FINAL ENVIRONMENTAL IMPACT STATEMENT

VOLUME 3 OF 3: APPENDICES

KULA NEI PROJECT

O‘oma, North Kona, Island of Hawai‘i

September 2007

Prepared by

Prepared for

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Prepared by Belt Collins Hawaii Ltd.

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RC-0312

An Archaeological Inventory Survey of TMK:3-7-3-009:007

‘O‘oma 2nd Ahupua‘a
North Kona District
Island of Hawai‘i

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ARCHAEOLOGICAL, CULTURAL, AND HISTORICAL STUDIES

An Archaeological Inventory Survey of TMK:3-7-3-009:007

‘O‘oma 2nd Ahupua‘a
North Kona District
Island of Hawai‘i

RECHTMAN CONSULTING

EXECUTIVE SUMMARY

At the request of Mr. Robert E. Lee Jr., Rechtman Consulting, LLC conducted an archaeological inventory survey of a 45.285 acre parcel (TMK:3-7-3-009:007) located in ʻOʻoma 2nd Ahupuaʻa, North Kona District, Island of Hawaiʻi. The parcel was formerly referred to as Lot 59 of the ʻOʻoma Homesteads (Grant 9468). This survey was performed in accordance with the Rules Governing Minimal Standards for Archaeological Inventory Surveys and Reports as contained in Hawaiʻi Administrative Rules13§13–284. The current project was undertaken in compliance with both the historic preservation review process requirements of the Department of Land and Natural Resources-State Historic Preservation Division (DLNR-SHPD) and the County of Hawaiʻi Planning Department.

Fieldwork for the current project began on April 25, 2005 and was completed on August 31, 2005 under the direction of Robert B. Rechtman, Ph.D. As a result of the current inventory survey eleven previously recorded archaeological sites (Sites 5699, 16103, 16105, 16106, 16107, 16125, 16126, 16127, 16128, 16131, 24424) and forty-two newly recorded sites (Sites 25034 to 25075) were identified on the subject parcel. The recorded sites include one Historic habitation complex (Site 25034) and four Historic boundary walls (Sites 5699, 16106, 16125, and 16126), 24 above ground Precontact habitation sites including nineteen complexes and five single feature sites (Sites 25035 to 25057), 2 Precontact habitation lava blisters (Sites 25061 and 25068), 12 Precontact lava tube habitation sites (Sites 16103, 16105, 16131, and 25059, 25060, 25062 to 25067, and 25069), 3 of which contained burials (Sites 16103, 16105, and 25069), 3 burial complexes (Sites 25070, 25071, and 25072), one burial platform (Site 16128), 3 trail segments (Sites 25073, 25074, and 25075), one large Precontact enclosure of uncertain function (Site 25058), a Precontact complex of uncertain function (Site 16127), one lava tube used exclusively for Precontact and Historic water collection purposes (Site 24424), and a large agricultural complex that spans the entire project area (Site 16107). Nineteen test units were excavated at sixteen of the recorded sites.

The archaeological resources recorded during this study were assessed for their significance based on criteria established and promoted by the DLNR-SHPD and contained in the Hawaiʻi Administrative Rules 13§13-284-6. These significance evaluations should be considered as preliminary until DLNR-SHPD provides concurrence. Treatment recommendations were offered based on significance evaluations and research potential. Eleven sites (Sites 16103, 16105, 16126, 16128, 24424, 25060, 25067, 25069, 25070, 25071, and 25072) are recommended for preservation. All of these have been evaluated as significant for their scientific research potential (Criterion D) and one other criterion. Seven are burial sites and are additionally significant for cultural reasons (Criterion E); one is a lava tube used as a locus for water collection and as such would have held additional traditional cultural value (Criterion E); one is a boundary wall associated with a transportation route that is characteristic of late eighteenth and early nineteenth century regional patterns (Criterion A); and two are habitation sites, one an excellent example of a site type (Criterion C) and one a location of petroglyphs giving the site added cultural significance (Criterion E). For the burial sites, a search for lineal and cultural descendants should be undertaken and a burial treatment plan prepared in consultation with any identified descendants and the Hawaiʻi Island Burial Council. For the non-burial archaeological sites, a preservation plan should be prepared in consultation with DLNR-SHPD.

Thirty-one sites (Sites 16127, 16131, 25035, 25036, 25037, 25038, 25039, 25040, 25041, 25042, 25043, 25044, 25045, 25046, 25047, 25048, 25049, 25050, 25051, 25052, 35053, 25054, 25055, 25056, 25057, 25058, 25059, 25061, 25062, 25063, and 25065) are recommended for data recovery. All are evaluated as significant under Criterion D, and as such this suite of habitation sites collectively represents an excellent opportunity to better understand Precontact settlement in a wetter and more fertile portion of Kekaha. Given the significant modern development that has already occurred in the region and continued development of this area, these sites provide an ever-increasingly unique opportunity for study of multiple research questions. As these sites still retain the potential for further data collection, and are recommended for data recovery, a data recovery plan should be prepared in consultation with DLNR-SHPD.

Eleven sites (Sites 5699, 16106, 16107, 16125, 25034, 25064, 25066, 25068, 25073, 25074, and 25075) have been evaluated as significant under Criterion D, and as a result of the current study, it is argued that the data already collected and presented in the current report is sufficient to mitigate any impacts to these sites that may result from the development of the study parcel.

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INTRODUCTION

At the request of Mr. Robert E. Lee Jr., Rechtman Consulting, LLC conducted an archaeological inventory survey of a 45.285 acre parcel (TMK:3-7-3-009:007) located in ʻOʻoma 2nd Ahupuaʻa, North Kona District, Island of Hawaiʻi (Figures 1 and 2). The parcel was formerly referred to as Lot 59 of the ʻOʻoma Homesteads (Grant 9468). A corridor along the southern boundary of the current study parcel was previously the subject of an archaeological inventory survey conducted by Drolet and Schilz (1991). During that study thirteen archaeological sites were recorded on the parcel. Clark and Rechtman (2005a) and Rosendahl (1989) each recorded single sites on adjacent study parcels that are also present within the current project area. As a result of the current inventory survey forty-two archaeological sites were newly recorded on the study parcel. This survey was performed in accordance with the Rules Governing Minimal Standards for Archaeological Inventory Surveys and Reports as contained in Hawaiʻi Administrative Rules 13§13–284. The current project was undertaken in compliance with both the historic preservation review process requirements of the Department of Land and Natural Resources-State Historic Preservation Division (DLNR-SHPD) and the County of Hawaiʻi Planning Department.

This report contains background information outlining the project area's physical and cultural contexts, a presentation of previous archaeological work in the immediate vicinity of the parcel, and current survey expectations based on that previous work. Also presented is an explanation of the project's methods, detailed description of the archaeological resources encountered, interpretation and evaluation of those resources, and treatment recommendations for all of the documented sites.

Project Area Description

The current project area consists of 45.285 acres (TMK:3-7-3-009:007) located in ʻOʻoma 2nd Ahupuaʻa, North Kona District, Island of Hawaiʻi (see Figures 1 and 2). The study parcel is located below Māmalahoa Highway at elevations ranging from approximately 760 feet to 870 feet above sea level. The parcel is bounded on all sides by undeveloped residential parcels. The project area is currently accessed from the east through the Kona Hills Estates gated community. Bulldozed 4WD roads encircle the entire parcel (Figure 3) and Historic boundary walls are also present on all sides. A double wall borders the parcel to the north, marking the former route of an old ʻOʻoma Homestead road. No bulldozing has occurred within the interior of the current project area.

The current project area is located on weathered *pāhoehoe* and *ʻaʻā* lava flows that originated from Hualālai between 3,000 and 5,000 years ago (Wolfe and Morris 1996). Thin, well-drained, organic soil, described as Punuluʻu extremely rocky peat (Armstrong et al. 1983), is present in pockets over the entire project area, which slopes steeply to the west with sustained 6 to 20 percent slopes. According to Drolet and Schilz, who previously studied a portion of the current project area:

> The climate in this inland sector is characterized by a scarcity of water and hot, sunny weather conditions. The mean annual rainfall measures 750 mm (Giambelluca et al. 1980:99), with temperature ranges from 75 to 85 degrees. No permanent water drainage exists within or near the project area. The minimum amount of soil development, scarcity of water and barren conditions caused by the blanket of lava cobbles and boulders on the surface of the slopes make this a marginal zone associated with limited resources. (1991:5)

The entire project area is blanketed by a dense growth of vegetation. Identified floral species included mango (*Mangifera indica*), silver oak (*Gravillea robusta*), Christmas-berry (*Schinus terebinthifolius*), *koa-haole* (*Leucaena leucocephala*), weeping fig (*Ficus benjamina*), *kukui* (*Aleurites moluccana*), guava (*Psidium guajava*), autograph trees (*Clusia rosea*), ti (*Cordyline fruticosa*), and fountain grass (*Pennisetum setaceum*), along with various other non-native vines, grasses, shrubs, and weeds.

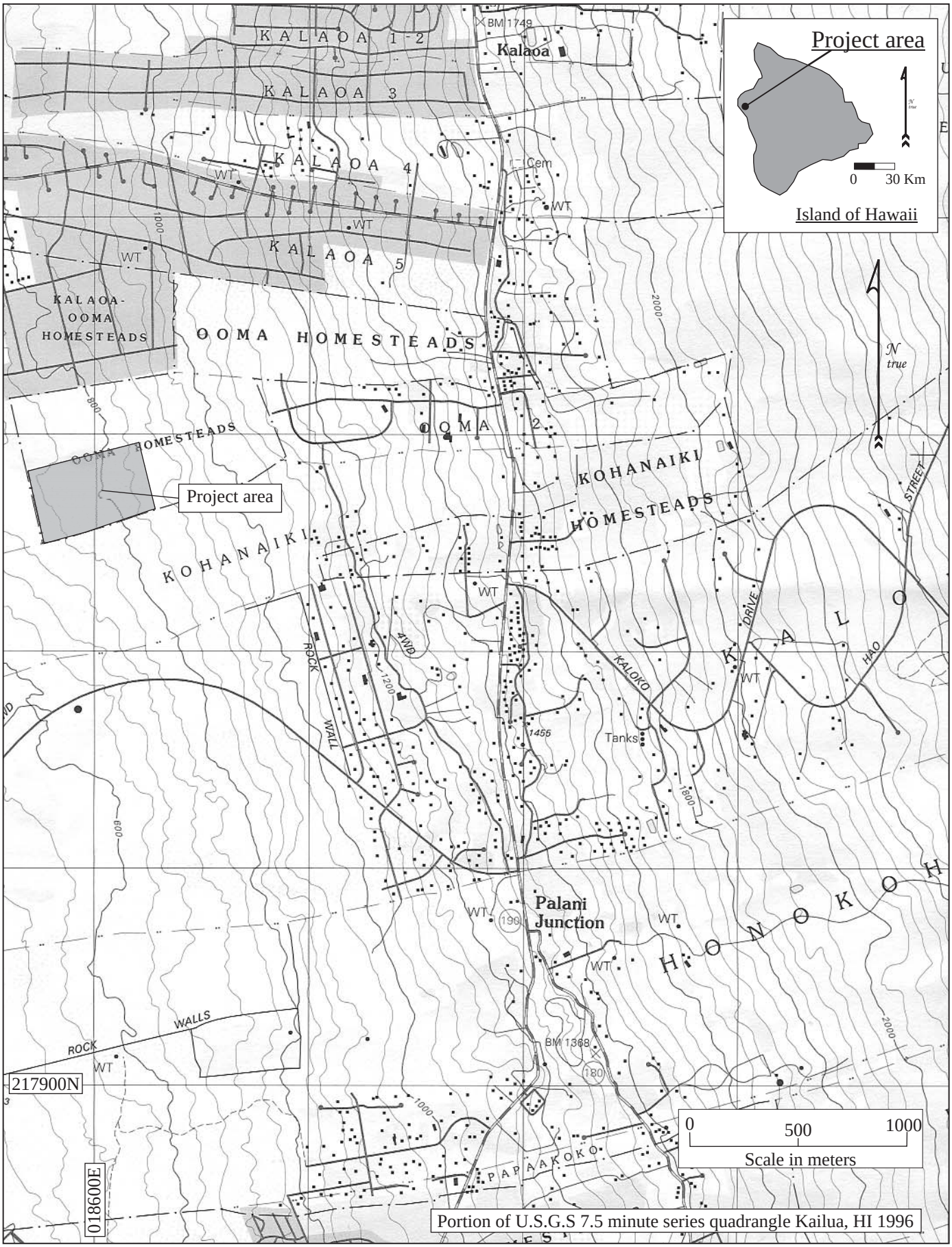

Figure 1. Project area location.

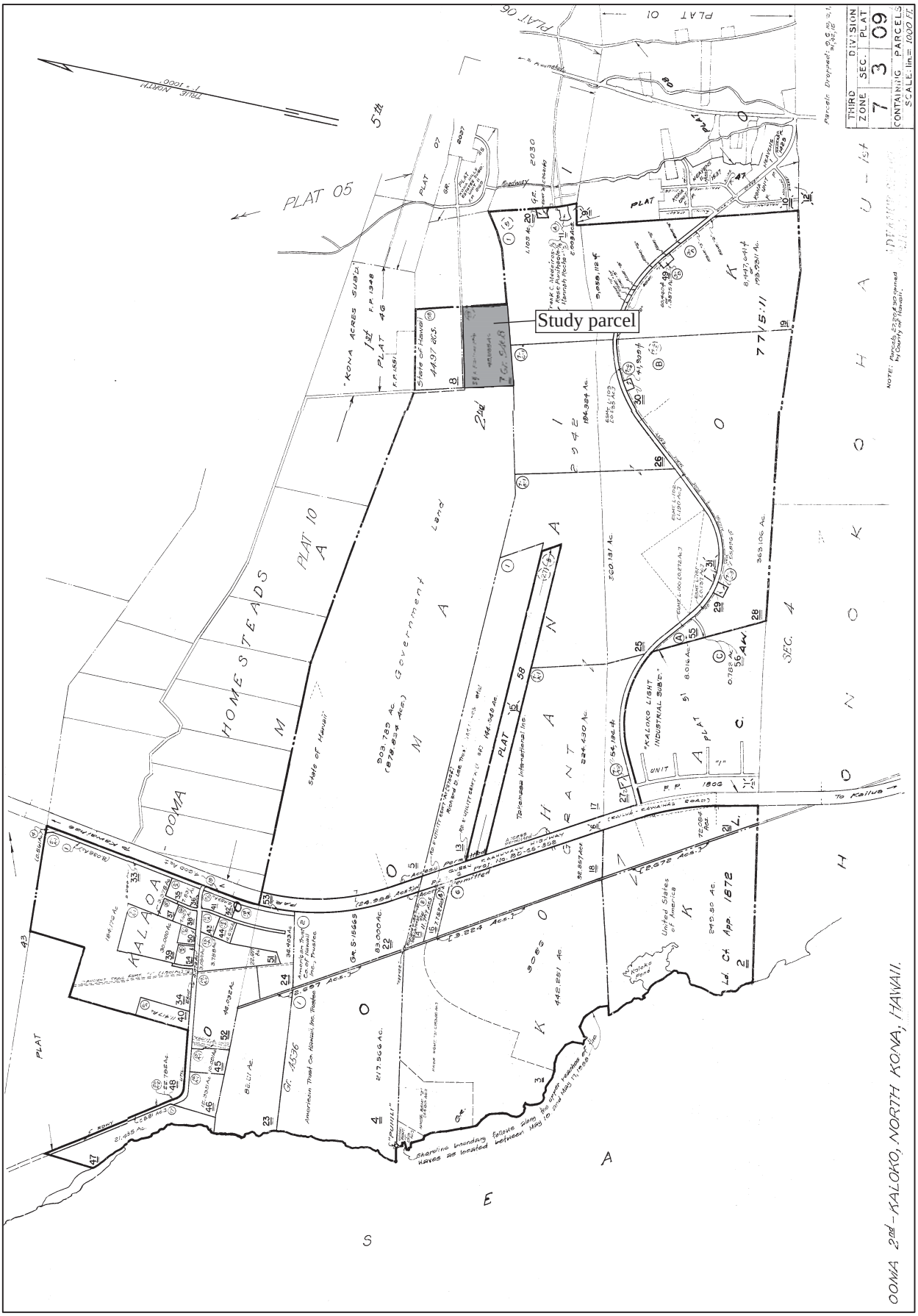

Figure 2. Tax Map Key (TMK):3-7-3-09 showing the location of the current study parcel (007).

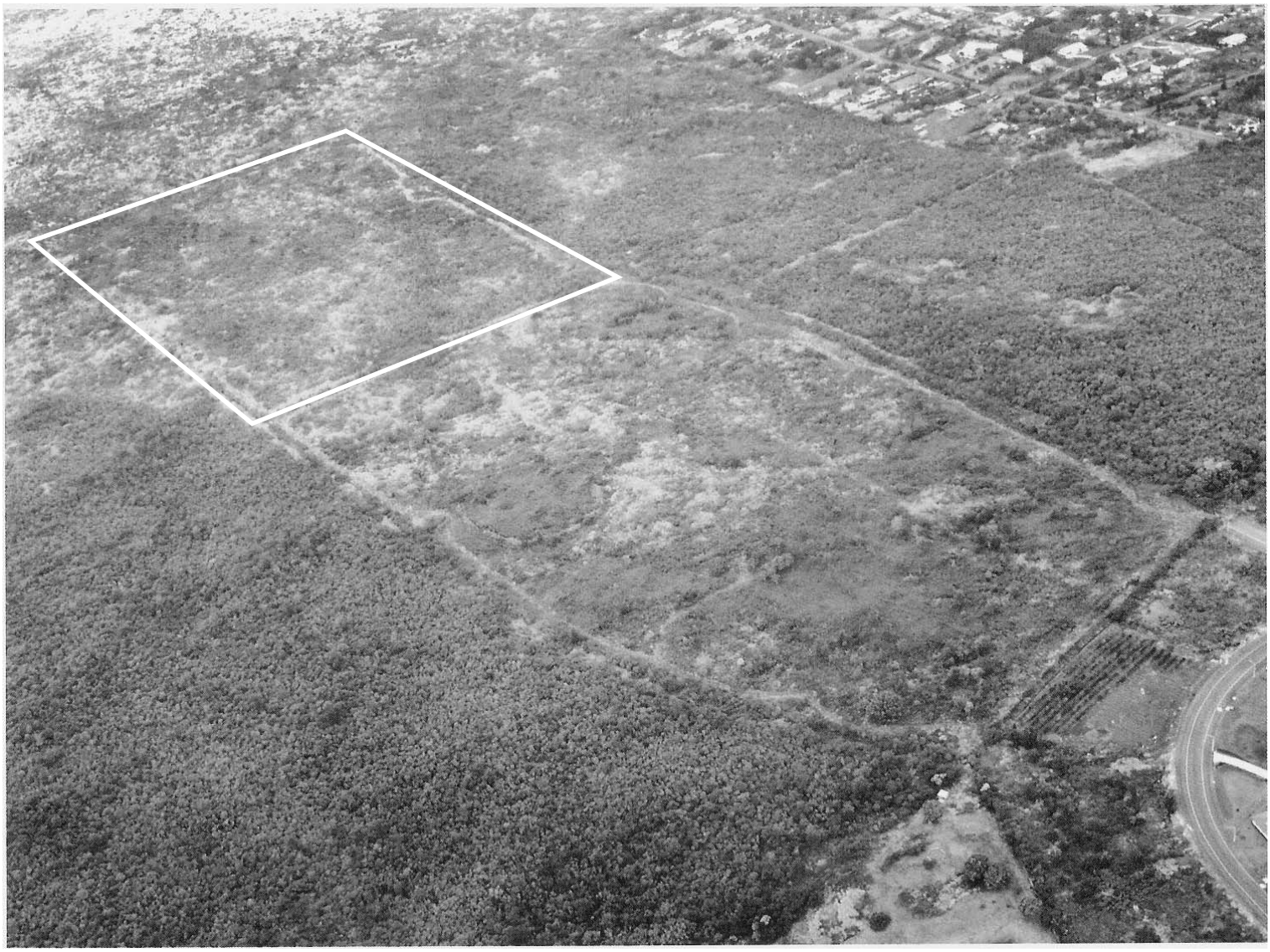

Figure 3. Aerial view of the project area to the northwest.

BACKGROUND

To generate set of expectations regarding the nature of archaeological resources that might be encountered on the study parcel, and to establish an environment within which to assess the significance of any such resources, previous archaeological studies relative to the project area and a historical context for the general North Kona region are presented.

Previous Archaeological Research

Thrum (1908) compiled the earliest systematic report on archaeological features—*heiau* or ceremonial sites—on the island of Hawai'i. Thrum's work was the result of literature review and field visits spanning several decades. Unfortunately, Thrum's work did not take him into 'O'oma, and his documentation on *heiau* ends at Lanihau, south of the study area; and picks up to the north, in the Pu'u Anahulu vicinity. Likewise, the 1906-1907, J.F.G. Stokes detailed field survey of *heiau* on the island of Hawai'i for the B. P. Pauahi Bishop Museum (Stokes and Dye 1991) stopped short of doing comprehensive work in the Kekaha region, and no sites were recorded in 'O'oma.

In 1929-1930, the Bishop Museum contracted John Reinecke to conduct a survey of Hawaiian sites in West Hawai'i, including 'O'oma and the Kekaha region (Reinecke n.d.). A portion of Reinecke's survey fieldwork extended north from Kailua as far as Kalāhuipua'a. His work being the first attempt at a survey of sites of varying function, ranging from ceremonial to residency and resource collection.

During his study, Reinecke traveled along the shore of Kekaha, documenting near-shore sites. Where he could, he spoke with the few native residents he encountered. Among his general descriptions of the Kekaha region, Reinecke observed:

> This coast formerly was the seat of a large population. Only a few years ago Keawaiki, now the permanent residence of one couple, was inhabited by about thirty-five Hawaiians. Kawaihae and Puako were the seat of several thousands, and smaller places numbered their inhabitants by the hundreds. Now there are perhaps fifty permanent inhabitants between Kailua and Kawaihae–certainly not over seventy-five.
>
> When the economy of Hawaii was based on fishing this was a fairly desirable coast; the fishing is good; there is a fairly abundant water supply of brackish water, some of it nearly fresh and very pleasant to the taste; and while there was no opportunity for agriculture on the beach, the more energetic Hawaiians could do some cultivation at a considerable distance mauka.
>
> The scarcity of remains is therefore disappointing. This I attribute to four reasons: (1) those simply over looked, especially those a short distance mauka, must have been numerous; (2) a number must have been destroyed, as everywhere, by man and by cattle grazing; (3) the coast is for the most part low and storm-swept, so that the most desirable building locations, on the coral beaches, have been repeatedly swept over and covered with loose coral and lava fragments, which have obscured hundreds of platforms and no doubt destroyed hundreds more; (4) many of the dwellings must have been built directly on the sand, as are those of the family at Kaupulehu, and when the posts have been pulled up, leave no trace after a very few years.
>
> The remains on this strip of coast have some special characteristics differentiating them from the rest in Kona. First, there is an unusual number of petroglyphs and papamu, especially about Kailua and at Kapalaoa. Second, probably because of the strong winds, there are many walled sites, both of houses and especially of temporary shelters… (Reinecke n.d.:1-2)

The following site descriptions are quoted from Reinecke's draft manuscript of fieldwork conducted between Pūhili Point on the Kohanaiki-'O'oma 2nd boundary, and into Kalaoa 5th. In the site descriptions below, Reinecke references the occurrence of at least—6-house sites; 7 enclosures and pens (one of which is an "old cattle pen"); 11 terraces and platforms (one of which he felt was a "*heiau*"); 2 caves; 2 ahu; 1 stepping stone trail; 3 waterholes and a well; and 11 shelters. Apparently, no one was residing in the area at the time of his field survey.

Reinecke's site descriptions, south to north, across 'O'oma 2nd and 'O'oma 1st included:

> Site 66. Very doubtful dwelling site. Then a row of sand-covered platforms at the border of the sand and the beach lava, enough for 6-10 homes. Remains of an old, large pen.
> Site 67. Dry well on the crest of the beach.
> Site 68. Water hole, two small platforms, four or more shelters, pens with very small platform.
> Site 69. Large cattle pen. Doubtful old, rough platform at its north end. Remains of two old platforms by an ahu to the north.
> Site 70. Walled platform, S.E. corner terraced, badly broken down. Platform mauka. The walls of this and of Site 73 are built of thin places of pahoehoe surface lava, rather unusual in appearance. [Reinecke n.d.:15]
> Site 71. A knob partly walled on its slopes, with house site. Adjoining it on the south is a rough platform with three smooth boulders – heiau and kuula? Back of this a house platform and a platform about a fine shelter cave. Another platform and wall are about a slight natural depression filled with bones, including those of a whale.
> Site 72. Ruins of a pen.
> Site 73. Apparently a modern dwelling site of unusual construction; two terraces of pebbles, the upper 29x25x2 in front and 4-5' high elsewhere; the lower 19x10x25x3, with a three-sided pen at N.E.; surrounded by a carefully laid wall.
> Site 74. A shelter about a shallow cave; remains of another shelter; an ahu.
> Site 75. Trace of site; house platform; enclosure on shore. There are many faint traces of sites on this strip of coast. Toward the north is an unmistakable small site.
> Site 76. Modern shelter pen; house or shelter site; shelter mauka by kiawe tree.
> Site 77. Platform; tiny pen; sites of some kind marked by stones in lines on the pahoehoe flow.
> Site 78. Slightly brackish springs and pools; house site, shelters, stepping stone path leading to the walled house site… [Reinecke n.d.:16]

In more recent times, Haun and Henry (2003:8) indicate that 40 archaeological surveys and excavation projects have been conducted in 'O'oma Ahupua'a and the adjacent (to the north) *ahupua'a* of Kalaoa. These studies identified (not including the Haun and Henry study) "53 permanent habitations, 379 temporary habitations, 3,736 agricultural features, 25 burials, 17 ritual features, 34 trail segments, 65 *ahu*, and 18 petroglyphs," and, "two hundred and twenty-one habitation features [that] were not categorized by residential permanence" (2003:13). According to Haun and Henry (2003:13), dates from these studies indicate initial settlement of the area by A.D. 1400, with gradual increase in population during the 15th century, and the most intensive use from the 1600's through the early Historic period.

Eight previous studies have been conducted at proximate locations to the current project area. One of these studies included a portion of the current project area (Drolet and Schilz 1991). Two other studies were conducted in 'O'oma 2nd Ahupua'a adjacent to the current project area (Clark and Rechtman 2005a and 2005b). Two other studies were conducted *makai* of the current project area within 'O'oma 2nd Ahupua'a (Rosendahl 1989; Walker and Rosendahl 1990). One study was conducted in 'O'oma 1st Ahupua'a to the north of the current project area (Haun and Henry 2003). Two studies were conducted in Kohanaiki Ahupua'a to the south of the current project area (Barrera 1991; Clark and Rechtman 2002). The findings of each of these studies is presented in chronological order below and their locations are depicted in Figure 4.

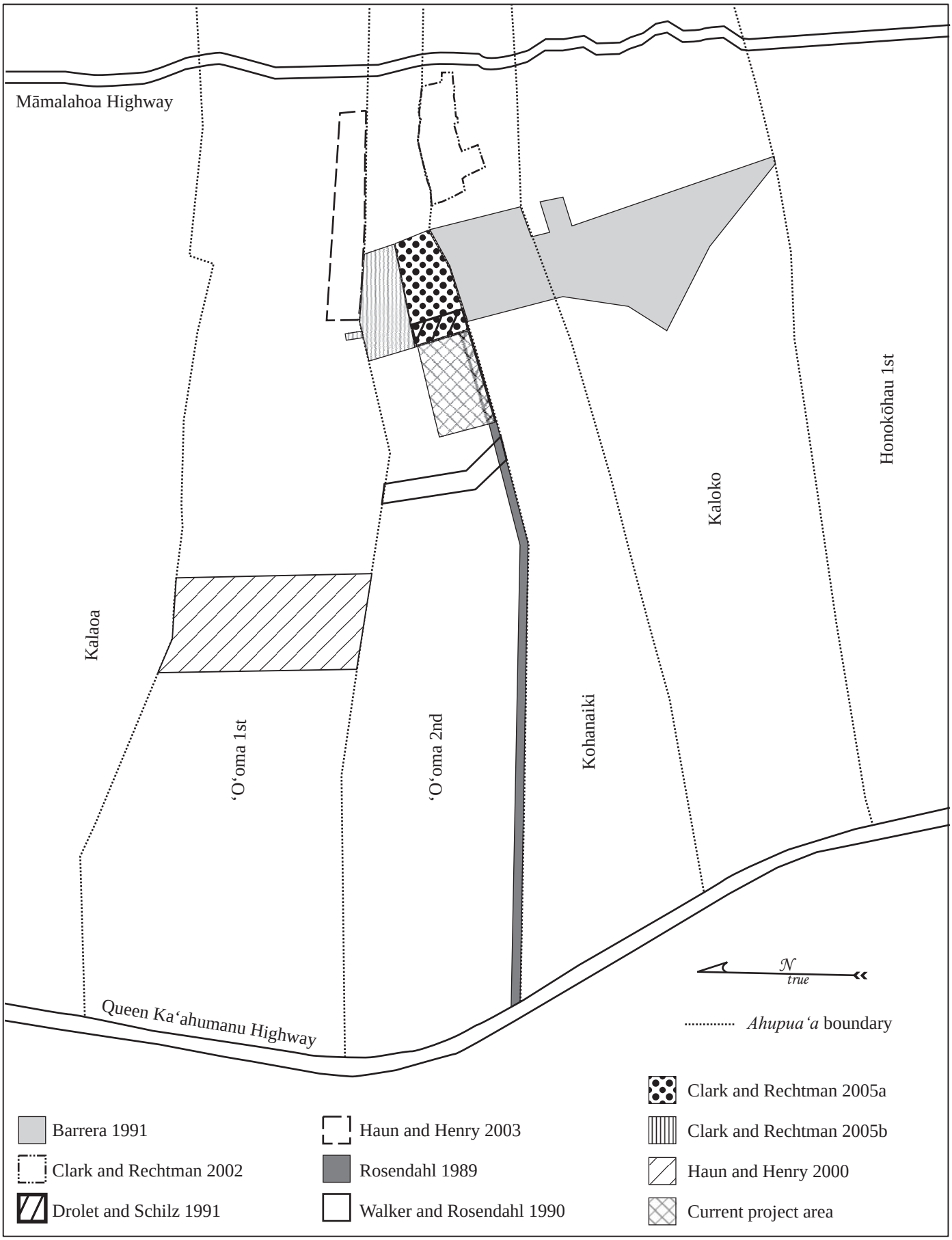

Figure 4. Previous archaeological studies in the vicinity of the current project area.

Rosendahl (1989) conducted an inventory survey of a 200-foot wide corridor in ʻOʻoma 2nd Ahupuaʻa for a proposed Kohana-Iki Resort water development project. The project area extended along the northern boundary of Kohanaiki Ahupuaʻa from Queen Kaʻahumanu Highway (at approximately 80 feet above sea level) to approximately 760 feet above sea level stopping at the *makai* boundary of the current project area (see Figure 4). As a result of that survey four archaeological sites were recorded. The sites included two *pāhoehoe* excavations located just above the highway (Site 5696), a ceremonial/habitation complex with an alignment, a cave, a rock shelter, two terraces, an enclosing wall, and a *papamū* located at 280 feet above sea level (Site 5697), a mound located at 440 feet above sea level (Site 5698), and a Historic boundary wall located at approximately 760 feet above sea level that runs along the *makai* boundary of the current project area (Site 5699).

Walker and Rosendahl (1990) also conducted an inventory survey in ʻOʻoma 2nd Ahupuaʻa for the same proposed water development project. Their project area consisted of a 2,600-foot long by 300-foot wide corridor that extended from the Rosendahl (1989) corridor north along the 700-foot contour across the entire *ahupuaʻa* (see Figure 4). Walker and Rosendahl (1990) identified 13 sites that encompassed more than 27 features. Although the report is described as an inventory survey, only temporary site numbers were assigned and no detailed recording was undertaken. They did note, however, that:

> The principal types of sites and features identified were mounds of varying sizes possibly related to agricultural activities. Several caves (one containing human burial remains), enclosures, cairns, a trail segment, a boulder alignment, and a terrace were also noted. In addition to agriculture, functional feature types encountered include boundary, habitation, transportation, burial, and marker. (Walker and Rosendahl 1990:4)

A third inventory survey for the proposed water development project within ʻOʻoma 2nd was conducted by Drolet and Schilz (1991). Their survey area consisted of a 100-foot wide corridor that followed the southern boundary of the current project area and ran from the termination of the Rosendahl (1989) corridor at approximately 760 feet above sea level to approximately 900 feet above sea level. The corridor then turned north, widened to 200 feet and crossed the *ahupuaʻa* just *mauka* of the current project area (see Figure 4). This survey area encompassed approximately 8.8 acres and 29 archaeological sites containing 41 distinct features were recorded within its boundaries. Drolet and Schilz conclude that:

> The most common feature found were cobble mounds. A total of 22 were found that included circular, oval, and linear forms. The mounds were presumably were constructed for agricultural use and suggest seasonal cropping of tuber plants such as sweet potato. Other types of features included one modified outcrop, one stone alignment, and two platforms, which appear to be associated with the agricultural mounds. There were four shelters located, each with evidence of temporary residence, and five enclosures, that also indicate habitation units. Four of the five enclosures were located within the cave sites. Finally, the last category of identified features included walls, nine of which were recorded. These were both high and low constructions. The presence of this latter type of wall construction suggests field divisions and possibly water diversion systems built during prehistoric occupation to facilitate agricultural development.
>
> All but three of the archaeological sites located appear to form a cluster of features dating to the late prehistoric period. The exceptions are Sites 16106, 16125, and 16126 that are historic walls reportedly built 60 to 70 years ago….
>
> There appears to be an important relationship between the cave complexes and the agricultural features found during the current survey. The lava tubes within the five clustered cave complexes located served as principal occupation sites, and the shallow midden deposits and limited structural constructions within these tubes suggest only temporary occupation and probably seasonal use. The dry farming garden features surrounding the caves also point to a seasonal cropping pattern. Clearly, the lack of soil build up within this zone, along with the deep lava deposits and lack of permanent water supply, had to have been factors that influenced the type of land use patterns evidenced in the archaeological record. (1991:30-32)

Thirteen of the recorded sites (Sites 16103—16108, 16125—16131) were located within, or along the boundary of the current project area. Drolet and Schilz (1991) also noted the presence of Site 5699 previously recorded by Rosendahl (1989). The sites newly recorded in 1991 included four cave complexes, five walls, a circular mound, a mound complex, and a feature cluster consisting of a mound a wall and an alignment. Appendix A contains detailed descriptions of each of these sites and a map depicting their locations. All of these sites were relocated during the current inventory survey and are discussed in detail below.

Barrera (1991) conducted an archaeological inventory survey and data recovery effort at two parcels (TMK:3-7-3-09:1 and 17) within Kohanaiki and Kaloko *ahupua'a* to the southeast of the current project area (see Figure 4). Barrera's study area ranged from 800 to 1,100 feet above sea level. As a result of the study, Barrera identified 140 archaeological sites that were located primarily within Kohanaiki Ahupua'a. He attributed the scarcity of sites within Kaloko Ahupua'a to "extensive recent land clearing that occurred there." Sixty-one of the sites were determined to lie within the boundaries of the Kohanaiki Homesteads, a collection of combined agricultural and residential lots (located to the south of the current project area) that were settled in the late 1800s. The majority of the remaining sites were determined to be components of the Kona Field System. These sites consisted primarily of *kuaiwi*, cross-walls, terraces, and mounds. Also several permanent and temporary habitations were identified, along with a single small *heiau* or men's house. Barrera (1991:63) suggests that human occupation of the project area began in the last quarter of the fifteenth century and continued unabated into the eighteenth century at which point there is a no residential population for nearly 150 years until the settlement of the Kohanaiki Homesteads.

Clark and Rechtman (2002) conducted an inventory survey of a fifty-two acre property (TMK:3-7-3-7:27 and 50) in Kohanaiki Ahupua'a to the southeast of the current project area (see Figure 4). As a result of that survey five archaeological sites were recorded, including an enclosure remnant (Site 23628), two stone terraces (Sites 23629 and 23630), and two sets of historic boundary walls (one set surrounding each parcel; Sites 23631 and 23632). Clark and Rechtman (2002:10) note that nearly the entire study area had been mechanically cleared to accommodate coffee cultivation, and that an interconnected series of old bulldozed access roads spanned the entire larger parcel (TMK:3-7-3-7:50). In addition to this, several rusted 50-gallon metal drums (perhaps as many a 100) were noted over the entire project area. These drums were typically found in groups and, more often then not, they were located near one of the old bulldozed access roads. There was also ample evidence of more recent agricultural pursuits on the study parcels—*pakalolo* (*Cannabis*) cultivation. Clark and Rechtman (2002:10) identified a number of recently constructed rock rings (perhaps as many as 50) containing soil mixed with vermiculite and often associated with modern artifacts (i.e. fertilizer bags, rubber hose, plastic bottles, etc.). These rock rings varied widely in size and shape, but were all certainly of modern construction, and at least one was observed to be currently under cultivation.

Haun and Henry (2003) conducted an inventory survey of a roughly 41-acre parcel (TMK:3-7-3-7:40) in 'O'oma 1st Ahupua'a to the northeast of the current project area (see Figure 4). The project area ranged in elevation from 980 to 1,280 feet above sea level. As a result of that survey twenty-one archaeological sites were recorded with an estimated 2,046 features. Haun and Henry report that:

> The sites are comprised of 14 single feature sites and eight complexes of features. The features consist of an estimated 1,105 modified outcrops and 788 mounds, 41 enclosures, 36 *kuaiwi*, 29 platforms, 21 terraces, ten walls, nine caves and seven field boundaries. Functionally, the features consist of agriculture (n=1,984), permanent habitation (n=32), livestock control (n=14), historic habitation (n=8), temporary habitation (n=6) storage (1), and burial (n=1). (2003:15)

Although the entire project area was subject to intensive pedestrian survey, Haun and Henry explain that:

> Hundreds of agricultural features, primarily mounds and modified outcrops, were identified throughout the parcel during the initial survey transects. A sample of these features was recorded in a 10 m wide transect extending across the entire parcel from east to west. Agricultural features within the transect were subjected to limited recording . . . Feature density values from the transect were used to estimate the total number of mounds and modified outcrops in the project area. Non-agricultural sites were subjected to detailed recording…(2003:4)

Of the non-agricultural sites, the six temporary habitations consisted exclusively of caves. Seven radiocarbon dates, ranging from A.D 1400 to A.D. 1800, were obtained from these caves, with five of the dates falling between the 1400s to the mid-1600s (Haun and Henry 2003:80). Six Precontact permanent habitation sites and two Historic habitation sites were also recorded. The Precontact permanent habitations all included from one to three structure foundations consisting of terraces, platforms, and enclosures. Three of these sites were enclosed by walled yards. The Historic habitation sites both included significant amounts of Historic debris. Five Historic ranching walls were also recorded. The one burial site discovered during the inventory survey (Site 23826) consisted of a large rectangular platform with stacked sides. In addition to this, several more burials were inadvertently discovered within concealed lava blisters during the initial grubbing of the parcel.

In 2005, Rechtman Consulting, LLC (Clark and Rechtman 2005a) completed a study of a roughly 43-acre parcel (TMK:3-7-3-7:38; former Lot 57 of the ‘O‘oma Homesteads) located directly east of the current project area within ‘O‘oma 2nd Ahupua‘a (see Figure 4). As a result of that study three archaeological sites previously recorded by Drolet and Schilz (1991) (Sites 16106, 16125, and 16126) and twelve newly recorded sites (Sites 24413–24424) were identified on the subject parcel. Drolet and Schilz (1991) had recorded nineteen sites on the subject parcel, but due to widespread mechanical clearing of the property in 1994, only three were remaining (all boundary walls) at the time of the Clark and Rechtman (2005) study. Sites 16106, 16125 and 16126 are also respectively the southern, eastern, and northern boundary walls of the current project area.

Clark and Rechtman (2005a) note that the fifteen sites recorded on TMK:3-7-3-7:38 represented nearly continual use of the parcel from Precontact times (perhaps as early as the 1400s; Haun and Henry 2003:80) to the 1940s. Historic sites located on the study parcel included the remains of a former residence that was occupied until ca. 1939 (Site 24422), the boundary walls that surrounded the entire parcel (Sites 16106, 16125, 16126, and 24423), a small enclosure of undetermined homesteading function (Site 24415), a large enclosure that may have functioned as a goat pen (Site 24414), and several core-filled wall segments that may have once formed several large enclosures on the property (Site 24416). Precontact sites recorded on the study parcel included a burial platform containing a slab-lined crypt with articulated human skeletal remains (Site 24413), a three-sided habitation enclosure (Site 24417), a modified outcrop (Site 24418), a stepping stone trail segment (Site 24419), a lava tube system containing four habitation areas near openings (Site 24420), two mounds (Site 24421), and a large lava tube that was used for water collection and extends beneath the current project area (Site 24424). The only entrances to that lava tube are located within the boundaries of the current project area.

Clark and Rechtman (2005a) also suggest that the widespread mechanical clearing that occurred on the study parcel in 1994 drastically altered the earlier cultural landscape of the property. They site earlier archaeological studies by Drolet and Schilz (1991) and Haun and Henry (2003), and historical research and oral interviews compiled by Rechtman and Maly (2003), that overwhelmingly indicates that the project area was likely blanketed by Precontact agricultural features prior to the land clearing. The extent and type of these potential features, however, could only be surmised based on the findings of these other studies.

Also in 2005, Rechtman Consulting, LLC (Clark and Rechtman 2005b) conducted an archaeological inventory survey of a 39.36 acre parcel (TMK:3-7-3-07:39) located in ‘O‘oma 2nd Ahupua‘a, and an adjoining 43,706 square foot parcel (TMK:3-7-3-46:105) located in ‘O‘oma 1st Ahupua‘a (see Figure 4). The larger parcel was formerly referred to as Lot 56 of the ‘O‘oma Homesteads. It was originally sold to E. M. Paiwa in 1898 as Grant 4273. The smaller parcel is a lot within the Kona Palisades Subdivision. These parcels are located to the northeast of the current study parcel and adjacent to the north of the Clark and Rechtman (2005a) study area.

As a result of the Clark and Rechtman (2005b) inventory survey seventeen archaeological sites were recorded on TMK:3-7-3-7:39 and a single archaeological site was recorded on TMK:3-7-3-46:105. The recorded sites include seven historic walls (Sites 23834, 24759, 24769, 24770, 24771, 24772, and 24774), one historic enclosure (Site 24760), a probable historic roadway (Site 24775), two trail segments (Sites 24761 and 24763), a modified outcrop used for Precontact habitation purposes (Site 24762), a terrace used for Precontact habitation purposes (Site 24764), three Precontact lava blister habitations (Sites 24765, 24766, and 24767), one human burial within a lava blister (Site 24768), a Precontact habitation complex containing five features (Site 24773), and a large agricultural complex that spanned the entire larger parcel of the project area (Site 24776).

Sixteen 1 x 1 meter test units were excavated at four of the recorded sites (Sites 24762, 24764, 24773, and 24776). Clark and Rechtman note that:

> By far the most numerous features present [on TMK:3-7-3-7:39] are features of Site 24776. These features blanket the landscape and record the history of agricultural pursuits that occurred on the study parcels. Features of this site are found in loosely arranged fields over the entire project area, except in locales where it has been previously bulldozed or where no soil is present. All of the fields correspond to soil areas within the current project area and most are delineated by rough walls that run along their boundaries. The features of Site 24776 appear, for the most part, to be clearing piles, and it is likely that the fields were used primarily for the planting of sweet potatoes. The use of these fields likely began during Precontact times and continued into Historic times…
>
> Several small Precontact habitation sites are interspersed among the agricultural features of Site 24776. These sites include, a modified outcrop (Site 24762), a terrace (Site 24764), four lava blisters (Sites 24765, 24766, 24767, and 24768), and a complex containing five features (Site 24773). The nature of the habitation that occurred at these sites appears to have been short term and recurrent, and primarily related to the agricultural use of the project area. The four lava blisters are all small with cleared floors, each containing a few fragments of marine shell. These blisters would have offered shelter from rain or sun, but are not comfortable, and would likely have been utilized solely on a nightly, daily, or as needed basis. One of the lava blisters (Site 24768) also contained human skeletal remains and appears to have been used both for habitation and burial. The three remaining Precontact habitation sites are all above ground cobble constructions. Based on the findings of subsurface testing at these sites it is likely that the nature of habitation that occurred at them was of longer duration, or more frequent, than at the lava blisters. However, the use of these sites was also likely related to the Precontact agricultural use of the current project area.
>
> Two trail segments (Sites 24761 and 24763) that appear to date to the Precontact Period were also recorded on the study parcels. These trails likely accessed a network of trails that connected the people living and farming in this middle-upland area to other resource and habitation areas further *mauka* and *makai*. They also likely connected habitation areas to agricultural fields and other habitation areas. Unfortunately, only small sections of each trail could be traced across the *pāhoehoe* bedrock landscape of the current project area, making interpretation of discrete associations between these sites and other sites extremely difficult.
>
> The most recently constructed sites located on the study parcels include seven Historic walls (Sites 23834, 24759, 24769, 24770, 24771, 24772, and 24774), one Historic enclosure (Site 24760), and a probable Historic roadway (Site 24775). These sites are all likely related to the homesteading use of the current project area. E. M. Paiwa purchased the larger parcel of the current project area in 1898 as Grant 4273 (Lot 56 of the ʻOʻoma Homesteads), and the smaller parcel was a portion of Grant 1590 to Kauhini (Lot 43 of the ʻOʻoma Homesteads) in 1855 that was never perfected. Four of the Historic walls run along the boundaries of the larger parcel, while the remaining three are present within the confines of the larger parcel. The presence of these walls, along with the Historic enclosure, suggests that cattle ranching may have occurred on the study parcels at some point during Historic times. The Historic roadway may have accessed the current project area at some point in the past, but interpretation of this site is made difficult by the fact that it has been bulldozed at both ends and very little of the roadway remains. (2005b:131-132)

CULTURAL AND HISTORICAL BACKGROUND

While the physical study area is limited to a portion of ʻOʻoma 2nd Ahupuaʻa identified as TMK:3-7-3-009:007, in an effort to provide a comprehensive and holistic understanding of the current project area, this section of the report examines the entire *ahupuaʻa* and its relationship to neighboring lands within the larger Kekaha region. In 2003, Rechtman Consulting, LLC prepared a Cultural Impact Assessment for the proposed development of TMK:3-7-3-09:22 within coastal ʻOʻoma 2nd Ahupuaʻa (Rechtman and Maly 2003). Extensive research for that study was conducted by Kepā Maly of Kumu Pono Associates, and it included a review of archival-historical literature from both Hawaiian and English language sources, including an examination of Hawaiian Land Commission Award records from the *Māhele ʻĀina* (Land Division) of 1848; survey records of the Kingdom and Territory of Hawaiʻi; and historical texts authored or compiled by D. Malo (1951), J.P. Iʻi (1959), S. M. Kamakau (1961, 1964, 1976, and 1991), Wm. Ellis (1963), A. Fornander (1916-1919 and 1996), T. Thrum (1908), J.F.G. Stokes and T. Dye (1991), M. Beckwith (1970), Reinecke (n.d.); and Handy and Handy with Pukui (1972). That study also included several native accounts from Hawaiian language newspapers (compiled and translated from Hawaiian to English, by Kepā Maly), and historical narratives authored by eighteenth and nineteenth century visitors to the region. The information was presented within thematic categories by ordered chronological by the date of publication.

The archival-historical resources were located in the collections of the Hawaiʻi State Archives (HSA), State Land Division (LD), State Survey Division (SD), and State Bureau of Conveyances (BoC); the Bishop Museum Archives (BPBM); Hawaiian Historical Society (HHS); University of Hawaiʻi-Hilo Moʻokini Library; private family collections; and in the collection of Kumu Pono Associates.

Over the last ten years, Kepā Maly of Kumu Pono Associates has researched and prepared several detailed studies—in the form of review and translation of accounts from Hawaiian language newspapers, historical accounts recorded by Hawaiian and non-Hawaiian residents, and government land use records—for lands in the Kekaha region of which ʻOʻoma is a part. Kepā Maly has also conducted a number of detailed oral history interviews with elder *kamaʻāina* documenting their knowledge of the Kekaha region (including ʻOʻoma), and he undertook new interviews and further consultation as a part of the 2003 study. All of the interview participants (both past and present) shared their personal knowledge of the land and practices of the families who lived in ʻOʻoma and vicinity. One additional oral-historical interview with Mrs. Elizabeth (Kahananui) Lee was also conducted for the current study.

As the information collected by Rechtman and Maly (2003) was so complete, this report presents only a slightly modified version of the cultural and historical background for ʻOʻoma Ahupuaʻa and the Kekaha region than was already generated. It is a comprehension of this background information that facilitates a more complete understanding of the potential significance of the resources that exist within the current study area.

Natural and Cultural Resources in a Hawaiian Context

In Hawaiian society, natural and cultural resources are one and the same. Native traditions describe the formation (the literal birth) of the Hawaiian Islands and the presence of life on and around them in the context of genealogical accounts. All forms in the natural environment, from the skies and mountain peaks, to the watered valleys and lava plains, and to the shoreline and ocean depths were believed to be embodiments of Hawaiian deities. One Hawaiian genealogical account, records that Wākea (the expanse of the sky–father) and Papa-hānau-moku (Papa—Earth-mother who gave birth to the islands)—also called Haumea-nui-hānau-wā-wā (Great Haumea—Woman-earth born time and time again)—and various gods and creative forces of nature, gave birth to the islands. Hawaiʻi, the largest of the islands, was the first-born of these island children. As the Hawaiian genealogical account continues, we find that these same god-beings, or creative forces of nature who gave birth to the islands, were also the parents of the first man (Hāloa), and from this ancestor, all Hawaiian people are descended (cf. Beckwith 1970; Malo 1951:3; Pukui and Korn 1973). It was in this context of kinship, that the ancient Hawaiians addressed their environment and it is the basis of the Hawaiian system of land use.

An Overview of Hawaiian Settlement

Archaeologists and historians describe the inhabiting of these islands in the context of settlement that resulted from voyages taken across the open ocean. For many years, researchers have proposed that early Polynesian settlement voyages between Kahiki (the ancestral homelands of the Hawaiian gods and people) and Hawai‘i were underway by A.D. 300, with long distance voyages occurring fairly regularly through at least the thirteenth century. It has been generally reported that the sources of the early Hawaiian population—the Hawaiian Kahiki—were the Marquesas and Society Islands (Cordy 2000; Emory in Tatar 1982:16-18).

For generations following initial settlement, communities were clustered along the watered, windward (*ko‘olau*) shores of the Hawaiian Islands. Along the *ko‘olau* shores, streams flowed and rainfall was abundant, and agricultural production became established. The *ko‘olau* region also offered sheltered bays from which deep sea fisheries could be easily accessed, and near shore fisheries, enriched by nutrients carried in the fresh water, could be maintained in fishponds and coastal waters. It was around these bays that clusters of houses where families lived could be found (McEldowney 1979:15). In these early times, Hawai‘i’s inhabitants were primarily engaged in subsistence level agriculture and fishing (Handy et al. 1972:287).

Over a period of several centuries, areas with the richest natural resources became populated and perhaps crowded, and by about A.D. 900 to 1100, the population began expanding to the *kona* (leeward side) and more remote regions of the island (Cordy 2000:130). In Kona, communities were initially established along sheltered bays with access to fresh water and rich marine resources. The primary “chiefly” centers were established at several locations—the Kailua (Kaiakeakua) vicinity, Kahalu‘u-Keauhou, Ka‘awaloa-Kealakekua, and Hōnaunau. The communities shared extended familial relations, and there was an occupational focus on the collection of marine resources. By the fourteenth century, inland elevations to around the 3,000-foot level were being turned into a complex and rich system of dryland agricultural fields (today referred to as the Kona Field System). By the fifteenth century, residency in the uplands was becoming permanent, and there was an increasing separation of the chiefly class from the common people. In the sixteenth century the population stabilized and the *ahupua‘a* land management system was established as a socioeconomic unit (see Ellis 1963; Handy et al. 1972; Kamakau 1961; Kelly 1983; and Tomonari-Tuggle 1985).

In Kona, where there were no regularly flowing streams to the coast, access to potable water (*wai*), was of great importance and played a role in determining the areas of settlement. The waters of Kona were found in springs and caves (found from shore to the mountain lands), or procured from rain catchments and dewfall. Traditional and historic narratives abound with descriptions and names of water sources, and also record that the forests were more extensive and extended much further seaward than they do today. These forests not only attracted rains from the clouds and provided shelter for cultivated crops, but also in dry times drew the *kēhau* and *kēwai* (mists and dew) from the upper mountain slopes to the low lands (see also traditional-historical narratives and oral history interviews in this study).

In the 1920s-1930s, Handy et al. (1972) conducted extensive research and field interviews with elder native Hawaiians. In lands of North and South Kona, they recorded native traditions describing agricultural practices and rituals associated with rains and water collection. Primary in these rituals and practices was the lore of Lono—a god of agriculture, fertility, and the rituals for inducing rainfall. Handy et al., observed:

> The sweet potato and gourd were suitable for cultivation in the drier areas of the islands. The cult of Lono was important in those areas, particularly in Kona on Hawai‘i . . . there were temples dedicated to Lono. The sweet potato was particularly the food of the common people. The festival in honor of Lono, preceding and during the rainy season, was essentially a festival for the whole people, in contrast to the war rite in honor of Ku which was a ritual identified with Ku as god of battle. (Handy et al. 1972:14)

Handy et al. (1972) noted that the worship of Lono was centered in Kona. Indeed, it was while Lono was dwelling at Keauhou, that he is said to have introduced taro, sweet potatoes, yams, sugarcane, bananas, and *‘awa* to Hawaiian farmers (Handy et al. 1972:14). The rituals of Lono “The father of waters” and the annual *Makahiki* festival, which honored Lono and which began before the coming of the *kona* (southerly) storms and

lasted through the rainy season (the summer months), were of great importance to the native residents of this region (Handy et al. 1972: 523). The significance of rituals and ceremonial observances in cultivation and indeed in all aspects of life was of great importance to the well being of the ancient Hawaiians, and cannot be overemphasized, or overlooked when viewing traditional sites of the cultural landscape.

Hawaiian Land Use and Resource Management Practices

Over the generations, the ancient Hawaiians developed a sophisticated system of land and resources management. By the time ʻUmi-a-Līloa rose to rule the island of Hawaiʻi in ca. 1525, the island (*moku-puni*) was divided into six districts or *moku-o-loko* (cf. Fornander 1973–Vol. II:100-102). On Hawaiʻi, the district of Kona is one of six major *moku-o-loko* within the island. The district of Kona itself, extends from the shore across the entire volcanic mountain of Hualālai, and continues to the summit of Mauna Loa, where Kona is joined by the districts of Kaʻū, Hilo, and Hāmākua. One traditional reference to the northern and southern-most coastal boundaries of Kona tells us of the district's extent:

> *Mai Ke-ahu-a-Lono i ke ʻā o Kani-kū, a hōʻea i ka ʻūlei kolo o Manukā i Kaulanamauna e pili aku i Kaʻū!*—From Keahualono [the Kona-Kohala boundary] on the rocky flats of Kanikū, to Kaulanamauna next to the crawling (tangled growth of) ʻūlei bushes at Manukā, where Kona clings to Kaʻū! (*Kaʻao Hoʻoniua Puʻuwai no Ka-Miki in Ka Hōkū o Hawaiʻi*, September 13, 1917; Translated by Kepā Maly)

Kona, like other large districts on Hawaiʻi, was further divided into ʻokana or kalana (regions of land smaller than the *moku-o-loko*, yet comprising a number of smaller units of land). In the region now known as Kona ʻakau (North Kona), there are several ancient regions (*kalana*) as well. The southern portion of North Kona was known as "Kona kai ʻōpua" (interpretively translated as: Kona of the distant horizon clouds above the ocean), and included the area extending from Lanihau (the present-day vicinity of Kailua Town) to Puʻuohau (now known as Red Hill). The northern-most portion of North Kona was called "Kekaha" (descriptive of an arid coastal place). Native residents of the region affectionately referred to their home as *Kekaha-wai-ʻole o nā Kona* (Waterless Kekaha of the Kona District), or simply as the *āina kaha*. It is within this region of Kekaha, that the lands of ʻOʻoma are found.

The *ahupuaʻa* were also divided into smaller individual parcels of land (such as the *ʻili, kōʻele, māla*, and *kīhāpai*, etc.), generally oriented in a *mauka-makai* direction, and often marked by stone alignments (*kuaiwi*). In these smaller land parcels the native tenants tended fields and cultivated crops necessary to sustain their families, and the chiefly communities with which they were associated. As long as sufficient tribute was offered and *kapu* (restrictions) were observed, the common people, who lived in a given *ahupuaʻa* had access to most of the resources from mountain slopes to the ocean. These access rights were almost uniformly tied to residency on a particular land, and earned as a result of taking responsibility for stewardship of the natural environment, and supplying the needs of the *aliʻi* (see Kamakau 1961:372-377 and Malo 1951:63-67).

Entire *ahupuaʻa*, or portions of the land were generally under the jurisdiction of appointed *konohiki* or lesser chief-landlords, who answered to an *aliʻi-ʻai-ahupuaʻa* (chief who controlled the *ahupuaʻa* resources). The *aliʻi-ʻai-ahupuaʻa* in turn answered to an *aliʻi ʻai moku* (chief who claimed the abundance of the entire district). Thus, *ahupuaʻa* resources supported not only the *makaʻāinana* and *ʻohana* who lived on the land, but also contributed to the support of the royal community of regional and/or island kingdoms. This form of district subdividing was integral to Hawaiian life and was the product of strictly adhered to resources management planning. In this system, the land provided fruits and vegetables and some meat in the diet, and the ocean provided a wealth of protein resources. Also, in communities with long-term royal residents, divisions of labor (with specialists in various occupations on land and in procurement of marine resources) came to be strictly adhered to. It is in this cultural setting that we find ʻOʻoma and the present study area.

The *ahupuaʻa* of ʻOʻoma (historically, ʻOʻoma 1st and 2nd) are two of some twenty ancient *ahupuaʻa* within the *ʻokana* of Kekaha-wai-ʻole. The place name ʻOʻoma can be literally translated as concave. To date, no tradition explaining the source of the place name has been located, though it is possible that the name refers to the indentation of the shoreline fronting a portion of ʻOʻoma. A few place names within ʻOʻoma were discussed in traditional accounts, thus we have some indication of the histories associated with this land.

While there are only limited native accounts that have been recorded about ʻOʻoma, we do know that the land was so esteemed, that during the youth of Kauikeaouli (later known as Kamehameha III), the young prince—son of Kamehameha I and his sacred wife Keōpūolani—was taken to be raised near the shore of ʻOʻoma under the care of his stewards from infancy until he was five years old (Kamakau 1961:263-264). Again, this is a significant part of the history of this land, as great consideration went into all aspects of the young king's upbringing (see Iʻi 1959 and Kamakau 1961).

The Environmental Setting of ʻOʻoma

The *ahupuaʻa* of ʻOʻoma cross several environmental zones that are generally called *wao* in the Hawaiian language. These environmental zones include the near-shore fisheries and shoreline strand (*kahakai*) and the *kula kai/kula uka* (shoreward/inland plains). These regional zones were greatly desired as places of residence by the natives of the land.

While the *kula* region of ʻOʻoma and greater Kekaha is now likened to a volcanic desert, native and historic accounts describe or reference groves of native hardwood shrubs and trees such as *ʻūlei* (*Osteomeles anthyllidifolia*), *ēlama* (*Diospyros ferrea*), *uhiuhi* (*Caesalpina kavaiensis*), and *ohe* (*Reynoldsia sandwicensis*) extending across the land and growing some distance shoreward. The few rare and endangered plants found in the region, along with small remnant communities of native dryland forest (Char 1991) give an indication that there was a significant diversity of plants growing upon the *kula* lands prior to the introduction of ungulates.

The lower *kula* lands receive only about 20 inches of rainfall annually, and it is because of their dryness, the larger region of which ʻOʻoma is a part, is known as "Kekaha." While on the surface, there appears to be little or no potable water to be found, the very lava flows which cover the land contain many underground streams that are channeled through subterranean lava tubes which feed the springs, fishponds and anchialine ponds on the *kula kai* (coastal flats). Also in this region, on the flat lands, about a half-mile from the shore, is the famed *Alanui Aupuni* (Government Trail), built in 1847, at the order of Kamehameha III. This trail or government roadway, was built to meet the needs of changing transportation in the Hawaiian Kingdom, and in many places it overlays the older near shore *ala loa* (ancient foot trail that encircled the island).

Continuing into the *kula uka* (inland slopes), the environment changes as elevation increases. Based on historic surveys, it appears that ʻOʻoma ends at a survey station named Kuhiaka, 2,145 feet above sea level (cf. Register Map No. 1449). This zone is called the *wao kanaka* (region of man) and *wao nahele* (forest region). Rainfall increases to 30 or 40 inches annually, and taller forest growth occurred. This region provided native residents with shelter for residential and agricultural uses, and a wide range of natural resources that were of importance for religious, domestic, and economic purposes. In ʻOʻoma, this region is generally between the 1,200 to 2,200 foot elevation, and is crossed by the present-day Māmalahoa Highway. The highway is situated not far below the ancient *ala loa*, or foot trail, also known as Ke-alaʻehu, and was part of a regional trail system passing through Kona from Kaʻū and Kohala.

The ancient Hawaiians saw (as do many Hawaiians today) all things within their environment as being interrelated. That which was in the uplands shared a relationship with that which was in the lowlands, coastal region, and even in the sea. This relationship and identity with place worked in reverse as well, and the *ahupuaʻa* as a land unit was the thread which bound all things together in Hawaiian life. In an early account written by Kihe (in *Ka Hōkū o Hawaiʻi*, 1914-1917), with contributions by John Wise and Steven Desha Sr., the significance of the dry season in Kekaha and the custom of the people departing from the uplands for the coastal region is further described:

> *…ʻOia ka wā e neʻe ana ka lā iā Kona, hele a maloʻo ka ʻāina i ka ʻai kupakupa ʻia e ka lā, a o nā kānaka, nā liʻi o Kona, pūheʻe aku la a noho i kahakai kāhi o ka wai e ola ai nā kānaka* – It was during the season, when the sun moved over Kona, drying and devouring the land, that the chiefs and people fled from the uplands to dwell along the shore where water could be found to give life to the people. (*Ka Hōkū o Hawaiʻi*, April 5, 1917)

It appears that the practice of traveling between upland and coastal communities in the ʻOʻoma *ahupuaʻa* greatly decreased by the middle nineteenth century. Indeed, the only claimant for *kuleana* land in ʻOʻoma,

during the *Māhele ʻĀina* of 1848—when native tenants were allowed to lay claim to lands on which they lived and cultivated—noted that he was the only resident in ʻOʻoma at the time (see *Helu* 9162 to Kahelekahi, in this study). This is perhaps explained by the fact that at time of the *Māhele* there was a significant decline in the Hawaiian population, and changes in Hawaiian land tenure led to the relocation of many individuals from various lands.

Native Traditions and Historical Accounts of ʻOʻoma and the Kekaha Region

This section of the study presents *moʻolelo*—native traditions and historical accounts (some translated from the original Hawaiian by Kepā Maly)—of the Kekaha region that span several centuries. There are very few accounts that have been found to date, that specifically mention ʻOʻoma. Thus, narratives that describe neighboring lands within the Kekaha region help provide an understanding of the history of ʻOʻoma, describing features and the use of resources that were encountered on the land.

It may be, that the reason there are so few accounts for ʻOʻoma, is that it may have been considered a marginal settlement area, occupied only after the better situated lands of Kekaha—those lands with the sheltered bays, and where fresh water could be easily obtained—were populated. As the island population grew, so too did the need to expand to more remote or marginal lands. This thought is found in some of the native traditions and early historic accounts below. However, as people populated the Kekaha lands, they came to value its fisheries—those of the deep sea, near shore, and inland fishponds.

The native account of Punia (also written Puniaiki – cf. Kamakau 1964), is perhaps among the earliest accounts of the Kekaha area, and in it is found a native explanation for the late settlement of Kekaha. The following narratives are paraphrased from Fornander's *Hawaiian Antiquities and Folklore* (Fornander 1959):

Punia: A Tale of Sharks and Ghosts of Kekaha

Punia was born in the district of Kohala, and was one of the children of Hina. One day, Punia desired to get lobster for his mother to eat, but she warned him of Kaiʻaleʻale and his hoards of sharks who guarded the caves in which lobster were found. These sharks were greatly feared by all who lived along, and fished the shores of Kohala for many people had been killed by the sharks. Heeding his mother's warning, Punia observed the habits of the sharks and devised a plan by which to kill each of the sharks. Setting his plan in motion, Punia brought about the deaths of all the subordinate sharks, leaving only Kaiʻaleʻale behind. Punia tricked Kaiʻaleʻale into swallowing him whole. Once inside Kaiʻaleʻale, Punia rubbed two sticks together to make a fire to cook the sweet potatoes he had brought with him. He also scraped the insides of Kaiʻaleʻale, causing great pain to the shark. In his weakened state, Kaiʻaleʻale swam along the coast of Kekaha, and finally beached himself at Alula, near the point of Maliu in the land of Kealakehe. The people of Alula, cut open the shark and Punia was released.

At that time Alula was the only place in all of Kekaha where people could live, for all the rest of the area was inhabited by ghosts. When Punia was released from the shark, he began walking along the trail, to return to Kohala. While on this walk, he saw several ghosts with nets all busy tying stones for sinkers to the bottom of the nets, and Punia called out in a chant trying to deceive the ghosts and save himself:

Auwe no hoi kuu makuakane o keia kaha e!	Alas, O my father of these coasts!
Elua wale no maua lawaia o keia wahi.	We were the only two fishermen of this place (Kaha).
Owau no o koʻu makuakane,	Myself and my father,
E hoowili aku ai maua i ka ia o ianei,	Where we used to twist the fish up in the nets,
O kala, o ka uhu, o ka palani,	The kala, the uhu, the palani,

O ka ia ku o ua wahi nei la,	The transient fish of this place.
Ua hele wale ia no e maua keia kai la!	We have traveled over all these seas,
Pau na kuuna, na lua, na puka ia.	All the different place, the holes, the runs.
Make koʻu makuakane, koe au.	Since you are dead, father, I am the only one left.

> Hearing Punia's wailing, the ghosts said among themselves, "Our nets will be of some use now, since here comes a man who is acquainted with this place and we will not be letting down our nets in the wrong place." They then called out to Punia, "Come here." When Punia went to the ghosts, he explained to them, the reason for his lamenting; "I am crying because of my father, this is the place where we used to fish. When I saw the lava rocks, I thought of him." Thinking to trick Punia and learn where all the kuʻuna (net fishing grounds) were, the ghosts told Punia that they would work under him. Punia went into the ocean, and one-by-one and two-by-two, he called the ghosts into the water with him, instructing them to dive below the surface. As each ghost dove into the water, Punia twisted the net entangling the ghosts. This was done until all but one of the ghosts had been killed. That ghost fled and Kekaha became safe for human habitation (Fornander 1959:9-17).

One of the earliest datable accounts that describes the importance of the Kekaha region fisheries comes from the mid-sixteenth century, following ʻUmi-a-Līloa's unification of the island of Hawaiʻi under his rule. Writing in the 1860s, native historian, Samuel Mānaiakalani Kamakau (1961) told readers about the reign of ʻUmi, and his visits to Kekaha:

> ʻUmi-a-Liloa did two things with his own hands, farming and fishing...and farming was done on all the lands. Much of this was done in Kona. He was noted for his skill in fishing and was called Puʻipuʻi a ka lawaiʻa (a stalwart fisherman). Aku fishing was his favorite occupation, and it often took him to the beaches (Ke-kaha) from Kalahuipuaʻa to Makaula[1]. He also fished for ʻahi and kala. He was accompanied by famed fishermen such as Pae, Kahuna, and all of the chiefs of his kingdom. He set apart fishing, farming and other practices… (Kamakau 1961:19-20)

In his accounts of events at the end of ʻUmi's life, Kamakau (1961) references Kekaha once again. He records that Koʻi, one of the faithful supporters and a foster son of ʻUmi, sailed to Kekaha, where he killed a man who resembled ʻUmi. Koʻi then took the body and sailed to Makaʻeo in the *ahupuaʻa* of Keahuolu. Landing at Makaʻeo in the night, Koʻi took the body to the cave where ʻUmi's body lay. Replacing ʻUmi's body with that of the other man, Koʻi then crossed the lava beds, returning to his canoe at Makaʻeo. From there, ʻUmi's body was taken to its' final resting place… (Kamakau 1961:32-33).

As a child in ca. 1812, Hawaiian historian John Papa Iʻi passed along the shores of Kekaha in a sailing ship, as a part of the procession by which Kamehameha I returned to Kailua-Kona from his residency on Oʻahu. In his narratives, Iʻi described the shiny lava flows and fishing canoe fleets of the "Kaha" (Kekaha) lands:

> The ship arrived outside of Kaelehuluhulu, where the fleet for aku fishing had been since the early morning hours. The sustenance of those lands was fish.
>
> When the sun was rather high, the boy [Iʻi] exclaimed, "How beautiful that flowing water is!" Those who recognized it, however, said, "That is not water, but pahoehoe. When the sun strikes it, it glistens, and you mistake it for water…"
>
> Soon the fishing canoes from Kawaihae, the Kaha lands, and Ooma drew close to the ship to trade for the paʻiʻai (hard poi) carried on board, and shortly a great quantity of aku lay silvery-hued on the deck. The fishes were cut into pieces and mashed; and all those aboard fell to and ate, the women by themselves.

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1 Kalāhuipuaʻa is situated in the district of Kohala, bounding the northern side of Puʻuanahulu in Kekaha. Makaʻula is situated a few *ahupuaʻa* north of ʻOʻoma.

> The gentle Eka sea breeze of the land was blowing when the ship sailed past the lands of the Mahaiulas, Awalua, Haleohiu, Kalaoas, Hoona, on to Oomas, Kohanaiki, Kaloko, Honokohaus, and Kealakehe, then around the cape of Hiiakanoholae…
> (I'i 1959:109-110)

Ka-Lani-Kau-i-ke-Aouli (Kamehameha III)

In ca. 1813, Ka-lani Kau-i-ke-aouli, who grew up to become Kamehameha III, was born. S.M. Kamakau (1961) tells us that the baby appeared to be still-born, but that shortly after birth, he was revived. Upon the revival of the baby, he was given to the care of Ka-iki-o-'ewa, who with Keawe-a-mahi and family, raised the child in seclusion at 'O'oma for the first five years of the young king's life. Kauikeaouli apparently held some interest in the land of 'O'oma 2nd through the Māhele 'Āina, as he originally claimed 'O'oma 2nd as his personal property. Though he subsequently gave it up to the Kingdom (Government) later during the Division (see records of *Māhele 'Āina* in this study).

Kamakau provides us with the following description of Kauikeaouli's birth and early life at 'O'oma:

> Ka-lani-kau-i-ke-aouli was the second son of Ke-opu-o-lani by Kamehameha, and she called him Kiwala'o after her own father. She was the daughter of Kiwala'o and Ke-ku'i-apo-iwa Liliha, both children of Ka-Iola Pupuka-o-Hono-ka-wai-lani, and hence she [Ke-opu-o- lani] was a ni'aupi'o and a naha chiefess, and the ni'aupi'o rank descended to her children and could not be lost by them. While she was carrying the child [Kau-i-ke-aouli] several of the chiefs begged to have the bringing up of the child, but she refused until her kahu, Ka-lua-i-konahale, known as Kua-kini, came with the same request. She bade him be at her side when the child was born lest some one else get possession of it. He was living this side of Keauhou in North Kona, and Ke-opu-o-lani lived on the opposite side.
>
> On the night of the birth the chiefs gathered about the mother. Early in the morning the child was born but as it appeared to be stillborn Kua-kini did not want to take it. Then came Ka-iki-o-'ewa from some miles away, close to Kuamo'o, and brought with him his prophet who said, "The child will not die, he will live." This man, Ka-malo-'ihi or Ka-pihe by name, came from the Napua line of kahunas descended from Makua-kau-mana whose god was Ka-'onohi-o-ka-la (similar to the child of God). The child was well cleaned and laid upon a consecrated place and the seer (kaula) took a fan (pe'ahi), fanned the child, prayed, and sprinkled it with water, at the same time reciting a prayer addressed to the child of God, something like that used by the Roman Catholics—
>
> "He is standing up, he is taking a step, he walks" (*Kulia-la, ka'ina-la, hele ia la*).
>
> Or another—
>
> | | |
> |---|---|
> | *Huila ka lani i ke Akua,* | The heavens lighten with the god, |
> | *Lapalapa ka honua i ke keiki* | The earth burns with the child, |
> | *E ke keiki e, hooua i ka punohu lani,* | O son, pour down the rain that brings the rainbow, [page 263] |
> | *Aia i ka lani ka Haku e,* | There in heaven is the Lord. |
> | *O ku'u 'uhane e kahe mau*, | Life flows through my spirit, |
> | *I la'a i kou kanawai.* | Dedicated to your law. |
>
> The child began to move, then to make sounds, and at last it came to life. The seer gave the boy the name of "The red trail" (Ke-aweawe-'ula) signifying the roadway by which the god descends from the heavens.
>
> Ka-iki-o-'ewa became the boy's guardian and took him to rear in an out-of-the-way place at 'O'oma, Kekaha. Here Keawe-a-mahi, the lesser chiefs, the younger brothers and sisters of Ka-iki-o-'ewa, and their friends were permitted to carry the child about and hold him on their

> laps (uha). Ka-pololu was the chief who attended him; Koʻi-pepeleleu and Ulu-nui's mother [were] the nurses who suckled him. Later Ka-ʻai-kane gave him her breast after she had given birth to Ke-kahu-puʻu. Here at ʻOʻoma he was brought up until his fifth year, chiefly occupied with his toy boats rigged like warships and with little brass cannon loaded with real powder mounted on [their] decks. The firing off of these cannon amused him immensely. He excelled in foot races. On one occasion when the bigger boys had joined in the sport, a [rascal] boy named Ka-hoa thought to play a practical joke by smearing with mud the stake set up to be grasped by the one who first reached the goal. He expected one of the larger boys to be the winner, but it was the little prince who first caught the stick and had his hands smeared. "You will be burnt alive for dirtying up the prince. We are going to tell Ka-pololu on you!" the boys threatened; but the prince objected, saying, "Anyone who tells on him shall never eat with me again or play with me and I will never give him anything again." Kau-i-ke-aouli was a splendid little fellow. He loved his playmates and never once did them any hurt, and he was kind and obedient to his teachers… [Kamakau 1961:264]

It is not until the early twentieth century, that we find a few detailed native accounts which tell of traditional features and residents of ʻOʻoma and vicinity. The writings of John Whalley Hermosa Isaac Kihe, a native son of Kekaha, in Hawaiian language newspapers (recently translated by Kepā Maly from the original Hawaiian texts), share the history of the land and sense the depth of attachment that native residents felt for ʻOʻoma and the larger Kekaha-wai-ʻole-o-nā-Kona.

> Kihe (who also wrote under the name of Ka-ʻohu-haʻaheo-i-nā-kuahiwi-ʻekolu) was born in 1853, his parents were native residents of Honokōhau and Kaloko (his grandfather, Kuapāhoa, was a famed kahuna of the Kekaha lands). During his life, Kihe taught at various schools in the Kekaha region; served as legal counsel to native residents applying for homestead lands in ʻOʻoma and vicinity; worked as a translator on the Hawaiian Antiquities collections of A. Fornander; and was a prolific writer himself. In the later years of his life, Kihe lived at Puʻu Anahulu and Kalaoa, and he is fondly remembered by elder kamaʻāina of the Kekaha region. Kihe, who died in 1929, was also one of the primary informants to Eliza Maguire, who translated some of the writings of Kihe, publishing them in abbreviated form in her book "Kona Legends" (1926).

Writers today have varying opinions and theories pertaining to the history of Kekaha, residency patterns, and practices of the people who called Kekaha-wai-ʻole-o-nā-Kona home. For the most part, our interpretations are limited by the fragmented nature of the physical remains and historical records, and by a lack of familiarity with the diverse qualities of the land. As a result, most of us only see the shadows of what once was, and it is difficult at times, to comprehend how anyone could have carried out a satisfactory existence in such a rugged land.

Kihe and his co-authors provide readers with several references to places and events in the history of ʻOʻoma and neighboring lands. Through the narratives, we learn of place name origins, areas of ceremonial significance, how resources were managed and accessed, and the practices of those native families who made this area their home.

One example of the rich materials recorded by native writers, is found in "*Kaʻao Hoʻoniua Puʻuwai no Ka-Miki*" (The Heart Stirring Story of Ka-Miki). This tradition is a long and complex account, that was published over a period of four years (1914-1917) in the weekly Hawaiian-language newspaper *Ka Hōkū o Hawaiʻi*. The narratives were primarily recorded for the paper by Hawaiian historians John Wise and J.W.H.I. Kihe.

While "*Ka-Miki*" is not an ancient account, the authors used a mixture of local stories, tales, and family traditions in association with place names to tie together fragments of site-specific histories that had been handed down over the generations. Also, while the personification of individuals and their associated place names may not be entirely "ancient," such place name-person accounts are common throughout Hawaiian (and Polynesian) traditions. The English translations below are a synopsis of the Hawaiian texts, with emphasis upon the main events and areas being discussed. Diacritical marks and hyphenation have been placed to help with pronunciation of certain words.

"Kaao Hooniua Puuwai no Ka-Miki" (The Heart stirring Story of Ka-Miki)

This *mo'olelo* (tradition) is set in the 1300s (by association with the chief Pili-a-Ka'aiaea), and is an account of two supernatural brothers, Ka-Miki (The quick, or adept, one) and Ma-Ka'iole (Rat [squinting] eyes). The narratives describe the birth of the brothers, their upbringing, and their journey around the island of Hawai'i along the ancient *ala loa* and *ala hele* (trails and paths) that encircled the island. During their journey, the brothers competed alongside the trails they traveled, and in famed *kahua* (contest fields) and royal courts, against *'ōlohe* (experts skilled in fighting or in other competitions, such as running, fishing, debating, or solving riddles, that were practiced by the ancient Hawaiians). They also challenged priests whose dishonorable conduct offended the gods of ancient Hawai'i. Ka-Miki and Ma-Ka'iole were empowered by their ancestress Ka-uluhe-nui-hihi-kolo-i-uka (The great entangled growth of uluhe fern which spreads across the uplands), who was one of the myriad of body forms of the goddess Haumea, the earth-mother, creative force of nature who was also called Papa or Hina. Among her many nature-form attributes were manifestations that caused her to be called upon as a goddess of priests and competitors (people, places named for them, and other place names are marked below with underlining):

> …Kūmua was the husband of Ka-uluhe-nui-hihi-kolo-i-uka. The place that is named for Kūmua is in the uplands of Kohanaiki, an elevated rise from where one can look towards the lowlands. The shore and deep sea are all clearly visible from this place. The reason that Kūmua dwelt there was so that he could see the children and grandchildren of he and his wife.
>
> Wailoa, a daughter, was the mother of Kapa'ihilani, also called Kapa'ihi. There is a place in the uplands of Kohanaiki, below Kūmua, to the northwest, a hidden water hole, that is called Kapa'ihi. Wailoa is a pond there on the shore of Kohanaiki. Because Wailoa married Kahunakalehu, a native of the area, she lived and worked there. Thus the name of that pond is Wailoa, and it remains so to this day.
>
> Pipipi'apo'o was another daughter of Kūmua and Ka-uluhe-nui-hihi-kolo-i-uka. She married Haleolono, one who cultivated sweet potatoes upon the 'ilima covered flat lands of Nānāwale, also called Nāhi'ahu (Nāwah'iahu), as it has been called from before and up to the present time. Cultivating the land was the skill of this youth Haleolono, and because he was so good at it, he was able to marry the beauty, Pipipi'apo'o.
>
> Pipipi'apo'o's skill was that of weaving pandanus mats, and there are growing many pandanus trees there, even now. The grove of pandanus trees and a nearby cave, is called Pipipi'apo'o to this day, and you may ask the natives of Kohanaiki to point it out to you.
>
> Kapukalua was a son of Kūmua and Ka'uluhe. He was an expert at aku lure fishing, and all other methods of fishing of those days gone by. He married Kauhi'onohua a beauty with skin as soft as the blossoms of the hīnano, found in the pandanus grove of 'O'oma. This girl was pleasingly beautiful, and because of her fame, Kapukalua, the exceptionally skilled son of the sea spray of 'Apo'ula, secured her as his wife. Here, we shall stop speaking of the elders of Ka-Miki… [January 8, 1914]

The tradition continues, recounting the training of the brothers, and preparations of their *hālau ali'i* (royal compound) at Kohanaiki. At the dedication ceremonies it was revealed that one of the *kahuna* of the Kaha lands, had taken up the habit of killing people, and that he had also thought to take the lives of Ka-Miki and Ma-Ka'iole. We revisit the story here, and learn the name of a priest of 'O'oma and Kohanaiki—

> …The sun broke forth and the voices of the roosters and the 'elepaio of the forests were heard resonating and rising upon the mountain slopes. The day became clear, with no clouds to be seen, it was calm. So too, the ocean was calm and the shore of La'i a 'Ehu (Kona) was calm. The flowers of the upland forest reddened and unfolded, and nodded gently in the kēhau breezes.

> The priests gathered together to discuss these events and prepared to apologize to the children of the chief, asking for their forgiveness. They selected ʻElepaio, Pūhili, Kaluaʻōlapa, and Kalua-ʻōlapa-uwila to go before the brothers for this purpose.
>
> ʻElepaio was the high priest of Honokōhau. The place where he dwelt bears the name ʻElepaio [an ʻili on the boundary of Honokōhau nui & iki]. It is in the great grove of *ʻulu (kaulu ʻulu)* on the boundary between Honokōhau-nui and Honokōhau-iki… [April 23, 1914]
>
> Pūhili was the high priest of ʻOʻoma and Kohanaiki, the place where he lived is on the plain of Kohanaiki, at the shore, and bears his name to this day. It is on the boundary between Kohanaiki and ʻOʻoma.
>
> Kaluaʻōlapa was the high priest of Haleʻōhiʻu and Kamāhoe, that is the waterless land of Kalaoa (Kalaoa wai ʻole). The place where he lived was in the uplands of Maulukua on the plain covered with *ʻilima* growth. This place bears his name to this day.
>
> Kalua-ʻōlapa-uwila was the high priest of Kealakehe and Keʻohuʻolu (Keahuolu), and it was he who built the *heiau* named Kalua-ʻōlapa-uwila, which is there along the shore of Kealakehe, next to the road that goes to Kailua. The nature of this priest was that of a shark and a man. The shark form was named Kaiwi, and there is a stone form of the shark that can be seen near the *heiau* to this day.
>
> These priests all went to the door of the house and presented the offerings of the black pig, the red fish, the black *ʻawa*, the white rooster, the *malo* (loin clothes), and all things that had been required of their class of priests. They also offered their prayers and asked forgiveness for their misspoken words. They then called for their prayers to be freed and the *kapu* ended… [April 30, 1914]

Through the 1920s, up to the time of his death in 1929, J.W.H.I. Kihe continued to submit traditional accounts and commentary on the changing times to the paper, *Ka Hōkū o Hawaiʻi*. In 1923, Kihe penned a series of articles, some of which formed the basis of Eliza Maguire's *Kona Legends* (1926). One of the accounts, "*Ka Punawai o Wawaloli*" (The Pond of Wawaloli), describes that the pond of Wawaloli, on the shore of ʻOʻoma, was named for a supernatural ocean being, who could take the form of the *loli* (sea cucumber) and of a handsome young man. Through this account it is learned that people regularly traveled between the uplands and shore of ʻOʻoma; the *kula* lands were covered with *ʻilima* growth; and that a variety of fish, seaweeds, and shellfish were harvested along the shore. Also, the main figures in the tradition are memorialized as places on the lands of ʻOʻoma, Kalaoa, and neighboring *ahupuaʻa*. These individuals and places include Kaluaʻōlapa (a hill on the boundary of Hāmanamana and Haleohiʻu), Wawaloli (a bay between ʻOʻoma and Kalaoa), Hoʻohila (on the boundary of Kaū and Puʻukala), Pāpaʻapoʻo (a cave site in Hāmanamana), Kamakaoiki and Malumaluiki (locations unknown). The following narratives were translated by Kepā Maly from the original Hawaiian texts published in *Ka Hōkū o Hawaiʻi* (September 23rd, October 4th & 11th, 1923):

Ka Punawai o Wawaloli (The Pond of Wawaloli)

> The place of this pond (Wawaloli) is set there on the shore of the ʻOʻoma near Kalaoa. It is a little pond, and is there to this day. It is very close to the sandy shore, and further towards the shore there is also a pond in which one can swim. There is a tradition of this pond, that is held dearly in the hearts of the elders of this community.
>
> Wawaloli is the name of a loli (sea cucumber) that possessed dual body forms (kino pāpālua), that of a loli, and that of a man!
>
> Above there on the ʻilima covered flat lands, there lived a man by the name of Kaluaʻōlapa and his wife, Kamakaoiki, and their beautiful daughter, Malumaluiki.
>
> One day the young maiden told her mother that she was going down to the shore to gather limu (seaweeds), ʻōpihi (limpets), and pupu (shellfish). Her mother consented, and so the

maiden traveled to the shore. Upon reaching the shore, Malumaluiki desired to drink some water, so she visited the pond and while she was drinking she saw a reflection in the rippling of the water, standing over her. She turned around and saw that there was a handsome young man there, with a smile upon his face. He said… [September 27, 1923] "…Pardon me for startling you here as we meet at this pond, in the afternoon heat which glistens off of the pāhoehoe."

She responded, "What is the mistake of our meeting, you are a stranger, and I am a stranger, and so we have met at this pond." The youth, filled with desire for the beautiful young maiden, answered "I am not a stranger here along this shore, indeed, I am very familiar with this place for this is my home. And when I saw you coming here, I came to meet you."

These two strangers, having thus met, then began to lay out their nets to catch kala, uhu, and pālani, the native fish of this land. And in this way, the beauty of the plains of Kalaoa was caught in the net of the young man who dwelt in the sea spray of ʻOʻoma.

These two strangers of the long day also fished for hīnālea, and then for kawele'ā. It was during this time, that their lines became entangled like those of the fishermen of Wailua (a poetic reference to those who become entangled in a love affair).

The desire for the limu, ʻōpihi, and pūpū was completely forgotten, and the fishing poles bent as the lines were pulled back in the sea spray. The handsome youth was moistened in the rains that fell, striking the land and the beloved shore of the land. The sun drew near, entering the edge of the sea and was taken by Lehua Island. Only then did these two fishers of the long day take up their nets.

Before the young maiden began her return to the uplands, she told the youth, "Tell me your name." He answered her, "The name by which I am known by, is Wawa. But my name, when I go and dwell in the pond here, is Loli. And when you return, you may call to me with the chant:

E Loli nui kīkewekewe[2]	Oh great Loli moving back and forth
I ka hana ana kīkewekewe	Doing your work moving back and forth
I kuʻu piko kīkewekewe	You are in my mind moving back and forth
A ka makua kīkewekewe	The parents moving back and forth
I hana ai kīkewekewe	Are at their work moving back and forth
E piʻi mai ʻoe kīkewekewe	Won't you arise moving back and forth
Ka kaua puni kīkewekewe	To that which we two desire moving back and forth
Puni kauoha kīkewekewe	Your command is desired moving back and forth

Having finished their conversation, the maiden then went to the uplands. It was dark, and the kukui lamps had been lit in the house. Malumaluiki's parents asked her, "Where are your limu, ʻōpihi and pūpū?" She replied, "It is proper that you have asked me, for when I went to the shore it was filled with people who took all there was? Thus I was left with nothing, not even a fragment of limu or anything else. So I have returned up here."

Well, the family meal had been made ready, so they all sat to eat together. But after a short while the maiden stood up. Her parents inquired of this, and she said she was no longer hungry, and that her feet were sore from traveling the long path. So the maiden went to sleep. She did not sleep well though, and felt a heat in her bosom, as she was filled with desire, thus she had no sleep that night.

[2] "Kīkewekewe" is translated by Eliza Maguire (1926) as "charmer." Kepā Maly was unfamiliar with this meaning of the word. It is most commonly used in the refrain of a song, and is here translated as "moving back and forth," as the word is used in the spoken language. Kewe also means concave, similar to the place name ʻOʻoma.

With the arrival of the first light of day, the Malumaluiki went once again down to the shore. Upon arriving at the place of the pond, she entered the water and called out as described above. Then, a loli appeared and turned into the handsome young man. They two then returned to their fishing for the kala, uhu and pālani, the native fish the land.

So it was that the two lovers met regularly there on the shore of ʻOʻoma. Now Malumaluiki's parents became suspicious because of the actions of the daughter, and her regular trips to the shore. So they determined that they should secretly follow her and spy on her.

One day, the father followed her to the shore, where he saw his daughter sit down by the side of the pond. He then heard her call out—

E Loli nui kīkewekekewe	Oh great Loli moving back and forth
I ka hana ana kīkewekekewe	Doing your work moving back and forth
I kuʻu piko kīkewekekewe	You are the center of my life moving back and forth
Piko maikaʻi kīkewekekewe	It is good moving back and forth
A ka makua kīkewekekewe	The parents moving back and forth
I hana ai kīkewekekewe	Are at their work moving back and forth
E piʻi mai ʻoe kīkewekekewe	Won't you arise moving back and forth
Ka kaua puni kīkewekekewe	To that which we two desire moving back and forth
Puni kauoha kīkewekekewe	Your command is desired moving back and forth

[October 4, 1923]

"O Loli, here is your desire, the one you command, Malumaluiki, who's eyes see nothing else."

Her father then saw a loli coming up from the pond, and when it was up, it turned into the youth. He watched the two for a while, unknown to them, and saw that his daughter and the youth of the two body forms (kino pāpālua), took their pleasure in one another.

The father returned to the uplands and told all of this to her mother, who upon hearing it, was filled with great anger, because of the deceitfulness of her daughter. But then she learned that the man with whom her daughter slept was of dual body forms. Kamakaoiki then told Kaluaʻōlapa that he should "Go down and capture the loli, and beat it to death," to which he agreed.

One day, Kaluaʻōlapa went down early, and hid, unseen by the two lovers. Malumaluiki arrived at the pond and called out, and he then memorized the lines spoken by his daughter. When she left, returning to the uplands, he then went to the pond and looked closely at it. He then saw a small circular opening near the top of the water in the pond. He then understood that that was where the loli came up from. He then slept that night and in the early morning, he went to the pond and set his net in the water. He then began to call out as his daughter had done with the above words.

When he finished the chant, the loli began to rise up through the hole, and was ensnared in the net. Kaluaʻōlapa then carried him up onto the kula, walking to the uplands. On his way, he saw his daughter coming down, and he hid until she passed him by.

When the daughter arrived at the pond, she called out in the chant as she always did. She called and called until the sun was overhead, but the loli did not appear in the pond, nor did he come forward in his human form. Thus, she thought that he had perhaps died, and she began to wail and mourn for the loss of her lover. Finally as evening came, the beautiful maiden stood, and ascended the kula to her home.

