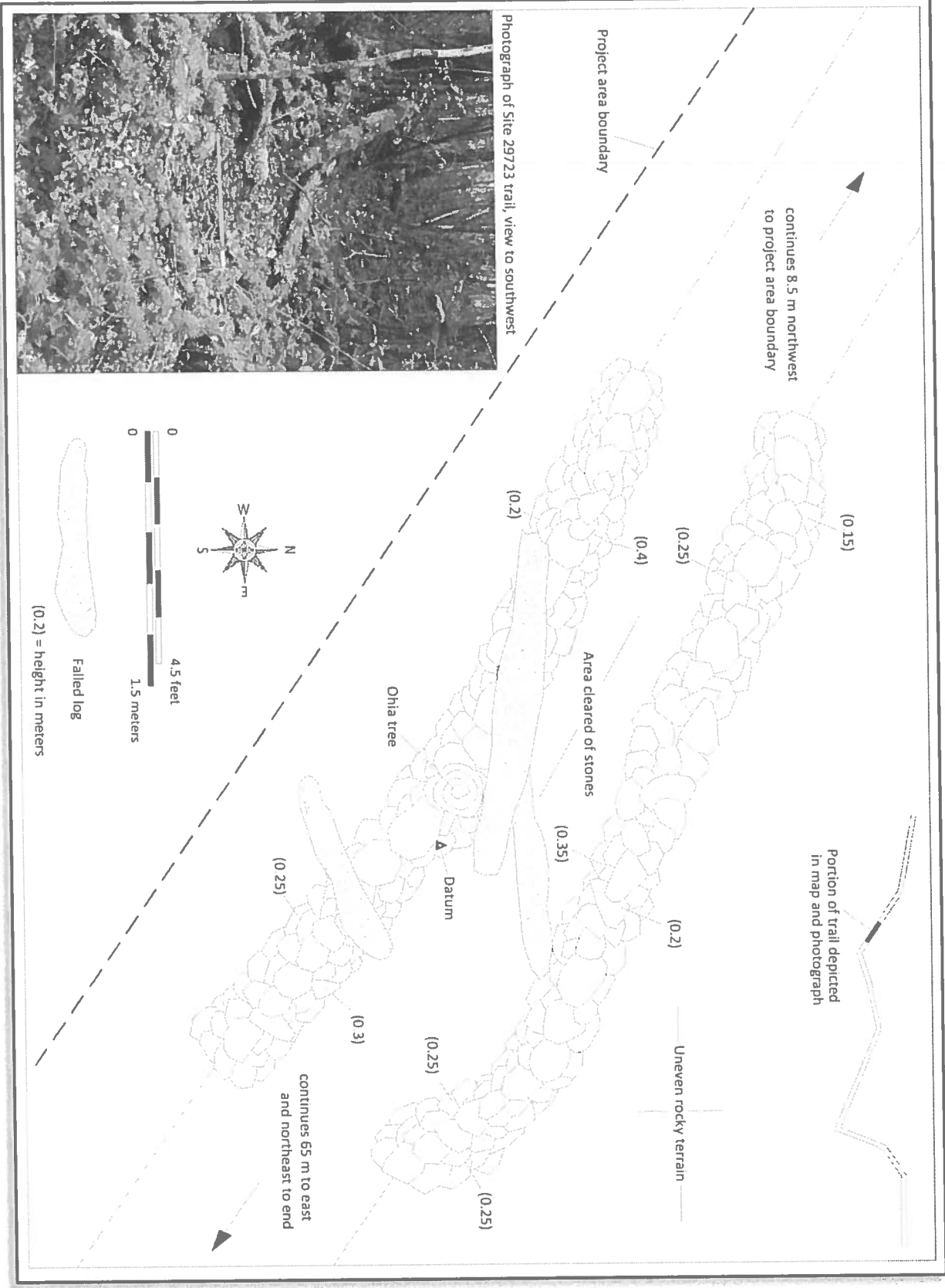


Figure 25. Site 29723 plan map and photograph

Site 29723 is interpreted as a prehistoric and historic transportation route based on its formal type, appearance and its possible association with trails on historic maps of the area. The trail is interpreted as a Type A, single file foot trail using Apples (1965) typology of trails for Honanau. According to Apple, a Type A trail was used during the pre-Contact to early Historic period prior to the abolishment of the *kapu* system, from prehistory to AD 1819. The portion of the trail within the project area is in fair condition and is unaltered, although the portion on the adjacent parcel, to the west of the project area apparently has been destroyed. It is assessed as significant for its information content and for its cultural value.

It is possible that the Site 29723 trail may represent a portion of the Kaaea Trail, listed as an ancient trail on the Loebenstein's 1895 map of the area (see *Figure 18*). The Kaaea Trail originated seaward of the project area at its southeast corner, roughly paralleling the southern boundary on the land division between Kaaea and Opihikao. According to *Figure 18*, trail terminates at the edge of the forest at the base of Pu'u Kailu. It is possible that the portion of the trail within the forest was not mapped and Site 29723 is an inland extension of it. The Site 29723 trail also roughly corresponds to a trail depicted on a 1927 map of the area (see *Figure 22*).

covered and logs have fallen over the trail in several locations. No cultural remains were observed at the site.

Non-cultural cave number	Type of feature
1	Small cave
2	Small overhang on side of fissure
3	Small cave
4	Small cave
5	Small cave in depression
6	Small cave
7	Small cave
8	Small cave in depression
9	Small cave in depression
10	Small cave in depression
11	Small cave in depression
12	Small cave in depression
13	Small cave in depression
14	Small cave in depression
15	Small cave
16	Small cave
17	Small cave
18	Small cave on side of fissure
19	Small cave on side of fissure
20	Small cave at base of fissure
21	Deep fissure with overhangs at base
