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# Historic Sites Review of a Proposed Mauna Loa Trail System\*

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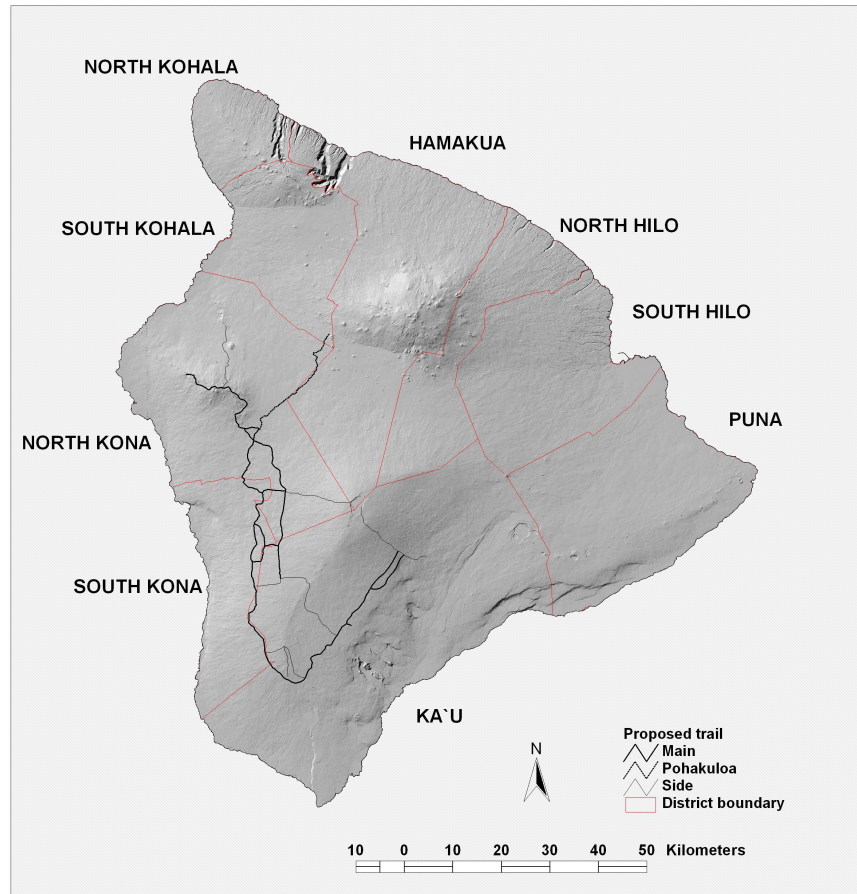
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## 1 Introduction

At the request of The Nature Conservancy, *T. S. Dye & Colleagues, Archaeologists, Inc.* has identified significant historic sites in the vicinity of a proposed trail system and has identified both the potential impacts of trail use on the cultural sites and management strategies to mitigate those impacts. The proposed trail system includes approximately 319 km of trails at high elevations on Hawai‘i Island (fig. 1). The main trail follows the southeast and northwest flanks of Mauna Loa and runs north to Hualālai. Side trails run from Hualālai to Pu‘uanahulu, to Moku‘āweoweo at the summit of Mauna Loa from the north and south, and over the southwest rift of Mauna Loa in two places. A preliminary alignment through Pōhakuloa Training Area ends near the base of the steep slopes of Mauna Kea. The system, as proposed, is located primarily in the districts of Ka‘ū and North and South Kona, but the Pōhakuloa segment extends for a short distance into Hāmākua and South Kohala districts, as well.



**Figure 1.** Location of proposed trail system.

The scope of work set out in the contract includes seven tasks:

1. Obtain and summarize available information about known and likely cultural sites along or close to the alignment of the proposed trail system, using the GIS database and library at the State Historic Preservation Division;
2. Describe known or likely patterns of use of cultural sites or areas along or near the proposed Trail System;
3. Establish and describe a likely pattern of use and settlement along or near the proposed Trail System alignment;
4. Prepare a cultural site distribution map for known or suspected sites along or close to the proposed Trail System alignment;
5. Describe the known or potential impacts of trail development on significant cultural resources;
6. Propose strategies to mitigate impacts to significant cultural resources along or in the area of the proposed Trail System; and
7. Prepare a report that includes information compiled for tasks 1–6 that can be used to assess the feasibility of the proposed Trail System, as it relates to protection and management of cultural resources.

Each task is addressed in its own section below. A review of the information sources used in the project (section 2) is followed by descriptions of the use of selected cultural sites (section 3). The sites selected for description were chosen to be representative of the activities indicated in the source materials; they serve as the basis for a general settlement pattern that posits a division of the lands along the route of the proposed trail system into various uses (section 4). A cultural site distribution map is presented in section 5. The final two sections set out the likely impacts of trail development (section 6) and propose strategies to manage and minimize them (section 7).

## 2 Sources of Information

Information about known and likely cultural sites in the vicinity of the proposed trail network is found in archaeological reports, which are the basis for locational data contained in the State Historic Preservation Division (SHPD) geographic information system (GIS), and in various historic records, primarily testimony by *kama‘āina* to the Commission of Boundaries in the late nineteenth century.