Now, let us look back to the Kaluaʻōlapa. He went up to his house and showed the loli to his wife. Seeing the loli, she told her husband, "Take it to the kahuna, Pāpaʻapoʻo who lives on

> the kula of Hoʻohila." So he went to the kahuna and explained everything that had occurred to him, and showed him the loli in his net. Seeing this and hearing of all that had happened, Pāpaʻapoʻo told the father to build an imu in which to kālua the great loli that moves back and forth (loli kīkewekewe). He said, "When the loli is killed, then your daughter will be well, so too will be the other daughters of the families of the land." Thus, the imu was lit and the supernatural loli cooked.
>
> When the daughter returned to her home, her eyes were all swollen from crying. Her mother asked her, "What is this, that your eyes are puffy from crying, my daughter?" She didn't answer, she just kneeled down, giving no response. At that time, her father returned to the house and saw his daughter kneeling down, and he said "Your man, with whom you have been making love at the beach has been taken by the kahuna Pāpaʻapoʻo. He has been cooked in the imu that you may live, that all of the girls who this loli has loved may live."
>
> That pond is still there on the shore, and the place with the small round opening is still on the side of that pond to this day. It is something to remember those things of days gone by, something that should not be forgotten by those of today and in time to come. [October 11, 1923]

Ka Loko o Paaiea (The Fishpond of Pāʻaiea)

The tradition of *Ka loko o Paaiea* (The fishpond of Pāʻaiea) was written by J.W.H.I. Kihe, and printed in *Ka Hōkū o Hawaiʻi* in 1914 and 1924. The narratives describe traditional life and practices in various *ahupuaʻa* of Kekaha, and specifically describes the ancient fishpond Pāʻaiea. The following excerpts from Kihe's *moʻolelo*, include references to Wawaloli, on the shore of ʻOʻoma and Kalaoa. Pāʻaiea, was destroyed by the Hualālai lava flows of 1801, reportedly as a result of the pond overseer's refusal to give the goddess Pele—traveling in human form—any fish from the pond:

> Pāʻaiea was a great fishpond, something like the ponds of Wainānāliʻi and Kīholo, in ancient times. At that time the high chiefs lived on the land, and these ponds were filled with fat awa, ʻanae, āhole, and all kinds of fish that swam inside. It is this pond that was filled by the lava flows and turned into pāhoehoe, that is written of here. At that time, at Hoʻonā. There was a Konohiki (overseer), Kepaʻalani, who was in charge of the houses (hale papaʻa) in which the valuables of the King [Kamehameha I] were kept. He was in charge of the King's food supplies, the fish, the hālau (long houses) in which the fishing canoes were kept, the fishing nets and all things. It was from there that the King's fishermen and the retainers were provisioned. The houses of the pond guardians and Konohiki were situated at Kaʻelehuluhulu and Hoʻonā.
>
> In the correct and true story of this pond, we see that its boundaries extended from Kaʻelehuluhulu on the north, and on the south, to the place called Wawaloli (between ʻOʻoma and Kalaoa). The pond was more than three miles long and one and a half miles wide, and today, within these boundaries, one can still see many water holes.
>
> While traveling in the form of an old woman, Pele visited the Kekaha region of Kona, bedecked in garlands of the *koʻokoʻolau* (*Bidens* spp.). Upon reaching Pāʻaiea at Hoʻonā, Pele inquired if she might perhaps have an *ʻamaʻama*, young *āholehole*, or a few *ʻōpae* (shrimp) to take home with her. Kepaʻalani, refused, "they are *kapu*, for the King." Pele then stood and walked along the *kuapā* (ocean side wall) of Pāʻaiea till she reached Kaʻelehuluhulu. There, some fishermen had returned from aku fishing, and were carrying their canoes up onto the shore…
>
> …Now because Kepaʻalani was stingy with the fishes of the pond Pāʻaiea, and refused to give any fish to Pele, the fishpond Pāʻaiea and the houses of the King were all destroyed by the lava flow. In ancient times, the canoe fleets would enter the pond and travel from Kaʻelehuluhulu to Hoʻonā, at Uaʻuʻālohi, and then return to the sea and go to Kailua and the other places of Kona. Those who traveled in this manner would sail gently across the pond pushed forward by the ʻ*Eka* wind, and thus avoid the strong currents which pushed out from the point of Keāhole

> It was at Hoʻonā that Kepaʻalani dwelt, that is where the houses in which the chiefs valuables (*hale papaʻa*) were kept. It was also one the canoe landings of the place. Today, it is where the light house of America is situated. Pelekāne (in Puʻukala) is where the houses of Kamehameha were located, near a stone mound that is partially covered by the *pāhoehoe* of Pele. If this fishpond had not been covered by the lava flows, it would surely be a thing of great wealth to the government today… [J.W.H.I. Kihe in *Ka Hoku o Hawaii*; compiled and translated by Maly, from the narratives written February 5-26, 1914 and May 1-15, 1924].

Na Hoʻomanao o ka Manawa (The Recollections of a Native Son)

Later in 1924, Kihe, described the changes which had occurred in the Kekaha region since his youth. In the following article, titled *Na Hoʻomanao o ka Manawa* (in *Ka Hōkū o Hawaiʻi* June 5th & 12th 1924), Kihe wrote about the villages that were once inhabited throughout Kekaha, identifying families, practices, and schools of the historic period (ca. 1860-1924). In the two part series (translated by Maly), he also shared his personal feelings about the changes that had occurred, including the demise of the families and the abandonment of the coastal lands of Kekaha.

> There has arisen in the mind of the author, some questions and thoughts about the nature, condition, living, traveling, and various things that bring pleasure and joy. Thinking about the various families and the many homes with their children, going to play and strengthening their bodies.
>
> In the year 1870, when I was a young man at the age of 17 years old, I went to serve as the substitute teacher at the school of Honokōhau. I was teaching under William G. Kanakaʻole who had suffered an illness (maʻi-lolo, a stroke).
>
> In those days at the Hawaiian Government Schools, the teachers were all Hawaiian and taught in the Hawaiian language. In those days, the students were all Hawaiian as well, and the books were in Hawaiian. The students were all Hawaiian… There were many, many Hawaiian students in the schools, no Japanese, Portuguese, or people of other nationalities. Everyone was Hawaiian or part Hawaiian, and there were only a few part Hawaiians.
>
> The schools included the school house at Kīholo where Joseph W. Keala taught, and later J.K. Kaʻailuwale taught there. At the school of Makalawena, J. Kaʻelemakule Sr., who now resides in Kailua, was the teacher. At the Kalaoa School, J.U. Keaweʻake was the teacher. There were also others here, including myself for four years, J. Kainuku, and J.H. Olohia who was the last one to teach in the Hawaiian language. At Kaloko, Miss Kaʻaimahuʻi was the last teacher before the Kaloko school was combined as one with the Honokōhau school where W.G. Kanakaʻole was the teacher. I taught there for two years as well... [Kihe includes additional descriptions on the schools of Kona]
>
> It was when they stopped teaching in Hawaiian, and began instructing in English, that significant changes took place among our children. Some of them became puffed up and stopped listening to their parents. The children spoke gibberish (English) and the parents couldn't understand (*nā keiki namu*). Before that time, the Hawaiians weren't marrying too many people of other races. The children and their parents dwelt together in peace with the children and parents speaking together… [June 5, 1924]
>
> …Now perhaps there are some who will not agree with what I am saying, but these are my true thoughts. Things which I have seen with my own eyes, and know to be true…In the year 1870 when I was substitute teaching at Honokōhau for W.G. Kanakaʻole, I taught more than 80 students. There were both boys and girls, and this school had the highest enrollment of students studying in Hawaiian at that time [in Kekaha]. And the students then were all knowledgeable, all knew how to read and write.

Now the majority of those people are all dead. Of those things remembered and thought of by the people who yet remain from that time in 1870; those who are here 53 years later, we cannot forget the many families who lived in the various (*ʻāpana*) land sections of Kekaha.

From the lands of Honokōhau, Kaloko, Kohanaiki, the lands of ʻOʻoma, Kalaoa, Haleʻohiʻu, Makaʻula, Kaū, Puʻukala-ʻŌhiki, Awalua, the lands of Kaulana, Mahaiʻula, Makalawena, Awakeʻe, the lands of Kūkiʻo, Kaʻūpūlehu, Kīholo, Keawaiki, Kapalaoa, Puʻuanahulu, and Puʻuwaʻawaʻa. These many lands were filled with people in those days.

There were men, women, and children, the houses were filled with large families. Truly there were many people [in Kekaha]. I would travel around with the young men and women in those days, and we would stay together, travel together, eat together, and spend the nights in homes filled with aloha.

The lands of Honokōhau were filled with people in those days, there were many women and children with whom I traveled with joy in the days of my youth. Those families are all gone, and the land is quiet. There are no people, only the rocks remain, and a few scattered trees growing, and only occasionally does one meet with a man today [1924]. One man and his children are all that remain.

Kaloko was the same in those days, but now, it is a land without people. The men, the women, and the children are all gone, they have passed away. Only one man, J.W. Haʻau, remains. He is the only native child (keiki kupa) besides this author, who remains.

At Kohanaiki, there were many people on this land between 1870 and 1878. These were happy years with the families there. In those years Kaiakoili was the haku ʻāina (land overseer)...

Now the land is desolate, there are no people, the houses are quiet. Only the houses remain standing, places simply to be counted. I dwelt here with the families of these homes. Indeed it was here that I dwelt with my kahu hānai (guardian), the one who raised me. All these families were closely related to me by blood. On my fathers' side, I was tied to the families of Kaloko [J.W.H.I. Kihe's father was Kihe, his grandfather was Kuapāhoa, a noted kahuna of Kaloko]. I am a native of these lands.

The lands of ʻOʻoma, and Kalaoa, and all the way to Kaulana and Mahaiʻula were also places of many people in those days, but today there are no people. At Mahaiʻula is where the great fishermen of that day dwelt. Among the fishermen were Poʻokoʻai mā, Pāʻaoʻao senior, Kaʻao mā, Kaiʻa mā, Kaʻāʻīkaula mā, Pāhia mā, and John Kaʻelemakule Sr., who now dwells at Kailua.

Kaʻelemakule moved from this place [Mahaiʻula] to Kailua where he prospered, but his family is buried there along that beloved shore (kapakai aloha). He is the only one who remains alive today… At Makalawena, there were many people, men, women, and their children. It was here that some of the great fishermen of those days lived as well. There were many people, and now, they are all gone, lost for all time.

Those who have passed away are Kahaʻialiʻi mā, Mamaʻe mā, Kapehe mā, Kauaionuʻuanu mā, Hopulāʻau mā, Kaihemakawalu mā, Kaomi, Keoni Aihaole mā, and Pahukula mā. They are all gone, there only remains the son-in-law of Kauaionuʻuanu, J.H. Mahikō, and Jack Punihaole, along with their children, living in the place where Kauaionuʻuanu and Ahu once lived.

At Kūkiʻo, not one person remains alive on that land, all are gone, only the ʻaʻā remains. It is the same at Kaʻūpūlehu, the old people are all gone, and it is all quiet…[June 12, 1924]

Ko Keoni Kaelemakule Moolelo Ponoi – Kakau ponoi ia mai no e ia (The True Story of John Ka‘elemakule – Actually written by him[3])

In the period between 1928 and 1930, John Ka‘elemakule Sr., who was a native of Kekaha, living at Mahai‘ula, Kaulana and Kohanaiki, wrote a series of articles that were published in serial form in *Ka Hōkū o Hawai‘i*. The story is a rich account of life in Kekaha between 1854 and 1900. Ka‘elemakule’s texts introduce us to the native residents of Kekaha, and include descriptions of the practices and customs of the families who resided there. In the following excerpts from Ka‘elemakule’s narratives (translated by Kepā Maly), we find reference once again to ‘O‘oma and neighboring lands, and the practices associated with procuring water in this region:

> *“Kekaha Wai Ole o na Kona”* (Waterless Kekaha of Kona)
>
> …We have seen the name “Kekaha wai ole o nā Kona” since the early part of my story in *Ka Hōkū o Hawai‘i*, and we have also seen it in the beautiful tradition of Mākālei. An account of the boy who dwelt in the uplands of Kekaha wai ‘ole, that was told by Ka-‘ohu-ha‘aheo-i-nā-kuahiwi-‘ekolu [the penname used by J.W.H.I. Kihe]. I think that certain people may want to know the reason and meaning of this name. So it is perhaps a good thing for me to explain how it came about. The source of it is that in this land of Kekaha even in the uplands, between Kaulana in the north and ‘O‘oma in the south, there was no water found even in the ancient times. For a little while, I lived in the uplands of Kaulana, and I saw that this land of Kekaha was indeed waterless.
>
> The water for bathing, washing one’s hands or feet, was the water of the banana stump (*wai pūma‘ia*). The *pūmai‘a* was grated and squeezed into balls to get the juice. The problem with this water is that it makes one itchy, and one does not really get clean. There were not many water holes, and the water that accumulated from rain dried up quickly. Also there would be weeks in which no rain fell… The water which the people who lived in the uplands of Kekaha drank, was found in caves. There are many caves from which the people of the uplands got water… [September 17, 1929:3]
>
> …The *kūpuna* had very strict *kapu* (restrictions) on these water caves. A woman who had her menstrual cycle could not enter the caves. The ancient people kept this as a sacred *kapu* from past generations. If a woman did not know that her time was coming and she entered the water cave, the water would die, that is, it would dry up. The water would stop dripping. This was a sign that the *kapu* of Kāne-of-the-water-of-life (Kaneikawaiola) had been desecrated. Through this, we learn that the ancient people of Kekaha believed that Kāne was the one who made the water drip from within the earth, even the water that entered the sea from the caves. This is what the ancient people of Kekaha wai ‘ole believed, and there were people who were *kia‘i* (guardians) who watched over and cleaned the caves, the house of Kāne… [September 24, 1929:3]
>
> When the *kapu* of the water cave had been broken, the priest was called to perform a ceremony and make offerings. The offerings were a small black pig; a white fish, and *āholehole*; young taro leaves; and *awa*. When the offering was prepared, the priest would chant to Kane:
>
> | | |
> |---|---|
> | *E Kane i uka, e Kane i kai,* | O Kane in the uplands, O Kāne at the shore, |
> | *E Kane i ka wai, eia ka puaa*, | O Kane in the water, here is the pig, |
> | *Eia ka awa, eia ka luau,* | Here is the ‘awa, here are the taro greens, |
> | *Eia ka ia kea.* | Here is the white fish. |

[3] This account was published in serial form in the Hawaiian newspaper *Ka Hōkū o Hawai‘i*, from May 29, 1928 to March 18, 1930. The translated excerpts in this section include narratives that describe Mahai‘ula and nearby lands in Kekaha with references to families, customs, practices, ceremonial observances, and sites identified in text. The larger narratives also include further detailed accounts of Ka‘elemakule’s life, and business ventures. A portion of the narratives pertaining to fishing customs (November 13, 1928 to March 12, 1929), and canoeing practices (March 19 to May 21, 1929) were translated by M. Kawena Pukui, and may be viewed in the Bishop Museum-Hawaiian Ethnological Notes (BPBM Archives).

Then all those people of the uplands and coast joined together in this offering, saying:

He mohai noi keia ia oe e Kane,	This is a request offering to you o Kāne,
E kala i ka hewa o ke kanaka i hana ai,	Forgive the transgression done by man,
A e hoomaemae i ka hale wai,	Clean the water house (source),
A e hoonui mai i ka wai o ka hale,	Cause the water to increase in the house,
I ola na kanaka,	That the people may live,
Na ohua o keia aina wai ole.	Those who are dependent on this waterless land.
Amama.	It is finished…

[October 1, 1929:3; Kepā Maly, translator]

It is not surprising today, when we hear of caves in which cultural materials are found. Along trails, near residences, and in once remote areas, a wide range of uses occurred. Caves in the Kekaha lands were used to store items, keep planting shoots cool and fresh for the next season, to hide or take shelter in, to catch water, and as burial sites.

Land Tenure in ʻOʻoma and Vicinity

Through the traditions and early historical accounts cited above, we see that there are descriptions of early residences and practices of the native families on the lands of ʻOʻoma and within greater Kekaha. Importantly, we find chiefly associations with the land of ʻOʻoma 2nd, as documented by the residency of the chiefs Kaikioʻewa, Keaweamahi, their families and retainers, while they were serving as the guardians of the young king, Kauikeaouli (Kamehameha III in ca. 1813-1818; Kamakau 1961 and Gov. Kapeau, 1847 in this study). Among the earliest government records documenting residency in ʻOʻoma and vicinity, are those of the *Māhele ʻĀina* (Land Division), Interior and Taxation Departments, Roads and Public Works, and the Government Survey Division.

This section of the study describes land tenure (residency and land use) and identifies families associated with ʻOʻoma and it's neighboring lands. The documentation is presented in chronologically within the following subsections, The *Māhele ʻĀina* (1848): Disposition of ʻOʻoma, Land Grants in ʻOʻoma and Vicinity (1855-1864), The Government Homesteading Program in Kekaha, Field Surveys of J.S. Emerson (1882-1889), and Trails and Roads of Kekaha (Governmental Communications).

A review of the records below reveals that none of the claims by native tenants made during the *Māhele*, or any of the applications for Royal Patent Grants, included lands that are a part of the current development area.

The *Māhele ʻĀina* (1848): Disposition of ʻOʻoma

In Precontact Hawaiʻi, all land, ocean, and natural resources were held in trust by the high chiefs (*aliʻi ʻai ahupuaʻa* or *aliʻi ʻai moku*). The use of land, fisheries and other resources were given to the *hoaʻāina* (native tenants) at the prerogative of the *aliʻi* and their representatives or land agents (*konohiki*), who were considered lesser chiefs. By 1845, the Hawaiian system of land tenure was being radically altered, and the foundation for implementing the *Māhele ʻĀina* was set in place, system of fee-simple right of ownership.

As the *Māhele* evolved, it defined the land interests of Kauikeaouli (King Kamehameha III), some 252 high-ranking *Aliʻi* and *Konohiki*, and the Government. As a result of the *Māhele*, all land in the Kingdom of Hawaiʻi came to be placed in one of three categories: (1) Crown Lands (for the occupant of the throne); (2) Government Lands; and (3) *Konohiki* Lands (cf. Indices of Awards 1929). The "Enabling" or "*Kuleana Act*" of the *Māhele* (December 21, 1849) further defined the frame work by which *hoaʻāina* (native tenants) could apply for, and be granted fee-simple interest in "*Kuleana*" lands (cf. Kamakau in *Ke Au Okoa* July 8 & 15, 1869; 1961:403-403). The *Kuleana Act* also reconfirmed the rights of *hoaʻāina* to access, subsistence and collection of resources necessary to their life upon the land in their given *ahupuaʻa* ("Enabling Act"[4], August 6, 1850—HSA DLNR 2-4).

[4] See also *"Kanawai Hoopai Karaima no ko Hawaii Pae Aina"* (Penal Code) 1850.

In the *Buke Kakau Paa no ka Mahele Aina* (Land Division Book), between Kamehameha III and his supporters, we learn that by the time of the *Māhele ʻĀina*, ʻOʻoma was divided into two *ahupuaʻa*, ʻOʻoma 1st and 2nd. ʻOʻoma 1st was claimed by Moses Kekūāiwa (brother of Kamehameha IV and V, and Victoria Kamāmalu), one of the children of Kīnaʻu and M. Kekūanaoʻa, thus, a grandson of Kamehameha I. ʻOʻoma 2nd was held by Kamehameha III (*Buke Māhele*, January 27, 1848:13-14). On March 8, 1848, Kamehameha III assigned his interest in ʻOʻoma 2nd to the Government land inventory (*Buke Māhele*, 1848:183).

Moses Kekūāiwa died on November 24, 1848, and his father, Mataio Kekūanaoʻa, administrator of the estate, relinquished in commutation, his rights to ʻOʻoma 1st, giving the land over to the Government land inventory (Foreign Testimony Volume 3:408). Thus, both ʻOʻoma 1st and 2nd were assigned to the Government Land inventory (Government Lands—Indices of Awards 1929:10).

In 2000, the Kumu Pono Associates digitized the entire collection of handwritten records from the *Māhele ʻĀina*. Most of the records are in the Hawaiian language, and to-date have not been accurately indexed. An extensive review of all the records identifies only one native tenant who filed a claim of residency and land use in ʻOʻoma during the *Māhele*. The claim—Helu 9162, by Kahelekahi—was not awarded, and except for an entry in Native Register Volume 8 (Figure 5), there is no further record of the claim. Below, is a copy of the original Hawaiian text from the Native Register. The account is of particular interest as Kahelekahi reported that in 1848, he was the only resident in ʻOʻoma:

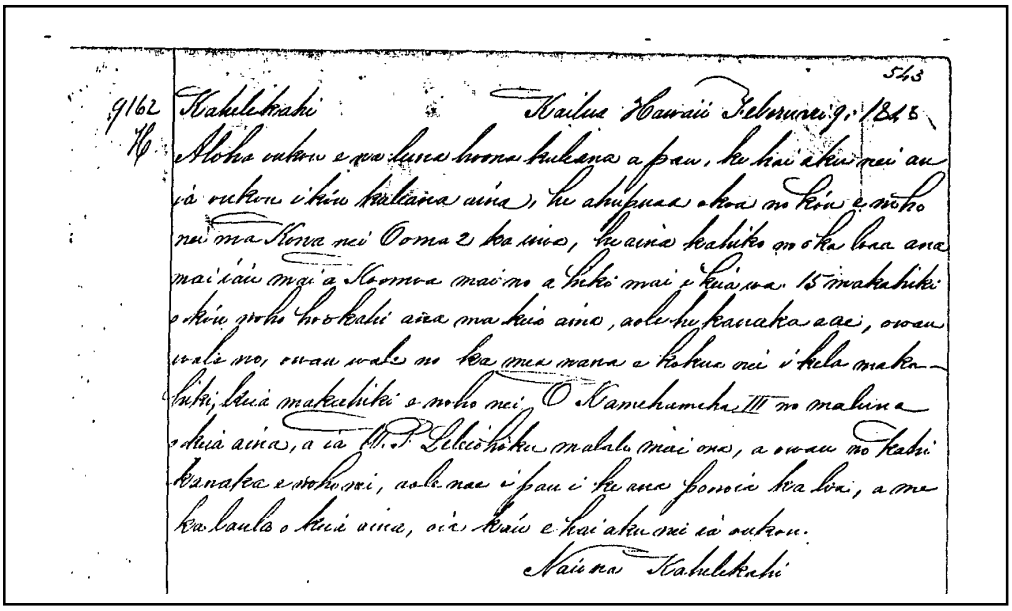


Figure 5. Copy of Native Register Vol. 8:543 Helu 9162, claim of Kahelekahi for kuleana at ʻOʻoma.

Kahelekahi – Helu 9162
Kailua, Hawaii February 9, 1848

Greetings to all of you commissioner who quiet land titles, I hereby tell you of my claim for land. I have an entire ahupuaa situated there in Kona, it's name is Ooma 2. It is an old land gotten by me from Koomoa, and held to this time. For 15 years, I have been the only one residing on this land, there are no other people, only me. I am the only one, there is no one living here to help from one year to the next year. Kamehameha III is the one above, who has this land, and W.P. Leleiohoku is below him, and I am the one man dwelling there. The survey of the length and width of this land is not accurately completed. That is what I have to tell you.

Done by me, Kahelekahi
[Native Register Vol. 8:543; translated by Kepā Maly]

In 1849, S. Haanio, Tax Assessor of North Kona, submitted a report to the Board of Education regarding those individuals who were subject to the Tuesday Tax Laws (*Poalua*), to be worked as a part of the School Tax requirements of the time. At the time of Haanio's report, three individual families were identified as residents of ʻOʻoma. Residents in the neighboring lands of Kalaoa and Kohanaiki were also listed, they were:

> Kalaoa: 1. Kila, 2. Piena, 3. Nakuala, 4. Kupono, 5. Loa, 6. Kaeha, 7. Keliipuipui, 8. Kapuolokai, 9. Kaainoa, 10. Paina, 11. Kalimaonaona, 12. Kaikeleaukai, 13. Kanahele, 14. Kukaani, 15. Kupuai, and 16. Helekahi5
>
> Ooma: 1. Kalua, 2. Kamaka and 3. Mamali
>
> Kohanaiki: 1. Hulikoa, 2. Kaoeno, 3. Honolii and 4. Awa [HSA—Series 262, Hawaii 1849].

Unfortunately, there is no indication of where Kalua, Kamaka, and Mamali were living in ʻOʻoma at the time. Based on traditional patterns of residency in the region, it is likely that they had primary residences in the uplands, near sheltered *māla ʻai* (agricultural fields), and kept near shore residences for seasonal fishing, collection of salt, and other resources of the coastal zone. Of the three names given for ʻOʻoma, descendants of the Kalua and Kamaka lines are known to still be residing in the Kekaha region.

Land Grants in ʻOʻoma and Vicinity (1855-1864)

In conjunction with the *Māhele*, the King also authorized the issuance of Royal Patent Grants to applicants for tracts of land, larger than those generally available through the Land Commission. The process for applications was set forth by the "Enabling Act" of August 6, 1850, which set aside portions of government lands for grants.

> Section 4. Resolved that a certain portion of the Government lands in each Island shall be set apart, and placed in the hands of special agents to be disposed of in lots of from one to fifty acres in fee simple to such natives as may not be otherwise furnished with sufficient lands at a minimum price of fifty cents per acre. [HSA—"Enabling Act" Series DLNR 2-4]

The Kingdoms' policy of providing land grants to native tenants was further clarified in a communication from Interior Department Clerk, A. G. Thurston, on behalf of Keoni Ana (John Young), Minister of the Interior; to J. Fuller, Government Land Agent-Kona:

> *February 23, 1852*
> …His Highness the Minister of the Interior instructs me to inform you that he has and does hereby appoint you to be Land Agent for the District of Kona, Hawaii. You will entertain no application for the purchase of any lands, without first receiving some part, say a fourth or fifth of the price; then the terms of sale being agreed upon between yourself and the applicant you will survey the land, and send the survey, with your report upon the same to this office, for the Approval of the Board of Finance, when your sales have been approved you will collect the balance due of the price; upon the receipt of which at this office, the Patent will be forwarded to you.
>
> <u>Natives who have no claims before the Land Commission have no Legal rights in the soil.</u>
>
> <u>They are therefore to be allowed the first chance to purchase their homesteads.</u> <u>Those who neglect or refuse to do this, must remain dependant upon the mercy of whoever purchases the land: as those natives now are who having no kuleanas are living on lands already Patented, or belonging to Konohikis.</u>
>
> <u>Where lands have been granted, but not yet Patented, the natives living on the land are to have the option of buying their homesteads, and then the grant be located, provided this can be done so as not to interfere with them.</u>

[5] Helekahi or Kahelekahi – the one who made a claim for a kuleana in ʻOʻoma during the Māhele (Helu 9162).

No Fish Ponds are to be sold, neither any landing places.

As a general thing you will charge the natives but 50 cents pr. acre, not exceeding 50 acres to any one individual.

Whenever about to survey land adjoining that of private individuals, notice must be given them or their agents to be present and point out their boundaries… [Interior Department Letter Book 3:210-211]

Between 1855 and 1864, at least six applications were made for land in the *ahupua'a* of 'O'oma, and four of them were patented. The applications were made by:

Grant	Applicant	Land	Acreage	Book and Year
1590	Kauhini	Hamanamana, Kalaoa and Ooma 1	1,816	8:1855 (canceled)
1599	J. Hall	Ooma 2	101.33	8:1855 (canceled)
1600	Kaakau	Ooma 2	58.5	8:1855
2027	Kameheu	Ooma 2	101.33	11:1856 (same area as Grant 1599)
2031	Koanui	Ooma 1	24.5	11:1856
2972	Kaakau & Kama	Kalaoa 5 & Ooma 1	515	14:1864

["Index of all Grants Issued…Previous to March 31, 1886;" 1887]

The grants to Ka'akau and Kameheu in 'O'oma 2nd were patented by 1859, as recorded in the following letter:

April 8, 1859
S. Spencer, Interior Department Clerk;
to Lot Kamehameha, Minister of the Interior;
Lands in Puaa and Ooma 2 in Kona, Hawaii which were sold by the Government Agent:

Royal Patent 1600, Kaakau 58 50/100 acres in Ooma	$29.25
Royal Patent 2027, Kameheu, 101 33/100 acres in Ooma	$38.00

[HSA—Interior Department, Lands]

In the years following issuance of the first Royal Patents in 'O'oma and vicinity, native tenants and others continued to express interest in the lands of 'O'oma and neighboring *ahupua'a*. Applications were made to either lease or purchase portions of the remaining government lands. In 1865, Government Surveyor and Land Agent, S.C. Wiltse, wrote to the Minister of the Interior, describing the condition and status of the lands remaining to the government.

September 5, 1865
S.C. Wiltse, Government Surveyor and Land Agent;
to F.W. Hutchinson, Minister of the Interior.
Kona Hawaii. Government Lands in this District not Sold;
also those Sold and Not Patented:

…"Kalaoa 5th"
Not in the Mahele book but believed to be Gov't. land. This land above the Govt. Road has been sold and Patented. Below the road I have surveyed 515 acres which was sold by Sheldon to "Kaakau" & "Kama" who payed him $165.00. As no valuation was made of this land per acre by Sheldon I afterwards valued it myself as follows, 300 Ac. at 50 cts. per acre, 215 at 25 cts. per Ac. The balance due according to this valuation including Patent was $42.75 which was payed to me in March 1864 and forwarded by me to your office. The survey of this land is in your office. If the payments made are satisfactory, these men would be very glad to get their Patent.

> This is a piece of 3rd rate land, used only as goat pasture, no improvements on it. Makai of this survey is about 400 Ac. remaining to the Govt., but of very little value.
>
> "Ooma 1st & 2nd,,
> The best part of these lands have been sold, there remains to the Govt. the forest part, 2 or 300 Ac., and the makai part some 1500 Ac., about 500 of which is 3rd rate land, the balance rocks.
>
> "Kohanaiki"
> The forest part of this land is all that remains to the Gov't., this is extensive, extending to the mauka side of the forest. It may contain 1500 to 2000 Ac.
>
> The makai part of this land containing 220 Ac. has been sold both by Sheldon and myself. In April 1863 I was surveying in Kona when "Nahuina" (who lives on the adjoining land of "Kaloko") applied to me to survey the makai part of the Gov't. land Kohanaiki which he wished to purchase. I inquired whether he had applied to Sheldon for this lands (Sheldon was then in Honolulu) he told me that he had not, but would do so immediately, if it was necessary he would go to Honolulu for that purpose. I told him that I was then writing to Sheldon and I would make the application for him which I did, but never got an answer. I wrote several times to him about that time, for information about Gov't. lands, but he declined to answer my letters.
>
> On the 30th of May following, I surveyed said piece of land for "Nahuina." When I was making this survey "Kapena" (who bought this land from Sheldon) was present, and afterwards went to Honolulu and payed Sheldon for this land.
>
> "Nahuina" had the money then to pay for this land, and I told him to keep it until he knew who he was paying it to. I was perfectly satisfied then that Sheldon's transaction as Gov't. land Agt. was not honest. Mr. Sheldon had then been away from Kona nearly three months, he had previous to this resigned his office as Judge and taken up his residence permanently in Honolulu. Afterwards when requested by Mr. S. Spencer to act as land Agt. for Kona, "Nahuina" payed me for this land at 25 cents per Acre. Its only value is for a place for a residence on the beach.
>
> I have been thus particular in giving you the history of this affair, so that you might be able to decide which of the parties were intitled to said land… [HSA—Interior Department, Lands]

Historical records document that the primary use of the *kula* – lowlands in the Kekaha region, was for goat ranching, with limited cattle ranching. Throughout the 1800s, most of the cattle ranching occurred on the *mauka* slopes nearer the old upper government road.

Summary of Land Tenure Described in Grant Records

Grant No.'s 1600 (for Kaakau) and 2031 (for Koanui) are situated on the *mauka* side of the Alanui Aupuni (the Upper Government Road, near present-day Māmalahoa Highway) in 'O'oma 2nd and 1st.

Grant No. 1590 (surveyed for Kauhini), was situated across the *kula* lands from O'oma 1st in the south, to Hāmanamana, in the north. Communications from the 1880s, indicate that the parcel was never patented, though Kauhini had lived in 'O'oma 1st, through the time of his death (before 1888). J.S. Emerson's Register Map No. 1449, identifies a Triangulation Station in 'O'oma 1st as "Kauhini." At almost the same time that Kauhini's grant was surveyed, other grants in Kalaoa and 'O'oma covering a portion of the area described under Kauhini's grant were patented to Kakau and Kama (Royal Patent Grant No. 2972). In 1888, this confusing situation was brought to the government's attention in a letter from more than 70 native residents of 'O'oma and the larger Kekaha region, when the Minister of the Interior was developing homestead lots for applicants (see communications below).

Grant No. 2027 (for Kameheu), situated in ʻOʻoma 2nd, extends from the *makai* edge of the Upper Government Road, to a short distance below the historic Homestead Road between Kaloko and Kalaoa, at about 900 feet above sea level (see Register Map No. 1449).

ʻOʻoma grantee Kaakau (Grant No. 1600), also held an interest in Grant No. 2972 in the land of Kalaoa 5th and ʻOʻoma 1st, which he shared with his relative, Kama. Historic survey records (in Register Maps and Survey Field Books) do identify "Kama's house" near the Wawaloli pond (Register Map No. 1449) in ʻOʻoma 2nd. The same house is later identified as "Keoki Mao's House" (Register Map No. 1280).

In 1888, government surveyor J.S. Emerson identified Kama as a resident in ʻOʻoma, near the mauka government road (see communication below). This Kama is identified in oral history interviews as being an elder of the Kamaka line, from whom the often-mentioned Palakiko Kamaka and others descend. A temporary beach shelter—in the vicinity of "Kama's House" marked near the shore of ʻOʻoma 2nd on Register Maps 1449 and 1280—remained in use by family members at least until the outbreak of World War II (see interviews with Peter Kaikuaana Park, Geo. Kinoulu Kahananui, and Valentine K. Ako).

While no formal awards or grants of land appear to have been made for the near shore *kula* or beach lands, it is logical to assume that families living in the uplands of the ʻOʻoma and Kalaoa-Kohanaiki *ahupuaʻa*, made regular visits to the near shore lands. The practice of continued travel between upland residences and near-shore shelters, is also described by *kupuna* Peter K. Park, who was born and raised in the *mauka* section of ʻOʻoma, and by other *kupuna* from neighboring lands.

No records indicating that the above Royal Patent Grantees had applied for coastal parcels as a part of their original claims were found while conducting the present research. A further review of the *Māhele* records was also made to determine if any of the grant applicants had been *Māhele* claimants (as is sometimes the case). Their names did not appear in the Register or Testimony volumes for the area.

Ka ʻĀina Kaha–(A Native's Perspective)

In 1875, J.P Puuokupa, a native resident of Kalaoa wrote a letter to the editor of the Hawaiian newspaper, *Ku Okoa*, responding to a letter which had been previously published in the paper (written by a visitor to Kona). The first account apparently described the Kekaha region as a hard land that presented many difficulties to the residents. It was also reported that a drought on Hawaiʻi had significantly impacted crop production, and that a "famine" was occurring. Puuokupa, responded to the account and described the situation as he knew it, from living upon the land. His letter is important as it provides us with an explanation as to why people of the region—including ʻOʻoma—lived mostly in the uplands, for it was there that the rich soils enabled residents to cultivate the land and sustain themselves.

> *Mai Kailua a hiki i Kiholo*–(From Kailua to Kiholo)
>
> …The people who live in the area around Kailua are not bothered by the famine. They all have food. There are sweet potatoes and taro. These are the foods of these lands. There are at this time, breadfruit bearing fruit at Honokohau on the side of Kailua, and at Kaloko, Kohanaiki, Ooma and the Kalaoas where lives J.P. [the author]. All of these lands are cultivated. There is land on which coffee is cultivated, where taro and sweet potatoes are cultivated, and land livestock is raised. All of us living from Kailua to Kalaoa are not in a famine, there is nothing we lack for the well being of our bodies.
>
> Mokuola[6] is seen clearly upon the ocean, like the featherless back of the *ʻukeke* (shore bird). So it is in the uplands where one may wander gathering what is needed, as far as Kiholo which opens like the mouth of a long house into the wind. It is there that the bow of the boats may safely land upon the shore. The livelihood of the people there is fishing and the raising of livestock. The people in the uplands of Napuu are farmers, and as is the custom of those

[6] *Moku-ola*—literally: Island of life—is a poetic reference to a small island in Hilo Bay which was known as a place of sanctuary, healing, and life. By poetic inference, the Kekaha region was described as a place of life and well-being.

> people of the backlands, they all eat in the morning and then go to work. So it is with all of the native people of these lands, they are a people that are well off.
>
> …As was said earlier, coffee is the plant of value on these lands, and so, is the raising of livestock. From the payments for those products, the people are well off, and they have built wooden houses. If you come here you shall see that it is true. Fish are also something which benefits the people. The people who make the *pai ai* on Maui bring it to Kona and trade it. Some people also trade their *poi* for the coffee of the natives here… (J.P. Puuokupa, in *Ku Okoa* November 27, 1875; translated by Kepā Maly)

The Government Homesteading Program in Kekaha

Following the *Māhele* and Grant programs of the middle 1800s, it was found that many native tenants still remained on lands for which they had no title. In 1884, the Hawaiian Kingdom initiated a program to create Homestead lots on Government lands—a primary goal being to get more Hawaiian tenants in possession of fee-simple property (Homestead Act of 1884). The Homestead Act allowed applicants to apply for lots of up to 20 acres in size, and required that they own no other land.

On Hawai‘i, several lands in the Kekaha region of North Kona, were selected and a surveying program was authorized to subdivide the lands. Initially, those lands extended from Kohanaiki to Kūki‘o. Because it was the intent of the Homestead Act to provide residents with land upon which they could cultivate crops or graze animals, most of the lots were situated near the *mauka* road (near the present-day Māmalahoa Highway) that ran between Kailua and ‘Akāhipu‘u.

Early in the process, native residents of Kekaha soon began writing letters to the Minister of the Interior, observing that 20 acre parcels were insufficient “to live on in every respect.” They noted that because of the rocky nature of the land, goats were the only animals that they could raise, and thus, try to make their living (cf. State Archives–Land File, December 26, 1888, and Land Matters Document No. 255; and communications below).

During the first years of the Homestead Program, all of the remaining government lands in the Kekaha region, from Kohanaiki to Kūki‘o 2nd, had been leased to King David Kalākaua for grazing purposes. The following lease was issued, with the notation that should portions of the land be desired for Homesteading purposes, the King would relinquish his lease:

> *August 2nd 1886*
> *General Lease 364*
> *Between His Majesty Kalakaua;*
> *and Walter M. Gibson, Minister of the Interior*
> [Lease of unencumbered government lands between Kealakehe to Kukio 2nd]:
>
> …Oma [Ooma] No. 1 & 2 – yearly rent Ten dollars…
> Each and every of the above mentioned lands are let subject to the express condition that at any time during the term of this lease, the Minister of the Interior may at his discretion peaceably enter upon, take possession, and dispose of such piece or pieces of land included in the lands hereby demised, as may be required for the purposes of carrying out the terms and intent of the Homestead Laws now in force, or that may be hereafter be enacted during the term of this lease… [State Land Division Lease Files]

By 1889, the demand for homestead lots in ‘O‘oma and other Kekaha lands was so great that King Kalākaua gave up his interest in the lands:

> *January 22, 1889*
> *J.W. Robertson, Acting Chamberlain;*
> *to J.A. Hassinger, Chief Clerk, Interior Department*
> [Regarding termination of Lease No. 364 for lands from Kukio to Kohanaiki]:

…I have the honor to acknowledge the receipt of your communication, of the 17th, instant, informing me that you are directed, by His Excellency the Minister of the Interior, to say, that he desires to take possession of the lands, described in Government Lease No. 364, for Homestead purposes, and requests the surrender of the lease.

His Majesty the King, is willing, for the purpose of assisting in carrying out the Homestead Act, to accede to the terms of the lease, so far as to give up only such portions of the lands, as are suitable to be apportioned off for Homestead purposes.

It has come to the knowledge of His Majesty, that several of the applicants for portions of the above lands, are already in possession of lands elsewhere, and living in comfortable homes. They are not poor people, nor are they entitled to the privilege of obtaining lands under the Homestead Act, but are desirous of obtaining more of such property, for the purpose of selling or leasing to the Chinese, which class is beginning to outnumber the natives in nearly every district…

His Majesty is desirous of retaining the balance of lands, that may be left after the apportionment has been completed; and also desires to lease remnants of other Government lands in that section of the Island…

Reply attached – Dated January 22, 1889:
The lands of Kohanaiki and Kalaoa and Makaula have been divided up into Homestead lots, and taken up.

Lands marked * are in Emerson's List of lands to be sold. Emerson's List attached.

His Majesty has paid rent to Aug. 22, 1889. Another rent is due in adv. from this date…

* Kukio 2	* Maniniowali
* Mahaiula	* Kaulana
* Awalua	Puukala
+ Makaula	+ Kalaoa 1, 2, 3, 4 & 5
* Oma 1 & 2	+ Kohanaiki

Lease cancelled by order – Minister of Int. August 2, 1889 [HSA—Interior Department, Lands]

One of the significant issues that arose with the development of homesteads in the Kekaha region, involved the lands of ʻOʻoma, Kalaoa and Hāmanamana, which had been surveyed for Kauhini in 1855, under Grant No. 1590. The grant was apparently never patented, and questions regarding the government's authority to divide portions of the ʻOʻoma-Kalaoa-Hāmanamana lands into Homestead lots were raised. Adding to the confusion, in 1888, John A. Maguire was also making his move from Kohala to Kona, and in the process of establishing his Huehue Ranch. One of the lands he reportedly purchased was covered under the unperfected Grant No. 1590. Thus, homestead applicants and program managers met with a wide range of challenges during the program's history.

Homestead Communications

There are a number of letters between native residents (applicants for Homestead lands) and government agents, documenting the development of the homesteading program and residency in Kekaha. Tracts of land in Kohanaiki, ʻOʻoma, Kalaoa and neighboring *ahupuaʻa* were let out to native residents, and eventually to non-native residents as well. Those lands which were not sold to native tenants were sold or leased to ranching interests—most of which came under John A. Maguire of Huehue Ranch.

One requirement of the Homestead Program was that lots which were to be sold as homesteads to the applicants, needed to be surveyed. J.S. Emerson, one of the most knowledgeable and best-informed surveyors to work in Kona, began surveying the Kekaha region homestead lots in 1888. Emerson's letters to Surveyor

General, W. D. Alexander, provide valuable historical documentation about the community and land. Writing from ʻOʻoma in April 1888, Emerson spoke highly of the Hawaiian families living on the land; he also described land conditions and weather at the time. In the letter, we find that questions regarding the status of several lands in Kona had arisen, and that John A. Maguire was planning to "settle" in Kona (see communications in Part 4 of this section of the study). Emerson's letters along with those below from the native tenants of the land, provide first hand accounts of the land development of the communities in Kekaha. The following communications are among those found in the collection of the Hawaiʻi State Archives (HSA).

May 1888
J.W.H. Isaac Kihe, Jr., et al.; to L.A. Thurston, Minister of the Interior
[Petition with 71 signatures, regarding discrepancy in land grant to Kauhini in Kalaoa and Ooma; and desires that said land be divided into Homestead Lots for applicants]:

…We, the undersigned, subjects residing within the boundaries of Kekaha, from Kohanaiki to Makalawena, and Whereas, the land said to belong to Kauhini is within the boundaries above set forth; Whereas, some doubt and hesitancy has come into our minds concerning the things relating to said land of Kauhini, and that it is proper that a very careful investigation be made, because, we have never known said Kauhini to have lands in the Kalaoas and Ooma 1, and because of such doubt, the Government sold some pieces in said land of 687 acres to Kama, Kaakau and Hueu, and they have been living with all the rights for 20 years and over, on pieces that were acquired by them. Therefore, we leave this request before your Excellency, the honorable one, with the grounds of this request:

First: The said land of Kauhini is not a land that is clear in every way, so that it can be shown truthfully and clearly that it belongs to Kauhini and his heirs – said kuleana.

Second: The land said to belong to Kauhini was only surveyed, but the money was not paid, that is the price for the land, only the payment for the survey was paid. We are ready with witnesses to prove this ground, as well as other grounds.

Third: Because of Kama and Kaakau and Hueu's knowing that Kauhini had no true interest in the land, therefore, they bought from the Government some acres of in the piece which Kauhini had surveyed, and the Government readily agreed to sell to them. This is real proof that said land was not conveyed to Kauhini, and the second is that Kauhini was living right there and he made no protest against the sale by the Government of those 687 acres to Kama (k), Kaakau (k) and Hueu (k), up to the time of his death, and only now has the question been raised through the plat of the survey, and thereby basing the claim that Kauhini had some land.

…We ask your honor that this matter be traced in the Government Departments, so as to find out the truth, there is much trouble and uncertainty about this land.

And our inquiry to be based upon these great questions. Does the land belong to Kauhini? Or to the Government?… [HSA—Interior Department, Lands]

May 16, 1888
Interior Department Clerk; to J.W.H. Isaac Kihe, Jr.:
…I have been directed by the Honorable Minister of the Interior, to say, that your request asking that Kauhini's interest in the lands of Kalaoa & Ooma 1 be investigated, and to let you know the you are wanted to send, or to bring here to Honolulu, 2 or 3 good witnesses, and all the papers found by you or them, concerning this land of Kauhini… [HSA Interior Department Lands]

May 16, 1888
J.F. Brown, Government Surveyor; to L.A. Thurston, Minister of the Interior
[Regarding disposition of Grant No. 1590, to Kauhini for Lands in Hamanamana, Kalaoa, and Ooma; Figure 6]:

…With reference to the letter of inquiry of numerous natives in N. Kona, Hawaii, I beg to report:

That as regards the land belonging to Kauhini, I find that Grant 1590 on record and signed in due form, assigned to Kauhini something over 1800 acres shown in sketch by yellow tinted boundary line. At the bottom of the page however and in different handwriting is the following remark "Memo – this to be cancelled" S.S. (Stephen Spencer)?

Later the grants shown in sketch by blue lines were issued to the parties indicated in the sketch, and this fact together with the memo attached to the Grant, and the statements and beliefs of the natives leads me to think that the Grant to Kauhini was actually cancelled, but of this I have not yet obtained further proof than I have here given… [HSA—Interior Department, Lands]

May 1888—J.W.H.I. Kihe, Jr.; to L.A. Thurston, Minister of the Interior:
…Oh honorable one, I am ready with the right witnesses to come when I receive the order, and if you agree, oh honorable one, to help with the fares for us on the vessel, and for our support while staying there and coming back.

Proofs are ample to prove that the land belongs to the Government, when I arrive with the witnesses, according to what you wish to be done…
[HSA—Interior Department, Lands]

[Applying to purchase remnant lands from Makaula to Ooma 2nd, as a native Hui; and that land not be sold to outsiders.]

…We the undersigned, kamaaina (old residents) who reside from "Makaula" to "Ooma 2," joining "Kohanaiki," hereby petition and we also file this petition with you, and for you to consider and conferring with the Minister of the Interior, whether to consent or refuse the petition which we humbly file, and at the same time setting forth the nature of the land and the boundaries desired.

We ask that all be sold to us as a Hui, that the remnants of all the Government lands from "Hamanamana" to "Ooma 2 (two)," that is from the Government remnant of "Hamanamana, Kalaoa 1, 2, 3, 4, 5, Ooma 1 & 2" running until it meets the sea. Being the remnants remaining from the "Homesteads" lately, and remaining after the sale of the lands formerly sold by the Government, these are the remnants which we wish to buy as a "HUI." If you consent, and also the "Minister of the Interior," for these reasons:

1. The "remnants of Government lands" aforesaid, join our land kuleanas and were lately surveyed, and for that reason we believe it proper that they be sold to us.

2. The "kuleanas" that were surveyed for us are not sufficient to live on in every respect, they are too small, and are not in accordance with the law, that is one hundred acres, (Laws 1888).

3. Because of our belonging to, and being old residents of said places, is why we ask that consent be granted us for the sale to us and not to any one from other places, or we may be put to trouble in the future.

With these reasons, we leave this with you, and for you to approve, and we also adhere to our first offer per acre, and the explanations in regards to said offer.

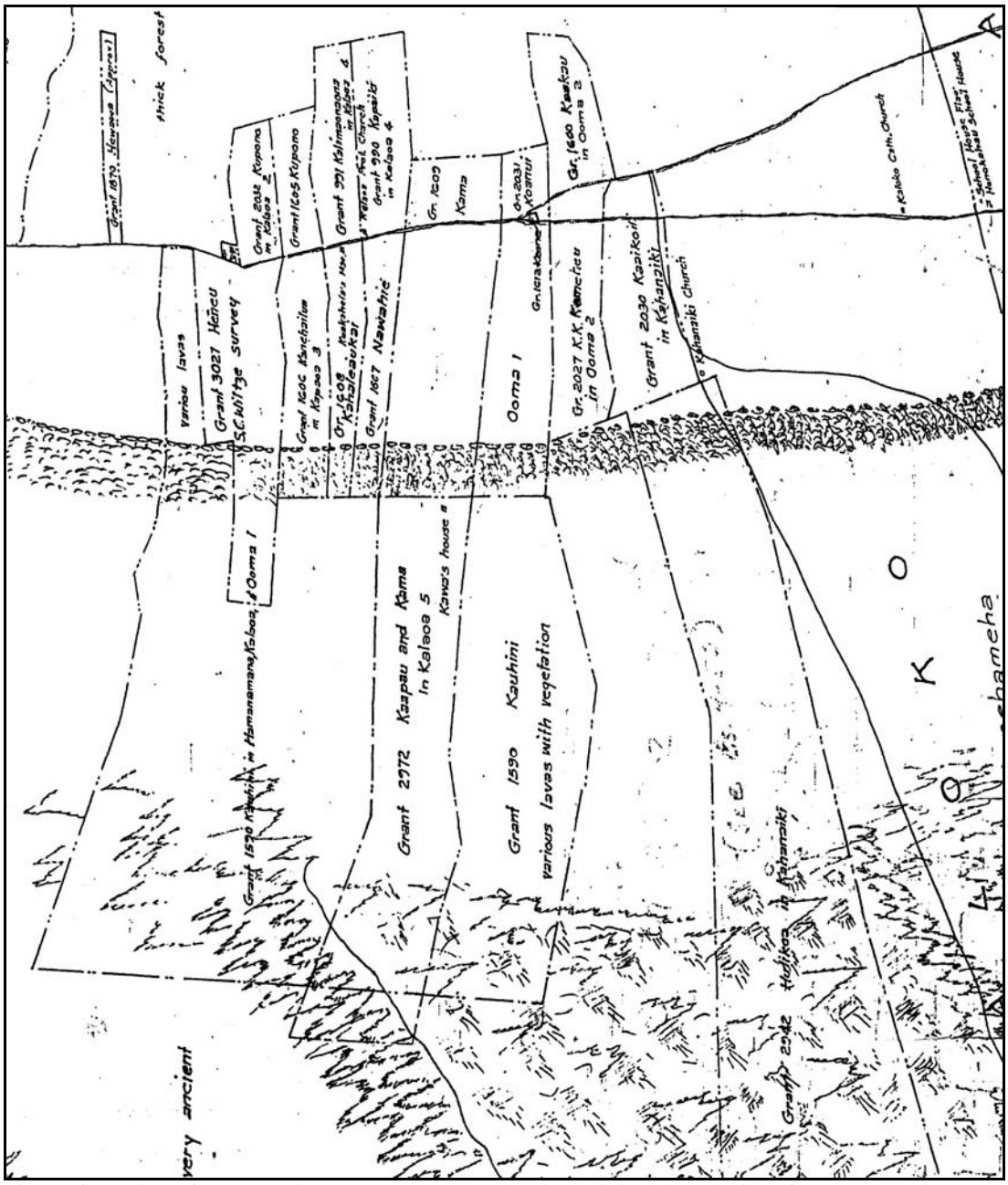


Figure 6. Portion of 1882 Register Map No. 1280 showing original boundaries of Grant No. 1590, to Kauhini.

FIRST: The price per acre to be 10 cents per acre.

SECOND: The nature of the land is rocky and lava stones in all from one and to the other, and there is only one kind of animal which can roam thereon, and it is goats, and that is the only thing to make anything out of, and to benefit us if we acquire it.

THIRD: If this land is acquired by others, they will probably cause us trouble, because the kuleanas which we have got are very small and not enough, not 20 acres of the land were acquired by us; very few of the lots reach 20 acres or more.

And because of these reasons and the explanations herein, we leave before your Excellency for the granting of the consent or not… [HSA—Interior Department, Lands]

ca. February 1889
Petition of J.W.H. Isaac Kihe, Jr. and 21 others;
to L.A. Thurston, Minister of the Interior
[Transmitting first payment for Homestead Land from Makaula to Kohanaiki]:

…We, the ones whose names are below, persons who but for the pieces of "Homestead" lands from Makaula to Kohanaiki, present to you documents of proof and money as first payment of ten ($10.00) dollars in the hands of J. Kaelemakule, the Agent appointed for the "Homestead" lands in North Kona, Hawaii.

We ask that the Agreements be sent up, with the Government for five years to J. Kaelemakule, the Agent here, in number the same as there are names below…

1. J.W.H. Isaac Kihe, Jr.	9. P. Nahulanui	17. Keawehawaii
2. S. Mahauluae	10. Kaukaliinea	18. D. Kaninau
3. D.P. Manuia	11. Kamahiai (w)	19. Mokuaikai
4. S.M. Kaawa	12. C.K. Kapa	20. Nuuanau
5. H.P. Ku	13. P.K. Kanuha	21. S. Kaimuloa
6. W.N. Kailiino	14. J. Haau	22. J. Kaloa
7. Z. Kawainui	15. G. Mao	
8. Kikane	16. J. Pule	

[HSA—Interior Department Document No. 227]

February 18, 1889
J. Kaelemakule, Land Agent; to L.A. Thurston, Minister of the Interior:
I am sending the correct report of the applicants for homestead lands here in North Kona, and their respective names, and the amount they have paid for their initial deposits in order that the agreements will be made correctly…

Pule $10.	Keoki Mao $10.	Mahuluae $10.	Haau $10.
Nuuanu $10.	Manuia $10.	Kaukaliinea $10.	Kamahiai (w) $10.
Kaawa $10.	Kaninau $10.	J. Kaelemakule $10.	Kawainui $10.
Mokuaikai $10.	Keawehawaii $10.	Nahulanui $10.	Kaloa $10.
Haiha $10.	Kapa $10.	Kaumuloa $10.	Isaac Kihe $10.
Kailiino $10.	Kanuha $10.	Ku $10.	Kikane $10.

[HSA—Interior Department, Lands]

October 7, 1889
J. Kaelemakule, Land Agent; to L.A. Thurston, Minister of the Interior:
…The applications of Kahinu and Lilinoe which were sent down during the month of August, please have the lots changed, because the map of Ooma has arrived with new numbers, as follows: Kahinu, Lot 51; Lilinoe, Lot 49, in Ooma 1st … [HSA—Interior Department, Lands]

October 10, 1889
J.W.H. Isaac Kihe, Secretary; to L.A. Thurston, Minister of the Interior:
…I leave some more names who make applications for homestead lands here in North Kona… The places wanted by those named are:

Pika Kaninau at Ooma 1
Kahinu at Ooma 2
Keaweiwi at Ooma 2… [HSA—Interior Department, Lands]

October 28, 1889
J. Kaelemakule, Land Agent; to L.A. Thurston, Minister of the Interior:
…The eight lots in Ooma have all been taken, none are left… These lots have been very quickly taken by the bidders, before the issuance of the notice from the Minister… Bear in mind the agreements for Kahinu and Lilinoe… [HSA—Interior Department, Lands]

December 31, 1890
J.W.H.I. Kihe, Jr.; to C.N. Spencer, Minister of the Interior:
We, the undersigned, who are without homes, and are destitute and have no place to live on, and whereas, the government has permitted all the people who have no lands, and that they receive homesteads, and for that reason, your humble servants make application that our application may be speedily granted which we now place before Your Excellency, that the Government land which was divided and surveyed by Joseph S. Emerson, be immediately sub-divided, the same being portions of Kalaoa 5 and Ooma, on the mauka side of Kama (k), Koanui (k), to the junction with Ooma of Kaakau (k), containing an area of one hundred and fifteen acres (115), and it is those acres which your applicants are applying for before Your Excellency, and where as your applicants are native Hawaiians by birth, residing at Kalaoa, North Kona, Island of Hawaii. And the minds of your servants hope and desire to have a place to live on in the future, and to have a home for all time, and Your Excellency, your servants humbly place their petition with the hope that you will grant this application...

M.E. Kuluwaimaka (k)
H. Hanawahine (k)
D.W. Kanui (k)
Mr. Kahumoku (k)
[HSA—Interior Department, Lands]

July 30, 1890
Petition of Kaihemakawalu and 63 native residents of Kekaha;
to C.N. Spencer, Minister of the Interior
[Requesting that lands available for Homesteading be sub-divided and granted to applicants]:

…We, the undersigned, old-timers living from Kealakehe to Kapalaoa, who are subject to taxes, and who have the right to vote in the District of Kona, Hawaii, and ones who are really without lands, and who wish to place this application before Your Excellency, that all of these Government lands here in North Kona, be given to the native Hawaiians who are destitute and poor, being the lots which were sub-divided by the Government which are lying idle and for which no Agreements have been given out, and also the lots which were granted Agreements and issued in the time when Lorrin A. Thurston was Minister of the Interior, and also the lots which still remain undivided. All of these Government lands are what we are now again asking that the dividing and sub-dividing be continued in these remnants of Government lands, until all of the poor and needy ones are provided for.

Your Excellency, we ask that no consent whatever be given to permitting lands to be acquired by the rich through sale at auction, or by lease, and if there is to be any lease, then to be leased to the poor ones, if they are supplied with homes.

Your Excellency, we ask that you immediately send copies of all agreements of the Government lands which were cut up and sub-divided, which are remaining and have no documents for those lots. And we also ask that a surveyor be sent now to again survey and sub-divide the remaining Government lands, being the Government lands of Kaulana, Mahaiula, Kukio 1 & 2, mauka of the Government Road, and Kalaoa 5 & Ooma 1, mauka of the Government Road, joining Kama's and Koanui's.

And now, Your Excellency, we also ask that all of the pieces of Government land lying idle outside of these lands which have been sub-divided, and lands which are to be sub-divided,

applied for above, to be allowed to be leased to use for five cents per acre, because, they are rocky and pahoehoe lands only left, and the number of acres being about three thousand and over, thereby giving the Government some income from these which have been lying idle and without any value… [HSA—Interior Department, Lands]

June 22, 1893
J. Kaelemakule, Land Agent; to J.A. King, Minister of the Interior:
…I am forwarding you with this, the copy of the agreement of Wm. Harbottle, and some applications as herein below set forth (Figure 7):

107, Kalua (w), for Lot # 59, Map 6, Ooma;
108, G.M. Paiwa, for Lot # 56, Map 6, Ooma;
109, Namakaokalani, for Lot # 58, Map 6, Ooma;
110, Pika Kaninau, for Lot # 57, Map 6, Ooma.

Lot # 57 above set forth, was formerly agreed with D. Kealoha Hoopii, but this applicant left altogether and lived a long time in Kohala, and has done nothing towards the land, and has never signed the agreement to this day. As two years have gone by, I thought it would be better to give the lands to the new applicant… [HSA—Interior Department, Lands]

August 31, 1898
Statement of Leases of Public Lands
Under Control of the Commissioner of Public Lands…
…Ooma (mauka) 1160 acres – Coffee, wood lands & grazing
Lease No. 432 – Annual rent $60. – Expires August 1st, 1906…
Reservation in lease by which the Gov't. may take up portions suited to settlement.
[HSA—F.O. & Ex, 1898 – Public Lands]

In May 1902, the Territorial Survey Office issued Register Map No. 2123, depicting a portion of the Kalaoa-Ooma Homesteads. ʻOʻoma 1st had been divided into 25 lots extending from near the shore (excluding the shore line) to the upper limits of the ahupuaʻa; also excluding the early Royal Patent Grant parcels previously sold to native tenants.

Applicants for land in ʻOʻoma 1st (from *makai* to *mauka*) included:

- Kanealii – Right of Purchase Lease # 30; Lot 4-B (cancelled);
  Kanealii's parcel was just mauka of the shore line exclusion.

- Wm. Keanaaina – Right of Purchase Lease #33; Lot 13 (Patented by Grant No. 5472);
  The makai end of Wm. Nuuanu Keanaaina's Grant 5472, is situated at approximately 325 feet above sea level.

- J. Maiola – Right of Purchase Lease # 28; Lot 14 (cancelled);
  J. Maiola's parcel was situated about 525 feet above sea level.

- K. Kama Jr. – Right of Purchase Lease #27; Lot 15
  (Patented by Grant No. 5046).
  The makai end of K. Kama's Grant No. 5046, is situated at approximately 725 feet above sea level.

Territorial Survey Map No. 6 (Homestead Lots, Akahipuu Section), surveyed by J.S. Emerson in 1889, depicts the eight original homestead lots sold to applicants. The lots are in the area extending from 1,022 feet above sea level to the old Māmalahoa Highway. The lots contained approximately 15 to 25 acres each, and were (*makai* to *mauka*) sold to:

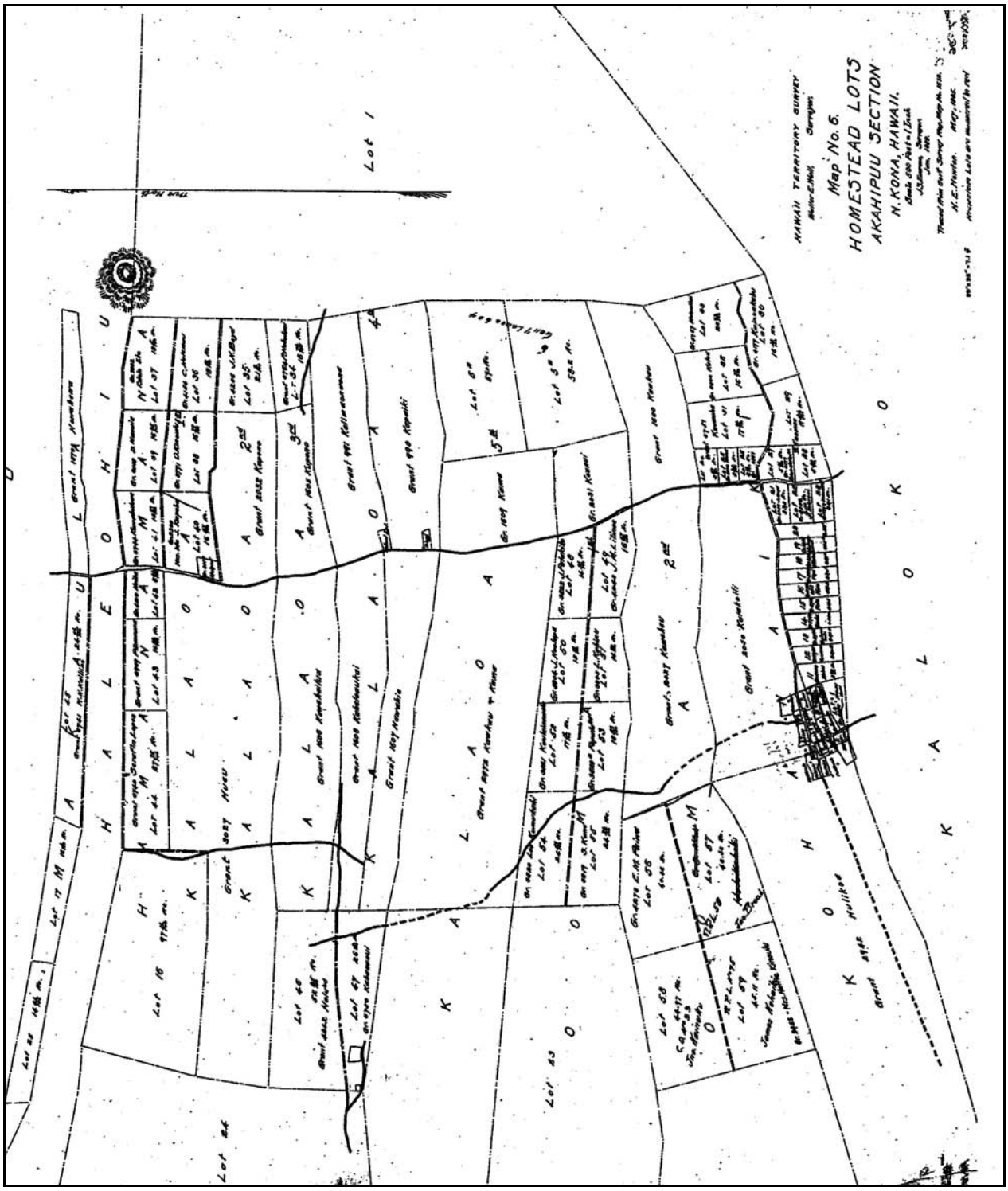


Figure 7. 1902 homestead map No. 6 showing Ooma-Kalaoa Homestead Lots (State Survey Division).

- S. Kane – Grant No. 3819, Lot 55;
- Loe Kumukahi – Grant No. 3820, Lot 54;
- Papala (w) – Grant No. 3820 B, Lot 53;
- Kaulainamoku – Grant No. 3821, Lot 52
- L. Kahinu – Grant No. 3805, Lot 51
- J. Hoolapa – Grant No. 3804, Lot 50
- J.M. Lilinoe – Grant No. 4343, Lot 49
- J. Palakiko – Grant No. 3822, Lot 48

Except for the Homestead parcels and the two lots patented to Keanaaina and Kama (totaling ten parcels of the available 25 parcels), no other land in ‘O‘oma 1st was sold during this time. The land was retained by the government and portions leased out for grazing (see General Lease No.’s 590 and 604).

‘O‘oma 2nd was also divided into homestead parcels, but only six lots were made in the subdivision (see Register Map No. 2123). The two *makai* lots consisted of approximately 1,333 acres—the first lot from above the shore to the 1847 *Alanui Aupuni*, containing approximately 302 acres, and the other lot running *mauka* from the same *Alanui Aupuni*, to about the 800 foot elevation (containing approximately 1,031 acres). In 1899, John A. Maguire, founder of Huehue Ranch applied for a Patent Grant on both of the *makai* lots, but he only secured Grant No. 4536, for the lower parcel of 302 acres, in ‘O‘oma 2nd. Maguire’s Huehue Ranch did hold General Lease No.’s 1001 and 590 for grazing purposes on the remaining government lands—both below and above the *mauka* highway—in ‘O‘oma 2nd.

Between 700 and 1,100 feet elevation, four Homestead lots were subdivided, containing 40.50 to 45 acres each. Applicants for the lots (*makai* to *mauka*) were:

- James Kuhaiki – Right of Purchase Lease # 75, Lot 59
  (Patented to Mrs. Hattie Kinoulu);
- Jno. Kainuku – C.O. No. 33, Lot 58 (not granted by 1902);
- Holokahiki – C.O. No. 11, Lot 57
  (cancelled; R.P.L. # 59 to Jno. Broad); and
- E.M. Paiwa – Grant No. 4273, Lot 56.

The notes of survey from Maguire’s Grant No. 4536 describes the near shore parcel in ‘O‘oma 2nd (Figure 8). Of particular interest, it also references one of the prominent cultural-historical features on the boundary between ‘O‘oma 2nd and Kohanaiki, an “old ‘Kahua hale’ on white sand…” The “kahua hale” is an old house site. The notes of survey read:

> Grant No. 4536
> To J.A. Maguire
> Purchase Price $351.00
> A Portion of Ooma 2nd, N. Kona, Hawaii Applied for by J.C. Lenhart, June 8, 1899.
> Beginning at Puhili Gov’t. trig. St. on the boundary between Kohanaiki and Ooma marked by a drill hole in stone 9 feet South of the South corner of an old “Kahua hale” on white sand at a point from which
> Akahipuu Gov’t. trig. Sta. is N 55º 27’ 39” E true 32634.7 feet
> Keahole Gov’t. Trig. Sta. is N 21º 52’ 36” W true 9310.5 ft.
> Keahuolu Gov’t Trig. Sta. is S 22º 24’ 36” E true 20,141.8 ft., and running—
> 1. S. 79º 26’ W. true 298.0 feet along Gr. 3086 Kapena, to a large [mark] on solid pahoehoe by the sea at Puhili Point, thence continuing the same line to the sea shore and along the sea shore to a point whose direct bearing and distance is:
> 2. N. 4º 54’ W. true 4192.0 feet;
> 3. Due east true 2920.0 feet along Ooma 1st;
> 4. S. 31º 30’ E. true 3920.0 feet along reservation for Gov’t. Road 30 feet wide;
> 5. S 790º 45’ W. true 4387.0 feet along Grant 3086 Kapena, to initial point and including an area of 302 acres.
>
> J.S. Emerson, Surveyor
> Oct. 10, 1901.

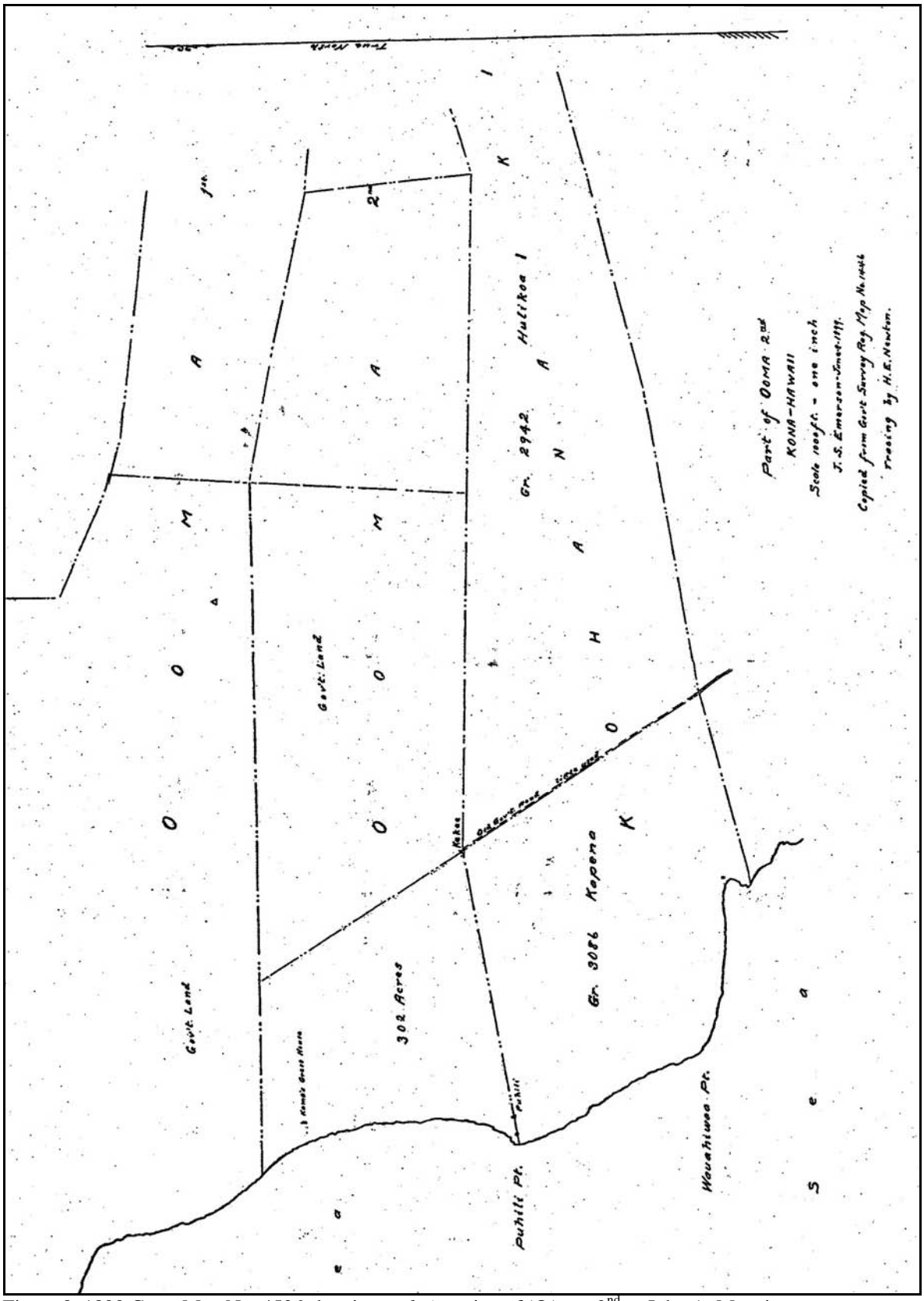


Figure 8. 1899 Grant Map No. 4536 showing *makai* portion of ʻOʻoma 2nd to John A. Maguire.

Field Surveys of J.S. Emerson (1882-1889)

Among the most interesting historic Government records of the study area—in the later nineteenth century—are the communications and field notebooks of Kingdom Surveyor, Joseph S. Emerson. Born on O‘ahu, J.S. Emerson (like his brother, Nathaniel Emerson, a compiler of Hawaiian history) had the ability to converse in Hawaiian, and he was greatly interested in Hawaiian beliefs, traditions, and customs. As a result of this interest, his letters and field notebooks record more than coordinates for developing maps. While in the field, Emerson also sought out knowledgeable native residents of the lands he surveyed, as guides. Thus, while he was in the field he also recorded their traditions of place names, residences, trails, and various features of the cultural and natural landscape (including the extent of the forest and areas impacted by grazing). Among the lands that Emerson worked in was the greater Kekaha region of North Kona, including the lands of ‘O‘oma and vicinity.

One of the unique facets of the Emerson field notebooks is that his assistant J. Perryman, was also a sketch artist. While in the field, Perryman prepared detailed sketches that help to bring the landscape of the period to life. In a letter to W.D. Alexander, Surveyor General, Emerson described his methods and wrote that he took readings off of:

> …every visible hill, cape, bay, or point of interest in the district, recording its local name, and the name of the *Ahupuaa* in which it is situated. Every item of local historical, mythological or geological interest has been carefully sought & noted. Perryman has embellished the pages of the field book with twenty four neatly executed views & sketches from the various trig stations we have occupied… [Emerson to Alexander, May 21, 1882; HSA—DAGS 6, Box 1]

Discussing the field books, Emerson also wrote to Alexander, reporting “I must compliment my comrade, Perryman, for his very artistic sketches in the field book of the grand mountain scenery…” (HSA—HGS DAGS 6, Box 1; Apr. 5, 1882). Later he noted, “Perryman is just laying himself out in the matter of topography. His sketches deserve the highest praise…” (ibid. May 5, 1882). Field book sketches and the Register Maps that resulted from the fieldwork provide a glimpse of the country side of more than 100 years ago.

Field Notebooks and Correspondence from the Kekaha Region

The following documentation is excerpted from the field notebooks and field communications of J. S. Emerson. Emerson undertook his original surveys of lands in the Kekaha region in 1882-1883 (producing Register Maps No. 1278 and 1280). Subsequently, in 1888-1889, Emerson returned to Kekaha to survey out the lots to be developed into Homesteads for native residents of ‘O‘oma and vicinity (see above, The Government Homesteading Program in Kekaha). Through Emerson’s letters and notes taken while surveying, we learn about the people who lived on the land—some of them identified in preceding parts of the study—and about places on the landscape. The numbered sites and place names cited from the field books coincide with sketches prepared by Perryman, which are shown as figures in the current study.

J.S. Emerson Field Notebook Vol. 111 Reg. No. 253
West Hawaii Primary Triangulation, Kona District
Akahipuu; May 27, 1882
(Figures 9 and 10)

Site # and Comment:

6 - Koanui’s frame house. E.G. In Honokohau – nui.

7 – Aimakapaa Cape. Extremity. In Honokohau-nui.

11 – Beniamina’s house (frame). N.G. In Aiopio. In Honokohau-nui.

12 – Beniamina’s house No. 2. E.G. In Honokohau-nui.

18 – Lae o Palaha. Between Kaloko and Honokohau-nui.

19 – Awanuka Bay (Haven of rest) Retreat during storms in this dist.

20 – Kealiihelepo’s (frame house). N.G. In Kaloko.

21 – Lae Maneo. From the “Maneo” fish in Kaloko.

22 – Kohanaiki Bay. By sea wall of fish pond.

23 – Kaloko-nui fish pond. Tang. S. end by Nuuanu's grass house.

24 – Wall between fish pond of Kaloko nui and iki.

25 – Kaloko iki fish pond. Tang. N. extremity.

Kaloko nui was originally a bay, shut off from the sea by a wall by Kamehameha 1st order.

26 – Kawaimaka's frame house. In Kohanaiki.

27 – Lae o Wawahiwaa. Rock cape. In Kohanaiki.

28 – Keoki Mao's grass house. In Ooma.

29 – Pahoehoe hill. Between Ooma and Kalaoa 5.

30 – Lae o Keahole. Extremity. In Kalaoa 5.

31 – Lae o Kukaenui. Resting place for boats.

32 – Makolea Bay.

33 – Lae o Unualoha.

34 – Pohaku Pelekane.

35 – Lae o Kahekaiao. Kahe-ka-iao – place of the "iao" which abound there. [Notebook 253:33,35]

…Keahole Bay.

Lae o Kalihi in Kalaoa 5.

Wawaloli Bay in Kalaoa 5.

Lae o Kekaaiki.

Limu Koko in Ooma 1.

Lae o Puhili in Kohanaiki.

Lae o Kealakehe in Kealakehe.

Hueu's frame house in Kalaoa 4, makai side of Gov't. Road.

Kuakahela's frame house in Kalaoa 5.

Protestant Church Steeple in Kalaoa 5.

Kama's frame house, N. gable in Ooma 1.

While taking sightings from Keāhole, Perryman prepared additional sketches of the landscape. One sketch on page 69 of the field book (Figure 11) depicts the view up the slope of Hualālai. Dated June 4, 1882, the sketch is of importance as it also depicts Kalaoa Village and church; the upper Government road; Kohanaiki Village; and two trails to the coast, one trail to Honokōhau, and the other near the Kaloko-Kohanaiki boundary. Use of these trails continued through the 1950s.

The other sketch on page 73 of the field book (dated June 8, 1882) depicts the coastline south from Keāhole, to an area beyond Keauhou (Figure 12). Of interest, we see only the near-shore "Trail" in the foreground, with no trail on the *kula* lands. Then a short distance south, a house is depicted on the shore, in the ʻOʻoma vicinity (identified as the house of Kama or Keoki Mao on Emerson's Register Maps). And a little further beyond (south) the house, two trails are indicated—presumably the *Alanui Aupuni* on the *kula* lands to ʻOʻoma, and the near shore trail, seen coming in from Honokōhau.

While surveying the uplands on Hualālai in August 1882, Perryman drew a sketch of the Keāhole-Honokōhauiki coastal lands. This sketch (Figure 13) from field Book No. 254 shows the reverse view of Figure 12. Noting again, that the only trail given at that time, was the near shore trail, running out of Honokōhau-Kaloko, Kohanaiki, ʻOʻoma and on to Keāhole.

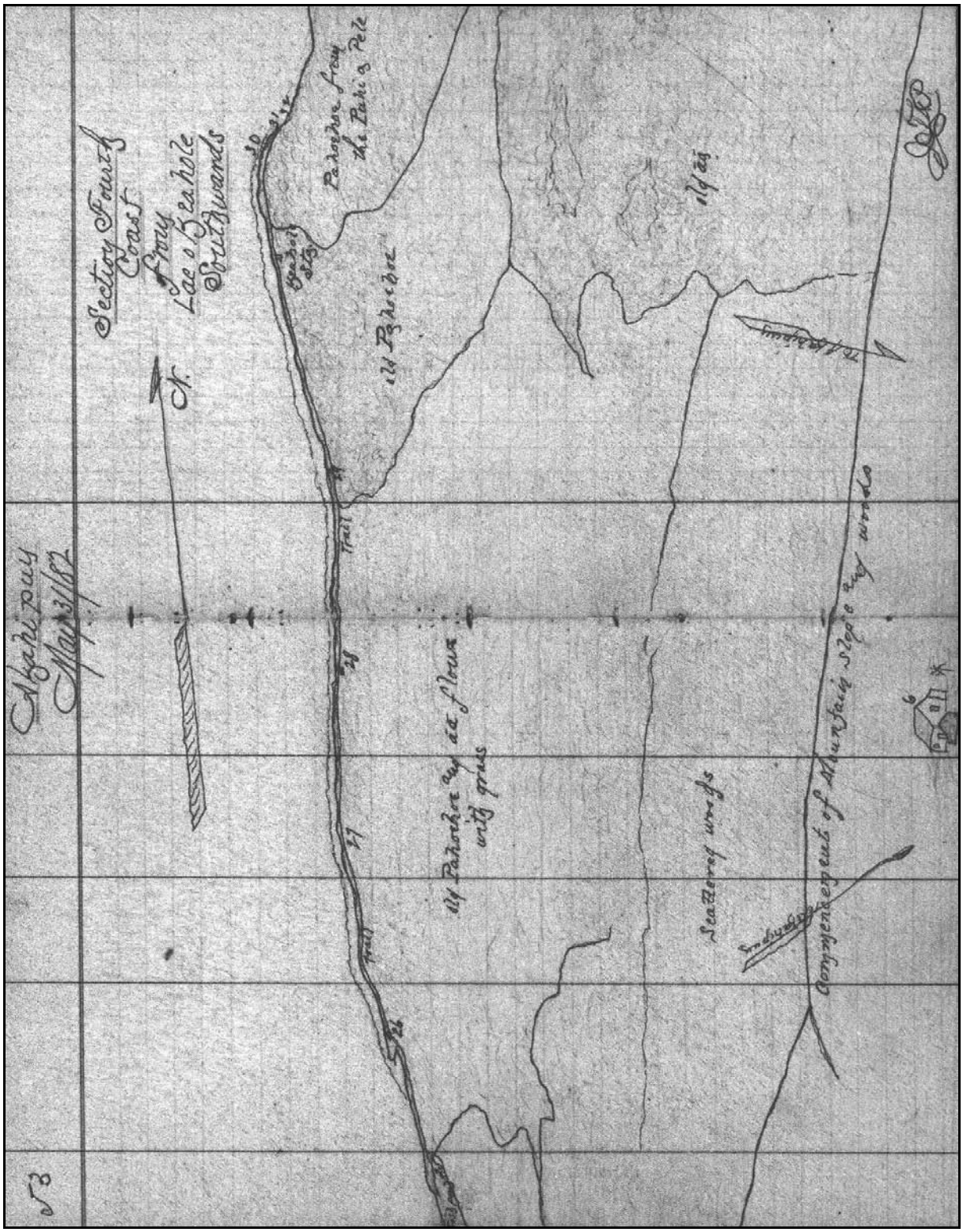


Figure 9. J. S. Emerson, field notebook map, Book 253:53 (State Survey Division).

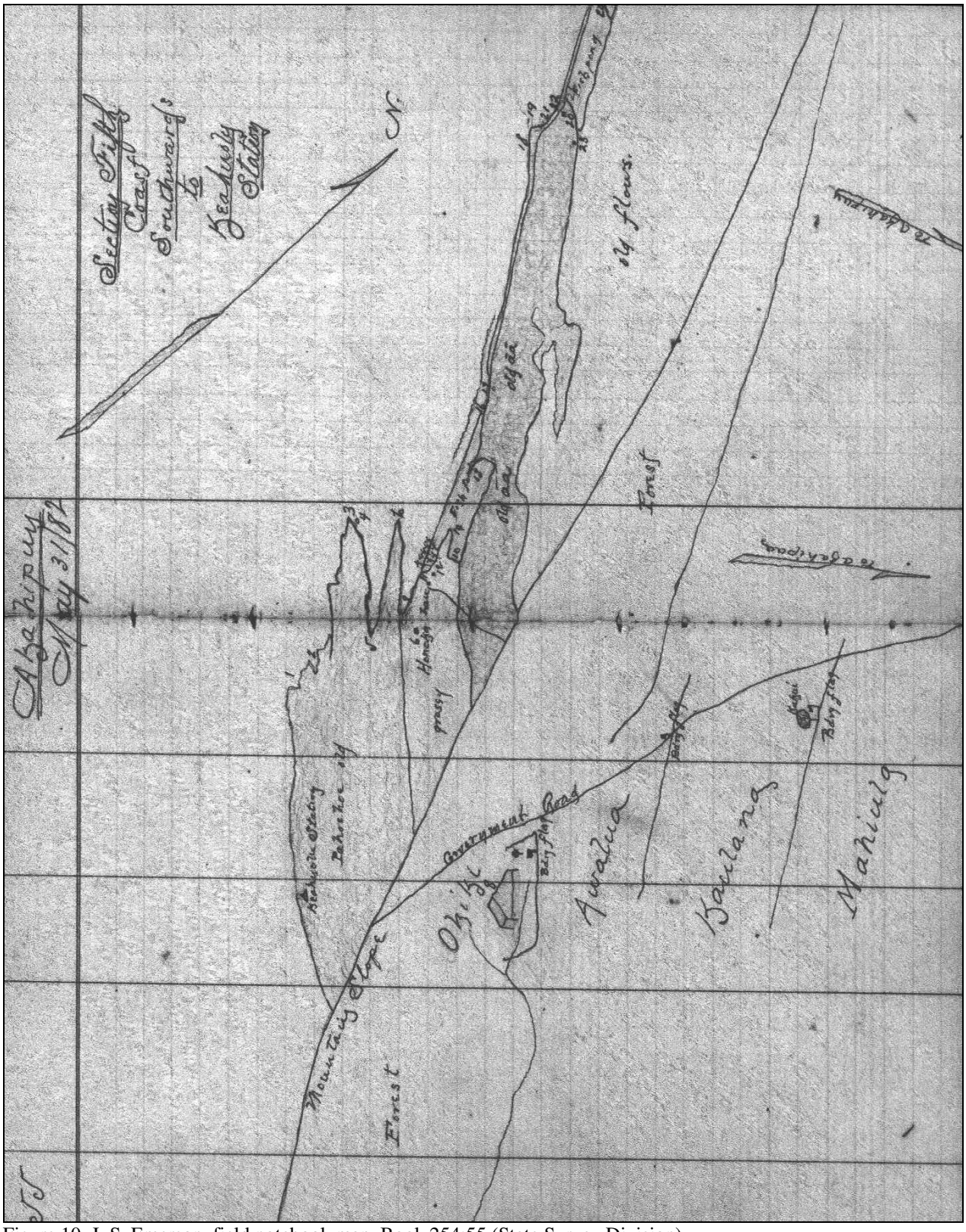


Figure 10. J. S. Emerson, field notebook map, Book 254:55 (State Survey Division).

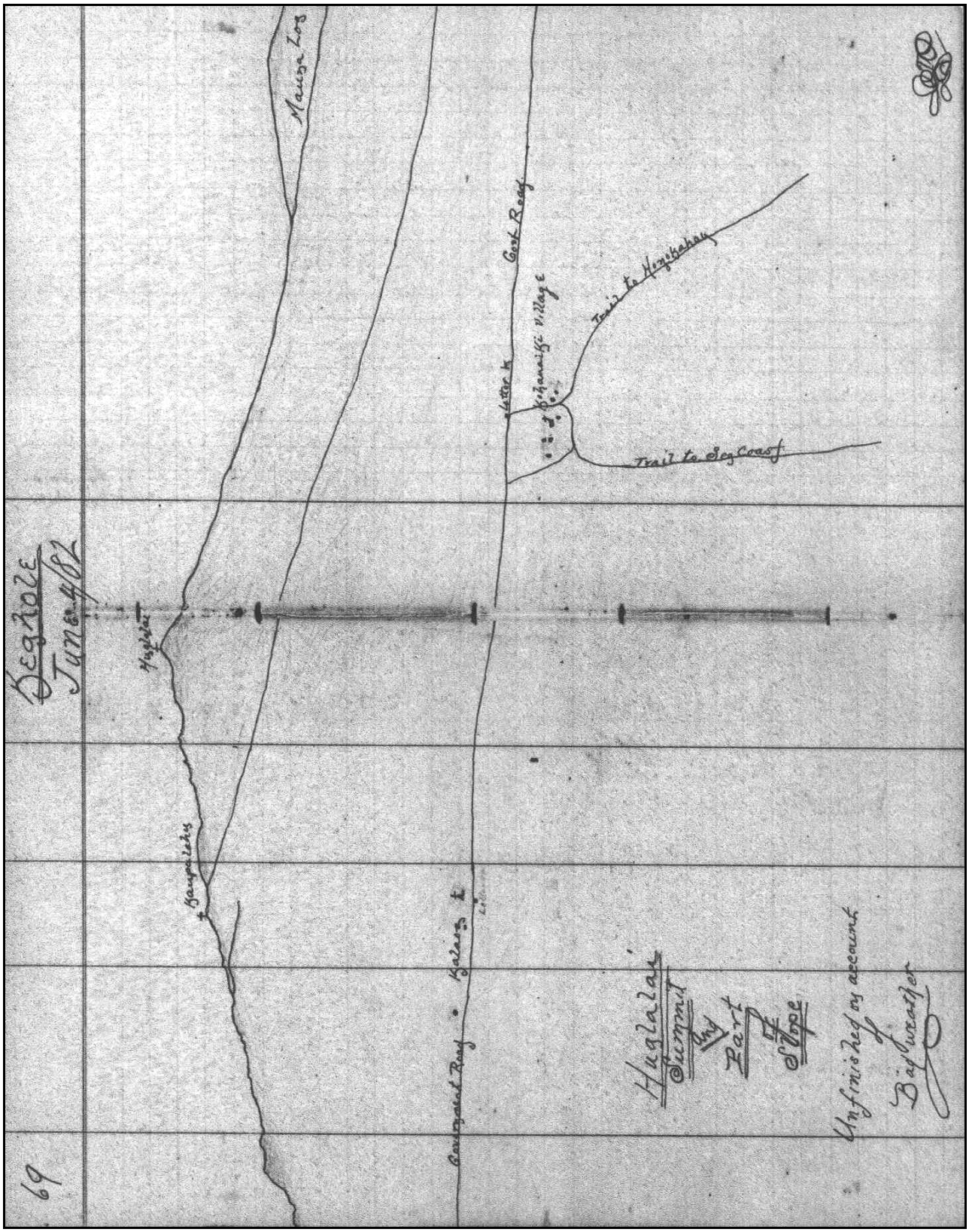


Figure 11. J. S. Emerson, field notebook map, Book 254:69 (State Survey Division).

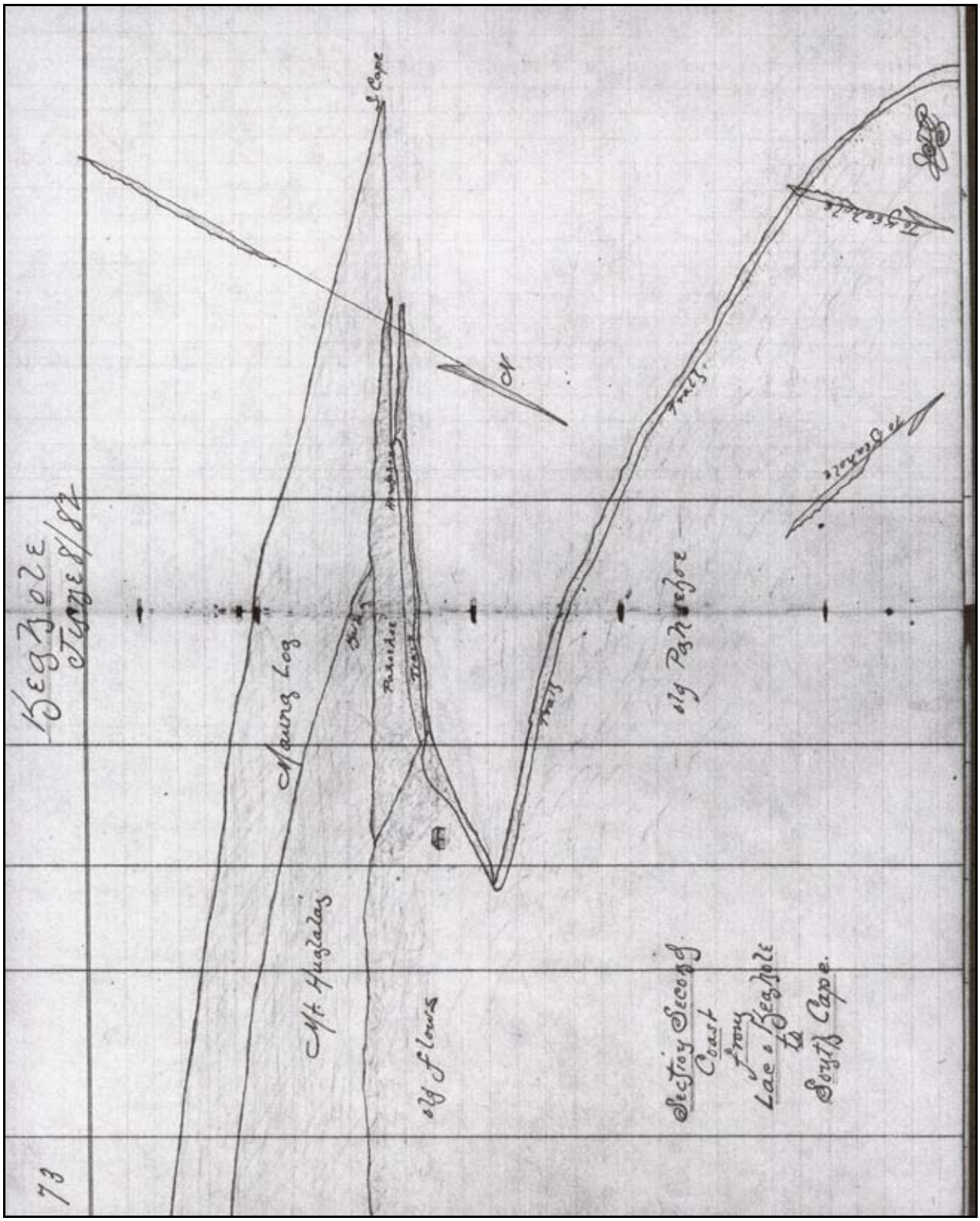


Figure 12. J. S. Emerson, field notebook map, Book 254:73 (State Survey Division).