22	Small cave on side of fissure
23	Small overhang on side of outcrop

Table 7. Summary of non-cultural caves

(3.65 m) to 18'6" (5.7 m) wide and is 28 to 39" in height above the surface of the main railroad grade. The raised bench is bordered on the southeast by an earthen slope with intermittent areas of a piled cobble and small boulder retaining wall (*Figure 42*). The northwestern side of the bench has been cut out of the bedrock slope. This cut varies in height from 4' (1.2 m) to 8'2" (2.49 m). No intact or displaced sections of rail or wooden ties are present and no cultural remains were observed.

There are a series of wooden posts located primarily in the portion of the site mapped in *Figure 40*. The posts are predominately 9" in diameter, two are 6" in diameter, and two are 6" by 8" rectangular posts. There is an alignment of four posts located along the southwestern side of the main railroad grade that are 4' (1.2 m) to 4'3" (1.29 m) in height and are spaced c. 22" (6.7 m) apart. The remaining posts are located on or adjacent to the raised bench. Several of the posts are positioned in a double alignment spaced 32" (0.82 m) to 36" (0.92 m) wide and 11' (3.3 m) to 15' (4.6 m) apart.

It is possible that the posts supported a fence along the southeast side of the railroad grade, used to restrict the movement of cattle. The paired posts associated with the raised bench potentially represent the remnants of a cattle chute. Longtime resident of the area, Rodney Kahaloa confirm this, stating that the wooden posts along the railroad grade were part of a cattle chute built within the past 50 years.

Site 29728 is an historic railroad grade used to transport sugarcane from the fields to the Ola'a sugar mill. This section of this rail line was constructed between 1915 and 1927 based on historic maps of the area (see *Figures 20* and *21*). The railroad grade follows the approximate path of the Kehena Trail (see *Figures 19* and *20*) potentially indicating the prehistoric transportation route was re-utilized historically. Site 29728 is unaltered and in fair condition. The site is assessed as significant for its information content.