The proposed trail system is located at an elevation well above the limits of most modern archaeological surveys, which typically take place in coastal or near-coastal settings. An exception to this generalization is the Pōhakuloa Training Area, where numerous archaeological surveys have been accomplished in the last 25 years. The surveys completed before 1994, along with their historical and environmental backgrounds, have been the subjects of useful overviews (Hommon and Ahlo 1983; Streck 1992; Hammatt and Shideler 1991; Cordy 1994). Major surveys since 1994 covering

parts of PTA near the proposed trail segment include Reinman and Pantaleo (1998), Reinman and Schilz (1994), Reinman (1999), and Athens and Kaschko (1988).

The SHPD GIS captures information on site location from archaeological reports in the SHPD library. Typically, archaeological reports plot site locations on a portion of a U.S.G.S. topographic map and this representation is used by SHPD to establish site locations on a set of geo-referenced digital topographic maps. In some cases, archaeological reports present site locations on a base map other than the standard U.S.G.S. topographic map; these locations are often difficult to capture and might or might not appear in the GIS. The project accessed all Hawai'i Island site location information held in January 2005 in the SHPD GIS as point, line, and polygon shapefiles compatible with ArcView 3.2a.

Nineteenth-century testimony to the Boundary Commission by elder *kama'āina* provides useful information on cultural practices and historic sites in the vicinity of the trail system. The Boundary Commission was set up in 1862 to establish the metes and bounds of *ahupua'a* awarded to *ali'i*, *konohiki*, and foreigners during the *māhele*. Much testimony was gathered from older Hawaiians born between 1780 and 1820 with first-hand knowledge of the traditions and practices of early historic-era Hawai'i. For this study, Boundary Commission records were not reviewed directly. Instead, summaries of testimony for Keauhou 2nd *ahupua'a* in North Kona (Hammatt and Shideler 1991; Maly and Maly 2004), Kapu'a *ahupua'a* in South Kona, and Kahuku in Ka'u (Maly and Maly 2004) were consulted.

### 3 Use of Cultural Sites

This section describes known or likely patterns of use of cultural sites or areas along or near the proposed trail system. Its focus is on the sites themselves. For historic sites, information is taken from SHPD site records. For traditional Hawaiian sites, reconstruction of likely patterns of use is based on historical records of the types of activities carried out traditionally in these high elevation areas and on the remains recovered from them by archaeologists.

#### 3.1 Historic-Era Sites

Site records at SHPD contain varying amounts of information on the historic sites located near the proposed trail system. The sites include camps, lumber mills, dairies, and ranch buildings.

The Wilkes expedition camp site, site 50–10–50–5507, is an area adjacent to the east rim of the summit crater of Mauna Loa volcano, at an altitude of 13,240 feet above sea level. It consists of a surface of *pāhoehoe* lava, with piled and scattered lava boulders as evidence of rearrangement by man.

The Pu'uana'hulu Congregational church, site –7189, is a simple, rectangular, one-story, wooden church with a gently sloping gable roof. Decorative touches include two thin brackets with ornamental pendants. An entrance porch with a gable roof and a small steeple with a slightly curved roof are located on entrance end of the main

gable. North of the church are the remains of a Hawaiian homestead, sites 50–10–20–18483 through –18499, –18933 through –18935, and –19415. The sites include habitations, agricultural features, and burials, most of which belong to the historic-era. These Hawaiian homestead sites are now found within the gated community of Puu Lani Ranch.

Pu‘uwa‘awa‘a Ranch, site –, contains several buildings. The main residence is a single-story, wood structure with a modified neck-guard and hip roof. The front entrance has a pedimental bay and a long band of windows runs along entire front of the house. There are modern shingles on the walls and gable ends. Other buildings include workers’ cottages, work and storage sheds, a stone cistern, carport, and out-buildings.

The Papaloa dairy, site –7290, is a red board-and-batten structure with a corrugated iron gable roof. There is a shed roof over the front porch, which runs about three-quarters the length of the house. There are three steps of stone blocks and two entrance doors. Some *koa* was used in construction of floor. A few rock wall pens remain.

The Pauahi dairy, site –7289, consists of three houses and several pens. The lower house is a rectangular, board-and-batten structure with a gable roof. Shed roofs extend over the porch areas from the main gable. Built partially out of *koa* wood, the house has some additions. In plan, it is a duplex with two rooms and two kitchens. Each unit has its own porch supported by log posts. The upper house, built on a hill, is partially constructed of *koa*. Board-and-batten construction is present on the exterior and interior of the house, which has undergone many alterations. It has two kitchens and a front verandah. Small capital mouldings embellish some of the interior posts. The third house is a small gabled butter house built of hand-hewn *koa* boards. Pen areas meander through the complex and are basically intact.

At C. Q. Yee Hop lumber mills, site 50–10–66–7365, an old abandoned *koa* saw mill lies on the lower western slopes of Mauna Loa. The land, which is on an ancient lava flow, is covered with forests of *koa* and ‘*ōhi‘a* trees. The mill was set on a fairly level open terrace. Buildings consist of open shed-type structures. There are work shops, storage sheds, and a saddle barn nearby. Down the narrow road about a half mile is a group of dwelling facilities consisting of a main house, a cottage, and a small barn. The houses are typical one-story turn-of-the-century wood-frame buildings with the usual verandah and Victorian decoration. The abandoned ruins of an ‘*ōhi‘a* mill are located on the open forest slopes above the highway. The remains consist of rough sheds and heavy machinery. There is also a bunk house with rooms and food facilities, work sheds, storage areas, and water catchment tanks. The older of the two mills was started about 1909 by a German by the name of Bolte. In the two years before operations began, lumber was hauled uphill to the site for the construction of the mill and surrounding mill camp. It had seven employees. The ‘*ōhi‘a* mill was built in 1915. Both mills were purchased by C. Q. Yee Hop in the 1920’s. The *koa* mill closed in 1926 and the ‘*ōhi‘a* mill was closed in 1953.