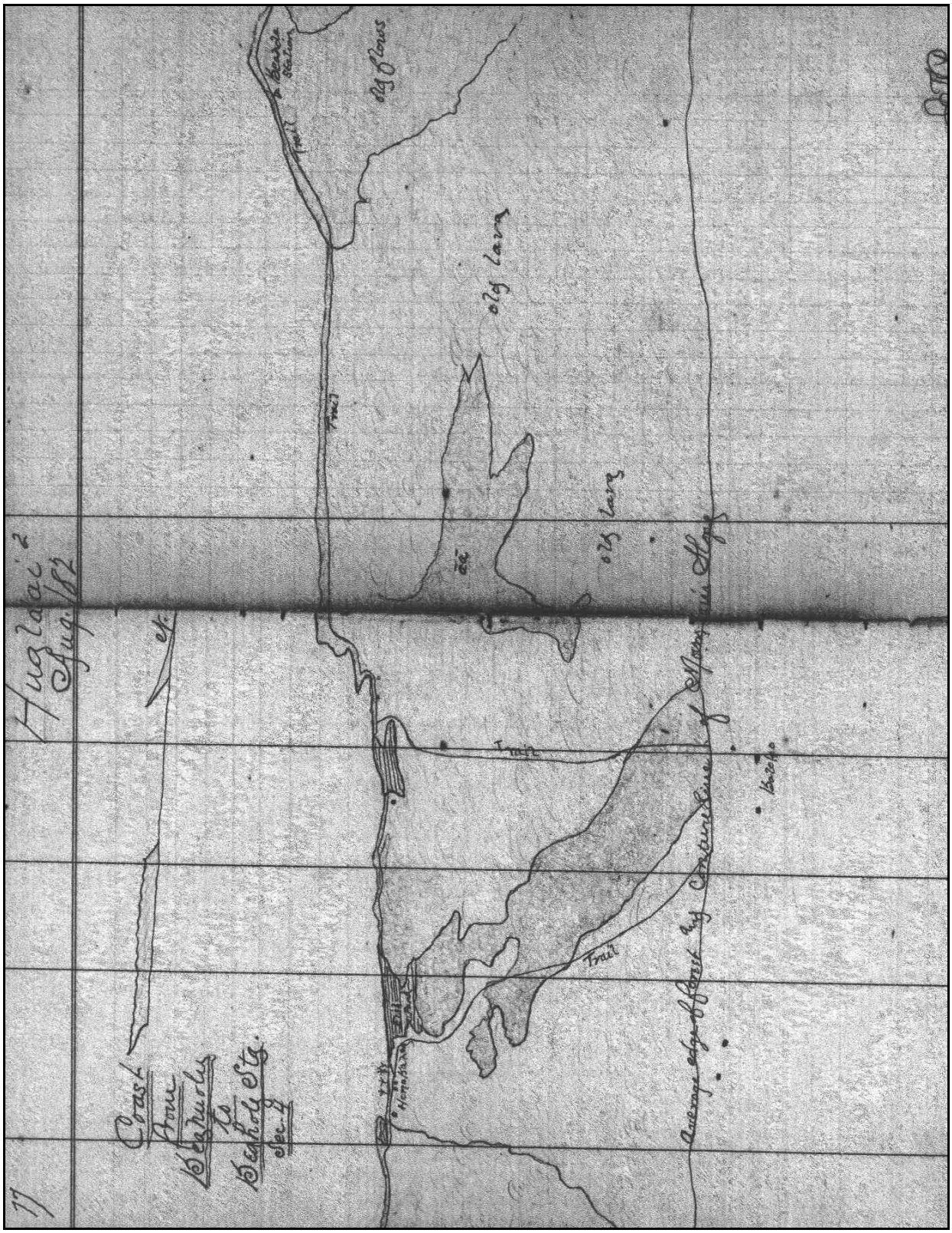


Figure 13. J. S. Emerson, field notebook map, Book 254:77 (State Survey Division).

While surveying the ‘O‘oma and vicinity homestead lots in 1888-1889, Emerson camped near Kama’s house in ‘O‘oma 1st. The following communications were sent by Emerson to W.D. Alexander, and tell us more about the people of the land, their beliefs, and commentary on then current events in the Kingdom. Of interest, we also find that J.W.H. Isaac Kihe, whose writing of traditions, and as a representative of the native families in the land application process—which have been cited extensively in this study—is also mentioned in Emerson’s narratives.

(Underlining, italics and brackets are inserted to draw attention to certain passages.)

> *April 8, 1888*
> …Our tent is pitched in Ooma on the *mauka* Govt. road at a convenient distance from Kama’s fine cistern which supplies us with the water we need. The pasturage is excellent and fire wood abundant. As I write 4:45 P.M. the thermometer is 71º, barometer 28.78. The entire sky is overcast with black storm clouds over the mountains. The rainy season comes late to Kona this year and has apparently just begun. We have had about three soaking rains with a good deal of cloud & drizzle. We are now having a gentle rain which gladdens the residents with water for their cisterns… We have set a large number of survey signals and identified many important corners of Gov’t. lands etc. from Puhiapele on the boundary of Kaupulehu to the boundary line of Kaloko. The natives welcome us and do a great deal to help the work along. Tomorrow I expect to go to Kuili station with a transit and make a few observations & reset the old signal... The Kamaainas tell me that Awakee belongs to the Gov’t. though I see it put down as LCA 10474 Namauu no Kekuanaoa.
>
> They also tell me that the heirs of Kanaina estate still receive rent for the Ahupuaa of Kaulana, though I have recorded as follows in my book, Kaulana ½ Gov’t. per civil Code 379, ½ J. Malo per Mahele Bk. Title not perfected; all Gov’t. Please examine into the facts about Kaulana and instruct me as to what I shall do about it. Kealoha Hopulaau rents it and if it is Gov’t. land the Gov’t. should receive the rent or sell it off as homesteads. It is a desirable piece of land, a part of it at least… [HSA—HGS DAGS 6, Box 2]
>
> *April 17, 1888*
> ...The work is being pushed rapidly and steadily forward. The natives render me most valuable assistance and find all the important corners for me as fast as I can locate them. It is hard getting around on account of the rocks & stones, to say nothing of trees etc., but there is a great deal of really fine land belonging to the Government, admirably adapted to coffee etc. The more I see of it the better it appears.
>
> As to Kaulana, if I hear nothing to the contrary from you, I will leave it all as Gov’t. land.
>
> Mr. McGuire [sic] of Kohala, the representative for that district, proposes to settle in Kona. He has bought Grant 1590, Kauhine, in Ooma, Kalaoa etc. and wants the Gov’t. to make good to him the amount taken from him by Grants 2972, Kaakau & Kama, and 3027, Hueu, which occupy portions of the same land granted to Kauhine. If his title is good, would it not be just to leave Kaakau & Kama as well as Hueu in possession of their lots where they have lived for over 20 years, and give McGuire an area in adjoining lands equal to that taken from him by these two grants.
>
> It is said that Chas. Achi has written to the natives that Grant 1590, Kauhine, has been cancelled. Will you learn the true state of the case and be so kind as to inform me…
> [HSA—HGS DAGS 6, box 2 Jan.-Apr. 1888]

In his field book notes, on May 1st, 1888, Emerson noted that he had placed the “Pulehu” station on the “ground by ahu, about 4 feet makai of Kama’s goat pen, on the iwi aina between Kalaoa 5 and Ooma 1…” (J.S. Emerson Field Book 291:83).

In the same field book on May 19th, 1888, while surveying the area near the boundary of ʻOʻoma 1st and 2nd, at the 325 foot elevation, Emerson cited off of a station named "Kahokukahi." The point is "on the entrance of the cave, Kahokukahi… The above is the vertical entrance of a famous *ana kaua*, which extends for a long distance to the E. and to the W…" (J.S. Emerson Field Book 291:137). An "ana kaua" would be a place, where during times of war, people could hide and fortify themselves. Emerson's description indicates that the cave runs some distance *mauka* and *makai* of "Kahokukahi."

On May 23, 1888, Emerson surveyed Pūhili, the boundary between Kohanaiki and ʻOʻoma 2nd. He observed, "Large [mark] on solid pahoehoe, on bound. bet. Kohanaiki & Ooma, by the sea, near the end of a cape… Station mark, drill hole in stone, 9 ft. S. of the S. corner of an old "kahua hale" on white sand…" (J.S. Emerson Field Book 291:151).

Returning to his "old camp Ooma," in August 1888, Emerson submitted the following letter to Alexander:

> *August 25th, 1888*
> …I have to report that the very intricate and irregular remainder of Gov't. land situated in Kealakehe is cut up into homesteads, ready for the committee to estimate its values. The job has been made unusually long & tedious by the absurd arrangement of the old kuleanas scattered around at random. I have also run out the boundaries of Papaakoko, ready for fencing. Thursday P.M. I made my way through a heavy rain to this place and set up tent in the storm. It rained a good deal every day since and is raining now. In spite of the weather the work of cutting up Ooma 1st goes bravely on. I have a huge umbrella to camp under while it rains. I propose to finish up Ooma 1st & return to Honolulu by the next trip of the *Hall*.
>
> Kailua beach is the great rendezvous for men & asses from all parts of the country when the steamer arrives from Honolulu. It has in consequence become the natural place to tell and hear gossip & news. Here, the sand-lot orator, mounted on a packing box, can address the largest crowd. T.N. Simeona, who stole the church money, keeps the pound and takes care of the court house wanting to make a speech, repaired to the beach last Wednesday morning and is reported to have made a windy harangue to the effect that the King was hewa and that the Ministers were pono! Up to that time he had always been the contemptible too of the King's party and was loud in his denunciation of the Government. I explain this change in his talk by his wish to retain his Gov't. billets & his desire to avoid arrest as a rebel.
>
> A native man told me the other day (Wednesday) that the Cabinet was hewa in two things viz.
>
> 1st They taxed chickens, banana trees and many other things that had not been heretofore taxed.
>
> 2nd They arrested and sent to Molokai many who were not lepers. For these reasons many justified Wilcox for trying to out the ministers.
>
> There is a sturdy old native living at Kaloko named Kealiihelepo, whom I greatly respect. Said he to me "When King Kalakaua returned from his foreign trip he made a speech at Kailua and said that 'in foreign lands the foreign God was losing his power. His former worshippers were deserting him. That the old Hawaiian Gods were still mana and them he would worship.'" But said Kealiihelepo "The King was mistaken. Our old Gods were once mighty, but the coming of the foreigner with his Gods has robbed them of their strength. Therefore the King has made the mistake to oppose the God who is now in power, and Jehovah is opposing him. Hence the King's pilikia."
>
> You are entirely justified in calling Kona "that heathen district." [HSA—HGS DAGS 6, box 2 Jan.-Apr. 1888]

On October 14th 1888, Emerson wrote to Alexander, briefing him on conversations he was having with J.W.H. Isaac Kihe, his "encyclopedia," "the son of a famous sorcerer." Later, Emerson used many of the notes taken during his conversations with Kihe, to develop his paper on Hawaiian religion (Emerson 1892). J.W.H. Isaac Kihe, was the son of Kihe, who was the son of Kuapahoa, of Kaloko (notes of J.S. Emerson, September 25, 1915; in collection of the Hawaiian Historical Society). While at ʻOʻoma, Kihe described the various nature forms taken by the deceased, and their role in the spiritual practices. On October 14th Kihe named for him some of the gods called upon by those who practiced the Kahuna Kuni sorcery.

> *Ooma*
> *October 14, 1888*
> *J.S. Emerson; to W.D. Alexander:*
> …I have just been having a chat with a son of a famous sorcerer, with the following for a summary of what he said.
>
> There are four gods worshipped by murders and sorcerers viz:
>
> (1). Kui-a-Lua, the god of the Lua, Mokomoko, Haihai and other forms of violence.
>
> (2). Uli, the god of the Anaana, Kuni, Hoopiopio and Lawe Maunu.
>
> (3). Kalaipahoa, god of the Hoounauna, Hookomokomo and Hooleilei.
>
> (4). Hiiaka-i-ka-poli-o-Pele, the goddess of the Poi uhane, Apo leo, Pahiuhiu and Hoonoho uhane… [J.S. Emerson, in collection of the Hawaiian Historical Society]

Trails and Roads of Kekaha (Governmental Communications)

Alahele (trails and byways) and *alaloa* (regional thoroughfares) are an integral part of the cultural landscape of Hawaiʻi. The *alahele* provided access for local and regional travel, subsistence activities, cultural and religious purposes, and for communication between extended families and communities. Trails were, and still remain important features of the cultural landscape.

Traditional and historical accounts (cited in this study) describe at least two traditional trails that were of regional importance which pass through the lands of ʻOʻoma. One trail is the *alaloa*—parts of which were modified in the 1840s and later, into what is now called the *Alanui Aupuni* (Government Road) or Māmalahoa Trail or King's Highway—that crosses the *makai* (near shore) lands, linking royal centers, coastal communities, and resources together. The other major thoroughfare of this region is "*Kealaehu*" (The path of Ehu), which passes through the uplands, generally a little above the *mauka* Government Road or old Māmalahoa Highway, out to the ʻAkāhipuʻu vicinity, and then cuts down to Kīholo in Puʻu Waʻawaʻa. From Kīholo, the *makai alaloa* and Kealaehu join together as the *Alanui Aupuni,* and into Kohala, passing through Kawaihae and beyond. The *mauka* route provided travelers with a zone for cooler traveling, and access to inland communities and resources. It also allowed for more direct travel between the extremities of North and South Kona (cf. Malo 1951; Iʻi 1959; Kamakau 1961; Ellis 1963; and *Māhele* and Boundary Commission Testimonies).

In addition to the *alahele* and *alaloa*, running laterally with the shore, there are another set of trails that run from the shore to the uplands. By nature of traditional land use and residency practices, every *ahupuaʻa* also included one or more *mauka-makai* trail. In native terminology, these trails were generally known as—*ala piʻi uka* or *ala piʻi mauna* (trails that ascend to the uplands or mountain). Some of these trails are described in native accounts and oral history interviews cited in this study.

Along the trails of the Kekaha region of which ʻOʻoma is a part, are found a wide variety of cultural resources, including, but not limited to residences (both permanent and temporary), enclosures and exclosures, wall alignments, agricultural complexes, resting places, resource collection sites, ceremonial features, *ilina* (burial sites), petroglyphs, subsidiary trails, and other sites of significance to the families who once lived in the vicinity of the trails. The trails themselves also exhibit a variety of construction methods, generally determined by the environmental zone and natural topography of the land. "Ancient" trail construction methods included the making of worn paths on *pāhoehoe* or *ʻaʻā* lava surfaces, curbstone and coral-cobble lined trails, or cobble stepping stone pavements, and trails across sandy shores and dry rocky soils.

Following the early nineteenth century, western contact brought about changes in the methods of travel (horses and other hoofed animals were introduced). By the mid-nineteenth century, wheeled carts were also being used on some of the trails. In the Kona region portions of both near shore and upland *ala hele-ala loa* were realigned (straightened out), widened, and smoothed over, while other sections were simply abandoned for newer more direct routes. In establishing modified trail—and early road-systems—portions of the routes were moved far enough inland so as to make a straight route, thus, taking travel away from the shoreline.

It was not until 1847, that detailed communications regarding road construction on Hawai‘i began to be written and preserved. It was also at that time that the ancient trail system began to be modified and the alignments became a part of a system of "roads" called the "*Alanui Aupuni*" or Government Roads. Work on the roads was funded in part by government appropriations, and through the labor or financial contributions of area residents and prisoners working off penalties (see communications below). Where the *Alanui Aupuni* crosses the lands of ‘O‘oma, the alignment includes several construction methods, such as being lined with curbstones; elevated; and with stone filled "bridges" in areas that level out the contour of the roadway.

The following letters provide readers with a historical overview of the *Alanui Aupuni*, and travel through ‘O‘oma and the Kekaha region. Of particular interest to the lands of ‘O‘oma, are those communications addressing the lower Government Road which passes through the proposed development area.

(Underlining, italics, and square brackets have been added.)

> *June 26, 1847*
> *George L. Kapeau to Keoni Ana*
> I have received your instructions, that I should explain to you about the *alaloa* (roadways), *alahaka* (bridges), lighthouses, markets, and animal pounds. I have not yet done all of these things. I have thought about where the *alanui heleloa* (highways) should be made, from Kailua to Kaawaloa and from Kailua to Ooma, where our King was cared for [7], and then afterwards around the island. It will be a thing of great value, for the roads to be completed. Please instruct me which is the proper thing for me to do about the *alaloa*, *alahaka*, and the laying out of the *alaloa*… [HSA—Interior Department Misc., Box 142; Kepā Maly, translator)

> *August 13, 1847*
> *Governor of Hawaii, George L. Kapeau; to*
> *Premier and Minister of Interior, Keoni Ana*
> *Aloha oe e ka mea Hanohano –*
> I have a few questions which I wish to ask you. Will the police officers be required to pay, when they do not attend the Tuesday (*Poalua*) labor days? How about parents who have several children? What about school teachers and school agents? Are they not required to work like all other people when there is Government work on the roads and highways?
>
> I believe that school agents, school teachers and parents who have several children, should only go and work on the weeks of the public, and not on the *konohiki* days…
>
> …The roads from Kailua and down the pali of Kealakekua, and from Kailua to Honokohau, Kaloko, Ooma, at the places that were told our King, and from thence to Kaelehuluhulu [at Kaulana in Kekaha], are now being surveyed. When I find a suitable day, I will go to Napoopoo immediately, to confer with the old timers of that place, in order to decide upon the proper place to build the highway from Napoopoo to Honaunau, and Kauhako, and thence continue on to meet the road from Kau. The road is close to the shore of Kapalilua…

7 For the first five years of his life (till ca. 1818), Kauikeaouli was raised at ‘O‘oma, by Ka-iki-o-‘ewa and Keawe-a-mahi *mā* (see Kamakau 1961; and this study).

The width of the highways around Hawaii, is only one fathom, but, where it is suitable to widen where there is plenty of dirt, two fathoms and over would be all right… If the roads are put into proper condition, there are a lot of places for the strangers to visit when they come here. The Kilauea volcano, and the mountains of Maunaloa, Maunakea, Hualalai.

There is only one trouble to prevent the building of a highway all around, it is the steep gulches at Waipio and Pololu, but this place can be left to the very last… [HSA—Roads, Hawaii]

March 29, 1848
Governor Kapeau; to Minister of the Interior, Keoni Ana:
[Acknowledging receipt of communication and answering questions regarding construction methods used in building the roads.]

…I do not know just what amount of work has been done, but, I can only let you know what has come under my notice.

The highway has been laid from Kailua to Kaloko, and running to the North West, about four miles long, but it is not completely finished with dirt. The place laid with dirt and in good condition is only 310 fathoms.

The highway from Kealakekua to Honaunau has been laid, but is not all finished, and are only small sections… [HSA—Roads, Hawaii]

July 9, 1873
R.A. Lyman; to
E.O. Hall, Minister of the Interior.
Notifies Minister that *the road from Kiholo to Kailua needs repairing*. [HSA—Interior Department – Land Files]

August 14, 1873
R.A. Lyman; to
E.O. Hall, Minister of the Interior:
I have just reached here [Kawaihae] from Kona. I have seen most of the roads in N. Kona, and they are being improved near where the people live. If there is any money to be expended on the roads in N. Kona, I would say that the place where it is most needed is from Kiholo to Makalawena, or the Notch on Hualalai.

This is the main road around the island and is in very bad condition. Hardly anyone lives there, and there are several miles of road across the lava there, that can only be worked by hiring men to do it. There is also a road across a strip of Aa a mile & a half or 2 in length in the south end of S. Kohala next to the boundary of N. Kona, that needs working, and then the road from here [Kawaihae] to Kona will be quite passable… [HSA—Roads, Hawaii]

November 4, 1880
J.W. Smith, Road Supervisor, North Kona; to
A.P. Carter, Minister of the Interior:
…Heretofore I have been paying one dollar per day, but few natives will work for that, they want $1.50 per day. Thus far I have refused to pay more than $1.00 and have been getting men for that sum.

The most urgent repairs are needed on the main road from Kaupulehu to Kiholo, and north of Kiholo to the Kohala boundary, a distance of about 20 miles… [HSA—Roads, Hawaii]

Kailua Nov. 19th, 1880
Geo. McDougall; to
A.P. Carter, Minister of the Interior —
…I noticed among the appropriation passed by the last Legislature, an item of $5000 for Roads in North Kona Hawaii — as I am very much interested about roads in this neighbourhood, I take the liberty to express my opinions what is wanted to put the roads in good repair and give the most satisfaction to all concerned.

The Road from Kailua going north for about eight miles to where it joins the upper Road, has never been made, it is only a mule track winding through the lava. It could cost to make it a good cart road, fully two thousand dollars. And from Kailua to where it joins the South Kona road, about 12 miles was made by Gov. Adams, and is in pretty much the same state as he left it, only a little worse of the ware of 20 years or more, it could cost to make it in good repair about 15 hundred dollars. Then we could have 20 miles of good road… [HSA—Interior Department Letters]

March 21st, 1885
C.N. Arnold, Road Superintendent-in-Chief, Hawaii; to
Charles Gulick, Minister of Interior:
…In accordance with your instructions I beg to hand you the following list of names as being those I would select for Supervisors in the different Road Districts under my charge:

… Judge J.K. Hoapili, North Kona District…

Hoping these parties may meet with your approval… [HSA—Roads, Hawaii]

March 1886
Petition to Charles Gulick, Minister of the Interior:
[Signed by 53 residents of North Kona, asking that the appropriated funds be expended for the Kailua-Kohanaiki Road]:

We the people whose names are below, subjects of the King, residing in North Kona, Island of Hawaii:

The funds have been appropriated by the Legislature for the opening of the road from Kailua to Kohanaiki, therefore, we humbly request that the road be made there. The length of this road being thought of is about five miles more or less. The road that is there at the present time is not fit for either man nor beast.

Your people have confidence that as so explained, you will kindly grant our request, and end this trouble in our District…

[those signing included names of individuals known to have ties to the ‘O‘oma vicinity]: ….J. Kamaka, Kuakahela, Kahulanui, & Palakiko… [HSA—Roads Hawaii; Maly, translator]

March 9th, 1887
C.N. Arnold, Road Superintendent-in-Chief, Hawaii; to
Chas. Gulick, Minister of the Interior:
[Arnold provides documentation of the early native trail from Kailua to the upper Kohanaiki region, and its’ ongoing use at the time. He also notes that McDougall (resident at Honokōhau) and others are presently in the business of dairy ranching]:

…The enclosed petition [cited above] has just come to hand from North Kona. The petitioners are mistaken when they say that any special appropriation has been made for this road as there has never been a Government road in this part of the District. There is however an old native trail which has always been used as a short cut, from the lower part of the district between

Keahou [sic] and Kailua, by persons who were traveling to Kawaihae and Waimea. The opening of a good road here would be a great convenience to the traveling public and also a great accommodation to a great many people who live on, or nearly on the line of it. I may mention among the number, Messrs. McDougall and Clark who are engaged in dairy ranching near the head of the proposed line. I may also mention that I, with Mr. Smith, made a preliminary survey of it, at the request of His Majesty the King, who is also interested in the opening of this road, as it opens up all of His Kailua lands for settlement. I regard the road as necessary for the above reasons.

From the preliminary survey made, I estimate that a wagon road 12 feet wide will cost from Kailua to the *mauka* Govt. road at Kohanaiki $6000. The length of the road is 5 ¾ miles. The elevation of highest point (*mauka* Road) is 1600 feet above tide at Kailua. Mr. Smith Supt. of Public Works has all the notes of the survey, and can give you full information in regard to this matter… [HSA—Roads, Hawaii]

July 14th, 1887
C.N. Arnold, Road Superintendent-in-Chief, Hawaii; to
L.A. Thurston, Minister of the Interior:
…In obedience to your request I beg to hand you the following list of the District Supervisors under my jurisdiction:

…North Kona – Hon. J.K. Nahale; Native… [HSA—Roads Hawaii]

March 8, 1888
J. Kaelemkule; Supervisor, North Kona Road Board; to
L.A. Thurston, Minister of the Interior.
[Ka‘elemakule provides Thurston with an overview of work on the roads of North Kona, and describes the Government roads (*Ala nui Aupuni* or *Ala loa*) which pass through the Kekaha region]:

The road that runs from Kailua to Kohanaiki, on the north of Kailua, perhaps 6 miles. It is covered with aa stone, and is perhaps one of the worst roads here. The Road Board of North Kona has appropriated $200 for work in the worst areas, and that work has been undertaken and the road improved. The work continues at this time. This is one of the important roads of this district, and it is one of the first roads that should be worked on.

The government road or ala loa from upland Kainaliu (that is the boundary between this district of South Kona) [Kealaehu], runs straight down to Kiholo and reaches the boundary of the district adjoining South Kohala, its length is 20 and 30 miles. With a troubled heart I explain to your Excellency that from the place called Kapalaoa next to South Kohala until Kiholo – this is a very bad section of about 8 miles; This place is always damaged by the animals of the people who travel along this road. The pahoehoe to the north of Kiholo called Ke A. hou, is a place that it is justified to work quickly without waiting. Schedule A, attached, will tell you what is proposed to care for these bad places…

Schedule A: [Appropriations needed]
The road from Kailua to Kohanaiki, and then joining with the inland Government Road – $500.

The upland Road from Kainaliu to the boundary adjoining S. Kohala – $1,500.00. [HSA—Roads Hawaii; Kepā Maly, translator]

September 30, 1889
Thos. Aiu, Secretary, North Kona Road Board (for J. Kaelemakule); to
L.A. Thurston, Minister of the Interior.
[Provides Thurston with an overview of work on the roads of North Kona, and identifies individuals who are responsible for road maintenance (cantoniers) in various portions of the district; several of the individuals named were also old residents and applicants for Homestead lots. Of interest, Kaelemakule's report indicates that maintenance of the Alanui Aupuni which crossed into the kula lands of ʻOʻoma, had not been assigned to anyone. (see report of Dec. 22, 1890)]:

1. In that section of the road which proceeds from Kailua near the shore to Kohanaiki, Mano is the cantonier.
2. That section of the road from Kukuioohiwai to Keahuolono, Paiwa is the cantonier…
3. That section of road from Kailua to the shore of Honokohau, Keaweiwi is the cantonier …
4. That section of road from Kukuioohiwai to Lanihau along the upland road, Isaac Kihe is the caretaker…

The work done along these sections is the cutting of brush – guava, lantana and such – which trouble the road, and the removal of bothersome stones… [HSA—Roads Hawaii; Kepā Maly, translator]

December 22, 1890
J. Kaelemkule; Supervisor, North Kona Road Board; to
C.N. Spencer, Minister of the Interior
[Reports on the cantoniers assigned to road work in various sections of North Kona. As in 1889, apparently no one was assigned to the lower Alanui Aupuni through the ʻOʻoma kula lands. Though Kaelemakule did include the road section on the land, extending through Kalaoa, on his attached diagram]:

…I forward to you the list of names of the cantoniers who have been hired to work on the roads of this district, totaling 15 sections; showing the alignment of the road and the length of each of the sections. The monthly pay is $4.00 per month, at one day of work each week. The board wanted to increase it to two days a week, but if that was done, there would not have been enough money as our road tax is only $700.00 for this district… You will receive here the diagram of the roads of North Kona. [HSA—Roads Hawaii; Kepā Maly, translator] (Figure 14)

Twentieth Century Travel in ʻOʻoma and Neighboring Lands of Kekaha

Kamaʻāina who have participated in oral history interviews (Rechtman and Maly 2003), describe on-going travel between the uplands and coastal lands of ʻOʻoma and other *ahupuaʻa* in Kekaha. The primary method of travel between 1900 and 1947, was by foot or on horse or donkey, and those who traveled the land, were generally residents of the ʻOʻoma, Kalaoa, Kohanaiki Homesteads and other lands in the immediate vicinity. The old ʻOʻoma Homestead road that borders the current project area to the north, was used during this time. After World War II, retired military vehicles became available to the public, after that time, the *Alanui Aupuni* and some of the smaller trails along the shore were modified for vehicular traffic.

The primary routes of travel through the 1960s, descended from upland Kohanaiki and Kaloko, or came out of Kailua. In the 1950s, Huʻehuʻe Ranch bulldozed a jeep road to the shore at Kaloko. The ranch, and some individuals who went to the shore either as a part of their ranch duties, or for leisure fishing along the coast, used this jeep road. The *Alanui Aupuni* was modified from Kailua, to at least as far as Honokōhau and Kaloko, and remained in use through the 1970s. It was not until the Queen Kaʻahumanu Highway was opened (ca. 1973) that travel across the *kula kai* (shoreward plains) of ʻOʻoma was once again made possible for the general public.

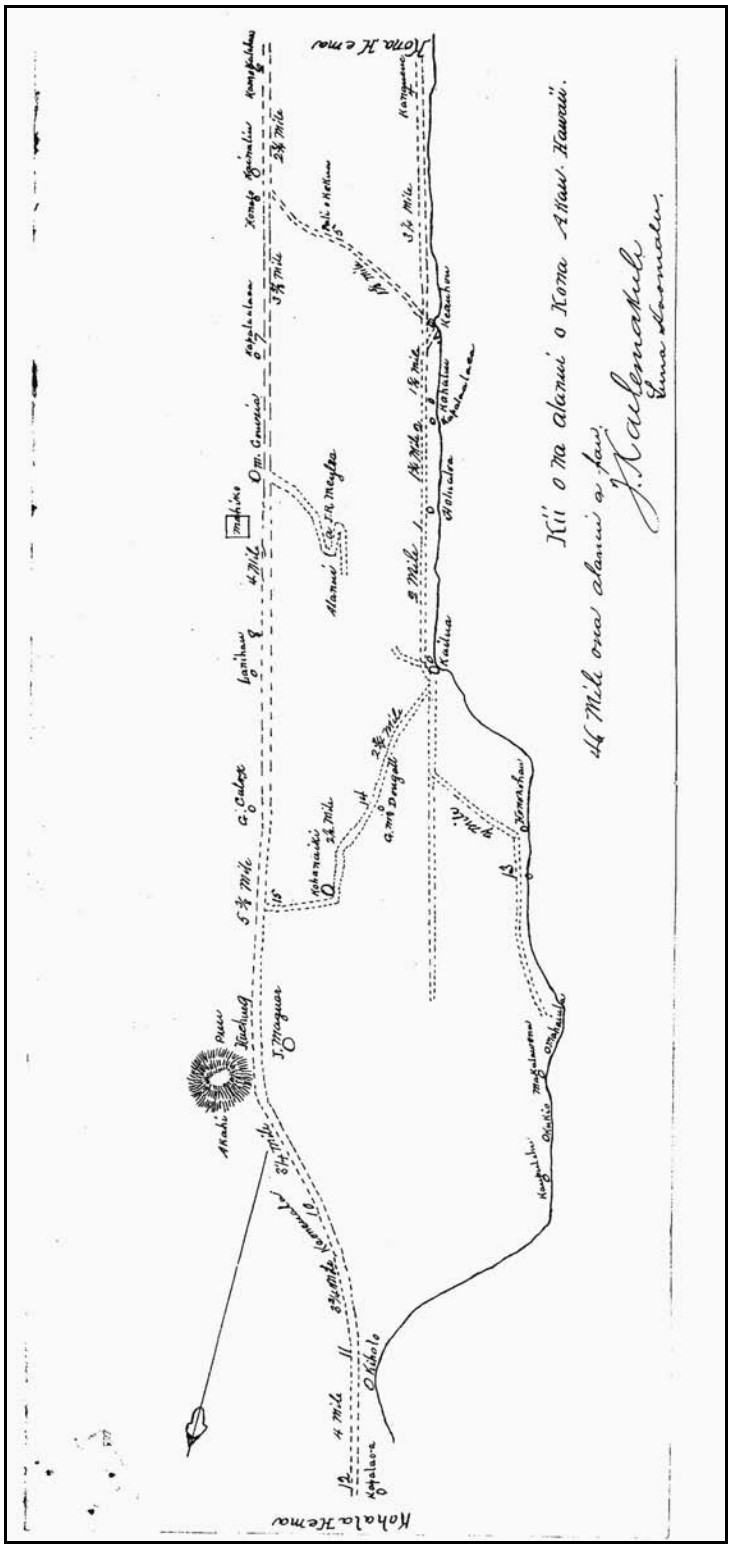


Figure 14. *Kii o na alanui o Kona Akau* (diagram of the roads of North Kona); J. Kaelemakule Sr., Road Supervisor (HSA—Roads, Hawaii; December 22, 1890).

Summary of Oral-Historical Information

In Rechtman and Maly (2003:Volume II) elder *kama'āina* of the Kekaha region, tell much the same story as that described in the communications from the period of homestead development, and in the accounts given by J. Puuokupa in 1875 and J.W.H. Isaac Kihe in 1924. By the late 1800s, only a few permanent residence remained along the ʻOʻoma (and Kekaha) coastline. Primary residences were in the uplands, in the vicinity of the old Māmalahoa Highway. In that region, people were able to cultivate a wide range of crops—both native staples and new introductions—with which to sustain themselves, and in some case even as cash crops.

By the middle to late 1800s, the *kula* lands, from around the 900-foot elevation to shore, were primarily used for goat, cattle, and donkey pasturage. The families of the uplands regularly traveled to the coast via trails. This was usually done to go fishing, or to round up cattle, goats, or donkeys. During periods of extreme dry weather, when water resources dried up, the families relied on the brackish water ponds in the near-shore lands. In ʻOʻoma, near Wawaloli, the area marked on J.S. Emerson's Register Maps 1280 (see Figure 6), as Kama's or Keoki Mao's house, families still took shelter, and drank the water from the spring, through the 1940s. Such was the case at various locations of the coast, between Kohanaiki, ʻOʻoma, Kalaoa, Hoʻonā, Kaulana, and lands further north to Kapalaoa.

An additional oral interview was conducted with *kama'āina* Elizabeth Maluihi Ako Lee (Auntie Elizabeth) for the current study. Auntie Elizabeth was born in 1929 and was raised by her *hanai* family, Kahananui, in upland ʻOʻoma. As a child she walked the upland trails and cultivated sweet potatoes on the current study parcel. Her *hanai* parents were responsible for building at least two of the boundary walls on the current study parcel for cattle control purposes. Her family also owned the parcel immediately *mauka* of the current study parcel, on which they used to graze cattle. Auntie Elizabeth recalled a Korean man living on that parcel during the 1930s.

AHUPUAʻA SETTLEMENT PATTERNS AND CURRENT SURVEY EXPECTATIONS

Archaeological studies undertaken within the greater North Kona District indicate that initial prehistoric settlement was concentrated primarily along the coast (Cordy 1981, Cordy et al. 1991). As coastal populations increased, so did the development of agricultural fields in the upland areas, reaching their greatest extent in the late 1700s. As the fields expanded so did native populations in the upland resource areas. By the sixteenth century temporary and permanent habitations were found at higher elevations within the *'apa'a* zone (Barrera 1991).

In Historic times, with the shift to a market economy and a western style of land ownership in Hawaiʻi, populations shifted from the coast to the upland areas. Much of the old style of agriculture was abandoned in favor of coffee farms and cattle ranches, which have had a significant impact on the Precontact archaeological record.

Based on the Historical information collected by Rechtman and Maly (2003) and the findings of the inventory survey previously conducted on a portion of the current study parcel (Drolet and Schilz 1991), along with the results of nearby studies (Clark and Rechtman 2005a and 2005b; Rosendahl 1989) a fairly detailed set of project area expectations can be arrived at. Precontact use of the project area is likely to be marked by diverse agricultural features (including modified outcrops and mounds) and associated habitation sites. The habitation sites could include platforms, enclosures, pavements, or lava tubes. A network of trails would have connected these upland agricultural and habitation areas to each other and to the coast and to more *mauka* resource areas. Remnants of this trail network may be present within the current project area. If burials are encountered, they are expected to be found within platforms, lava tubes, or concealed lava blisters. Lava tubes may have also been used for water collection and refuge. Historic use of the current study parcel is likely to be marked by ranching and habitation related sites. Historic feature types could include core-filled walls, enclosures, roads, or house pads.

Fifteen archaeological sites were previously recorded on, or along the boundary of, the current study parcel (Clark and Rechtman 2005a; Drolet and Schilz 1991; Rosendahl 1989). These sites include five lava tubes (Sites 16103, 16104, 16105, 16131, and 24424), four Historic boundary walls (Sites 5699, 16106, 16125, and 16126), a circular mound (Site 16107), a mound cluster (Site 16108), three low walls (Sites 16127, 16129, and 16130), and a wall, a mound, and an alignment (Site 16128). These sites should all still be present within the current project area.

Also, during a recent field visit to the current project area with Mr. Robert E. Lee (the parcel owner), and his mother, Mrs. Elizabeth Maluihi Ako Lee (Auntie Elizabeth), and the authors of this report, Auntie Elizabeth related that as a child in the 1930s and early 1940s she helped her *hanai* family cultivate sweet potatoes on the parcel. She described clearing cobbles from soil areas and then planting sweet potato cuttings in the rock-free soil. The cobbles removed from the soil were collected into clearing mounds. Auntie Elizabeth pointed out several small mounds that were similar to those she had created as a child, but she noted that they were not nearly as tidy as the neatly stacked features her family normally built. Mr. Lee related that his grandfather had built the western and northern boundary walls of the parcel during this same time period.

FIELDWORK

Fieldwork for the current project began on April 25, 2005 and was completed on August 31, 2005. Robert B. Rechtman, Ph.D. directed all fieldwork. Fieldworkers included J. David Nelson, B.A., Michael E. Rivera, B.A., Mark J. Winburn B.A., Olivier M. Bautista, B.A., Christopher S. Hand, B.A., and Thomas B. Jones, B.A.

Methods

During the intensive inventory survey of the study area, the entire parcel was subject to north/south pedestrian transects with fieldworkers spaced at 10-meter intervals. When archaeological resources were encountered (with the exception of a large number of crudely constructed presumed agricultural features), they were plotted on a map of the study parcel using Garmin 76s handheld GPS technology (with sub five-meter accuracy), and then (when appropriate) cleared of vegetation, mapped in detail using tape and compass, photographed, tagged with their temporary site number, and described using standardized site record forms. The recorded archaeological features were grouped into sites based on perceived proximity, functionality, and temporality. When these associations could not be confidently established, isolated features were assigned an individual site number. Sites were also evaluated at that time for the need of subsurface testing.

During these initial transect sweeps a large number of crudely constructed, presumed agricultural features were also noted on the study parcel. To record these small, crude constructions that dotted nearly the entire landscape, fieldworkers (in a group of four to six people) began in the northeastern corner of the study parcel and worked in tight formation north/south across the project area, progressing to the west as each sweep was completed. As features were encountered they were recorded using standardized agricultural feature description forms (Appendix B), marked with metal tags containing their temporary site number (in this case Site 25064) and feature number, and plotted on a map of the project area using Garmin 76s handheld GPS technology (with sub five-meter accuracy). Each fieldworker was assigned a specific task (i.e. clearing vegetation, marking with site tags, photographing, measuring, filling out feature description forms, and plotting on a map of the project area). In this manner the entire project area was explored and all discrete features were recorded. The features were also evaluated at that time for the need of subsurface testing.

Test units were placed at features within sites whose function was uncertain based solely on surface observations. All test units (TUs) excavated during the current project measured 1 x 1 meter. Excavation of the test units proceeded following natural stratigraphic layers. Where applicable, the layers were excavated in arbitrary 10-centimeter levels. All recovered soil matrix was passed through 1/4-inch mesh screen, and all recovered cultural material was remanded to the laboratory for detailed analysis. Level record forms, filled out for each level of each layer in each unit, were used to record soil descriptions, Munsell color notations, cultural constituents collected, and a general description of the level. Upon completion of a unit, photographs were taken, a profile drawing was prepared, and the unit was back-filled as close to its original specifications as possible.

Recovered cultural material was processed at the Rechtman Consulting, LLC laboratory facility and is currently curated at that location as well. To begin the laboratory process, the recovered cultural material was washed, separated by level within individual units, divided into material classes and separated by species or type (to the lowest taxonomic level possible). An accession number (ACC#) was then sequentially assigned to each group of separated, related items. The material encompassed by an individual accession number was quantified by the number of identified specimens (NISP), weighed, and when applicable, considered for the minimum number of individuals (MNI) present. The findings of the inventory survey along with detailed descriptions of the encountered archaeological resources and the results of subsurface testing are presented below.

Findings

As a result of the current inventory survey eleven previously recorded archaeological sites (Sites 5699, 16103, 16105, 16106, 16107, 16125, 16126, 16127, 16128, 16131, 24424) and forty-two newly recorded sites (Sites 25034 to 25075) were identified on the subject parcel (Table 1). The recorded sites include one Historic habitation complex (Site 25034) and four Historic boundary walls (Sites 5699, 16106, 16125, and 16126), twenty-three above ground Precontact habitation sites including seventeen complexes and six single feature sites (Sites 25036 to 25057), one Precontact ceremonial complex (Site 25035), two Precontact habitation lava blisters (Sites 25061 and 25068), twelve Precontact lava tube habitation sites (Sites 16103, 16105, 16131, and 25059, 25060, 25062 to 25067, and 25069), three of which contained burials (Sites 16103, 16105, and 25069), three burial complexes (Sites 25070, 25071, and 25072), one burial platform (Site 16128), three trail segments (Sites 25073, 25074, and 25075), one large Precontact enclosure of uncertain function (Site 25058), a Precontact complex of uncertain function (Site 16127), one lava tube used exclusively for Precontact and Historic water collection purposes (Site 24424), and a large agricultural complex that spans the entire project area (Site 16107). Nineteen test units were excavated at sixteen of the recorded sites (see Table 1).

Table 1. Archaeological sites recorded during the current inventory survey.

SIHP No.	*Formal Type*	*Functional Type*	*Age*	*Test Unit*
5699	Wall	Boundary	Historic	-
16103	Lava tube	Burial/habitation	Precontact	TU-19
16105	Lava tube	Burial/habitation	Precontact	-
16106	Wall	Boundary	Historic	-
16107	Complex	Agricultural	Precontact/Historic	TU-6, 17, and 18
16125	Wall	Boundary	Historic	-
16126	Wall	Boundary	Historic	-
16127	Complex	Habitation/agricultural	Precontact	-
16128	Platform	Burial	Precontact	TU-3
16131	Lava tube	Habitation	Precontact	-
24424	Lava tube	Water collection	Precontact/Historic	-
25034	Complex	Habitation	Historic	-
25035	Complex	Ceremonial	Precontact	-
25036	Enclosure	Habitation	Precontact	-
25037	Modified outcrop	Habitation	Precontact	-
25038	Complex	Habitation	Precontact	-
25039	Complex	Habitation	Precontact	-
25040	Platform	Habitation	Precontact	-
25041	Terrace	Habitation	Precontact	-
25042	Platform	Habitation	Precontact	TU-7
25043	Complex	Habitation	Precontact	-
25044	Complex	Habitation	Precontact	TU-15
25045	Complex	Habitation	Precontact	TU-16
25046	Complex	Habitation	Precontact	-
25047	Complex	Habitation	Precontact	TU-9
25048	Complex	Habitation	Precontact	-
25049	Complex	Habitation	Precontact	TU-13

Table 1 continued on page 65.

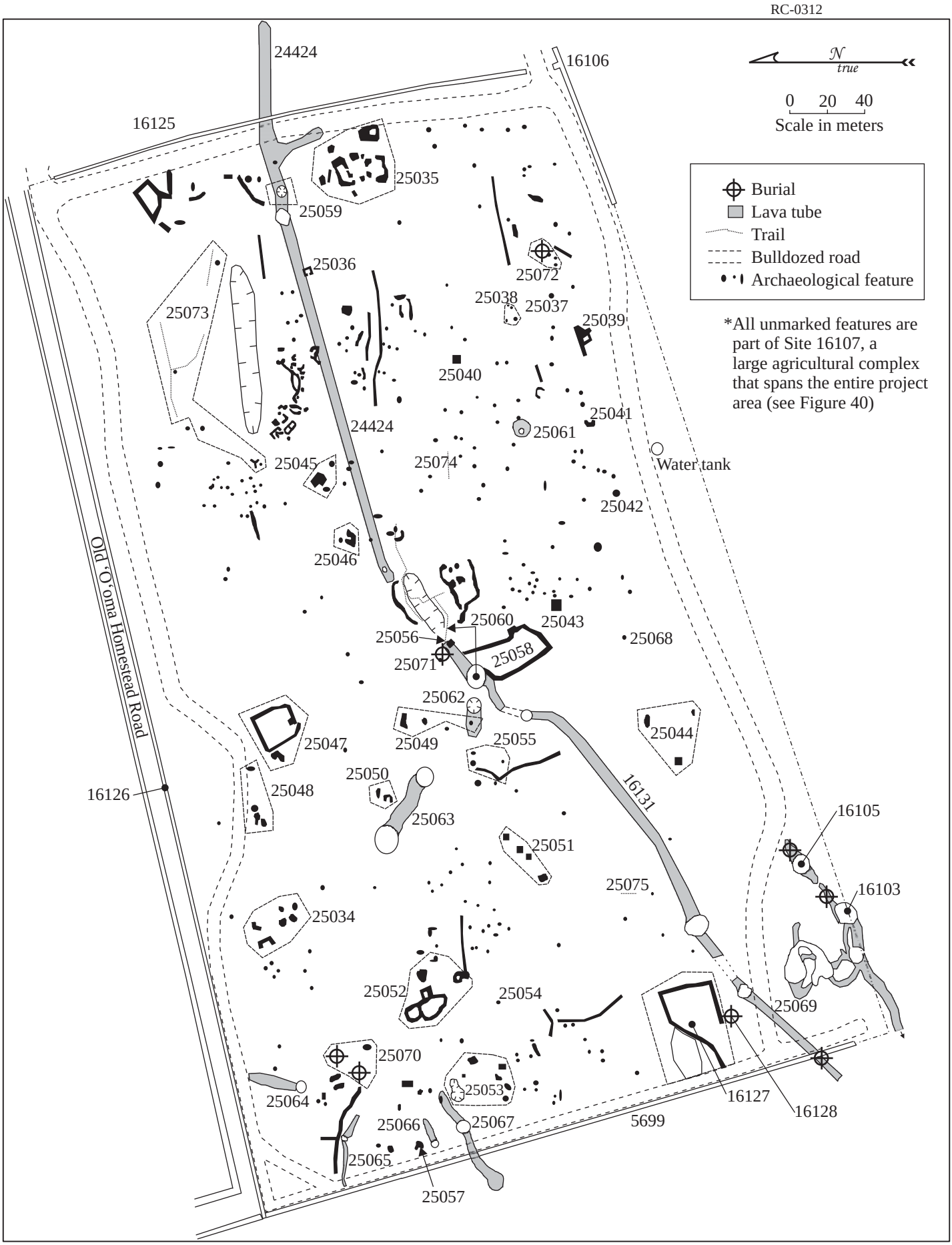


Figure 15. Project area plan view.

Table 1. continued.

SIHP No.	*Formal Type*	*Functional Type*	*Age*	*Test Unit*
25050	Complex	Habitation	Precontact	-
25051	Complex	Habitation	Precontact	TU-14
25052	Complex	Habitation	Precontact	TU-5 and 8
25053	Complex	Habitation	Precontact	TU-4
25054	Complex	Habitation	Precontact	-
25055	Complex	Habitation	Precontact	-
25056	Platform	Habitation	Precontact	TU-12
25057	Complex	Habitation	Precontact	TU-2
25058	Enclosure	Habitation	Precontact	-
25059	Lava tube	Habitation	Precontact	-
25060	Lava tube	Habitation	Precontact	-
25061	Lava blister	Habitation	Precontact	-
25062	Lava tube	Habitation	Precontact	-
25063	Lava tube	Habitation	Precontact	-
25064	Lava tube	Habitation	Precontact	-
25065	Lava tube	Habitation	Precontact	-
25066	Lava tube	Habitation	Precontact	-
25067	Lava tube	Habitation	Precontact	-
25068	Lava blister	Habitation	Precontact	-
25069	Lava tube	Burial/habitation	Precontact	-
25070	Complex	Burial	Precontact	TU-1
25071	Complex	Burial	Precontact	TU-11
25072	Complex	Burial	Precontact	TU-10
25073	Trail	Trail	Precontact	-
25074	Trail	Trail	Precontact	-
25075	Trail	Trail	Precontact	-

Although thirteen sites were previously recorded by Drolet and Schilz (1991) on the subject parcel (see Appendix A), four of the sites (Sites 16104, 16108, 16129, and 16130) were found to be features of larger site complexes. Site 16104 is now considered part of Site 16103, a habitation/burial lava tube; Site 16108 is now considered part of Site 16107, a large agricultural complex that spans the entire project area; and Sites 16129 and 16130 are now considered part of 16127, a large enclosure. Site 5699 was first recorded by Rosendahl (1989), and Clark and Rechtman (2005a) previously recorded Site 24424. All of the recorded archaeological sites are described in detail below and their locations are shown in Figure 15.

SIHP Site 5699

Site 5699 is a core-filled wall that runs along the western boundary of the current study area (see Figure 15). Site 5699 runs north-south (trending at 344/164 degrees) along the western parcel boundary for 340 meters. The average height of the wall is one meter and the average width is 0.6 meters (Figure 16). The wall edges are constructed of large cobbles, small boulders, and slabs, both upright and flat-stacked, which are used to retain a small cobble fill. At its north end, Site 5699 abuts the western end of Site 16126 (northern boundary wall); at its southern termination, near the southwestern corner of the current study parcel, the wall is collapsed. This site was originally recorded by Rosendahl (1989). During a recent field visit to the current project area with Mr. Robert E. Lee (the parcel owner), he related that his grandfather had built this boundary wall during the early part of the 20th century for cattle control purposes. Site 5699 retains integrity of location and is in good condition.


Figure 16. SIHP Site 5699, view to the west.

SIHP Site 16103

Site 16103 is a lava tube complex located in the southwestern corner of the current study area (see Figure 15). Site 16103 was originally recorded by Drolet and Schilz (1991:18) as two cave complexes (Sites 16103 and 16104; see Appendix A). However, during fieldwork for this project, it was determined that these cave complexes connect underground to form a single lava tube complex, and are therefore considered a single site for the purposes of the current study. The site contains several architectural modifications, a plethora of cultural debris, and a single human burial. The tube complex is accessible through three collapsed ceilings, or sinks (Sink 1, 2, and 3) in the bedrock ground surface that surrounds the site. Each sink is described below, and with each sink description are the descriptions of surface features observed within them (Features A-H), followed by descriptions of subsurface lava tubes that can be accessed through them (Tubes A to H) (Figure 17). Human skeletal remains were discovered within Tube C to the east of Sink 3, and a single test unit (TU-19) was excavated at a terrace in the southwestern portion of Sink 3. Based the type of cultural debris present at Site 16103 and the formal attributes of the architectural modifications, it appears that this lava tube was used primarily for Precontact habitation purposes. Site 16103 retains integrity of location and is in good condition for an archaeological ruin.

Sink 1

Sink 1 is the southwestern most sink of Site 16103, located just north of the current study area's southern boundary, eight meters south of Sink 2, and twelve meters west of Sink 3 (see Figure 17). Sink 1 is roughly oval in shape (Figure 18). It measures 7.0 meters (east-west) by 9.0 meters (north-south), and has a vertical drop (up to 1.7 meters deep) along all edges. Possible entrances into the sink are located along its north, east, and south sides. The possible entrances on the south and east consist of boulders that have been piled up almost to the rim of the sink, and the northern entrance has a one meter drop down to a built up ground surface. The flat ground surface in the sink slopes moderately to the west and is composed of boulders and medium to large sized cobbles. A large boulder pile composed of collapsed ceiling debris lines the southern wall of the sink under a slight overhang. Leveling of the sink floor must have been conducted; otherwise the area would consist of scattered ceiling rubble from the collapse episode, and would not be flat and easy to traverse. No cultural debris was observed within this sink. Three separate lava tubes can be accessed through Sink 1; Tube F extends east from the eastern end of Sink 1, connecting it to Sink 3; Tube G extends north, east, and west from the northern edge of Sink 1 connecting it to both Sink 2 and Sink 3; and Tube H, a large lava tube, extends west from the western end of Sink 1 before continuing for an undetermined distance to the southwest out of the current project area. Each of these tubes is discussed in detail below.

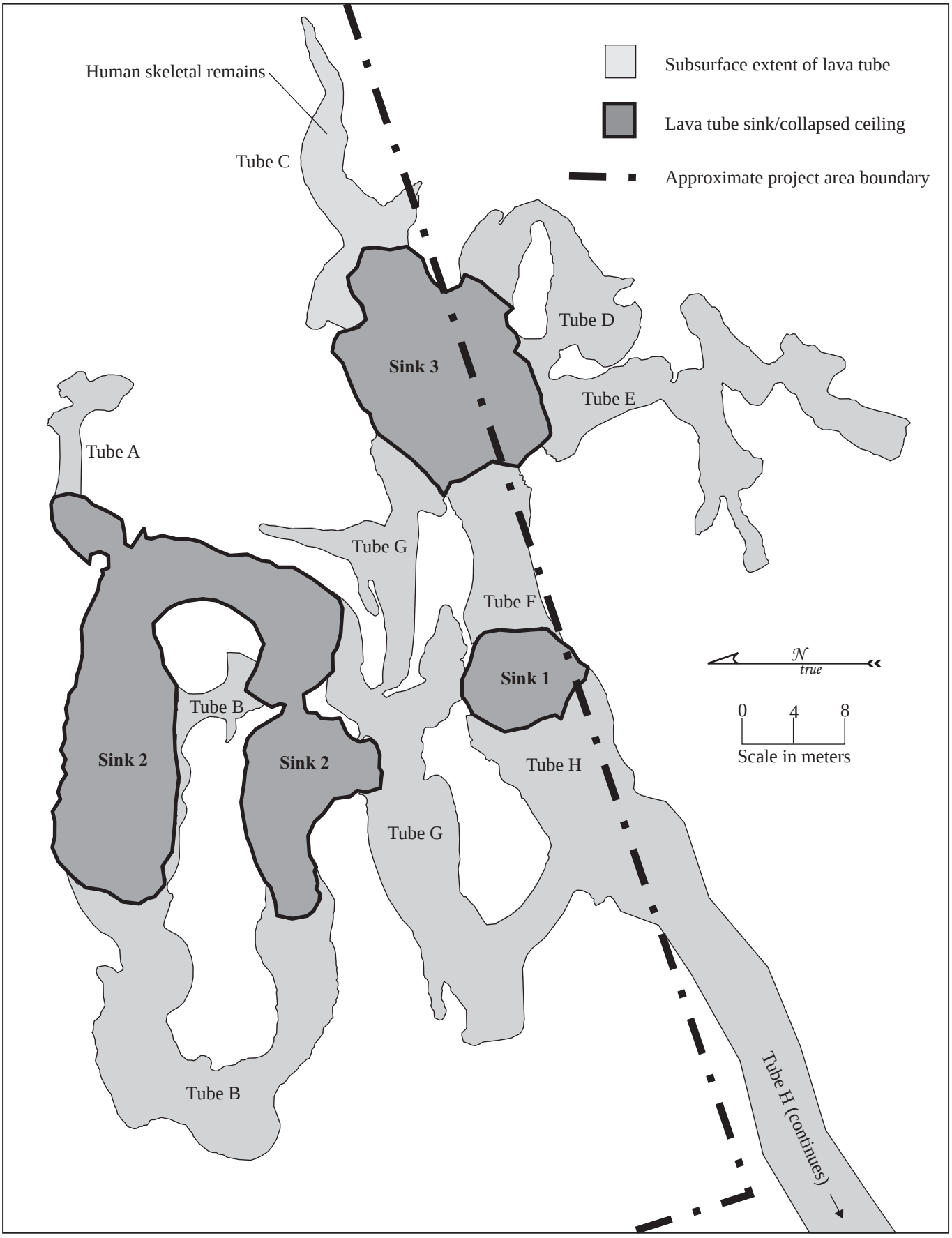


Figure 17. SIHP Site 16103 plan view.

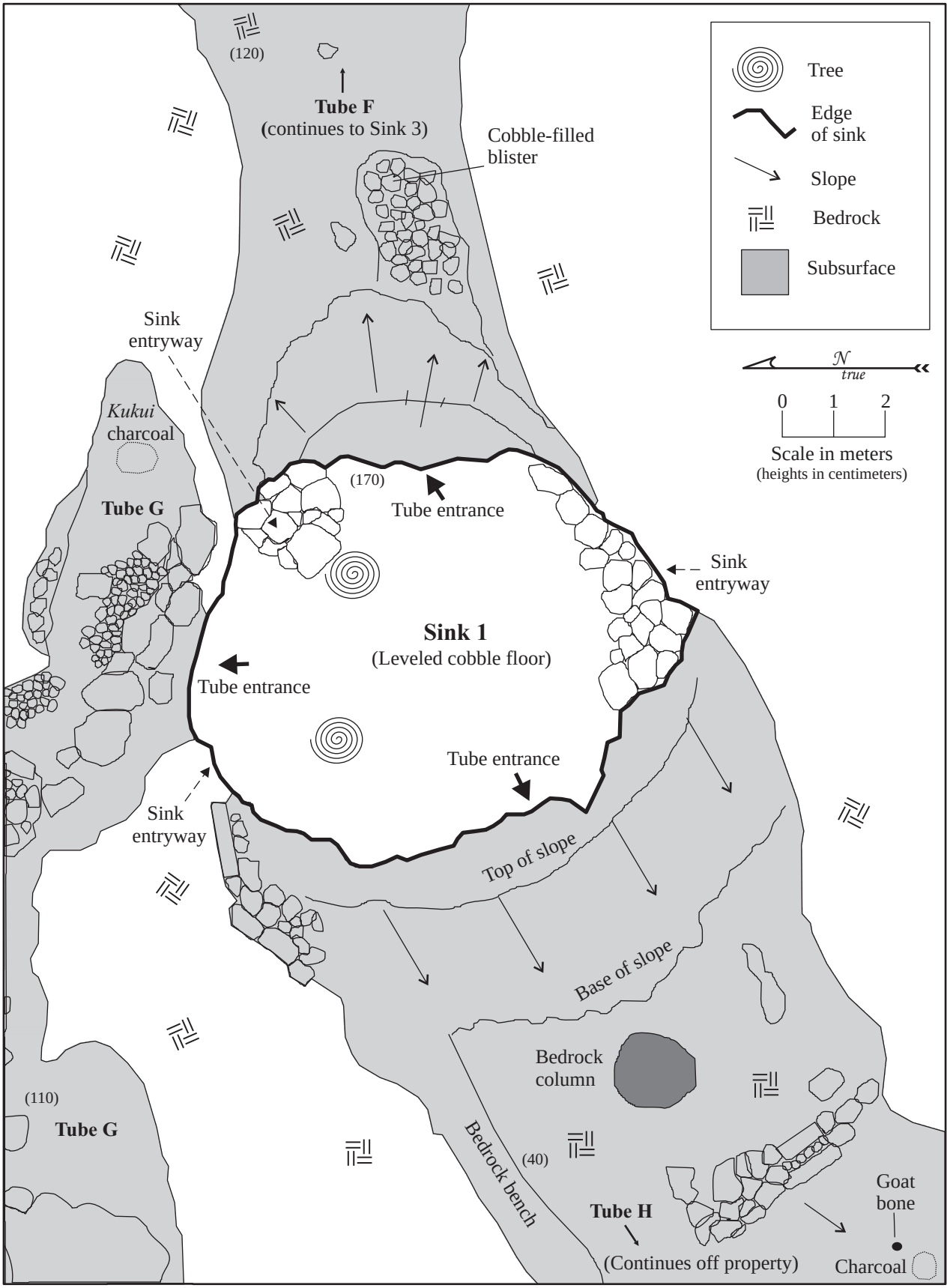


Figure 18. SIHP Site 16103 Sink 1 plan view.

Sink 2

Sink 2 is the largest of the three sinks at Site 16103 (see Figure 17). It is located eight meters north of Sink 1, and twelve meters northwest of Sink 3. Sink 2 is horseshoe-shaped with a *pāhoehoe* bedrock ridge formation running *mauka-makai* through its center that forms two halves that are connected at the eastern end of the sink (Figure 19). The northern half of the sink measures roughly thirty-two meters long (east-west) by up to ten meters wide (north-south). The southern half of the sink measures roughly twenty-six meters long (east-west) by up to ten meters wide (north-south). Each half of the sink has an entryway. The entrance from the northwest has minimal construction, and relies on natural steps that descend the steeply sloped bedrock escarpment of the ridge formation to access the sink. The entrance at the southern end is a narrow trail (0.6 meters wide) that consists of three large cobble steps descending 1.4 meters from the rim to the floor of the sink. Cultural debris observed on ground surface within Sink 2 included a few scattered *kukui* and marine shell fragments. Three subsurface lava tubes are accessible through Sink 3; Tube A runs east for a short distance from the northeastern corner of Sink 2; Tube B runs west and loops around from the western end of the northern half of Sink 2 to the western end of the southern half of Sink 2; and Tube G extends south, east, and west from the southern edge of Sink 2 connecting it to both Sink 1 and Sink 3. In addition to these lava tubes, four distinct architectural features are also present within the northern half of Sink 2 (Features A-D). These features include a terrace (Feature A), a small lava tube chamber (Feature B), an L-shaped wall (Feature C), and a retaining wall (Feature D). No features were observed in the southern half of Sink 2. Each of the features is discussed in detail below, and descriptions of the lava tubes follow the sink descriptions.

Feature A

Feature A consists of a small terrace located along the southern edge of the northern half of Sink 2, approximately five meters west of Feature D (see Figure 19). The terrace consists of a paved surface on top of a roughly two-meter long ceiling boulder that lies on the sink floor. Feature A consists of medium to large sized cobbles creating level pavement that measures 2.6 meters by 2.2 meters covering the boulder. The northern and western edges of the terrace stand one meter above the sink floor, and the southern edge abuts the vertical bedrock edge of the sink, which rise 1.35 meters above the feature surface. A possible trail route leading *mauka-makai* runs along the northern side of the terrace on the sink floor. Based on the small size of Feature A, it is likely that the terrace was created as a by-product of clearing the trail route, rather than used as a living surface.

Feature B

Feature B consists of a small, modified section of lava tube located along the southern edge of the northern half of Sink 2, approximately two meters west of Feature A (see Figure 19). The tube opening is partially blocked by a 1.5-meter tall, stacked wall that is constructed parallel to the edge of the sink (Figure 20). The entrance to the tube, which measures one meter wide, is located to the west of the stacked wall. The subsurface portion of the tube extends south for roughly six meters beneath the ridge formation that segments Sink 2. The tube averages one to two meters wide and has a maximum floor to ceiling height of 1.5 meters. Just inside the opening of the tube, the floor consists of level bedrock with scattered cobbles and patches of ash and charcoal-rich soil also present. Four meters south of the entrance, a wall (constructed of stacked cobbles and slabs) that measures 1.0 meter tall by 1.4 meters long, runs west off the eastern wall of the tube, leaving a narrow pathway between its termination and the western tube edge. South of the wall is a soil-covered floor (0.6 meters by 2.8 meters) that stretches the width of the cave. At the southern termination of Feature B a second stacked wall that stands 0.65 meters tall blocks the entire tube passageway. The wall retains cobbles, slabs, and boulders that have collapsed from the ceiling to block the tube. Feature B may have formerly opened to the southern half of Sink 2 prior to this collapse. Cultural debris observed scattered on the floor of Feature B included *kukui* and a few marine shell fragments. Based on the presence of this debris, the cleared tube floor, and the architectural modifications, it appears that Feature B was used for Precontact habitation purposes.

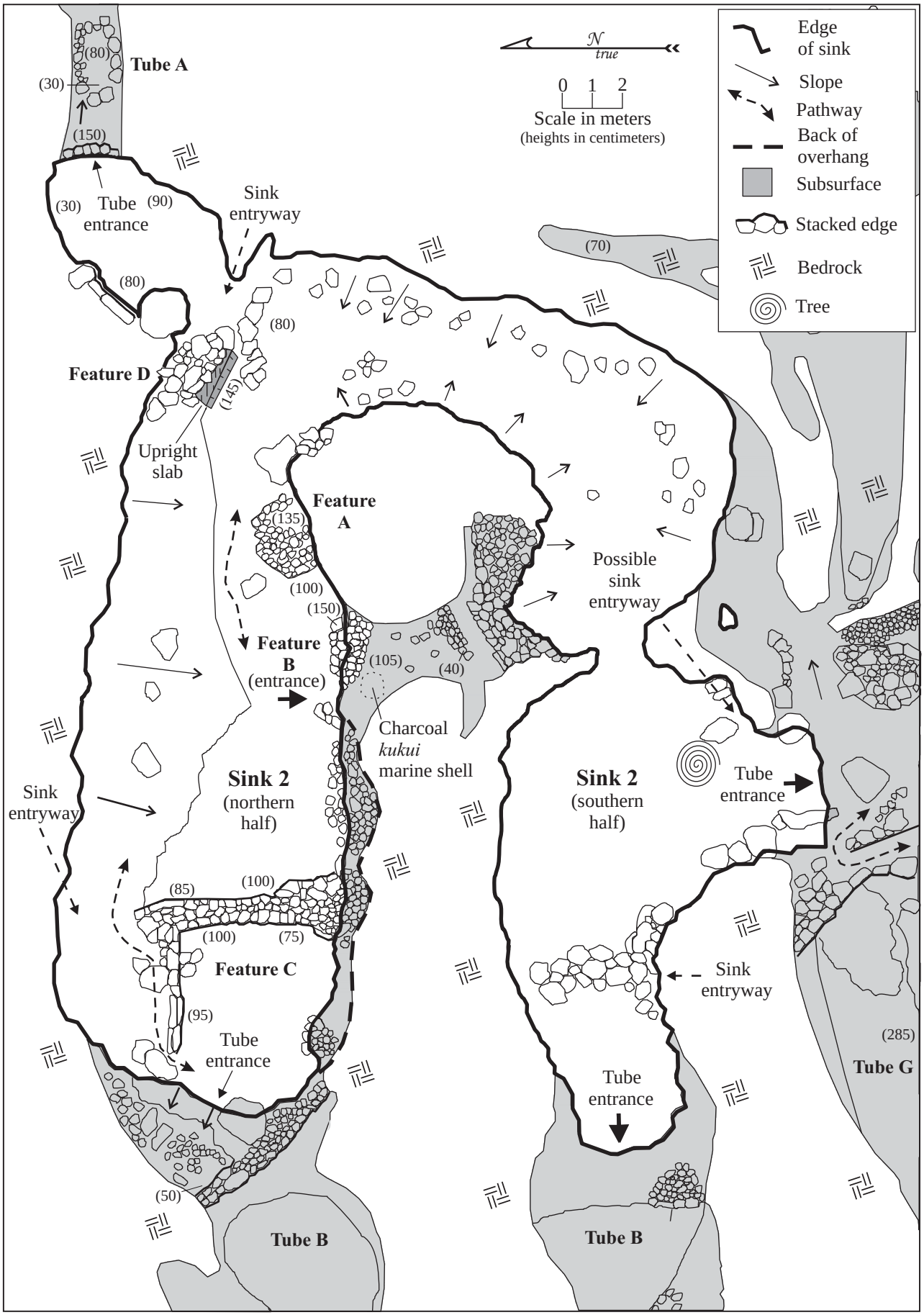


Figure 19. SIHP Site 16103 Sink 2 plan view.

Figure 20. SIHP Site 16103, Sink 2, Feature B entrance, view to the southeast.

Figure 21. SIHP Site 16103, Sink 2, Feature C, view to the northwest.

Feature C

Feature C consists of an L-shaped wall located at the western end of the northern half of Sink 2 near the entrance to Tube B (see Figure 19). The wall runs six meters north/south across the sink from vertical bedrock at its south end to sloped bedrock at its northern end. This section of wall is stacked, and measures 0.8 meters wide by up to 1.0 meter tall (Figure 21). At its north end the wall turns to the west and runs for four meters along the sloped edge of Sink 2. This section is also stacked along its southern face, but retains sloped rubble to the north. The sink floor in this area consists of jumbled large cobbles and small boulders, but is relatively level. Feature C is the mostly likely entry point for access into the northern half of Sink 2. It is likely that Feature C was created to define or segment space within Sink 2, or perhaps as a by-product of clearing cobbles from the entrance to Tube B to allow for easier access to the tube.

Feature D

Feature D consists of a retaining wall located along the northern edge of the northern half of Sink 2, eight meters southwest of the entrance to Tube A (see Figure 19). In this area a placed upright slab (1.45 meters tall by 2.05 meters wide, by 0.4 meter thick) lines the sink edge and retains a rubble fill that consists of jumbled medium cobbles and slabs (Figure 22). To the east side of the placed slab three boulders have been placed on the sink floor as steps that lead down into the entryway to Tube A. Feature D was likely created to allow for easier, safer access into Tube A.

Figure 22. SIHP Site 16103, Sink 2, Feature D, view to the north.

Sink 3

Sink 3 is located in the eastern portion of Site 16103, twelve meters east of Sink 1, and twelve meters southeast of Sink 2 (see Figure 17). Sink 3 is roughly rectangular in shape measuring twenty meters long (northeast-southwest) by thirteen meters (northwest-southeast) (Figure 23). The northeast and southwest sides consist of vertical bedrock dropping from ground surface along the upper edge of the sink to the base of the sink. The southeast and northwest sides consist of cobble rubble that slopes down from ground surface along the upper edge of the sink to the base of the sink. The sink floor slopes to the west and is composed of cobbles and large boulders; some areas are neatly paved with small cobbles and other areas are craggy with large boulders locked together. Along the southeast and northwest sides of the sink small discrete steps have been created in the rubble to allow for access into Sink 3, and a constructed cobble trail (Feature E) crosses Sink 3 from southeast to northwest. A stone terrace (Feature F) is also present along the western edge of the constructed trail in the central portion of Sink 3, a modified boulder pile (Feature G) is present in the southwestern corner of Sink 3, and a stacked cobble wall (Feature H) partially blocks the entrance to a lava tube (Tube G) in the northwestern corner of Sink 3. A 1 x 1 meter test unit (TU-19) was excavated at Feature F. No additional architectural modifications are present within the sink, but a few scattered fragments of marine shell and *kukui* were observed on ground surface.

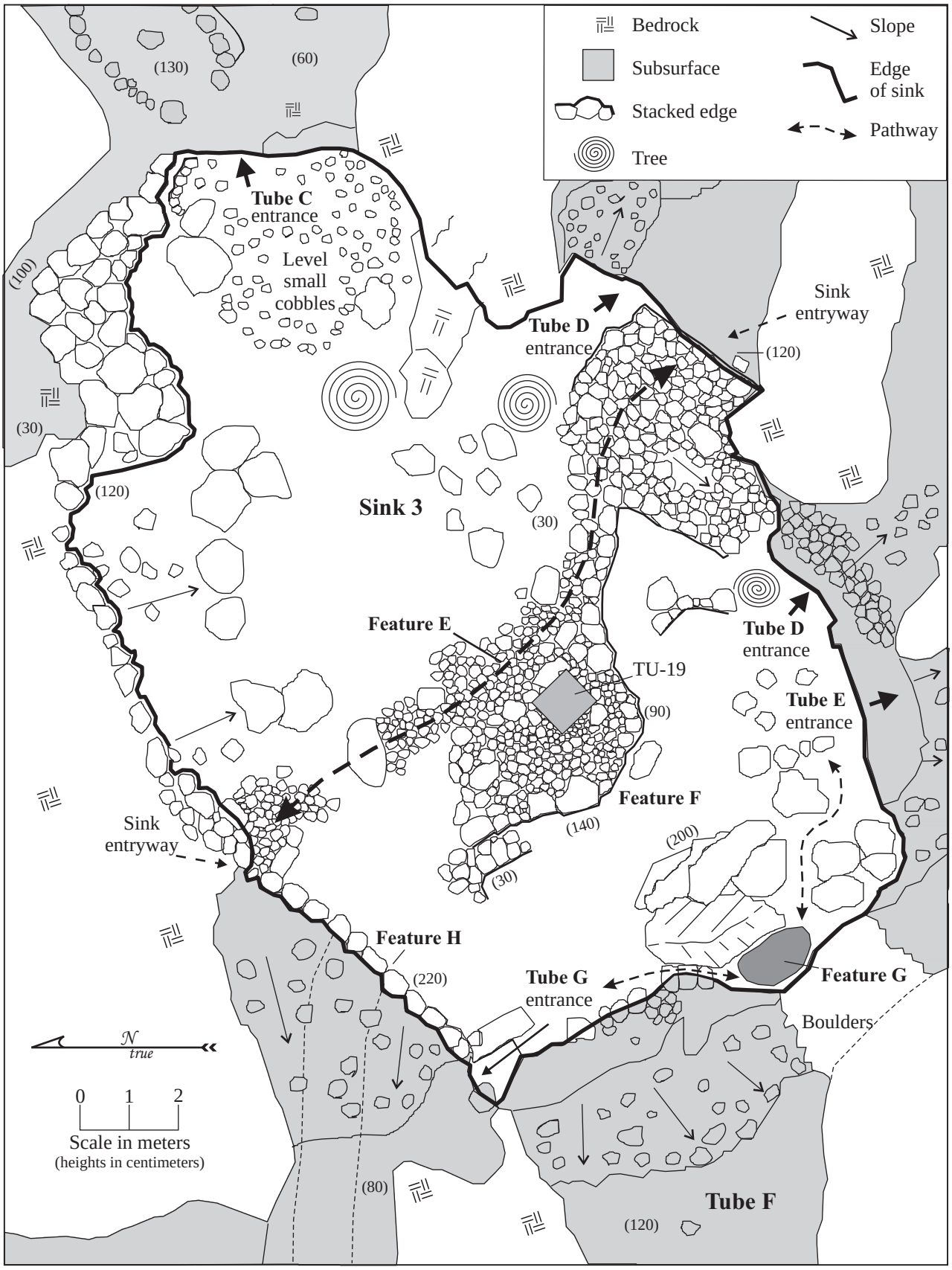


Figure 23. SIHP Site 16103, Sink 3 plan view.

Five separate subsurface lava tubes can be accessed through Sink 3; Tube C, which contains human skeletal remains at its easternmost termination, runs northeast from the northeastern end of Sink 3; Tube D runs from the southeastern corner of Sink 3 southeast and then west back to the southern edge of Sink 3 and the entrance to Tube E; Tube E runs south from the southern edge of Sink 3; Tube F runs west from the western end of Sink 3 connecting it to Sink 1; and Tube G extends north, east, and west from the northern edge of Sink 3 connecting it to both Sink 1 and Sink 2. The southern portion of Sink 3, and Tubes D and E in their entirety, are located south (outside) of the current study parcel. Each of the features within Sink 3 is discussed in detail below, followed by descriptions of the lava tubes.

Feature E

Feature E consists of a constructed cobble trail that crosses the central portion of Sink 3 from southeast to northwest (see Figure 23). Beginning along the upper edge of the sink rim in the middle of its southeastern side, a constructed stacked cobble ramp descends four meters (1.1 vertical meters) to the sink floor. From there, a constructed trail that is paved with small and medium cobbles and lined on both edges with large cobbles and slabs leads northwest across the sink. This trail section runs along the eastern edge of Feature B. It measures 9.0 meters long by 1.4 meters wide and stands up to 0.3 meters above the floor of Sink 3. On the northeast side of the sink a discrete path has been cleared up the steep boulder and cobble covered slope just to the east of Feature H that rises two meters (2.2 vertical meters) to the rim of the sink. The route of Feature E could not be traced across the *pāhoehoe* bedrock ground surface to the northwest or southeast of Sink 3.

Feature F

Feature F is a terrace located in the central western portion of Sink 3 (see Figure 23). This feature measures five meters (northwest-southeast) by four meters (northeast-southwest), and its level surface is paved with small cobbles, with a few medium and large cobbles and slabs also present. The west and south edges are constructed of stacked cobbles, slabs, and boulders that attain a height of 1.4 meters above the sink floor along the western edge of the feature, and 0.9 meters along the southern edge (Figure 24). Along the north and east sides of the terrace the cobble paving fades into the outlying sink surface. The trail that crosses Sink 3 (Feature E) runs northeast/southwest adjacent to the *mauka* edge of Feature F. The southern edge of the feature curves to the southeast and becomes the western edge of the trail/ramp (Feature E) that is built up the sink edge near the entrance to Tube D. The terrace is fairly level and large enough that it likely functioned as a Precontact habitation related area.

A single 1 x 1 meter test unit (TU-19) was excavated at Sink 3 within the southern portion of the Feature F to test for the possibility of buried cultural deposits. Excavation of TU-19 revealed two stratigraphic layers (Layers I and II) (Figure 25). Layer I, the architectural layer, consisted of pebbles, cobbles, and boulders that extended from the unit's surface to a depth of 120 centimeters. Artifacts recovered from Layer I included charcoal (uncollected small particles), marine shell, volcanic glass shatter, and fire-cracked rock (Table 2). Below Layer I was a soil and cobble layer (Layer II). Layer II consisted of 10-centimeters of very dark brown (7.5YR 2.5/2) granular silt containing approximately 40% small cobbles and gravel. Artifacts recovered from Layer II included two small basalt flakes, volcanic glass shatter, marine shell, bird bone, urchin, *kukui*, and charcoal (see Table 2). The basalt flakes recovered from TU-19 measured 1.19 x 0.67 x 0.26 centimeters (ACC#110) and 1.34 x 0.9 x 0.15 centimeters (ACC#111); ACC#110 had a polished surface and may have fractured off an adze. It is possible that both flakes were created while sharpening a single adze as the basalt is nearly identical, and both flakes are small. The recovered cultural debris from TU-19 supports the hypothesis that Feature F was used for activities associated with Precontact habitation. Excavation of TU-19 terminated at undulating bedrock 130 centimeters below the unit's surface (see Figure 25).

Figure 24. SIHP Site 16103, Sink 3, Feature F, view to the northeast.

Table 2. Cultural material recovered from SIHP Site 16103, TU-19.

Acc#	*Layer*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
104	I	Volcanic glass	Shatter	4	-	2.3
105	I	Basalt	Fire-cracked	2	-	157.0
106	I	Shell	*Drupa*	4	3	4.8
107	I	Shell	*Cypraea*	3	2	5.4
108	I	Shell	*Isognomon*	1	1	<0.1
109	II	Organic	Charcoal	-	-	2.6
110	II	Basalt	Flake (1 polished surface)	1	-	0.2
111	II	Basalt	Flake	1	-	0.2
112	II	Volcanic glass	Shatter	16	-	14.1
113	II	Shell	*Mitridae*	1	1	0.1
114	II	Shell	*Cypraea*	24	6	7.8
115	II	Shell	*Nerita*	22	18	4.3
116	II	Shell	*Drupa*	7	3	0.8
117	II	Shell	*Isognomon*	11	2	0.8
118	II	Echinoderm	*Echinoidea*	22	1	2.1
119	II	Bird bone	Unknown	1	1	0.6
120	II	Organic	*Kukui*	7	5	20.3

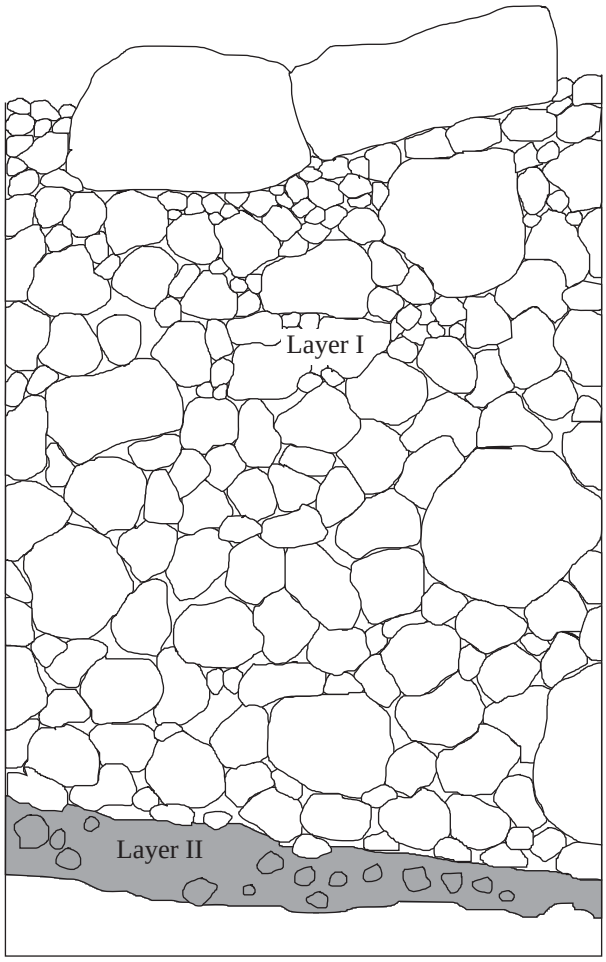
Northeast wall profile

Layer I - Architectural layer composed of small to large cobbles with a few small boulders.

Layer II - Black (10YR 2/1) silt with 40% gravel content and small and medium sized cobbles.

0 10 20

Scale in centimeters



TU-19 base of excavation, view to the northeast.

Figure 25. SIHP Site 16103 Sink 3 TU-19 northeast wall profile and TU-19 base of excavation view to the northeast.

Feature G

Feature G consists of a modified boulder pile located in the southwestern corner of Sink 3 (see Figure 23). A small, enclosed area is present atop the boulder pile that measures one meter by two meters. Feature G is bordered to the southwest by the bedrock wall of the sink and to the northeast by several large collapsed boulders. The floor surface within the feature consists of medium to large sized cobbles. The elevated small enclosure is accessible from the north via a steep stairway composed of placed slabs, and from the south via a trail that leads around boulders up to the feature. The bedrock wall to the southwest of the feature stands one meter tall from the feature surface to the top rim of Sink 3; the northeastern side of the boulder pile stands two meters above the sink floor. The boulders are all over two meters long and are probably too large to have been manipulated by humans; the only modifications to the pile are the entrances (path and stairway) and the leveling of the top surface with cobbles. Feature G may have been utilized during Precontact Times as a sitting area, or a work area; the elevated position of the feature allows for a better view out from the inside of Sink 3.

Feature H

Feature H consists of a stacked cobble wall located in the northwestern corner of Sink 3 just west of Feature E (see Figure 23). The wall nearly completely blocks the entrance to Tube G, allowing for only a small passageway into the tube at its western termination. Feature H measures five meters long. It is constructed of stacked cobbles and boulders that attain a maximum height of 2.2 meters above the floor of Sink 3. The top of the wall is even with the upper rim of Sink 3. Feature H was likely constructed during Precontact Times to control access into Tube G and provide a more sheltered environment within the lava tube.

Tube A

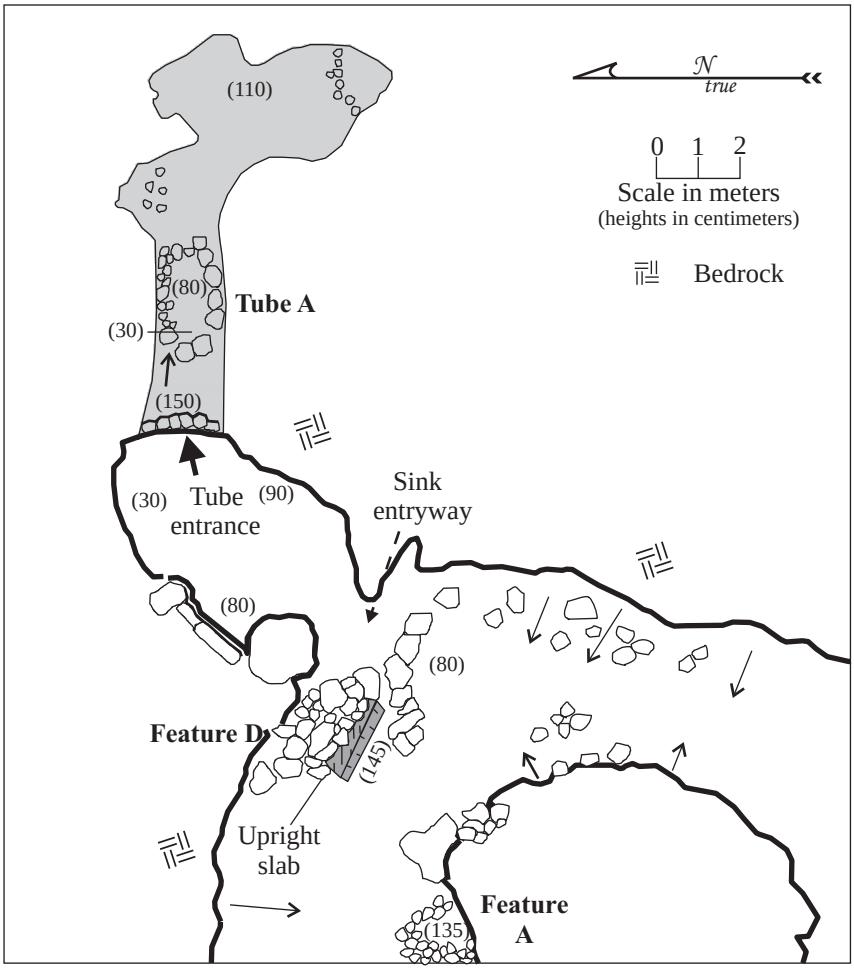
Tube A is accessed through the northeastern corner of Sink 2 (see Figure 17). It measures 10.0 meters long by 1.7 meters wide (Figure 26). The entrance is a narrow opening in the bedrock (0.9 meters wide by 0.3 meters tall) that faces west. Inside the opening the floor drops to the east almost vertically 1.5 meters down a rubble slope of soil and cobbles. An oval, cobble and boulder ring measuring 2.2 meters (east-west) by 1.5 meters (north-south) is located 2.2 meters east of the entrance under a 0.8-meter tall ceiling. The ring occupies the entire passageway, and the largest stones rise up to 30 centimeters above the tube floor. The function of this ring is uncertain; it may have been cleared out of existing cobble rubble to allow for easier access through the narrow passageway where the tube ceiling is lowest. East of the cobble ring the tube turns to the southeast and enters a larger chamber (5.0 meters by 2.5 meters) with a maximum ceiling height of 1.1 meters. In the southeastern-most corner of this chamber the tube ceiling has collapsed, and soil has spilled through cracks in the rubble and fanned out on the bedrock tube floor. Marine shell was observed among the soil. It is possible that this chamber was used occasionally for Precontact habitation related purposes. Further access to Tube A beyond the ceiling collapse is not possible.

Tube B

Tube B loops around from the northwestern end of Sink 2, south, to the southwestern end of Sink 2 (see Figure 17). Beginning at the northwestern end of the Sink 2, the entrance to Tube B measures 7.0 meters wide by 1.4 meters tall (Figure 27). From there, cobble rubble slopes steeply down to the west from the sink floor into the tube. The rubble stops at a constructed retaining wall that crosses the bedrock floor of the tube. The wall runs diagonally across the tube in a northwest/southeast direction for six meters. It stands 0.5 meters tall at its the southern end and 0.8 meters tall at its the northern end. At the southern end, east of the wall, cobbles slope down to it, but at the northern end the wall lines the *makai* edge of a level cobble terrace floor. The terrace measures 2.0 meters by 2.0 meters. Its surface is paved with slabs and small cobbles, indicating that it was probably constructed to provide a sheltered surface to conduct daily activities upon.

West of the wall, a large pile of fallen ceiling boulders and cobbles rests on the tube floor. Further west, thirteen meters from the entrance to Tube B, a U-shaped cobble alignment, and a double ring cobble alignment are present. The U-shaped alignment measures 1.0 meter by 0.4 meters, stands one course high, and is constructed of medium sized cobbles. The other alignment is a figure-8 shape of placed cobbles standing one course high, and measuring 1.9 meters by 0.5 meters. The two alignments are both located beneath ceiling drip locations, and were likely used to hold containers for water collection (Clark and Rechtman 2005a).

Tube A plan view.



SIHP Site 16103 Sink 3, entrance to Tube A, view to the east.

Figure 26. SIHP Site 16103 Tube A plan view and photo.

Beyond the cobble alignments, the tube runs south for seven meters, and then turns southeast and runs for twelve meters to the east to the tube entrance (see Figure 27). Just west of this entrance, which measures 5.0 meters wide by 1.5 meters tall, is a wide, cobble-floored chamber that has been artificially leveled. This area measures six meters by six meters and a large amount of cultural debris was observed scattered on its surface and on the bedrock tube floor to the west of the leveled cobble floor. The debris included urchin, marine shell, *kukui*, coral, and a basalt abrader fragment. Also, a small terrace is located along the southern wall of the chamber to the east of the leveled cobble floor. The terrace surface is level and paved with slabs. It rises 0.6 meter along its western edge and measures 2.0 meters by 2.0 meters. A bee's nest is present above this terrace in a crevasse in the ceiling bedrock; therefore minimal inspection of the area was conducted. But, under the overhang at the entrance to Tube B in the southwestern corner of Sink 2, cobble and boulder rubble slopes upward to the east for two meters from the terrace to the floor of Sink 2. Based on the cultural debris and architectural modifications present, it appears that Tube B was used for Precontact habitation and water collection purposes.

Tube C

Tube C extends eighteen meters to the east off the eastern end of Sink 3 (see Figure 17). Outside the entrance is a 3.0-meter by 3.0-meter area of level small cobbles on the floor of Sink 3. The entrance to the tube consists of a small hole measuring 0.7 meters wide by 0.55 meters tall (Figure 28). Inside the entrance an upper tube (located one meter below the opening to the south) and a lower tube with a narrow opening (located two meters below the entrance to the north) are present.

The upper tube is small with two branches, one that extends six meters to the east/southeast, and another 2.5 meters east of the opening, that extends 4.5 meters to the northeast. The area two meters from the entrance is 0.6 meter tall by 2.3 meter wide with a bedrock floor. The remainder of the floor is covered in cobbles and soil, cultural debris including charcoal, *kukui*, and marine shell (*Cypraea*) were observed within this upper portion of Tube C.

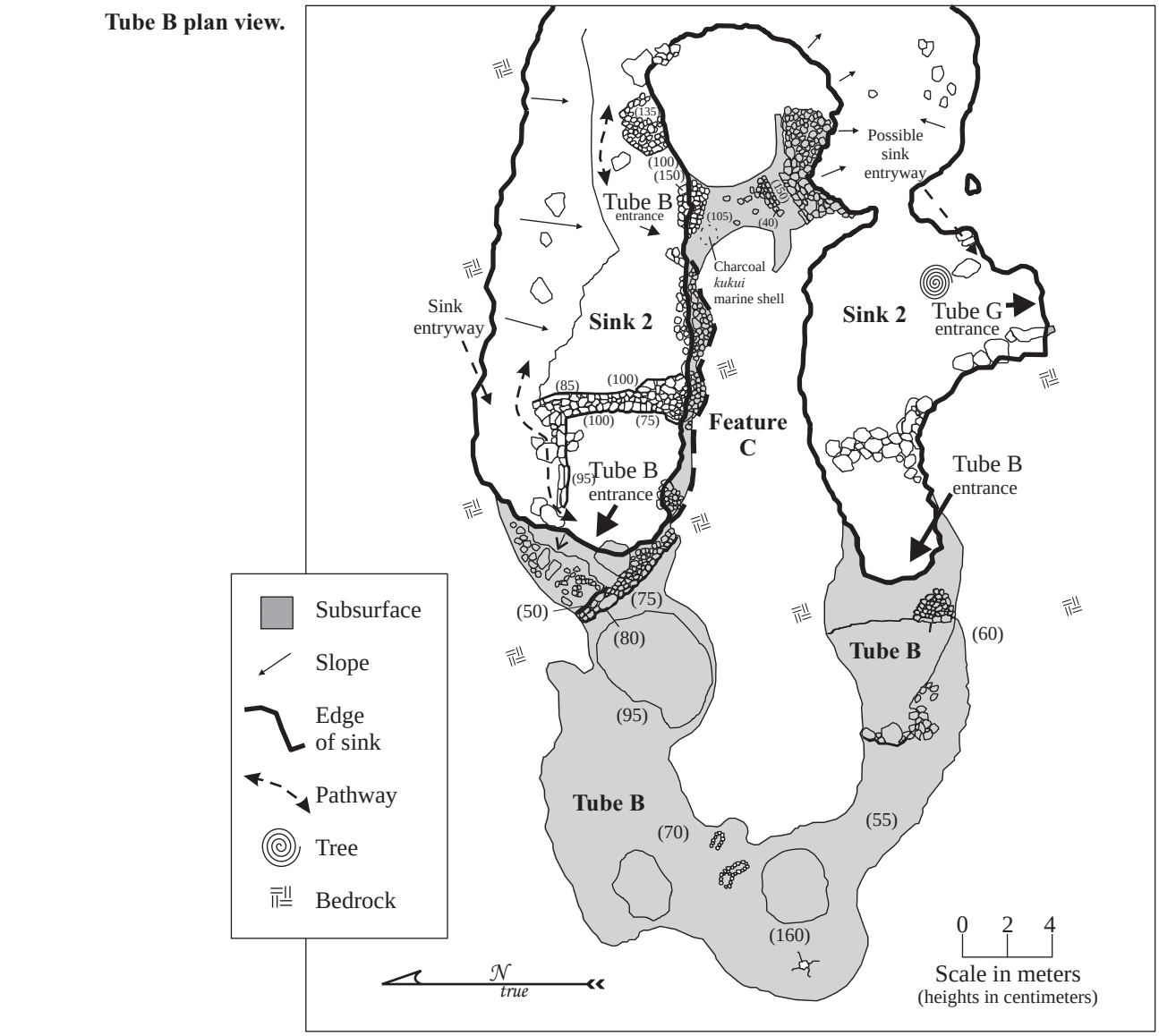
The lower tube entrance is a near vertical drop lined with loose cobbles. At the entrance the tube is 4.0 meters wide by 1.3 meters tall from the ceiling to the smooth, level *pāhoehoe* bedrock floor. A narrow segment of tube also extends to the northwest for seven meters. Collapsed rubble blocks off the southern side of the lower tube, while the north side consists of a bedrock wall. Charcoal and *kukui* fragments, likely from artificial light sources, were found also found scattered throughout the lower portion of Tube C.