CONCLUSION

Discussion

Historic documentary research indicates that several named trails were present in the project area vicinity. These include the Kehena Trail that extended across the southeastern corner of the area and the Kauaea Trail which entered the project area at the southeast corner and extended inland, paralleling the southern project area boundary. The Kaueleau Trail is also documented in the vicinity of the project area passing to the south of the area in the late 1800s and later, in 1927, potentially extending through the southwestern corner of the project area.

Figure 43 is a map overlaying the identified sites with trails depicted on 1895 (see *Figures 18 and 19*), 1915 (see *Figure 20*), and 1927 (see *Figures 21 and 22*) maps of the area. The Site 29728 railroad grade follows the approximate path of the Kehena Trail, indicating that this probable prehistoric to early historic transportation route was re-utilized in the early 1900s for transporting sugarcane. The trail is depicted on both the 1895 and 1915 maps; however, on the 1927 map the trail was replaced by the railroad grade indicating that the grade was constructed during the period between 1915 and 1927.

The Kauaea Trail originates seaward of the project area at a coconut grove and community labeled Kikiikii. It extends inland and enters the project area at the southeast corner, roughly paralleling the southern boundary on the land division between Kauaea and Opihikao. According to the 1895 map, the trail terminated at the edge of the forest at the base of Pu'u Kaliu. The portion of the Kauaea Trail on the 1895 map is located in an area that was altered by sugarcane cultivation and the depicted trail segment in this area was not relocated during the project.

The 1895 map also shows the Kaueleau Trail that originates in coastal Opihikao and extends inland through Kaueleau Ahupua'a. This map shows the trail continuing inland to the south of Pu'u Kaliu and the project area. The 1915 map shows a trail that likely represents the Kaueleau Trail, but it terminates along the seaward side of the Kehena Trail and does not continue inland. The 1927 map of the area depicts the same trail continuing inland beyond the former path of the Kehena Trail (current path of Site 29728 railroad grade). This trail enters the project area along the southern boundary and extends to the west, exiting the parcel at the southwest corner and continuing inland.

According to *Figure 43*, the inland end of the Kauaea Trail terminated at the southern end of the Site 29724, Feature B road. This road segment also roughly matches the route of the Kaueleau Trail on the 1927 map. This suggests that this section of road may have followed the route of a pre-existing prehistoric to early historic trail that was re-used in the early 1900s.

The Site 29723 trail may represent the inland extension of the Kauaea Trail. It is also possible that Site 29723 may be an inland portion of the Kaueleau Trail. On the 1895 map the Kaueleau Trail is depicted south of the project area within Kaueleau Ahupua'a. On the 1915 map, it terminates at the Kehena Trail; however, on the 1927 map the Kaueleau Trail appears to extend into the project area, roughly following the path of the Site 29724, Feature B road, then turning to the west and northwest, roughly following the alignment of the Site 29723 trail segment. The varying trail routes on historic maps suggest that the locations of the trails may have shifted over time, and that the inland portions of the Kaueleau and Kauaea trails may have merged in the early 1900s.

The survey confirmed that a large portion of the parcel was used for sugarcane cultivation. Sugarcane plantation agriculture in Puna began with the founding of the Ola'a Sugar Company in 1899; however, cultivation in the project area likely did not occur until between 1915 and 1927. This is indicated by the presence of the railroad grade on a 1927 map (see *Figure 21*) and its absence on the 1915 map (see *Figure 20*).

According to a longtime resident of the area, Mr. Rodney Kahaloo, sugarcane in the project area was harvested by field workers who used donkeys and carts to transport the cane to the railroad. According to Kahaloo, sugarcane cultivation ended when the railroad stopped operation. The Hawaii Sugarcane Plantation Archives records indicate that the railroad was abandoned after it was damaged by the 1946 tidal wave.