The history of Pauwaena Dairy, site 50–10–38–7288, is little known. It is believed to have been built around 1850 and run by Portuguese. This is the smallest of three dairies in the vicinity. Consists of a single butter house, built of hand-hewn *koa* boards, associated pens, and a water tank.

A ranching out-station, site 50–10–38–7273, was once used by dairymen. Wooden structures served as residences for the families that worked the dairies. The houses

were used by cowboys in the 1970's. The two houses are board and batten structures resembling New England salt box roof lines.

The Kanahaha sheep station, site 50–10–38–7274, was the site of sheep station operations. The only remains consist of a portion of the large screw wool press, which was housed in an octagonal structure fitted with a catwalk, and scattered minor building fragments. The site is associated with Dr. George Trousseau, a Frenchman who was port physician of Honolulu and served on the Board of Health for Kalākaua and Lunalilo. He ranched sheep here for about three years, after which he sold his ranch to H. N. Greenwell for \$30,000.00.

The Trousseau road, site –7269, runs from Kainaliu to Pu‘ulehua. It was approximately nine miles long and is still visible. Sections of the unpaved road are flanked by lava rock walls approximately 3 ft. tall. The uphill road runs to an elevation of approximately 4,900 ft.

### 3.2 Traditional Hawaiian Sites

Boundary commission testimony for Keauhou 2nd *ahupua‘a* contains some of the best information on late eighteenth and nineteenth century uses of high elevation areas on Hawai‘i Island (Hammatt and Shideler 1991:54 ff.). The testimony by elderly *kama‘āina* clearly distinguishes the forested lands from those above the forest line. Within the forest are noted the homes or temporary camps of canoe makers and bird feather collectors. These are specifically noted at elevations as high as 5,500 ft., well within the 5 km buffer for the proposed trail. The available records do not identify any substantial construction that might have taken place at these temporary camps, however. Above the forest line, the primary traditional Hawaiian resources appear to have been ‘*ua‘u* and *nēnē* birds. These resources were actively managed and “[b]oundary disputes . . . were common in the interior with men of one district killing men of other districts ‘for stealing food’” (Hammatt and Shideler 1991:34). By the time boundary commission testimony was collected in the 1870's the area was used by goat and bullock catchers, as well. Maly and Maly (2004:152) dates this shift in the resources of the lands above the forest line to c. 1815, and attributes it first to the demands of landlords and later to the operation of large-scale ranches.

The widespread historic-era use of high elevation areas on Hawai‘i Island, primarily for cattle ranching, has made it difficult for archaeologists to reconstruct the traditional Hawaiian trails there. The problem is being able to determine the age of a modern trail—is it new, or was it laid out over an existing trail? This problem is compounded somewhat by the lack of a detailed record of trails and by the nature of the trails themselves; over rough ‘*a‘ā* lava a definite route is often marked, but over *pāhoehoe*, which is easily traversed, the “trail” might be poorly marked, if at all, and hikers could have walked anywhere within a wide corridor.<sup>1</sup> Two precisely located trails managed by Nā Ala Hele fall within the proposed trail system. The ‘Ainapō trail forms part of the proposed trail system, running up the southeast flank of Mauna Loa to the summit.

<sup>1</sup>The difficulty of fixing precise locations in remote areas complicated archaeological efforts to record trails before the advent of the geographic positioning system. An example of this is trail site –19528 which might have been recorded and incorrectly located earlier as site –5006, the Nā‘ōhule‘elua curbstone trail (Reinman and Pantaleo 1998:101).

The Mauna Kea Hunters' Road meets the northern end of the Bobcat Trail at the Saddle Road and runs around the mountain. General routes known to have been used in traditional Hawaiian times follow generally along the paths of modern trails. A trail from Waimea to Kona passed by Ahu a 'Umi *heiau* (Cordy 2000:48) and, as described, appears to have followed Bobcat Trail along the Hāmākua boundary, then the Judd trail down the slopes to coastal Kona. A trail called Alanui o 'Umi, or 'Umi's Road, ran over the southwest rift of Mauna Loa from Ka'ū and followed the approximate path of the upper main trail on its way to Ahu a 'Umi *heiau* (Cordy 2000:212).

Most of the archaeological sites known from high elevations on Hawai'i Island are located above the forest line in lava tube caves, overhang shelters, or lava blisters that afford some measure of protection from the elements. Sites on the surface are limited primarily to small cairns and volcanic glass quarries, where a surface layer of glassy lava provided material for small cutting tools apparently used in food preparation and perhaps other tasks. Three exceptions to this generalization are: Ahu a 'Umi, an unusual and important *heiau* located directly along the path of the proposed trail system; a low platform reported by Haun (1986) as feature T-101E; and a platform at an elevation of 6,920 ft. reported by the geologist Jack Lockwood. Hammatt and Shideler (1991:42) believe these latter two platforms are district boundary markers. Ahu a 'Umi *heiau* traditionally commemorates the political unification of the island by 'Umi.