A rock ring is located one meter east of the entrance to the lower portion of Tube C (see Figure 28). The ring consists of one course of large cobbles placed in an oval on the floor in the center of the tube. The ring measures 3.0 meters (east-west) by 2.0 meters (north-south). The intended function of the ring is uncertain, but hardwood fragments, possibly the remains of a Precontact wooden implement, were observed within it.

Ten meters east of the entrance to the lower portion of Tube C human skeletal remains were discovered along the northern tube edge. The area of the remains consists of a concentration of charcoal and ash on the cave floor (with marine shell and burnt bird bone also present) that measures 0.8 meters in diameter. On the east edge of the charcoal area are non-burnt skull fragments and teeth and 25 perforated pig teeth, and a *lei palaoa* made of unidentified mammal bone. The pig teeth measure (average) 2.8 centimeters long, 0.8 centimeter wide, by 0.5 centimeter thick, and are ground smooth on all sides (rectangular) and have the natural curve of a canine pig tooth. They are the remnants of a necklace with the *lei palaoa* as the pendant, probably worn by the deceased individual. Encircling the charcoal and skull fragments are seven medium sized cobbles. No other bones were present suggesting only the cranium of the individual was brought to the cave or that the remaining bones were burned within the charcoal concentration.

Along the southern edge of Tube C in this area, opposite the skeletal remains, stacked slabs are present. The stacking consists of ten upright slabs (30-40 centimeter in length) sandwiched together up against the cave wall. The slabs are at the base of a naturally formed bench in the tube wall, and two additional slabs are resting on the bench. The slabs may have been stockpiled for construction of either a burial feature to the north or possibly for a water collection station. The lower portion of Tube C terminates eight meters beyond the skeletal remains.

Tube B plan view.



Tube B entrance, view to the west.

Figure 27. SIHP Site 16103 Tube B plan view and photo.

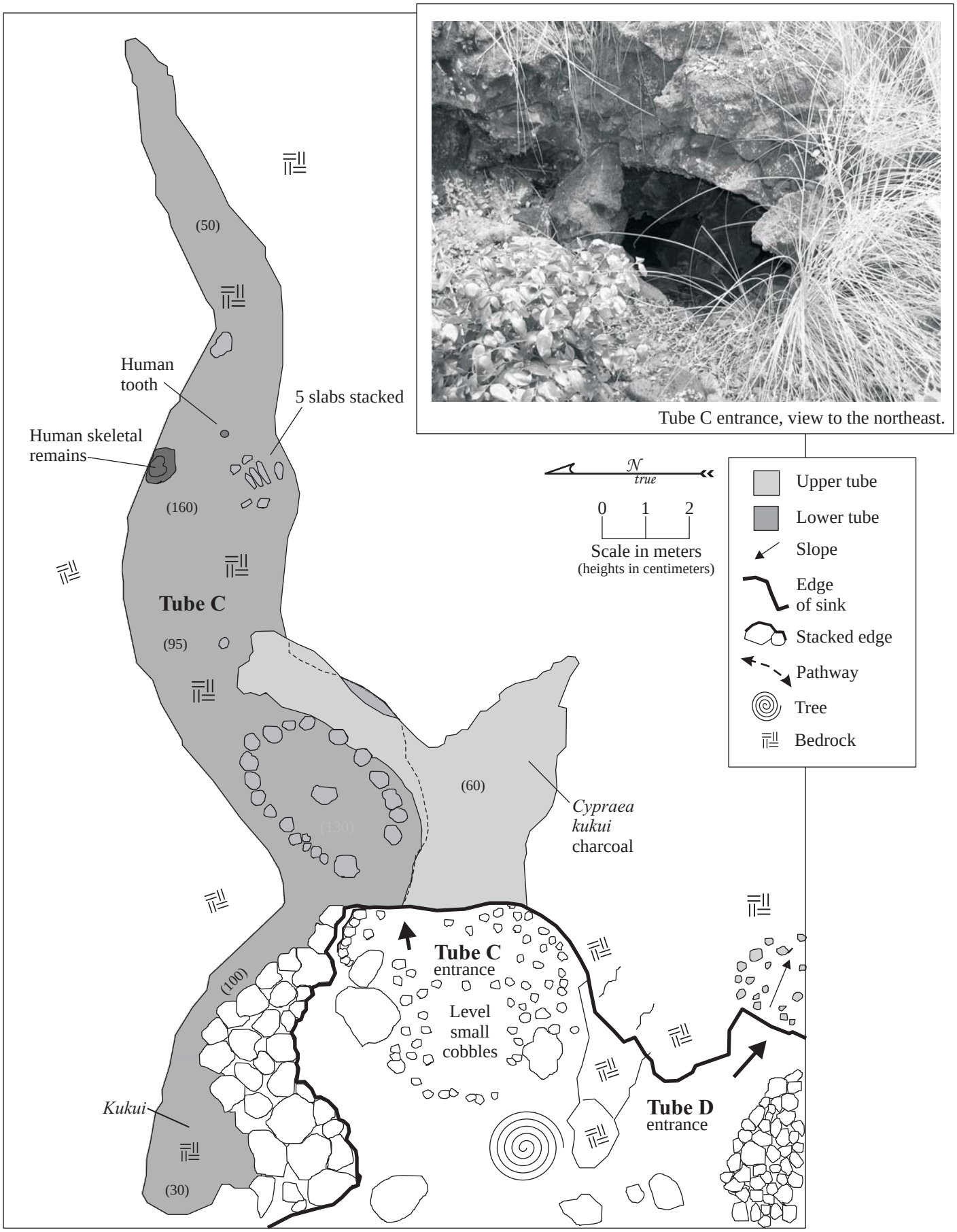


Figure 28. SIHP Site 16103 Tube C plan view and photo.

Tube D

Tube D has two connecting entrances located along the southwestern side of Sink 3 (see Figure 17). This tube is located south (outside) of the current project area. The entrances are seven meters apart (Figure 29). The larger entrance (1.1 meters tall by 1.7 meter wide) is to the east and is partially blocked by the ramped trail that cuts across the sink (Feature E). The western entrance is narrower (0.6 meter tall by 1.7 meter wide), and the tube beyond it is more constricted (Figure 29). From the eastern entrance the tube runs seven meters southeast, then turns to the west. From this point the tube extends ten meters west back to the western entrance.

The eastern tube segment contains a plethora of habitation debris. From the entrance the tube floor is sloped to the southeast and composed of large and medium sized cobbles. A large amount of debris, scattered among patches of ash and charcoal rich soil, was observed within five meters of the entrance. The debris included marine shell (*Cypraea, Conus, Nerita,* and *Isognomon*), urchin (*Echinoidea*), *kukui*, volcanic glass shatter, and a possible wooden tool fragment. Beyond five meters from the entrance, the tube is narrow and nearly impassible. At seven meters from the entrance it constricts to 0.4 meter tall and difficult to pass. The western half of Tube D is lower (average 0.7 meter) and wider (maximum seven meters across) than the eastern segment. The entrance is narrow, but four meters to the south the tube opens up to a broad, low chamber. A small patch of soil in the chamber contains trace amounts of marine shell, charcoal, and *kukui.* Based on the cultural debris observed within Tube D, it is likely that both the eastern and western half were used for Precontact habitation activities.

Tube E

Tube E is located one meter north of Tube D in the southwestern corner of Sink 3 (see Figure 17). This tube is located south (outside) of the current project area. The entrance is beneath a bedrock overhang that stands 0.9 meters above a level, large cobble-paved area (Figure 30). One meter south of the overhang edge, the cobble covered ground surface slopes into the cave at a forty-five degree angle onto the smooth *pāhoehoe* floor of Tube E. A triangular coral abrader measuring 6.5 centimeters long by 3.1 centimeters wide (at base) by 1.6 centimeters thick, was observed among sloping cobbles, 2 meters south of the top of the slope. At the entrance on the level cobble surface area, a hardwood stick burnt on one end, 56 centimeters long, was observed. At the base of the slope a cleared chamber extends to the south for seven meters. A short segment of tube also extends to the northwest and would link up with Tube F, but it is blocked off by boulder rubble. Although Tube E is just west of Tube D, its floor is two meters below the floor level of Tube D. On the cave floor beyond the sloped entryway are scattered large cobbles and cultural debris including marine shell (*Cypraea, Nerita, Cellana,* and *Drupa*), *kukui*, and charcoal. Beyond seven meters from the entrance the floor becomes jagged bedrock and cobbles, the tube narrows to a passageway 1.0 meter wide by 0.5 meters wide. At the end of the corridor is a 0.4- meter tall by 0.7-meter wide opening into a larger chamber to the south. The tubes that extend beyond the narrow entrance were explored but no features were observed, only a light scattering of habitation related debris. It is likely that the chamber immediately south of the entrance to Tube E was the area primarily used for Precontact habitation purposes.

Tube F

Tube F extends west from the western end of Sink 3 for eleven meters to the eastern end of Sink 1 (see Figure 17). The tube averages four meters wide for its entire length, and has a maximum floor to ceiling height of 1.2 meters. At the eastern entrance to Tube F (from Sink 3), the ground surface at the entrance is level and paved with large cobbles; it is 1.5 meters below a bedrock overhang (Figure 31). An alignment of four medium sized boulders on the paved ground surface extends from the southern side of the entrance to the middle of the opening. From the sink edge at the entrance, a cobble and boulder covered slope extends west for two meters down to the bedrock floor of the tube. On the south side of the cobble slope is an ash and charcoal concentration. One large marine shell (*Cellana*) was observed at the base of the slope in the center of the tube. The floor is mainly bedrock with slabs and cobbles scattered throughout; charcoal and *kukui* fragments were observed in many areas, probably the remnants of artificial light sources. At the western end of Tube F is the entrance from Sink 1. This entrance measures 0.5 meter tall by 0.8 meter wide, and also consists of a steep cobble and boulder slope that leads down from the floor of Sink 1 to the floor of Tube F. At the top of the slope, in Sink 1, a large paved surface is present under an overhang. Based on the scarcity of cultural debris, Tube F appears to have been minimally used for habitation purposes during Precontact times.

SIHP Site 16103: eastern entrance to Tube D, view to the southeast.

SIHP Site 16103: western entrance to Tube D, view to the southeast.

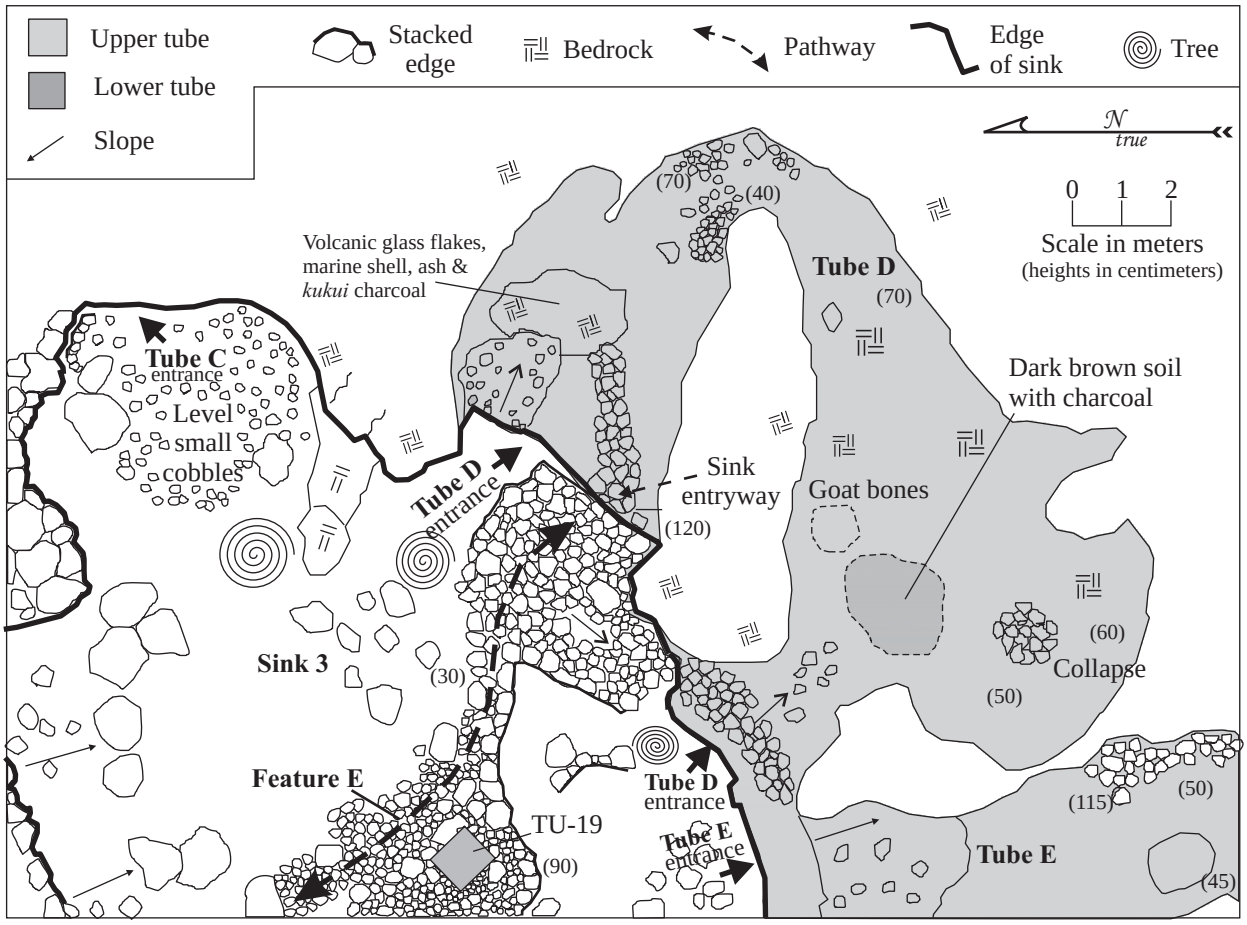


Figure 29. SIHP Site 16103 Tube D plan view and photos.

SIHP Site 16103: entrance to Tube E, view to the south.

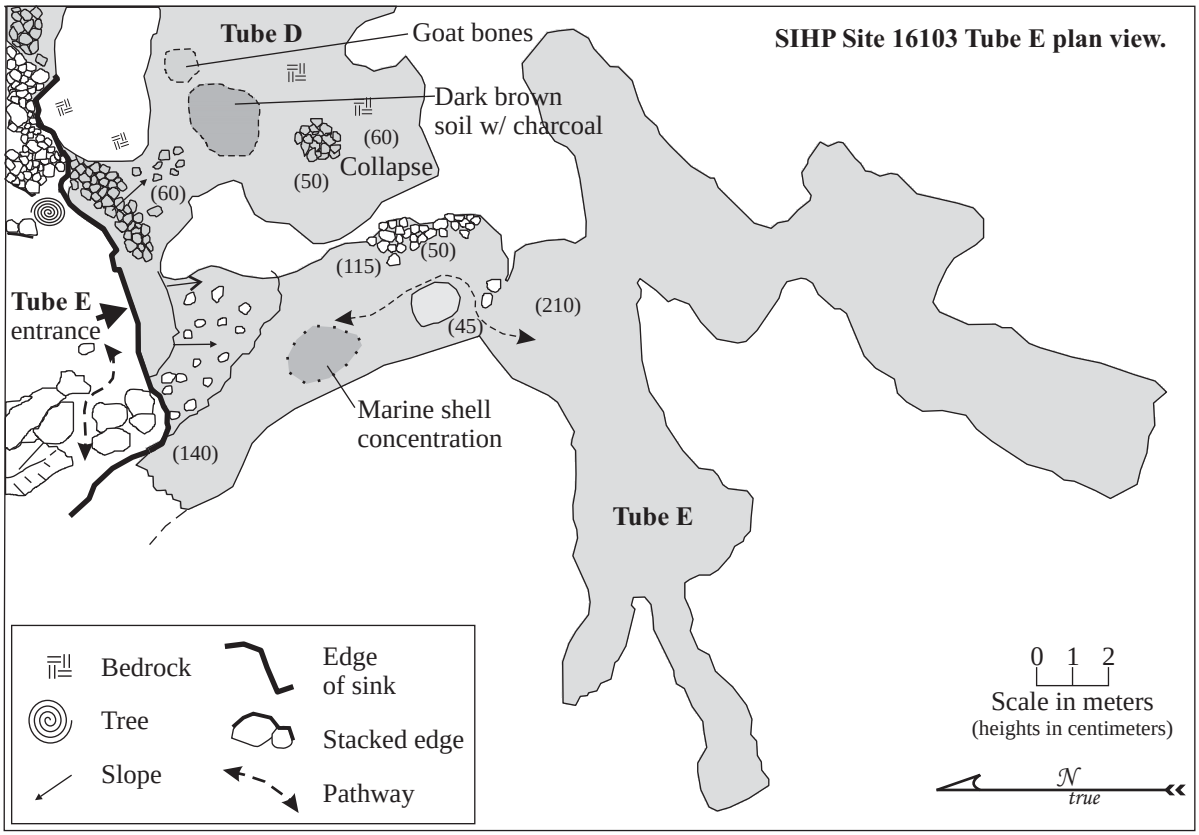
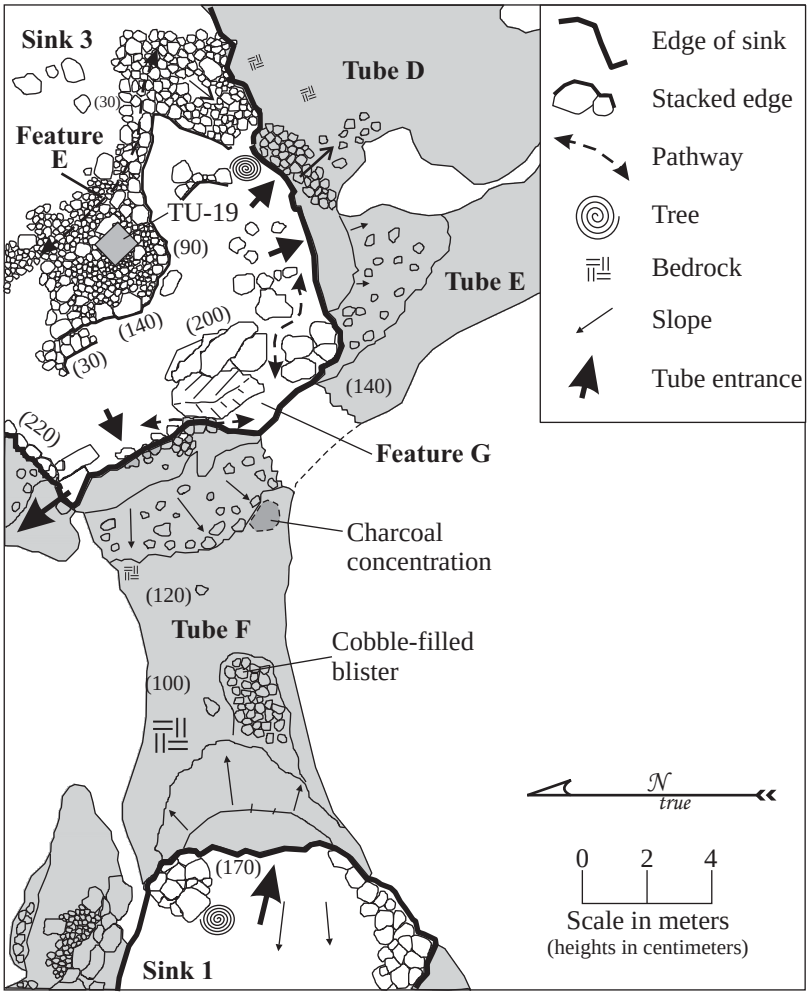


Figure 30. SIHP Site 16103 Tube E plan view and photo.

SIHP Site 16103: eastern entrance to Tube F from Sink 3, view to the west.



SIHP Site 16103 Tube F plan view.

Figure 31. SIHP Site 16103 Tube F plan view and photo.

Tube G

Tube G is a long tube that can be accessed through, and connects to, Sinks 1, 2, and 3 (see Figure 17). For the purposes of this discussion Tube G is described in four sections: southern, western, eastern, and northern (Figure 32). The sections are separated by sloped rubble that has poured into the north-central portion of Tube G from a 4.6-meter by 2.0-meter opening in the southern edge of Sink 2 (Figure 33). Each tube section has a separate entrance from within this Sink 2 rubble; the eastern section has an additional entrance from Sink 3; the southern section has an additional entrance from Sink 1; and the western section has an additional entrance from Tube H. Overall, it appears that Tube G, based on the type of cultural debris present, was used minimally for Precontact habitation purposes. Descriptions of each of the three sections follow below.

The southern section of Tube G connects Sink 1 (to the south) with Sink 2 (to the north). Along the northern edge of Sink 1 is an entrance to Tube G that measures 2.2 meters wide by 0.8 meter tall (Figure 34). Just inside the entrance there is a vertical drop, 1.4 meters to the north, from the ground surface of Sink 1 to the floor of Tube G. A small chamber, two meters wide by 0.8 meters tall, then extends six meter east from the opening before pinching out. The chamber floor consists of bedrock with small patches of thin soil also present. Scattered charcoal and *kukui*, probably remnants of artificial light sources, were observed within the chamber. South of the chamber, strewn cobble rubble ascends eight meters north to the Sink 2 opening.

The western section of Tube G runs west for nineteen meters from the rubble at the opening in the southern edge of Sink 2. A constructed entrance trail (1.0 meter wide) that is terraced and runs northwest for three meters, and then switches back to the southwest for three meters, while descending the sloped rubble for 1.5 vertical meters, provides access to the floor of the western section of Tube G. The trail provides for an easy descent into the tube. A stacked boulder retaining wall (4.2 meters long by 0.8 meters wide by 0.4 meter tall) is present at the base the entrance trail along the northern half of the rubble. From there much of the tube floor is covered with cobbles and boulders, and some areas have exposed bedrock. The passageway measures roughly seven meters wide by up to 1.5 meters tall. Ten meters west of the entrance a branch tube (three meters wide) heads southeast for eight meters, connecting to Tube H. At its western extent the western section of Tube G is blocked off by collapsed ceiling rubble. Cultural debris observed in this section was limited to a small amount of scattered *kukui* and charcoal. The skeleton of a recently deceased goat that died in the cave was also present.

The eastern section of Tube G runs east from the rubble filled entrance along the southern edge of Sink 2 to the western end of Sink 3. The western entrance to this section is through a small opening in the rubble to north of the southern segment. The small opening leads to a two-meter wide passageway that runs east for eleven meters to a point where the tube splits into three segments. One culturally sterile segment leads ten meters to the north before terminating; a second a low, narrow segment in which a coral fragment and a marine shell fragment (*Cypraea*) were observed, continues east for nine meters before pinching out beneath Sink 3; and a third, upper level that can be climbed up into, leads six meters to the entrance in the northwestern corner of Sink 3. This upper tube is full of rubble to the north with a passageway along the southern wall leading to the opening at Sink 3. This entrance is mostly blocked by a stacked wall (Feature H), but a narrow hole (0.6 meter tall by 0.7 meter wide; Figure 35) to the southwest of the wall allows for access between Sink 3 and the eastern section of Tube G.

The northern section of Tube G runs ten meters northeast from the rubble at the Sink 2 entrance. This section narrows from three meters to one meter wide before pinching out beneath Sink 2. It has a soil and cobble floor and a maximum floor to ceiling height of 1.3 meters. No cultural debris was observed within this northern section.

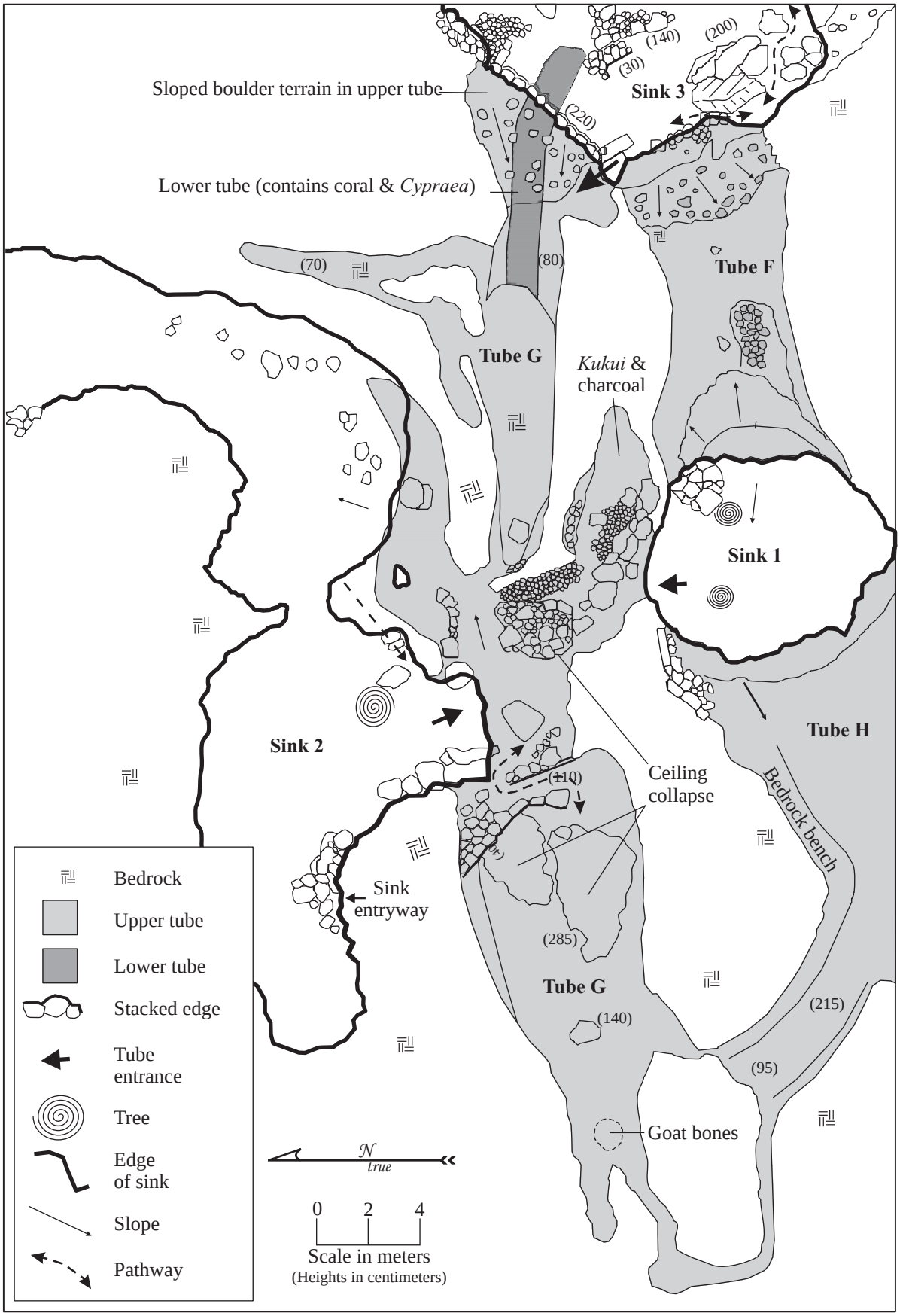


Figure 32. SIHP Site 16103 Tube G plan view.

Figure 33. SIHP Site 16103, Tube G, entrance from Sink 2, view to the southwest.

Figure 34. SIHP Site 16103, Tube G, entrance at the northern end of Sink 1, view to north.

Figure 35. SIHP Site 16103, Tube G entrance at the western end of Sink 3, view to the northwest.

Tube H

Tube H is a large lava tube that runs west from the western end of Sink 1 (see Figure 17). Most of this lengthy tube is located south and west of the current project area, and was therefore not recorded in detail. The beginning section is described below, and can be seen in Figure 18. The entrance to Tube H measures roughly eight meters long by up to 1.7 meters tall. From the entrance sloped cobble rubble descends five meters to the bedrock floor of the tube. The tube has a width of 8.0 meters and a maximum floor to ceiling height of 1.6 meters in this area. Ten meters west of the entrance along the northern wall of Tube H is a branch tube that leads eight meters southwest to Tube G. Eight meters beyond the entrance, along the southern wall of Tube H a staked, north-south running cobble and slab wall is present across the southern half of the tube. The wall measures 4.4 meters long by 1.0 meter wide by up to 0.6 meters tall, and it partially blocks access along the passageway. Charcoal and recently deposited goat bones were present on the tube floor to the west of this wall. Tube H was investigated to approximately 42 meters beyond this wall. A few small cobble alignments were observed, but nothing else. Although Tube H continued to the west and southwest, the recordation of the tube ceased at the wall, as further portions of Site 16103 were well outside the boundaries of the current project area.

SIHP Site 16105

Site 16105 is a lava tube containing habitation features and a burial that is located in the southwestern corner of the current study area, ten meters north of the southern property boundary (see Figure 15). This site was originally recorded by Drolet and Schilz (1991) (see Appendix A). The tube is accessible via a collapsed section of its ceiling; from this sink the tube extends nineteen meters to the east and twenty-nine meters to the west (Figure 36). Site 16105 is located 30 meters upslope (east) of Site 16103 (see Figure 15), a lava tube complex; the two tubes are likely part of the same system, but the tube connecting them has collapsed and is impassable. The terrain in the vicinity of the tube opening is moderately sloped to the west and composed of *pāhoehoe*

bedrock outcrops and cobbles with scattered patches of thin soil also present. Vegetation in the area consists of *koa-haole* (*Leucaena leucocephala*), Christmas berry (*Schinus terebinthifolius*), weeping fig (*Ficus benjamina*), ferns, and airplant (*Bryophyllum pinnatum*). Ten distinct features were recorded within Site 16105 (Features A-J). These features include two terraces (Features A, and H), a terrace with human skeletal remains present (Feature C), a cleared area (Feature B), two isolated lava tube chambers (Features D and J), a modified collapse/ramp (Feature E), two pavements (Features F and I), and a rock pile (Feature G) (see Figure 36). Each of these features is discussed in detail below. Site 16105 retains integrity of location and is in good condition for an archaeological ruin.

Feature A

Feature A is a terraced area located just outside of, and beneath, the eastern tube entrance (see Figure 36). The terrace measures approximately five meters by five meters. A partially collapsed wall at the entrance to the tube borders the western side of the terrace. The wall has a maximum height of 1.1 meters above the feature surface on the northern end, but is more collapsed on the eastern end and has a gap where the trail from sink entrance runs into the tube. The south and north sides of the terrace abut the tube walls, and the eastern edge of the feature consists of a terrace wall that spans the 3.5-meter width of the tube. The wall is composed of stacked large cobbles, slabs, and small boulders; the eastern edge stands 0.8 meter above the cave floor. In the center of the wall are two slab steps leading down to the surface of Feature B. The surface of the terrace (Feature A) consists of level ash-rich soil with scattered pebbles and cobbles of various sizes (Figure 37). Cultural debris on the terrace surface included marine shell, and a waterworn hammerstone that was observed in the northwestern corner near the entrance.

Feature B

Feature B is a segment of the lava tube that was modified through the removal of cobbles and the leveling of the cave floor (see Figure 36). Feature B also includes a modified bedrock outcrop in its northwestern portion. Feature B is located northeast of Feature A, and measures eight meters (east-west) by six meters (north-south). The low, cleared area is bordered on the west side by the eastern terrace wall of Feature A. Near the northwest corner of Feature B there is a narrow tube entrance (0.45 meter tall) that is constricted to a crawlspace by a bedrock outcrop. The top surface of the outcrop is modified with placed small cobbles, probably used to create a level surface to aid in accessing the narrow tube. The modified area measures two meters by one meter and is surrounded by boulders, cobbles, and bedrock. A single piece of coral was observed among the small cobble fill. The center of the Feature B area has a floor to ceiling height of 1.9 meters. The level soil floor of Feature B contains small to large cobbles (fallen ceiling debris), goat bones, charcoal, and *kukui* (Figure 38). As Feature B contains a cleared floor and a fairly tall ceiling, it is likely that this portion of the lava tube was used for Precontact habitation purposes, perhaps as a comfortable work surface or sleeping area.

Feature C

Feature C is a stacked cobble terrace wall located at the eastern terminus of Site 16105 that partially blocks a lower chamber, which contains human skeletal remains (see Figure 36). The terrace wall is located directly to the east of Feature B, and is composed of stacked cobbles and slabs standing up to 0.75 meter tall. East of the terrace wall collapsed ceiling rubble spans the five-meter width of the cave and extends six meters to the east. A narrow trail is traceable through the rubble that runs to the east. Along the northern edge of the trail is an alignment of large cobble that measures two meters long (northwest-southeast) by 0.5 meter wide. On the east side of the cobble alignment a rectangular coral abrader that measured 12.0 centimeters by 5.0 centimeters by 1.5 centimeters thick was observed. At the eastern end of the rubble area near the terminus of Site 16105 is a modified area consisting of small cobble paving atop the rubble. The pavement measures 3.0 meters (north-south) by 1.5 meters (east-west). The pavement partially blocks a lower chamber of the lava tube, which is only accessible through a 0.5-meter tall by 0.5-meter wide passage. The small chamber was not entered, but human skeletal remains were observed within resting on the bedrock floor of the tube.

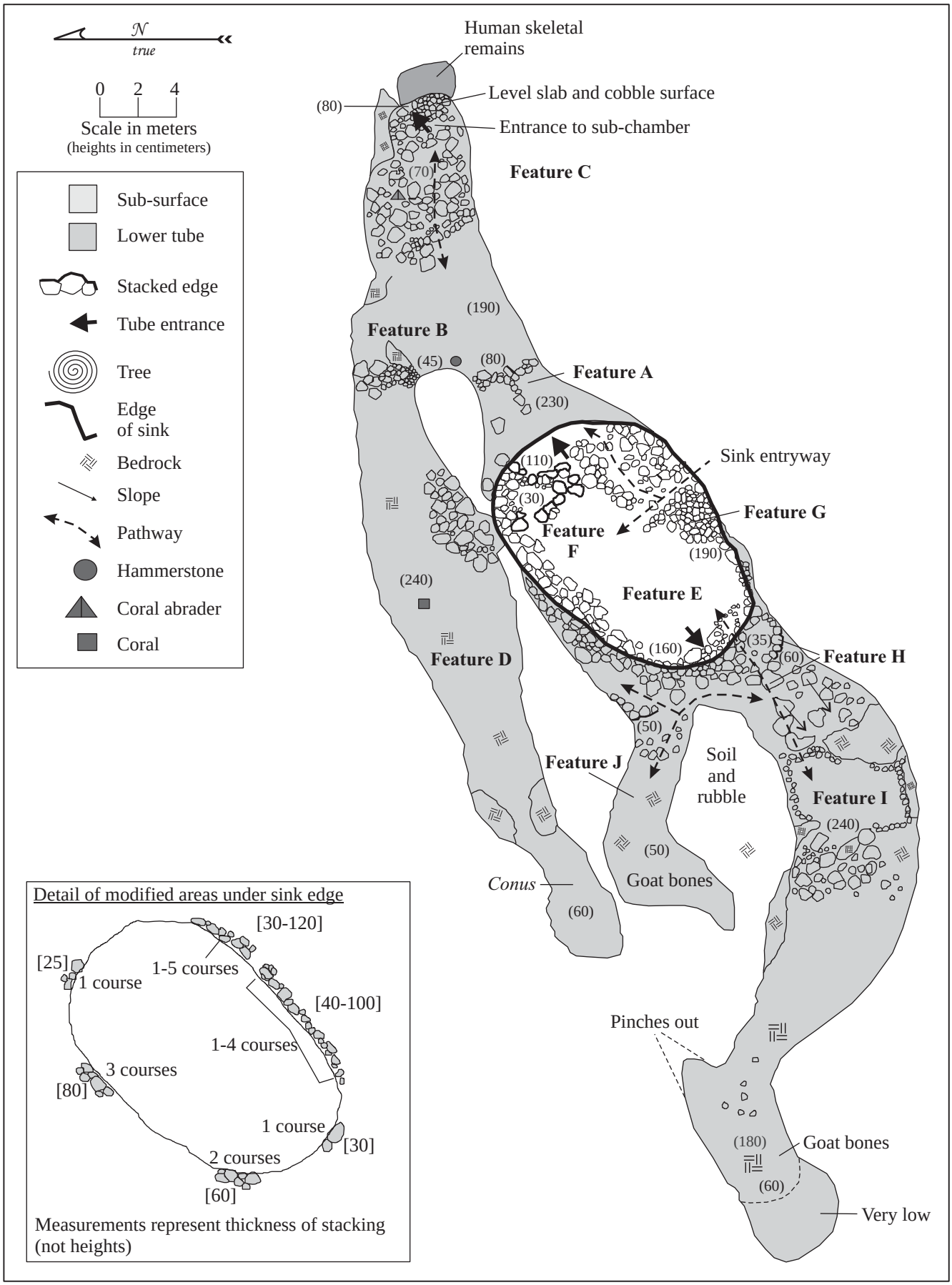


Figure 36. SIHP Site 16105 plan view.

Figure 37. SIHP Site 16105, Feature A terrace, view to the north.

Figure 38. SIHP Site 16105, Feature B, view to the northeast.

Feature D

Feature D is an isolated section of lava tube that is accessible on the eastern end via the small-modified outcrop crawlspace at the northwestern end of Feature B (see Figure 36). This chamber extends thirty-one meters to the west/southwest from Feature B, with tube widths ranging from 1.0 to 3.2 meters and floor to ceiling heights ranging from 0.6 to 2.4 meters. The cave floor consists of flat *pāhoehoe*, and a large pile of cobbles and boulders has spilled into the southern side of the center of the tube's span from a skylight in the ceiling. Cultural debris observed in this tube segment included a marine shell fragment (*Conus*) and a piece of coral. Feature D was an area of light cultural use compared to other well-utilized portions of the lava tube.

Feature E

Feature E is the modified sink that acts as the main entrance to the lava tubes (see Figure 36). The sink measures 10.2 meters (northwest-southeast) by 15 meters (northeast-southwest) and has an average depth of 1.9 meters below the upper ground surface. The only entrance to the sink is located on the southeastern side and consists of a constructed cobble and boulder ramp (Feature G) that descends from the edge of the sink to the central level area of the sink. The ramp measures 4.8 meters long (northeast-southwest) by 2.0 meters wide, and 3.5 meters from the top edge of the sink the ramp has an off chute trail (four meters long) leading to the northeast toward the eastern lava tube entrance. Other edges of the sink also contain minimal cobble stacking and clearing of the floor (see Figure 36). Feature F (a pavement) is present in the northeastern corner of Feature E.

Feature F

Feature F is a pavement located in the northeastern corner of the sink (Feature E) west of Feature A (see Figure 36). The feature consists of a pebble and small *pāhoehoe* cobble pavement that measures 2.2 meters (north-south) by 1.2 meters (east-west) (Figure 39). The western edge is lined with large cobbles loosely stacked 0.3 meter tall; the eastern edge is also lined with large cobbles (part of Feature A) that are stacked 1.1 meters above the tube floor. The northern end is paved up to large cobbles that separate the pavement from the northern wall of the sink, and the southern end of the pavement terminates at large cobbles. The pavement probably functioned as a level habitation surface.

Figure 39. SIHP Site 16105 Feature F, view to the northwest.

Feature G

Feature G is a large pile of cobbles, boulders, and slabs located west of the (Feature E) entrance ramp on the southern side of the sink (see Figure 36). The cobbles are piled up against the sink wall and cover an area that measures 6.5 meters (northeast-southwest) by 2.1 meters (northwest-southeast) (Figure 40). The piled rocks were probably cleared from the center of the level sink area.

Feature H

Feature H is a terrace and trail located at the entrance to the lava tube segment that extends *makai* from Feature E (see Figure 36). The entrance is located beneath an overhang that spans the width of the 3.6-meter wide sink. The terrace measures two meters wide, and its western wall edge is 0.25 meter tall. A trail with cobbles piled on either side is traceable running east/west across the terrace and descending into the tube; it is traceable for 10 meters. West of the terrace wall the trail passes over sloping rubble that tapers three meters down to bedrock.

Feature I

Feature I is a pavement located seven meters west of the *makai* lava tube entrance (see Figure 36). The paved area stretches six meters across the width of the tube (north-south) and is five meters wide (east-west). The pavement is constructed atop a relatively level, and in places exposed, *pāhoehoe* bedrock cave floor; on the east and west it terminates at bedrock outcrops. The ceiling height above the pavement measures 2.4 meters. No artifacts were observed on the feature, but the bones of a recently deceased goat were present. The tube continues an additional 20 meters to the west; no features were observed beyond Feature I.

Feature J

Feature J is an isolated tube segment that is partially blocked off by a stacked wall constructed along the western edge of Feature E. This chamber is accessed by entering the *makai* tube entrance at Feature H, and heading north through a 1.8-meter wide gap between a stacked wall on the sink side, and a cave wall on the west. Inside the small tube the floor is covered with soil and cobbles. This portion of tube would be accessible by entering directly from the sink, but a stacked cobble and boulder wall 1.6 meters tall was built blocking it off. No artifacts were observed in this area; it may have been sealed off to allow only a single point of entry to the Feature J chamber.

Figure 40. SIHP Site 16105, Feature G with Feature E (to left), view to the southeast.

SIHP Site 16106

Site 16106 is a core-filled wall that runs along the southern boundary of the current study parcel (see Figure 15). This site was originally recorded by Drolet and Schilz (1991) (see Appendix A), and more recently recorded by Clark and Rechtman (2005a) along the southern boundary of a parcel located directly *mauka* of the current study parcel. Clark and Rechtman (2005a) describe Site 16106 as standing roughly 0.6 meters tall by 0.9 meters wide, and running for 670 meters from the southeastern to the southwestern corners of their study parcel. Within the current study area, Site 16106 continues *makai* beyond the Clark and Rechtman (2005a) project area for approximately 80 meters along the southern parcel boundary before terminating in collapse. This section of wall consists of *pāhoehoe* cobbles that were formerly stacked, but are now mostly collapsed. The most intact section of Site 16106 within the current project area has a maximum height of 0.8 meters and measures 0.6 meters wide (Figure 41). A bulldozed road parallels this wall to north for its entire length. No cultural materials were observed on ground surface in the vicinity of Site 16106. Clark and Rechtman (2005a) suggest that Site 16106 was likely built sometime after 1913 when the parcel *mauka* of the current project area was sold to John Broad as Lot 57 of the ʻOʻoma Homesteads (Grant 5912). It is possible that the wall along the southern boundary of the current study parcel was built during the same construction episode, as it only runs for a short distance along the southern property line. Site 16106 retains integrity of setting, but the section along the southern boundary of the current study parcel is in poor condition.

Figure 41. SIHP Site 16106, southern boundary wall, view to the southeast.

SIHP Site 16107

Site 16107 is an agricultural complex, consisting of 316 features, that spans the current project area (Figure 42). Features of this site are found in loosely arranged fields over the entire parcel, except in locales where it has been previously bulldozed or where no soil is present. Haun and Henry (2003) and Clark and Rechtman (2005b) recorded similar large complexes that spanned their respective project areas to the northeast of the current study parcel. These complexes were also interpreted as being the remnants of agricultural fields. Four features of Site 16107 (all mounds) were previously recorded by Drolet and Schilz (1991) on the study parcel as Sites 16107 and 16108 (see Appendix A). For the purposes of the current study, however, the agricultural features are discussed under the single designation of Site 16107. This site contains numerous distinct features that appear to have been used for Precontact and continued Historic Period agriculture. Most appear to have functioned as clearing, planting, or boundary features. To understand how these features were used for agricultural purposes, we first need to define the physical characteristics of each type of feature encountered within the current project area. For examples of these feature types see Appendix B, which contains detailed descriptions, photographs, and sketches of all of the recorded features at Site 16107.

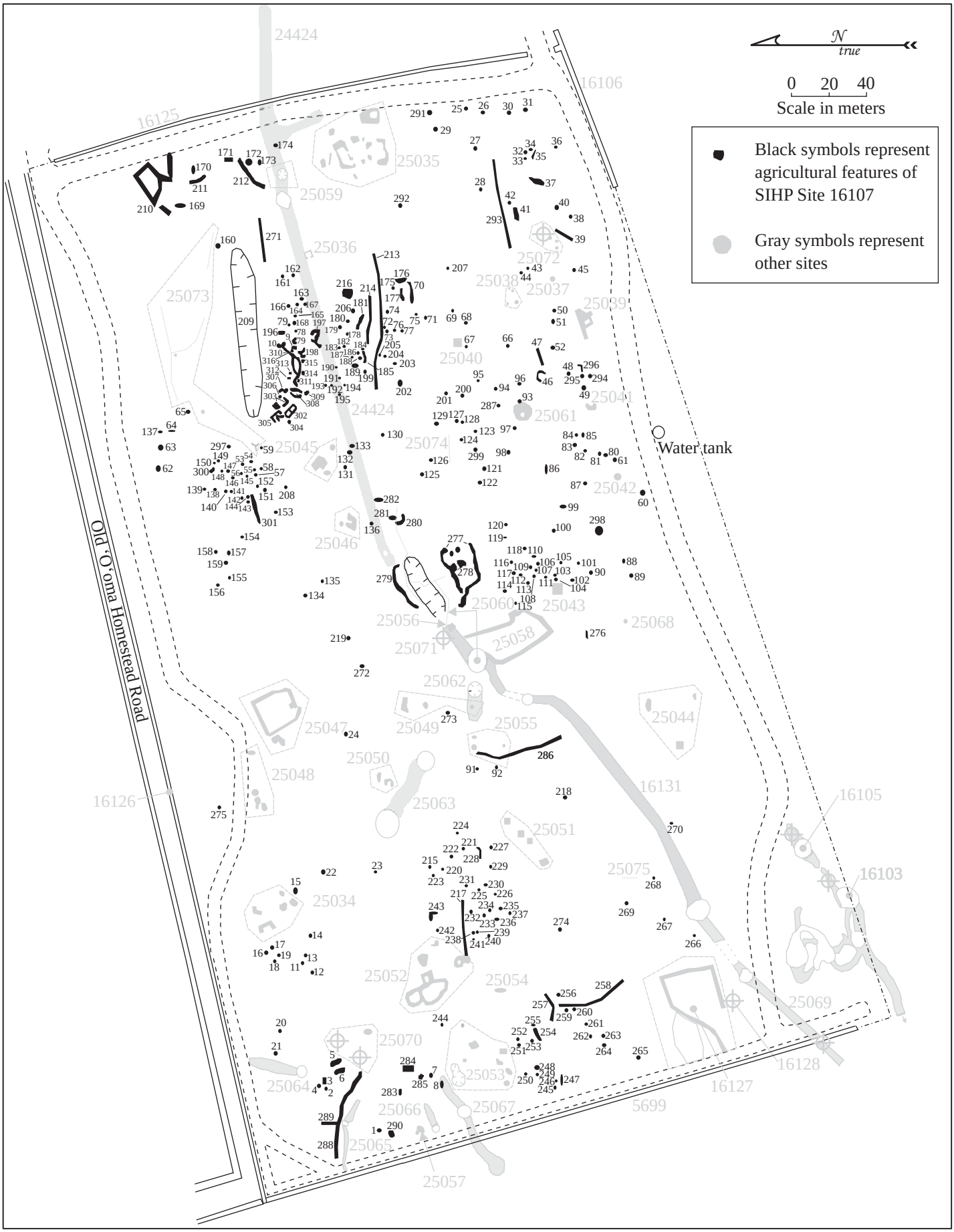


Figure 42. SIHP Site 16107 plan view.

Agricultural Feature Definitions

The features of Site 16107 are quantifiable forms, constructed or modified by human hands, which make up the archaeological landscape and record generations of human occupation. It is important to keep in mind that individuals construct features at a certain time for a specific purpose. However, by the time archaeologists encounter these features, they are often overgrown with vegetation, collapsed and destroyed, and sometimes dismantled or rebuilt; and almost always lack all perishable components. Numerous formal feature types have been identified (but not agreed upon) during the past 100 or so years of archaeological research (augmented by historical documentation and oral historical accounts) on the island of Hawai'i. Indeed, as Kirch points out, "given the bewildering variety of forms and permutations that Hawaiian structures take…no single classification has yet been found to be entirely satisfactory. In fact, Hawaiian archaeologists commonly use ad hoc combinations of functional and formal types in their survey work, applying functional terms to sites whose past use seems relatively unambiguous, and using formal, descriptive terms for sites that might have been used for several alternative purposes" (1985:36-38). By nature, this lack of agreement on feature terminology hinders comparisons between sites and projects, and the "ad hoc" combination of formal and functional terms used in describing features in the field can preclude innovative interpretation.

To help alleviate the hindrance of conflicting terminology, a set of formal feature definitions, specific to the current project area—but keeping in mind previous archaeological work—is presented below. The definitions present only the common attributes that enabled us to place the diverse formal feature types into easily quantifiable groups and are followed by a discussion of possible function within this agricultural context. The formal feature types encountered at Site 16107 are mound, modified outcrop, wall, enclosure, terrace, pavement and pit. A definition of each type is presented below.

Mound

A mound is collection of stones with an irregular surface. Mounds range considerably in size, shape, method of construction, and type of stone used. They are constructed from as few as four stones or as many as the topography and the effort of the individual(s) constructing them allow. The shape of a mound varies considerably depending on the terrain and the individual purpose of construction. However, all mounds, as dictated by gravity, have sloped sides. Mounds are either piled or stacked, or a combination of both. Stacked mounds usually contain a fill of piled stones with an outside layer stacked around the edges. The type of stone used in mound construction is a reflection of the immediately available source material. The size of stone used is also a function of material availability. A mound can have a different function depending on its temporal and spatial associations. Mounds observed within the current project area are thought to have functioned primarily as clearing features, but may also have been utilized as planting features.

Modified outcrop

A modified outcrop is a natural bedrock formation with an associated collection of stones placed against and supported by it. Unlike a mound, the stone collection is not freestanding and depends on the bedrock formation for support, although it may rise above the level of the outcrop itself. The type and size of the stones used is a function of the immediately available source materials. The stones are either stacked, piled, or a combination of both, but the size of the stone collection must be significantly smaller than the size of the bedrock formation, otherwise the feature is considered a mound. The surface of a modified outcrop is always irregular with sloped sides and incorporated bedrock. Occasionally, if the stones are stacked against a vertical bedrock formation, the stacked edges will also approach vertical. Modified outcrops observed within the current project area are thought to have functioned primarily as clearing features.

Wall

A wall is a linear or curvilinear alignment of stones (at least two courses high) that is considerably longer than it is wide. Walls are constructed using stones of various type and size depending upon the source material. They generally have sloped sides, although in neatly stacked walls the slope approaches vertical. Walls may also form adjoining or shaped segments (i.e. L-shaped, T-shaped, U-shaped, etc.). The recorded walls at Site 16107 appear to have functioned primarily as agricultural field boundaries that were created during the clearing of soil areas (Cordy 2000; Kirch 1985; Soehren and Newman 1968). The *mauka/makai* trending boundary walls appear to

have functioned as *kuaiwi*. The *kuaiwi* consist of stones cleared from the soil areas, and piled against the bedrock swales. The other features of the agricultural fields are generally present in the soil areas between these *kuaiwi*.

Enclosure

An enclosure is a construction of stones that surrounds an interior space around at least 75% of its perimeter. The construction may incorporate natural formations (i.e. bedrock outcrops, boulders, etc.) or other formal feature types (i.e. walls, terraces, etc.) into its length. Construction materials are of varying type and size depending on the source. The shape of an enclosure (i.e. square, rectangular, three sided, many sided, circular, oval, or irregular) varies considerably depending on the topography and its intended function. The enclosure walls may be stacked, piled, or collapsed (formerly stacked). Some enclosures completely surround an interior space with no openings. The enclosure recorded at Site 16107 all contain at least some soil and appear to have functioned as planting features. The walls seem to have been constructed primarily of cobbles cleared from the interior space and it is likely they were designed to keep animals out of the planting area.

Pavement

A pavement is a stone surfaced area, level with the surrounding ground surface on at least one side. Pavements are generally constructed against or into sloping terrain, and are then filled with stones to create a relatively flat surface. Pavements come in many shapes (including square, rectangular, and irregular) and sizes. The outside edges of a pavement may be piled or stacked (piled edges are sloped, while stacked edges are generally vertical). Small (cobble to gravel size) stones are generally used as the fill material. Within the current study area a pavement is a specialized feature associated with agricultural activity, and used as a produce staging or processing area. This interpretation is based on Logical Supposition and previous work conducted by Rechtman et al. (2001).

Pit

A pit is a stone excavation, or a modified natural depression, with primarily subsurface attributes. Pits are generally small and round (circular or oval) with concave bottoms. They are created by either removing stones from the ground surface until a desired depth is reached, or by modifying a natural depression until a desired size is reached. On occasion, the removed stones are placed around the outside edges of the pit to increase depth. Pits recorded within the current project area appear to have functioned as planting features.

Agricultural Features Recorded During the Current Inventory Survey

During the current inventory survey 316 distinct agricultural features were recorded on the study parcel (see Figure 42). These features included 143 mounds (45%), 145 modified outcrops (46%), 9 enclosures (2.8%), 14 walls (4.4%), 4 pits (1.3%), and 1 pavement (0.3%). Appendix B contains detailed descriptions, photographs, and sketches of all of the recorded features at Site 16107. Most of these features appear to have origins dating to the Precontact Period. There is a possibility, however, that at least some of the features saw continued use, or had origins, in the Historic Period. During an oral interview with Auntie Elizabeth (see below), she indicated that when she was a child her *hanai* family planted sweet potato on the study parcel and created stacked rock mounds during the process of clearing soil areas. Auntie Elizabeth could not recall any of the specific areas where her family planted, or point out any mounds that they had created.

Although very little soil is present over most of the study parcel, areas with the most soil also contain the highest density of agricultural features (see Figure 42). It was in these agriculturally productive areas, the areas that offered the likelihood of the most plentiful yields at harvest time, that the greatest effort was expended to clear cobble debris from the soil. This resulted in a higher number of clearing features in these soil areas. Ethnohistorical sources (i.e. Handy and Handy 1972) also indicate that in some cases rocks were mounded up over root crops to help protect them from damage and to increase soil and moisture retention. Therefore, in areas with plentiful soil a greater number of these planting features would also be expected. Within the current study parcel areas that do not contain agricultural features are those areas that do not have sufficient soil for planting or that are located on steep slopes not suited for agriculture. Within the project area no agricultural features were

present on *ʻaʻā* lava flows that occur at a few isolated locations, such as in the vicinity of Sites 25047 and 25048. Also very few agricultural features were present in a band that crosses the central portion of the project area from north to south between Sites 25048 and 25044 where the steepest slopes occur and the ground surface consists primarily of exposed *pāhoehoe* bedrock (see Figure 42). Soil erosion caused by run-off may have been a limiting factor in effective use of these areas for agriculture.

Overall, the features of Site 16107 are in poor condition. Most are collapsed and covered by dense vegetation. This disturbance to the site that has occurred since the fields fell into disuse sometime during the Historic Period makes feature functional interpretations difficult, and prohibits a holistic understanding of discrete associations between the features themselves. Site 16107 does retain integrity of setting, however, and its associations with the other archaeological sites recorded on the study parcel make it significant for understanding the past life ways of Precontact Hawaiians who once lived and gardened on the study parcel.

No cultural debris of any kind was observed on ground surface at any of the features of Site 16107. Three of the features of Site 16107 (Features 287, 295, and 299) were tested to determine the nature of any subsurface deposits present at these agricultural features, but no cultural materials were recovered from any of these excavations. Descriptions of the subsurface testing at these three features follows below.

Results of Subsurface Testing at Site 16107

Three test units were excavated at three of the recorded agricultural features. The tested features included a mound (Feature 287) and two modified outcrops (Features 295 and 299). In all cases, the findings from the test units were consistent with the assigned agricultural function of the features. All three test units revealed a complete lack of cultural debris. The excavated features also lacked any significant amount of soil, suggesting that they are likely clearing features, rather than planting features. Each of the tested features and the subsurface findings at these features are discussed in detail below.

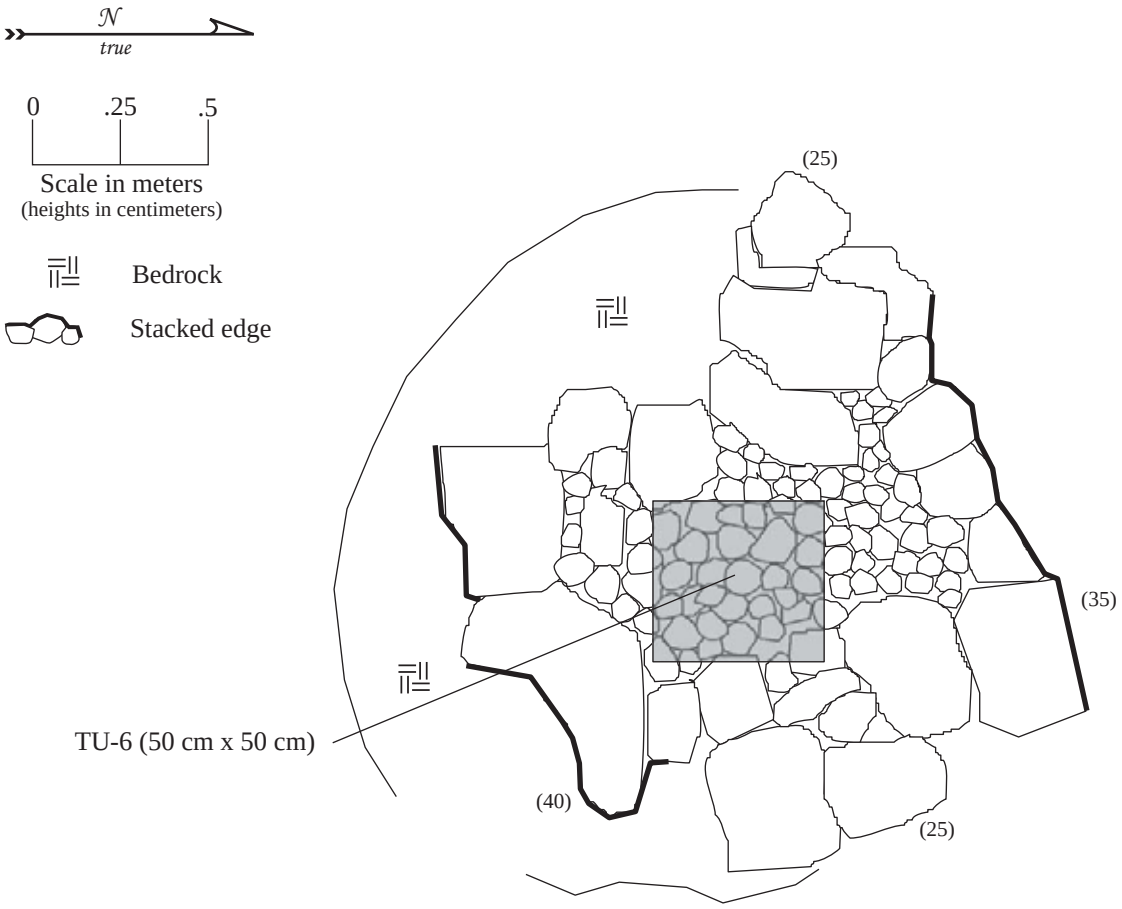
Feature 287

Feature 287 is a clearing mound located on the western side of the southeastern quarter of the project area (see Figure 42). The feature measures 1.8 meters (north-south) by 1.55 meters (east-west), with an average height on the exterior edges of 0.3 meters. The feature is constructed on top of a domed pāhoehoe outcrop and consists of large cobbles around the periphery with a level interior that is paved with small cobbles (Figure 43). The feature was probably made of cobbles that were discarded during clearing of nearby soil areas in preparation of planting.

A single 0.5 x 0.5 meter test unit (TU-6) was excavated at Feature 287 in the center of the mound to test for the possibility of buried cultural deposits or a concealed blister opening in the domed bedrock. Excavation of TU-6 revealed two stratigraphic layers (Layers I and II; see Figure 43). Layer I, the 25-centimeter thick architectural layer, consisted of small angular pāhoehoe cobbles. Layer II continued beneath Layer I to a depth of 30 centimeters below the unit's surface. This layer consisted of very dark brown (10YR 2/2) silt with dense grass root content, and with approximately 2% gravel content. Excavation of TU-6 terminated at smooth bedrock at the base of Layer II, 30 centimeters below the unit's surface. No artifacts were recovered from TU-6.

Feature 295

Feature 295 consists of cobble modification that covers a small crack in a *pāhoehoe* bedrock dome located at the northern end of a large bedrock formation in the southeastern portion of the current project area (see Figure 42). Feature 295 is located on the same outcrop as Feature 294. The feature is composed of small to large cobbles and measures 1.5 meters (north-south) by 0.5 meter (east-west) (Figure 44). Feature 295 has large cobbles aligned on the periphery, but is roughly paved with small cobbles. The top surface is fairly level, as it is constructed in a relatively level portion of the dome. The maximum height occurs along the western edge where large cobbles rise 0.4 meter above the surrounding bedrock. This feature is possibly a clearing pile made neat by aligning and filling in large periphery stones. It was also likely designed, along with Feature 294, to help level the top of the bedrock dome, perhaps to be used for agricultural related activities (i.e. processing).



TU-6 west wall profile.

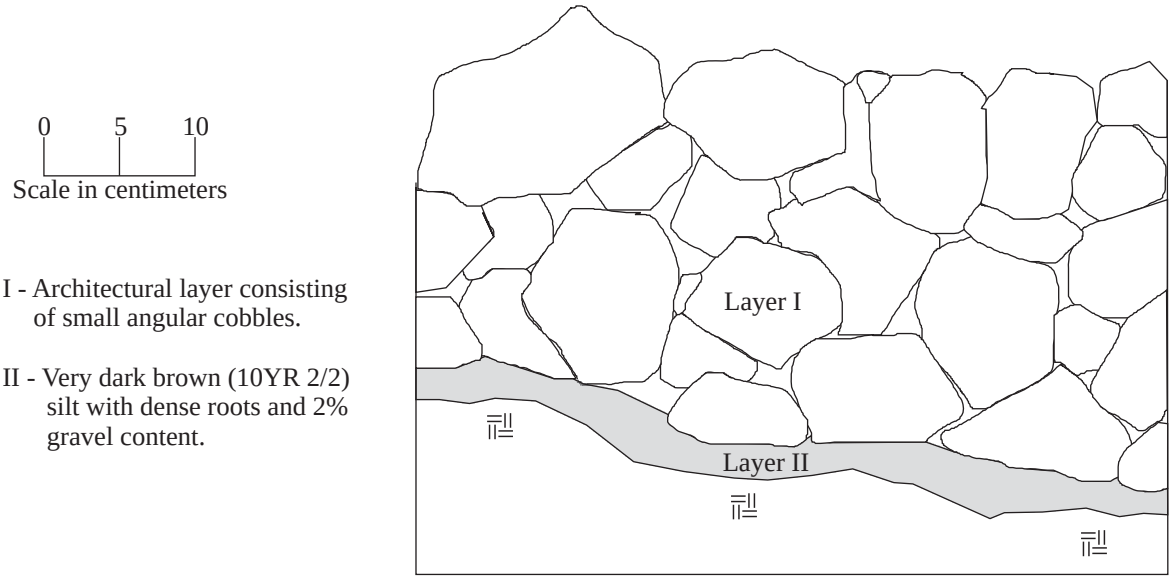


Figure 43. SIHP Site 16107 Feature 287 plan view and TU-6 profile.

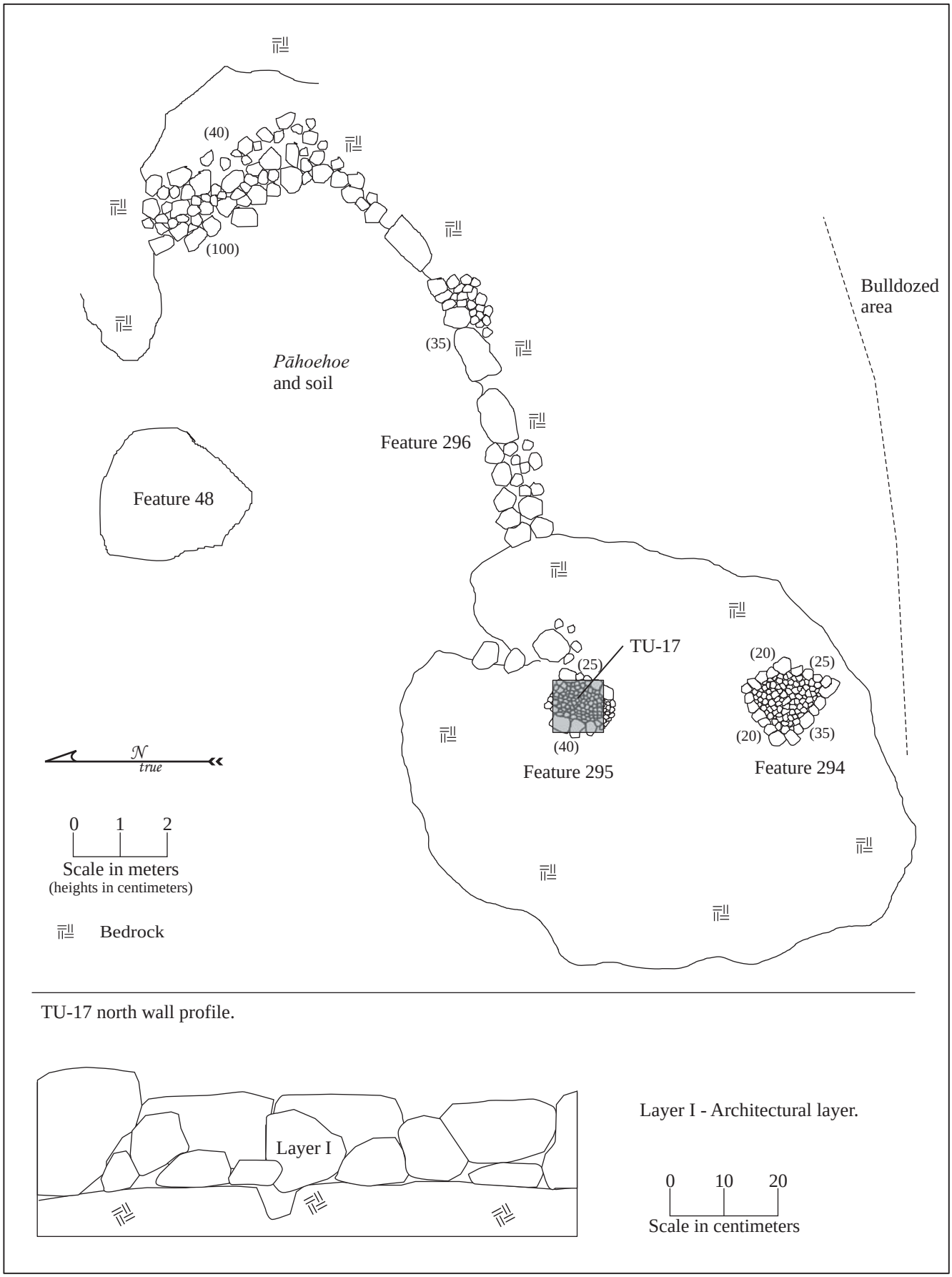


Figure 44. SIHP Site 16107 Feature 295 plan view and TU-17 profile.

A single 1 x 1 test unit (TU-17) was excavated in the center of Feature 295 to test for the possibility of a burial, or concealed entrance to a blister inside the dome of bedrock. Excavation of TU-17 revealed one stratigraphic layer (Layer I; see Figure 44). Layer I, the architectural layer, consisted of large and medium cobbles on the periphery of the feature, and small *pāhoehoe* cobbles in the center. Excavation of TU-17 terminated at bedrock at the base of Layer I, 15 centimeters below the unit's surface. No artifacts were recovered from TU-17, and no subsurface blister entrance was present.

Feature 299

Feature 299 is a modified outcrop constructed on a west-sloping terrain that is located in the southeastern quarter of the project area (see Figure 42). The feature consists of a crack in the *pāhoehoe* bedrock that is filled in with various sized cobbles (Figure 45). The crack may have been expanded by excavation prior to being filled. The surface of the feature is level and measures 3.5 meters (north-south) by 2.0 meters (east-west). The *makai* edge of the modified area is aligned and loosely stacked with large cobbles and small boulders to a height of 0.85 meter above the down-slope ground surface. The level surface of the feature could have functioned as a work area where agricultural activities were performed, but the feature most likely represents a clearing pile.

A single 1 x 1 meter test unit (TU-18) was excavated in the level paved area at the north end of Feature 299, adjacent to bedrock. Excavation of TU-18 revealed two stratigraphic layers (Layers I and II; see Figure 45). Layer I, the 20-centimeter thick architectural layer, consisted of small to large *pāhoehoe* cobbles with small roots. Layer II consisted of a dark brown (10YR 3/3) silt containing 70% pebble gravel with many small cobbles. Excavation of TU-18 terminated at south-sloping *pāhoehoe* bedrock 30 centimeters below the unit's surface. Some fragments of burnt wood were recovered from near the surface of TU-18, but no other cultural debris was observed.

Discussion of Agricultural Practices within the Current Project Area

The current project area lies within what has been termed the Kona Field System (Cordy 1995; Newman 1970; Schilt 1984). This area of dryland agricultural fields extends north from Hoʻokena Ahupuaʻa to at least Kaū Ahupuaʻa and east from the coastline all the way to the forested slopes of Hualālai (Cordy 1995). A large portion of the field system is designated in the Hawaiʻi State Inventory of Historic Places (SIHP) as Site 50-10-37-6601 and has been determined eligible for inclusion in the National Register of Historic Places. The basic characteristics of this agricultural/residential system as presented in Newman (1970) have been confirmed and elaborated on by ethnohistorical investigations (Kelly 1983) and summarized by Cordy (1995). The construct is based on the Hawaiian terms for the major vegetation zones, which are used to define and segregate space within the region's *ahupuaʻa*. These zones are bands roughly parallel to the coast that mark changes in elevation and rainfall (Table 3).

Table 3. Traditional Hawaiian agricultural zones*.

Zone	*Annual Rainfall*	*Description*	*Elevation*	*Primary Crops*
Kula	c. 30-50 in (0.8-1.2 m)	Plain, open country inland from the coast	Coast-500 ft (0-150 m)	*Wauke,* gourd, and sweet potato
Kalu or *Kaluʻulu*	c. 40-55 in. (1.00-1.35 m)	Luxuriant, cultivable zone	500-1,000 ft. (150-300 m)	Breadfruit, *wauke*, sweet potato, mountain apple, some taro
ʻĀpaʻa	c. 55-80 in. (1.35-2.00 m)	Dryland cultivation zone	1,000-2,500 ft (300-750 m)	Taro, sweet potato, sugar cane, *kī*, and banana
ʻAmaʻu	c. 80 in. (2.0 m)	Upland/fern zone	2,000-3,000 ft (600-900 m)	Banana and *ʻamaʻu* (fern)

*Based on Cordy's (1995) summary of land zones and agricultural patterns in Central Kona.

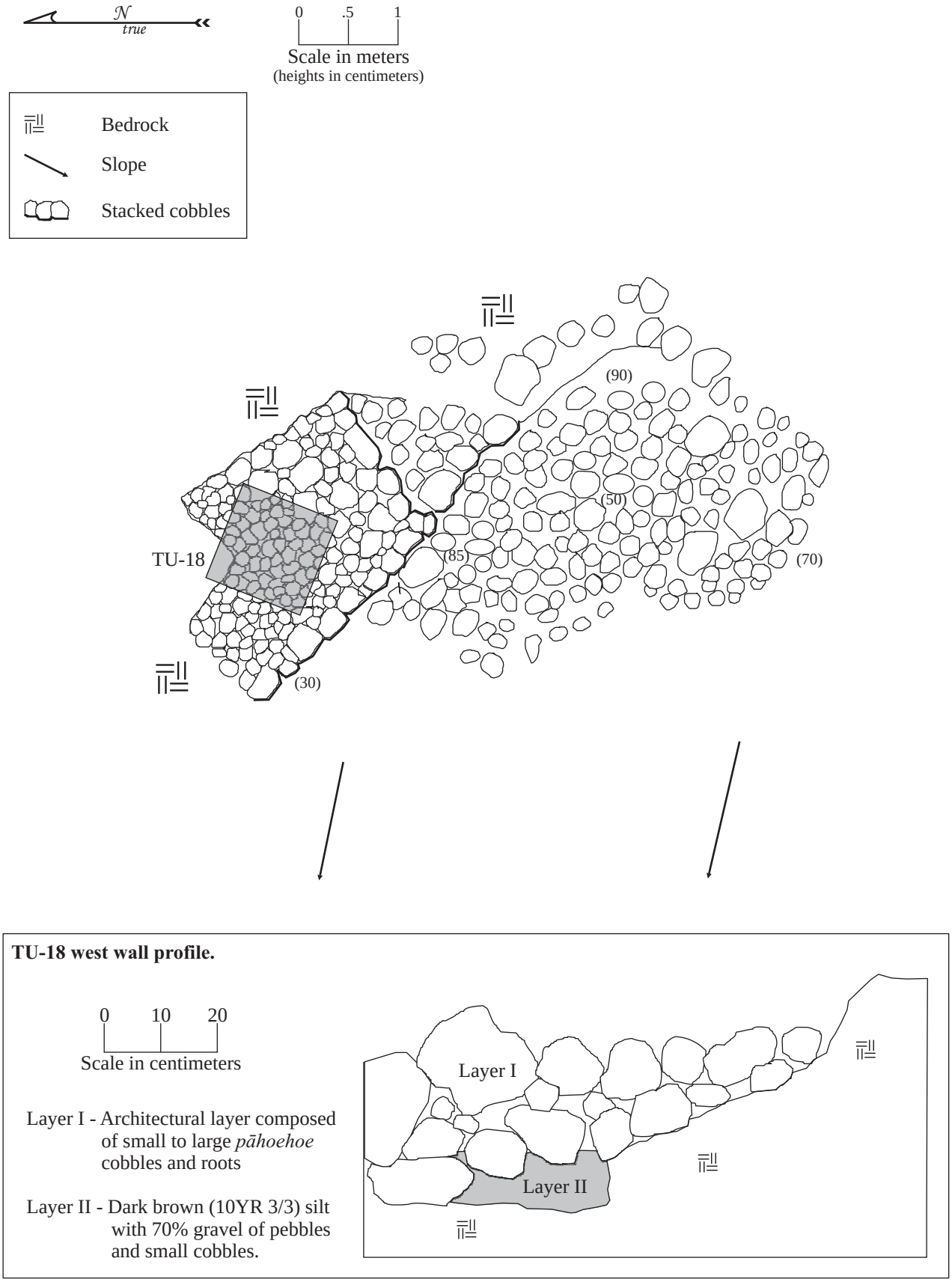


Figure 45. SIHP Site 16107 Feature 299 plan view and TU-18 profile.

The Cordy (1995) model for traditional Hawaiian agricultural zones summarized above in Table 3 is meant to describe the Precontact land use patterns for Central Kona; an area to the south of the current project area. In fact, these zones were first described in the context of the entire Kona Field System by Newman (1974) who was looking at the area above Kealakekua Bay. As Cordy (1995:10) relates several types of variations have been noted in the fields of central Kona since the Newman (1974) study. These variations include localized lava flow and soil patterns which can have a considerable impact on soil depth and coverage and accordingly on field patterns (Cordy 1995). Localized variations in the amount of rainfall would have also had a considerable impact on field patterns.

The current project area is located to the north of the area described in the Cordy (1995) model, near the northern extent of the Kona Field System. The further north one travels along the Kona coast, the more arid the environment becomes. It stands to reason that as the amount of rainfall decreases near the coast the elevational bands that define the traditional agricultural zones begin to shift inland, as dictated by the localized rainfall patterns. Indeed, as Cordy (1995:18) notes, the pattern is somewhat different in the North Kona *ahupua'a* north of Kailua. Although the Kona fields extend into this area, he relates that, "the rainfall lines pull further up the mountain", and that although similar, "the zones are at different distances from the shore and at different elevations than in Central Kona" (Cordy 1995:18). Keeping this in mind, based on the formal attributes of the agricultural features recorded at Site 16107 and the amount of annual rainfall the area receives (ca. 750 mm; Giambelluca et al. 1980:99), it appears that the current project area, despite its elevation (ca. 760 feet to 870 feet above sea level), falls within the upper *kula* zone of North Kona, perhaps near the transition to the *kalu'ulu* zone.

The *kula* zone is traditionally associated with the cultivation of sweet potatoes (*'uala*), but paper mulberry (*wauke*) and gourds (*ipu*) were also grown in this zone. According to Cordy, agricultural ruins often cover much of the ground surface within the *kula*, and formal feature types usually include "mounds, short and irregular terrace facings without soil behind, small clearings in which stones have been removed, small enclosures with soil inside, and pits sometimes with soil and sometimes not" (1995:6). Cordy also notes that localized soils in the *kula* zone have resulted in the variations in field types, that "if soils are present, sometimes low and irregular terraces are present", and that "if soils are more limited, mounds and small clearings are common" (1995:10).

As was recorded by countless early European visitors to Kona, these soil areas would have been planted to the greatest possible extent, primarily in sweet potatoes. For example, Lt. King who traveled with Captain Cook to Kealakekua Bay in 1779, wrote of the near shore *kula*, "the Sweet Potatoe grows everywhere" (in Beaglehole 1967:608) and further inland, "for the first 2½ miles [the ground] is composed of burnt loose stone, & yet almost the hole surface beginning a little at the back of the town, is made to yield Sweet potatoes & the cloth plant" (in Beaglehole 1967:521).

Handy and Handy note that "Sweet potatoe culture was secondary in Hawaii to that of taro, the preferred dietary item, but owing to the exigencies of terrain and climate it was nevertheless widespread and attended by systematic care, both horticultural and ritualistic" (1972:124). They go on to describe that the planters of old Hawai'i were adept at the selection and adaptation of particular sweet potato varieties to varying localities, and that many different names and rituals existed for the various aspects of the sweet potato and its cultivation. Handy and Handy (1972:127) relate that sweet potato was more valuable than taro in three main ways: (1) it could be grown in much less favorable localities with respect to sun and soil; (2) it matured more rapidly (within three to six months); and (3) in terms of planting and care of cultivation, it was much less labor intensive.

The time factor regulating the planting of sweet potato is somewhat variable and depends upon weather rather than the regular seasons (Handy and Handy 1972:128). In dry areas such as the current project area, Precontact farmers would wait until the ground had received several good soakings before planting. In Kona, where precipitation at lower elevations is always generally low, planting generally took place during the summer months (Handy and Handy 1972:128). Sweet potatoes were always propagated from cuttings and never from seeds (Handy and Handy 1972:129). Soil planting areas were prepared by burning off grasses and shrubs, removing any stubble, and then turning over the soil. Patches in rocky places were called *makaili*; these patches often consisted of small pockets of semi decomposed lava into which the sweet potato cuttings were placed and then fertilized "with rubbish [mulch] and by heaping up of fine gravel and stones around the vines" (Handy and

Handy 1972:129). Handy and Handy relate that the yields of *makaili* patches were said to be rather tasteless and rigid or wrinkled.

The Hawaiian Newspaper *Ka Nupepa Kuʻokoʻa* for March 24, 1922 contained the following account of another method of Precontact Hawaiian planting:

> Rocky lands in the olden days were walled up all around with the big and small stones of the patch until there was a wall about 2 feet high and in the enclosure were put weeds of every kind, *ʻamaʻu* tree ferns and so on, and then topped with soil taken from the patch itself, to enrich it, or in other words to rot the rubbish and weeds and make soil.
>
> After several long months, the rotted weeds were truly converted into soil of the best grade. The farmer waited for the time when he knew that the rains would fall, then he made the patch ready for planting. If for sweet potatoes, he made mounds for them and for taro too, on some places on Hawaii.
>
> In planting his sweet potato slips or taro, his work ended when the rain fell. When the rains came the farmer's heart was gladdened because it gave the slips a start, the roots began to creep and his troubles were all over. (in Handy and Handy 1972:131)

As illustrated in the above article and reiterated by Handy and Handy (1972:132-133), cultivation of sweet potatoes after planting was minimal. During the growth of the tubers soil was occasionally mounded up around the roots for protection from pests such as rats and weevils and for the continued presence of need soil nutrients. Small unhealthy tubers were generally removed from the patch so that the larger healthy ones could flourish, and unwanted weeds were also occasionally removed. The vines were not allowed to grow out of control or to get too wet. When the potatoes were ready, only enough were harvested to supply the immediate needs of the farmer, the plants were never dug out completely (Handy and Handy 1972:133). This ensured that further food and cutting stock would be available on an as needed basis. All aspects of sweet potato cultivation were accompanied by ritual to help ensure a bountiful harvest (c.f. Handy and Handy 1972:136-149).

Although the feature types and feature distribution within the current project area appears to fit the expected archaeological pattern for the *kula* zone where sweet potatoes were the primary crop, it is possible, based on the elevation and the presence of rough *kuaiwi,* that the area is located near the transition to the *kaluʻulu* zone. This zone is somewhat indistinguishable from the *ʻapaʻa* zone in site patterning (Cordy 1995:7). For this reason, most information about the *kaluʻulu* is the same for the *ʻapaʻa*. Formal walled agricultural fields consisting of *kuaiwi* characterize this zone. *Kuaiwi* are low, broad, long multifunctional piles of rocks created by land clearing and rock removal from soil areas. *Kuaiwi* are oriented *mauka/makai* with shorter, perpendicular cross-wall segments connecting them. The cross-wall segments function as soil traps and retaining features, creating terrace-like areas to enhance planting. The distribution of soils suitable for agriculture determines, in part, the locations of the formal walled fields, and there is a direct relationship between suitable soils and older lava flows. Consequently, areas of young lava flow in the *kaluʻulu* and *ʻapaʻa* do not always have *kuaiwi* (Burtchard 1995; Hammatt et al. 1987; Haun et al. 1998). Breadfruit, *wauke*, sweet potato, mountain apple, and some taro were the dominant crops in this zone.

William Ellis, one of the first missionaries to arrive on the Island of Hawaiʻi, visited the area above Kailua (likely to the south of the current project area) on a tour around the island in 1825. Ellis' description of the area provides a sense of what the transition from the *kula* zone to the *kaluʻulu* zone to the upper zones may have been like during Precontact times. Ellis writes:

> After traveling over the lava for about a mile, the hollows in rocks began to be filled with a light brown soil; and about half a mile further, the surface was entirely covered with a rich mould, formed by decayed vegetation and decomposed lava. Here through a beautiful part of the country, quite a garden compared with that through which they had passed, on first leaving town. It was generally divided into small fields, about fifteen rods square, fenced with low stone walls, made of fragments of lava which had been gathered from the surface of the

> enclosures. These fields were planted with bananas, sweet potatoes, mountain taro, tapa trees, melons, and sugar cane, flourishing luxuriantly in every direction. Having traveled about three or four miles through this delightful region, and passed several pools of fresh water, they arrived at the thick woods, which extends several miles up the sides of the lofty mountain that rises immediately behind Kairua. (1963:27-28)

Further information relating to the probable use of the current project area for the cultivation of sweet potato, and perhaps its continued use for that purpose into Historic times, comes from an oral interview conducted with *kama'āina* Elizabeth Maluihi Ako Lee. Auntie Elizabeth related that as a child in the 1930s and early 1940s she helped her *hanai* family cultivate sweet potatoes within the current project area. Auntie Elizabeth described clearing cobbles from soil areas and then planting sweet potato cuttings in the rock-free soil. The cobbles removed from the soil were collected into clearing mounds. During a recent field visit to the study parcel with the authors of this report, Auntie Elizabeth pointed out several small mounds that were similar to those she had created as a child, but she noted that they were not nearly as tidy as the neatly stacked features her family normally built. She could not identify any specific features that she had built. When asked if she ever used the mounds for planting or covering the young sweet potato cuttings to protect them, Auntie Elizabeth replied that, no, they always planted in the cleared soil areas. The interview with Auntie Elizabeth provides interesting insights into the Hawaiian methods of sweet potato cultivation, and suggests that continued Historic use of the upper *kula* for agricultural purposes may have altered the earlier agricultural landscape.

SIHP Site 16125

Site 16125 is a core-filled wall that runs along the eastern boundary of the current study parcel (see Figure 15). This site was originally recorded by Drolet and Schilz (1991) and later studied by Clark and Rechtman (2005a) (see Appendix A). The wall stretches for 315 meters along the entire eastern boundary of the current study parcel. It has been breached in two locations by bulldozer roads and two ten-meter long sections of wall are missing at its northern and southern ends. Bulldozed roads run parallel to the wall approximately two meters distant from both its eastern and western edges. Site 16125 averages 0.6 meters tall by 0.8 meters wide (Figure 46). It is constructed of stacked *pāhoehoe* cobbles that have collapsed in several locations. This Historic boundary wall was likely built sometime after 1913 when the parcel immediately *mauka* of the current study parcel was sold to John Broad as Lot 57 of the ʻOʻoma Homesteads (Grant 5912). Site 16125 is in poor condition, but retains integrity of setting.

SIHP Site 16126

Site 16126 is a core-filled wall that runs along the northern boundary of the current study parcel (see Figure 15). Site 16126 also borders the southern edge of a portion of an old ʻOʻoma Homestead road and a second wall is present along the northern edge of the road approximately three meters distant. These two walls appear to have been constructed during separate episodes by the individual homestead owners. Drolet and Schilz (1991) also recorded this site originally (see Appendix A). Site 16126 runs along the entire northern boundary of the current study parcel for a distance of approximately 580 meters. At its eastern end the wall forms a continuous junction with Site 16125 (the eastern boundary wall). A bulldozed road runs parallel to the wall to the south for its entire length. At its western end the wall terminates at the northwestern corner of the current study parcel. Site 5699 (the western boundary wall) abuts the wall on the south and north sides and continues to the north beyond the current study area. Site 16126 averages 1.0 meter tall by 0.8 meters wide (Figure 47). It is constructed of stacked *pāhoehoe* cobbles that have collapsed in only a few locations. This Historic boundary wall was likely built at the same time as the other boundary walls surrounding the study parcel—sometime during the early part of the 20th century. Site 16126 is in fair condition and it retains integrity f design, function and setting.

The old Homestead road that Site 16126 borders was discussed in oral interviews with Kepā Maly by *kupuna* Peter Keikuaʻana Park, who was born in ʻOʻoma in 1918, as the route that was taken from the uplands to the coast (Rechtman and Maly 2003:II-31). In a side note Rechtman and Maly describe the route of the road thusly:

Figure 46. SIHP Site 16125 eastern boundary wall, view to the east.

Figure 47. SIHP Site 16126 northern boundary wall, view to the northwest.

> The road as described by *kupuna* starts *mauka* in ʻOʻoma 2nd, goes *makai* between Homestead lots 58 and 59 [see Figure 7], held for Kuhaiki and Kainuku; then runs north across ʻOʻoma 1st, into Kalaoa and the old Kamaka House, from where it then cuts *makai* to the shore (see Register map No. 2123). (2003:II-32)

Auntie Elizabeth also recalled traveling this trail in the 1930s and 40s to access her family lands and to travel from the upland areas to the coast.

SIHP Site 16127

Site 16127 consists of an enclosed paved area (Feature A) attached to a large enclosure (Feature B) located in the southeastern portion of the project area approximately 10 meters east of the western bulldozer road (see Figure 15). This site was originally recorded by Drolet and Schilz (1991) as four separate low walls (Sites 16127, a portion of 16128, 16129, and 16130; see Appendix A). However, it was discovered during the current fieldwork, while clearing the site of vegetation, that that the walls formed a single enclosure with an attached paved area. For this reason the lowest site designation was retained (Site 16127) for the purpose of the current study. Site 16127 was originally recorded as the north wall of Feature B; Site 16130 was the east wall of Feature B; Site 16129 and a portion of Site 16128 were portions of the south wall of Feature B. Feature A was not recorded by Drolet and Schilz (1991). Although being partially bulldozed, Site 16127 is in fair condition and it retains integrity of setting. No cultural debris was observed on ground surface in the vicinity of Site 16127, but based on its formal attributes, the features were likely used for Precontact habitation purposes with associated agricultural activities also possibly occurring.

Feature A

Feature A is a large enclosed paved area located along the western edge of Feature B (Figure 48). A collapsed wall borders the northern and western sides, and a more intact, though collapsing wall (Feature B), lines the southern and eastern sides of the paved area. In the northeastern corner of the enclosed area, the northern wall of the feature intersects with Feature B. The northeastern wall is low to the ground, averaging 0.3 meter tall and 0.5 meter wide; it runs to the northwest for ten meters along the edge of the paved area. On the northeastern side of the northeastern wall is a higher tier paved with small cobbles that measures nine meters by eight meters. Feature A is not enclosed on the northwestern or northeastern sides. In the northwestern corner, the wall turns to the southwest and runs along the northwestern edge of the pavement for twenty-one meters; at the western end the wall it is obliterated by the western bulldozer road on the parcel. A *pāhoehoe* bedrock outcrop that stands 0.4 meters taller than the feature's surface borders the southern edge of the pavement. The west wall (Feature B) runs north/northeast along the eastern side of the paved area, but is collapsed onto the pavement in some areas. Feature B is constructed with upright slabs and variously sized cobbles atop an elevated bedrock outcrop; it continues to the north/northeast beyond the paved area of Feature A.

The interior surface and paved area northeast of the northeastern wall of Feature B is composed of mostly small *pāhoehoe* cobbles 5-10 centimeters in size, with a few medium sized *pāhoehoe* cobbles (Figure 49). The surface is relatively level with some areas more jumbled, a few areas with exposed bedrock, and a depression (one meter in diameter) is located within the surface of the eastern end of the pavement. The cobble ground surface was probably natural, but modified by leveling certain areas, and constructing walls around the periphery. The level, enclosed area could have been a surface that was used for habitation purposes, or perhaps used to perform agricultural-related activities upon such as drying or processing.

Feature B

Feature B is an enclosure located east of Feature A (see Figure 48). The enclosure measures twenty-four meters (east-west) by twenty-eight meters (north-south), with average wall heights of 0.4 meter above ground surface. The walls consist of slabs, small boulders and cobbles, and are collapsed and appear piled now, but were probably stacked when originally constructed (Figure 50). The enclosed area consists of soil and *pāhoehoe* bedrock; no features were observed. The western wall of Feature B is the eastern wall of Feature A. Feature B may have been an enclosed Precontact habitation area, or possibly an enclosed planting area, although the soil within the enclosure appears too thin to have been used for this purpose.

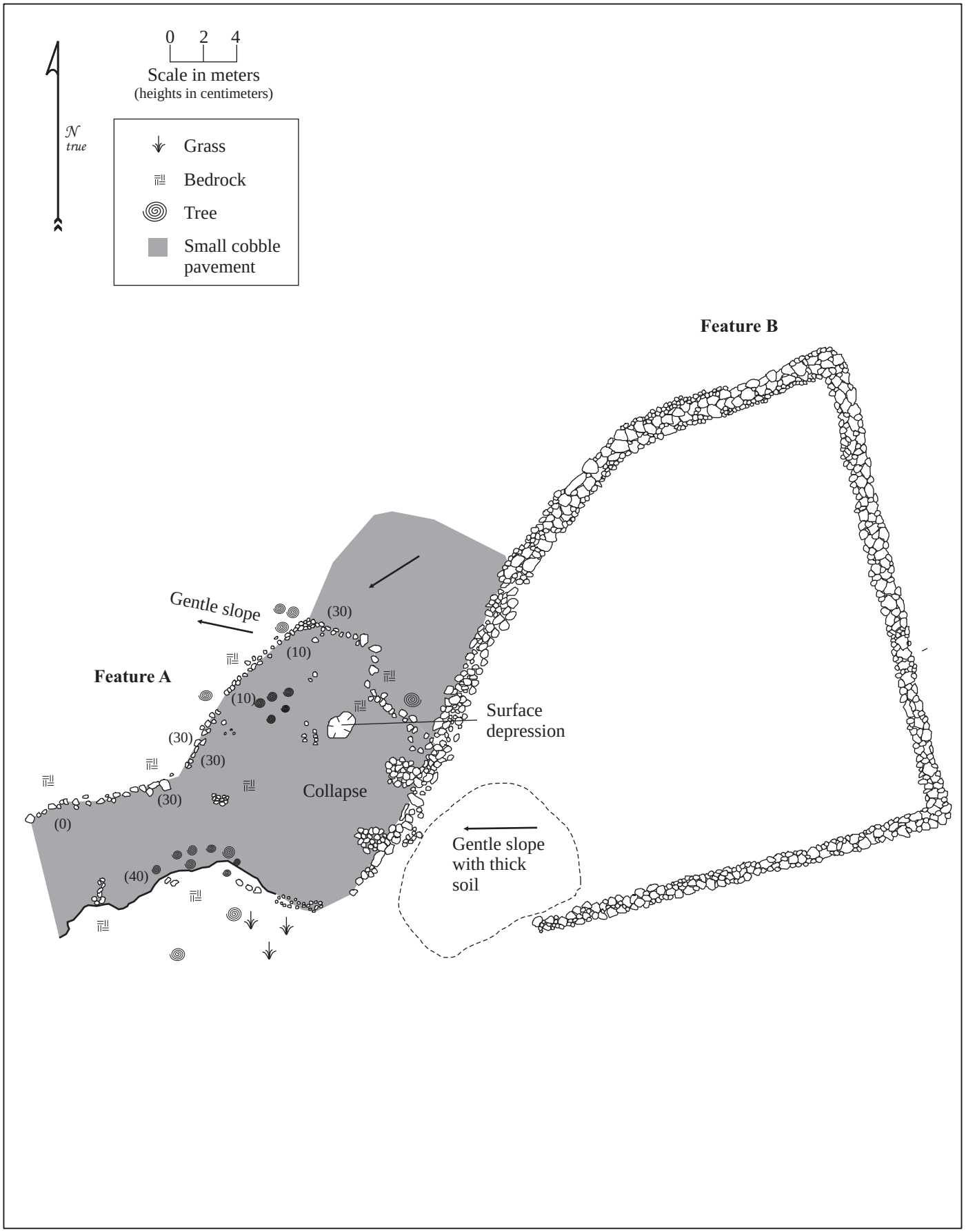


Figure 48. SIHP Site 16127 plan view.