The two remaining sites documented in the project area are associated with historic land surveying. The Site 29725 enclosure functioned as a survey marker. Site 29727, which is situated on the summit of Pu'u Kaliu, functioned as a triangulation station for mapping the horizontal ground displacement of Kiluaea Volcano.

As discussed in the Methods section of this report, the project area was subjected to a variable intensity survey based the survey findings as the work progressed and as it became apparent that some areas lacked sites (see *Table 4*). Nearly half of the project area (146-acres or 47%) was subjected to a high intensity survey with the crewmembers spaced at 10 meter intervals. The disturbed quarry area (31-acres, 10%) was subjected to a low intensity survey, comprised of a non-systematic vehicular and pedestrian survey.

The remaining 132-acres (43%) were examined using a moderate intensity survey with crewmembers spaced at intervals ranging from 30 to 50 meters. These areas were either disturbed by sugarcane (57-acres) or papaya (7-acres) cultivation, located on a 1955 lava flow (7-acres), or were in the area of high canopy forest with hazardous terrain where no sites were expected based high intensity survey of adjacent portions of the same high canopy forested hazardous terrain.

According to Wolfe and Morris (2001), the high canopy forest with hazardous terrain area is characterized by lava flows that date to either 400-750 or 750 to 1,500 years ago (see *Figure 14*); however, the nature of the terrain and one historic map potentially indicate a more recent age for some lava flows in this area. The 1895 map of the project area vicinity (see *Figure 19*) indicates that much of this area, located on the "Slopes of Kaliu" was characterized as "Good coffee land" at the time the map was made. It is very unlikely that this area; which today is characterized by a very uneven ground surface with narrow ridges, deep fissures, and lava channels that is almost devoid of soil; would be suitable for coffee cultivation. These terrain characteristics and map notations potentially indicate that portions of this area were covered by lava flows post-dating 1895.

The Wolfe and Morris map was compiled using aerial photograph interpretation, radiocarbon dating, and previous data collected by Sterns and Macdonald (1946). It is possible that the dense, high canopy forest in this area obscured evidence of more recent volcanic activity. The obscuring effect of this forest vegetation is also reflected in the USGS Quadrangle topography that shows this area as characterized by nearly level to very gently sloping terrain when it is actually extremely irregular with numerous localized changes in elevation exceeding the 20 ft contour line interval on the USGS map (see *Figure 1 and 43*).

Significance Assessments

Pursuant to DLNR (2003) Chapter 13-284-6, the initial significance assessments provided herein are not final until concurrence from the DLNR has been obtained. Sites identified during the survey are assessed for significance based on the criteria outlined in the Rules Governing Procedures for Historic Preservation Review (DLNR 2003, Chapter 284). According to these rules, a site must possess integrity of location, design, setting, materials, workmanship, feeling, and association and shall meet one or more of the following criteria:

1. Criterion "a". Be associated with events that have made an important contribution to the broad patterns of our history;