The archaeological record for areas along or near the proposed trail system comes primarily from the Army's Pōhakuloa Training Area. Sites investigated here provide strong evidential support for the traditional Hawaiian practice of hunting 'ua'u and *nēnē* above the forest line. In an early excavation of one of the largest and best-used of the inland sites discovered so far, Haun (1986) determined that the Bobcat trail habitation cave was used repeatedly during the last 400 years of Hawaiian prehistory for short stays by small groups of people who lived at the coast. The cave offered several commodious living spaces along a large lava tube with at least five entrances. Hawaiians who visited the cave wore sandals of plaited *lau hala* leaves, clothes of tapa cloth, and probably *kī* leaf capes to protect them from the rain and cold. Some of their belongings were carried in plaited bags. Water was carried and collected in gourd containers, pieces of which were numerous in the cave. Fires were started with a traditional Hawaiian fire plow. Food brought to the cave from the coast—*kalo*, banana, coconut, and sugar cane, along with a bit of fish, 'ōpihi, sea urchin, and crustacean—made up a small part of the diet. The bulk of the diet consisted of 'ua'u, supplemented by *nēnē*. The birds were cooked with the aid of stones, *pōhaku eho manu*. According to J. S. Emerson,

[t]he stone was heated red hot and inserted in the interior of the bird to be cooked. Bird and stone were then wrapped in suitable leaves and covered with earth to steam in its own juice. This saved the use of water which was often a scarce article on the southern and western slopes of the mountains of Hawaii (Summers 1999:2).

Eight stones that fit the description of *pōhaku eho manu* were recovered from the cave, but were identified as pestles (Haun 1986:80). Volcanic glass collected locally and brought to the cave was likely used as a knife in the preparation of food.

Aside from catching, cooking, and eating birds, the inhabitants of the cave appear to have spent much of their time working wood with stone adzes. Most of the items fashioned by the wood workers were removed from the cave, perhaps taken back to the coast for use there. One finished adze handle was left behind; *māmane*, which provided a preferred wood for adze handles, is common around the cave.

A variety of other smaller caves, overhangs, and lava blisters near the trail system also provided temporary shelter for bird catchers. These sites contain a restricted range of the same types of materials recovered at the Bobcat trail habitation cave, usually in small amounts. Some of them show a bit of structural modification in the form of low walls, terraces, and hearths, but others were used without modification. The bones of 'ua'u and *nēnē* make up the bulk of remains at many of these sites.

It is likely that most visits to the Bobcat trail habitation site, and to others in the region, were made in the late summer or early fall, when 'ua'u and *nēnē* would have been most abundant.

Archaeological evidence for the capture of perching birds prized in traditional Hawai'i for their brightly-colored features is less abundant than evidence for the hunting of meat birds. Evidence for this practice was collected by Athens et al. (1991) from several small cave shelters located in an area with a relatively thick *naio-māmane* forest. Most of these sites were used after A.D. 1400 and are located less than 5 km from the proposed trail system. The shelters were all smaller than the Bobcat trail habitation cave and each of them yielded evidence for temporary use of short duration and intensity. Athens et al. (1991) was able to find evidence of perching birds by passing the archaeological sediments through extremely fine-meshed sieves to retrieve small bones. This procedure yielded more than 200 bones of perching birds, including three—the 'akialoa, 'apapane, and 'amakihi—prized for their feathers. These were found with the more common bones of 'ua'u and *nēnē*, along with several other birds, including two extinct Hawaiian rails in the genus *Porzana*.

Other types of traditional Hawaiian site found along or near the proposed trail system include portions of several trails and human burials. Human bones were found in the Bobcat Trail habitation cave and a human burial was exposed in the cinder road leading to the top of Pu'u Ahumoa in 1990. Although high-elevation burial sites were valued in traditional Hawai'i, they do not seem to have been plentiful in the portions of the trail system that have been surveyed archaeologically.

## 4 Settlement Pattern

Archaeological survey in the vicinity of the proposed trail network has taken place primarily in sub-alpine forests and shrub-lands, above the montane forests of 'ōhi'a and *koa* exploited by canoe builders and bird catchers. The montane forests traversed by the proposed trail system are virtually *terra incognita* for archaeologists.

It was once thought that relatively few traditional Hawaiian sites would be found in the sub-alpine forests and shrub lands because harsh environmental conditions would have limited traditional activities there. Archaeological survey in the Pōhakuloa Training Area has shown that evidence of traditional Hawaiian activity is in fact quite plentiful. Large areas of sub-alpine forests and shrub-lands on Mauna Loa have not been sur-



vayed for archaeological sites. Archaeologists who have traveled these parts of Mauna Loa report an archaeological landscape rich in sites and it is not unreasonable to expect that site densities similar to the Pōhakuloa Training Area will be found elsewhere on Mauna Loa as well.

Two factors appear to be dominant in the determination of site locations; the presence of natural shelters, such as caves, overhangs, and lava blisters, and proximity to resources. The most important resources appear to be nesting grounds of the meat birds ‘ua‘u and *nēnē*, forests inhabited by perching birds prized for their feathers, and stands of *māmane* trees suitable for woodworking.