Figure 49. SIHP Site 16127 Feature A, view to the west.

Figure 50. SIHP Site 16127 Feature B, view to the northeast.

SIHP Site 16128

Site 16128 consists of a small burial platform (Feature A) and a terrace (Feature B) located in the southwestern corner of the project area (see Figure 15). The site occupies an area that measures twenty-two meters by ten meters (Figure 51). Both features are connected. No cultural debris was observed on the ground surface in the vicinity of Site 16128. A bulldozed roadway has impacted the southern end of Feature B. Site 16128 was originally recorded by Drolet and Schilz (1991:23) as a feature cluster containing a wall, a mound, and a rock alignment (see Appendix A), but the presence of the burial was not discovered during the earlier study. The wall was recorded during the current study as part of Site 16127. During fieldwork, a single test unit (TU-3) was excavated at Feature A of Site 16128 revealing the presence of human skeletal remains. Feature B may have been used for Precontact habitation purposes. This site is in fair condition, it is retains integrity of setting, and it is significant for obvious cultural reasons. Detailed descriptions of each of the features of Site 16128, and the results of subsurface testing at TU-3, follow below.

Feature A

Feature A is a small stacked and paved platform constructed on a *pāhoehoe* cobble outcrop located at the northern end of Feature B (see Figure 51). The feature is roughly circular, and measures three meters in diameter with a maximum height of 0.7 meters, and an average height of 0.5 meters. The edges are constructed of stacked large *pāhoehoe* cobbles with level small cobble fill in the interior and on the top surface (Figure 52).

A single 1 x 1 meter test unit (TU-3) was excavated at Feature A in the center of the small platform (see Figure 51). Excavation of TU-3 revealed two stratigraphic layers (Layers I and II), and the presence of human skeletal remains (Figure 53). Layer I, the 85-centimeter thick architectural layer, consisted of various sized *pāhoehoe* cobbles, with smaller cobbles near the top, larger cobbles near the base, and a large horizontal slab located across the unit 30 centimeters below the surface of the unit. Cultural debris observed in Layer I included marine shell, waterworn coral, a coral abrader, a scoria basalt abrader, and charcoal. Below the architectural layer was Layer II. This layer consisted of black (10YR 2/2) charcoal-rich silt with 20% gravel content and marine shell present. Within Layer II, Precontact human skeletal remains were encountered in the northeastern portion of TU-3 at a depth of 105 centimeters below the unit's surface. Excavation of TU-3 immediately terminated, 105 centimeters below the surface of Feature A, upon discovery of the human remains. The charcoal and marine shell rich Layer II was probably habitation related material that was taken from elsewhere and used as burial fill, a pattern also observed elsewhere in Kona. The remains, which were not moved from their original position, were stabilized and reburied with the soil excavated from the unit. All cultural debris recovered from the unit was returned to Feature A and reburied prior to any detailed examination of the material. The architectural layer was then rebuilt, as close to its original specifications as possible.

Feature B

Feature B consists of a terrace with a level paved area running north-south to the south of Feature A (see Figure 51). The southern end of the terrace has been severely impacted by bulldozing associated with southern access road along the parcel boundary. Feature B measures twenty-four meters long (north-south) by up to four meters wide. It is constructed of loosely stacked/piled medium to large sized cobbles against north/south trending natural bedrock. In the central portion of Feature B a pavement is present along the eastern edge of the terrace that measures three meters (east-west) by four meters (north-south) and has a level cobble covered surface. The western edge of the pavement consists of two courses of stacked *pāhoehoe* cobbles, standing up to 0.5 meters tall. Along the *mauka*, eastern edge, the pavement surface stands 0.2 meters above the soil ground surface (Figure 54). This level paved area was likely used for Precontact habitation purposes. At the north end of the pavement, within the terrace, two upright slabs are set 0.8 meter apart with small cobble paving between them (Figure 55). The slabs may be lining the sides of a *mauka-makai* path (although no such path could be traced across the surrounding ground surface) that allowed for access to either side of Feature B and the paved habitation area. Level areas to the east and west of Feature B may have also been used for habitation purposes, although modifications or cultural deposits were observed at these locales. Based on the association of the two features and their similar construction styles, it is likely that the habitation that occurred at Feature B, was temporally and functionally associated with the burial at Feature A.

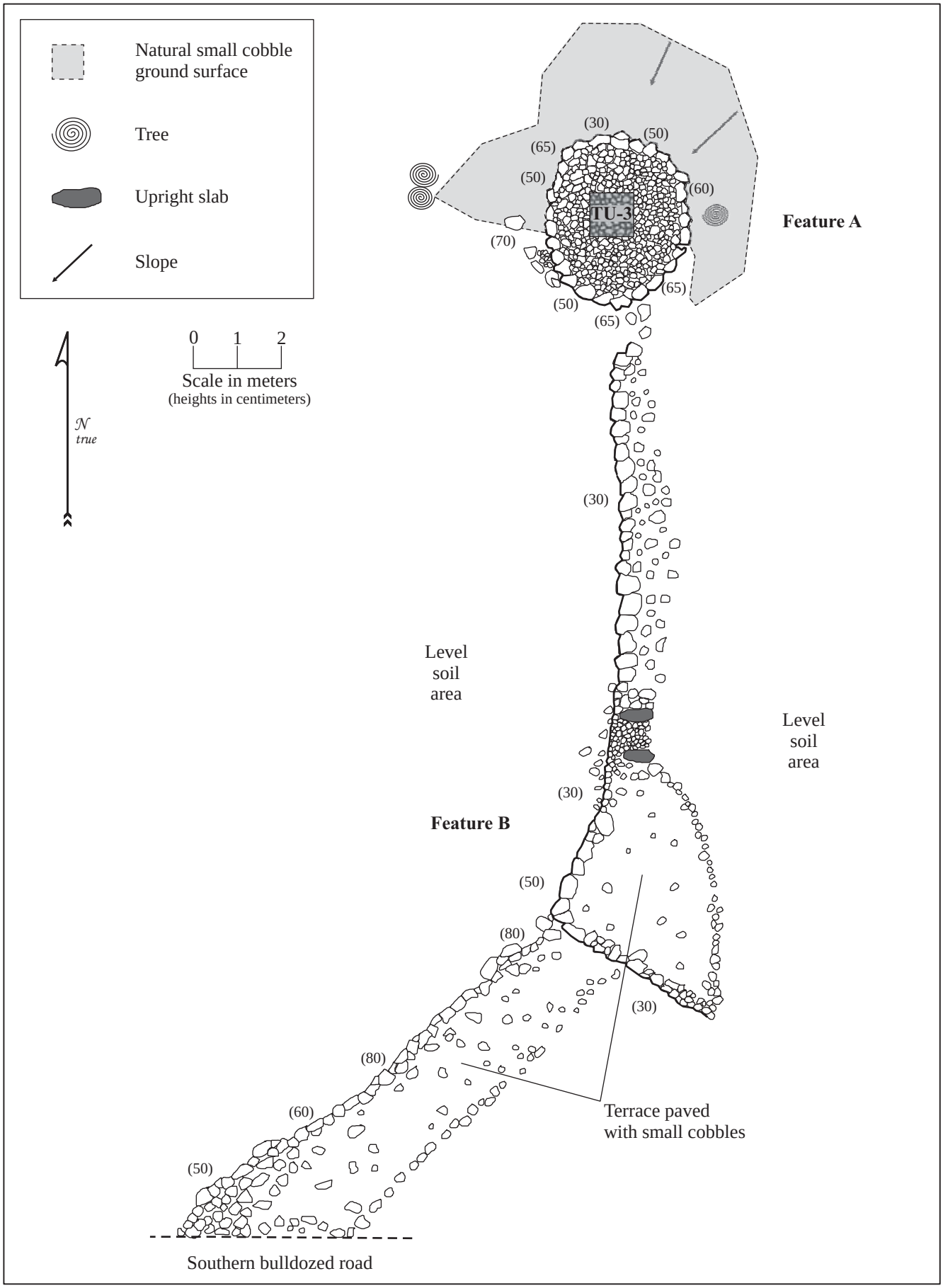


Figure 51. SIHP Site 16128 plan view.

Figure 52. SIHP Site 16128 Feature A, view to the northeast.

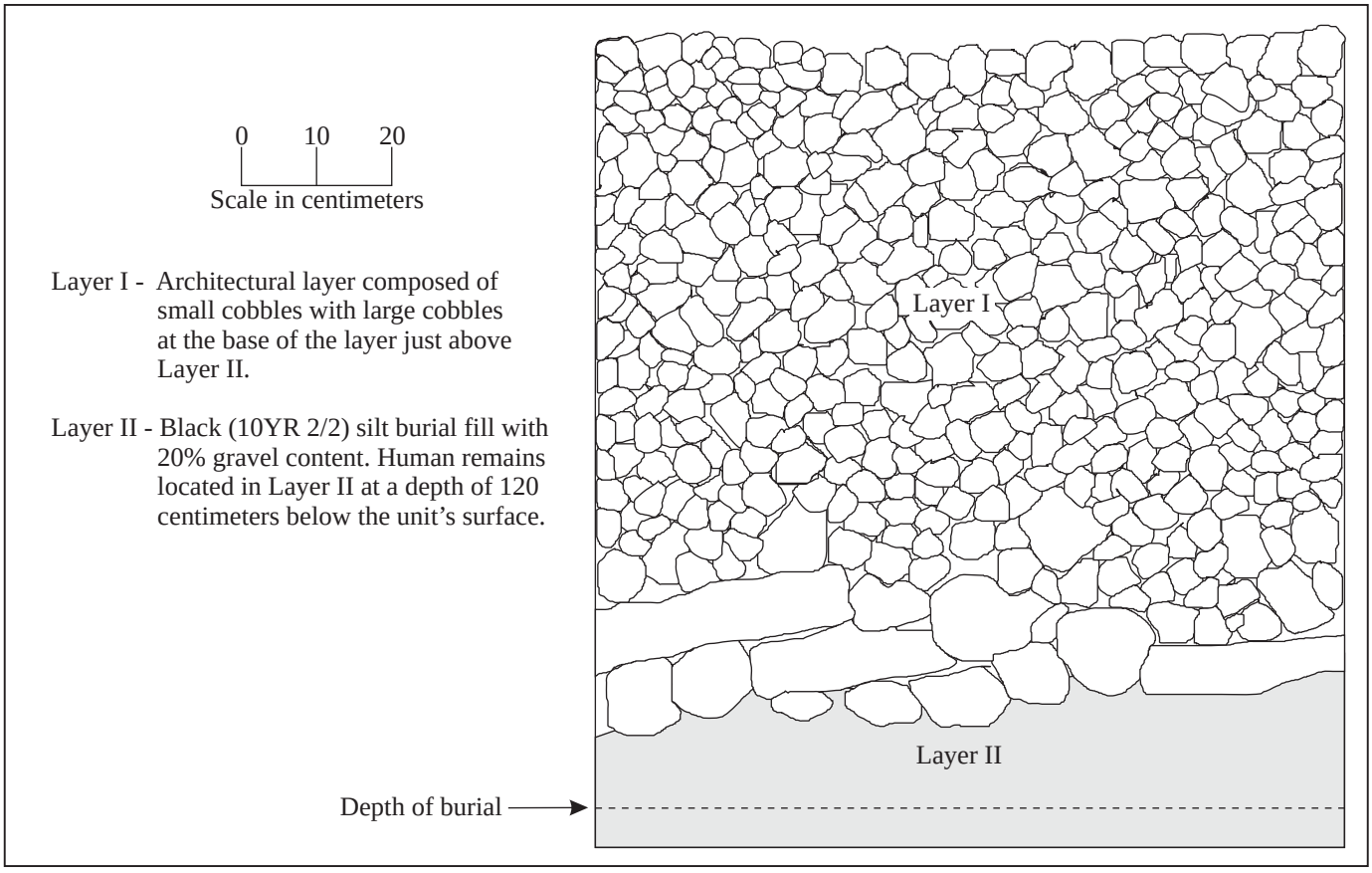


Figure 53. SIHP Site 16128 Feature A TU-3 north wall profile.

Figure 54. SIHP Site 16128 Feature B stacking along its western edge, view to southeast.

Figure 55. SIHP Site 16128 Feature B upright slabs, view to southeast.

SIHP Site 16131

Site 16131 consists of a lava tube that was utilized for Precontact habitation purposes, located in the southwestern portion of the project area (see Figure 15). This site was originally recorded by Drolet and Schilz (1991) (see Appendix A). The lava tube has two entrances leading to a single sub-surface passageway that ends in collapse to both the east and the west (Figure 56). The overall length of the accessible portion of the lava tube is 180 meters. The tube is the *mauka* extension of Site 25069, and the *makai* extension of Sites 24424 and 25060, all lava tubes that were once part of the same system; collapse has blocked off the tube system in places, breaking it up into segments that are not accessible between one another. For this reason the segments are discussed as separate sites in this report, Site 16131 being one of the segments. Based upon surface cultural debris and formal feature types within the lava tube, it appears that Site 16131 was used primarily for Precontact habitation purposes with associated water collection activities also taking place. The features of Site 16131 are in fair condition and the lava tube retains integrity of setting.

The *makai* entrance to Site 16131 is accessed through a collapsed section of ceiling that measures 4.4 meters in diameter (Figure 57). The primary habitation at this site appears to have taken place in and around this tube entrance. In this area Site 16131 contains a platform located directly below the *makai* entrance (Feature A), a smaller adjacent platform (Feature B), four enclosures (Features C, E, H, and I), three circular depressions (possible hearths; Feature D), and three pavement features (Features F, G, and J). A fifth enclosure (Feature K) is located slightly further into the tube thirty meters east of the *makai* entrance (see Figure 56). In addition to these features twenty-three water collection features (Features L-1 through L-23) were recorded at various locations throughout the lava tube (see Figure 56). Each of the features of Site 16131 are described in detail below and their locations are depicted in Figure 53.

The tube continues east/northeast from Feature K for 112 meters (see Figure 53). The segment from Feature K to a collapse across the tube is 54 meters long, and has two areas that divide into two narrow tubes. In this segment several water collection features were observed, mostly on the north side of the tube. The ceiling in this section averages two meters tall, and the floor is bedrock with areas covered in cobbles and boulders that have collapsed. A collapsed area that nearly blocks off the cave with rubble is located at the eastern end of this segment. Two narrow passages were created by the removal of boulders and cobbles on the top (1.2 meters by 0.5 meter) and bottom (1.0 meter by 1.0 meter) of the rubble pile.

Beyond this, the tube continues to the east/northeast for 58 meters to the *mauka* entrance. In this section are several more water collection features and a cleared trail that leads to a long ramp that ascends to the *mauka* entrance. Twelve meters east of the collapsed section is a tube segment that extends twenty-eight meters to the south, and then terminates. A trail runs east of the collapsed section toward the *mauka* entrance. In areas the trail is lined with small boulders that were probably cleared from the center. The trail leads to the base of a soil ramp that is lined with small boulders. The ramp steeply ascends ten meters to a *mauka* entrance that measures 2.0 meters by 1.0 meter (Figure 58).

Feature A

Feature A is a platform constructed 1.2 meters below the collapsed ceiling opening at the *makai* entrance to the lava tube (see Figure 57). The entry down onto the platform is on the northern edge of the sink via cobbles that have been stacked atop the platform (Figure 59). The cobble stack measures one meter by two meters and is 1.2 meters tall. The platform measures ten meters by ten meters and consists of a small cobble paved level surface, with larger cobbles on the periphery; a soil accumulation area is located on the eastern side. The western edge of the platform is a large cobble wall that extends across the 9-meter width of the tube, and is 1.4 meters tall on the western edge, and 0.35 meter tall on the eastern/platform side. In the center of the tube on the western edge of the platform are steps that lead west to a trail. The eastern edge of the platform is stacked large cobbles 0.95 meter tall. A ramp leads down from the platform on the eastern edge to a trail that is lined with upright slabs to the east, and a trail that wraps around the platform's southern edge to the west. The trail is 11.4 meters long (east-west) by approximately 1.5 meters wide. The platform probably functioned as a temporary habitation, and was opportunistically placed below the ceiling collapse to aid in entering the tube and to shelter it.

Figure 58. SIHP Site 16131 *mauka* entrance from outside tube, view to the south.

Figure 59. SIHP Site 16131, constructed step on top of Feature A below sink, view to the north.

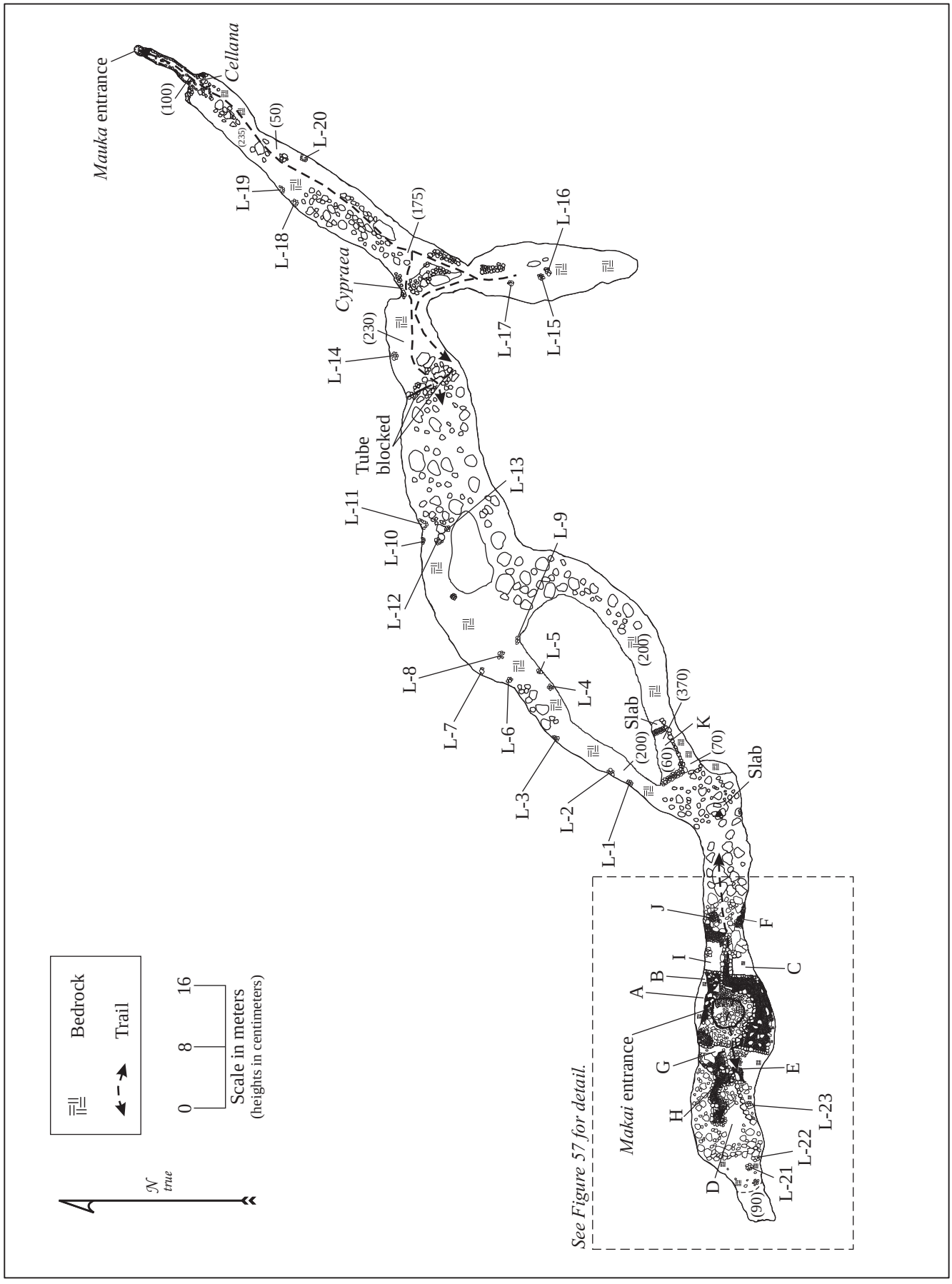


Figure 56. SIHP Site 16131 plan view.

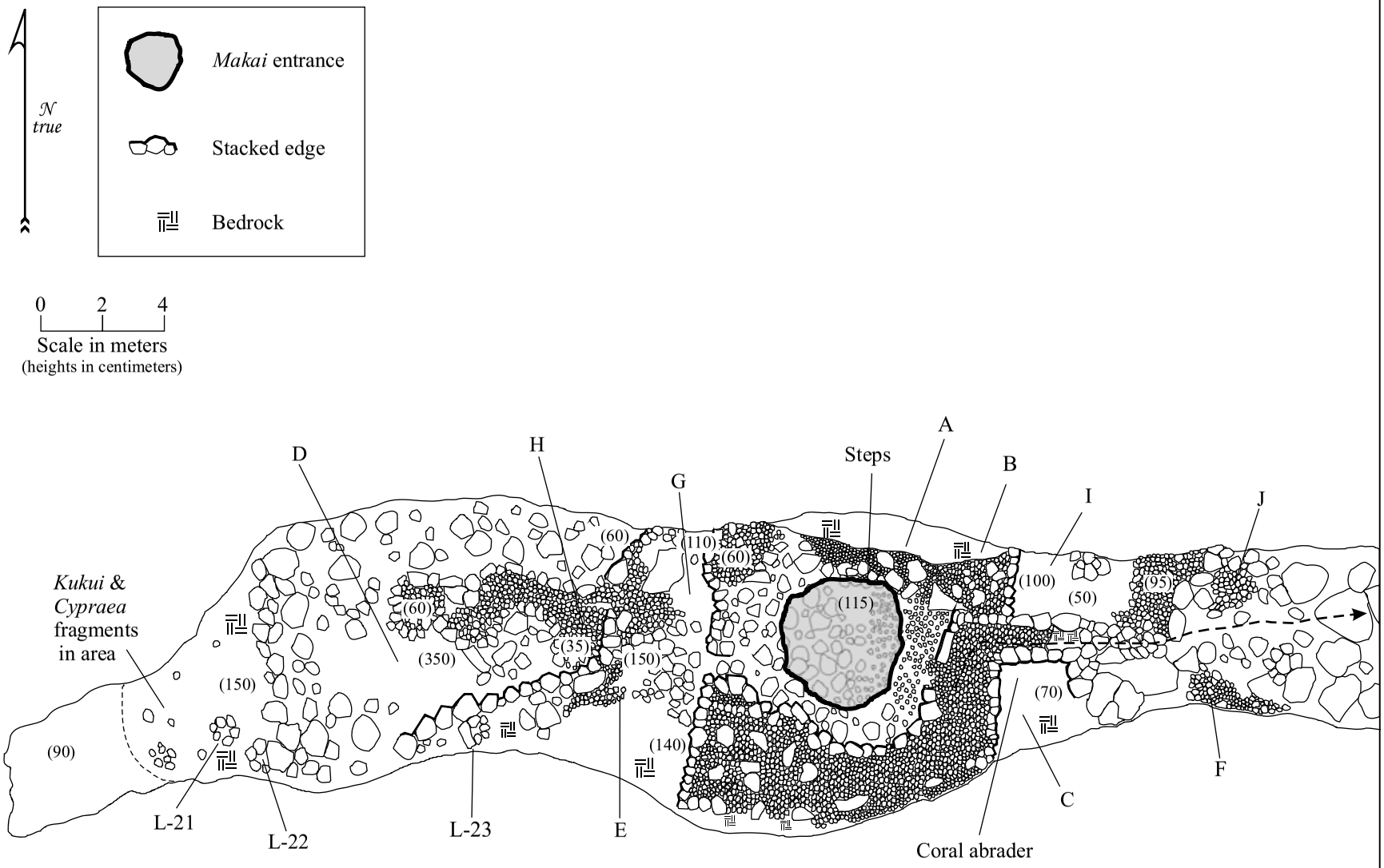


Figure 57. Detail of SIHP Site 16131 *makai* entrance and features.

Feature B

Feature B is a platform that is constructed off the northeastern corner of Feature A (see Figure 57). The platform measures 1.8 meters (north-south) by 1.4 meters (east-west), and is 1.0 meter tall on the eastern edge. The northern edge is constructed up to the north wall of the tube, and the western edge is constructed up to the eastern edge of Feature A. The southern edge of the platform is lined with large cobbles that separate it from the trail to the south. The top surface is level and paved with *pāhoehoe* slabs. This small platform is possibly a work surface or habitation related area.

Feature C

Feature C is the southern enclosure of two enclosures (the other being Feature I) that are bisected by an elevated trail located four meters east of the *makai* entrance to Site 16131 to east of Features A and B (see Figure 57). The enclosure measures 3.0 meters by 3.0 meters. The west wall of the enclosure is the eastern edge of Feature A, which stands 0.7 meter tall. The elevated trail that runs east/west through the center of the tube is 1.5 meters wide by 6 meters long, and composed of stacked large cobbles on the edges with small cobbles on the surface. The southern side of this trail stands 0.4 meters tall above the floor of Feature C. The eastern wall consists of unmodified rubble on the tube floor, and the southern wall consists of the bedrock wall of the lava tube. A coral abrader was discovered in the northwestern corner of the enclosure (Figure 60). The floor of the enclosure is relatively flat bedrock, with small cobbles and areas of charcoal-rich soil. Feature C possibly functioned as a habitation area and/or work area.

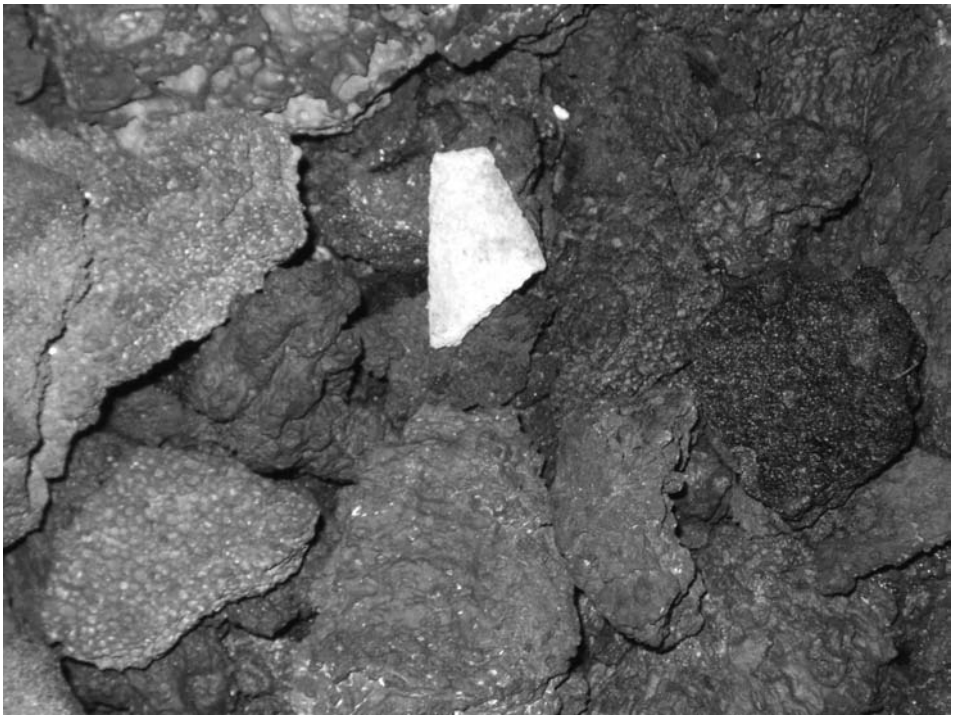


Figure 60. Coral abrader discovered in the northwestern corner of Feature C, overview.

Feature D

Feature D is a cluster of three circular, depressions in the center of the tube located approximately twelve meters west of the *makai* entrance (see Figure 57). Two of the features are side by side, and the third is located one-meter west. The eastern depressions are approximately 1.5 meters by 1.0 meter and are 0.6 meter below the cobble tube surface. The bases of the depressions are paved with small cobbles and pebbles. The third depression is more crudely constructed with small boulders; it measures 1.0 meter by 1.1 meters and is 0.3 meter deep. In the center of this depression is a crack that measures 0.15 meter by 0.4 meter with a depth of 0.8 meter. The depressions in the cobble ground surface may have functioned as fire pits, suggested by heavy charcoal deposits were observed in and around the features.

Feature E

Feature E is an enclosure located on the southern side of the tube, west of Feature A (see Figure 57). The enclosure is three meters wide at the eastern end, and two meters wide at the western end, by 4.5 meters long. The eastern edge of the enclosure is the southern extension of the western wall of Feature A. This stacked large cobble wall is 1.4 meters tall; on the northern end is a roughly stepped trail/ramp that descends to the west along the northern edge of the enclosure. The northern wall of the enclosure is a stacked small boulder and large cobble wall standing 1.5 meters tall, and the southern wall of the enclosure is the southern wall of the tube. The floor of the enclosure is level and paved with small cobbles. The enclosure may have been used as a habitation area for conducting daily activities.

Feature F

Feature F is the southern pavement of two adjacent pavements (the other being Feature J) located on the north and south sides of the tube, ten meters east of the *makai* entrance (see Figure 57). This pavement is located along the southern tube wall, and is composed of small cobbles covering a level area that measures 3.0 meters (east-west) by 1.0 meter (north-south). Feature F was constructed to provide a level surface on which daily activities could be performed.

Feature G

Feature G is a level paved area located west of Feature A, three meters west of the *makai* entrance (see Figure 57). The paved area measures 6.0 meters by 8.0 meters, and the northern side of the pavement is built up 0.8 meters with large boulders. The pavement surface is composed of small cobbles and pebbles. The area was probably a surface on which daily activities were performed.

Feature H

Feature H is an enclosure located west of Feature G, six meters west of the *makai* entrance (see Figure 57). The enclosure measures 3.0 meters (east-west) by 2.0 meters (north-south). The eastern edge is 0.3 meter below the surface of Feature G, on the northern edge boulders are stacked up to 2.0 meters tall, the western side is 0.4-meter tall, and the southern wall is the northern wall of Feature E, which is 0.35 meter tall. The interior floor is level and composed of small cobble pavement; a trail passes through the enclosure that leads west to Feature D. The enclosure may have been used as a habitation area for conducting daily activities in.

Feature I

Feature I is the northern enclosure of two enclosures (the other being Feature C) that are bisected by an elevated trail located four meters east of the *makai* entrance to Site 16131 to east of Features A and B (see Figure 57). The enclosure measures 2.0 meters by 3.5 meters. The west wall of each enclosure is the eastern edge of Feature A, which stands 1.0 meter tall. The elevated trail that runs east/west through the center of the tube is 1.5 meters wide by 6.0 meters long, and composed of stacked large cobbles on the edges with small cobbles on the surface. The northern side stands 0.5 meters tall above the floor of Feature I. The eastern wall consists of unmodified rubble on the tube floor, and the northern wall consists of the bedrock wall of the lava tube. A possible water collection feature composed of stacked slabs and cobbles is located adjacent the northern tube wall of Feature I. The floor of the enclosure is relatively flat bedrock, with small cobbles and areas of charcoal-rich soil. This low enclosure possibly functioned as a habitation and/or work area.

Feature J

Feature J is the northern pavement of two adjacent pavements (the other being Feature J) located on the north and south sides of the tube, ten meters east of the *makai* entrance (see Figure 57). This pavement is along a 0.95 meter tall stacked edge of cobbles that makes up the eastern edge of the northern enclosure of Feature I. It measures 2.0 meters by 2.0 meters and is composed of small cobbles. Feature JF was constructed to provide a level surface on which daily activities could be performed.

Feature K

Feature K is an enclosure located approximately 30 meters east of the *makai* entrance to Site 16131 (see Figure 57). The feature is constructed off the northern wall of the southern tube of a confluence where the tube has diverged into two passageways and then come back together. The enclosure measures 8.0 meters (east-west) by 5.0 meters (north-south), with 0.6-meter high stacked walls on the south and west sides. The eastern wall is broad and level, with a paved surface measuring 2.0 meters by 2.0 meters by 0.6 meter tall along the interior edge of the enclosure. The southern and western walls consist of unmodified cobble rubble on the tube floor (Feature K has been cleared out of this rubble). The northern wall consists of the bedrock wall of the lava tube. The floor of the enclosure is mostly paved with small cobbles, but has patches of exposed bedrock, and soil with heavy charcoal content. The enclosure probably functioned as a habitation area.

Feature L

Feature L consists of twenty-three water collection features that are located throughout the sub-surface portion of Site 16131 (see Figure 56). The features take two forms (either oval or circular rings—Figure 61, or rock stacks or piles against the tube wall). These informal rock constructions appear to have supported containers used to hold water that dripped from the tube ceiling. A large amount of charcoal and several burned *kukui* fragments were observed on the tube floor in the vicinity of these presumed water collection features. The proximity of the charcoal deposits to the recorded features seems to indicate that light sources were placed next to the water collection features during the process of gathering water. Each of the water collection features (Features L-1 through L-23) are summarized in Table 4 and their locations are shown in Figure 56.

Figure 61. SIHP Site 16131 Feature L-21 water collection rock ring, view to the southwest.

Table 4. Water collection features recorded as Feature L of SIHP Site 16131.

Feature #	*Length (cm)*	*Width (cm)*	*Height (cm)*	*Description*
L-1	110	40	56	Slabs piled against tube wall creating small level area for water; 12 slabs.
L-2	100	60	10	Semi-circular ring against wall constructed of 15 cobbles.
L-3	40	30	20	5 cobbles piled at an active drip location.
L-4	60	80	30	4 medium cobbles stacked against a large flat boulder at an active drip location.
L-5	50	30	65	Piled medium cobbles against tube wall; constructed of 15 cobbles.
L-6	55	30	40	6 medium cobbles slabs stacked against tube wall at a drip location.
L-7	65	45	25	3 cobbles & 1 slab create a flat surface at a drip location. Built up on tube shelf.
L-8	60	60	20	Circular ring on tube floor; constructed of 12 cobbles, at an active drip location.
L-9	40	40	25	8 medium cobbles against the tube wall at a drip location.
L-10	45	30	15	8 cobbles piled against the sloping side of tube at an active drip location.
L-11	85	65	35	20 cobbles piled against the tube wall creating a level space at an active drip location.
L-12	70	70	25	6 large cobbles in a circular ring on the tube floor at an active drip location.
L-13	85	60	20	20 small to medium cobbles stacked against the tube wall.
L-14	60	40	50	25 cobbles stacked against tube wall.
L-15	85	60	15	Medium cobbles in a circular ring 1 course high.
L-16		50	20	2 courses of medium cobbles and slabs in a circular stacked ring (concave on top) at a drip location.
L-17	70	50	25	Semi-circular ring piled against tube wall at a drip location.
L-18	55	70	10	15 small cobbles piled near the tube wall.
L-19	110	60	23	12 medium slabs piled against the tube wall; C-shaped.
L-20	130	60	30	30 medium slabs piled against the tube wall; C-shaped.
L-21	60	60	20	1-course of medium cobbles in a ring on the bedrock tube floor.
L-22	60	60	15	1-course of medium cobbles in a ring on the bedrock tube floor.
L-23	200	50	35	Boulders stacked up against the vertical bedrock southern wall of the tube.

SIHP Site 24424

Site 24424 is a large lava tube that runs for approximately 260 meters beneath the east-central portion of the current study parcel (see Figure 15). The entrance to the lava tube is located 45 meters west of the eastern bulldozer road in the center of the current study area. Site 24424 extends also 55 meters east beneath the adjoining parcel (TMK: 3-7-3-07:38), and was originally reported on during an inventory survey of that parcel (Clark and Rechtman 2005a). Based on artifacts and features recorded within the lava tube, it appears that Site 24424 was used primarily for water collection during Precontact and early Historic times, but may have also had a Precontact habitation component. The features of the site are in fair condition and the lava tube itself retains integrity of setting.

The *mauka* opening to Site 24424 is rather deep and requires a ladder to enter it (Figure 62). The opening measures 2.8 meters long by 1.0 meter wide and it drops approximately 4.0 meters to the tube floor below. Once inside the lava tube a broad subsurface passageway leads both *mauka* and *makai*. Overall the lava tube extends for a distance of approximately 315 meters (115 meters *mauka* and 200 meters *makai* from the *mauka* entrance) in an easterly/westerly direction (at 254º/74º).

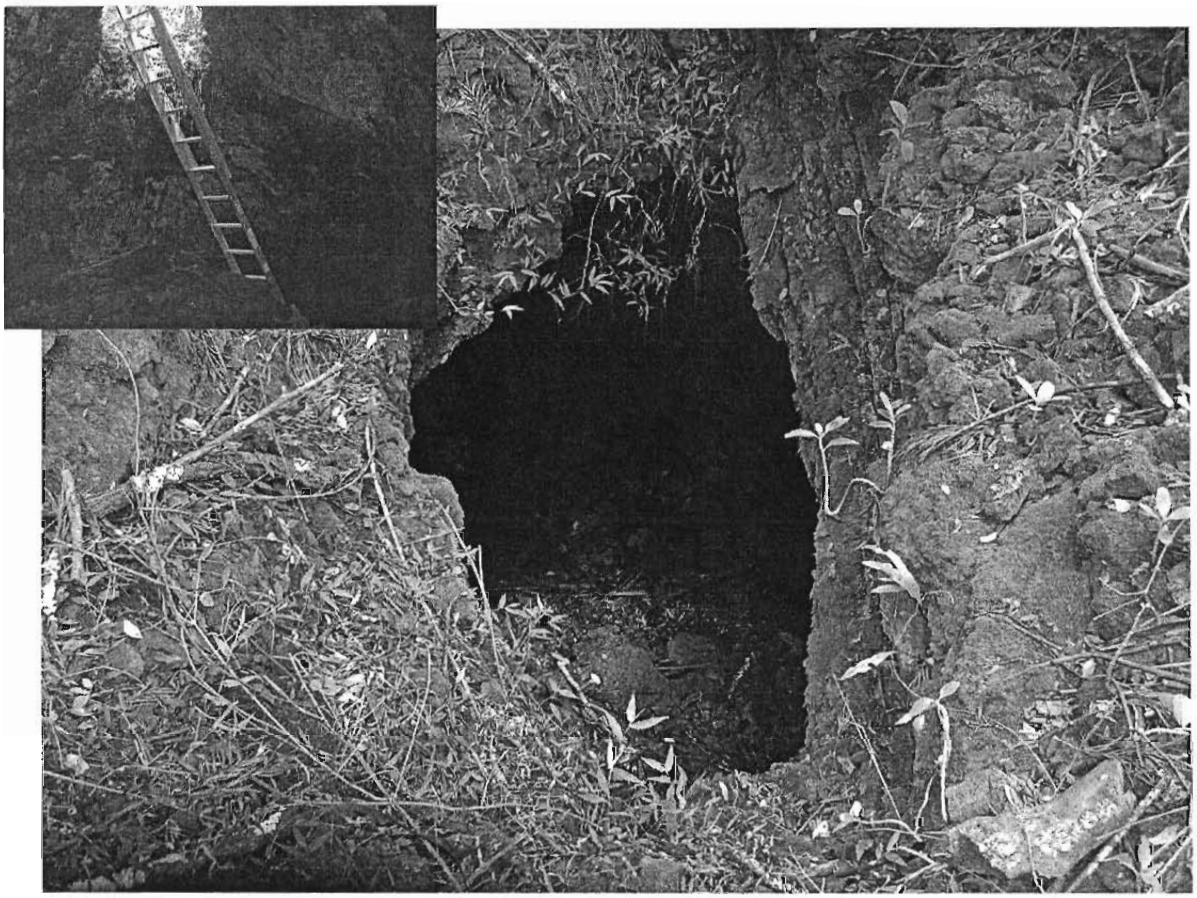


Figure 62. SIHP Site 24424, exterior overview (and interior inset) of tube entrance to west.

As a result of the earlier survey, twenty-three features were recorded east of the *mauka* entrance (the location of each of these features is shown in Figure 63, and they are each discussed in detail below). The features included two trail segments (Features 7 and 11), one of which leads up an earthen ramp to what appears to be a filled in entrance (Feature 7), and twenty-one small rock rings or small rock piles that are invariably located beneath water dripping from the tube ceiling (Features 1-6, 8-10, and 12-24). During the current study, eight other features were recorded west of the *mauka* entrance to the lava tube including four terraces (Features 24-27), and four water collection features (Features 28-31). Features 24-27 are located within ten meters of the *mauka* entrance, and Features 28-31 are located in a concentration approximately sixty meters west of the *mauka* entrance. These informal rock constructions appear to have supported containers used to hold the dripping water (Figure 64). A large amount of charcoal and several burned *kukui* fragments were observed on the tube floor, primarily in the vicinity of these presumed water collection features. The proximity of the charcoal deposits to the recorded features seems to indicate that light sources were placed next to the water collection features during the process of gathering water. In addition to the charcoal and *kukui*, a single marine shell fragment (*Cypraea*), a coral fragment, and three isolated artifacts were also discovered within the Site 24424 lava tube.

The isolated artifacts discovered at Site 24424 included a basalt abrader and two broken glass bottles (see Figure 63). The basalt abrader consists of a nearly perfectly round disk with two flat sides (Figure 65). It measures 6.4 centimeters in diameter by 4.5 centimeters thick. Two identical broken Historic bottles were also discovered within Site 24424; both are dark green glass with round, punted bases and applied double bead finishes (Figure 66). Bottles exhibiting these characteristics were typically manufactured during the early 19th century. The presence of the broken bottles within the lava tube seems to indicate that Site 24424 was used into Historic times for water collection purposes. Detailed feature descriptions of all the features of Site 24424 follow below.

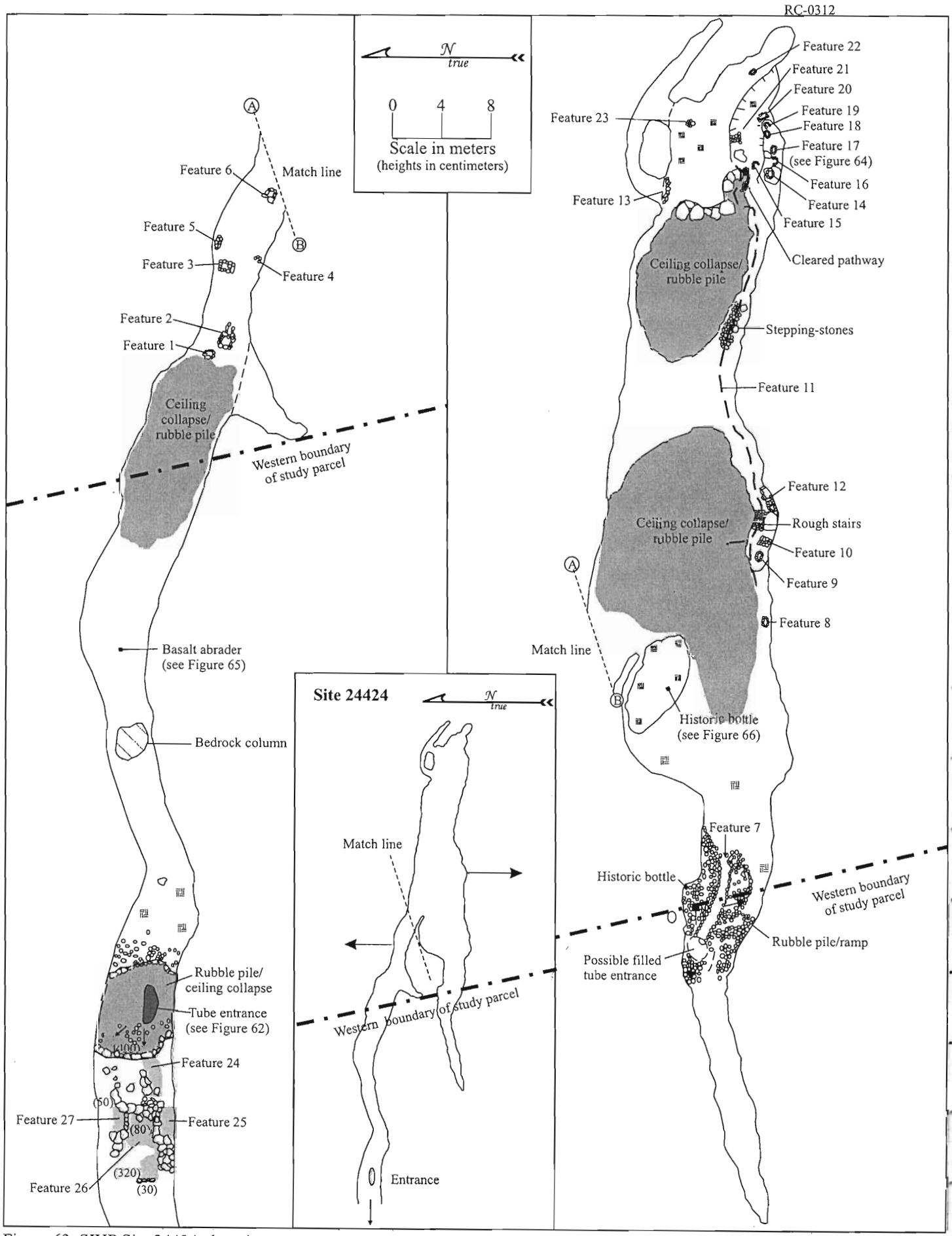


Figure 63. SIHP Site 24424 plan view.

Figure 64. SIHP Site 24424, typical water collection feature (Feature 17), view to southwest.

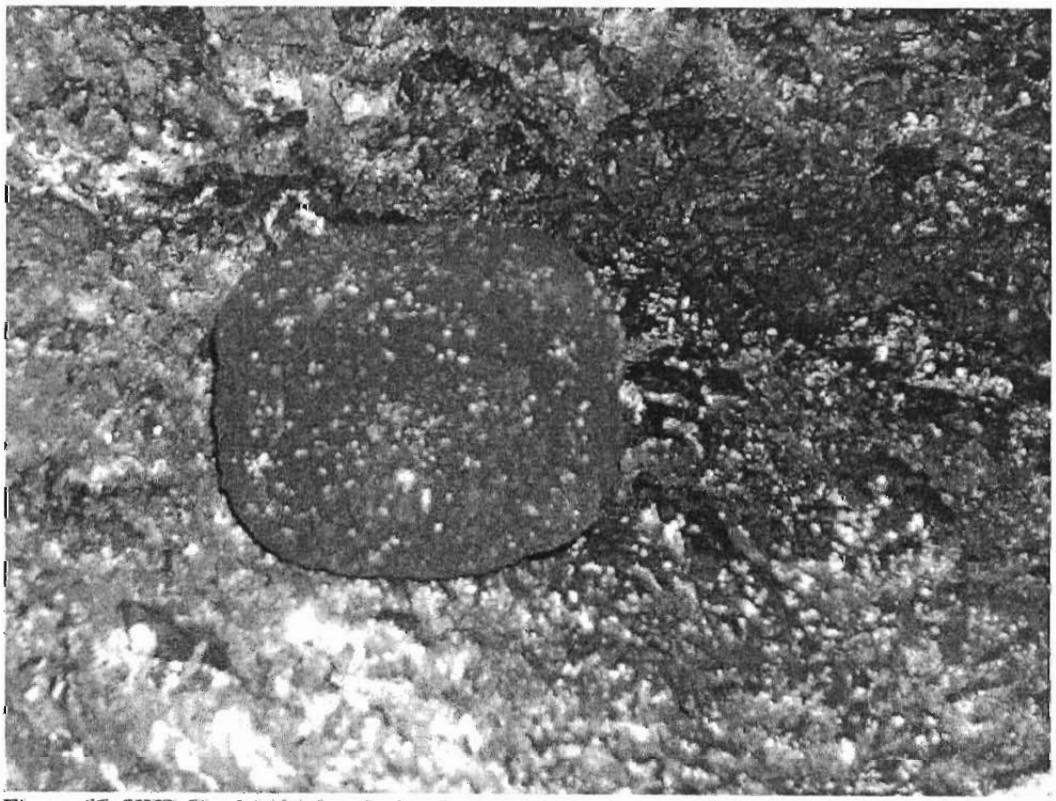


Figure 65. SIHP Site 24424, basalt abrader, overview.

Figure 66. SIHP Site 24424, Historic bottle neck, overview.

Feature 1

Feature 1 is a circular ring of small to medium sized cobbles standing one course high by 90 centimeters in diameter that is located in the center of the tube floor (see Figure 63). The ring is located beneath dripping water and charcoal is present on the floor surrounding it. Feature 1 appears to have been used for water collection purposes.

Feature 2

Feature 2 is a roughly square alignment of small to medium sized cobbles with some long slabs present that stands a single course high. A short, double alignment of cobbles also extends east from the eastern edge of the square shape. Feature 2 has the overall dimensions of 1.8 meters long by 1.3 meters wide. The ring is located beneath dripping water to the east of Feature 1 and charcoal is present on the floor surrounding it (see Figure 63). Feature 2 appears to have been used for water collection purposes.

Feature 3

Feature 3 is a roughly rectangular single-course alignment of medium sized cobbles and slabs measuring 1.3 meters long by 0.6 meters wide. It is located along the northern edge of the tube beneath dripping water (see Figure 63). Feature 3 appears to have been used for water collection purposes.

Feature 4

Feature 4 is a semi-circular alignment of four medium sized cobbles located along the southern edge of the tube beneath dripping water (see Figure 63). Feature 4 measures 0.5 meters in diameter and was likely used for water collection purposes.

Feature 5

Feature 5 consists of slabs stacked against the sloped northern edge of the tube beneath dripping water (see Figure 63). Feature 5 creates a mini-terrace against the bedrock tube wall (0.4 meters tall) with a level surface that measures by 1.0 meter long by 0.5 meters wide. Feature 5 appears to have been used for water collection purposes.

Feature 6

Feature 6 is a roughly rectangular, single-course alignment of medium sized cobbles and slabs measuring 0.9 meters long by 0.5 meters wide. It is located in the center of the tube on the bedrock floor beneath dripping water (see Figure 63). Charcoal is located all around the alignment. Feature 6 appears to have been used for water collection purposes.

Feature 7

Feature 7 is a trail segment that leads up a rubble ramp to a possible filled in surface access in the southern portion of Site 24424 (see Figure 63). The trail segment measures 7.0 meters long by 1.0 meter wide. It leads west from the bedrock floor of the lava tube at its eastern end up a sloped rubble pile to what appears to be a filled in former tube entrance. The filled entrance is located nearly 2.5 vertical meters above the tube floor near the tube ceiling. Feature 7 consists of a cleared soil pathway in the rubble pile that is lined on both sides by the cleared cobbles. A *Cypraea* shell fragment, coral, burned *kukui*, and charcoal was discovered at the eastern end of Feature 7, and a broken Historic bottle was found along the tube wall to the north of the feature.

A similar trail segment, leading up a rubble ramp to a narrow tube entrance, was observed within another lava tube on the current study parcel (Site 16131). That tube entrance appeared to have been excavated through a naturally rubble filled collapse to create a passageway. A surface projection of the possible filled entrance within Site 24424 places Feature 7 beneath the eastern bulldozed roadway approximately ten meters west of Site 16125 (the eastern boundary wall) within the current study area. The area where the filled entrance should have reached the surface was thoroughly inspected, but no sign of a lava tube opening was encountered. It is likely that the entrance was obscured by a bulldozer when the 4WD road was created on TMK:3-7-3-009:007. When at Feature 7 within Site 24424, vehicle traffic on the 4WD road sounds as though it is right above the entrance and the weight of the vehicle causes the tube ceiling to shake ominously.

Feature 8

Feature 8 is an oval ring of small to medium sized cobbles standing one course high that is located along the southern edge of the tube (see Figure 63). The ring measures 1.0 meter long by 0.6 meters wide. It is located beneath dripping water and charcoal is present on the floor surrounding it. Feature 8 appears to have been used for water collection purposes.

Feature 9

Feature 9 is an oval ring of small to medium sized cobbles standing one course high that is located along the southern edge of the tube (see Figure 63). The ring measures 1.0 meter long by 0.6 meters wide. It is located beneath dripping water and charcoal is present on the floor surrounding it. Feature 9 is nearly identical to Feature 8, and it too appears to have been used for water collection purposes.

Feature 10

Feature 10 is a rectangular construction of piled small to large size cobbles located against the southern edge of the lava tube (see Figure 63). The feature is raised above the tube floor on three sides and it measures 1.3 meters long by 1.0 meter wide and stands up to 30 centimeters tall. It is located beneath dripping water and charcoal is present on the tube floor nearby. Feature 10 appears to have been used for water collection purposes.

Feature 11

Feature 11 is a trail segment located along the southern edge of the lava tube near its eastern end (see Figure 63). The logical route of the trail is traceable between Features 10 and 14, but the actual route could only be positively identified in three sections. A two-meter long section of trail is present at the eastern end of Feature 11 where large cobbles and slabs from a ceiling collapse have been moved to either side of the pathway, creating a cleared space (0.5 meters wide) of small cobbles that allows for easy pedestrian travel. A second, four-meter long section of trail in the central portion of Feature 11 consists of flat-laid slabs across a rubble area. The third traceable section of trail is located at the western end of Feature 11 where two rough steps have been created to allow for easier access up the steep slope of a large pile of collapsed ceiling material. The remaining portions of Feature 11 were likely present on the exposed bedrock floor of the lava tube, or covered over by a more recent ceiling collapse, and are therefore not traceable. It is probable that the trail once connected one of the two (or both) possible entrances to the lava tube with all the water collection features.

Feature 12

Feature 12 is a roughly rectangular, single-course alignment constructed of upright angular slabs and cobbles. The feature is segmented into two adjoining sections by an upright slab. The eastern section measures 1.2 meters long by 0.6 meters wide, while the western section measures 1.7 meters long by 0.7 meters wide. Feature 12 is located along the southern edge of the lava tube beneath dripping water, and charcoal is located all around the alignment (see Figure 63). Feature 12 appears to have been used for water collection purposes.

Feature 13

Feature 13 is a curvilinear alignment of cobbles located along the northern edge of the lava tube where it branches (see Figure 63). The alignment measures 2.0 meters long by a single course high, and is constructed on the exposed bedrock floor of the tube. The function of Feature 13 is uncertain. It may have been used for water collection purposes (dripping water is present), or it could mark the route of Feature 11 (a trail).

Feature 14

Feature 14 is an oval ring built on top of a large boulder along the southern edge of the lava tube beneath dripping water (see Figure 63). The feature is constructed of a single course of small to medium sized cobbles. It measures 1.0 meter long by 0.7 meters wide. Charcoal is present on the large boulder and within the ring. Feature 14 appears to have been used for water collection purposes.

Feature 15

Feature 15 is an oval ring of small to medium sized cobbles standing one course high that is located along the southern edge of the tube on elevated bedrock (see Figure 63). The ring measures 0.9 meters long by 0.6 meters wide. It is located beneath dripping water and charcoal is present on the floor surrounding it. Feature 15 appears to have been used for water collection purposes.

Feature 16

Feature 16 is an oval ring of small to medium sized cobbles standing one course high that is located along the southern edge of the tube near its eastern end (see Figure 63). The ring measures 1.3 meters long by 0.7 meters wide. It is located beneath dripping water and charcoal is present on the floor surrounding it. Feature 16 appears to have been used for water collection purposes.

Feature 17

Feature 17 is an oval ring of small to medium sized cobbles standing one course high that is located along the southern edge of the tube near its eastern end (see Figure 63). The ring measures 1.1 meters long by 0.5 meters wide. It is located beneath dripping water and charcoal is present on the floor surrounding it. Feature 17 appears to have been used for water collection purposes.

Feature 18

Feature 18 is an oval ring of small to medium sized cobbles standing one course high that is located along the southern edge of the tube near its eastern end (see Figure 63). The ring measures 1.0 meter long by 0.7 meters wide. It is located beneath dripping water and charcoal is present on the floor surrounding it. Feature 18 appears to have been used for water collection purposes.

Feature 19

Feature 19 is a semi-circular alignment of small to medium sized cobbles standing one course high that is located along the southern edge of the tube in a small alcove (see Figure 63). The alignment measures 0.6 meters long by 0.4 meters wide. It is located beneath dripping water and charcoal is present on the floor surrounding it. Feature 19 appears to have been used for water collection purposes.

Feature 20

Feature 18 is an oval ring of small to medium sized cobbles located along the southern edge of the tube near its eastern end beneath dripping water (see Figure 63). The ring measures 1.0 meter long by 0.8 meters wide. The feature is constructed on a sloped ground surface; the western side of the ring stands two courses high (up to 25 centimeters), while the eastern side is only a single course high. Charcoal is present on the tube floor in the vicinity of the ring. Feature 18 appears to have been used for water collection purposes.

Feature 21

Feature 21 is a roughly rectangular construction of piled small to large size cobbles located against sloped bedrock near the eastern end of the lava tube (see Figure 63). The feature is raised above the tube floor on three sides and it measures 1.0 meter long by 0.6 meters wide and stands up to 20 centimeters tall. It is located beneath dripping water and charcoal is present on the tube floor nearby. Feature 21 appears to have been used for water collection purposes.

Feature 22

Feature 22 is an oval ring of small to medium sized cobbles standing one course high that is located near the eastern termination of the lava tube (see Figure 63). The ring measures 1.0 meter long by 0.7 meters wide. It is located beneath dripping water and charcoal is present on the floor surrounding it. Feature 22 appears to have been used for water collection purposes.

Feature 23

Feature 23 is a small pile of cobbles with two slabs present located on bedrock near the eastern termination of the lava tube (see Figure 63). The pile measures 0.8 meters long by 0.6 meters wide and it stands up to 0.3 meters above ground surface. It is located beneath dripping water and charcoal is present on the floor surrounding it. Although the central portion of Feature 23 is filled in, unlike most of the water collection features recorded at Site 24424, it too appears to have been used for water collection purposes.

Feature 24

Feature 24 is a level paved terrace located along the south wall of the tube just west of the base of the cobble slope below the entrance to the cave (see Figure 63). The feature measures 3.2 meters long by 1.1 meters wide, and has small boulders lining the northern edge, retaining small cobbles that pave the surface. Charcoal and *kukui* are present on the feature's surface; this feature appears to be a leveled terrace where daily activities, possibly associated with water collection, were conducted.

Feature 25

Feature 25 is a small terrace constructed between two collapsed ceiling boulders, on the southern edge of the cave (see Figure 63). The terrace measures 2.2 meters (east-west) by 1.1 meters (north-south), and has a height of 0.8 meters above Feature 26's surface to the south. The top surface is level and tightly paved with red pebbles

and small cobbles that are common, and naturally occurring, in this section of the lava tube. Feature 25 appears to be a possible habitation or work-related surface.

Feature 26

Feature 26 is a long terrace located between Features 25 and 27 in the center of the lava tube (see Figure 63). The terrace surface measures 5.0 meters (east-west) by 2.4 meters (north-south), being narrow on the western end. The west end is lined with four large cobbles aligned along the edge 0.3 meter tall, The surface is level and paved with small cobbles up to aligned large cobbles on the north edge, large ceiling boulders on the east side, and up to the base of the northern terrace wall (of Feature 25) on the southern side. This terrace is the middle level of 3 tiers of terraces that start with the upper (Feature 25) to the south, and the lower (Feature 27) to the north. Feature 26 appears to be a level work surface.

Feature 27

Feature 27 is a small terrace located north of Feature 26 along the northern edge of Site 24424 (see Figure 63). The terrace is rectangular and measures 1.0 meter by 2.0 meters. East and west of the paved surface is a pile of collapsed ceiling boulders. The surface is level and paved with small cobbles with a few small slabs.

Feature 28

Feature 28 is an oval ring of seven angular slabs and cobbles standing one course high on bedrock, located approximately 60 meters west of the *mauka* entrance, in the northern half of Site 24424 beneath dripping water (not shown in Figure 63; see Figure 15). The feature measures 0.9 meter wide by 1 meter long. Feature 28 appears to have been used for water collection purposes.

Feature 29

Feature 29 is a circular ring of seven medium sized cobbles standing on course high on rough bedrock cave floor beneath dripping water. Feature 29 is located three meters south of Feature 28 in the center of Site 24424 (see Figure 15). The feature measures 0.45 meters in diameter. This feature appears to have been used for water collection purposes

Feature 30

Feature 30 is a stacked slab and cobble shelf constructed on the sloping base of the cave wall along the northern side of Site 24424 beneath dripping water (located near the *makai*-most tube entrance;). Cobbles support large slabs that are laid flat to create a shelf measuring 1.2 meters long, by 0.35 meter tall, by 0.3 meter wide. Feature 30 appears to have been used for water collection purposes.

Feature 31

Feature 31 is a stacked slab and cobble shelf constructed on the sloping base of the cave wall, 0.4 meter south of Feature 30, on the northern side of Site 24424 beneath dripping water (located near the *makai*-most tube entrance; see Figure 15). Cobbles support large slabs that are laid flat to create a shelf measuring 0.6 meters long, by 0.35 meter tall, by 0.3 meter wide. Feature 31 appears to have been used for water collection purposes.

SIHP Site 25034

Site 25034 is a Historic habitation complex located approximately fifteen meters south of the northern bulldozer road in the western portion of the current study area (see Figure 15). The site consists of three features including a 3-sided, core-filled wall enclosure (Feature A), an L-shaped core-filled wall (Feature B), and an area of three quarried bedrock depressions (Feature C) (Figure 67). Site 25034 occupies a roughly forty meter by twenty-five meter area on an exposed *pāhoehoe* bedrock, thin soil, and strewn cobble ground surface. A Historic bottle was collected from Feature A, but no other cultural debris was observed on ground surface in the vicinity of the site. Based on the presence of this bottle, and the core-filled construction of the walls, it is likely that Site 25034 was used for Historic habitation or ranching related purposes. Features A and B may have formerly supported a roofed, wooden structure or structures. The features of Site 25034 are in fair condition and the site itself retains integrity of setting.

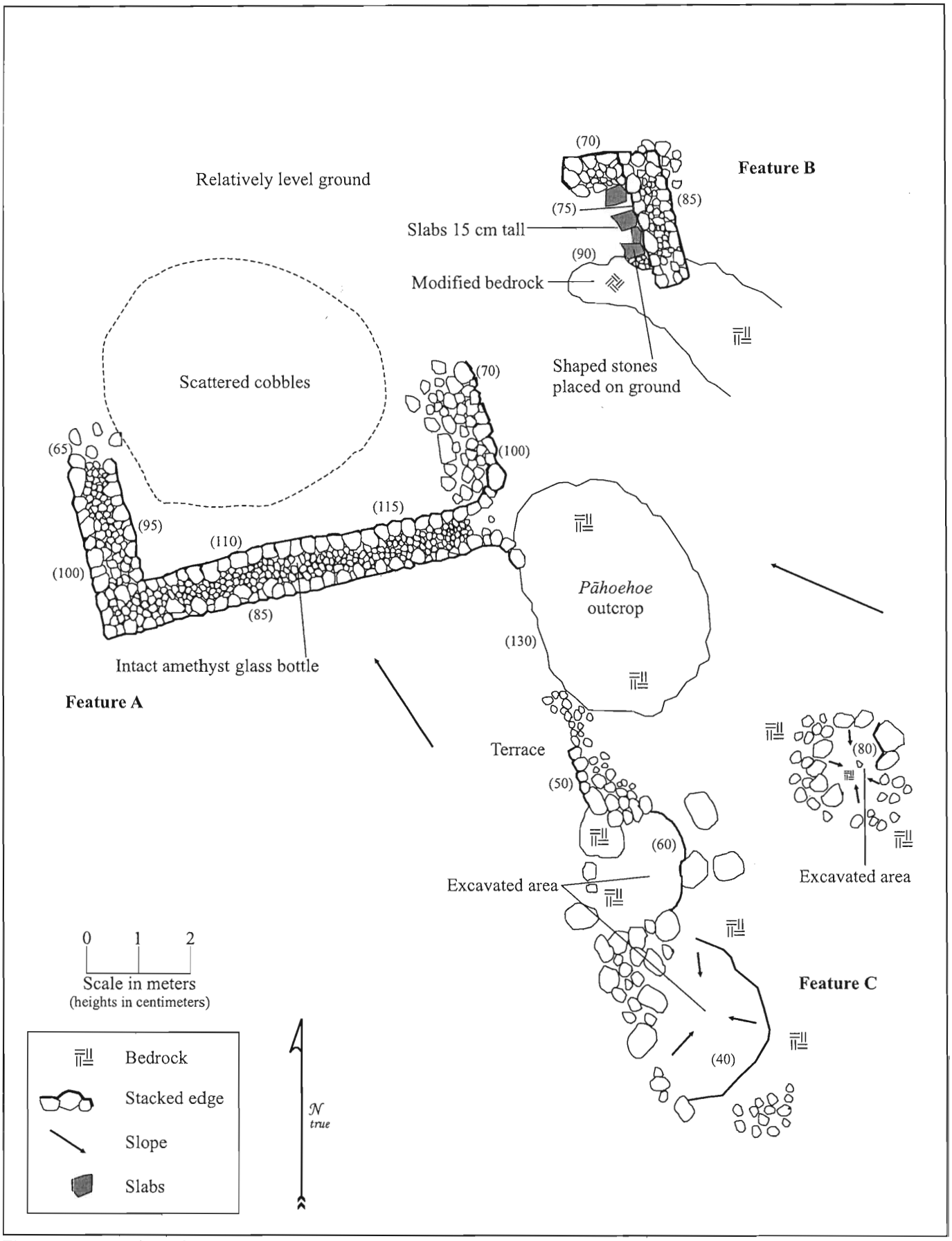


Figure 67. SIHP Site 25034 plan view.

Feature A

Feature A is a three-sided, core-filled wall enclosure that opens to the north and measures eight meters long by 2.5 meters wide (see Figure 67). The long wall of the enclosure runs east/west and is constructed along the northern edge of a slightly elevated bedrock and thin soil ground surface. Two short wall segments extend north from either end of the long segment. The wall is 0.9 to 1 meter wide, and is composed of large cobbles on the exterior, with small cobbles used in the center (core-filled). The eastern and western shorter segments were constructed as add-ons to the main long wall, and they taper down toward ground surface as they leave that wall. These segments were either never completed or have completely collapsed beyond 2.5 meters from the other wall. The central area of the enclosure contains scattered cobbles, likely naturally occurring and from wall collapse. The long wall is largely intact, and sands up to 1.15 meters (six courses) above ground surface along its northern edge, and 0.85 meters above ground surface along its southern edge (Figure 68). Ground surface to both the north and south of Feature A is fairly level and would have been suitable for housing a Historic structure. An intact amethyst bottle (ACC#079) was collected from the center of the east/west trending wall. The bottle measures 14.2 centimeters tall by 4.5 centimeters wide (Figure 69). It has a square base embossed with the number 63, rounded shoulders, a tooled prescription finish, and was manufactured in a two-piece bottle mold. Bottles of this type were typically produced for use in drug stores between 1880 and 1915. The bottle would have formerly had a paper label. Feature A probably functioned for ranching purposes as an animal enclosure, but it has been obliterated on the northern end by machinery.

Figure 68. SIHP Site 25034 Feature A, view to the east.

Feature B

Feature B is located 3.5 meters north of Feature A (see Figure 67). The feature consists of an L-shaped, core-filled wall constructed off the north end of a *pāhoehoe* bedrock outcrop to form a small three sided enclosure opening to the west. The feature measures 2.5 meters (north-south) by 2 meters (east-west), with an interior area that measures 1.5 meters (north-south) by 1.0 meter (east-west). The wall average 0.7 meters (three to four courses) tall. The outcrop on the southern side stands 0.9 meter tall, and has been somewhat squared off, through

the removal of loose cobbles, to create the southern bedrock wall of the enclosed area. Along the interior edge of the eastern wall five, naturally-square, basalt blocks have been placed on ground surface, with the two smaller blocks between three evenly spaced larger blocks (Figure 70). The blocks were certainly selected because of their desirable formal attributes, but were placed at Feature B for an undetermined purpose, perhaps for supporting wooden posts. Feature B may have supported a wooden structure, possibly the same structure as Feature A, or a smaller related outbuilding.

Figure 69. SIHP Site 25034, amethyst bottle (ACC#079) found at Feature A (actual size).

Feature C

Feature C consists of a concentration of three excavated depressions located south of Features A and B in the eastern portion of Site 25034 (see Figure 67). The depressions are located in a area of loose *pāhoehoe* cobbles and fractured *pāhoehoe* bedrock. The two westernmost depressions are located adjacent to one another along a raised, linear section of exposed bedrock six meters south of Feature A. the northern depression measures 2.0 meters in diameter and has a maximum depth of 0.6 meters, while the southern depression measures 3.0 meters in diameter and has a maximum depth of 0.4 meters. The third depression is located 2.5 meters east of the other two in an area of loose cobbles. This depression measures 2.0 meters in diameter and has a maximum depth of 0.8 meters. These excavated depressions likely represent areas where cobbles and slabs were taken from to construct Features A and B. No signs of quarrying are present at Feature C, so it is likely that only loose easily acquired materials where taken from the depressions.

Figure 70. SIHP Site 25034 Feature B, view to the east (note placed basalt blocks at the base of the wall).

SIHP Site 25035

Site 25035 is a complex of twelve features located in the north central portion of the project area, just *makai* of the bulldozed road that runs along the eastern parcel boundary (see Figure 15). The bulldozing of the road and the placement of modern wire fencing has impacted portions of this site. The complex consists of a large platform (Feature A), a constructed trail (Feature B), seven modified outcrops (Features C, D, G, H, J, K, and L), an enclosure (Feature F), a stacked mound (Feature I), and a pavement (Feature E) (Figure 71). The site is situated on moderately west-sloping terrain with a combination of *pāhoehoe* outcrops and relatively level natural shallow soil areas throughout. Vegetation in the vicinity includes Christmas-berry, *koa-haole*, weeping figs, silver oak, and mango trees, with ground cover of airplant, ferns, and various weeds. The overhead tree canopy shades the overall site, inhibiting extensive vegetation growth on the features. Feature A is more exposed as a result of prior bulldozing and thus exhibited a thick cover of airplants, which were clearing prior to mapping. The features of Site 25035 were grouped as a site based on their proximity to one another and seeming connectedness by a constructed pathway. The site occupies a roughly 40 by 40 meter area, and despite the prior bulldozing and fencing, is in relatively good condition as the architectural and spatial integrity of the extant features has been preserved. A rusted metal handle (perhaps from a teapot) and an adze fragment were collected from within the bulldozed roadway to the east of Feature A, but no other surface cultural debris was observed at the site. This site is interpreted as a Precontact habitation complex, with Feature A being the main residential platform. Detailed feature descriptions follow below.

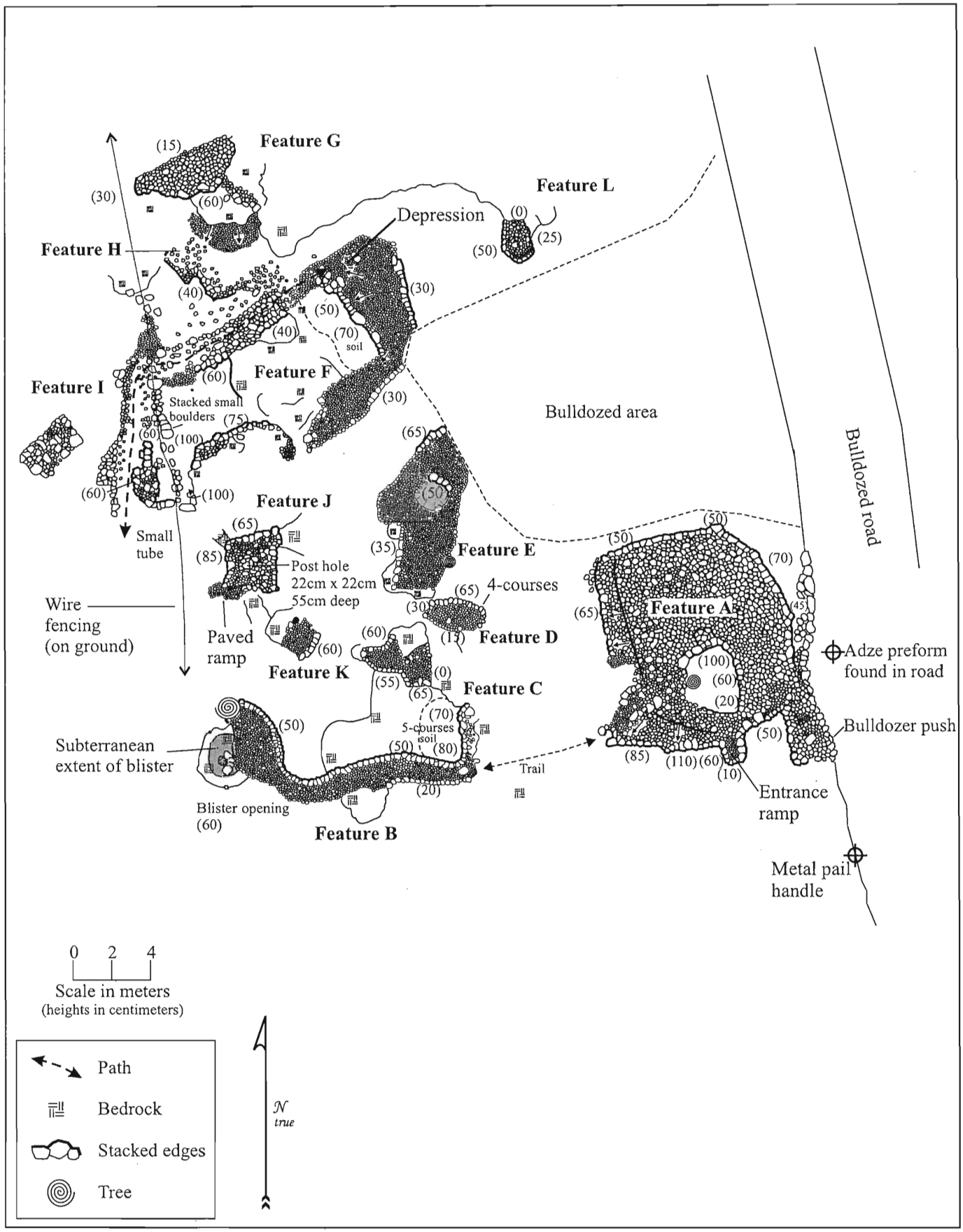


Figure 71. SIHP Site 25035 plan view.

Feature A

Feature A is a relatively large platform with a recessed area in the center on the southern half of the platform (see Figure 71). Feature A measures 11 meters (north-south) by 9.5 meters (east-west) and is barrel shaped in plan view, with the two long sides bowed out and the two shorter sides are relatively straight. The north edge runs east/northeast, is 6 meters long, and consists of intact-stacked small boulders and slabs 3-courses (50 centimeters) high. Just to the north of the northern edge the ground has been grubbed but no damage to the platform was observed. The bulldozing of the eastern boundary road impacted the southeastern corner of the platform; the feature may have extended to the east but has been obliterated where the road passes through. A basalt adze fragment (Figure 72) was collected from the center of the road adjacent to Feature A. A rusty metal handle (Figure 73) was also collected from the roadway at about 10 meters distant from the southeastern corner of the platform. It is not clear whether this artifact originated from the site or was deposited during more recent times, the latter is suspected.

Where intact, the arched eastern edge of the feature is neatly stacked large cobbles up to 4 courses (60 centimeters) above the ground surface. The partially collapsed western edge of the feature appears more like a retaining wall of large cobbles 1-2 courses (maximum 65 centimeters tall) with cobbles filling in and leveling the platform surface to the east. The southern edge of the platform is 9.5 meters long, neatly stacked, with one ramp extending to the south from the center, and another ramp extending to the west from the corner. The south edge between the southeastern corner and the centrally located ramp is 1-2 courses of small boulders stacked up to 50 centimeters above the ground surface (Figure 74). The ramp is built with small boulders on the periphery and filled in the center with small cobble paving on the sloped surface. The ramp measures 1.4 meters long (north-south) by 1.2 meters wide (east-west), and creates a southern entrance to the platform. The southern edge of the platform between the central ramp and the southwestern corner is constructed of small boulders and large cobbles neatly stacked up to 5-courses (1.1 meter tall). The ramp at the southeastern corner leads up from the west and connects to a trail extending from Feature B. Boulders line the edges of the ramp and small cobbles pave its surface; the ramp measures 3 meters (northwest-southeast) by 1.5 meters (southeast-southwest). The western edge of the platform measures 11 meters long, is 1 meter tall, and mostly collapsed with only the bottom 3 courses of stacking intact; the higher (perhaps two) courses have collapsed.

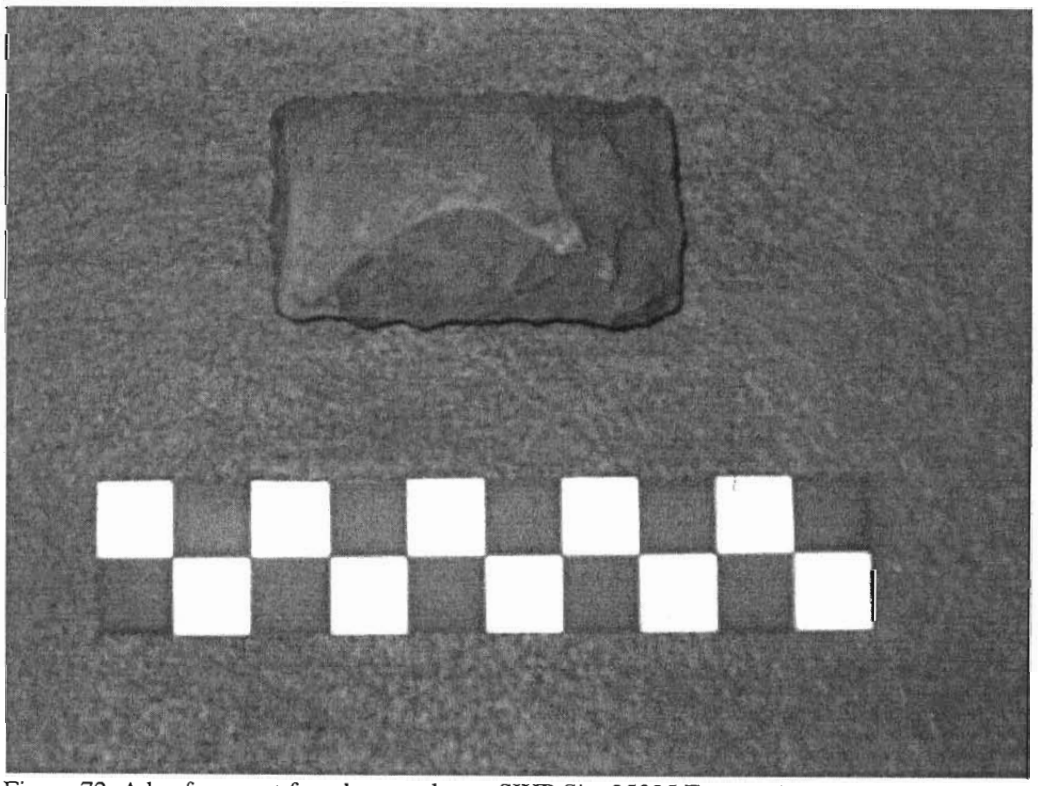


Figure 72. Adze fragment found on road near SIHP Site 25035 Feature A.

Figure 73. Metal handle found on road near SIHP Site 25035 Feature A.

Figure 74. SIHP Site 25035, southern half of Feature A, view to the west.

The north half of the platform is uneven boulders and cobbles. Centrally located in the southern portion of the platform is a roughly oval area is recessed 60 centimeters below the surface of the platform. The depression measures 3.5 meters (north-south) by 2.8 meters (east-west) with a floor of soil and cobbles. The eastern edge of the depression is stacked cobbles up to 4-courses/1 meter tall. The western edge of the depression is mostly collapsed and slopes down to the depression floor. The south edge is curved and lined with 1-course of large cobbles. At the northwest corner is a rough entrance with a large boulder step 0.25 meter tall. East of the step are the ruins of a once stacked vertical feature that is now collapsed and mound-like. The jumble of cobbles is 0.8 meter in diameter and built on the eastern edge of the depression where it is stacked 0.9 meter tall; at the northern end it is 0.5 meter tall above the platform surface. This depressed are may have served as an altar for the residence. Such features are typical of Precontact and early historic permanent habitation sites.

Feature B

Feature B is a modified outcrop and elevated trail located seven meters west of Feature A (see Figure 71). The elevated trail connects to Feature A via a footpath that leads to the ramp at the southwest corner of Feature A. The modified outcrop has 5-courses of large cobbles stacked along its *makai* side to a height of 0.8 meter above the ground surface. The *mauka* side is level with the bedrock ground surface to the east. The north/south running modified outcrop is 3 meters long; at the southern end it curves to the west and becomes the north edge of the elevated trail. The trail portion is 14 meters long (east-west) with an average width of 1.3 meters. The north-facing edge is intact stacking with an average height of 0.5 meter. The south-facing edge of the trail is stacked 0.2 meter tall for 4 meters from the eastern end, the remaining southern edge to the west consists of cobble paving up to exposed bedrock. The trail was probably constructed by first stacking the edges and then filling the interior with cobbles, using the smallest on the surface for paving. The western end of the trail curves to the north wrapping around the eastern and northern sides of a *pāhoehoe* domed blister. A 0.4-meter diameter opening is located at the top of the low dome; the blister floor is 0.6 meter deep. The small blister chamber is 2 meters in diameter; the floor consisted of soil and small cobbles and contained no artifacts.

The ground surface to the north of the elevated trail is also partially enclosed by two modified outcrops, Features C and K. The area has ample soil with exposed bedrock, is void of cobbles, and may have been a planting area. The elevated walkway and adjacent features were probably constructed with discarded cobbles removed from the interior soil area. A footpath was untraceable to the west of Feature B.

Feature C

Feature C is a stacked modified outcrop constructed on the same bedrock outcrop as the eastern end of Feature B, 2 meters to the northeast (see Figure 71). The feature measures 3.6 meters long (east-west) by 2 meters wide (north-south) and composed of cobbles stacked on the south and northwestern sides. The south and northwest sides are stacked medium and large cobbles that average 4-courses/0.6 meter tall. The eastern edge is where the small cobble paving that covers the top surface of the feature meets and is level to a low, exposed *pāhoehoe* bedrock outcrop along the eastern side. The small cobble paving is constructed up to the same *pāhoehoe* outcrop in the northeastern corner. Feature C, with Feature B (trail/enclosure wall) to the south and Feature K (stacked modified outcrop) to the west, are all constructed around and partially enclose an interior area of exposed bedrock and deep soil. Their construction appears to be a byproduct of the clearing of the interior space, which is relatively void of cobbles.

Feature D

Feature D is a stacked modified outcrop located one meter northeast of Feature C, and 6 meters west of Feature A (see Figure 71). Feature D is oval shaped with stacked medium and large *pāhoehoe* cobbles, and measures two meters north-south by three meters east-west. The north side is stacked to a maximum height of 65 centimeters; the south edge consists of small cobbles that slope down to the ground surface. The top surface, which measures 1.5 meters north-south by 2.2 meters east-west, slopes slightly to the west, is fairly flat, and paved with small and medium sized cobbles. The feature is constructed on bedrock on the eastern end, and soil at the western end. The feature was likely constructed from the cobbles that were cleared from the nearby soil area.

Feature E

Feature E is a pavement with a ramp at the northeastern corner; it is located 0.5 meter from the northwest corner of Feature D, and 7 meters northwest of Feature A (see Figure 71). The southern half of the feature is a level, small *pāhoehoe* cobble pavement measuring 5 meters (north-south) by 2.5 meters (east-west), with stacked large cobbles up to 35 centimeters tall along the western edge. The eastern and southern edges consist of small cobbles tapering down to the outlying ground surfaces. A depression that measures 1.4 meter in diameter is located at the northern end of the level paved area; the level pavement continues around the western side of the depression to a ramp that ascends to the northeast on the northwest side of the depression. The ramp is paved with small cobbles; the southeastern side of the ramp has cobbles tapering down into the depression, and the northwestern edge of the ramp is lined with stacked large cobbles 0.65 meter above the sloping ground surface. The ramp leads up to a bulldozed area; the feature may have continued to the northeast but has been obliterated. The feature appears to be an ancillary habitation area associated with the main residential platform (Feature A).

Feature F

Feature F is an enclosure composed of a series of modified outcrops located in the northwestern portion of Site 25035 (see Figure 71). The enclosure is roughly rectangular measuring 18 meters (northeast-southwest) by 8 meters (northwest-southeast). A large paved modified outcrop that measures 7 meters long by 4 meters wide forms the eastern end of the enclosure. The southeast corner has bulldozer push piles on it from grubbing activity to the south and east. The eastern (exterior) edge is lined with 1-2 courses of stacked large *pāhoehoe* cobbles up to 0.3 meter tall; the western (interior) edge consists of stacked small boulders and large cobbles up to 0.7 meter tall, retaining medium-sized cobbles that make up the top surface. The surface is highest at the eastern end and slopes down to the west. At the north end of the paved surface is a one-meter diameter depression with two large cobbles lining its *mauka* side. The depression extends 55 centimeters below the paved surface.

At the southeastern corner of the enclosure is a paved ramp that descends to the southwest on to a lower natural terrace. The southern (exterior) edge of the ramp is lined with large cobbles stacked up to 0.3 meter tall, and the northern (interior) edge is small cobble paving tapering down to the soil or bedrock ground surface. The ramp leads down to a paved trail that continues south for 6 meters and terminates. This trail likely connected to the trail at Feature B. The constructed trail segment makes up the southern wall of the enclosure. A 0.5-meter gap in construction is located near the southwestern corner of the enclosure. West of the gap, small cobbles are piled on an elevated bedrock outcrop; further west the outcrop is 0.75 meter tall and is modified with stacked large cobbles along the northern (interior) edge. The modified outcrop curves around to the northwest along a blister-like *pāhoehoe* dome. The stacking ceases where the outcrop is vertical, standing one meter above the enclosure floor. The natural bedrock is modified with cobble stacking and forms an approximately two meter long section of the western wall of the enclosure.

Feature G

Feature G is a stacked modified outcrop located at the northern end of Site 25035, 6 meters northeast of the Feature F enclosure (see Figure 71). The feature measures 5.5 meters (northeast-southwest) by 2 meters wide (northwest-southeast). The feature is composed of loosely stacked medium to large cobbles and small boulders 3-courses/0.6 meter tall on the south edge. The north edge is piled small to medium sized cobbles elevated 0.15 meter above the cobble-covered ground surface to the north. Along the eastern edge cobbles that pave the top surface of the feature are built level to a *pāhoehoe* bedrock outcrop that runs northwest/southeast. The top surface of the feature is flat and slopes slightly to the west. At the western end the north and south edges form a point; large cobbles line the edge and retain cobble fill in the center of the feature. This modified outcrop is probably constructed with cobbles that were cleared from nearby soil areas.

Feature H

Feature H is a modified outcrop/terrace located between the north wall of Feature F (enclosure) and Feature G (see Figure 71). The feature consists of loosely stacked cobbles, 0.4 meter tall by 0.6 meters long, along the *makai* edge of a *pāhoehoe* outcrop that runs from the western end of Feature G to the southeast zigzagging toward the northeastern corner of Feature F. The terrace area *mauka* of the modified edge slopes to the west and

is 2 meters wide; its surface is covered with small and medium sized cobbles. The terrace appears to have been constructed to stabilize the cobble and bedrock slope; there is no soil on the terrace.

Feature I

Feature I is a rectangular stacked mound located at the western edge of Site 25035, one meter west of Feature F (see Figure 71). The mound measures 3 meters (northeast-southwest) by 1.5 meters (northwest-southeast) with a maximum height of 55 centimeters. The mound is mostly collapsed but has large cobbles still stacked 1-2 courses along the northwestern edge. The mound is constructed with small to large cobbles and small boulders; it exhibits collapse along the periphery with the center as the highest point. The feature is placed in an area of shallow soil with exposed bedrock.

Feature J

Feature J is a modified outcrop with a large cobble-lined hole in the center of the top surface. The feature is located two meters south of the southwestern corner of Feature F (see Figure 71). The modified outcrop is roughly square, measuring three meters by three meters. The western facing edge is neatly stacked large cobbles 5-courses/85 centimeters tall. A small lava blister (30 centimeters in diameter by one meter long) with an opening at its northwestern end extends out from under the northeastern corner of the outcrop. The subterranean cavity that runs under the feature was inspected and found to be culturally sterile. The north edge of Feature J is stacked 4-courses/65 centimeters above the ground surface. The east edge is stacked 3 courses/45 centimeters tall; the northeastern corner is constructed on a bedrock outcrop. The eastern half of the south edge is stacked 2-courses/30 centimeters high, and on the western half the cobbles are level with a bedrock outcrop. In the southeast corner a small cobble-paved ramp is constructed that slopes north up to the paved, level top surface of the feature. In the center of the top surface is a large cobble lined depression. The depression measures 0.22 x 0.22 meter by 0.55 meter deep (below surface of feature). The paving on the surface of the feature consists of small cobble on the area north of the depression, and large cobbles east and south of the depression. This feature may have served as the residential altar for the site complex.

Feature K

Feature K is a modified outcrop/stacked clearing mound located two meters south of Feature J, and two meters east of Feature C in the southwestern portion of Site 25035 (see Figure 71). The feature is square and measures 1.7 meters x 1.7 meters; the southeast facing edge is stacked 3-courses/60 centimeters tall. The top of the feature consists of very small cobbles piled almost to the top level of the stacked cobbles on the southeastern side, and is level with the bedrock outcrop that lines the northwestern side. The piled small cobbles create a mounded top surface that slopes down to ground surface on the northeast and southwest sides. The *pāhoehoe* bedrock outcrop on the northwest side may be a blister that has been blocked off by the small cobbles making up the mound. Feature K, with Feature B (trail/enclosure wall) to the south and Feature C (stacked modified outcrop/clearing mound) to the east, are all constructed around and partially enclose an interior area of exposed bedrock with pockets of deep soil.

Feature L

Feature L is a stacked modified outcrop located in the northeastern corner of Site 25035, five meters northeast of Feature F (see Figure 71). The irregularly shaped feature measures 2.3 meters (north-south) by 1.3 meters (east-west). The north side of the feature is constructed up against, and level with, a *pāhoehoe* bedrock outcrop. The western edge consists of stacked large cobbles 2-courses/50 centimeters tall; the southern and eastern sides are also stacked and reach a maximum of 30 centimeters above the ground surface. The top surface of the feature consists of mounded up small cobbles on the south end, and medium sized mounded up cobbles on the north end.

SIHP Site 25036

Site 25036 consists of a habitation enclosure (Feature A) and a cairn (Feature B) located in the east-central portion of the current study area (see Figure 15). The site occupies a roughly twenty meters by ten meters in an area where loose cobbles are strewn across the thin soil ground surface. No cultural debris was observed on in the vicinity Site 25036, but based on the formal attributes of Feature A and the presence of a storage cubby at that feature, it is thought to have been used for Precontact habitation purposes. Feature B, the cairn, is located to the west of Feature A and, based on proximity, its construction may have been associated with the use of the

enclosure. The features of this site are in fair condition for archaeological ruins, and the site itself retains integrity of location. Detailed descriptions of the features of Site 25036 follow below.