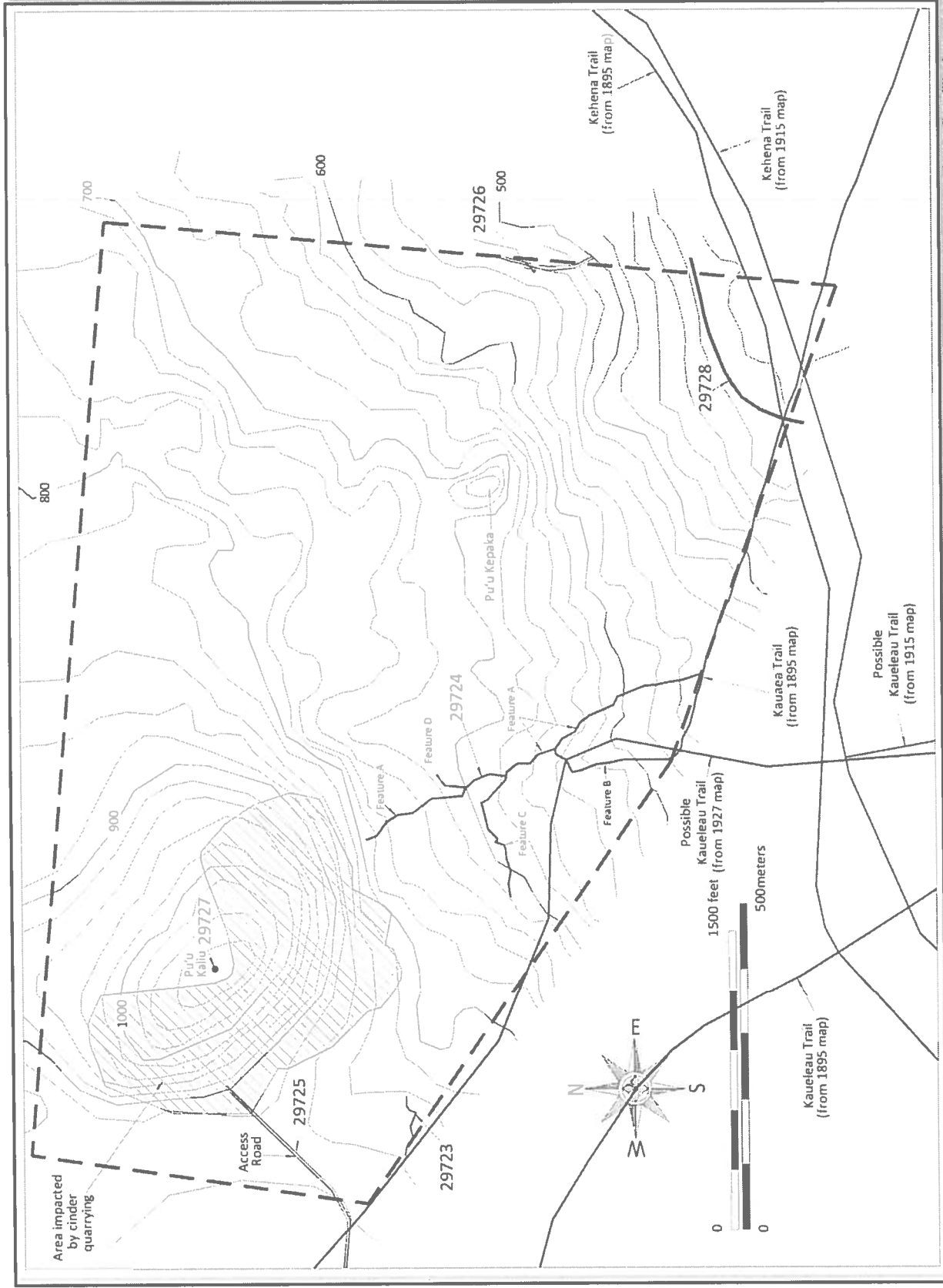


Figure 43. Site location map showing trails depicted on historic maps

2. Criterion "b". Be associated with the lives of persons important in our past;
3. Criterion "c". Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value;
4. Criterion "d". Have yielded, or is likely to yield, information important for research on prehistory or history; and
5. Criterion "e". Have an important traditional cultural value to the native Hawaiian people or to another ethnic group of the state due to associations with traditional cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts--these associations being important to the group's history and cultural identity.

Based on the above criteria, all of the sites are assessed as significant under Criterion "d". These sites have yielded information important for understanding prehistoric to historic land use in project area. The Site 29723 trail is additionally assessed as culturally significant under Criterion "e"¹ as a main, probably named trail.

Recommended Treatments

The mapping, written descriptions and photography at Sites 29724-29728 adequately document them and no further work or preservation is recommended. The Site 29723 trail is recommended for preservation. Measures to protect this site would be detailed in a Site Preservation Plan prepared for DLNR-SHPD review and approval. Consultation with the Na Ala Hele is also recommended.

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