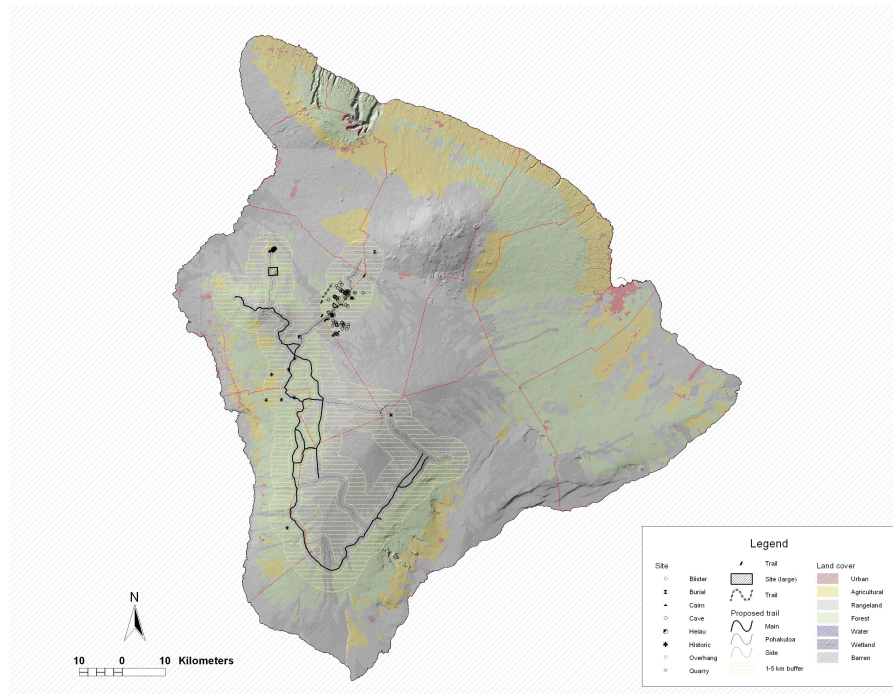
Hammatt and Shideler (1991:78) found that, for the Pōhakuloa Training Area, sites are most densely distributed on lava more than about 2,000 years old and are less often found on younger flows. Presumably, the more heavily vegetated older flows were attractive to birds and would have provided larger stands of *māmane*. It wasn't possible to plot the proposed trail on ArcView coverages of the geologic map for Hawai'i Island (Wolfe and Morris 1996), because these are not yet available. An inspection of the geologic map shows, however, that the proposed trail mostly crosses lava flows less than 2,000 years old. The k1 units of the geologic maps, which represent Mauna Loa lava flows 3,000–10,000 years old, are relatively rare along and near the proposed trail network, found primarily at the southern end of the North Kona district, along its boundary with South Kona. The k2 units, representing lava flows 1,500–3,000 years old, are more widespread and are found on both sides of Mauna Loa. Flows of *pāhoehoe* lava appear to have been preferred over ‘a‘ā flows at these elevations. *Pāhoehoe* flows with abundant lava tubes seem to have been especially favored, owing to the ready availability of shelter.

A third factor influencing the location of archaeological sites, probably less important than the other two, is the location of district boundaries. Boundary commission testimony for the *ahupua‘a* of Keauhou 2nd in North Kona (summarized by Hammatt and Shideler 1991:55 ff.), Kapu‘a *ahupua‘a* in South Kona, and Kahuku *ahupua‘a* of Ka‘ū (Maly and Maly 2004) indicate that land boundaries in areas above the forest line were actively contested because they established rights of access to ‘ua‘u and *nēnē* that nested there. The people of Ka‘ohe *ahupua‘a* marked the western boundary of their land with stone constructions (Hammatt and Shideler 1991:41). It is not known if this was a general pattern, and the archaeological evidence supporting it is still poorly developed. The suggestion that it is a general pattern is plausible and might prove a useful predictor of surface site location along or near the proposed trail.

## 5 Site Distribution Map

The distribution of historic sites along or near the proposed trail system is shown in figure 2. Figure 3 is a close-up of the Pōhakuloa section of the trail system. This map was created in ArcView software using the Universal Transverse Mercator (UTM) zone 4 projection based on the 1983 North American Datum (NAD83). The base map for the figure is a shaded relief model of the Hawai'i island available from the state department of business, economic development, and tourism (DBEDT) as *hillhaw.sid*. Colors representing land use and land cover as of 1976 have been added to the shaded relief

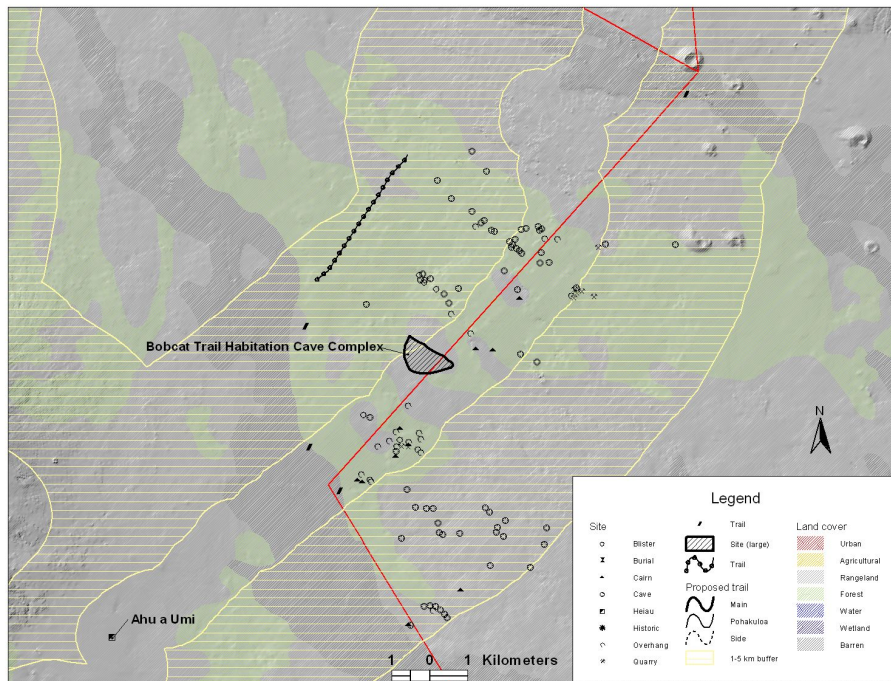
model; these were derived from another DBEDT file, `lulc.shp`. The land use and land cover data provide a fairly coarse-grained overview because the data were classified at the most general level; local variations from the plotted distributions are to be expected. Most usefully, the land use and land cover data do indicate the *mauka* edge of the forest line and its relationship to the proposed trail system. District boundaries were derived from the DBEDT file `judicial.shp`, which was transformed from a coverage based on the Old Hawaiian datum using an ArcView extension called Hawaiian Datums and Projections written by Richard Stone.