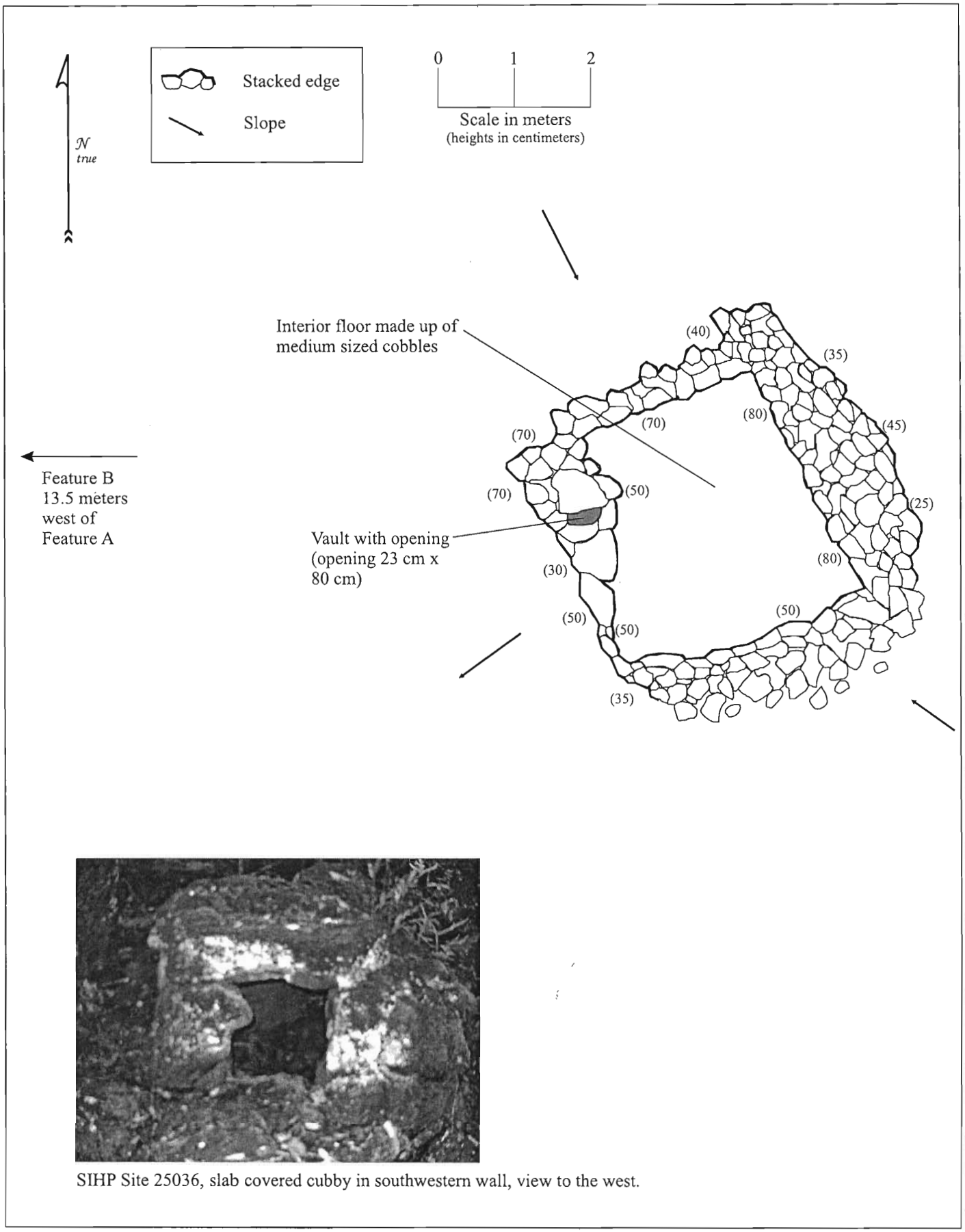
Feature A

Feature A consists of an enclosure situated on level terrain at the base of a steep slope to the east. The enclosure is square and measures 4.5 meters (north-south) by 4.5 meters (east-west) (Figures 75 and 76). The southwestern-facing wall is constructed of medium and large sized cobbles at the base of the steep slope. The partially collapsed wall is level with the exterior ground surface, and raised 0.5 meters above the interior floor of the enclosure. The northeastern wall is constructed of upright and stacked slabs, and stacked large cobbles and small boulders. The wall is approximately one meter thick in the center. It stands 0.8 meters tall on the interior and 0.45 meters tall on the exterior. The northwest wall is constructed of stacked boulders and one upright slab. It is 0.5 meters wide, 0.7 meters tall on the interior, and 0.4 meters tall on the exterior. The southwest wall has a slab-covered cubby incorporated into its northwestern corner (see Figure 76). The cubby measures 0.9 meters (north-south) by 0.5 meters (east-west), and has a depth of 0.6 meters from floor to ceiling. It is constructed of stacked small boulders along the northeast and southwest sides that are covered by two large, flat-laid slabs. In the center of the southwest wall, a 0.4-meter wide opening to the cubby has a 0.3-meter tall step up to it (a flat slab) that rests on the interior floor of the enclosure. The southern end of this wall consists of stacked cobbles that are 0.35 meter tall on the exterior and 0.5 meter tall on the interior. The floor of the enclosure is level and composed of medium sized cobbles; the interior area measures three meters by three meters. Feature A was probably used for Precontact habitation purposes and the cubby may have been used for storage.

Feature B

Feature B is a cairn located 13.5 meters west of Feature A (see Figure 76). The cairn is constructed of stacked cobbles and small boulders (Figure 77). It measures 0.7 meters by 1.0 meter, and stands 1.0 meter tall. Based on its proximity to Feature A, the two features are likely related. No obvious reason was apparent for the construction of Feature B, although cairns are commonly erected as markers. It may be that the cairn marked the former route of a trail (no such trail route was identified during fieldwork) that ran in the vicinity of Feature A, and that Feature A was constructed as a resting area along this trail route. Or that Feature B marks the route of a trail that once ran to Feature A (again no such trail route was identified during fieldwork).

Figure 75. SIHP Site 25036 Feature A, view to the northwest.



SIHP Site 25036, slab covered cubby in southwestern wall, view to the west.

Figure 76. SIHP Site 25036 plan view and photo.

Figure 77. SIHP Site 25036 Feature B, view to the northwest.

SIHP Site 25037

Site 25037 consists of a modified outcrop located in the southeastern portion of the project area approximately thirty meters north of the southern bulldozer road (see Figure 15). The site is constructed on and against a raised section of *pāhoehoe* bedrock that measures twenty-four meters long (north-south) by eight meters wide (east-west) (Figure 78). Thin soil is present on ground surface to the east and west of Site 25037, but almost no soil is present within the feature itself. Overall, the site has the appearance of an enclosed area created by a series of modified outcrops and natural bedrock. The enclosed area contains exposed bedrock and terraced paving within. The eastern side of the feature consists of a few cobbles piled against a linear section of vertical bedrock (22.3 meters long by 0.5meters tall along its western edge) that that forms a natural eastern wall. The northern edge of the feature consists of two separate piles of cobbles (each one meter in diameter by up to 0.7 meters tall) against bedrock, one in the northeastern corner and the other in the northwestern corner (Figure 79). The piles are connected by a raised linear bedrock formation that measures two meters wide by five meters long by up to 0.5 meters tall along either edge. To the south of the linear outcrop an area of cobble and bedrock rubble (seven meters long by four meters wide) is present that does not appear to have been modified or utilized for habitation.

The western wall of the enclosed area is marked by a rough, single course, cobble alignment raised up to 0.3 meters above ground surface to the west and level with the interior bedrock to the east. The alignment runs for a total distance of twenty-four meters, although the northern half is more clearly defined than the southern half. In the center of the alignment, where raised bedrock juts into the alignment from the east, is an area of piled cobbles next to a small lava blister (see Figure 78). This roughly circular construction measures four meters in diameter. It consists of small to large sized cobbles piled on the jutting bedrock that have a fairly level top surface. The north, south, and west edges of this construction (including bedrock) stand approximately 1.5 meters above ground surface, the east side stands 0.7 meters above the jutting bedrock. This construction with its level surface may have been used for habitation purposes. At the southern edge of the cobble surface where cobbles abut bedrock is a blister opening that measures 0.6 meters by 0.7 meters, with a depth of 0.9 meters to the blister floor (Figure 80). The interior of the blister measures 0.7 meters wide (north-south) by 1.2 meters long (east-west), and it has an interior floor to ceiling height of 0.5 meters. The floor contains level soil covered by organic debris. No cultural debris was observed within the blister, but it was likely utilized for storage purposes.

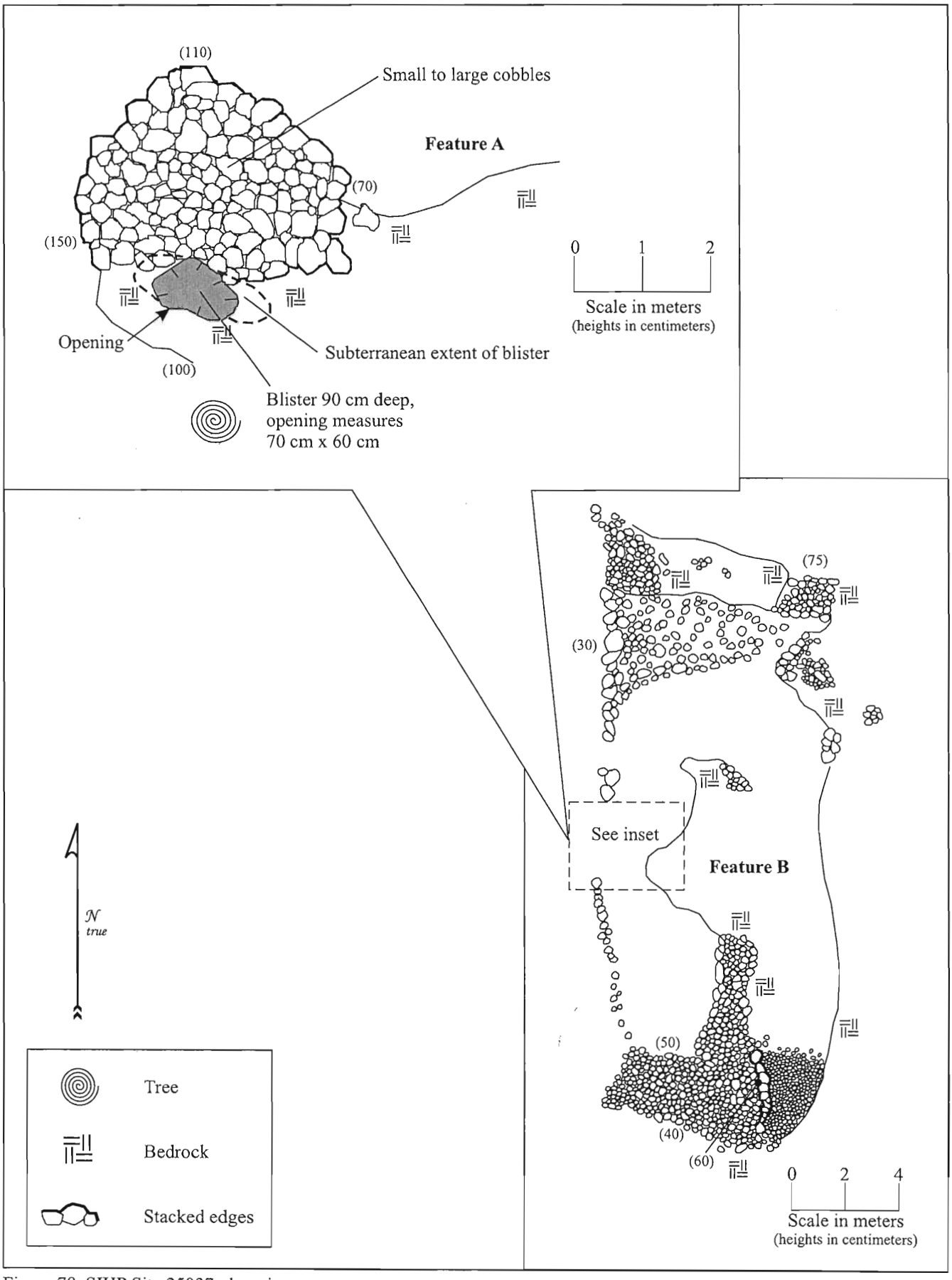


Figure 78. SIHP Site 25037 plan view.

The southern edge of the enclosed area consists of piled cobbles on bedrock. The cobbles form a rough, mounded wall running east-west that measures two meters wide by six meter long by 0.4 to 0.5 meters tall. A terrace wall runs north for five meters from the northern edge of the southern wall following a natural bedrock contour to an exposed bedrock outcrop (the aforementioned jutting bedrock). The terrace wall is 1.5 meters wide and it consists primarily of piled small cobbles with loosely arranged larger cobbles along its western (down slope) edge. The western edge stands up to 0.6 meters above the feature surface to the west, and is level with exposed bedrock and a small (two meter by two-meter) cobble pavement to the east. To the west of the terrace wall and to the south of the southern wall, along the eastern edge of the western alignment, a six meter by four meter level area on the exposed bedrock has been cleared of cobbles. This level area and the level, terraced area to the east of the terrace wall were likely used for habitation purposes. and In the southeastern corner of the enclosed area is a terrace 2 meters long (north-south) with a paved level surface east of the stacked 0.6-meter tall terrace wall.

No cultural debris was observed on ground surface within, or in the vicinity of, Site 25037. However, based on the formal attributes of the features (i.e., incorporating level paved areas), the site was likely used for Precontact habitation purposes. The use of this site was likely temporary and recurrent, and related to agricultural activities that took place in the surrounding area (at Site 16107). It is possible that the remnant of Site 25037 once supported a roofed structure. This site is in fair condition for an archaeological ruin and it retains integrity of setting.

Figure 79. SIHP Site 25037, rock pile in the northeastern corner, view to the north.

Figure 80. SIHP Site 25037, small lava blister, view to the north.

SIHP Site 25038

Site 25038 is a Precontact habitation complex located in the southeastern corner of the project area, approximately sixty meters north of the southern bulldozer road (see Figure 15) Site 25038 consists of five features including an enclosure (Feature A) and four modified outcrops (Features B-E) (Figure 81) that occupy a roughly thirty-five meter by twenty meter area on a moderately sloped (to the west) exposed bedrock and thin soil ground surface. The features all contain relatively level paved surfaces constructed on bedrock. No cultural debris was observed at the site, but based on the formal attributes of the features it is thought to have functioned as a Precontact habitation area. The use of this site was likely related to the use of the agricultural fields in the surrounding area (Site 16107), and may have been seasonal. The features of Site 25038 are in fair condition for an archaeological ruin and the site retains integrity of setting. Detailed feature descriptions follow below and their locations relative to one another are shown in Figure 81.

Feature A

Feature A is an oval enclosure located in the southwestern portion of Site 25038 (see Figure 81). The enclosure is constructed within a natural sink in the *pāhoehoe* bedrock ground surface. The walls of the enclosure are composed of piled cobbles and the natural bedrock along the edges of the sink (Figure 82). The enclosed area measures six meters (north-south) by four meters (east-west) and the average interior height of the walls (natural or piled) is roughly 0.5 meters. For the most part, the walls are level with the surrounding bedrock along their exterior edges. The cobble material used to create the periphery walls was cleared from the center of the sink area. In most areas cobbles are piled against the bedrock walls, except in the northeastern corner where cobbles have been loosely stacked and piled to complete the enclosure where a gap in the bedrock once existed. The constructed wall section in the northwestern corner of Feature A is L-shaped and measures 5.5 meters long by 1.0 to 1.5 meters wide. The wall connects to exposed bedrock at both ends and stands 0.4 to 0.5 meters above both the exterior and interior ground surfaces at Feature A. The exterior western portion of the wall is loosely stacked, while the remaining edges are piled or collapsed. Otherwise, the eastern and northern sides consist solely of piled cobbles on bedrock, and the southern and western sides consist of exposed bedrock with some loosely stacked cobbles and boulders present along their interior edges. The naturally occurring cobbles that make up the interior floor of the enclosure have been artificially leveled through the removal and replacement of selected cobbles. This enclosure probably functioned as a Precontact habitation area, and could have supported a roofed structure. A rectangular pavement, Feature E, is constructed off the *makai* end of Feature A (see Feature E description).

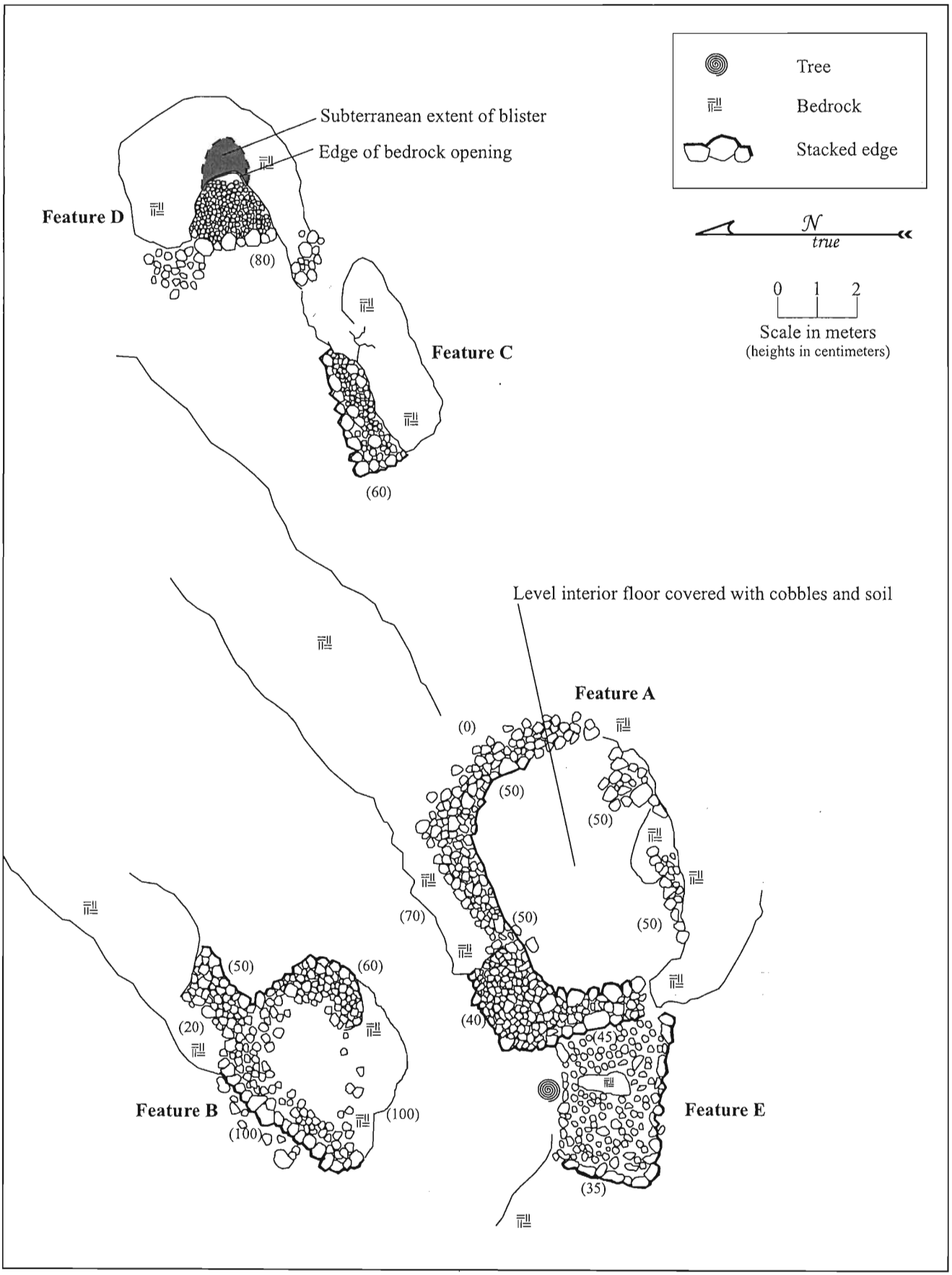


Figure 81. SIHP Site 25038 plan view.

Feature B

Feature B is a modified outcrop located three meters northwest of Feature A (see Figure 81). The feature consists of an outcrop that has been modified on the northeast and northwest sides creating a squared off platform-like structure (Figure 83). Feature B measures 5.0 meters (northeast-southwest) by 4.0 meters (northwest-southeast) and has a maximum height of 1.0 meter above the surrounding ground surface. The south side is mostly bedrock that drops off 1.0 meter to the south. The northeast and northwest sides are constructed of stacked cobbles standing 0.6 to 1.0 meter tall that are filled along their interior edges with a small cobble paving. This paving abuts natural bedrock to the south. Atop the feature is accumulated soil and grass on what appears to be a level constructed cobble surface (construction abuts bedrock on the south side). A wall-like segment of stacked cobbles is 1.1 meter wide by 0.5 meter tall and extends 2.0 meters to the northeast from the northeastern corner of the feature. The segment is constructed up to a bedrock outcrop, and possibly served as a bridge/entrance to the feature from the northeast. Feature B was probably used for habitation purposes.

Feature C

Feature C is a modified outcrop located on the south side of a *mauka-makai* pathway that leads through the site and into the enclosure, Feature A; Feature C is 8 meters east of Feature A (see Figure 81). Feature C consists of small boulders and cobbles loosely stacked parallel to a *pāhoehoe* outcrop and filled in (partially) between with small cobbles creating a level surface with some exposed bedrock (Figure 84). The feature measures 3 meters (east-west) by 1 meter (north-south) and has a maximum height of 0.6 meter at the 2-course stacking on the northwestern corner. This arrangement of cobbles was probably a byproduct of the clearing of cobbles from the footpath to the north.

Figure 82. SIHP Site 25038 Feature A enclosure, view to the northwest.

Figure 83. SIHP Site 25038 Feature B, modified outcrop, view to the southwest.

Figure 84. SIHP Site 25038 Feature C, modified outcrop, view to the east.

Feature D

Feature D is a modified outcrop/pavement located at the eastern extent of Site 25038, fourteen meters from Feature A (see Figure 81). Feature D consists of a horseshoe shaped *pāhoehoe* outcrop that opens to the west. The center is filled with small boulders and cobbles forming a paved area. The *makai* edge measures 2.0 meters and is composed of cobbles and small to medium sized boulders aligned and collapsed, standing 0.8 meter above the *makai* ground surface. The paved area measures 2 meters (north-south) by 1.5 meters (east-west); at the eastern end is a blister opening (0.3 meter wide) at the point where pavement meets bedrock (Figure 85). The blister extends east 1.0 meter and has an interior height of 0.35 meter, and has a soil floor. The feature probably functioned as a work surface with the blister possibly serving as a storage area.

Feature E

Feature E is a modified outcrop/pavement that is constructed off the *makai* side of the enclosure Feature A (see Figure 81). Feature E is rectangular and measures 4 meters (east-west) by 3.5 meters (north-south) and has a maximum height of 0.35 meter at the western edge (Figure 86). The eastern edge is 0.45 meter beneath the top of the stacked portion of Feature A, while the north and south edges of the feature taper down to the ground surface. The western edge is 1 course of aligned cobbles. The center of the feature has exposed bedrock, but is otherwise level and paved with small cobbles. Feature E, like Feature A, was probably used for habitation purposes.

Figure 85. SIHP Site 25038 Feature D, modified outcrop with blister, view to the east.

Figure 86. SIHP Site 25038 Feature E, modified outcrop, view to the south.

SIHP Site 25039

Site 25039 consists of a Precontact habitation enclosure and a modified outcrop located in the southeastern portion of the project area approximately twenty-five meters north of the southern bulldozed road (see Figure 15). The feature measures 15.0 meters (east-west) by 8.0 meters (north-south) and is situated on slightly western sloping terrain (Figure 87). The eastern end of the feature (the modified outcrop) is constructed up against a 0.8-meter tall *pāhoehoe* bedrock outcrop. Large cobbles are stacked up to the level of the outcrop creating a level, 1.5 meters wide, medium cobble paved area that could have acted as a pathway providing easy walking onto the surface of the feature from the east. The eastern half of the feature (the area east of the enclosure) is triangular, measuring 6.0 meters by 5.0 meters, with a fairly level, paved surface toward the eastern end. An alignment of large cobbles trends north/south along the western side of this part of the feature that marks the top of a slope that descends to the west and ends at the east side of the enclosure. The alignment acts as a retaining wall and has a maximum height of 0.75 meters along the western (*makai*) side. The southeast-facing edge of the feature is stacked from the north end to a bedrock outcrop in the center, and from there south the edge, which is composed of sloping cobbles, is less well defined. At the southeastern corner of the feature is a natural slope that ascends southeast two meters to the top of a small bedrock escarpment. Along the northern portion of the feature running east west is a paved, relatively level trail-like surface that is a continuation of the bridge like construction abutting the outcrop to the east. The northern edge of the feature is composed of stacked large cobbles with a maximum height of 0.65 meter at the eastern end.

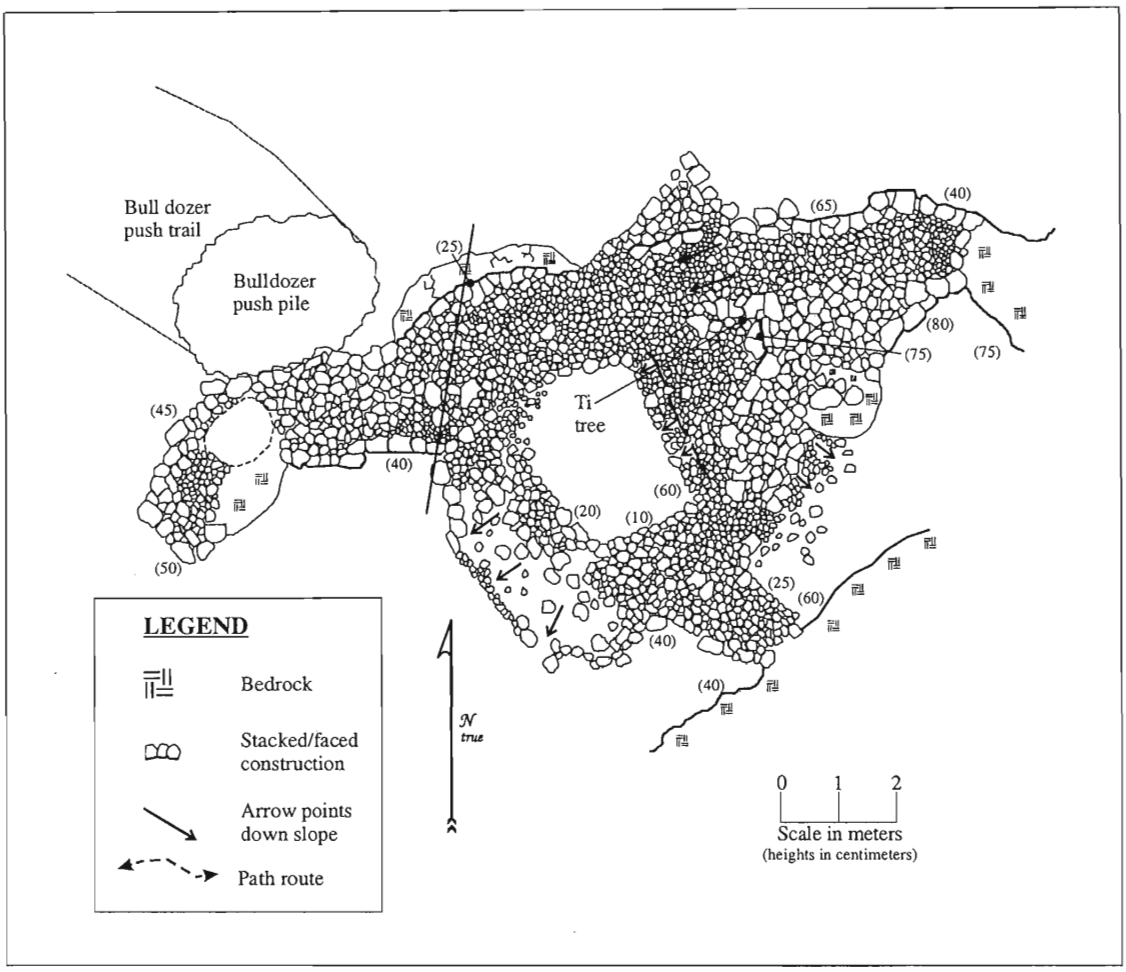


Figure 87. SIHP Site 25039 plan view.

The enclosure is located west of the modified outcrop. On the south and west sides of the enclosure are walls that average 0.5 meter in height by 1.5 meters wide and are composed of piled and loosely stacked small to large cobbles. The interior area of the enclosure measures 3.0 meters (north-south) by 2.0 meters (east-west); the floor is level soil and cobbles, and the walls may be composed of cobbles that were cleared from the interior. The north and east walls stand 0.5 meters tall above the interior of the enclosure. Northwest of the enclosure a trail-like surface continues for five meters; the southern edge is curbed with large cobbles, and the north edge has been disturbed by adjacent bulldozing. At the western end is an aligned row of cobbles 0.5 meter tall where the feature terminates. No cultural debris was observed on ground surface in the vicinity of the feature, but Site 25039 probably functioned as a Precontact habitation area associated with the agricultural activities that were conducted at Site 16107 in the surrounding area. This interpretation is based on the formal attributes of the features. This site is in poor condition, but it retains integrity of setting.

SIHP Site 25040

Site 25040 is a modified outcrop located in the center of the southeastern quarter of the project area (see Figure 15). The feature is a low rectangular platform-like structure constructed atop of and off the northern side of a *pāhoehoe* bedrock outcrop (Figure 88). The feature measures 3.9 meters (north-south) by 3 meters (east-west). The eastern side of Site 25040 has the maximum height of 0.6 meter, the northern side is 0.3 meter tall, the western side is stacked on the northwestern corner 0.2 meter, and the southwestern corner is stacked 0.1 meter tall. The top surface consists of a level, small cobble paving with a few medium cobbles scattered about on top of the pavement. A few medium sized slabs are incorporated into the surface in the northeastern corner. Based on its formal attributes, Site 25040 probably functioned as a Precontact habitation area, or possibly as a work surface related to agricultural activities. No cultural debris was observed on ground surface at this site.

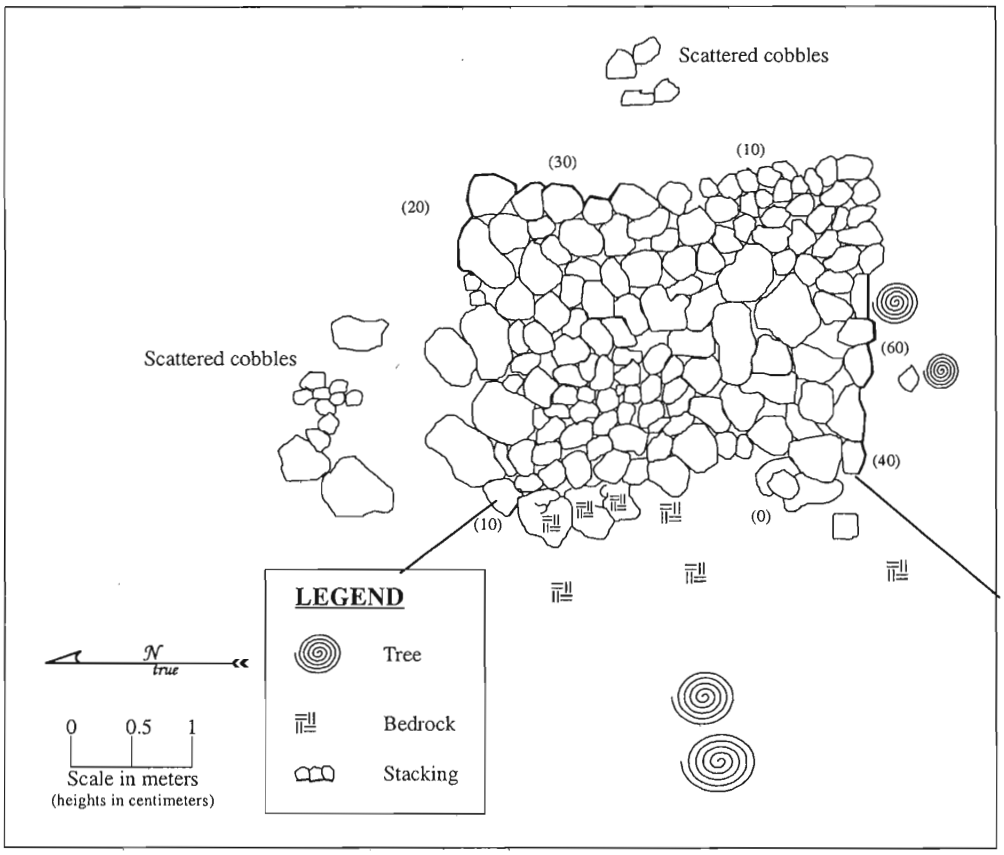


Figure 88. SIHP Site 25040 plan view.

SIHP Site 25041

Site 25041 consists of a modified outcrop located in the eastern half of the current study parcel approximately twenty meters north of the southern bulldozer road that runs along the southern boundary (see Figure 15). The feature consists of three constructed sides with a level surface in the center of mixed bedrock and cobbles, built on the side of western sloping outcrop (Figure 89). The feature measures 4.5 meters (northwest-southeast) by 4.0 meters (northeast-southwest). The south side averages 0.6 meter tall and is composed of loosely stacked large cobbles. The west-facing side averages 0.6 meter above the western-sloping ground surface and consists of loosely stacked large cobbles retaining smaller cobbles on the interior of the feature. In the center of the western side is a large 0.25-meter square *pāhoehoe* block step at the base of the feature, leading to a second step, 0.25 meter tall, that leads to the top of the feature (Figure 90). The northern side of the feature consists of a 0.5-meter tall, neatly stacked edge along the base. Atop this vertically stacked lower wall are more stacked cobbles that angle into the center of the feature. The overall height of the northern edge is 0.65 meter. Atop the northern wall of the feature in the northeastern corner is a U-shaped cobble alignment, measuring 1 meter by 0.6 meter, and is open to the west. The upright cobbles are loosely stacked 1-2 courses (0.6 meters) high on top of the surface of the feature. The eastern edge of the feature merges with the natural terrain, which ascends to the east. The top of the feature is level and small cobble paving is visible around the inside of the large structural cobbles along the periphery. The center of the top surface has substantial soil accumulation, probably on top of cobble paving. Site 25041 is in fair condition and retains integrity of setting. It was likely used for Precontact habitation purposes. This interpretation is based on the formal attributes of the feature, as no cultural debris was observed on ground surface at this site.

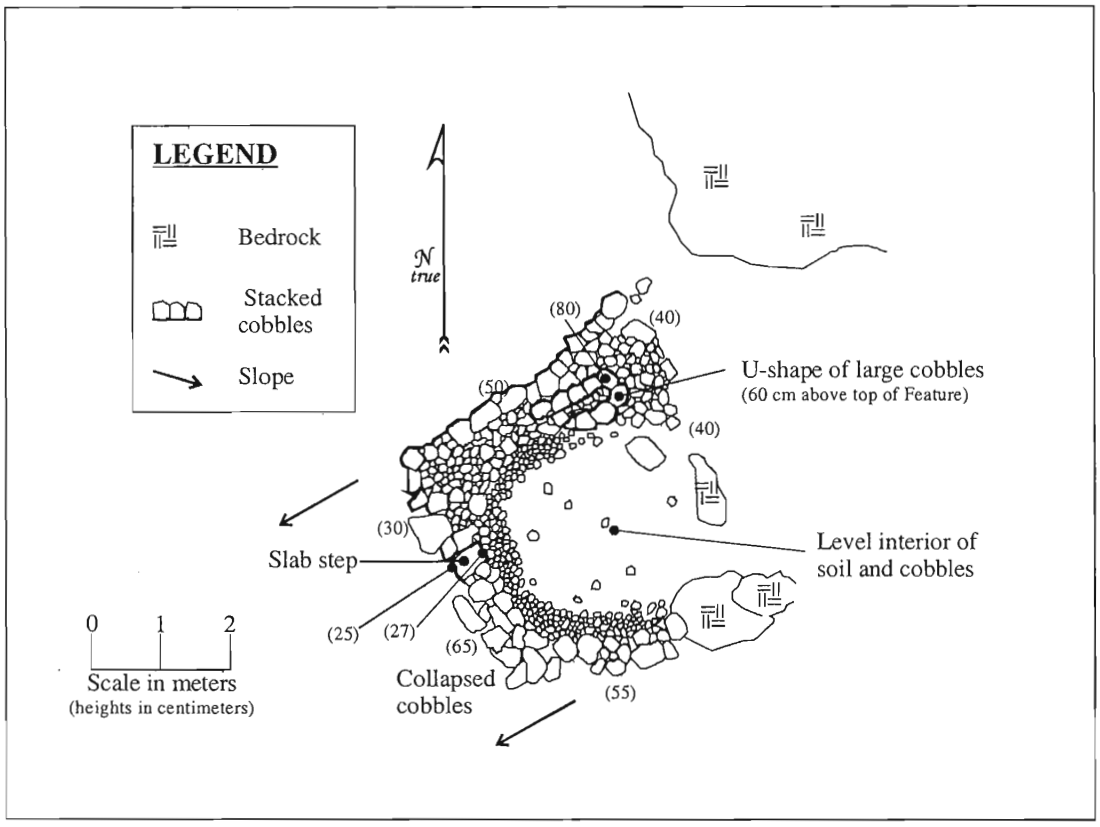


Figure 89. SIHP Site 25041 plan view.

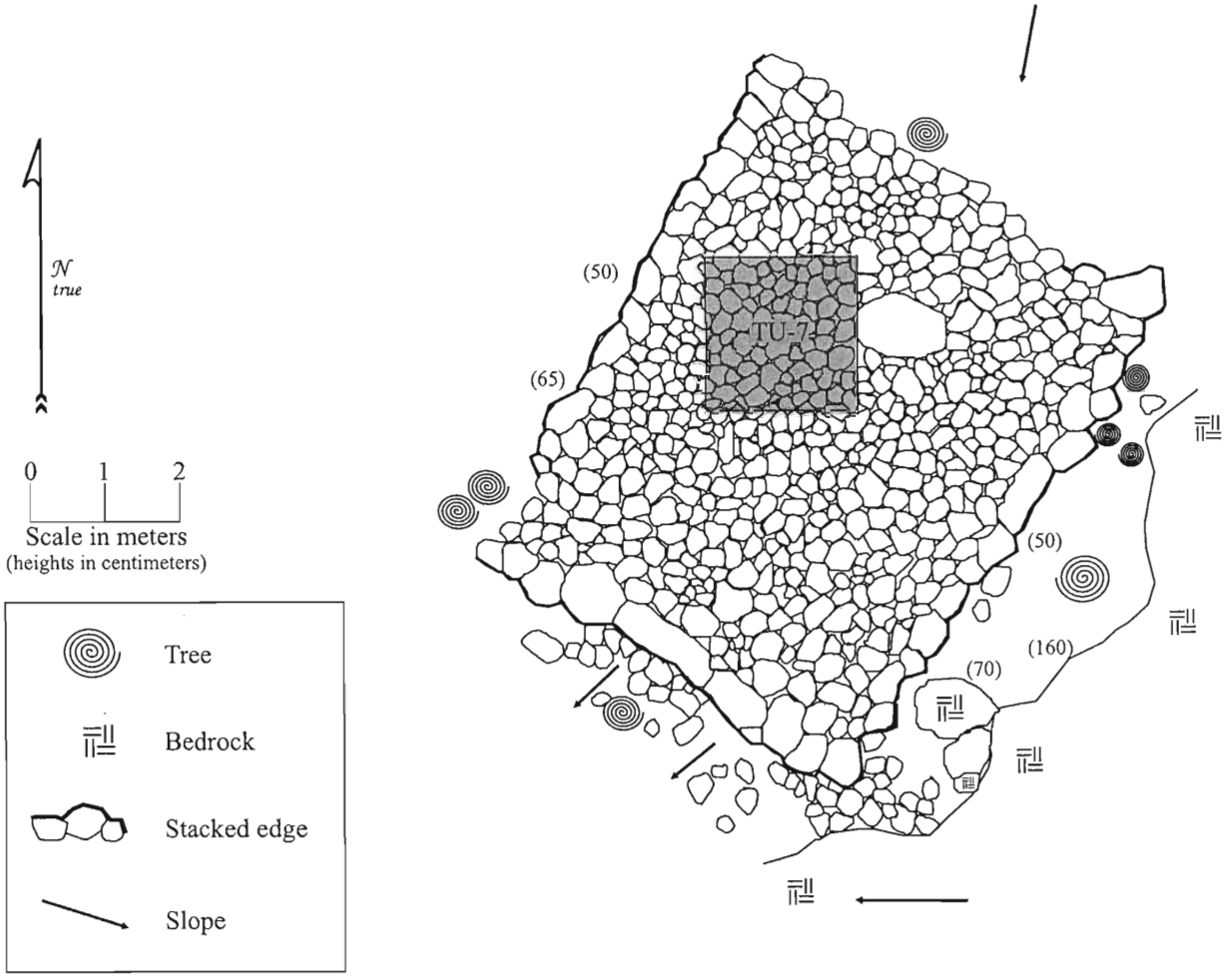
Figure 90. SIHP Site 25041, view to the east.

SIHP Site 25042

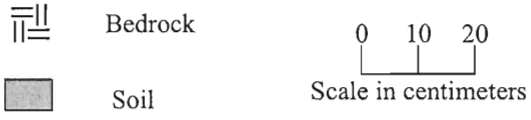
Site 25042 is a low rectangular platform located in the eastern half of the current study parcel approximately 15 meters north of the southern bulldozer road that runs along the southern boundary (see Figure 15). The site is in fair condition and retains integrity of setting. The platform measures 3.5 meters (northeast-southwest) by 2.8 meters (northwest-southeast), and has an average height of 0.5 meter tall on the elevated sides. The feature is constructed with large angular *pāhoehoe* block-like cobbles along the perimeter, and the center is filled in cobbles and capped with small cobble paving, making a level surface (Figures 91 and 92). The northwest, southwest and southeastern sides are stacked, and the northeastern side is constructed level to a bedrock outcrop. To the south of the feature is a bedrock outcrop that is 1.5 meters tall. The outcrop could have supported a roof or lean-to style shelter over the platform and functioned as a habitation area or an agricultural staging area.

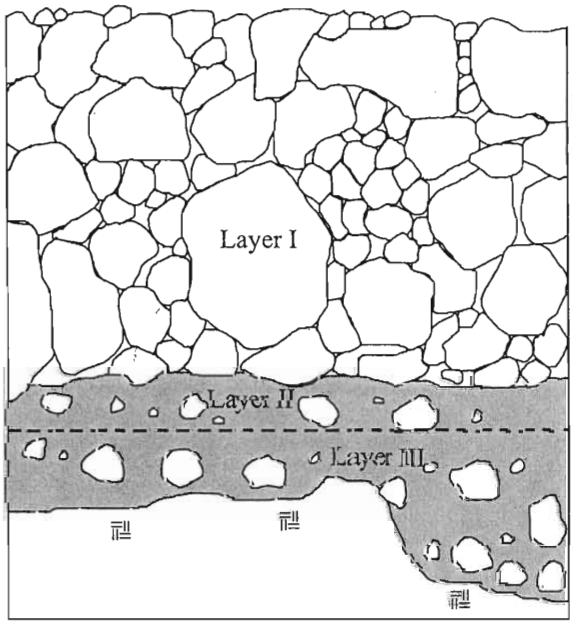
A single 1 x 1 meter test unit (TU-7) was excavated at Site 25042 in the northwestern portion of the platform to test for possible buried cultural deposits. Excavation of TU-7 revealed three stratigraphic layers (Layers I, II, and III) (see Figure 91). Layer I, the 65-centimeter thick architectural layer, consisted of small to large *pāhoehoe* cobbles and small boulders. Layer II continued beneath Layer I to a depth of 75 centimeters below the unit's surface. This layer consisted of very dark brown (7.5YR 2.5/2) silt mottled with black (10YR 2/1) silt with 50% gravel content. Layer III continued beneath Layer II to a depth of 100 centimeters below the unit's surface. This layer consisted of black (10YR 2/1) silt with dense charcoal and 30% gravel content. Excavation of TU-7 terminated at undulating *'a'ā* bedrock at the base of Layer III, 100 centimeters below the unit's surface (Figure 93). Charcoal was observed throughout TU-7, but no other cultural materials were recovered during the excavation.

Figure 91. SIHP Site 25042, surface of platform, view to the east.



TU-7 east wall profile.





Layer I - Architectural layer consisting of small to large *pāhoehoe* cobbles and small boulders.

Layer II - Very dark brown (7.5YR 2.5/2) silt mottled with black (10YR 2/1) silt containing 50% gravel.

Layer III - Black (10YR 2/1) silt with charcoal and 30% gravel.

Figure 92. SIHP Site 25042 plan view and TU-7 profile.

Figure 93. SIHP Site 25042, TU-7 base of excavation, view to the east.

SIHP Site 25043

Site 25043 consists of two pavements (Features A and B) located in the center of the southern half of the project area (see Figure 15). The terrain in this area slopes to the west and has many *pāhoehoe* bedrock outcrops. No cultural debris was observed at this site. Based on the formal attributes of Features A and B, it is likely that Site 25043 was used for Precontact habitation purposes. This site is in fair condition and retains integrity of setting.

Feature A

Feature A is a pavement located at the southern end of the site. The feature is roughly rectangular in shape and measures 5.0 meters (north-south) by 4.0 meters (east-west) (Figure 94). The pavement is built up to a bedrock outcrop on the north side; the *makai* (west) side has a semi-circular stacking of *pāhoehoe* boulders standing one to two courses (0.75 meters) tall. The southern and eastern edges are composed of piled cobbles that sloped down to the ground surface. The top surface of the pavement consists of jumbled large cobbles and small boulders; the surface has probably been disturbed by livestock, and perhaps had a smoother surface in the past (Figure 95). This feature may have supported a roofed structure used for habitation.

Feature B

Feature B is a pavement located nine meters north of Feature A. The feature is irregularly shaped and measures 7.0 meters (north-south) by 5.5 meters (east-west) (see Figure 92). The south edge is loosely stacked large cobbles and boulders with a height of 0.6 meters above the surrounding ground surface. The west and north edges are constructed up to a bedrock outcrop and the east edge is 0.4 meter tall and slopes down to ground surface. There is a raised, loosely stacked (1-2 courses) mound of cobbles in the northeast corner atop the feature measuring 2.5 meters (north-south) by 1.5 meters (east-west) by 0.3 meter above the feature surface. The top surface of the platform is fairly level cobbles, small boulders and slabs (Figure 96). This feature may have also supported a roofed structure used for habitation.

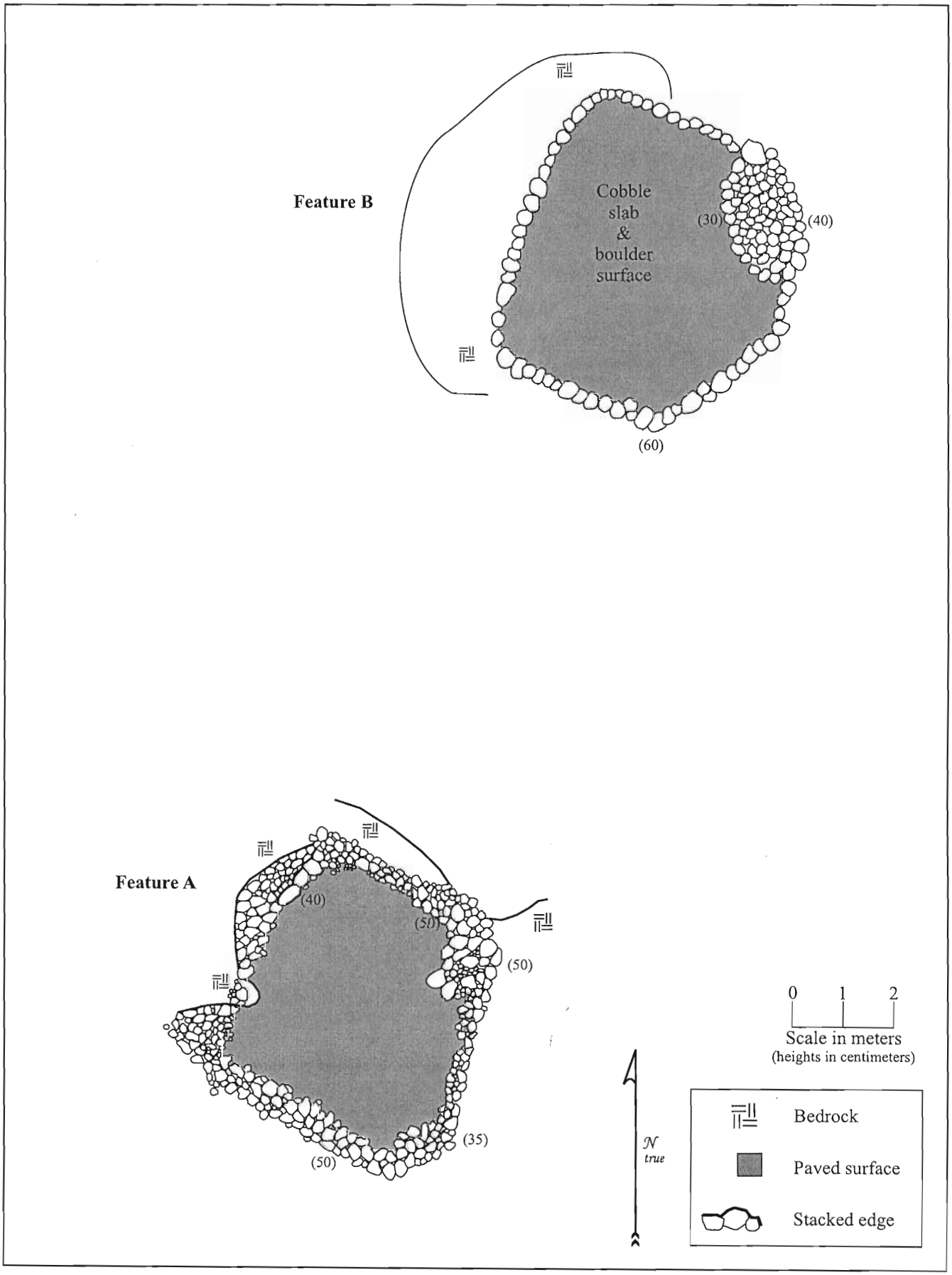


Figure 94. SIHP Site 25043 plan view.

Figure 95. SIHP Site 25043 Feature A, view to the northwest.

Figure 96. SIHP Site 25043 Feature B, view to the north.

SIHP Site 25044

Site 25044 consists of two habitation features and an agricultural feature; the site is located in the southwestern portion of the current study area (see Figure 15). The features include a small enclosure with a paved surface (Feature A), a modified blister (Feature B), and a clearing mound (Feature C). The three features are within close proximity, and fairly isolated from other sites; thin to moderate soil deposits are present in the vicinity of Feature C. Site 25044 may have been utilized for Precontact temporary habitation purposes associated with creating and tending agricultural plots in the vicinity. This site is in fair condition and retains integrity of setting.

Feature A

Feature A is an enclosure located in the southwestern portion of the project area, approximately 45 meters north of the southern bulldozer road. The enclosure is constructed on the side of a moderate slope and commands a prominent view of the coastline to the west and south. The enclosure is constructed on a blister formation that has an opening measuring 1.2 meters (east-west) by 0.8 meter (north-south) located 1.5 meters to the northeast. The blister is void of cultural constituents and modifications but was perhaps used for storage. The enclosure measures 4.5 meters (northwest-southeast) by 3.5 meters (northeast-southwest). The 3 constructed walls are on the southeast, southwest and northwest facing sides, and the northeast side consists of a natural bedrock wall with cobbles loosely stacked against it (Figure 97). The southeast wall is 1 meter wide, with stacking on the interior edge 0.3 meter tall; the outside edge is stacked 0.65 meter tall above the south-sloping ground surface (Figure 98). The southwest-facing wall is 1 meter wide, 0.45 meter tall on the interior and loosely stacked and sloping west on the exterior. The northwest facing wall is 1.5 meters wide and 0.4 meter tall on the interior and is collapsed and slopes north on the exterior. The walls are composed of medium and large *pāhoehoe* cobbles and are level on the top surfaces. The interior floor of the enclosure is paved with small cobbles with a few larger cobbles scattered around from collapsed walls.

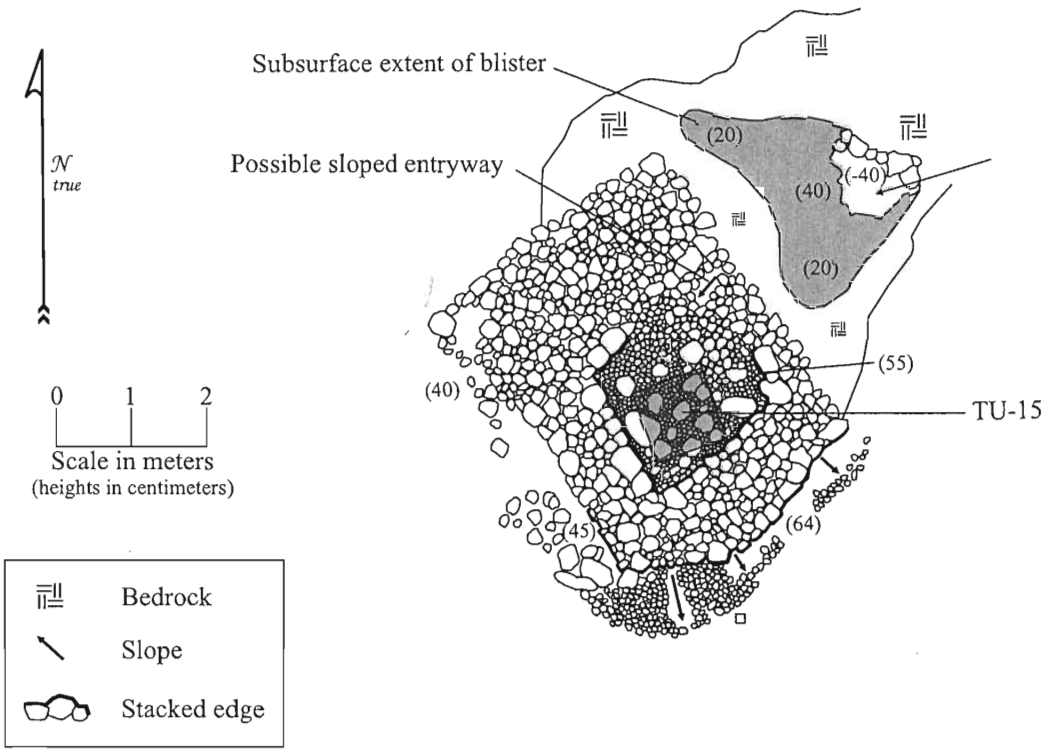
A single 1 x 1 meter test unit (TU-15) was excavated at Site 25044 Feature A in the southwestern corner of the interior of the enclosure. Excavation of TU-15 revealed two stratigraphic layers (Layers I and II). Layer I, the architectural layer, consisted of small to large cobbles and slabs. The small cobbles covered collapsed bedrock slabs and cobbles filling in a blister under the enclosure. Layer I, including the collapsed slabs, had a depth of 67 centimeters below the unit's surface. Layer II consisted of a 7-centimeter thick layer of very dark brown (10YR 2/2) silt containing 35% gravel. Excavation of TU-15 terminated at bedrock beneath Layer II, 75 centimeters below the unit's surface (Figure 99). The blister was intact extending north of the unit. Artifacts recovered from the unit (Table 5) included volcanic glass flakes, *Echinoidea*, and charcoal; the artifacts were located in cracks between the fallen ceiling slabs, no artifacts were observed in the blister. Based on these findings, Feature A was likely used for Precontact habitation or agricultural processing purposes.

Table 5. Cultural material recovered from SIHP Site 25044 TU-15.

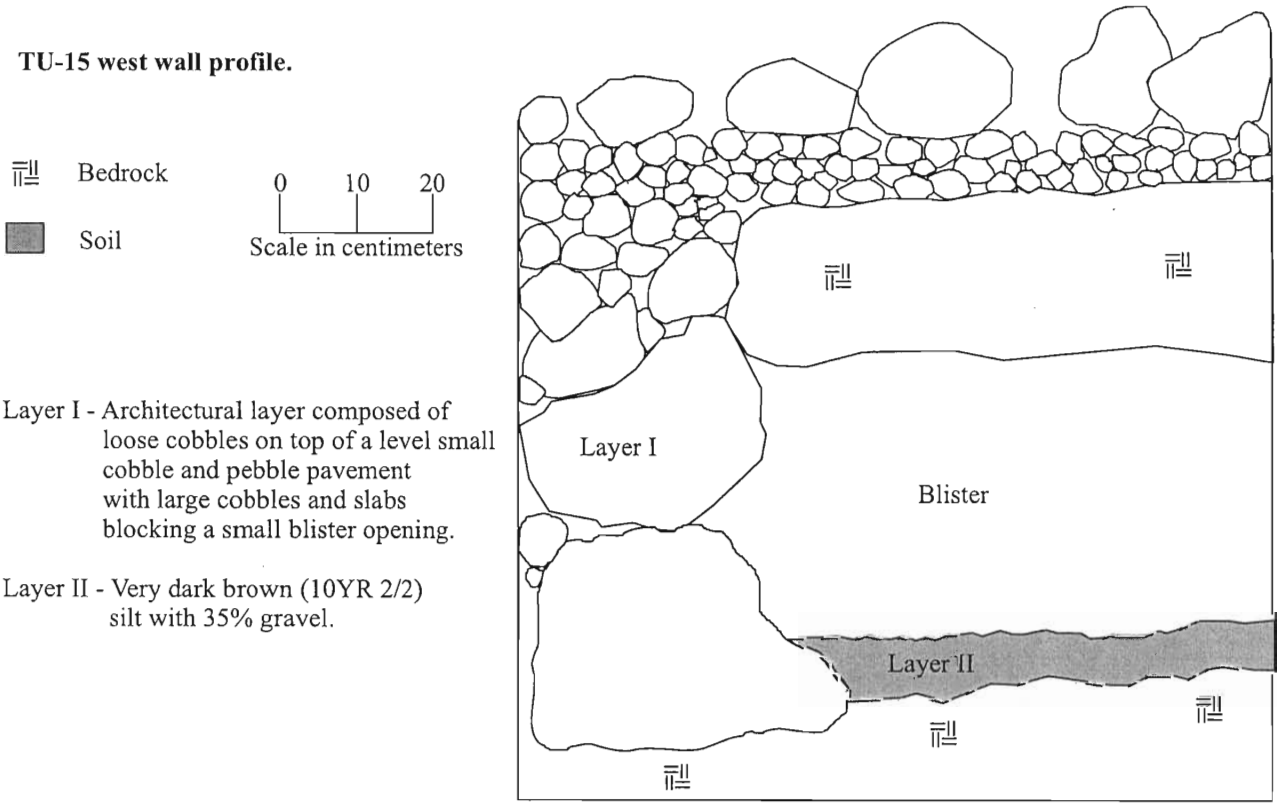
Acc#	*Layer*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
74	I	*Echinoderm*	*Echinoidea*	69	2	3.1
75	I	Volcanic glass	Flake	2	NA	1.4
76	I	Organic	Charcoal	20	NA	2.5

Feature B

Feature B is a collapsed lava tube segment with modifications located approximately 30 meters east/northeast of Feature A in the southwestern portion of the current study area (see Figure 15). The ceiling of the tube collapsed leaving an opening 3.7 meters (east-west) by 1 meter (north-south) (Figure 100). The floor of the tube averages 0.8 meter below the surrounding upper ground surface (Figure 101). At the western end of the exposed tube a subsurface portion extends 1.5 meters with a ceiling height of 0.4 meter. The floor in this section consists of cobbles with collapsed ceiling boulders further west that block off the tube in that direction. A small overhang at the eastern end of the northern side covers an area of 1 meter by 2 meters; a marine shell was observed below the overhang. The overhang continues to the east end where the tube extends 2.2 meters with a ceiling height of 0.6 meter; on the floor of this small cavity *kukui* and charcoal were observed. The eastern extent of the cavity is blocked by ceiling collapse. At the western end of the collapsed tube on the top ground surface is piled small and medium sized *pāhoehoe* cobbles. These may have been piled as they were cleared from the collapsed tube. This small, exposed, lava tube likely served as a shelter for Precontact temporary habitation.



TU-15 west wall profile.



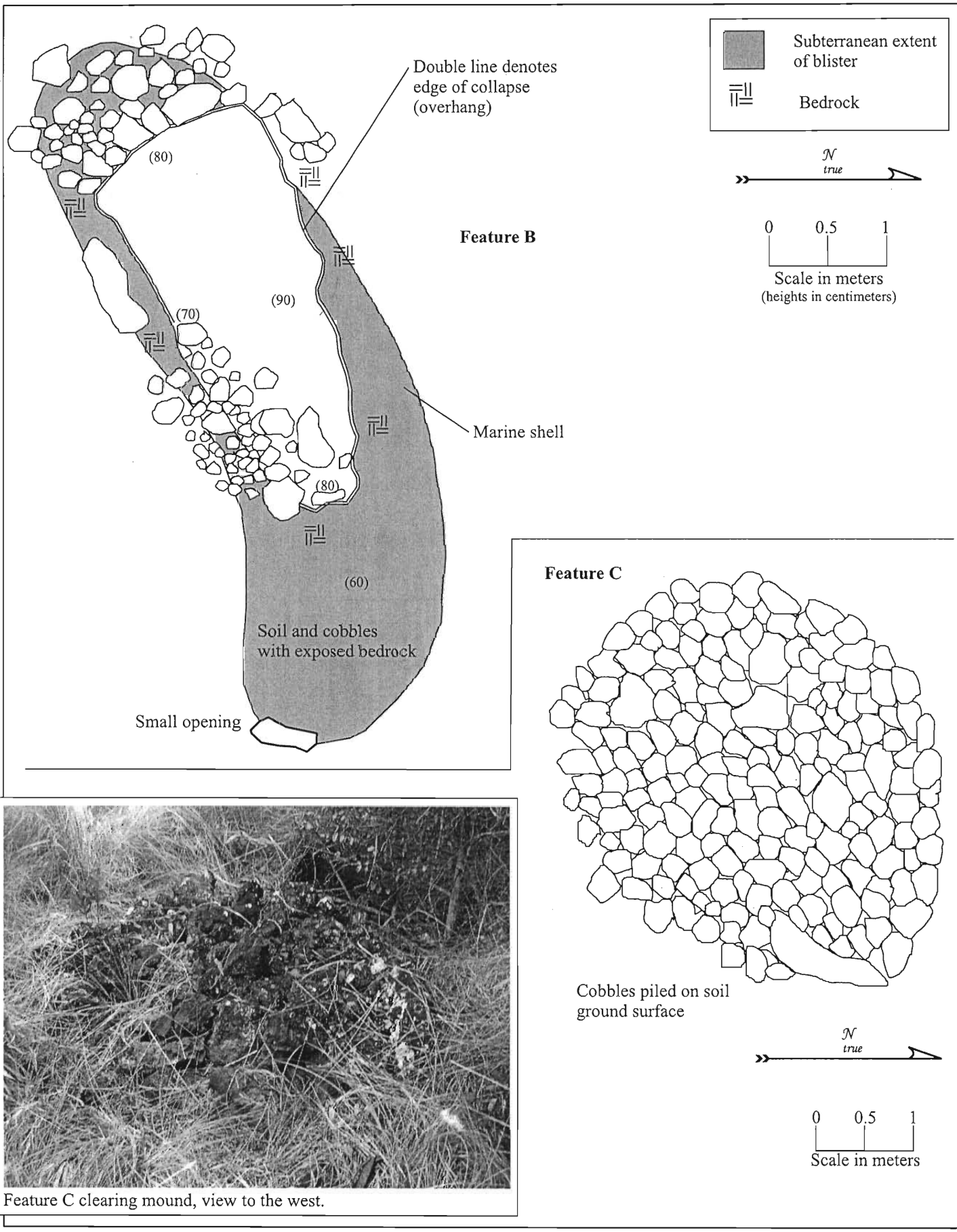
Layer I - Architectural layer composed of loose cobbles on top of a level small cobble and pebble pavement with large cobbles and slabs blocking a small blister opening.

Layer II - Very dark brown (10YR 2/2) silt with 35% gravel.

Figure 97. SIHP Site 25044 Feature A plan view and TU-15 west wall profile.

Figure 98. SIHP Site 25044 Feature A enclosure, view to the northeast.

Figure 99. SIHP Site 25044 Feature A, TU-15 base of excavation, view to the west.



Feature C clearing mound, view to the west.

Figure 100. SIHP Site 25044 Features B and C plan views and Feature C photo.

Figure 101. SIHP Site 25044 Feature B, view to the west.

Feature C

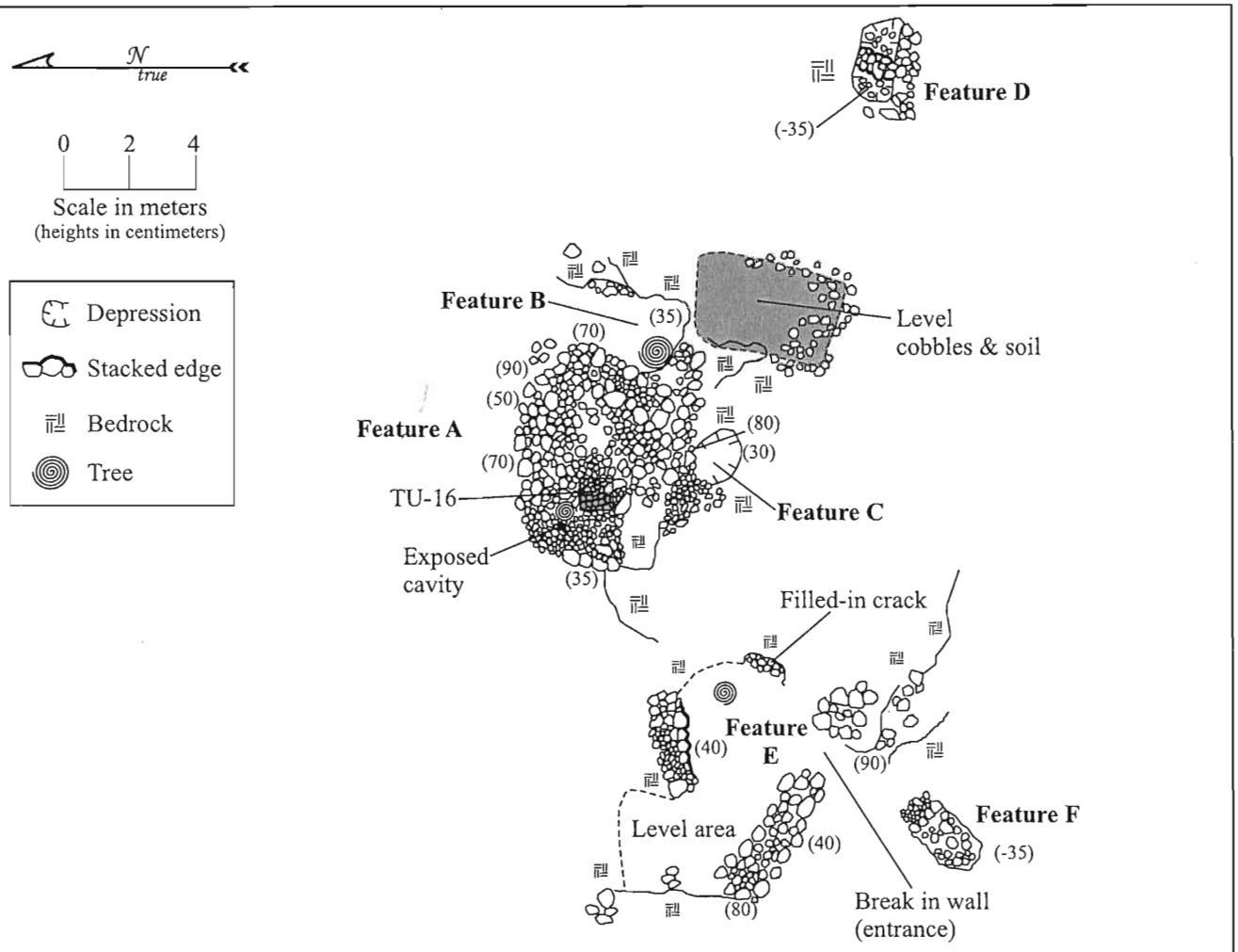
Feature C is an oval pile of cobbles located approximately 30 meters southeast of Feature A (see Figure 15). The mound measures 2.1 meters long (east-west) by 2 meters wide (north-south) and is composed of small to large *pāhoehoe* and *'a'ā* cobbles piled 0.5 meter tall (see Figure 100). *Makai* of the mound is a soil area possibly used for planting; the mound is likely a clearing pile of cobbles removed from the planting area. Feature C is probably an agricultural feature associated with the temporary habitations, Features A and B, due to its close proximity.

SIHP Site 25045

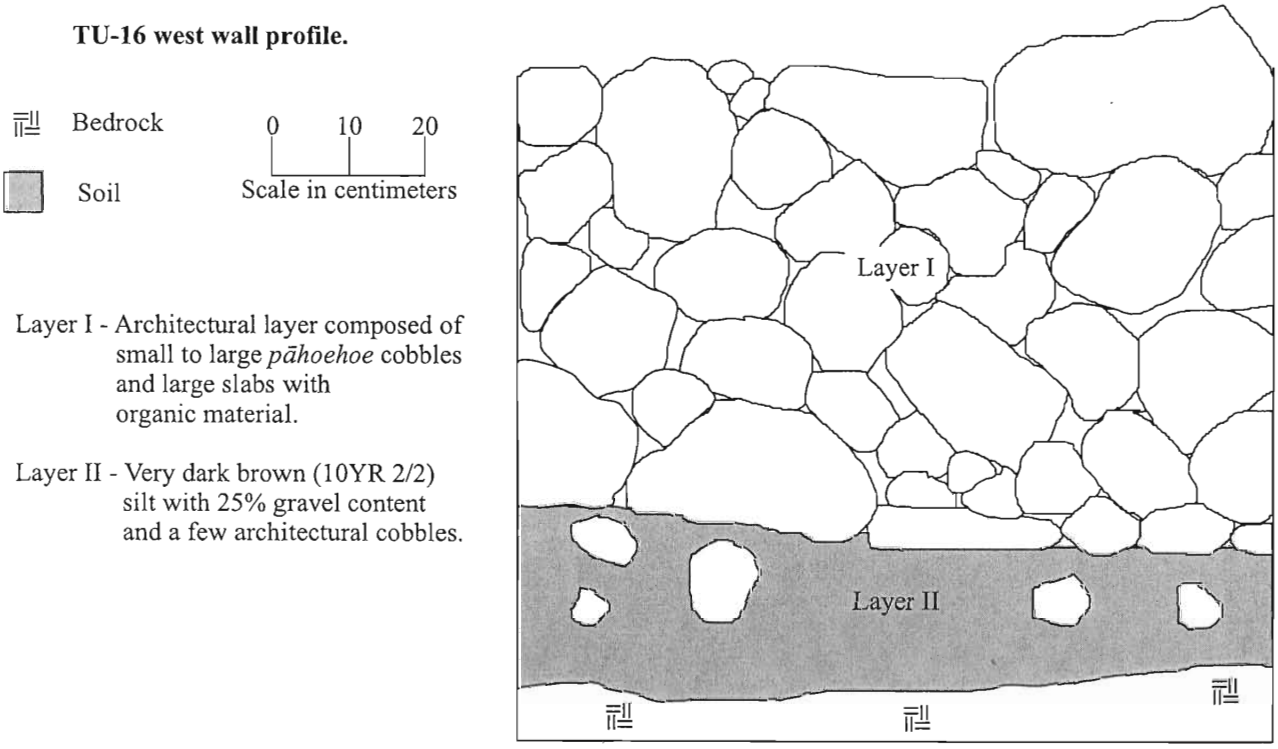
Site 25045 is a complex of six features located in the central portion of the project area (see Figure 15). The features include four modified blisters (Feature A, C, D, and F), a three-sided enclosure (Feature B), and a modified (leveled) area (Feature E) (Figure 102). The features are clustered in a 25-meter by 20-meter area; the concentrated area of modifications suggests that Site 25045 was well utilized and the land was altered to conform to the activities (habitation and agricultural processing) of the inhabitants of the site. This site is in fair condition and retains integrity of setting. Detailed descriptions of the features of Site 25045 follow below.

Feature A

Feature A is a large modified blister that measures 4 meters (north-south) by 5 meters (east-west) (see Figure 102). The feature consists of a roughly paved surface of cobbles, small boulders, and slabs (Figure 103); the western half has two cavities that have been partially filled in. The eastern half has a relatively level surface with the eastern and southern sides of the feature built up with cobbles up to 0.5 meter above the interior surface. The northern edge of the feature is constructed of large cobbles that taper down 0.9 meter to ground surface. The western edge is stacked large cobbles, 0.35 meter above ground surface; the southern edge is piled up and level with a *pāhoehoe* outcrop on the western end; just south of this side is Feature C, a modified blister.



TU-16 west wall profile.



Layer I - Architectural layer composed of small to large *pāhoehoe* cobbles and large slabs with organic material.

Layer II - Very dark brown (10YR 2/2) silt with 25% gravel content and a few architectural cobbles.

Figure 102. SIHP Site 25045 plan view and TU-16 west wall profile.

Figure 103. SIHP Site 25045, surface of Feature A, view to the west.

A 1 x 1 meter test unit (TU-16) was excavated at Site 25045 Feature A in the center of the southern half of the feature to test for the possibility of buried cultural deposits (see Figure 102). Excavation of TU-16 revealed two stratigraphic layers (Layers I and II) (see Figure 102). Layer I, the architectural layer, consisted of small to large *pāhoehoe* cobbles and large slabs and organic matter. Layer I terminated 60 centimeters below the unit's surface at the Layer II soil. Layer II consisted of very dark brown (10YR 2/2) silt with 25% gravel content, and a few larger cobbles extending down from the architectural layer. Excavation of TU-16 terminated at level bedrock at the base of Layer II, 82 centimeters below the unit's surface (Figure 104). Cultural material recovered from the unit (Table 6) included marine shell, volcanic glass flakes, an adze fragment, and charcoal. Based on these findings it is likely that Feature A is a temporary habitation constructed over a collapsed blister; it was probably used during periods of Precontact agricultural activities.

Figure 104. SIHP Site 25045 Feature A, TU-16 west wall profile, view to the west.

Table 6. Cultural material recovered from SIHP Site 25045, TU-16.

Acc#	*Layer*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
84	I	Volcanic glass	Flake	1	NA	1.1
85	I	Shell	*Cypraea*	1	NA	2.5
86	I	*Echinoderm*	*Echinoidea*	1	NA	0.4
87	II	Organic	Charcoal	NA	NA	2.0
88	II	Basalt	Polished adze fragment	1	NA	0.9
89	II	Basalt	Polished adze fragment	1	NA	0.1
90	II	Basalt	Polished adze fragment	1	NA	0.9
91	II	Volcanic glass	Flake	5	NA	2.8
92	II	Shell	*Nerita*	4	2	0.4
93	II	Shell	*Cypraea*	4	2	2.1
94	II	*Echinoderm*	*Echinoidea*	14	NA	1.3
95	II	Shell	*Isognomon*	3	1	0.3
96	II	Crustacean	Crab	1	1	0.1
97	II	Organic	Charcoal	7	NA	1.1
98	II	Volcanic glass	Flake	4	NA	0.7
99	II	Shell	*Cypraea*	10	4	10.0
100	II	Shell	*Isognomon*	9	3	0.8
101	II	*Echinoderm*	*Echinoidea*	11	NA	1.4
102	II	Shell	*Drupa*	1	1	0.3
103	II	Shell	*Nerita*	5	5	2.1

Feature B

Feature B is a 3-sided enclosure located east of the eastern edge of Feature A (see Figure 102). The feature consists of stacked cobbles up against bedrock outcrops, 0.35 meter tall, on the east and south sides; the western side is stacked large cobbles (0.7 meter tall) that are also the eastern edge of Feature A, and the northern portion is void of construction and is left open. The feature measures 3.9 meters (north-south) by 3 meters (east-west). The interior ground surface is level and composed of soil with small cobbles present (Figure 105). The feature probably functioned as a temporary habitation like Feature A to the west.

Figure 105. SIHP Site 25045 Feature B, enclosure, view to the northwest.

Feature C

Feature C is a modified blister located just south of the southern side of Feature A (see Figure 102). The feature consists of a depression that measures 1.5 meters (north-south) by 2.5 meters (east-west), and is 0.3 meter below the top of bedrock to the east and south. The interior of the depression has been filled and leveled with cobbles (Figure 106). This feature may have been filled to create a small work surface; the bedrock to sit on and the depression for one's feet would have made a good sitting area.

Figure 106. SIHP Site 25045 Feature C, view to the southeast.

Feature D

Feature D is a modified blister/*pāhoehoe* excavation located east, 8 meters up the slope above Features A, B and C (see Figure 102). The blister measures 2.3 meters (east-west) by 1.5 meters (north-south), and is 0.35 meter deep. Large blocks of *pāhoehoe* have been excavated out of the blister, some are stacked in the center of the feature, and approximately 50 cobbles and small boulders are piled 0.4 meter tall around the south and west sides of the excavated area (Figure 107). The function of this excavated blister may have been to produce construction cobbles. It appears that some of the cobbles were stockpiled and never used.

Figure 107. SIHP Site 25045 Feature D, modified blister, view to the east.

Feature E

Feature E is a level area partially enclosed by two linear modified outcrops. The feature is located southwest of Feature A (see Figure 102). The cleared area bounded by the modified outcrops measures roughly eight meters by six meters. The smaller of the two modified outcrops is along the northern side of the level area. It measures 4.5 meters long, trending east/west, by 1.2 meters wide and has a maximum height of 1 meter above the interior ground surface to the south (Figure 108). The other modified outcrop is along the southern edge of the level area and has an overall length of 8.0 meters long, with an average width of 1.0 meter wide and maximum height of 1.2 meters tall. A gap in the construction at the eastern end may be an entrance into the level area. Both modified outcrops consist of piled cobbles and boulders on bedrock. The eastern end of the leveled area has a bedrock outcrop creating a natural boundary; a small blister opening is located at the base of the outcrop and appears to have been blocked with cobbles. The level area probably functioned as a habitation or planting area; the cobbles piled around the level area were probably cleared out of the soil interior and used to build the wall-like features on the outcrops surrounding the area.

Figure 108. SIHP Site 25045 Feature E, linear modified outcrop, view to the west.

Feature F

Feature F is a cobble filled blister located 3 meters south of Feature E (see Figure 102). From edge to edge the blister measures 2.4 meters (northeast-southwest) by 1.2 meters (northwest-southeast), and is filled in level to the ground surface except on the west side where it is 0.3 meter deep (Figure 109). The cobble fill consists of small to large *pāhoehoe* cobbles and small boulders, and a few cobbles are outside the blister lining the edge on the surface. Cobbles cleared from nearby areas were used for filling the blister.

Figure 109. SIHP Site 25045 Feature F, filled bedrock crack, view to the southwest.

SIHP Site 25046

Site 25046 consists of an enclosure (Feature A) with a modified blister (Feature B) approximately five meters north of it. The site is located on western sloping terrain in the center of the project area (see Figure 15). It occupies a roughly 15-meter by 15-meter area. Based on the formal attributes of the features, Site 25046 likely represents the remains of a small, Precontact temporary habitation complex; it was possibly a multi-use site and associated with agricultural processing. This site is in fair condition and retains integrity of setting.

Feature A

Feature A is an enclosure composed of stacked cobbles on and against bedrock outcrops and is open to the east (Figure 110). Overall, it measures nine meters by nine meters. The western portion of the feature is a wall (0.8 meter tall by 1.3 meters wide) of stacked large slabs and cobbles that bridges a gap between two bedrock outcrops 5 meters apart. The top surface of the wall is sloped down to the southwest and may have functioned as a ramp that led from bedrock surface in the south up to the surface of a modified outcrop at the northern end of the feature. The northern portion of the enclosure consists of small to large cobbles that create a relatively level surface that also doubles as the northern wall of the enclosure (Figure 111). The eastern end of the enclosure is left open; the southern wall of the enclosure is bedrock with modification consisting of stacked large cobbles up to the outcrop at the eastern end. The western end of the south wall is an unmodified bedrock outcrop. The enclosure has a level interior composed of soil. Based on its formal attributes, Feature A may have functioned as a Precontact habitation area.

Feature B

Feature B is a modified blister located four meters north of Feature A (see Figure 110). Overall, it measures 6.5 meters long by 1.0 meter wide. The opening is 1.0 meter by 0.8 meter with a depth of 0.4-meter floor to ceiling. The opening is lined with five small boulders along the north side and three on the south side (Figure 112). The tube is very narrow and extends 3 meters to the east and west from the opening. This small blister probably functioned as a storage area associated with the Precontact habitation at Feature A, to the south.

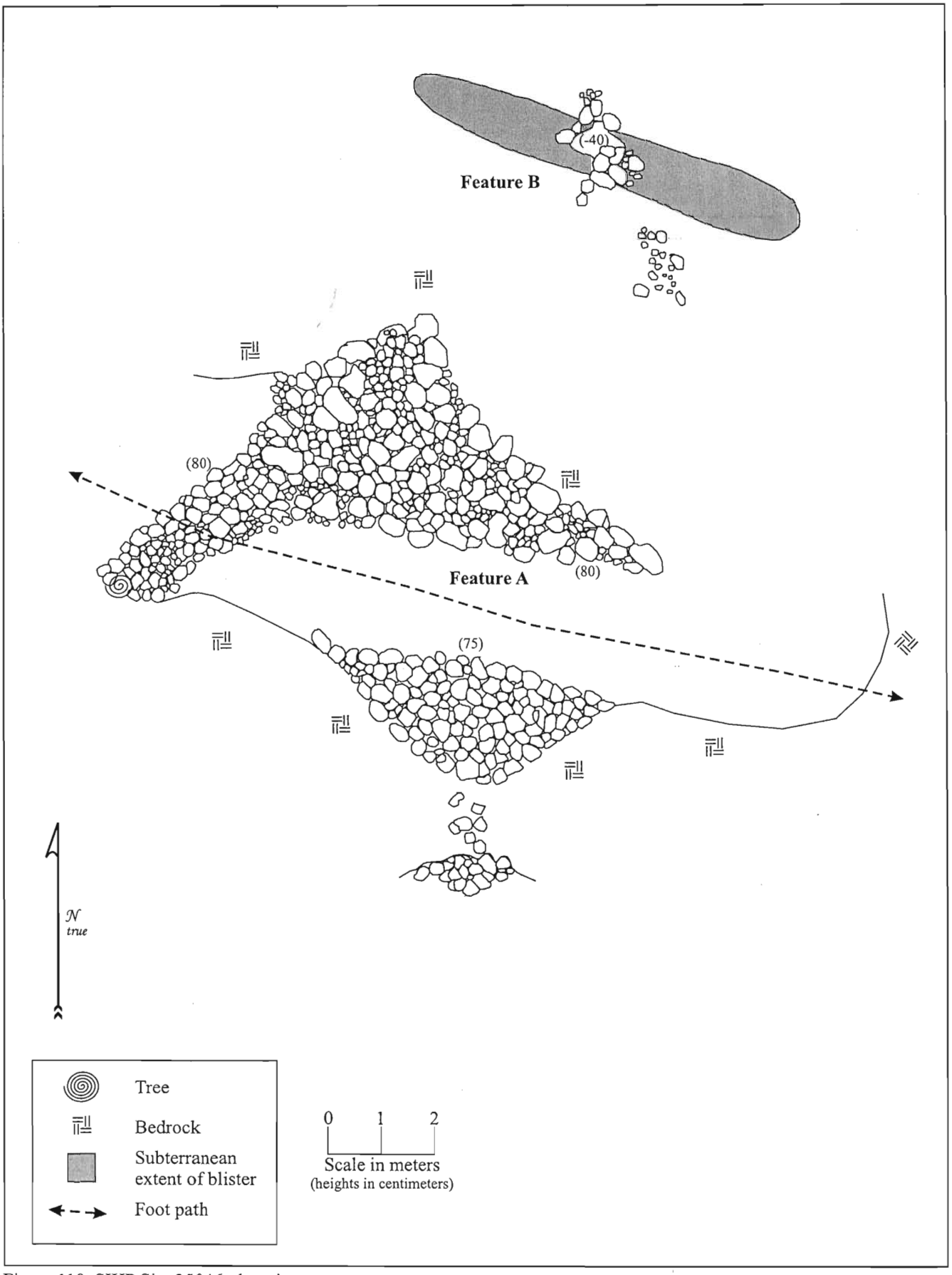


Figure 110. SIHP Site 25046 plan view.

Figure 111. SIHP Site 25046 Feature A (note cobble surface in foreground), view to the south.

Figure 112. SIHP Site 25046 Feature B, view to the north.

SIHP Site 25047

Site 25047 consists of a platform (Feature A), located just west of a large enclosure (Feature B); the features were combined into one site due to their close proximity (Figure 113). The site is located approximately 20 meters south of the northern bulldozer road in the central/western portion of the current study area (see Figure 15). No cultural debris was observed on ground surface at Site 25047, but a test unit excavated at Feature A (TU-9) revealed the presence of Precontact habitation debris. Based on the results of testing at Feature A and the formal attributes of the features, Site 25047 was likely used for Precontact habitation purposes. This site is in fair condition and retains integrity of setting.

Feature A

Feature A is a platform that measures 3.0 meters by 3.0 meters, and is constructed with loosely stacked and piled *pāhoehoe* cobbles and small boulders along the periphery, and small cobbles on the top paving the level surface (see Figure 112). The platform is level with the ground surface on the eastern edge, and 0.6 meter above the ground surface on the western edge.

A 1 x 1 meter test unit (TU-9) was excavated at Feature A in the northeastern corner of the platform. Excavation of TU-9 revealed two stratigraphic layers (Layers I and II). Layer I, the architectural layer, consisted of piled small to large *pāhoehoe* cobbles; it terminated 20 centimeters below the unit's surface. Layer II consisted of dark brown (10YR 3/2) silt with 90% gravel and small cobble content. Excavation of TU-9 terminated at eroding *pāhoehoe* bedrock at the base of Layer II, 35 centimeters below the unit's surface. Cultural material including marine shell, volcanic glass flakes, and charcoal was recovered from the unit (Table 7), indicating that Feature A likely functioned as a temporary habitation.

Table 7. Cultural material recovered from SIHP Site 25047 TU-9.

Acc#	*Layer*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
45	I	Shell	*Cypraea*	3	2	10.0
44	I	Organic	Charcoal	7	-	1.0
47	II	Volcanic glass	Flake	2	-	7.0
48	II	Shell	*Conus*	1	1	6.8
49	II	*Echinoderm*	*Echinoidea*	5	1	0.4
50	II	Shell	Unknown	2	1	0.3
51	II	Coral	Waterworn	1	1	0.7
52	II	Organic	*Kukui*	1	1	0.7
53	II	Shell	*Cypraea*	1	1	0.3
54	II	Organic	Charcoal	-	-	1.8

Feature B

Feature B is a large enclosure located just east of Feature A (see Figure 113). The enclosure wall encircles a cobble-covered *'a'ā* lava flow zone that has been modified with small cobble paving on much of the southern half. The paved area measures roughly sixteen meters by twelve meters. The northern half contains a tall outcrop in the western portion, with a large cobble and small boulder-stacked wall (4-courses/1 meter tall by 6 meters long by 0.5 meter wide) constructed up against its eastern edge. The enclosure has a rounded irregular shape that measures 26 meters by 26 meters. The enclosure wall consists of stacked large cobbles and boulders 0.6-0.7 meter tall in most places, but is composed of single large upright boulders and slabs set side by side on the northern end with a maximum height of 1.3 meters. A break in the southern section of the wall was likely caused by collapse, and is not an entrance to the feature. A cobble lined posthole-like depression was observed in the northeastern corner that measures 0.3 meter in diameter, and 0.2 meter deep. A small blister was observed 6 meters southwest of the enclosure. The natural cavity has an opening that measures 0.3 meter by 1 meter, and is 0.5 meter deep. Adjacent to the blister is a large slab; the blister may have been used for storing items, and the slab was probably used as a cover over the opening. No cultural debris was observed within the enclosure or the small blister. The enclosure probably functioned as a protective barrier to deter animals from entering the habitation area on top of the paved surfaces inside the walls.

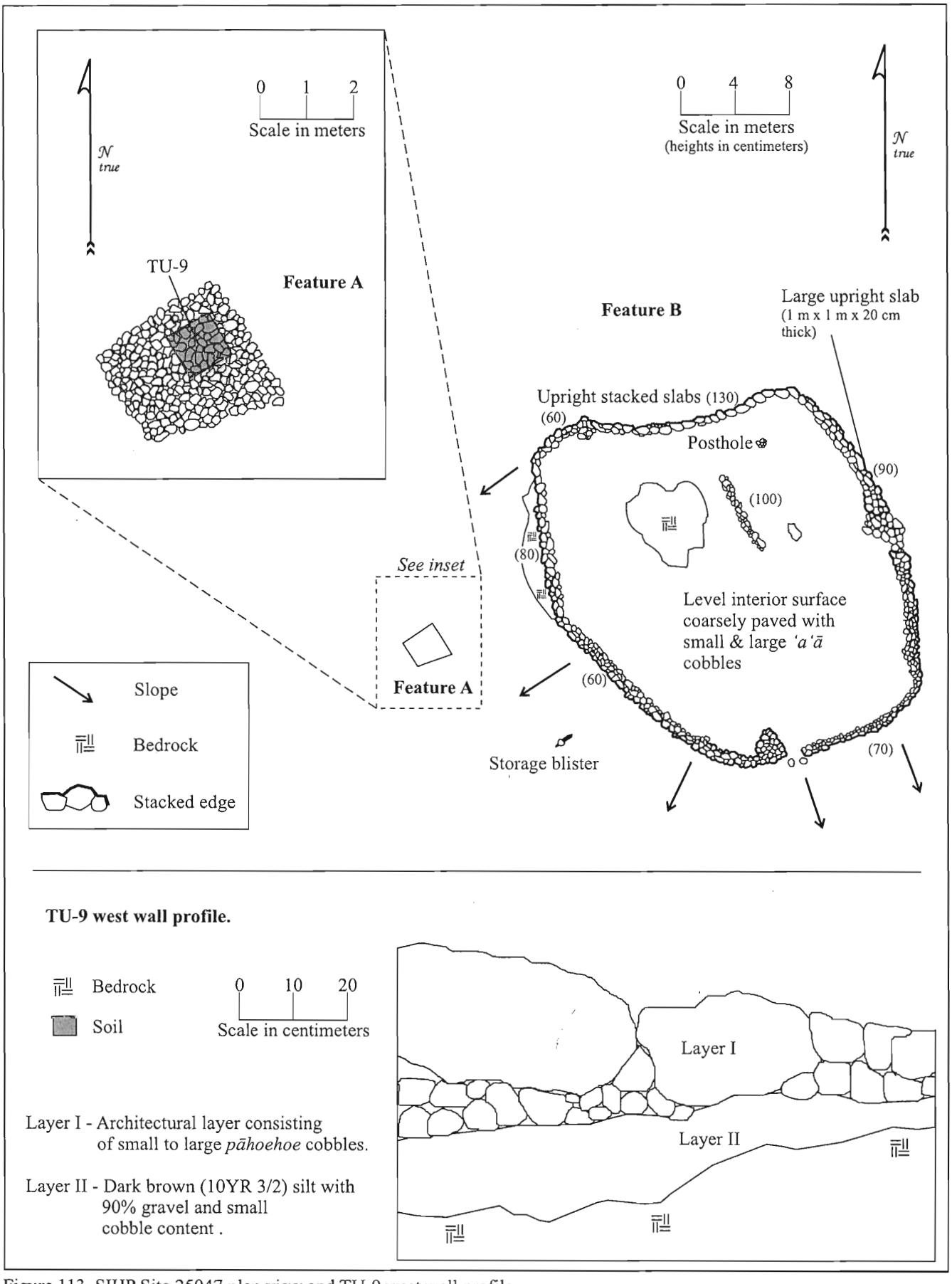


Figure 113. SIHP Site 25047 plan view and TU-9 west wall profile.

SIHP Site 25048

Site 25048 consists of a modified blister (Feature A) approximately 20 meters east of another modified blister (Feature B), and two modified outcrops (Features C and D). This site is located 3 to 10 meters south of the northern bulldozer road in the central/western portion of the current study area (see Figure 15). Overall, the site occupies a thirty-meter by ten-meter area. The features were grouped as a site because they are all modified areas on the same flow line that drops off to the north and south of the features. Feature A is located nearby Site 25047 and residents of that site may have also utilized it. Features B-D are situated on natural bedrock and cobble covered terrace with a prominent view to areas *makai.* Based on the formal attributes of these features and the presence of marine shell and urchin at Features A and B, it is likely that Site 25048 was used for Precontact habitation purposes, perhaps on a seasonal basis associated with the agricultural pursuits within the current project area. This site is in fair condition and it retains integrity of setting.

Feature A

Feature A is a Precontact lava blister habitation that consists of a roughly rectangular subsurface chamber (running north-south) with a large opening created by the collapse of the ceiling bedrock on its eastern side (Figure 114). The adjacent modified area consists of a raised collection of cobbles that runs north/south east of the eastern edge of the blister. Feature A is located approximately five meters south of the northern bulldozer road in the central portion of the current study area (see Figure 15).

The blister measures 6.5 meters (north-south) by 3.0 meters (east-west). The opening is centrally located along the eastern side and measures 3.5 meters (north-south) by 1.3 meters (east-west). The floor of the blister has an average depth of 1.0 meter below the outside (upper) ground surface. The blister's sheltered portions are on the north, west, and south sides; the average floor to ceiling height is 0.9 meter (Figure 115). The main modification to the blister is along the eastern wall. This wall is 4 meters long and consists of stacked large cobbles and small boulders 0.9 meter above the blister floor; on the southern end, cobbles are stacked on top of bedrock that makes up the lower half of the eastern wall. The blister floor is level and composed of scattered small to large cobbles; many cobbles line the base of the eastern, stacked wall. Soil is present in areas, mainly under the overhang on the southern end. Cultural debris including branch coral, *Conus, Echinoidea*, charcoal, and *kukui* were observed inside the blister. The branch coral may indicate that a household shrine was present within the feature.

The modified area to the east consists of a small cobble pavement approximately six meters long by one meter wide that parallels the blister, and extends to the northeast. This area is trail-like in that it is roughly paved and linear, but it probably was created while clearing the blister for habitation, and not utilized as a living area. This modification may have helped to support a roof over the blister. A small cobble covered slope descends to the east from the eastern edge of the level pavement into a depression. The depression does not appear to have been modified. Feature A appears to have functioned as a habitation shelter.

Feature B

Feature B is a blister located in the west-central portion of Site 25048 (see Figure 15). The blister measures approximately 3.5 meters (north-south) by 3 meters (east-west), not including a 2-meter long subsurface extension off the northwest corner (Figure 116). The blister has no ceiling except for small overhangs in the southeast corner, northern side, and northwestern corner (Figure 117). The floor of the blister is approximately 1.5 meters below the upper ground surface; the floor consists of scattered large cobbles, with small cobble paving under the overhangs on the northern edge, and eastern edge. The northwestern extension has a ceiling height of 0.9 meter above 1-meter wide soil and cobble covered floor. On the soil, charcoal and *Echinoidea* were observed. In the center on the western end of the floor is a large slab that measures 0.8 meter by 0.8 meter, and was probably propped against the western wall of the blister as a ramp, but has fallen. Along the rim of the blister on the north and south sides are stacked large cobbles up to 2-courses. This blister likely functioned as a Precontact temporary habitation.

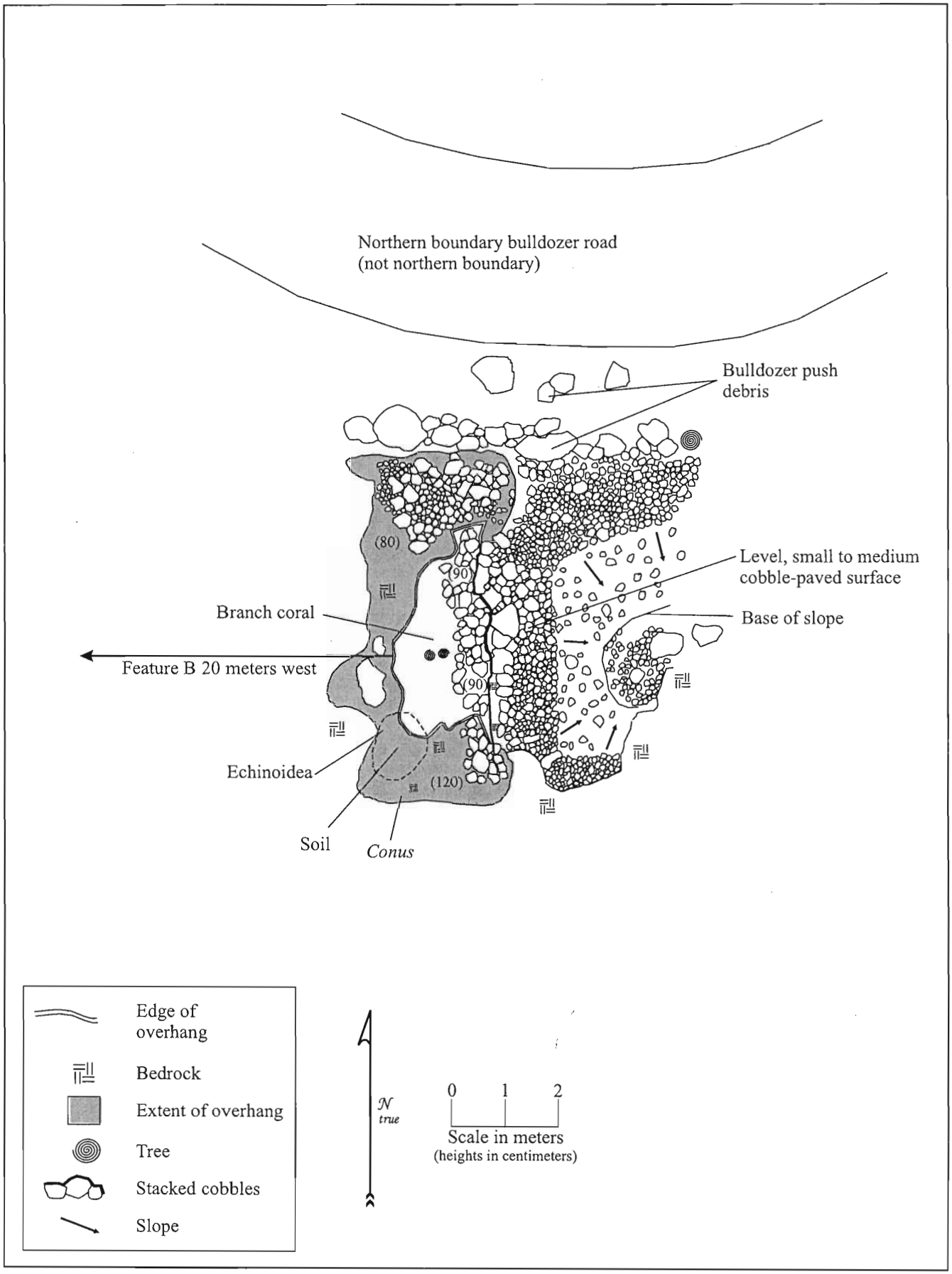


Figure 114. SIHP Site 25048 Feature A plan view.

Figure 115. SIHP Site 25048 Feature A, view to the south.

Figure 116. SIHP Site 25048 Feature B, modified blister, view to the northwest.

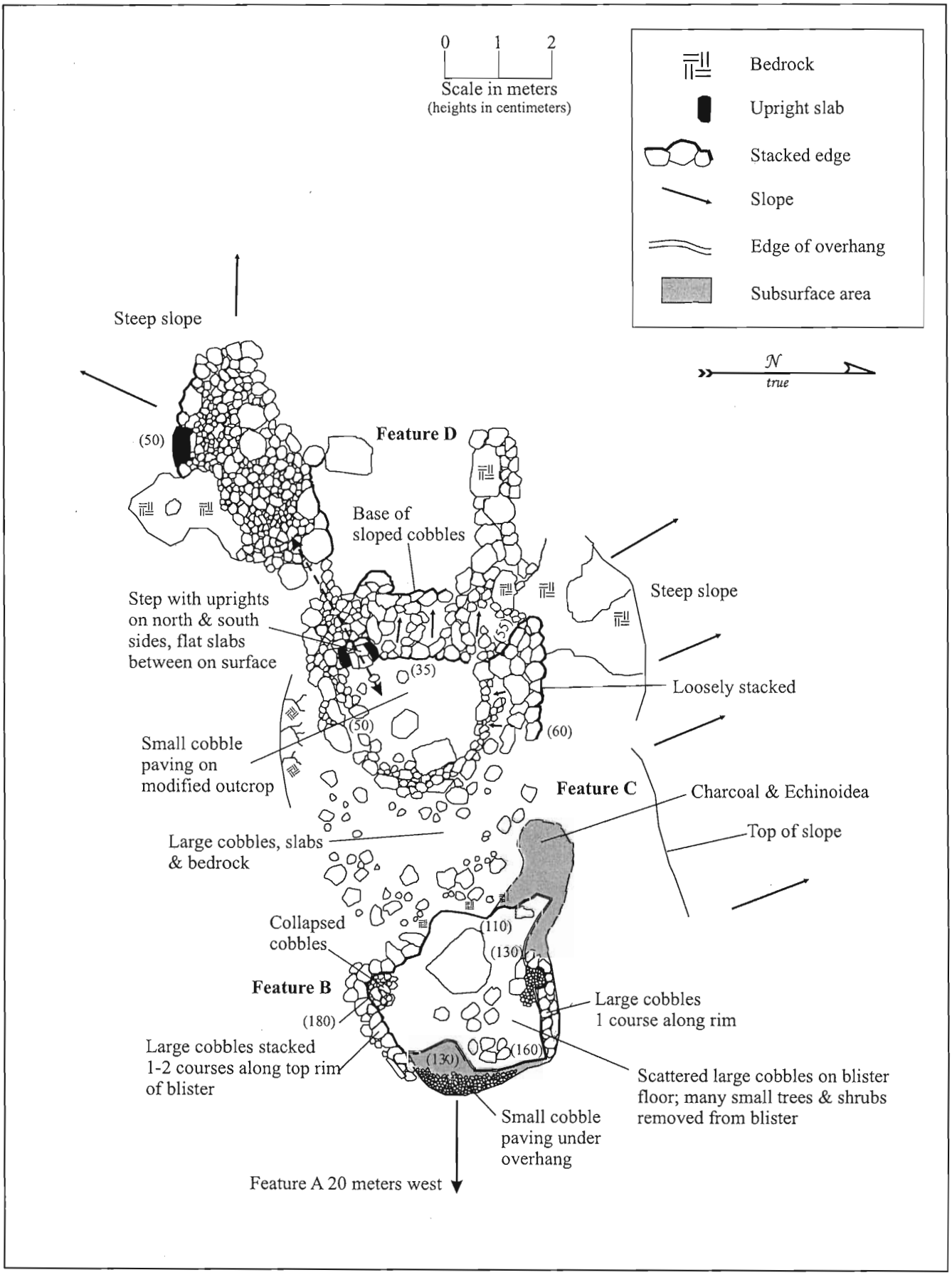


Figure 117. SIHP Site 25048 plan view of Features B, C, and D.

Feature C

Feature C is a modified outcrop located two meters west of Feature B (see Figure 117). The feature was constructed on a western sloping bedrock outcrop, with the eastern edge level to the ground surface, and the western edge stacked up to compensate for the slope and create a level surface in the center. The feature measures 4.0 meters (north-south) by 3.5 meters (east-west), and has a maximum *makai* height of 1.4 meters. A low, loosely stacked wall was constructed around the level paved surface on the north, south, and western edges; the eastern side was left open. The wall on the northern side consists of large cobbles and slabs loosely stacked 0.5 meter high on the interior edge, and is 0.55 meter above the bedrock ground surface to the north. The southern wall consists of loosely stacked large cobbles 0.5 meter above the paved surface on the northern edge, and is level to a bedrock outcrop on the southern edge. The western wall is 0.3 meter tall on the eastern edge, and on the west drops 1.4 meters to the level ground surface *makai* of the feature (Figure 118). The top, paved surface measures 2.5 meters (north-south) by 2 meters (east-west) and is paved with small cobbles with a few large slabs on top of the paving. In the southwestern corner is an entrance feature consisting of 2 upright slabs, 0.3 meter tall that are spaced 0.5 meter apart (Figure 119). The surface between the slabs is paved with horizontal slabs that were fit together. The slab arrangement is on the same level as the paved area of Feature C and was probably part of a now collapsed stairway or ramp that ascended the feature from the west. Natural bedrock and loose cobbles extend west from the northwestern corner of the feature. Based on its formal attributers and proximity to Feature B, Feature C probably functioned as a Precontact temporary habitation.

Figure 118. SIHP Site 25048 Feature C, view of *makai* edge, toward the northeast.

Feature D

Feature D is a modified outcrop located southwest of Feature C (see Figure 117). Feature D measures 4.5 meters (east-west) by 2.0 meters (north-south). The feature consists of medium and large cobbles around the periphery, with smaller cobbles in the center that pave a relatively level top surface (Figure 120). The northern edge of the feature consists of loosely stacked cobbles 0.5 meter tall; the southern edge is loosely stacked *ʻaʻā* cobbles and slabs (one upright), constructed up to a bedrock outcrop on the eastern end. The area to the north of the feature consists of cleared bedrock covered by grass. This feature was likely constructed during clearing activities associated with the habitations at Features B and C and especially to the west of Feature C.

Figure 119. SIHP Site 25048 Feature C, upright slabs in southwest corner, overview to the west.

Figure 120. SIHP Site 25048 Feature D, modified outcrop, view to the west.

SIHP Site 25049

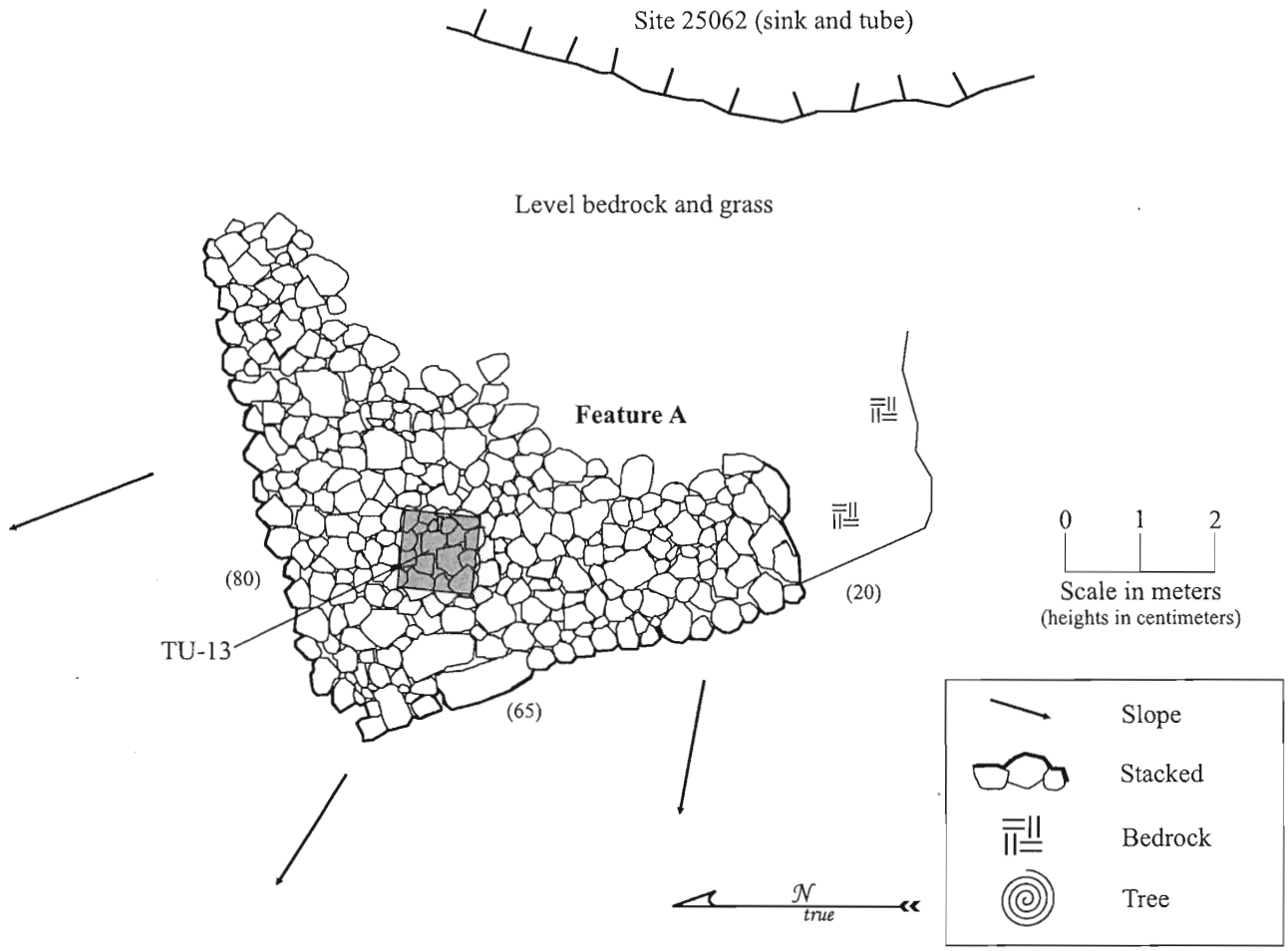
Site 25049 consists of three features located in the west-central portion of the study area (see Figure 15). The features include two modified outcrops (Features A and C) and a pavement (Feature B) located at the northern end of the site. Site 25049 is a complex of habitation features that were combined into one site due to their function, and relative close proximity. The features occupy a 40-meter by 15-meter area. The features within Site 25049 were used for Precontact habitation purposes, perhaps on a seasonal basis associated with the agricultural pursuits within the project area. This site is in fair condition and it retains integrity of setting.

Feature A

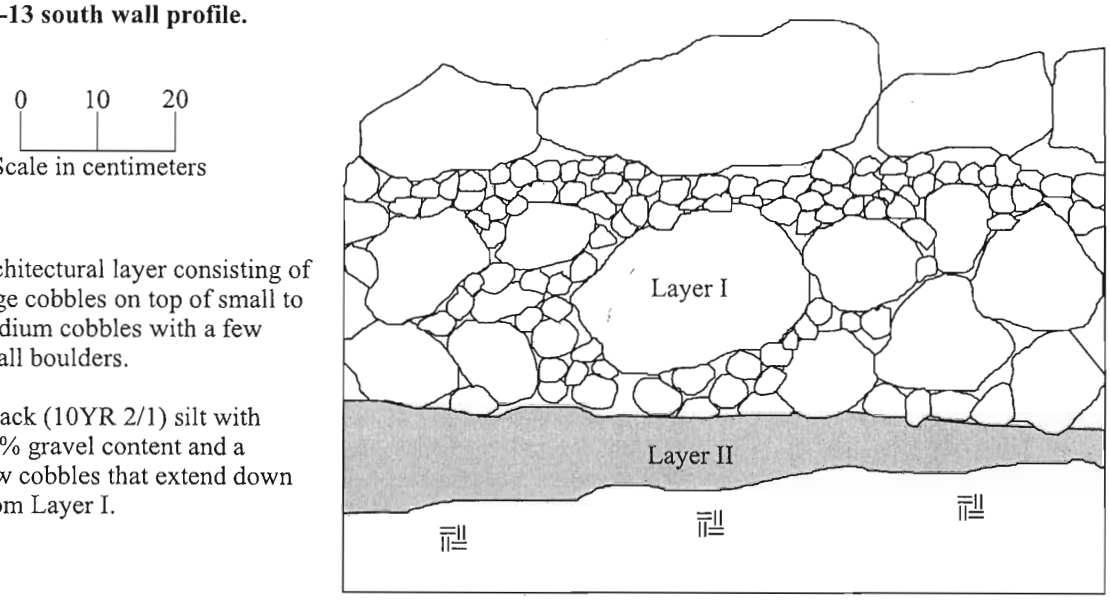
Feature A is a modified outcrop located four meters west of the western rim of Site 25062, a lava tube habitation (Figure 121). Feature A is approximately 40 meters north of Feature B, and 25 meters south of Feature C. The feature is constructed against the western side of an outcrop and is triangular in shape (Figure 122). The northern and western sides are stacked, and the southeastern edge is constructed level to the outcrop to the east. The western edge is 6.0 meters long with a maximum height of 0.65 meter above the ground surface. The northern edge is approximately 7.0 meters long with a maximum height of 0.8 meters. The ground surface to the north and west slopes steeply *makai.* The edges are composed of 2-4 courses of stacked large cobbles and small boulders; large upright slabs were also used along the edge to retain interior cobble fill. The top of the feature is composed of small to large cobbles and slabs used to pave the relatively level surface. Feature A probably functioned as a habitation feature and may have also been used for agricultural processing purposes.

Figure 121. SIHP Site 25049 Feature A, view to the north.

A single 1 x 1 meter test unit (TU-13) was excavated at Feature A in the center of the top surface to test for the possibility of buried cultural deposits. Excavation of TU-13 revealed two stratigraphic layers (see Figure 122). Layer I, the 35-centimeter thick architectural layer, consisted of large cobbles on the surface, with small and medium cobbles, and a few small boulders. Layer II continued beneath Layer I to a depth of 45 centimeters below the unit's surface. This layer consisted of black (10YR 2/1) silt with 50% gravel content, and small to large cobbles, part of the architectural layer that extends into Layer II. Excavation of TU-13 terminated at undulating bedrock at the base of Layer II, 45 centimeters below the unit's surface. No cultural material was recovered during the excavation of TU-13. Despite the absence of cultural material in TU-13, Feature A was likely a temporary habitation based on its construction characteristics. The feature is constructed in a similar fashion to other temporary habitation features within the project area. The use of this feature may have been related to the use of the habitation at Site 25062, a lava tube to the east, and may have also been used for agricultural processing.



TU-13 south wall profile.



Layer I - Architectural layer consisting of large cobbles on top of small to medium cobbles with a few small boulders.

Layer II - Black (10YR 2/1) silt with 50% gravel content and a few cobbles that extend down from Layer I.

Figure 122. SIHP Site 25049 Feature A and TU-13 south wall profile.

Feature B

Feature B is a pavement constructed on level bedrock terrain just north of a bedrock outcrop that has a vertical drop on the southwest facing edge of one meter. Feature B is located 40 meters north of Feature A, and 10 meters north of Feature C in the central portion of the current study area (see Figure 15). The feature consists of a level pavement on the southeastern end and a mounded small cobble pavement on the northwestern end (Figure 123). The feature measures 11.0 meters (northwest-southeast) by 5.0 meters (northeast-southwest) overall. The level pavement on the southeastern end measures 1.8 meters (northeast-southwest) by 1.4 meters (northwest-southeast). The pavement is composed of small cobbles that are constructed up to the bedrock ledge on the southwestern edge (Figure 124). The southeastern edge terminates where small cobble paving changes to large cobbles, and the northeastern edge has a well-defined alignment of medium to large cobbles stacked 2-courses/0.3 meter above the outlying ground surface. The northwestern edge is a faint line of small cobbles that are elevated slightly (0.05–0.08 meter) above the ground surface to the northwest. Northwest of the level pavement is an area covered with small cobbles that measures 8.5 meters (northwest-southeast) by 5.0 meters wide. The center of the area is mounded up and slopes down on the southeastern and southwestern sides; the northern and western sides are relatively level below the mounded area. This portion of the feature is probably a clearing pile; the level pavement on the eastern end was possibly used for habitation or for agricultural processing.

Figure 123. SIHP Site 25049 Feature B, view to the southwest.

Feature C

Feature C is a small, modified outcrop located between Features A and B; 25 meters north of Feature A, and 10 meters south of Feature B (see Figure 15). The feature is constructed up against and level to a *pāhoehoe* bedrock outcrop on the east side (see Figure 124). The feature measures 2.6 meters (north-south) by 1.6 meters (east-west); the tallest point above ground surface is on the northwest corner where it is 0.7 meter above the ground surface. Large cobbles are piled on the top surface along the western and northern edges surrounding the level, small cobble pavement on the top (Figure 125). The feature was possibly utilized for habitation or for agricultural processing.

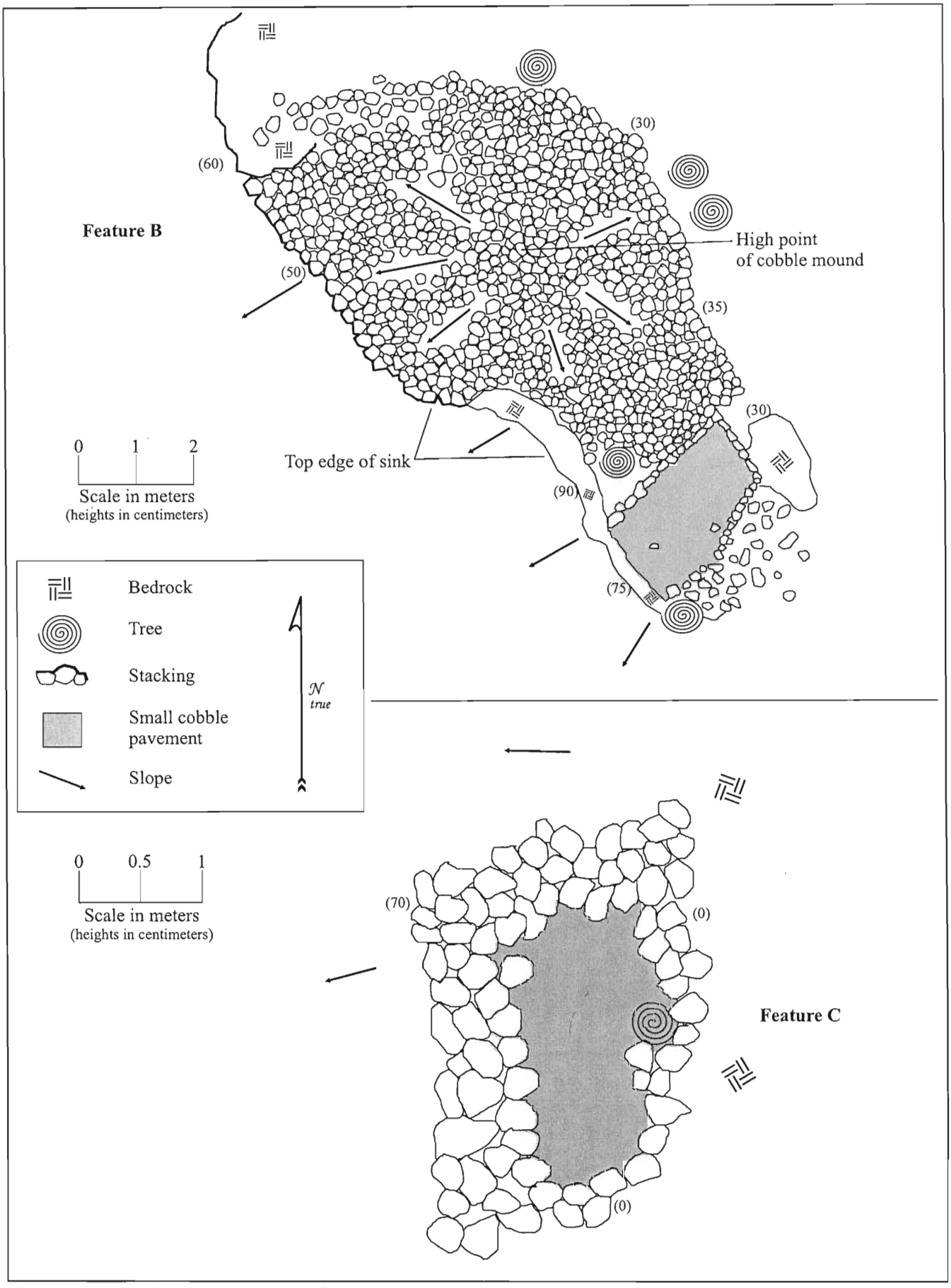


Figure 124. SIHP Site 25049 plan view of Features B and C.

Figure 125. SIHP Site 25049 Feature C, view to the southeast.

SIHP Site 25050

Site 25050 is a habitation complex located in the northwestern portion of the current study area, approximately 80 meters south of the northern bulldozer road (see Figure 15). The site, which occupies a roughly 16-meter by 16-meter area, is situated on a slight to moderate western slope with thin soil and exposed bedrock. It consists of four features including an enclosure (Feature A), a wall (Feature B), and two modified outcrops (Features C and D). Based on the formal attributes of Feature A, it is likely that Site 25050 was used for Precontact habitation purposes, perhaps on a seasonal basis associated with the agricultural pursuits within the current project area. Features B-D are less formal, and probably were constructed as a result of clearing the ground in the site vicinity for allowing easier traversing around the habitation area. This site is in fair condition and it retains integrity of setting.

Feature A

Feature A is an enclosure located in the southwestern portion of the site (Figure 126). The feature measures 8.0 meters (east-west) by 6.0 meters (north-south). The enclosure consists of a naturally enclosed level soil area that is surrounded on the north, east, and southern sides by elevated bedrock outcrops. Cobbles were piled on the outcrops to enhance the enclosed area; the piles stand 0.1 to 0.8 meters tall. The western side of the enclosure was left open with a gap two meters wide. The interior is level and consists of soil and scattered cobbles that have probably collapsed from the surrounding walls. Based on its formal attributes Feature A probably functioned as a temporary habitation.

Feature B

Feature B is a wall that extends to the west from the southern wall of Feature A, an enclosure (see Figure 126). The wall is 0.3 meter above the ground surface to the north, and 6.7 meters long; it is level with ground surface to the south. The feature consists of stacked large cobbles and small boulders 1-2 courses tall, along a west trending low bedrock outcrop. The area to the south of the wall consists primarily of bedrock, and the area to the north consists of thin soil. The wall was probably created to clear the area north of it a define space within the habitation area.

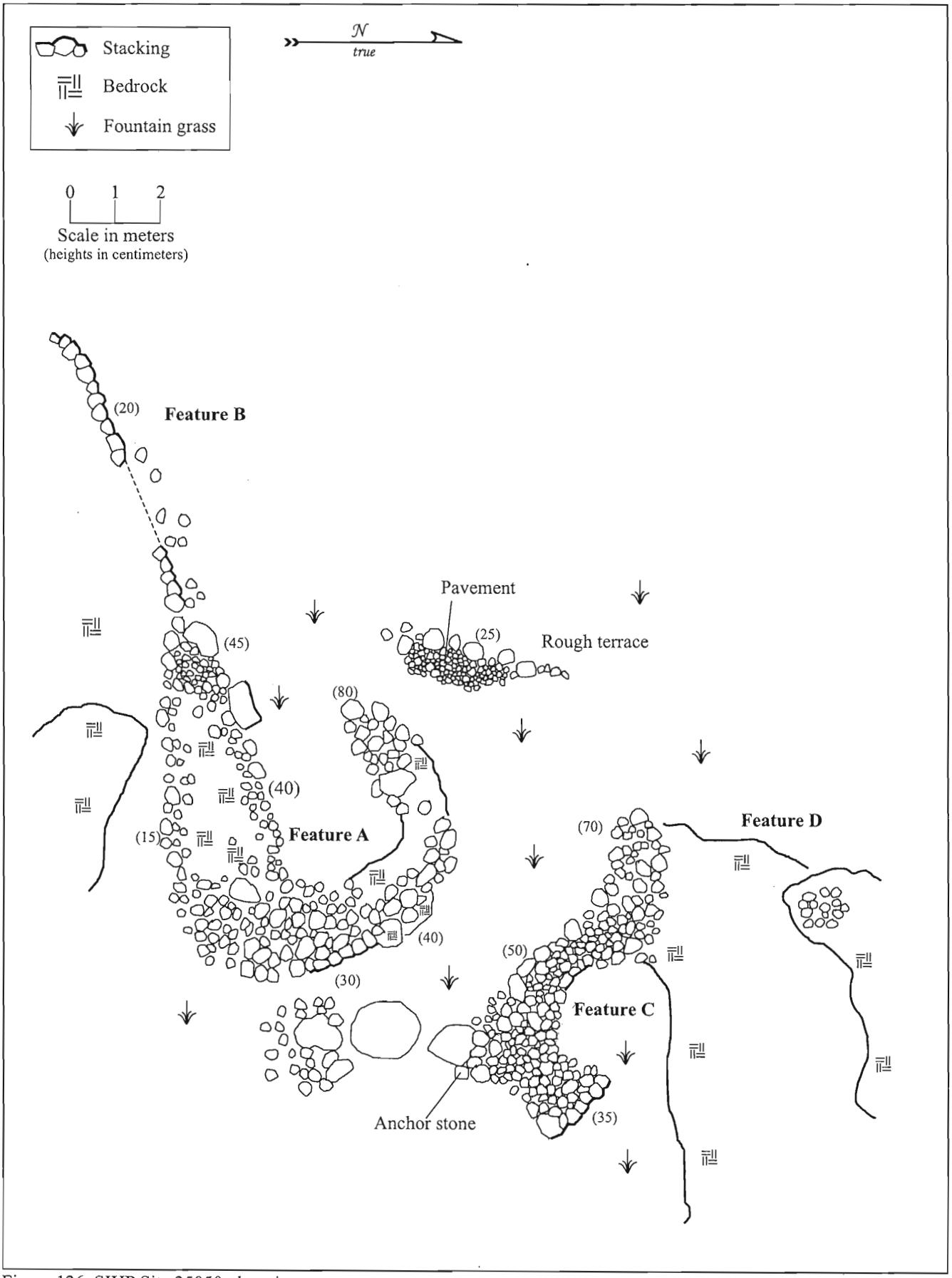


Figure 126. SIHP Site 25050 plan view.

Feature C

Feature C is a modified outcrop located three meters north of Feature A (see Figure 126). The feature consists of piled and stacked large cobbles and small boulders along the southern edge of a *pāhoehoe* bedrock outcrop. Extending off the southern end is a low wall composed of two large slabs and cobbles extending to the south toward the *mauka* wall of Feature A. The feature measures 9.4 meters (north-south) by 1.2 meters wide, and has an average height of 0.6 meters. Adjacent to the southern end of the modified outcrop, an anchor stone with a ground groove around its circumference was observed. The modified outcrop is probably the result of piling cobbles that were removed from the soil (possible planting area) to the east.

Feature D

Feature D is a modified outcrop that consists of piled, small to large cobbles located in the northern portion of Site 25050 (see Figure 126). The feature is constructed up against the western end of a *pāhoehoe* outcrop and measures two meters (north-south) by one meter (east-west). The surface of the feature is mounded and it is surrounded by exposed bedrock. The construction of Feature D is probably the result of piling cobbles that were removed from the soil (possibly planting area) to the west.

SIHP Site 25051

Site 25051 is a complex of features including four enclosures (Features A, B, C, E), a trail (Feature D), and a large platform (Feature F). The site occupies a 40-meter by 15-meter area in the center of the western half of the project area (see Figure 15). Features A-E are located within close proximity, and Feature F is approximately 15 meters to the west. Based on the formal attributes of these features, it is likely that Site 25051 was used for Precontact habitation purposes, perhaps on a seasonal basis associated with the agricultural pursuits within the current project area. This site is in fair condition and it retains integrity of setting.

Feature A

Feature A is a rectangular enclosure that measures 6.0 meters (north-south) by 5.0 meters (east-west). Feature A is located between Feature B (to the east) and Feature C (to the west), in the eastern portion of Site 25051 (Figure 127). The enclosure is constructed with *pāhoehoe* slabs and cobbles with some intact stacking but the walls are mostly collapsed. The enclosure is situated in a low level area below a large *pāhoehoe* bedrock formation to the north. The enclosure's north wall consists of cobbles piled on sloping bedrock with upright *pāhoehoe* slabs lining the interior edge that act as retainers holding the piled cobbles that make up the wall. The eastern wall is loosely stacked and piled cobbles and small boulders with an interior height of 0.8 meter tall and exterior height of 0.35 meter. The southern wall consists of loosely stacked cobbles and small boulders with 3 large upright slabs retaining the cobbles; the interior height is 0.45 and the exterior side is 0.25 meter tall (Figure 128). The western side of the enclosure is loosely stacked to the middle of its span to the northern wall, the northern half is blown out with cobbles scattered about. The interior of the enclosure has a fairly level floor consisting of scattered small cobbles and grass. This feature was probably utilized as a Precontact habitation enclosure.

Feature B

Feature B is a crude enclosure located just *mauka* of Feature A at the east end of Site 25051 (see Figure 127). The east side of the enclosure consists of a 2-meter wide outcrop that has been modified with 2 courses of loosely stacked cobbles on top of eroding bedrock rubble; the height above the interior floor is 0.9 meter (Figure 129). The northern edge is similar, cobbles loosely stacked on eroding bedrock. The south edge is open, and the western boundary is the eastern wall of Feature A, which stands 0.35 meter tall. The interior floor of the enclosure measures 4.0 meters by 3.0 meters and is fairly level with soil, cobbles and dense grass. This feature, based on its proximity to Feature A, was probably utilized as a Precontact habitation enclosure.

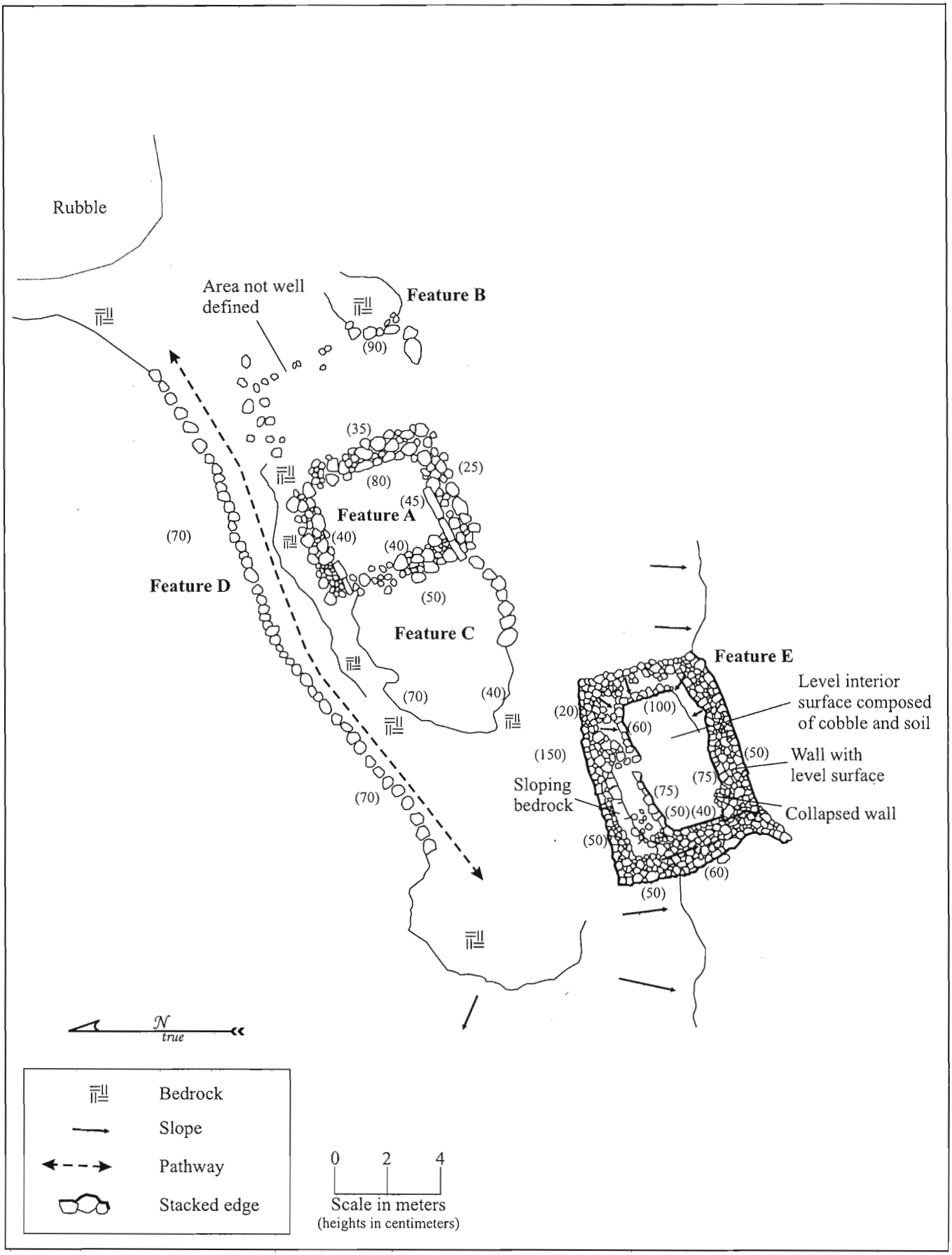


Figure 127. SIHP Site 25051 Features A-E plan view.

Figure 128. SIHP Site 25051 Feature A, enclosure, view to the south.

Figure 129. SIHP Site 25051 Feature B, enclosure, view to the southeast.

Feature C

Feature C is a collapsed blister depression *makai* of Feature A (see Figure 127). The apparent modification to the area was the removal of broken ceiling cobbles to create a natural enclosure with natural bedrock edges (Figure 130). Small boulders line the southern edge for approximately four meters; the eastern edge is also the western wall of Feature A, and the northern edge is natural bedrock, as is the edge to the west. In the northwest and southwest corners of the modified area are blisters that extend a short way under the bedrock but have been partially filled in with cobbles. The interior floor consists of loose cobbles and bedrock covered by grass. The depression was probably utilized as a Precontact habitation enclosure.

Figure 130. SIHP Site 25051 Feature C, enclosure, view to the west.

Feature D

Feature D is a long modified outcrop edge that spans the site on the northern side of Features A, B, and C (see Figure 127). The modification is 20 meters long (east-west) by up to 2 meters wide (north-south) and consists of stacked slabs, boulders and cobbles with intact portions of 3-5 courses with a maximum height of 0.9 meter (Figure 131), but most of the feature is collapsed. The south side of the stacked edge is a level constructed path-like surface with patches of exposed bedrock that runs along the north side of the enclosure features. This modified surface was probably a footpath, but it would have added a level adjacent area to Features A, B, and C upon which activities associated with temporary habitation could be conducted.

Feature E

Feature E is an enclosure located 2 meters south of Feature A's southwestern corner (see Figure 127). The enclosure is constructed off the south side of the large *pāhoehoe* formation that Features A, B, C and D are constructed upon (Feature F, a large platform, is constructed at the west end of the distinctive flow formation). Feature E is rectangular and measures 8 meters (east-west) by 5 meters (north-south). The northern wall is constructed on the side of the outcrop on a steep slope descending to the south with an overall height of 1.25 meters from the floor of the enclosure. The entire slope is modified with stacked cobbles at the top and at the base; between the top and base is exposed bedrock. The eastern wall is also constructed on a steep slope that descends to the west; the base of this slope marks the eastern interior edge of the enclosure. The eastern side is 1.5 meters in height from top of slope to the interior floor of the enclosure. The southern wall is neatly stacked and mostly intact; its interior wall height is 0.75 meter and the exterior wall height is 0.5 meter above the higher exterior ground surface (Figure 132). The western wall is constructed on the bedrock slope on the northern half, and on level ground on the southern end. The wall is stacked and has a maximum height of 0.6 meter. The interior floor of the enclosure is fairly level and composed of mostly small and medium cobbles with some soil present. Feature E was probably utilized as a habitation enclosure.

Figure 131. SIHP Site 25051 Feature D, stacking on east side of enclosure, view to the east.

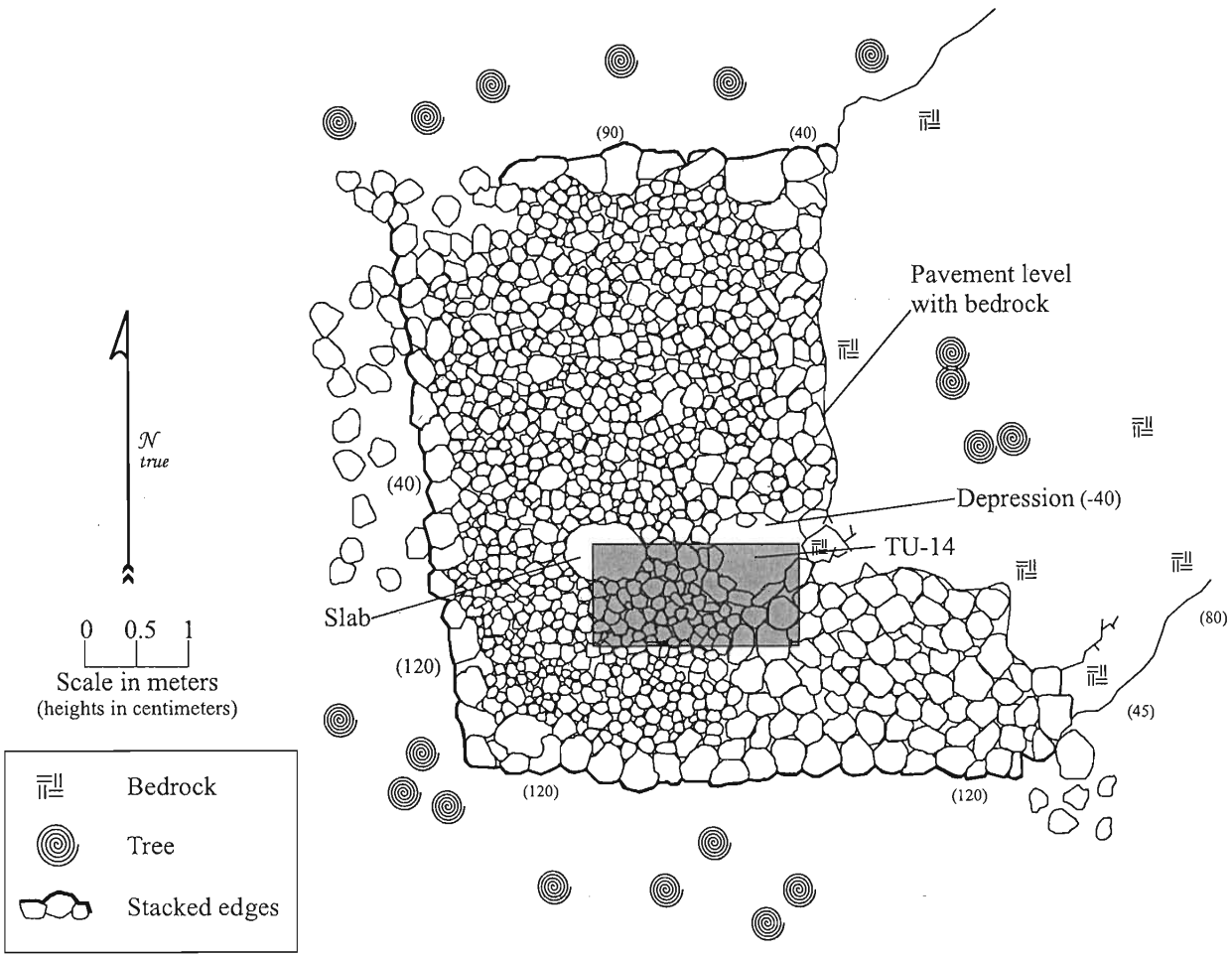
Figure 132. SIHP Site 25051 Feature E, stacked southern wall of enclosure, view to the southwest.

Feature F

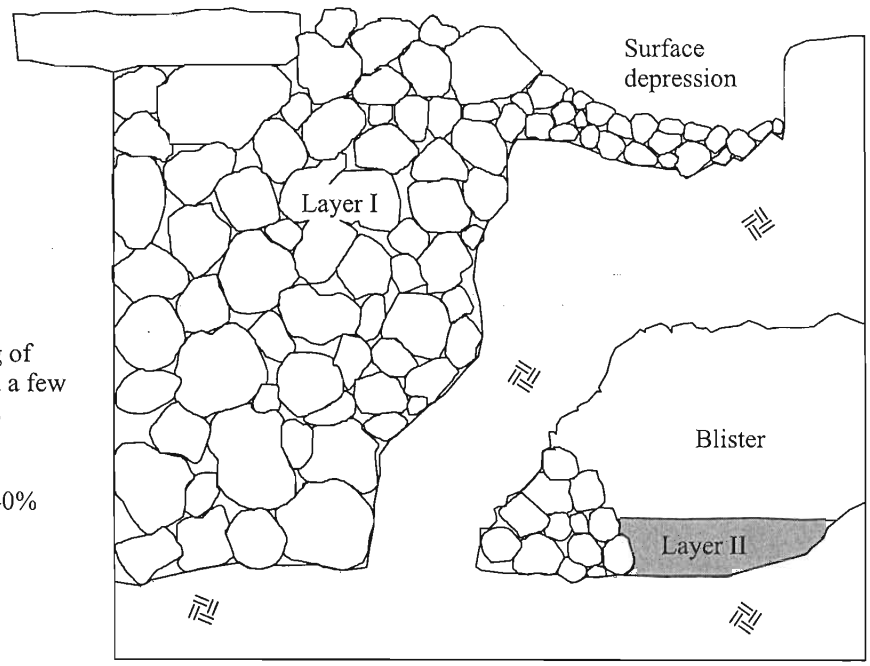
Feature F is a large platform located at the western extent of Site 25051. The platform is constructed off the west end of a large *pāhoehoe* flow formation that Features A-D are constructed upon, and Feature E is built off of to the east. The platform is level with the outcrop on the eastern side, and all other sides are vertically stacked cobbles, although some edges have collapsed (Figure 133). The platform measures 6 by 6 meters with a fairly level top surface composed of small to large cobbles, small boulders and slabs (Figure 134). The southern edge is intact with 4-6 courses of large cobbles averaging 1.2 meters above the ground surface. The western edge is intact at the southern end where it is 1.2 meters tall, but the northern portion of the edge has collapsed and is now sloped tapering down to the bedrock ground surface to the west. The northern edge consists of intact-stacked small boulders 0.9 meter tall. The eastern edge is built up to the bedrock formation; in the southeastern corner the platform wraps around the formation giving the platform an L-shape. In this corner on the surface of the platform is a depression 0.4 meter deep, 0.75 meter in diameter. The depression appears to be a result of settling among the cobbles beneath the surface of the platform as apposed to a deliberately constructed, slab-lined depression seen on other platforms.

A single 1 x 2 meter test unit (TU-14) was excavated at Site 25051 Feature F in its southeastern corner to test for the possibility of buried cultural deposits (see Figure 134). Excavation of TU-14 revealed two stratigraphic layers (Layers I and II) and a lava blister. Layer I, the architectural layer, consisted of small to medium sized cobble paving on the top, level surface. Below the paving were larger cobbles and boulders (a few immovable). Layer I could not be entirely removed due to immovable dense basalt boulders in portions of the western end of the unit. Layer I terminated at a depth of approximately 140 centimeters below the unit's surface. Layer II consisted of a 15-centimeter thick layer of black (10YR 2/1) granular silt with 40% gravel content located under the overhang of a blister that was exposed in the northeastern corner (Figure 135). The blister in the northeastern corner measured 65 centimeters from floor to ceiling by 80 centimeters wide and extends 120 centimeters to the north and northeast, and 1 meter to the east. Excavation terminated at undulating eroding bedrock at the base of Layer II, approximately 145 centimeters below the unit's surface (see Figure 134). No artifacts were recovered from TU-14. Despite the lack of cultural material, but based on the formal attributes of the platform, it is likely that Feature F functioned as a Precontact habitation feature associated with the other features of Site 25051.

Figure 133. SIHP Site 25051 Feature F, view to the southwest.



TU-14 north wall profile.



0 20 40
Scale in centimeters

Layer I - Architectural layer consisting of small to medium cobbles and a few immovable medium boulders placed over a small blister.

Layer II - Black (10YR 2/1) silt with 40% gravel content.

Figure 134. SIHP Site 25051 Feature F plan view and TU-14 north wall profile.

Figure 135. SIHP Site 25051 Feature F TU-14; note blister at east end, view to the northeast.

SIHP Site 25052

Site 25052 is a complex of related features located in the northwestern portion of the current study area (see Figure 15). The site consists of seven features (Figure 136) that are constructed on slightly western-sloped terrain. The ground surface is a combination of exposed *'a'ā* and *pāhoehoe* with thick fountain grass and a few clusters of trees, with very little soil formation. The features are located in an area that measures approximately 40 meters by 40 meters. The site is in fair condition and retains most of its structural integrity and its integrity of location. Marine shell is scattered throughout the site area. Features A-D are interconnected; they consist of an enclosure (Feature A) at the north end of a larger enclosure (Feature B), a rock overhang (Feature C), and a platform enclosure (Feature D). Southeast of Features A-D are two modified outcrops (Feature E and F), and south of Features A-D is a large modified outcrop (Feature G) that includes paved and enclosed areas. Site 25052 appears to have been used for habitation purposes during the Precontact Period, perhaps on a seasonal basis associated with the agricultural activities.

Feature A

Feature A is an enclosure located in the northwestern portion of Site 25052. Feature A is connected to Features B, C and D (Figure 137). The enclosure is rectangular measuring 12 meters (north-south) by 10 meters (east-west) and is constructed with mostly flat slabs laid like bricks, with upright slabs used as wall retainers. The walls are mostly collapsed making them appear more massive than they were when originally constructed. The interior area of the enclosure measures seven meters (north-south) by four meters (east-west). The interior floor is relatively level with a slight slope to the west, and paved with small cobbles. Two ramps, one heading west and one east, extend up from the interior the enclosure. The western ramp is one meter wide and the eastern nearly 2 meters wide.

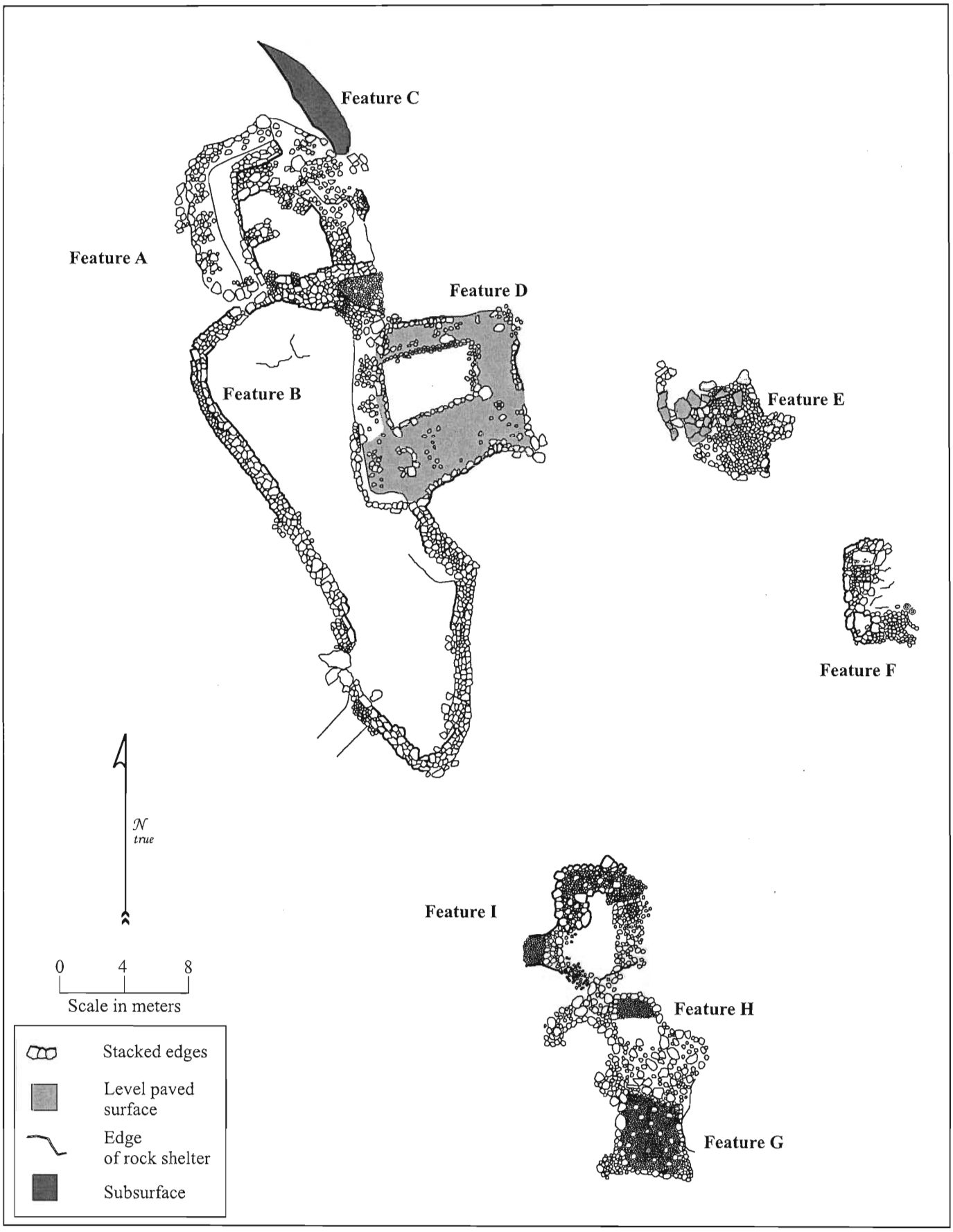


Figure 136. SIHP Site 25052 plan view.

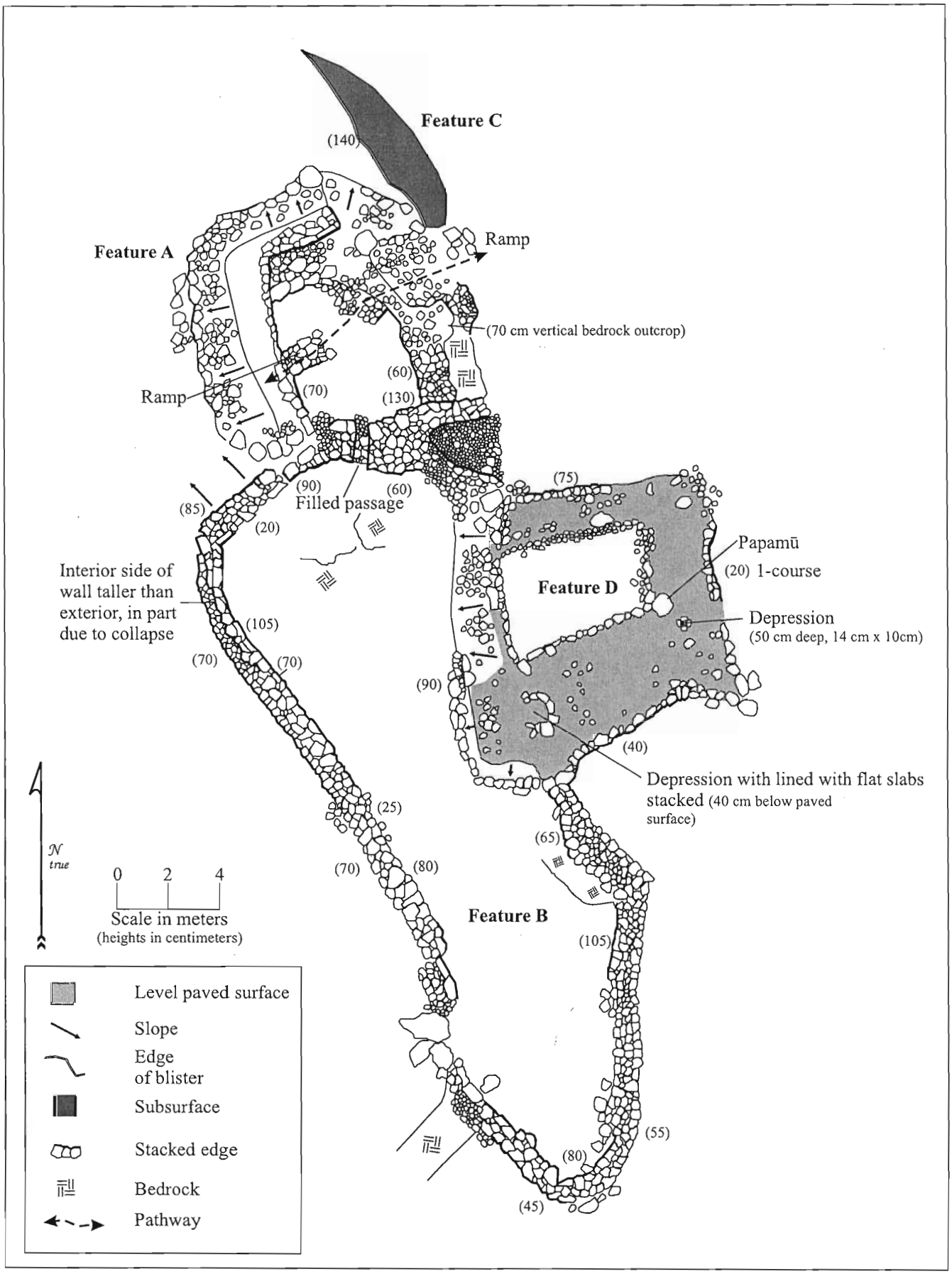


Figure 137. SIHP Site 25052 detailed plan view of Features A-D.

The western wall is constructed on westerly sloping terrain; the interior side is stacked slabs with a maximum height of one meter above the interior ground surface. The top of the wall slopes gently to the west, and the western edge is large cobbles and small boulders that slope steeply down to the natural level cobble-covered ground surface. The overall width of the wall in its collapsed state is three meters. The north wall is two meters wide in its collapsed state and consists of stacked slabs up to 55 centimeters tall (Figure 138). The eastern side of the enclosure is a modified natural slope of bedrock outcrop. The base of the slope is modified with loosely stacked cobbles 60 centimeters tall along the interior edge of the enclosure. The southern wall of Feature A is constructed of large and medium sized slabs, cobbles, and boulders, with a maximum height of 1.3 meters. This wall is also the northern wall of Feature B, a larger enclosure that extends to the south. A constructed slab-lined passageway is located in the center of this wall, which has been filled with cobbles to block passage.

Figure 138. SIHP Site 25052 Feature A, interior of enclosure's northwest corner (note Feature C in background), view to the north.

Feature B

Feature B is an enclosure located in the northwestern portion of Site 25052 (see Figure 136). Feature B extends south from the southern edge of Feature A and measures 32 meters (north-south) by 12 meters (east-west) (see Figure 136). The walls are constructed of stacked angular large cobbles; in some sections upright slabs were used to retain smaller cobble fill on the interior. There are collapsed portions but overall, the wall is intact, averaging 80 centimeters in width. Wall heights are indicated of Figure 137. From the southwestern corner of Feature A, the wall of Feature B extends southwest for six meters and curves to the southeast and runs 30 meters to the southern end. At the southern end the wall curves and heads back to the north for 16 meters where it intersects with the southern edge of Feature D, a platform enclosure. The northern wall extends off the northwest corner of Feature D and heads west; this section is also the southern wall of Feature A. The interior surface of the enclosure consists of bedrock outcrops, cobbles, and boulders and soil patches hidden by thick fountain grass. Feature B (enclosure wall) likely deterred animals from entering the interior area, which may have been used as an adjoining garden plot. Feature B is probably an agricultural enclosure, but was included with Site 25052 because it is interconnected with habitation features, and associated with nearby habitation features within the site.

Feature C

Feature C is a rock hang situated off the northeastern corner of Feature A (see Figure 137). The sheltered area under the overhang measures 2 meters wide by 8 meters long; no artifacts or modifications were observed, but the overhang may have provided shelter from the sun and inclement weather as the interior vertical clearance measures 1.4 meters.

Feature D

Feature D is a platform with central enclosure constructed off the northeastern corner of Feature B (see Figure 137). The overall measurements of Feature D are 11 meters by 11 meters; the enclosed area is slightly offset to the north and measures 5.5 meters (east-west) by 4 meters (north-south). The platform area is a level surface with small to large cobble paving. To the south of the central enclosure the platform measures 4 meters wide. The southern edge of the feature consists of stacked large cobbles 40 centimeters high. On the eastern side of the central enclosure the platform paving is 2.5-meter wide. The east face of the feature is a single course of large cobbles 20 centimeters tall, and on the interior edge small cobble paving slopes down to the enclosure floor. In the southeastern corner of the feature is a depression in the pavement lined by four cobbles that measures 10 centimeters by 14 centimeters, by 50 centimeters deep. A second depression is located in the pavement near the southwest corner of the feature. It measures one meter in diameter by 40 centimeters deep and is lined with flat-stacked slabs. The platform on the northern side of the central enclosure is two meters wide with a stacked northern edge up to 75 centimeters tall. The interior edge consists of small cobble paving sloping down to the enclosure floor. The western side of the feature exhibits some paving, but is mostly collapsed into the Feature B enclosure. The intact southern portions of the western edge stands 90 centimeter tall. The interior of the enclosure portion of the feature is level and paved with small cobbles. It is recessed between 30 and 45 centimeters below the surrounding platform surface. On the surface of the platform at the southeastern corner of the enclosure is a 50-centimeter square slab that has been modified into a *papamū* (Figure 139).

Feature E

Feature E is a modified outcrop located approximately ten meters east of Feature B, and approximately seven meters northwest of Feature F, in the northern portion of Site 25052 (see Figure 136). The overall feature measures 8 meters (north-south) by 6 meters (east-west). A lower terrace is located on the southern half; it measures 5 meters by 4 meters, and an upper terrace composed mostly of bedrock is located to the north (Figure 140). The lower terrace consists of large slabs and small boulders stacked on the eastern edge that are retaining small cobbles that make up the surface of the terrace (Figure 141). The southern edge of the feature is constructed up to and level with bedrock, which slopes down to the south. The southern end of the western edge is loosely stacked large cobbles along a north-south trending bedrock outcrop. The lower terrace surface is level and paved with small to large sized cobbles; a few slabs are on top of the paved surface on the eastern half. The surface on the western half consists of soil and large rectangular slabs, and is not paved. The northern end of the western edge consists of stacked large slabs two courses, 40 centimeters, tall. A terrace wall separates the lower terrace to the south with the upper terrace to the north. The terrace wall consists of small boulders loosely stacked 0.4 meter tall. The western edge of the upper terrace consists of neatly stacked rectangular small boulder slabs. The northwestern corner is elevated bedrock that is level to the stacking on the west edge. The northern edge is not well defined because it is where cobbles meet fractured bedrock. The eastern edge of the upper terrace is mostly bedrock with a large slab on the southern end. The surface of the upper tier consists of small and medium sized cobble paving. The feature probably functioned as a temporary habitation within the Site 25052 habitation complex, and may have also been used for agricultural processing.

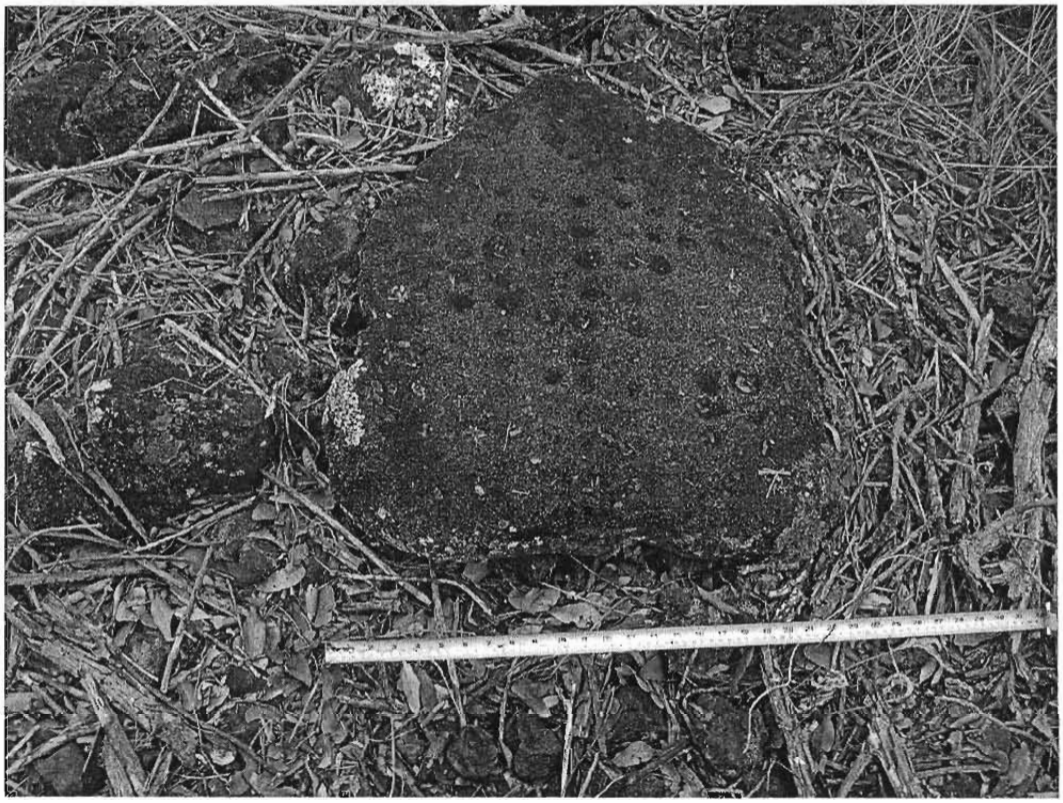


Figure 139. SIHP Site 25052 Feature D *papamū*.

Figure 140. SIHP Site 25052 Feature E, lower tier of modified outcrop, view to the southwest.

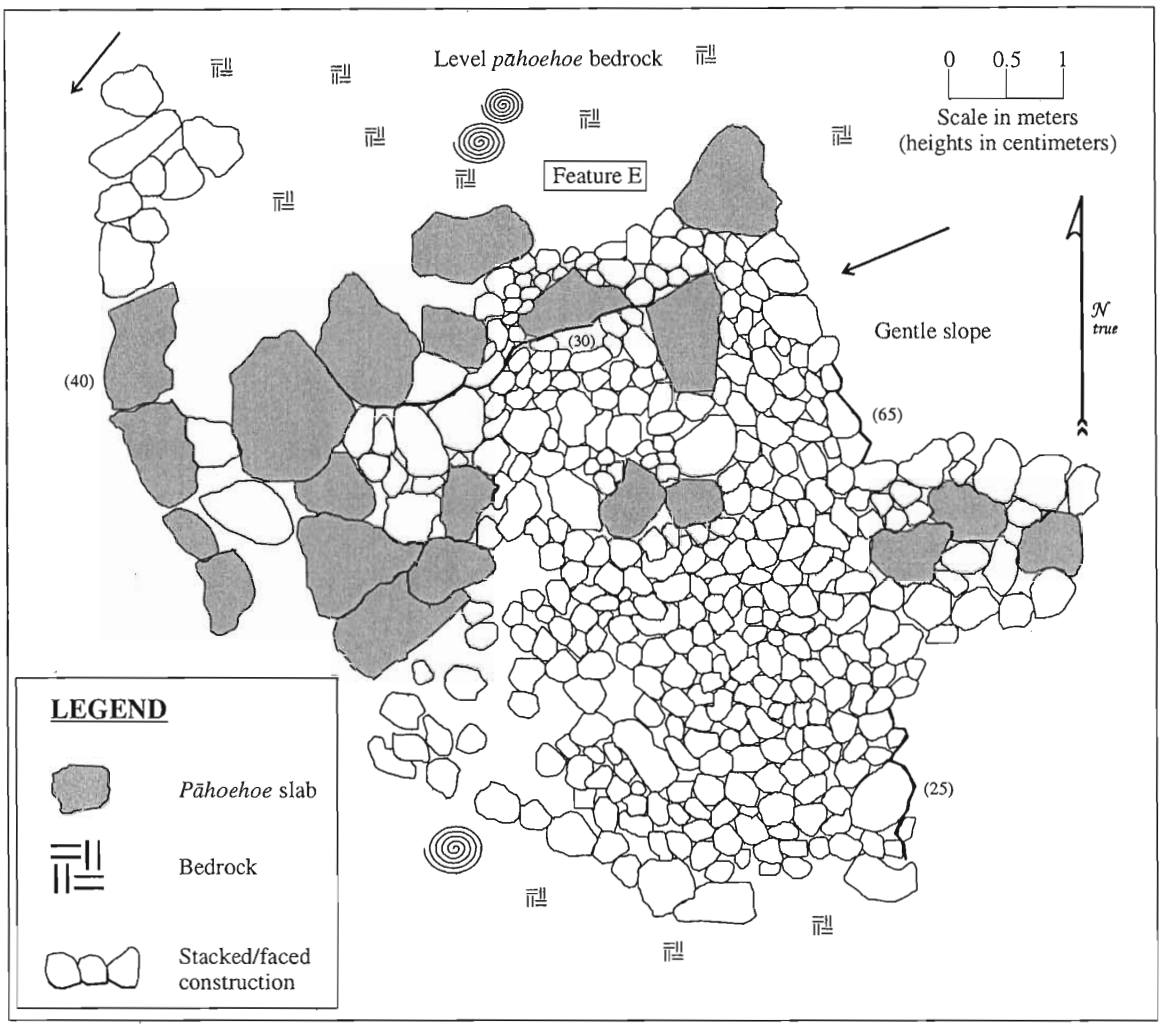


Figure 141. SIHP Site 25052 Feature E plan view.

Feature F

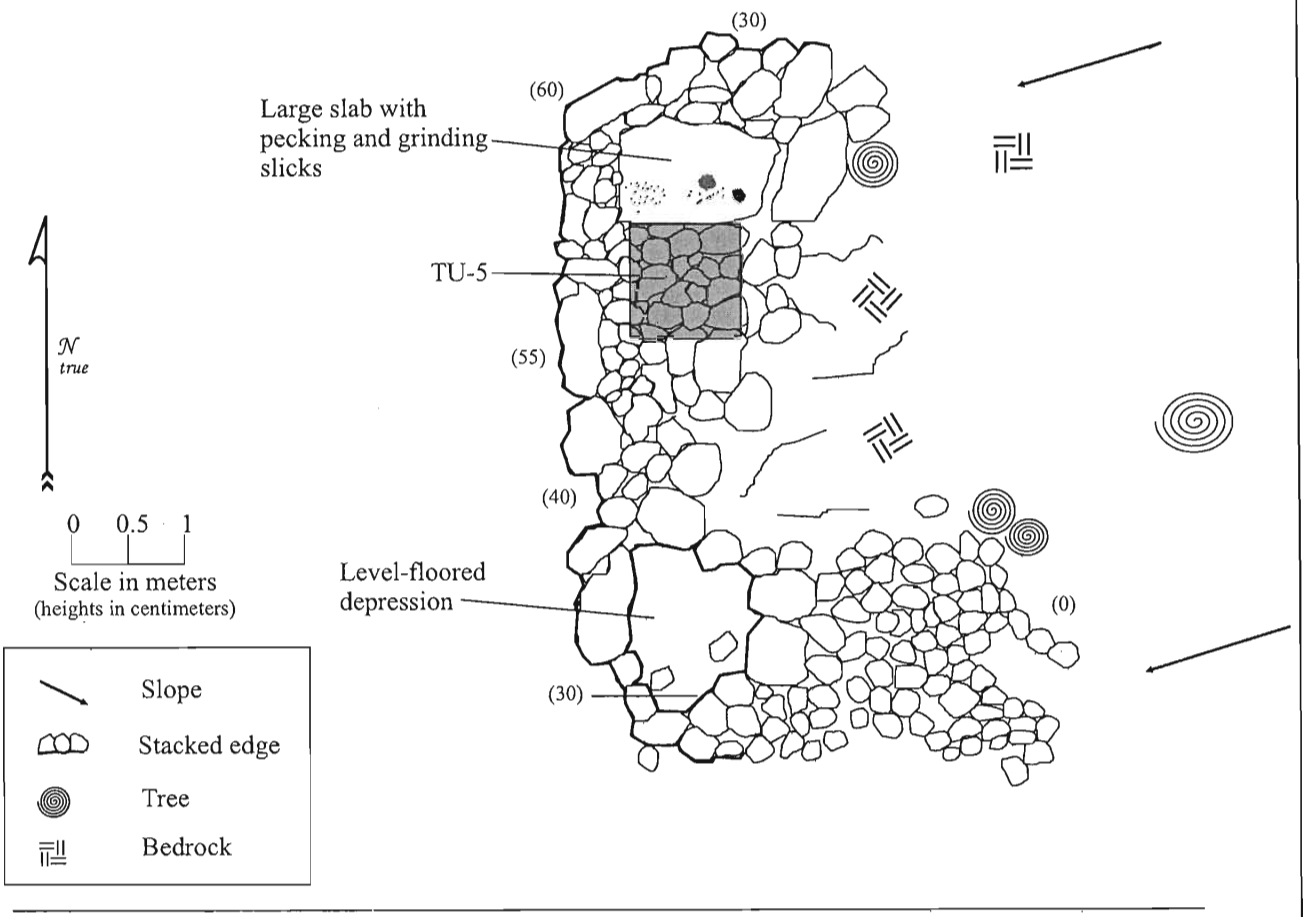
Feature F is a modified outcrop located in the eastern portion of Site 25052 (see Figure 136). It is situated on a moderate slope with *pāhoehoe* outcrops and patches of soil. The feature is composed of small to large *pāhoehoe* cobbles and large slabs stacked on the western edge with a paved top surface constructed against a bedrock outcrop. The northern half of the top surface is paved with slabs that fit together (Figure 142). One large basalt slab that measures 1.3 meters by 1 meter was placed in the northwestern corner of the feature (see Figure 142 inset). The surface of the slab has pecked areas, and grinding slicks. The feature measures 6 meter (north-south) by 3 meters (east-west) and has an average height of 0.5 meter above ground surface along the western edge. The northern edge is also stacked 0.6 meter tall with 2-courses of large cobbles. The southern half of the feature is paved on the eastern end, and in the southwestern corner is a cobble and slab lined depression one meter in diameter by 30 centimeters deep. The modified outcrop was probably a work area or possibly a small temporary habitation. The utilized surface of the large slab in the northwest corner suggests that activities such as tool manufacturing or food processing were conducted.

Figure 142. SIHP Site 25052 Feature F, modified outcrop, view to the north, and (interior inset) slab with pecked surface, overview to the north.

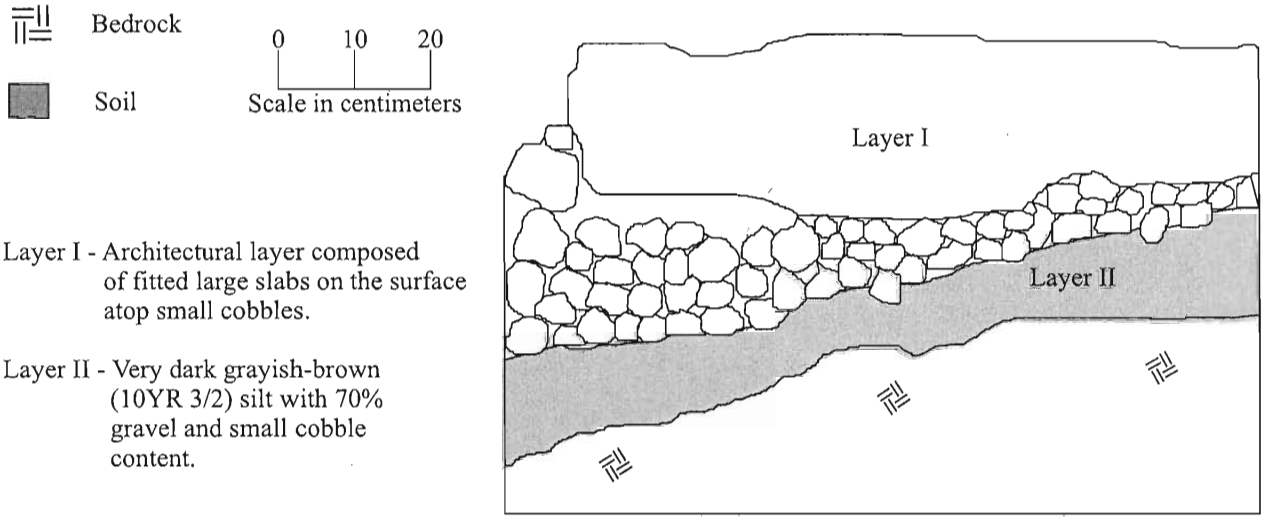
A single 1 x 1 meter test unit (TU-5) was excavated at Site 25052 Feature F in the northern end of the feature (just south of the large pecked slab) to test for buried cultural deposits (Figure 143). Excavation of TU-5 revealed two stratigraphic layers (Layers I and II). Layer I, the architectural layer, consisted of large fitted slabs on the top course, with small cobbles beneath; the depth of Layer I was 30 centimeters below the unit's surface (see Figure 143). Layer II consisted of very dark grayish-brown (10YR 3/2) silt with 70% gravel and small cobble content. Excavation of TU-5 terminated at western sloping *pāhoehoe* bedrock below Layer II, 40 centimeters beneath the unit's surface (Figure 144). Cultural material recovered from the unit included marine shell and burned *kukui* nutshell (Table 8).

Table 8. Cultural material recovered from SIHP Site 25052 Feature B TU-5.

Acc#	*Layer*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
37	I	Organic	*Kukui*	3	NA	6.2
38	I	Shell	*Cypraea*	3	1	1.3



TU-5 north wall profile.



Layer I - Architectural layer composed of fitted large slabs on the surface atop small cobbles.

Layer II - Very dark grayish-brown (10YR 3/2) silt with 70% gravel and small cobble content.

Figure 143. SIHP Site 25052 Feature F plan view and TU-5 north wall profile.

Figure 144. SIHP Site 25052 Feature F, base of excavation.

Feature G

Feature G is a large modified outcrop located in the southern portion of Site 25052 (see Figure 136). At the south end of the outcrop is a pavement that measures 4.3 meters (east-west) by 5.5 meters (north-south). The southern and western edges consists of stacked *pāhoehoe* cobbles with a maximum height of 40 centimeters tall, and the eastern edge is constructed level with bedrock (Figure 145). Just off the northwest corner of the paved area is an upright slab that measures 0.55 meter wide, by 0.17 meter thick, and 0.67 meter tall. The surface of the pavement is level with cobbles, slabs and small boulders (Figure 146). North of the paved area, the ground remains level, consisting of large jumbled cobbles. A second paved area located 4.5 meters to the north and measures 1.5 meters wide (north-south) by 3 meters long (east-west). This area is level and composed of small cobbles and pebbles. South of the pavement is a small soil patch, and around the east, north, and west sides is larger pāhoehoe cobbles lining the pavement (see Figure 145). Beginning roughly 1.3 meters north of this paved area is an enclosed depression forming the northern extent of Feature G (see Figure 145). The enclosed area measures 6.5 meters (north-south) by 5 meters (east-west) with a level interior space, 40 centimeters lower than the surrounding ground surface. The enclosed space measures 4 meters (north-south) by 2 meters (east-west). The southern end of the enclosure is a natural bedrock ledge 0.5 meter tall. The western side of the enclosure consists of a wall segment constructed on bedrock that is 50 centimeters tall on the interior side, and 30 centimeters tall on the exterior. At the northwestern corner and along the northern end of the enclosure is a constructed wall 2 meters wide by 45 centimeters tall. This wall is stacked with large cobbles on the edges and filled and paved with smaller cobbles on the level surface. In the northeastern corner is a ramp that ascends from inside the enclosure to the upper ground surface outside the enclosure. The ramp surface is 1 meter wide, 2 meters long, and paved with small cobbles. To the east of the enclosed area is a cobble-covered slope that descends into the enclosed from the upper ground surface. A *mauka-makai* running wall, SIHP Site 16107 Feature 217, extends east from Feature G; this wall probably functioned as an agricultural field boundary. Feature G was probably utilized as a temporary habitation, and possibly for agriculture processing.

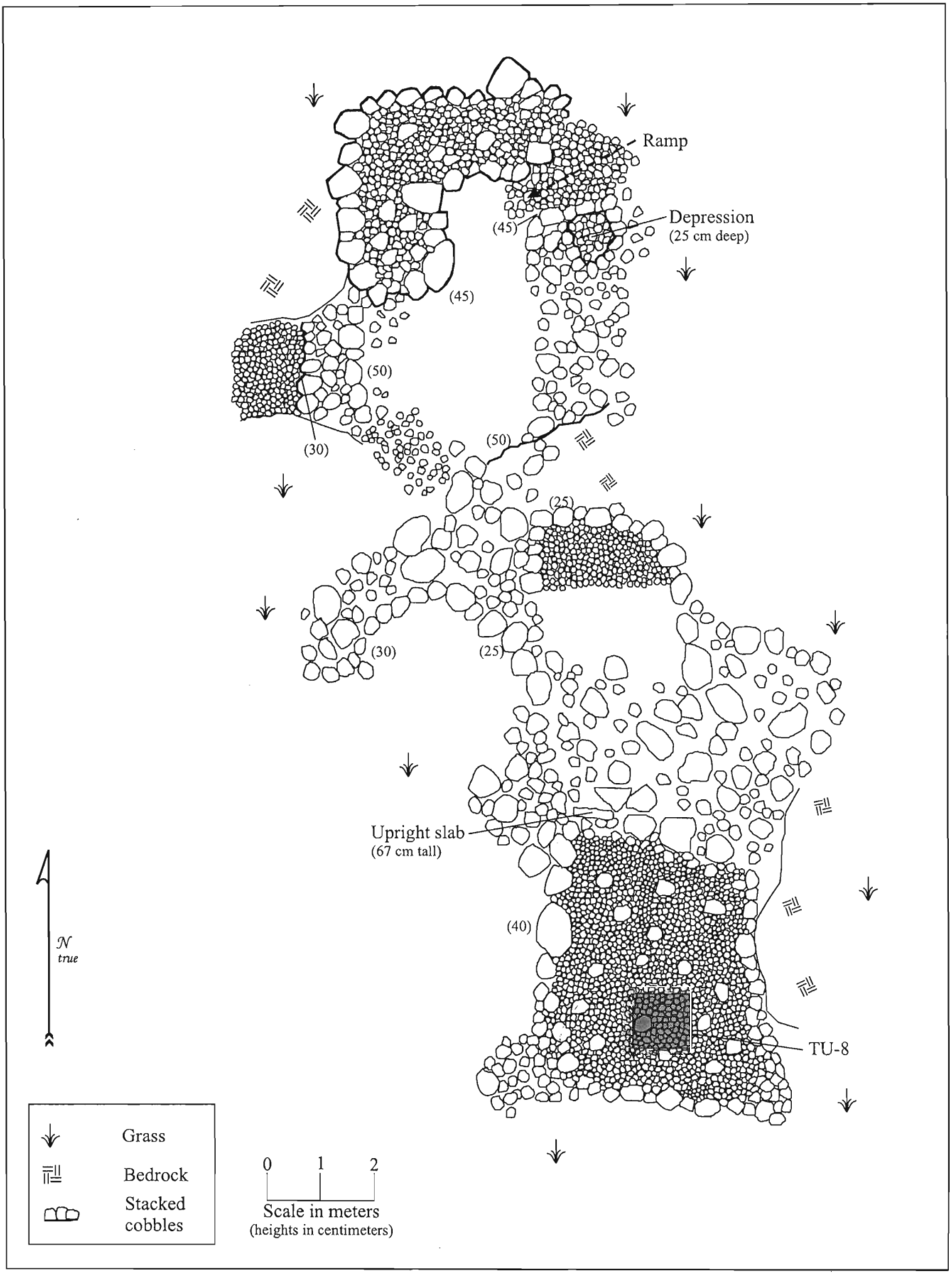


Figure 145. SIHP Site 25052 Feature G plan view.

Figure 146. SIHP Site 25052 Feature G, surface of southern pavement, view to the east.

A single 1 x 1 meter test unit (TU-8) was excavated at Site 25052 Feature G in the center of the southern pavement to test for the possibility of buried cultural deposits (see Figure 145). Excavation of TU-8 revealed two stratigraphic layers (Layers I and II) (Figure 147). Layer I, the 50-centimeter thick architectural layer, consisted of small *pāhoehoe* cobbles and pebble pavement on the surface on top of medium and large cobbles. Layer II continued beneath Layer I to a depth of 60 centimeters below the unit's surface. Layer II consisted of very dark brown (10YR 2/2) granular silt with 20% gravel content with small cobbles. Excavation of TU-8 terminated at southwest sloping ropey *pāhoehoe* bedrock at the base of Layer II 60 centimeters below the unit's surface (Figure 148). *Kukui* nut shells and charcoal were recovered during excavation, but no other cultural material was encountered in TU-8.

Table 9. Cultural material recovered from SIHP Site 25052 Feature G TU-8.

Acc#	*Layer*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
41	I	Organic	*Kukui*	3	1	3.0
42	II	Organic	Charcoal	10	NA	1.4
43	II	Organic	*Kukui*	6	1	0.8
44	II	Organic	Charcoal	7	NA	1.0

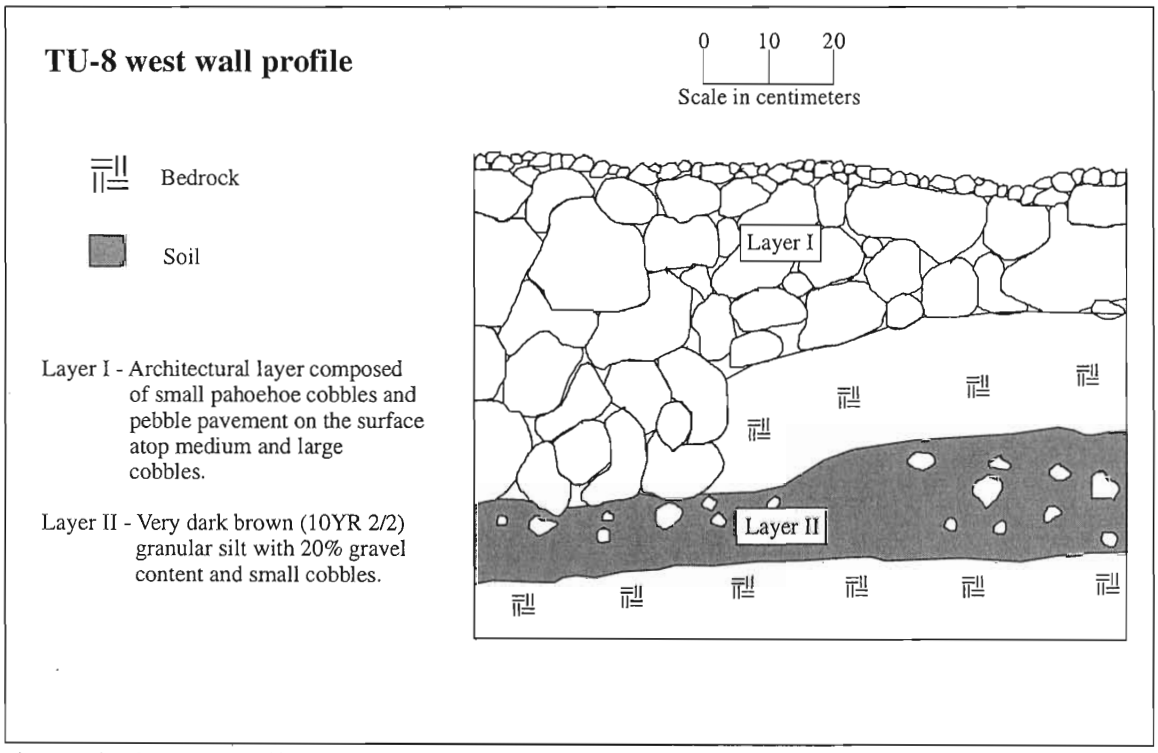


Figure 147. SIHP Site 25052 Feature G TU-8 west wall profile.

Figure 148. SIHP Site 25052 Feature G TU-8 base of excavation.

SIHP Site 25053

Site 25053 is a complex of nine features located in the central portion of the western side of the current study area approximately 30 meters east of the western bulldozer road (see Figure 15). The features within Site 25053 include a collapsed lava blister (Feature A), a double enclosure (Feature B), two pavements (Features C and D), a platform (Feature E), a pavement with upright aligned slabs (Feature F), an enclosure (Feature G), and two stone mounds (Features H and I) (Figure 149). This site is in fair condition and retains its integrity of setting. Based on the formal attributes of these features, it is likely that Site 25053 was used for habitation purposes during the Precontact Period, perhaps on a seasonal basis associated with the agricultural pursuits.

Feature A

Feature A is a collapsed lava blister located at the northern end of Site 25053 (Figure 150). The blister is in the vicinity of several lava tubes; the entrance to Site 25067 is located 12 meters to the west, and is part of the same tube system as Feature A (though collapse has blocked passage). The surrounding terrain consists of *pāhoehoe* outcrops with intermittent pockets of soil on a gentle to moderate western slope. Vegetation in and adjacent to the blister consists of Christmas-berry (*Schinus terebinthifolius*), *noni,* ti (*Cordyline fruticosa*), weeping fig, fountain grass (*Pennisetum setaceum*), and ferns. There is a series of modifications to the edges and interior portions of the collapsed blister that measure 18 meters (northeast-southwest) by 7 meters (northwest-southeast), and are approximately 2 meters below the outlying ground surface (see Figure 150). The southwestern rim of the blister is an overhang with a level paved small to large cobble surface constructed in the sheltered area below. Under the overhang at its southwestern end, a void between the paved cobble ground and bedrock wall of the overhang was observed. Cobbles that were suspected of being placed to conceal a lava tube chamber were removed to reveal a small tube segment 1.5 meters wide (northeast-southwest) by 3 meters long (northwest-southeast); no artifacts or other cultural material were observed in the cavity.

Five meters to the east of the hidden cavity, rocks were removed from a second area to inspect for a concealed lava tube opening. No opening was found, but removal of the rocks exposed a charcoal and organic deposit, and a decomposing wooden item that appears to be *kauwila (Colubrina oppositifolia)* (Acc. #121) at 30 centimeters depth (Figure 151). Along the eastern side of the southwestern end of the blister, at the end of the overhanging bedrock ceiling, is a small tube segment that extends to the northeast for 4 meters and is 1 meter wide by 0.5-meter floor to ceiling; no cultural material was observed in the small tube. A bridged footpath is constructed perpendicular to the southeastern facing edge of the blister (Figure 152). It is 2.2 meters wide by 5 meters long (northwest-southeast) constructed with upright slabs (70 centimeters tall) lining the eastern edge, and with stacked large cobbles (30 centimeters tall) along the western edge; the surface is paved with large slabs. There is a level paved area east of the clearly defined path that is 4 meters by 4 meters and lined on the southeast and southwest sides with boulders. On the northwest facing edge of the blister is a modified outcrop located 2 meters northeast of the constructed pathway. The feature consists of large stacked cobbles 6-7 courses tall (1.25 meter) with a relatively level top surface; the feature is constructed up against the steep edge of the blister and measures 1.8 meters (northeast-southwest) by 1.4 meter wide. Other modifications to the blister can be found at its northeastern end where a large slab boulder measuring 1.5 meters by 1 meter is placed against the slope with loosely stacked cobbles on either side, and a collapsed feature with an alignment of cobbles stacked 1-2 courses up against the blister edge east of the constructed pathway. Feature A appears to have been utilized for temporary habitation and possibly the processing of agricultural products.