**Figure 2.** Locations of historic sites, showing 1 km and 5 km buffers around the proposed trail system.

The locations of the proposed main and side trails was provided by Rob Shallenberger in ArcView shapefile format. Shallenberger provided the location of the Pōhaku-Loa segment as a line drawn on a 1:50000 scale topographic map of the Pōhaku-Loa Training Area. This line was digitized in ArcView against the background of a U.S.G.S. topographic map using the contour lines, which are identical on the two maps, as guides.

Historic site locations were derived from ArcView shapefiles kindly provided by Eric Komori at SHPD and from archaeological reports. Site locations from Reinman and Pantaleo (1998:table 3) were converted from a table of latitudes and longitudes; locations from the other reports (Reinman and Schilz 1994; Reinman and Pantaleo



**Figure 3.** Historic sites in the archaeologically surveyed areas along or near the Pōhakuloa trail section.

1998; Reinman 1999) were digitized from plots of sites on copies of U.S.G.S. topographic maps. The site locations are provided in three coverages, one each for points, lines, and polygons. The shapefiles for these coverages are `all_pt_n83_6.shp`, `all_ln_n83.shp`, and `site_py_1km.shp`, respectively. Buffers at 1 km and 5 km from the proposed trail system were generated using facilities present in ArcView. These buffers are provided as an ArcView shapefile, `donut-buffers.shp`.

Known historic sites within 1 km and 5 km of the proposed trail are listed in appendices A and B. Most of these sites are not labeled with site numbers on figures 2 and 3 because the concentration of sites recorded along the Pōhakuloa section of the trail is too dense. It is anticipated that this information will be accessed primarily through the GIS, using the shapefiles provided with this report.

## 6 Impacts of Trail Development

Development of the trail network will have both positive and negative impacts. On the positive side, the trail will provide access to a range of interesting and important historic sites for the enjoyment and interest of hikers. Most of these sites have previously been

very difficult to access. The trail network has the potential to contribute substantially to the SHPD's mission of using historic sites for the education, inspiration, pleasure, and enrichment of the state's citizens. Sites can also be an attractive nuisance, dangerous for the inexperienced or naive visitor. Rock walls can collapse underneath or on top of someone who chooses to climb on them. Entrances to lava tube caves can have substantial drops, with a potential for injury during a fall.

The negative impacts of trail development on historic sites follow directly from the increased access the trails will provide for visitors. It is assumed that the trail can be routed around known sites and that sites discovered before or during trail construction will be small, similar to most of those that are known, so that the trail can be routed around these, as well. Flexibility in the positioning of the trail on the local landscape should suffice to limit or eliminate any direct negative effects of trail construction.

The indirect negative effects of increased access vary according to site type, but can be serious. Traditional Hawaiian cave sites over a large portion of Hawai'i Island have been systematically looted for their artifacts over the last 40 years. The high elevation cave sites that make up the bulk of known sites along or near the proposed trail system often preserve a wide variety of normally perishable artifacts, many of which would be attractive to looters. These sites, with their shallow deposits rich in bird bones and other fragile evidence of past activities, can even be disturbed by the well-intentioned, but uninformed visitor. Human remains, although apparently not plentiful along or near the trail, are found in caves and buried in cinder deposits. These sites are considered sacred and their disturbance by any kind of development is certain to elicit a strong protest from the local community.

Although traditional Hawaiian surface architecture is relatively rare along or near the proposed trail system, the architectural sites that are known are interesting and important. Ahu a 'Umi *heiau* is an unusual structure with an important history. The platforms that possibly mark district boundaries clearly deserve additional study. The primary problem of increased access is that visitors hasten the deterioration of the dry stone masonry by climbing over walls and on top of platforms. Direct acts of vandalism at these sites would not be expected, however, given the relative difficulty of hiking long distances to visit them.

The historic-era sites generally contain a mix of wooden structures and dry stone masonry walls. The likely effects of increased access will, in the main, be similar to those at the traditional Hawaiian surface architectural sites. Several of the house structures were built of *koa* planks and, depending on their condition, these might be considered valuable by thieves. The remote locations of the sites would probably deter thieves from using the proposed trail system to transport *koa* planks, however.

## 7 Mitigative Strategies

The most effective mitigative strategies minimize the negative effects of increased access by maximizing responsible enjoyment of sites through a program of information and education. Coupled with a program to monitor changes in the integrity of sites over time, there is good reason to believe that the net effect of the trail system on historic sites will be positive. Sites with human remains are an exception to this general strat-

egy. For these sites mitigation should re-route the trail system so that its construction and use do not increase access to these sites. In cases of cave burials that cannot be avoided by the trail system, the cave entrance can be blocked with one or more stone walls.

The first step in mitigative strategy at sites without human remains close to the proposed trail is to make a record of the current condition. Large sections of the trail system have not been surveyed for historic sites and this will have to be accomplished prior to its use. The survey should be designed to find the sites most likely to be accessed by hikers and, in our opinion, need not expend the considerable effort needed to search for the remains of temporary canoe-builder camps in heavily overgrown forests. Rather, the survey would concentrate on the more easily accessible, open areas where hikers might be expected to stray from the trail. The survey could be further stratified by concentrating on older substrates, with relatively less effort given to the search for sites on younger lava flows.

At the historic-era sites, a standard photographic record of the structural remains would likely be sufficient to record current condition. Photographs would provide a permanent record of the architectural features of interest, as well, something that appears to be lacking in the SHPD files. Ahu a 'Umi was mapped in 1841 by the Wilkes expedition before it was made into a goat corral (Baker 1916). Portions of the original *heiau* remain, and a plane-table map of the site, drawn at a scale of 1:100, would provide a permanent record of the site's condition prior to trail construction. The cave sites along the Pōhakuloa trail segment have all been recorded at a suitable level of detail. The reports of this work might serve as a guide for recording newly discovered sites elsewhere along the trail system.

Several sites along the trail should be identified with signs that identify the site, outline its history, and provide guidelines for its responsible use by hikers. Historic-era sites along the currently proposed route that would benefit from interpretive signs include the Wilkes Expedition camp site, Papaloa Dairy, Kanahaha Sheep Station, and Trousseau Road. Other historic-era sites within 1 km of the proposed trail system include Pu'uwa'awa'a Ranch and the Pu'uana'hulu Congregational Church. Neither of these sites will be adversely affected by construction of the trail network. The two most prominent traditional Hawaiian sites along the route of the proposed trail network are Ahu a 'Umi *heiau* and the Bobcat Trail Habitation Cave complex. Both of these sites need interpretive signs, and the human bones within the habitation cave will need to be secured.

A reasonable strategy for the smaller cave, overhang, and blister sites along the Pōhakuloa section would be to not draw attention to them. Many of them are modest features that wouldn't be found by the average hiker. They could be preserved "as is" by avoidance.

A regular program of site inspection would document changes in site condition by comparing the sites with maps and photographs. Changes would be noted and their causes determined. Changes attributable to increased access would be reviewed by SHPD and revisions to the mitigative strategy implemented as appropriate. Initially, this program might require annual visits, but the frequency could be adjusted depending on the nature and extent of recorded changes.

Any proposed mitigative strategy for sites along the Pōhakuloa section of the trail should be worked out in conjunction with cultural resource managers at the Pōhakuloa

Training Area. The investigation of cultural sites is relatively advanced there. Mitigative strategies developed at the Pōhakuloa Training Area might be applicable elsewhere within the proposed trail system.

## A Historic Sites Within 1 Km of the Proposed Trail System

Site	Form	Name	Source
3810	<i>Heiau</i>	Ahu a 'Umi	Site Quad
5005	Cave	Bobcat Trail Shelter Cave	Haun (1986)
5007	Trail	Nā'ōhule'elua Trail	Cordy (1994)
5008	Trail	Nā'ōhule'elua Foot Trail	Cordy (1994)
5507	Historic	Wilkes campsite	SHPD site records
7189	Historic	Pu'uana'hulu Congregational Church	SHPD site records
7190	Historic	Pu'uwa'awa'a Ranch	SHPD site records
7269	Historic	Trousseau Road	SHPD site records
7274	Historic	Kanahaha Sheep Station site	SHPD site records
7290	Historic	Papaloa Dairy	SHPD site records
10265	Cave		Reinman (1999)
10265	Cave		Reinman (1999)
17117	Cairn		Reinman (1999)
17118	Cairn		Reinman (1999)
17124	Cairn		Reinman (1999)
17127	Overhang		Reinman (1999)
17128	Overhang		Reinman (1999)
17129	Overhang		Reinman (1999)
17130	Cairn		Reinman (1999)
17131	Overhang		Reinman (1999)
17132	Overhang		Reinman (1999)
17133	Cave		Reinman (1999)
17134	Overhang		Reinman (1999)
17135	Overhang		Reinman (1999)
17136	Blister		Reinman (1999)
17137	Quarry		Reinman (1999)
17138	Cairn		Reinman (1999)
17143	Quarry		Reinman (1999)
17144	Overhang		Reinman (1999)
17145	Overhang		Reinman (1999)
17147	Cairn		Reinman (1999)
17148	Overhang		Reinman (1999)
17149	Overhang		Reinman (1999)
17150	Blister		Reinman (1999)
17151	Cave		Reinman (1999)
17153	Cairn		Reinman (1999)
17154	Overhang		Reinman (1999)
17155	Cave		Reinman (1999)
17157	Overhang		Reinman (1999)
17159	Cairn		Reinman (1999)
17161	Overhang		Reinman (1999)
17163	Cave		Reinman (1999)
17166	Quarry		Reinman (1999)
19491	Cave		Reinman and Pantaleo (1998)
19492 N	Cave		Reinman and Pantaleo (1998)
19492 S	Cave		Reinman and Pantaleo (1998)
19493	Overhang		Reinman and Pantaleo (1998)
19494	Overhang		Reinman and Pantaleo (1998)
19495	Cave		Reinman and Pantaleo (1998)
19496	Cave		Reinman and Pantaleo (1998)

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Site	Form	Name	Source
19497	Cave		Reinman and Pantaleo (1998)
19498	Cave		Reinman and Pantaleo (1998)
19499	Cave		Reinman and Pantaleo (1998)
19500	Cave		Reinman and Pantaleo (1998)
19503	Cave		Reinman and Pantaleo (1998)
19505	Cave		Reinman and Pantaleo (1998)
19510	Quarry		Reinman and Pantaleo (1998)
19511	Cave		Reinman and Pantaleo (1998)
19520	Overhang		Reinman and Pantaleo (1998)
19527	Cave		Reinman and Pantaleo (1998)



## B Historic Sites Within 5 Km of the Proposed Trail System

Site	Form	Name	Source
05000	Cave	Na Pu'u Kulua Shelter Cave	Cordy (1994)
05006	Trail	Nā'ōhuele'elua Curbstone Trail	Cordy (1994)
05009	Trail	Pu'u Ka Pele Trail	Cordy (1994)
07273	Historic	Ranching outstations	SHPD site records
07288	Historic	Pauwaena Dairy	SHPD site records
07289	Historic	Pauahi Dairy	SHPD site records
07365	Historic	C. Q. Yee Hop Lumber Mills	SHPD site records
10221	Cave		Cordy (1994)
10222	Cave		Cordy (1994)
10266	Cave		Reinman (1999)
10266	Cave		Reinman (1999)
10267	Cave		Reinman (1999)
10268	Cave		Reinman (1999)
10270	Cave		Reinman (1999)
10270	Cave		Reinman (1999)
10271	Cave		Reinman (1999)
10271	Cave		Reinman (1999)
10271	Cave		Reinman (1999)
10271	Cave		Reinman (1999)
10271	Cave		Reinman (1999)
10271	Cave		Reinman (1999)
10271	Cave		Reinman (1999)
10272	Cave		Cordy (1994)
10272	Overhang		Cordy (1994)
10644	Cave		Athens and Kaschko (1988)
10645	Cave		Athens and Kaschko (1988)
10646	Cave		Athens and Kaschko (1988)
10649	Cave		Athens and Kaschko (1988)
10650	Cave		Athens and Kaschko (1988)
10653	Cave		Athens and Kaschko (1988)
10656	Cave		Athens and Kaschko (1988)
10657	Cave		Athens and Kaschko (1988)
10658	Cave		Athens and Kaschko (1988)
16247	Burial	Pu'u Ahumoa Reburial Site	SHPD quad map
17116	Cave		Reinman (1999)
17123	Cairn		Reinman (1999)
17139	Cave		Reinman (1999)
17142	Cairn		Reinman (1999)
17156			Reinman (1999)
17158	Cave		Reinman (1999)
17160	Quarry		Reinman (1999)
17162	Quarry		Reinman (1999)
17164	Quarry		Reinman (1999)
17165	Quarry		Reinman (1999)
18483	Historic		Dye et al. (2002)
18484	Historic		Dye et al. (2002)
18485	Historic		Dye et al. (2002)
18486	Historic		Dye et al. (2002)
18487	Historic		Dye et al. (2002)
18488	Historic		Dye et al. (2002)

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Site	Form	Name	Source
18489	Historic		Dye et al. (2002)
18490	Historic		Dye et al. (2002)
18491	Historic		Dye et al. (2002)
18493	Historic		Dye et al. (2002)
18494	Burial		Dye et al. (2002)
18495	Burial		Dye et al. (2002)
18496	Historic		Dye et al. (2002)
18497	Burial		Dye et al. (2002)
18498	Historic		Dye et al. (2002)
18499	Historic		Dye et al. (2002)
18933	Historic		Dye et al. (2002)
18934	Historic		Dye et al. (2002)
18935	Historic		Dye et al. (2002)
19415	Burial		Dye et al. (2002)
19501	Cave		Reinman and Pantaleo (1998)
19502	Cave		Reinman and Pantaleo (1998)
19504	Cave		Reinman and Pantaleo (1998)
19506	Cave		Reinman and Pantaleo (1998)
19507	Overhang		Reinman and Pantaleo (1998)
19508	Cave		Reinman and Pantaleo (1998)
19509 N	Cave		Reinman and Pantaleo (1998)
19509 S	Cave		Reinman and Pantaleo (1998)
19512	Cave		Reinman and Pantaleo (1998)
19513	Cave		Reinman and Pantaleo (1998)
19514	Cave		Reinman and Pantaleo (1998)
19515	Cave		Reinman and Pantaleo (1998)
19516	Cave		Reinman and Pantaleo (1998)
19517	Cave		Reinman and Pantaleo (1998)
19518	Cave		Reinman and Pantaleo (1998)
19519	Cave		Reinman and Pantaleo (1998)
19521	Overhang		Reinman and Pantaleo (1998)
19522	Blister		Reinman and Pantaleo (1998)
19523	Blister		Reinman and Pantaleo (1998)
19524	Cave		Reinman and Pantaleo (1998)
19525	Blister		Reinman and Pantaleo (1998)
19526	Blister		Reinman and Pantaleo (1998)
19529	Cave		Reinman and Pantaleo (1998)

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