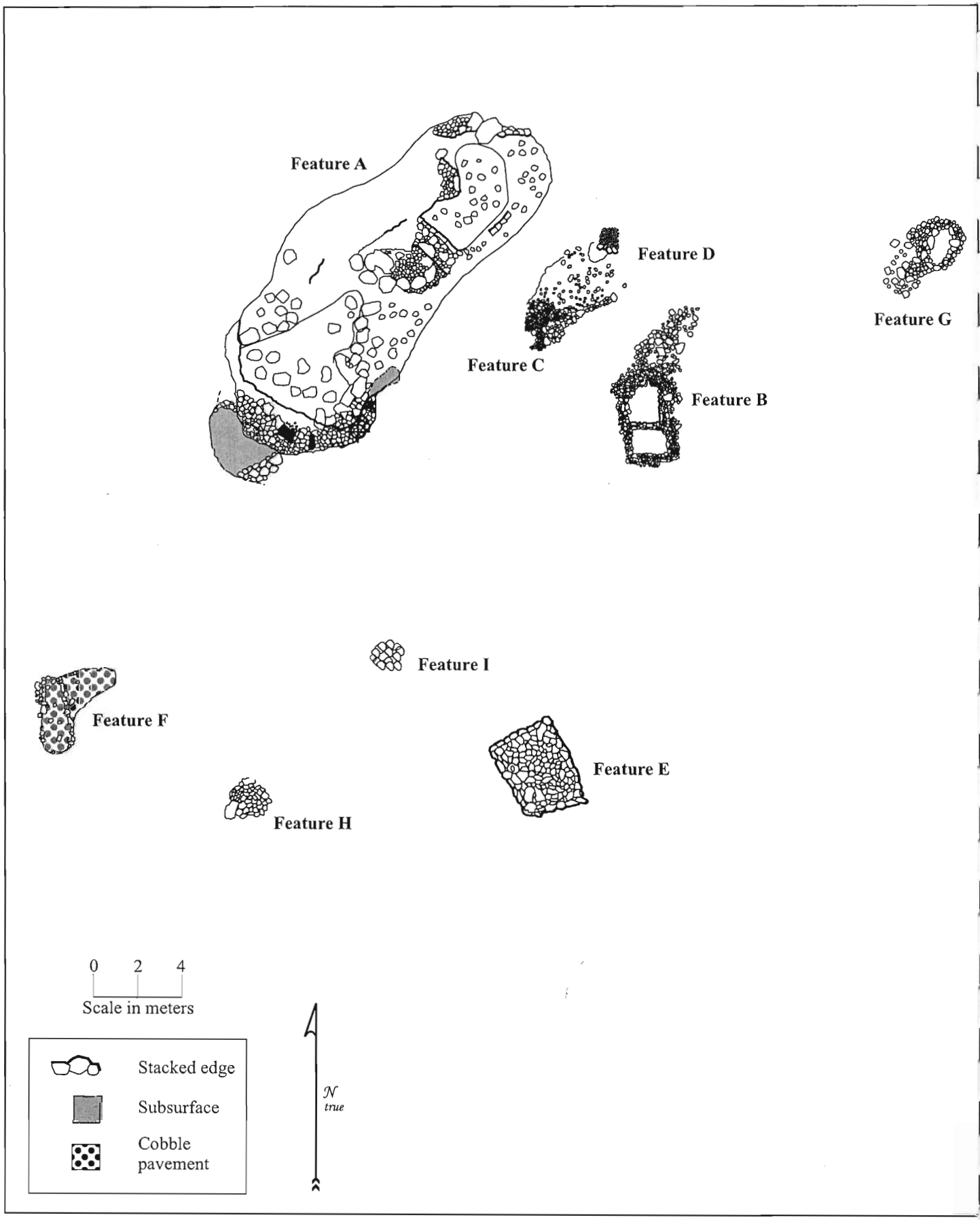


Figure 149. SIHP Site 25053 plan view.

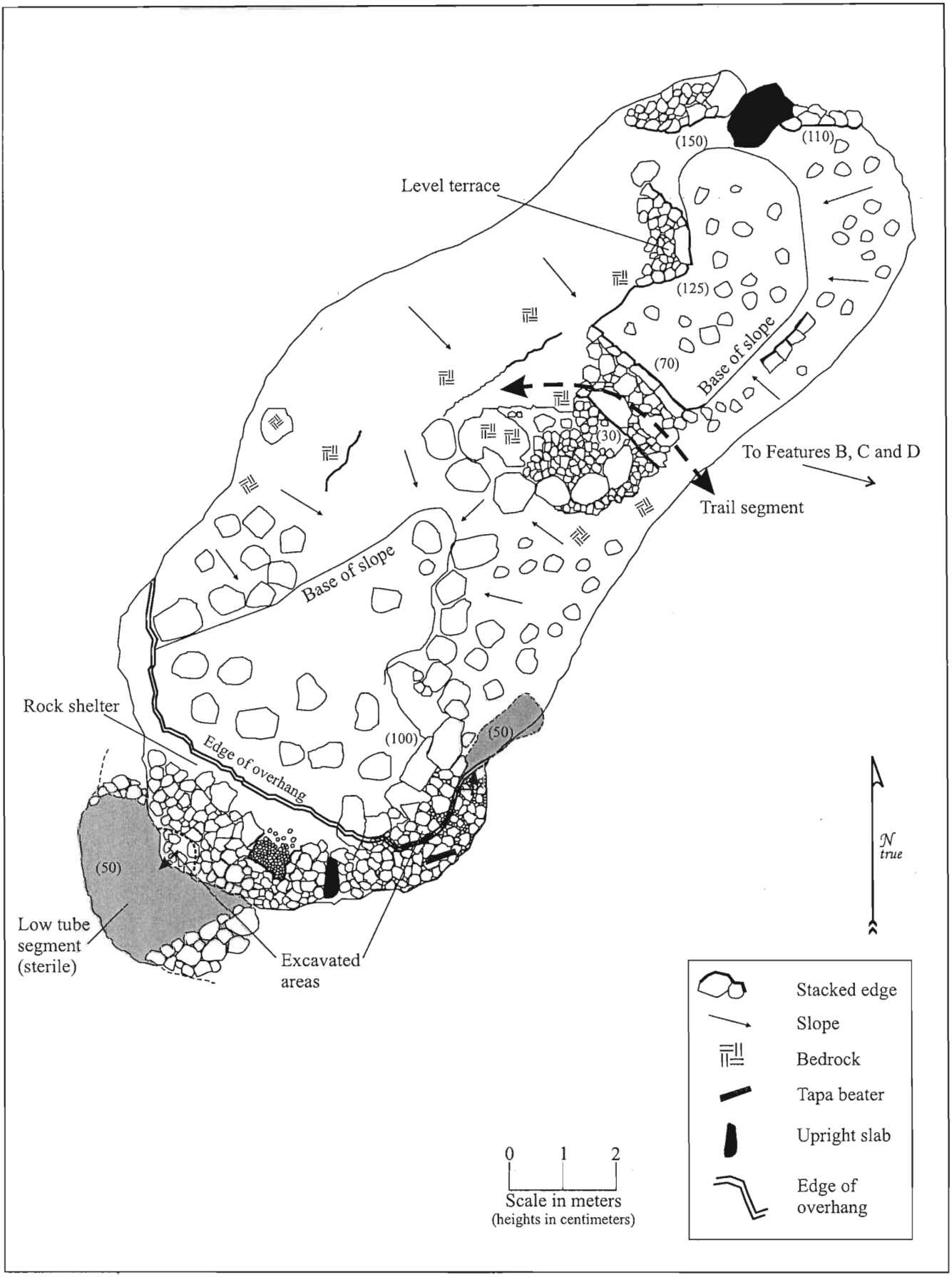


Figure 150. SIHP Site 25053 Feature A plan view.

Figure 151. SIHP Site 25053, decomposed wooden object in southwestern portion of Feature A.

Figure 152. SIHP Site 25053, bridged footpath through the center of Feature A, view to the east.

Feature B

Feature B is a double enclosure situated on moderately sloped terrain (Figure 153) in the central-eastern portion of Site 25053 (see Figure 149). Feature B measures 8 meters (north-south) by 4 meters wide (Figure 154). The walls are mostly collapsed, but intact portions of wall consist of upright slabs on the edges retaining smaller cobbles that fill in the gap up to the top of the slabs. The northern enclosure measures 2.7 meters wide (east-west) by 3 meters long (north-south); the walls have an average height of 0.5 meter above the ground surface. The enclosed ground surface is fairly level, with scattered cobbles that have collapsed in from the walls. The wall in the northwestern corner is heavily damaged from collapse, but the other segments are relative intact. The southern enclosure measures 2.3 meters (north-south) by 3.2 meters (east-west); it is wider than the northern enclosure. The walls in this portion of the feature are less collapsed, with an average height of 0.5 meter, and a maximum height of 0.9 meter tall at an upright slab in the southeastern corner. The common wall of the enclosures is 0.4 meter tall on the south side, and 0.6 meter tall on the northern side. The enclosed ground surface on the southern half is level with no cobbles unlike the area to the north. A collapsed alignment of large cobbles and small boulders extends 4 meters to the northeast off the northern end of Feature B. The enclosure probably functioned as a temporary habitation.

Figure 153. SIHP Site 25053, southeastern corner of Feature B (enclosure), view to the southeast.

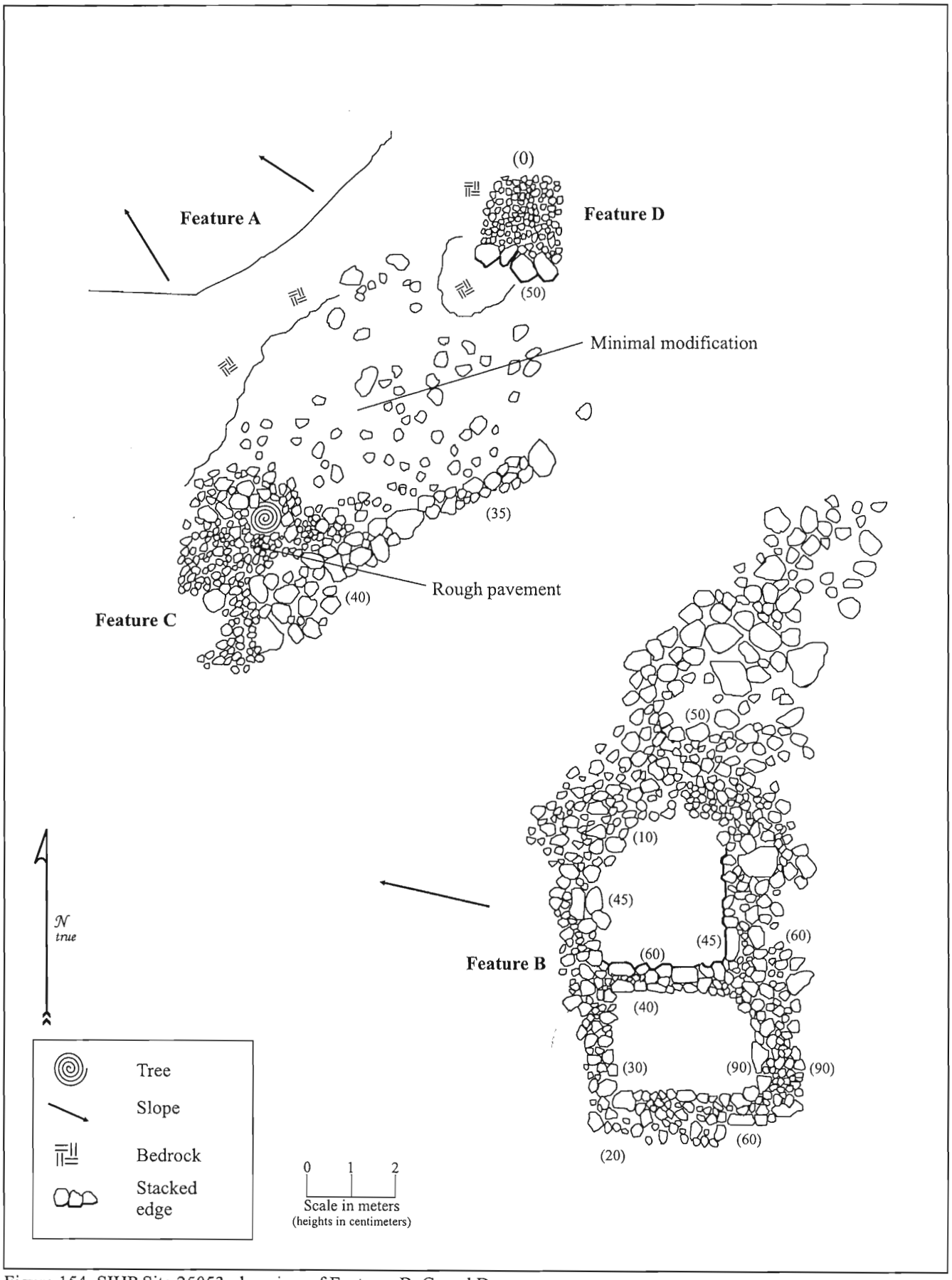


Figure 154. SIHP Site 25053 plan view of Features B, C, and D.

Feature C

Feature C is a rough pavement located 6 meters northwest of Feature B in the northern portion of Site 25053 (see Figure 149). The feature consists of a paved area 4 meters (northwest-southeast) by 3.1 meters (northeast-southwest), with an alignment of large cobbles and small boulders that extends to the northeast (see Figure 154). The pavement edges are composed of stacked large cobbles and small boulders, and the interior is level and paved with small and medium sized *pāhoehoe* cobbles. The paved area is no more than 15 centimeters above the surrounding ground surface. A tree is growing out of the center of this feature, which has significantly affected its integrity. Given the level of natural disturbance it is difficult to assign a specific function to this feature.

Feature D

Feature D is a small pavement located approximately 4 meters north of the northeastern end of the Feature C alignment in the northern portion of Site 25053 (see Figure 149). The feature consists of a level paved area constructed on a bedrock outcrop (see Figure 154). Feature D measures 1.5 meters (east-west) by 2 meters (north-south) and has a maximum height of 0.5 meter on the southern end where large cobbles are stacked 2-courses on the edge of the feature. The northern edge consists of small cobble paving level to the bedrock ground surface (Figure 155). Feature D probably functioned as a temporary habitation and possibly as a surface for agricultural processing.

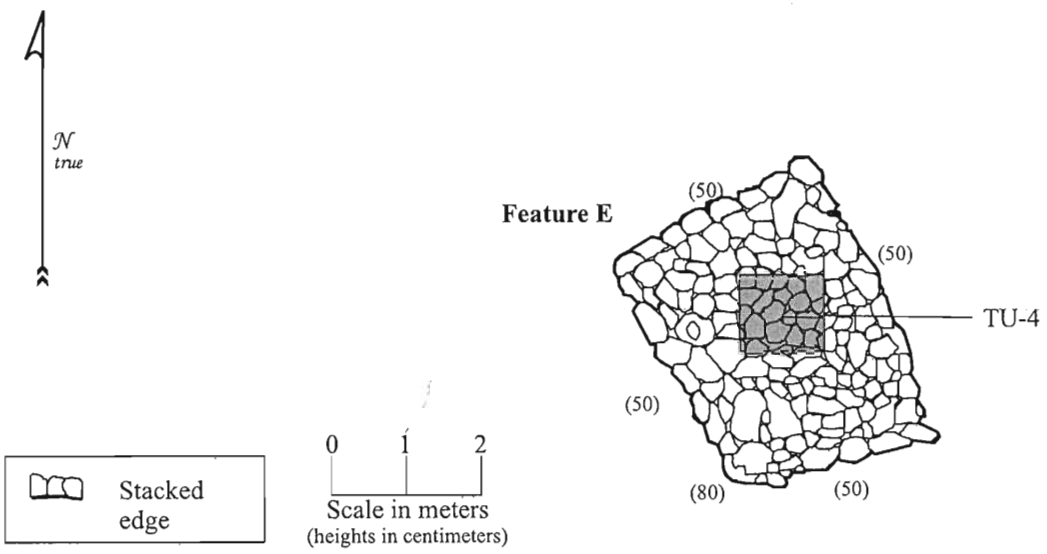
Figure 155. SIHP Site 25053 Feature D, pavement, view to the northwest.

Feature E

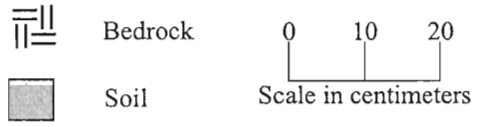
Feature E is a rectangular platform located approximately 15 meters south of Feature B in the southern portion of Site 25053 (see Figure 149). The platform is rectangular, measuring 2.8 meters (northwest-southeast) by 2.6 meters (northeast-southwest). The platform is constructed of loosely stacked large *pāhoehoe* cobbles on the perimeter (Figure 156), with small and medium cobbles on the interior and top surface (Figure 157). The stacked edges are 3-courses with an average height on all sides of 0.5 meter. The southwest corner has the maximum height of 0.8 meter above the ground surface. The top surface is relatively level; collapse has occurred in a few places along the edges.

Figure 156. SIHP Site 25053 Feature E, platform, view to the northeast.

A single 1 x 1 meter test unit (TU-4) was excavated at Site 25053 in the center of the platform (see Figure 157) to test for the possibility of buried cultural deposits. Excavation of TU-4 revealed two stratigraphic layers (Layers I and II). Layer I, the 80 centimeter thick architectural layer, consisted of small cobbles from the surface to 10 centimeters deep, and medium and large cobbles from 10 to 80 centimeters below the surface. Layer I contained artifacts including marine shell and fish bone (Table 9). Layer II continued below Layer I to a depth of 90 centimeters below the unit's surface. This layer consisted of dark grayish-brown (10YR 3/2) silt with 70% gravel content. Layer II contained artifacts including marine shell, volcanic glass flakes, and fish bone (see Table 9). Excavation of TU-4 terminated at smooth bedrock at the base of Layer II 40 centimeters below the unit's surface (Figure 158).



TU-4 north wall profile.



Layer I - Architectural layer composed of small cobbles to 10 centimeters below the surface, with medium and large cobbles to 80 centimeters below the surface.

Layer II - Dark grayish-brown (10YR 3/2) silt with 70% gravel content.

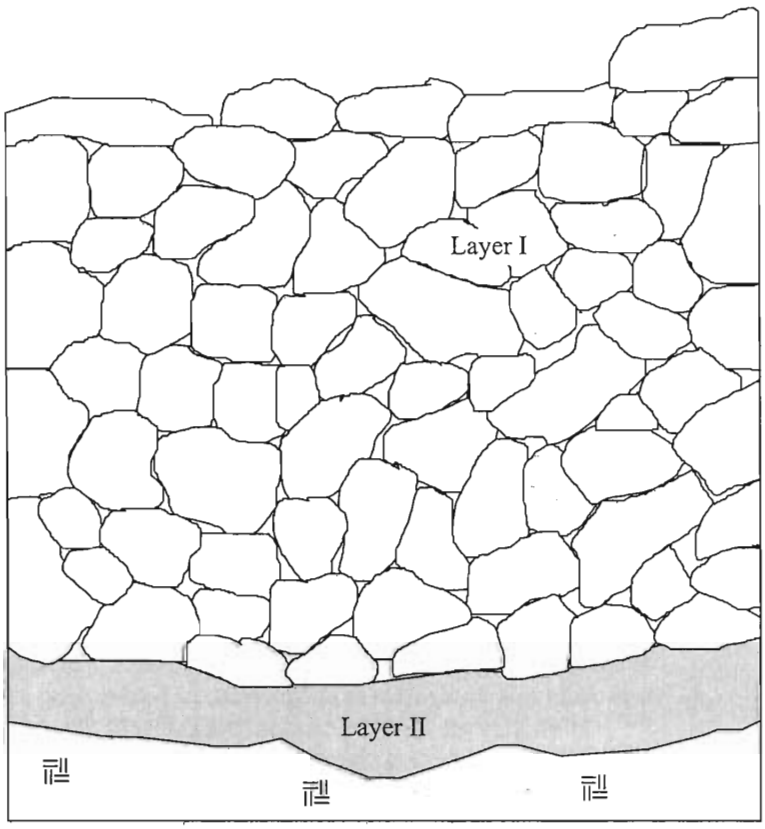


Figure 157. SIHP Site 25053 Feature E plan view and TU-4 north wall profile.

Table 10. Cultural material recovered from SIHP Site 25053 Feature E TU-4.

Acc#	*Layer*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
26	I	Bone	Fish	1	NA	0.2
27	I	Shell	*Cypraea*	3	2	7.1
28	I	Shell	*Conus*	1	1	0.4
29	II	Volcanic glass	Flake	5	NA	0.9
30	II	Shell	*Nerita*	1	1	0.3
31	II	Shell	*Drupa*	2	2	2.2
32	II	Shell	*Conus*	2	2	1.9
33	II	Bone	Fish	1	1	0.2
34	II	Shell	*Cypraea*	2	1	0.4
35	II	Echinoderm	*Echinoidea*	10	1	0.9
36	II	Shell	Unknown	2	1	0.5

Figure 158. SIHP Site 25053 Feature E TU-4 base of excavation.

Feature F

Feature F is a pavement with an upright slab alignment. The feature is located at the southern end of Site 25053 (see Figure 149). The pavement is level, L-shaped, and measures 3 meters (north-south) by 4.2 meters (east-west) (Figure 159). The feature is composed of mostly small *pāhoehoe* cobbles with a few medium sized cobbles. The pavement is 0.2 meter (average) taller than the surrounding ground surface; the edges slope down on all sides and no stacking was observed. A 3-meter long alignment of upright slabs runs through the pavement in a north/northwest (340°) direction (Figure 160). The slabs are firmly set into the pavement, and have an average height of 25 centimeters. The pavement east of the aligned slabs is less jumbled than the area to the west. The pavement may have functioned as a temporary habitation, or possibly a work area associated with agricultural processing.

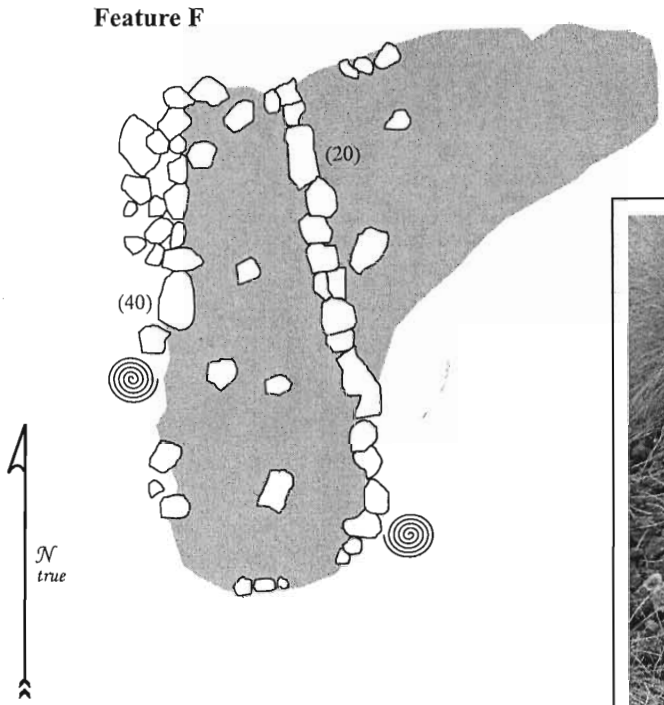
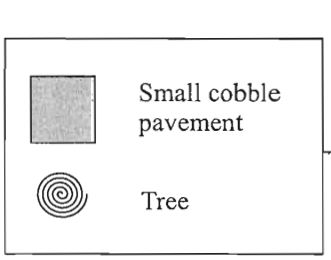
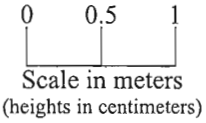
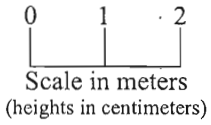
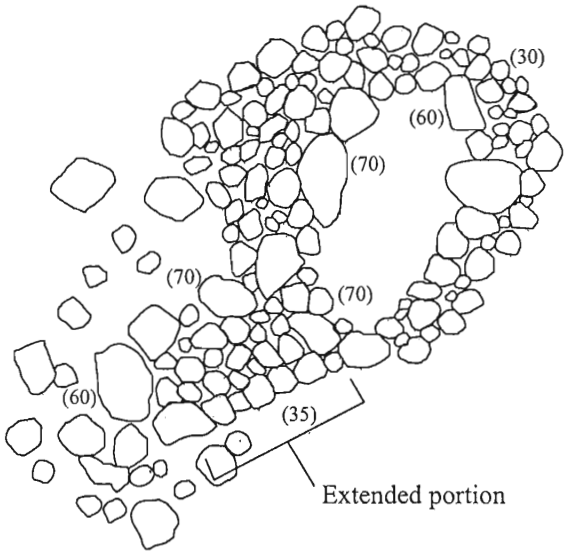


Figure 160. SIHP Site 25053 Feature F, view to the northwest.









Feature G

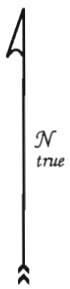


Figure 159. SIHP Site 25053; plan view of Features F and G.

Feature G

Feature G is a small enclosure located in the northeastern portion of Site 25053 approximately 12 meters east of Feature B (see Figure 148). The enclosure is composed of large cobbles, slabs, and small boulders jumbled and in places loosely stacked 2 courses tall (Figure 161). The walls vary in width of 1 to 2 meters; the interior area of the enclosure measures 3.5 meters (north-south) by 1.5 meters (east-west) (see Figure 159). The interior wall heights are 0.6 to 0.7 meter tall and the exterior heights range from 0.3 to 0.6 meter above the ground surface. The interior floor is level with cobbles and soil. A rectangular extension 1.8 meters wide by 2.5 meters long is constructed off the southwestern corner of the enclosure. The extension is composed of large cobbles and small boulders on the periphery with smaller cobbles filling the interior. The feature probably functioned as a temporary habitation enclosure, and possibly was utilized for agricultural processing.

Figure 161. SIHP Site 25053 Feature G, enclosure, view to the west.

Feature H

Feature H is a rock mound located in the southern portion of Site 25053 (see Figure 148). The feature consists of piled medium sized *pāhoehoe* cobbles partially on bedrock. The pile is irregularly shaped measuring 2.5 meters (east-west) by 2 meters (north-south) (Figure 162). The western edge is 0.4 meter tall, and the eastern edge is 0.65 meter above the ground surface (Figure 163). The feature appears to be a clearing pile.

Feature I

Feature I is a rock mound located in the southern portion of Site 25053 (see Figure 148). The feature consists of medium to large sized *pāhoehoe* cobbles piled in a linear mound with loose stacking 2-courses high along the western edge (Figure 164). The mound measures 3.2 meters (north-south) by 1.3 meters (east-west), and has a height of 0.6 meter on the western-stacked edge, and 0.6 meter on the eastern piled side (see Figure 162). Feature I was constructed on relatively level soil ground surface. This feature also appears to simply be a clearing pile.

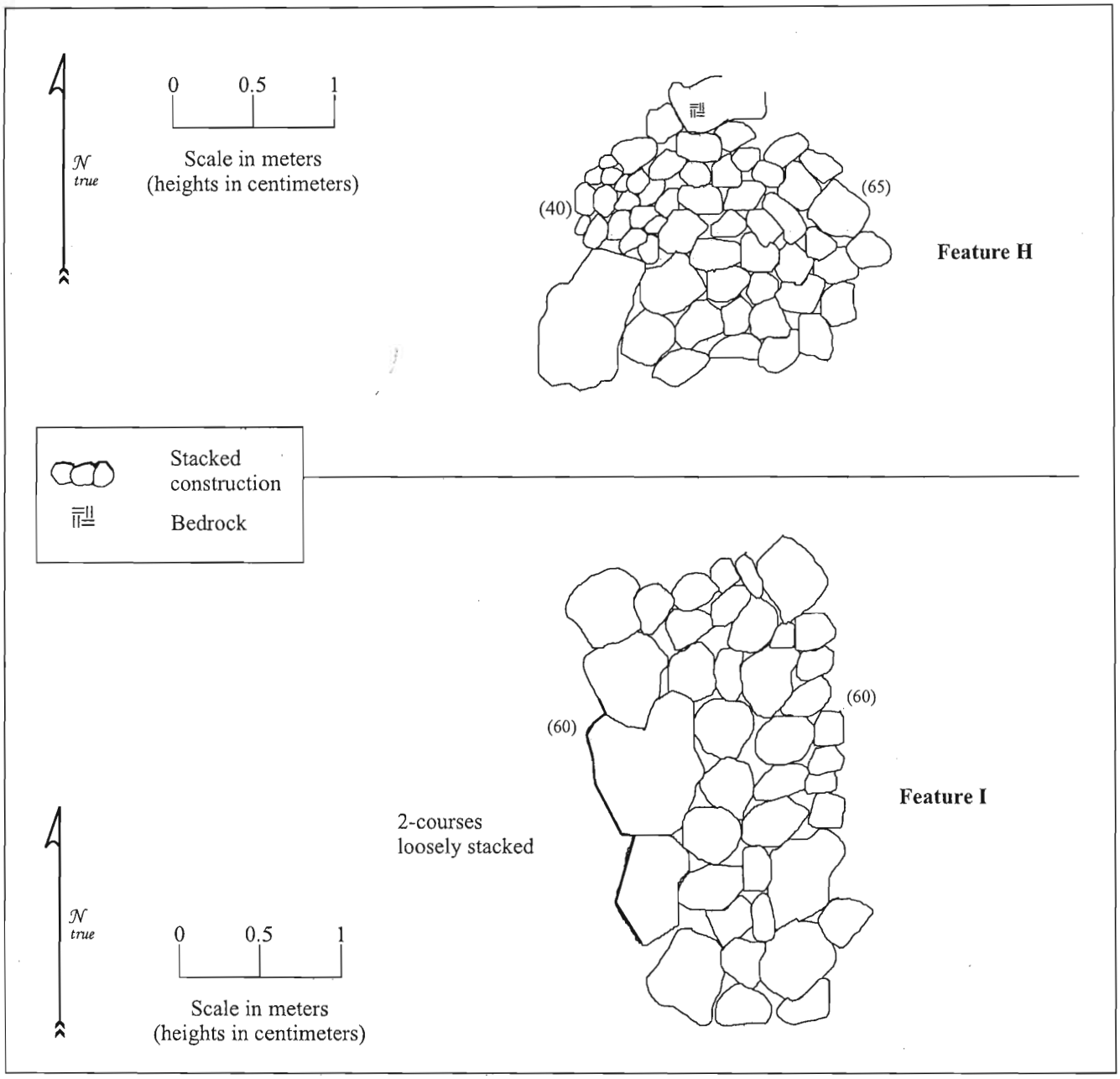


Figure 162. SIHP Site 25053; plan view of Features H and I.

Figure 163. SIHP Site 25053 Feature H, modified outcrop, view to the north.

Figure 164. SIHP Site 25053 Feature I, mound, view to the east.

SIHP Site 25054

Site 25054 is a complex consisting of two features located in the center of the western end of the study area (see Figure 15). The features are both low platforms with attached stacked wall structures. Feature A is located in the northern half of the site, and Feature B in the southern half of the site (Figure 165). Overall site condition and integrity are good, however both features exhibit some degree of tumbled and dislodged construction rocks. No cultural material was observed at the site, and the surrounding area is mostly exposed bedrock. Based on the formal attributes of these features, 25054 was likely used for Precontact habitation purposes, perhaps on a seasonal basis associated with the agricultural pursuits.

Feature A

The overall dimensions of Feature A are 9.4 meters (northeast-southwest) by 3 meters wide. This includes the main platform area and two bordering walls. It appears that this feature was modified from its original construction some time in the past. A rough wall alignment was built across the lowest level of the platform; the rocks used in its construction appear to have been taken from the platform itself. The surface of the platform portion of Feature A was constructed in three levels (see Figure 165). The feature is situated on a slight to moderate western slope. The upper level of the platform is on the northeastern end, and the lowest is on the southwestern end. The upper level measures 4 meters (north-south) by 2 meters (east-west). This area is elevated 30 centimeters above the middle level of the platform and has a fairly level, albeit jumbled, surface consisting of large *pāhoehoe* cobbles. In the northeastern corner of the upper level is a slab-lined depression (probably the location of a former household alter) that measures 65 centimeters by 4 centimeters by 10 centimeters deep. The middle level of the platform consists of a pavement of small cobbles and measures 2.5 meters (north-south) by 1 meter wide. The western edge of this tier of the platform is loosely stacked large cobbles that are approximately 20 centimeters above the eastern side of the lowest level of the platform. The lowest level of the platform has been impacted by the construction of a wall that bisects the surface, which was paved with small to medium sized cobbles and originally measured 2 meters by 5.5 meters.

The southern edge of the overall feature is lined with large cobbles that retain the interior paving. An elevated wall, one meter wide and 30 centimeters tall, was constructed on top of the platform surface along its entire northern side. A second wall was constructed across the lowest (western) level of the platform. This wall extends for nearly six meters and may have once been connected to the walls that were added to Feature B. This wall is 40 centimeters tall by 1.2 meters wide; it is composed of piled medium and large sized cobbles that appear to have been pirated from Feature A. To the west of the southern end of this wall is a jumble of rocks that may be a dislodged portion of the wall, and the connecting portion to Feature B.

Feature B

Feature B is a platform with adjoining wall located to the south of Feature A (see Figure 165). The platform portion of this feature is at the southern extent of the site; the attached wall extends from the northwestern corner of the platform toward Feature A.

The platform portion of the feature is roughly square, measuring six meters by six meters. The surface is level and paved with large cobbles and slabs, except for the southeastern corner where it is paved with small cobbles. All four sides of the platform are elevated (maximum height 0.6 meter) above the surrounding ground surface; the edges consist of sloping, piled cobbles that were probably stacked but have collapsed. A wall, roughly 40 centimeters tall, appears to be an added construction, and extends to the north toward Feature A. The wall is a bit jumbled, but appears to once have been neatly stacked. It extends for 1.5 meters north where it turns to the east for 2 meters, then north again for 3.5 meters, then to the west for 3 meters where it terminates in collapse. It seems as though this wall was part of the same construction episode as the wall across Feature A, and that the wall segments at one time connected. The wall also appears to have been built subsequent to the original construction of Features A and B.

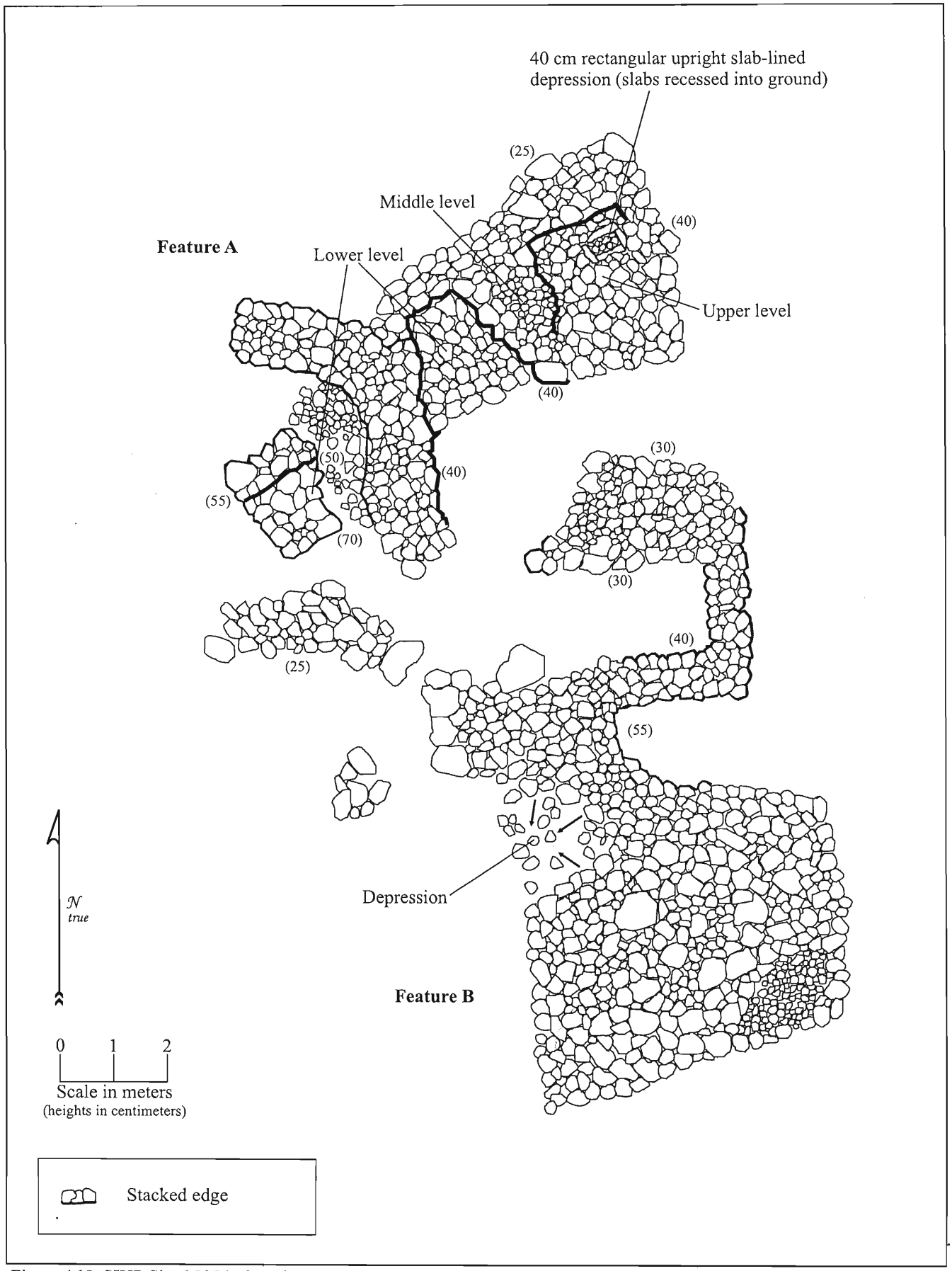


Figure 165. SIHP Site 25054 plan view.

SIHP Site 25055

Site 25055 consists of a modified outcrop located in the west-central portion of the study area (see Figure 15). It is located roughly twenty meters west of Site 25049 Feature A (a modified outcrop habitation) and Site 25062 (a lava tube habitation). The site occupies a 24-meter by 16-meter area on a raised *pāhoehoe* bedrock outcrop. The outcrop itself is a domed *pāhoehoe* formation (tumulus) that measures 13 meters in diameter by several meters tall (Figure 166). From on top of the outcrop is a 360° view of the surrounding landscape. Level bedrock is present to the east of the tumulus that could have been used for habitation purposes. No cultural material was observed on the mostly bedrock surface within the site boundary. The site is in fair condition and retains integrity of setting.

The outcrop exhibits several areas of modification. There is a constructed pathway (modification 1), a rough alignment (modification 2), and three clearing piles (modifications 3, 4, and 5) (see Figure 166). Modification 1 is a constructed pathway segment skirting the tumulus, measuring 5 meters (east-west) by 2.5 meters wide (Figure 167). The northern stacked retaining edge is 50 centimeters high and the pathway connects to raised outcrop areas bridging a two meters gap that is 40 centimeter deep. The pathway construction terminates at a tumbled wall (SIHP Site 16107 Feature 286). Modification 2 is a rough alignment, a single course high, extending west for 5 meters from the pathway across exposed bedrock.

Figure 167. SIHP Site 25055 Modification 1, view to the southwest.

Modification 3 is a rock pile located on the southern side of *pāhoehoe* tumulus (see Figure 166). The feature is constructed with small to large cobbles and small boulders and measures 2.5 meters by 2.5 meters (Figure 168). Modification 4 is a rock pile located 1.0 meter northwest of Modification 3 on the southern base of tumulus (see Figure 166). The feature is composed of small boulders and cobbles and measures 2.2 meters (northwest-southeast), by 0.5 meter wide, and is 1.3 meters tall (Figure 169). Modification 5 is a circular rock pile located northeast of Modifications 3 and 4, along the eastern edge of the tumulus (see Figure 166). The pile is constructed of loosely stacked *pāhoehoe* cobbles and small boulders placed directly on bedrock. It measures 2.5 meters in diameter by 70 centimeters tall (Figure 170).

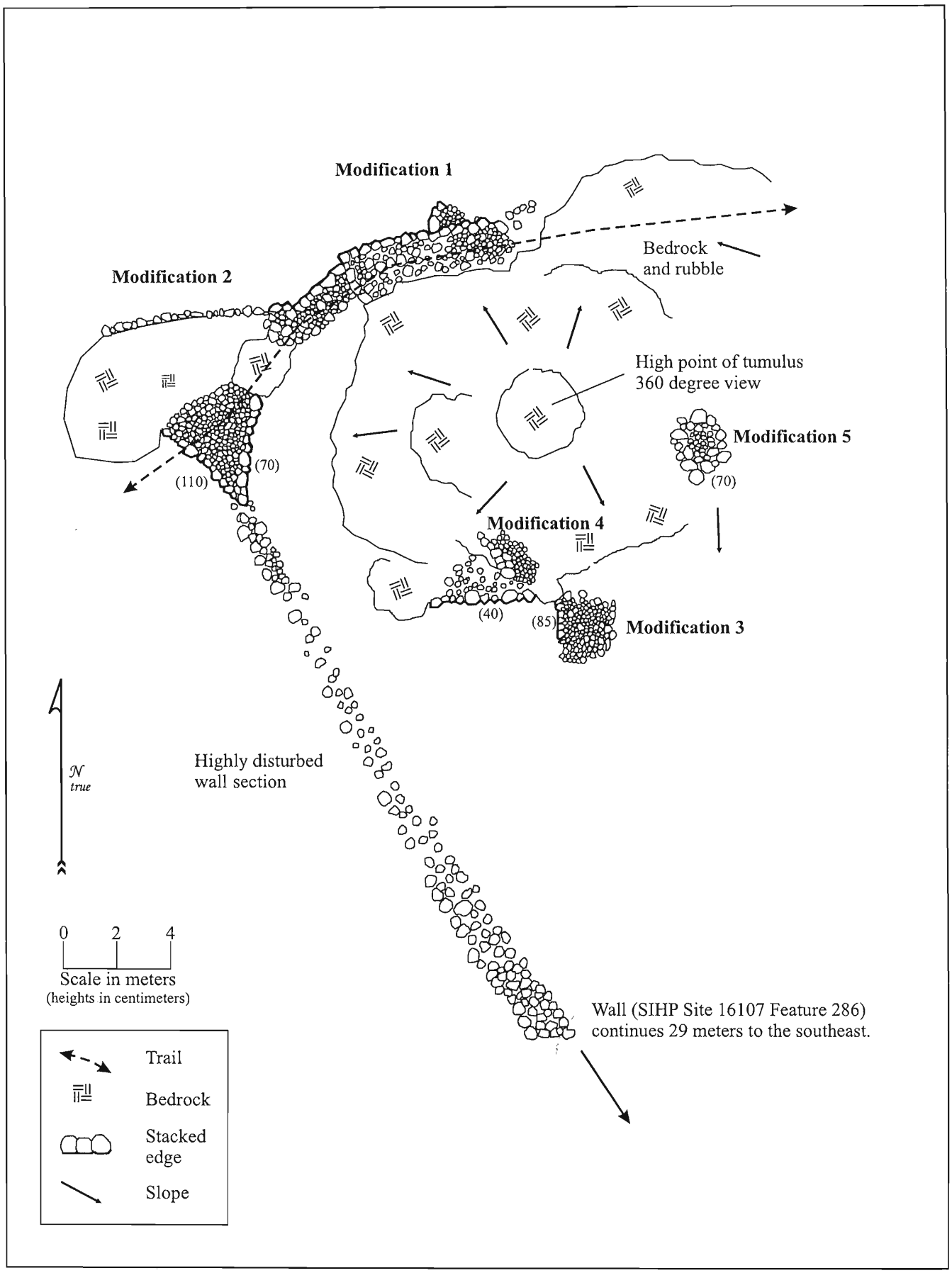


Figure 166. SIHP Site 25055 plan view.

Figure 168. SIHP Site 25055 Modification 3 view to the south.

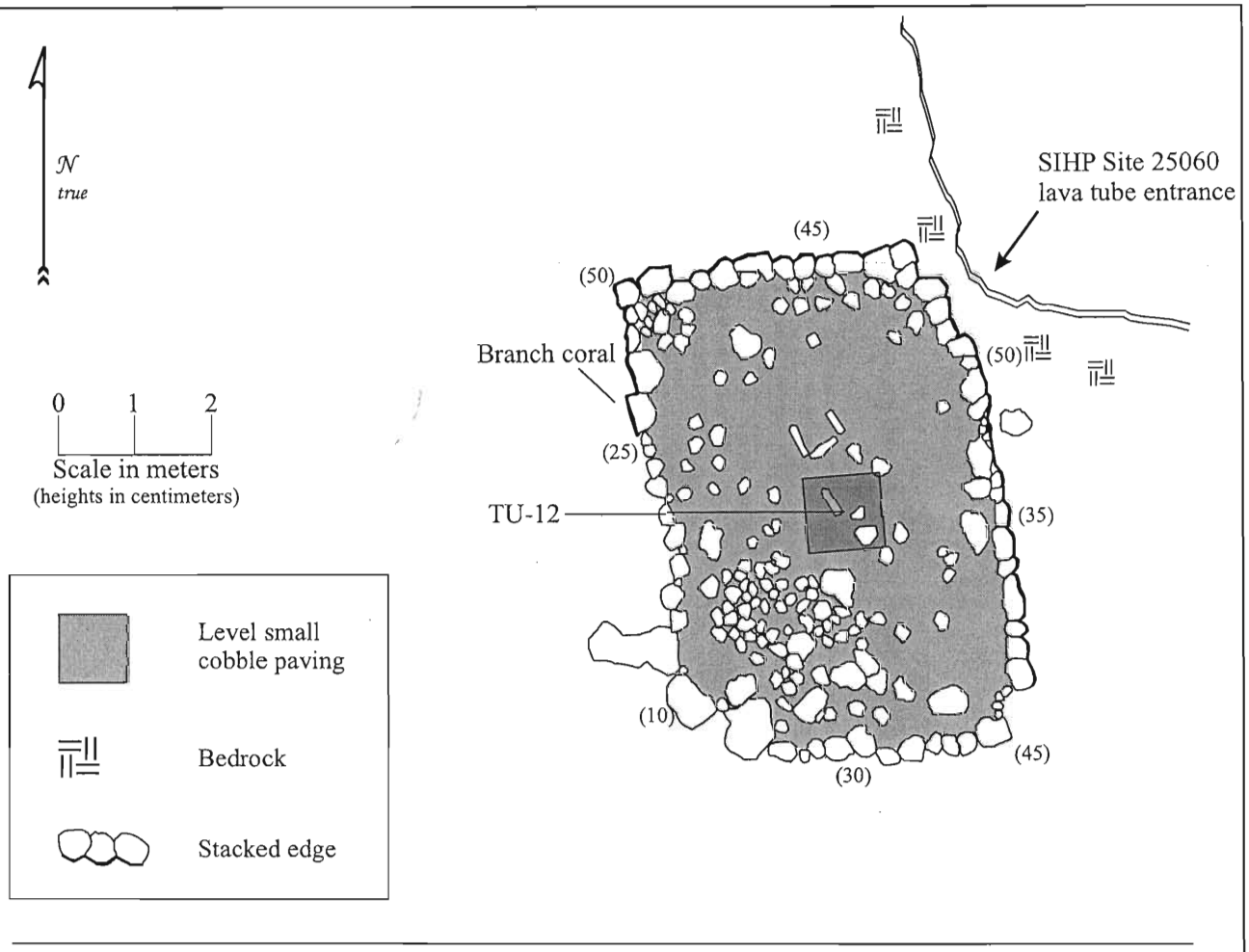
Figure 169. SIHP Site 25055 Modification 4, view to the north.

Figure 170. SIHP Site 25055 Modification 5, view to the east.

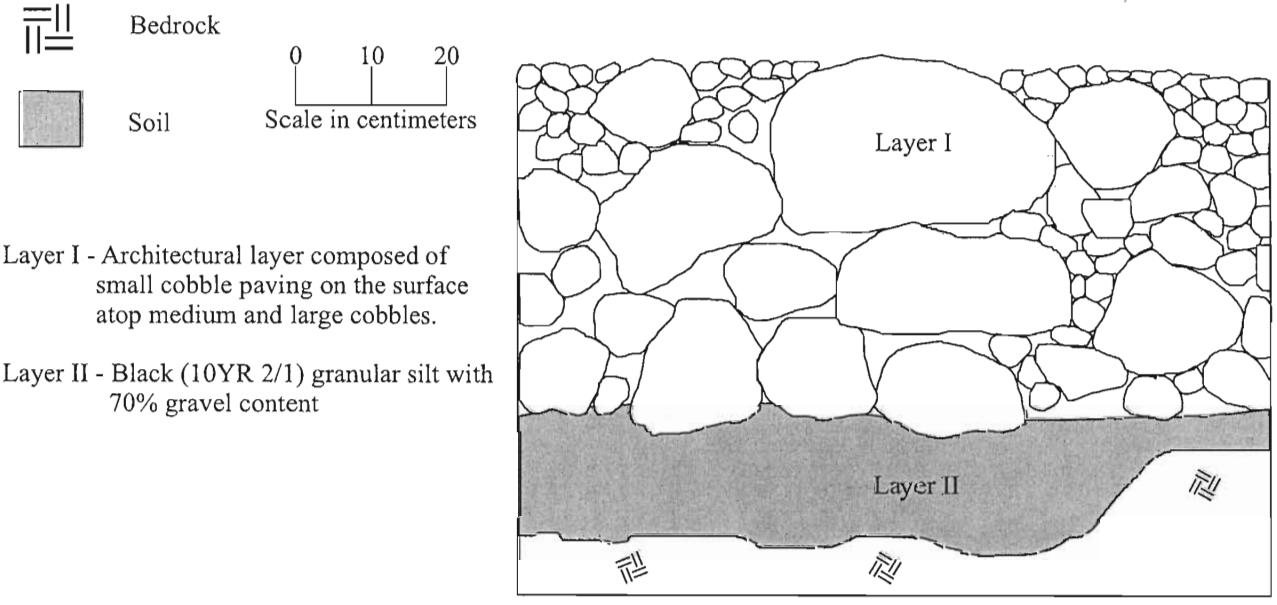
SIHP Site 25056

Site 25056 is a platform located in the center of the project area (see Figure 15). The platform was constructed on top, and just west of the *mauka* opening of SIHP Site 25060, a habitation lava tube (Figure 171). The platform is rectangular and measures 3.7 meters (east-west) by 6 meters (north-south). The feature is stacked on all sides with large angular cobbles; the northern side is 0.45 meter tall, the west and south sides are 0.35 meter tall, and the eastern side is 0.35-0.5 meter tall. The top surface is level and paved with mostly small *pāhoehoe* cobbles with a few medium cobbles. In the center of the northern half of the platform are 3 upright slabs sunken below the surface in a U shape, open-ended to the northwest (Figure 172). The top of the slabs is 0.05 meter above the paved surface; inside the U is filled in and paved with small cobbles. The slabs may have lined a former posthole used for a structure or that held a *ki'i*. Based on the formal attribute of this feature, Site 25056 was likely used for Precontact habitation purposes, perhaps on a seasonal basis associated with the agricultural pursuits within the current project area. SIHP Site 25071 to the northwest contains a burial, and may have had an association with SIHP Site 25056.

A single 1 x 1 meter test unit (TU-12) was excavated at Site 25056 in the center of the platform to test for the possibility of buried cultural deposits (see Figure 171). Excavation of TU-12 revealed two stratigraphic layers (Layers I and II). Layer I, the 45-centimeter thick architectural layer, consisted of mostly small cobbles from the surface to a depth of 30 centimeters, and larger cobbles at the base of the layer. Cultural material (Table 10) was mostly located at depths of 10 to 30 centimeters below the surface; and included branch coral, marine shell, volcanic glass flakes, and *kukui*. Layer II continued beneath Layer I to a depth of 65 centimeters below the unit's surface. This layer consisted of black (10YR 2/1) granular silt containing 70% gravel content. Layer II cultural material including marine shell, a volcanic glass fragment, a possible basalt flake, coral, charcoal, and *kukui*. Excavation of TU-12 terminated at undulating bedrock at the base of Layer II 65 centimeters below the unit's surface (Figure 173).



TU-12 east wall profile.



Layer I - Architectural layer composed of small cobble paving on the surface atop medium and large cobbles.

Layer II - Black (10YR 2/1) granular silt with 70% gravel content

Figure 171. SIHP Site 25056 plan view and TU-12 east wall profile .

Figure 172. SIHP Site 25056, surface of platform, view to the south (note upright slab in foreground).

Table 11. Cultural material recovered from SIHP Site 25056 TU-12.

Acc#	*Layer*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
55	I	Organic	*Kukui*	6	NA	23.7
56	I	Coral	Branch	2	NA	10.2
57	I	Coral	Water worn	4	NA	17.8
58	I	Shell	*Cypraea*	2	2	3.1
59	I	Echinoderm	*Echinoidea*	1	NA	0.3
60	I	Shell	*Drupa*	1	1	8.7
61	II	Organic	*Kukui*	3	NA	0.6
62	II	Coral	Other	5	NA	1.2
63	II	Shell	*Nerita*	4	4	1.5
64	II	Echinoderm	*Echinoidea*	10	NA	0.7
65	II	Shell	*Cypraea*	4	2	1.8
66	II	Bone	*Sus*	2	1	1.5
67	II	Volcanic glass	Flake	1	NA	1.1
68	II	Basalt	Flake	2	NA	0.2
69	II	Shell	*Conus*	1	1	0.3
70	II	Shell	*Isognomon*	1	1	0.1
71	II	Shell	Unknown	2	2	0.2
72	II	Organic	Charcoal	83	NA	10.8

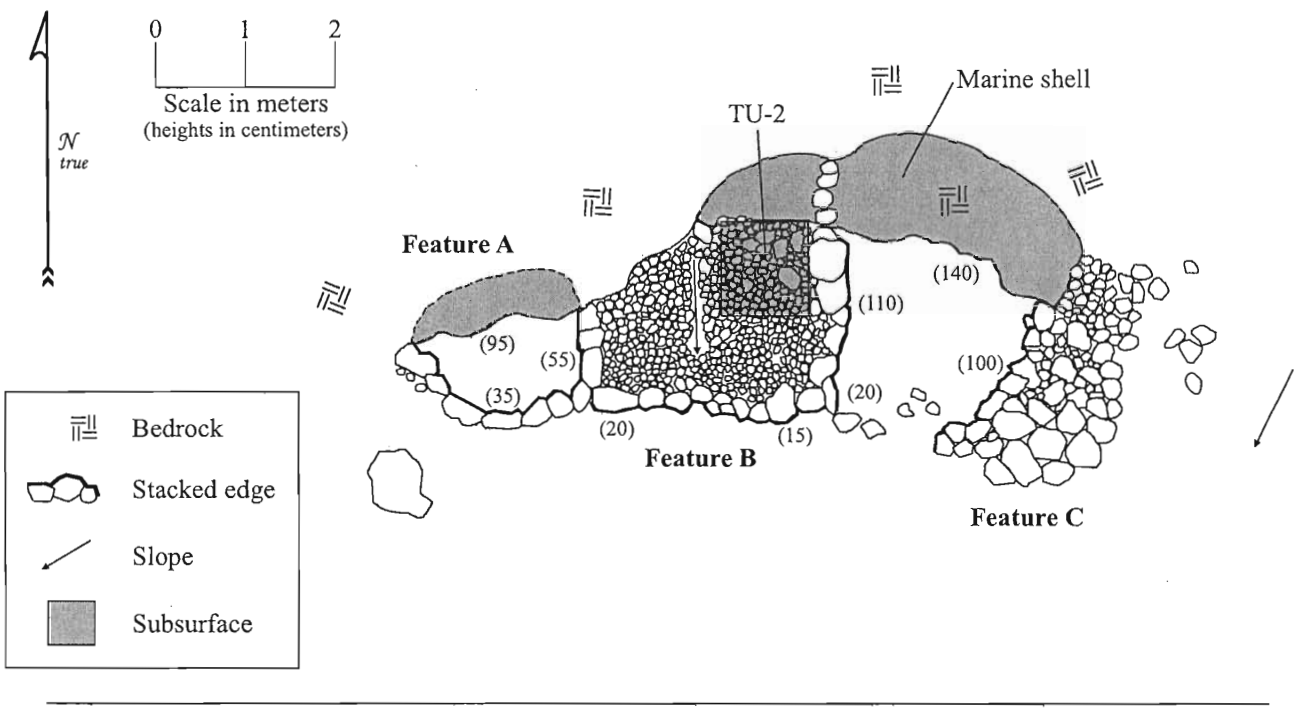
Figure 173. SIHP Site 25056, east wall profile of TU-12, view to the east.

SIHP Site 25057

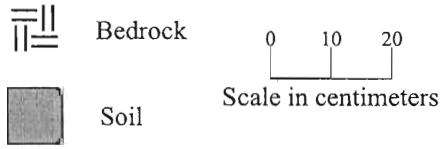
Site 25057 is an overhanging bedrock outcrop with 2 rockshelters separated by a sloping platform. Site 25057 is located in the northwestern corner of the project area, approximately 10 meters east of the western boundary bulldozer road (see Figure 15). The site is constructed on a *pāhoehoe* outcrop that faces and slopes to the south, although the overall slope is moderate and to the west. The site consists of 3 features including a small modified rockshelter (Feature A), a sloped platform (Feature B), and a larger modified rockshelter (Feature C) (Figure 174). Many lava tube systems are located in the immediate vicinity; the modified overhang that is discussed below is a remnant of a collapsed lava tube. Vegetation in the area consists of Christmas-berry (*Schinus terebinthifolius*), *koa-haole* (*Leucaena leucocephala*), *Ficus* sp., fountain grass (*Pennisetum setaceum*), and lantana (*Lantana camara*). Based on the formal attributes of these features, it is likely that Site 25057 was used for Precontact habitation purposes, perhaps on a seasonal basis associated with the agricultural pursuits within the current project area.

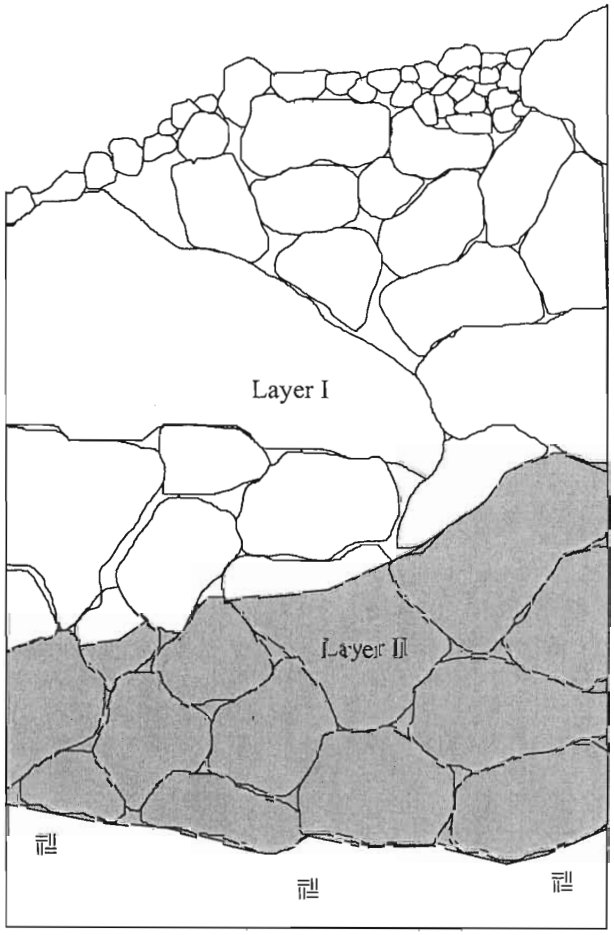
Feature A

Feature A is a small oval-shaped enclosure partially under an overhang located at the western end of Site 25057 (see Figure 174). Large *pāhoehoe* slabs and angular cobbles are stacked in a semi-circle on the south side of a bedrock overhang. The small, enclosed area measures 1.8 meters (east-west) by 1.5 meters (north-south); 60 centimeters of which are under the 0.4-meter tall overhang. The southern edge is 1 course/0.35 meter tall on the interior; the eastern edge is 1 to 3 courses tall (taller to the north), and the western edge is 1-2 courses of stacked cobbles and slabs (Figure 175). The small sheltered enclosure was possibly a storage area associated with the habitation feature (Feature B) to the east.



TU-2 west wall profile.





Layer I - Architectural layer consisting of small to large cobbles, and large slabs.

Layer II - Very dark grayish-brown silt layer containing many various sized cobbles

Figure 174. SIHP Site 25057 plan view and TU-2 west wall profile.

Figure 175. SIHP Site 25057 Feature A, west edge of Feature B on the right, view to the north.

Feature B

Feature B is a sloped surface platform constructed up against the southern edge of the overhanging outcrop, located between two rockshelters, Features A and C (see Figure 174). Feature B measures 2.8 meters (east-west) by 1.9 meters (north-south); the eastern, southern and western edges of the platform are composed of stacked cobbles and the northern side is paved up to the bedrock outcrop. The southern edge is 0.2 meter above the ground surface; the east edge slopes up to the north with a maximum height at the northern end of 1.1 meters, and western edges slope up to the north with a maximum height of 0.55 meter. The top surface is flat but slopes to the south and is composed of small cobbles paving the surface. Although the surface is sloped the feature is a temporary habitation.

A 1 x 1 meter test unit (TU-2) was excavated in Feature B at the northeastern corner of the sloping surface to test for the possibility of buried cultural deposits. Excavation of TU-2 revealed two stratigraphic layers (see Figure 174). Layer I, the architectural layer, was composed of medium and large sized *pāhoehoe* slabs along the outcrop on the north, with small to large cobbles in the southern portion of the unit. Artifacts in this layer included charcoal, marine shell, and a waterworn basalt tool. Layer I extended to a depth of approximately 80 centimeters to a soil and cobble layer, Layer II. Layer II consisted of very dark grayish-brown (10YR 3/2) silt containing 30% gravel content of small cobbles and pebbles, with declining gravel content at the base of the unit. A dark grayish-brown (10YR 4/2) silt, possible ash deposit, was observed in the center of the eastern half of the unit from a depth of 115 centimeters to 126 centimeters, the depth of bedrock, and the termination of the unit. Layer II contained artifacts including an intact adze (northwestern portion of unit, 85 centimeters below surface), and marine shell, volcanic glass flakes, fish bones, and charcoal found throughout the layer (Table 11; Figures 176, 177 and 178). Excavation of TU-2 terminated at smooth, level *pāhoehoe* bedrock, 126 centimeters below the center of the unit's sloped top surface.

Table 12. Cultural material recovered from SIHP Site 25057 Feature B, TU-2.

Acc#	*Layer*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
1	II	Volcanic glass	Flake	2	NA	3.7
2	II	Shell	*Isognomon*	2	1	1.4
3	II	Basalt	Abrader	2	NA	2.7
4	II	Shell	*Cypraea*	1	1	1.8
5	II	Shell	Unknown	3	1	2.5
6	II	Organic	Charcoal	15	NA	5.5
7	II	Basalt	Abrader	1	NA	163.0
8	II	Basalt	Adze	1	NA	45.9
9	II	Organic	Charcoal	20	NA	3.4
10	II	Organic	*Kukui*	1	NA	0.4
11	II	Volcanic glass	Flake	2	NA	2.4
12	II	Shell	*Conus*	1	1	0.7
13	II	Shell	*Isognomon*	1	1	0.7
14	II	Echinoderm	*Echinoidea*	2	NA	0.6
15	II	Shell	Unknown	3	1	0.5
16	II	Bone	Fish	2	1	0.6
17	II	Echinoderm	*Echinoidea*	13	NA	1.8
18	II	Bone	Fish	1	1	0.3
19	II	Organic	Charcoal	22	NA	4.5
20	II	Organic	Charcoal	18	NA	5.1
21	II	Shell	*Calliostoma*	1	1	1.8
22	II	Echinoderm	*Echinoidea*	3	NA	0.5
23	II	Volcanic glass	Flake	1	NA	0.2
24	II	Organic	Charcoal	26	NA	6.2
25	II	Echinoderm	*Echinoidea*	7	NA	0.7

Figure 176. Basalt abrader recovered from Site 25057 Feature B, TU-2 (Acc # 3).

Figure 177. Basalt abrader recovered from Site 25057 Feature B, TU-2 (Acc # 7).

Figure 178. Adze recovered from Site 25057 Feature B, TU-2 (Acc # 8).

Feature C

Feature C is a rockshelter located at the eastern end of Site 25057, just east of Feature B (see Figure 176). The feature consists of an enclosed area, partially sheltered by overhanging bedrock that measures 2 meters (east-west) by 3 meters (north-south) overall (Figure 179). The western edge of the enclosed area is the wall that forms the eastern edge of Feature B; it is low, 0.2 meter tall at the southern end and slopes up to a height of 1.1 meter tall on the northern end. The wall continues under the overhang, terminating into bedrock at the northern end. The northern edge of the area is bedrock under the overhang; the eastern edge of the enclosed area consists of stacked cobbles 1 meter tall. The southern edge is partially collapsed into the interior of the enclosure, but 0.2-meter tall remnant of intact stacking is still present in the southwestern corner. Marine shell was observed inside the sheltered area in the northwest corner. The ground surface inside the enclosure consists of small pebble and small cobble paving with larger cobbles on the southern end that collapsed in. East of the stacked eastern edge is a level surface of medium sized cobbles that were probably utilized as a work surface. Feature C probably functioned as a temporary habitation in association with the platform to the west.

Figure 179. SIHP Site 25057, Feature C, rockshelter, view to the northwest.

SIHP Site 25058

Site 25058 is a large enclosure located in the center of the project area (see Figure 15). The enclosure measures approximately 40 meters (north-south) by 20 meters (east-west) and is roughly rectangular. At the north end the west and east walls are constructed up to the edge of Site 25060, a lava tube sink, with a 10-meter gap along the sink rim. The 2-meter vertical drop into the lava tube was a sufficient natural barrier and would have prevented entry or escape regarding the enclosed area. The eastern wall of the enclosure extends from the lava tube sink edge in the north, 35 meters to the south/southeast. The wall is stacked large cobbles, small boulders, and upright slabs that were used to retain smaller cobbles although the wall is not core-filled (Figure 180). Near the southeastern corner, it is stacked along the west side of an outcrop; this is the only portion that is not freestanding. The southern wall is 20 meters long and runs down a slight western slope in a southwestern direction. The western wall runs north/northwest for 30 meters, and at the north end it curves to the northeast

and terminates at the Site 25060, lava tube sink edge. The walls are constructed with stacked small to large cobbles, small boulders, and upright slabs that were used to retain smaller cobbles although the wall is not core-filled. The wall is constructed on soil and bedrock ground with widths averaging 0.8 meter wide (maximum 2 meters in collapsed segments), and heights average 0.7 meter tall. The interior area of the enclosure is thickly wooded with Christmas berry and ficus trees; the ground surface has many patches of thick soil with *pāhoehoe* outcrops running in a north-south direction. The enclosure may have been built to enclose a planting area and exclude animals (pigs and dogs) that could damage crops. Whatever the exact function, this site seems to be associated with the habitation Site 25060.

Figure 180. SIHP Site 25058, enclosure wall, view to the west.

SIHP Site 25059

Site 25059 is a lava tube habitation that runs a short distance east and west from a large collapsed depression. This site is in good condition and retains integrity of location and setting. Site 25059 is located in the middle of the eastern end of the current study area, approximately 40 meters west of the eastern bulldozer road (see Figure 15). Site 25059 is a short tube segment that was formed on top of a lower lava tube, Site 24424, a very long lava tube that extends 100 meters to the east of Site 25034, and 210 meters to the west. Site 25034 may have connected with Site 24424, but there is currently no passage linking the two tubes.

Site 25059's collapsed area measures 15 meters (north-south) by 8 meters (east-west) with vertical bedrock edges on the west and northeast sides. The sunken area is accessible from the north and southeastern sides where cobble-covered ground slopes into the collapsed area. The natural ground surface is composed of cobbles and small boulders; it is relatively level at the base of the collapse on the north end between the two tube entrances. Based on the formal attributes of this site and the presence of cultural debris, it is likely that Site 25048 was used for Precontact habitation purposes, perhaps on a seasonal basis associated with the agricultural pursuits within the current project area.

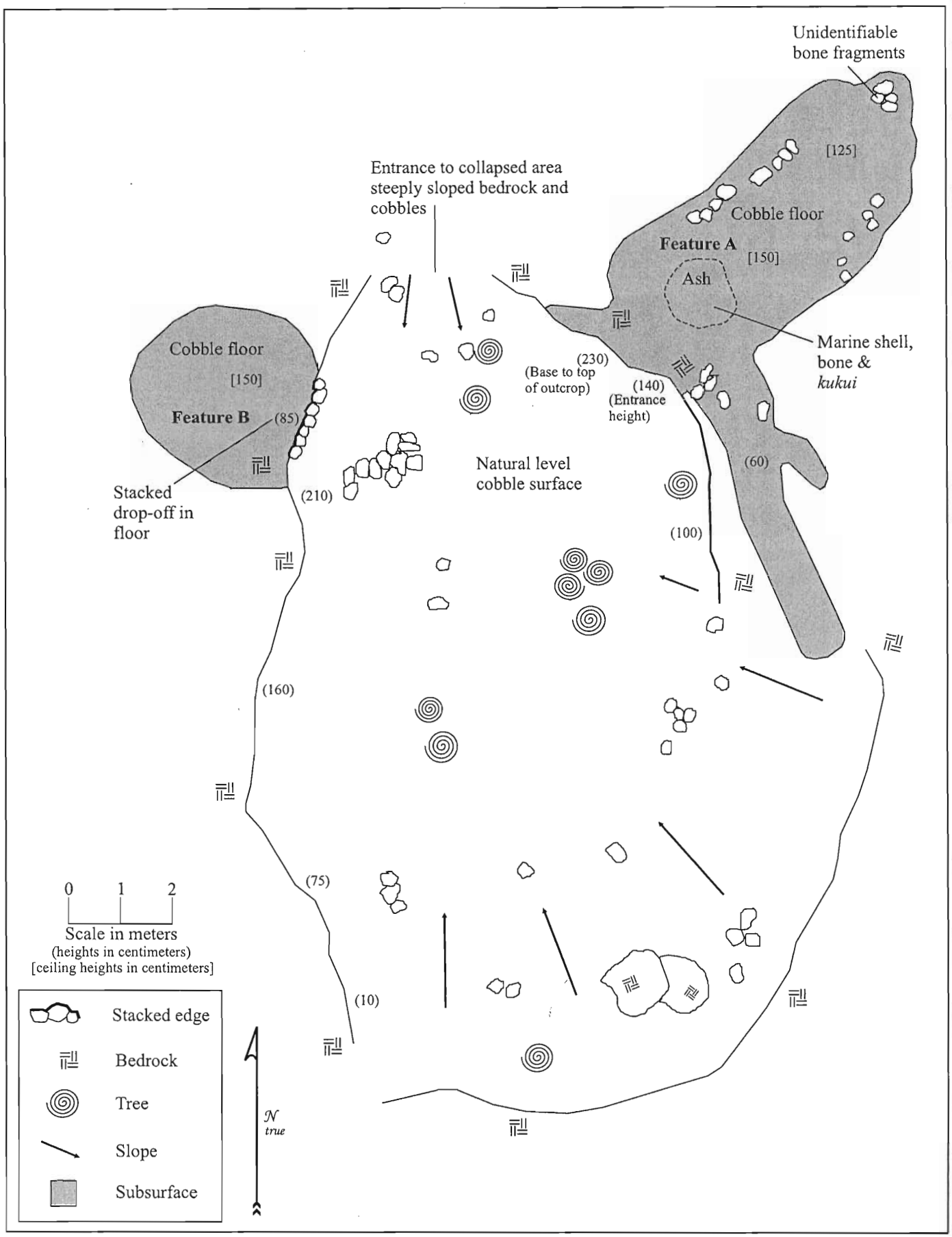


Figure 181. SIHP Site 25059 plan view.

Feature A

Feature A is a lava tube that extends 7.3 meters to the east from the northeastern corner of the collapsed area (Figure 181). The tube opening is vertical measuring 2.7 meters wide by 1.4 meters tall; the ceiling bedrock is 0.9 meter thick. The floor of Feature A is composed of scattered small to large cobbles with an ashy soil deposit in the center, 2 meters east of the entrance. In and adjacent to the ash deposit, marine shell, *kukui,* bone fragments, and volcanic glass flakes were observed. At the eastern extent of Feature A is a cluster of piled cobbles and a few unidentifiable mammal bones. At the entrance of Feature A, a narrow tube segment 1.3 meters wide by 1 meter tall (floor to ceiling) extends to the southeast for 6 meters. Cobbles are piled along the northeast wall sealing off a low adjacent area; at the terminus of the narrow passage it pinches out. Feature A functioned as a temporary habitation.

Feature B

Feature B is a circular lava tube chamber 3.5 meters in diameter that is accessible in the northwestern corner of the lava tube sink area (see Figure 181). The opening measures 1.7 meters wide by 0.65 meter from ground to ceiling. Just inside the chamber under the bedrock overhang is a stacked cobble retaining wall that drops 4-5 courses/0.85 meter from the ground surface of the outside collapsed area. The interior of the circular chamber is up to 1.5 meter from floor to ceiling. The floor is composed of various sized cobbles and slopes slightly to the west. A large basalt abrader was observed among cobbles in the center of the chamber; *kukui* nutshell and marine shell were also observed, along with more recently deposited goat bones. Feature B appears to have functioned as a temporary habitation.

SIHP Site 25060

Site 25060 is a lava tube located in the center of the current study parcel (see Figure 15). The tube is the *mauka* extension of Site 25069 and Site 16131 and is the *makai* extension of Site 24424; collapse has blocked off the entire tube in places, breaking up the tube into segments. This segment has an overall *mauka-makai* length of 50 meters, at the *makai* end the tube splits and has two narrow passages extending out to the north and south (Figure 182). The eastern entrance into the tube is a walk-in vertical opening. The western entrance is located 20 meters *makai* from the eastern entrance and consists of a collapsed ceiling with vertical drops around the 9 meters (east-west) by 8 meters (north-south) sink rim. Site 25060 contains 21 features including a stairway entrance (Feature A), cobble rings probably used for water collection (Features B-I), 2 pavements (Features J and R), 2 stacked walls (Features K and L), a terrace (Feature Q), a stacked mound (Feature N), 4 walls (Features M, O, S and T), a platform (Feature P), and a trail leading into the *mauka* entrance (Feature U). Overall the site is in good condition and retains integrity of location, setting, and workmanship. Site 25060 likely dates to the Precontact Period and functioned as a habitation lava tube with water collection features; the trail was associated with this site, and other utilized areas to the east.

The tube has a lower level that is approximately 5 meters below the level of the entrance and the chamber containing Features B-I in the segment of tube west of the sink. The change in elevation is evident in two locations, one is a vertical shaft that is on the north side of the tube, 4 meters west of the entrance, and the other is a large steeply sloped tube segment that drops down on the western side of the large chamber (see Figure 182). The shaft is 2 meters in diameter, and drops vertically 5.2 meters. The steeply sloped tube segment is 6 meters wide, and covered in loose cobbles and boulders. Pig bone was observed on the west side of the steep section. At the base of the slope is rough *pāhoehoe* tube floor that extends to the northwest for 35 meters at which point the passage becomes too narrow to access. The lower level also has an extension that heads back toward the sink and terminates in the area below Feature A (staircase), and a narrow route ends at the base of the vertical shaft. No cultural debris or features were observed anywhere in the lower level.

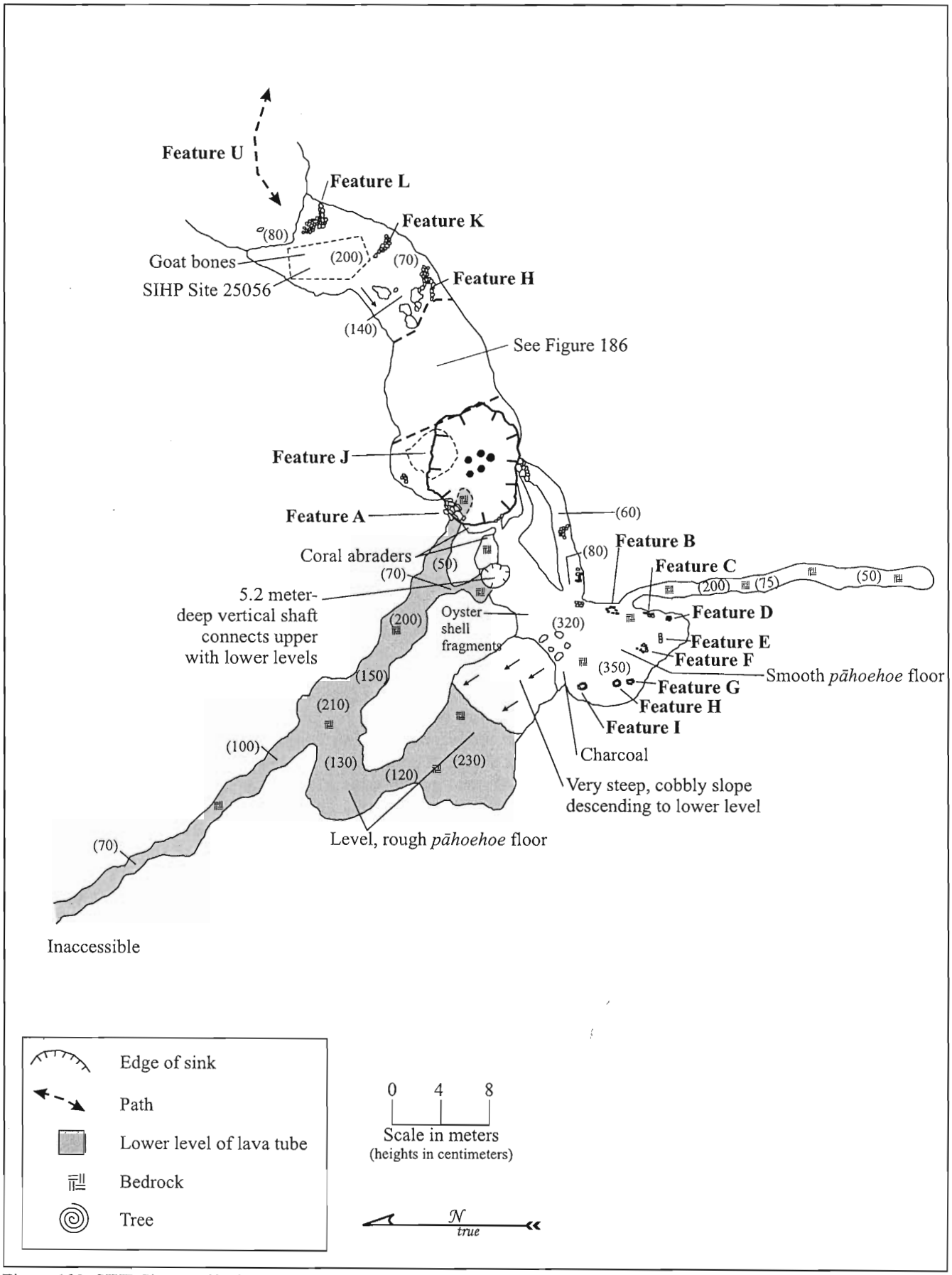


Figure 182. SIHP Site 25060 plan view.

Feature A

Feature A is a staircase that is constructed in the northwestern corner of the sink (see Figure 182). It is the only entrance on the sink perimeter, which has an average depth of 2.5 meters below the upper ground surface. The stairway is constructed of 10-courses of stacked *pāhoehoe* slabs placed against the vertical side of the sink (Figure 183). The stairs extend from the interior of the sink up to a height of 1.6 meters above the interior floor to *pāhoehoe* bedrock that slopes 1 meter up to the outside ground surface. The stairway averages 2 meters wide. Feature A is in good condition and is usable, although one step at the bottom is loose and a hazard. The steps average 0.15 meter thick. At the base of the steps to the west under a bedrock overhang is a coral artifact in the shape of an *'ulu maika* measuring 7 centimeters in diameter by 4 centimeters thick. The elaborate entrance into the sink has remained intact.

Figure 183. SIHP Site 25060 Feature A, slab stairs leading into sink, view to the northwest.

The *makai* (western) lava tube entrance in the western end of the sink appeared to have been closed off by cobbles stacked up against the sink wall around the opening that are now collapsed and scattered about the entrance (Vienna sausage cans observed in the sink suggests recent visitors probably removed the formerly blocked entrance). The opening is 0.9 meter wide by 1 meter tall (Figure 184). A 2-meter by 2-meter shelf is located to the north inside the entrance; a coral abrader was observed on the shelf. A sloping path runs along the south side of the tube to a smooth, level, *pāhoehoe*-floored chamber 9 meters west of the entrance. The chamber is approximately 12 meters (north-south) by 8 meters (east-west) with a ceiling height of 3 meters. Two tubes extend off the eastern wall of the chamber, one to the east that heads back to the southern edge of the sink, and one extends south for 25 meters. One crab claw was observed in the tube extending to the south. There are eight features (Features B-I) constructed on the level floor of the chamber.

Figure 184. SIHP Site 25060, entrance into western portion of the lava tube, view to the southwest.

Features B through I are water collection rings and alignments that are located under water drips inside the western lava tube (see Figure 182). The features appear to have been used for water collection, and functioned as both locators that marked the drips, and probably supported containers such as calabashes or broad leaves that would catch the water.

Feature B

Feature B is an oval ring standing 1-course high by 0.9 meter long and 0.55 meter wide. The rock ring is located in the eastern portion of the chamber, just north of the entrance to the tube that extends south (see Figure 182). The ring is located beneath dripping water. Feature B appears to have been used for water collection purposes.

Feature C

Feature C is a C-shaped cobble arrangement on a shelf against the eastern wall of the chamber (see Figure 182). The cobble feature stands 1 course high by 0.9 meter long by 0.45 meter wide. Feature C appears to have been used for water collection purposes.

Feature D

Feature D is an oval ring of small cobbles standing 1-course high by 0.7 meter long by 0.45 meter. It is located in the southern corner of the chamber on the smooth *pāhoehoe* floor (see Figure 182). Feature D appears to have been used for water collection purposes.

Feature E

Feature E is an arrangement of 3 cobbles located just west of Feature D in the southern end of the chamber (see Figure 182). The cobbles are aligned in a north-south direction measuring 0.7 meter by 0.4 meter. The center cobble is a slab, and the others are medium sized angular cobbles that lean in on the slab. This feature was probably used for placing water containers in or on for water collection purposes.

Feature F

Feature F is an oval ring that stands one-course high by 1.2 meters long, by 0.65 meters wide. The feature is constructed on the level floor of the chamber on the southwestern side (see Figure 182). The ring is located beneath dripping water and charcoal is present on the floor surrounding it. Feature F appears to have been used for water collection purposes.

Feature G

Feature G is an oval ring of small cobbles that stands 1-course high by 0.7 meter by 0.5 meter. The feature is located in the southwestern corner of the chamber, approximately 1 meter from the western wall (see Figure 182). The ring is located beneath dripping water. Feature G appears to have been used for water collection purposes.

Feature H

Feature H is an oval ring composed of small cobbles that stands 1-course high by 0.8 meter long, by 0.55 meter wide. The feature is located approximately 1 meter north of the south wall in the western portion of the chamber (see Figure 182). The ring is located beneath dripping water and charcoal is present on the floor surrounding it. Feature H appears to have been used for water collection purposes.

Feature I

Feature I is an oval ring composed of small cobbles that stands 1-course high by 0.9 meter long, by 0.55 meter wide. The feature is located approximately 1 meter north of the south wall in the western portion of the chamber (see Figure 182). The ring is located beneath dripping water and charcoal is present on the floor surrounding it. Feature I appears to have been used for water collection purposes.

Feature J

At the *mauka* (eastern) lava tube entrance, Feature J is a paved area in the northeastern corner of the sink, half under an overhang, and half exposed (see Figure 182). The pavement measures approximately 3 meters by 3 meters and consists of level small cobble paving that is lined on the eastern edge by a low alignment of stones. The western and southern extent of the pavement is where the small cobbles transition to large cobbles and boulders, and the northern side of the pavement slopes to the north down to the edge of the sink (Figure 185). Feature J is a constructed level surface possibly for habitation or as an activity area; prior to its construction, the sink floor may have been treacherous with fallen ceiling boulders and crevasses.

Figure 185. SIHP Site 25060 Feature J, pavement, view to the northwest.

Feature K

Feature K, within the *mauka* portion of the lava tube, is a low, stacked wall running from the south edge of the tube to the northwest for 2.2 meters. This feature is located at the eastern end of the lava tube, approximately 7 meters from the eastern (*mauka*) entrance (Figure 186). The wall is loosely stacked with medium sized *pāhoehoe* cobbles. An adjacent cleared area that measures 1.5 meters by 3 is located east of the 0.45-meter tall wall. The wall and cleared area probably functioned as a temporary habitation; the wall may have been for privacy inside the tube.

Feature L

Feature L is a stacked wall located 1 meter from the eastern end of the tube adjacent to the southern tube wall (see Figure 186). The wall consists of stacked medium sized *pāhoehoe* cobbles 2.5 meters long by 1 meter wide from floor to ceiling (50 centimeters) creating an enclosed, relatively level area east of the wall measuring 2 meters square. The small walled feature probably functioned as a temporary habitation; the wall may have been for privacy inside the tube.

Features M-T are located in an extremely modified area of the *mauka* tube portion of Site 25060. The modifications include terracing, small cobble paving, alignments, and a platform. This area contains habitation remains including bird and mammal (goat, pig, possibly marine) bone, and marine shell (*Cellana, Cypraea, Echinoidea, Isognomon*). Tools observed (not collected) include possible marine mammal bone tool, coral and basalt abraders, dense basalt adze and adze fragment, medium cobble sized porous basalt anchorstone with 3 centimeter wide groove around center, coconut bowl with cut edge, hollow cut bird bone tube, various decomposing wooden implements, and a whetstone-like basalt adze polisher.

Feature M

Feature M is a terrace wall that separates the upper sink ground level from the lower level of the paved ground surface, located under the overhang in the eastern portion of the tube (see Figure 186). The wall extends from the southern wall of the tube to the northern wall of the tube, 11 meters long. It consists of large and medium cobbles and small boulders, and has an average height of 0.5 meter tall. Width is variable depending on the size of the rock used for construction, but ranges from 20 centimeters to 70 centimeters. The upper level is paved (Feature J), as is the lower surface (Feature R). On the northern end of the wall is a paved ramp-like surface that descends from the sink into the tube. Feature M was probably used for sitting upon; many horizontally laid slabs are on the top course of the wall, and several tools were found in the adjacent (in the vicinity of Feature R) area (see Figure 186).

Feature N

Feature N is a collapsed rectangular cobble structure located 2.3 meters from the overhang edge in the northern portion of the tube (see Figure 186). Feature N measures 1.2 meters (northeast-southwest) by 0.6 meter wide with a height of 0.35 meter above the small cobble paved floor. The feature consists of large angular cobbles lining the periphery, with the center filled in with small and medium cobbles, creating a level surface. The southeast corner is collapsed with small cobbles spilling out. Observed among the small cobble in the center were a small piece of waterworn coral, a large piece of waterworn coral, and a dense basalt waterworn cobble with battering (hammerstone). Feature N possibly functioned as a sitting platform, or possibly a location for stocking tool materials, i.e., the coral and waterworn cobble.

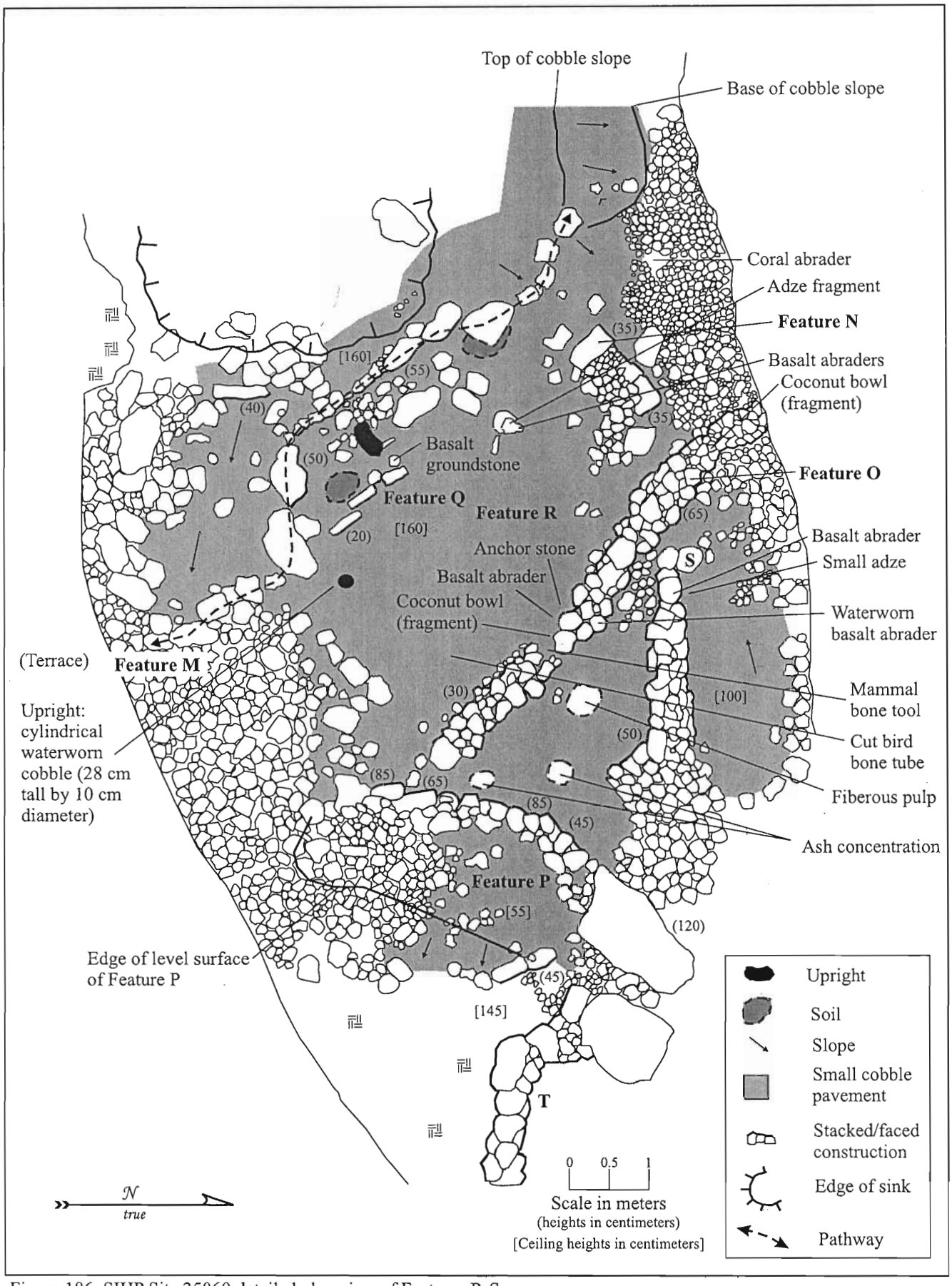


Figure 186. SIHP Site 25060 detailed plan view of Features R-S.

Feature O

Feature O is a small boulder wall extending 6 meters southeast from the northern wall to the center of the tube (see Figure 186). The wall is tallest on the northern, stacked end, 0.6 meter, but is collapsed and appears piled for the remaining portion to the south that averages 0.3 meter tall. The width of the wall ranges between 0.5 and 0.6 meter. At the southern end the wall tapers out near the western extent of the platform, Feature D. Inspection of the wall revealed many artifacts on and immediately adjacent to the west, including a marine mammal bone tool (Figure 187), a coral abrader, charcoal, an apparent anchorstone of dense, yet porous waterworn basalt that measures 22 centimeters by 19 centimeters. A groove 3 centimeters wide was pecked or worn all around the center of the cobble. A coconut bowl (Figure 188) 9 centimeters in diameter by 5 centimeters deep (projected measurements due to fragmented remains), and another coconut fragment were observed in the wall to the southeast. The wall is surrounded by, and was probably constructed upon a level small cobble pavement (Feature R). The wall was probably constructed to divide the paved area into two sections.

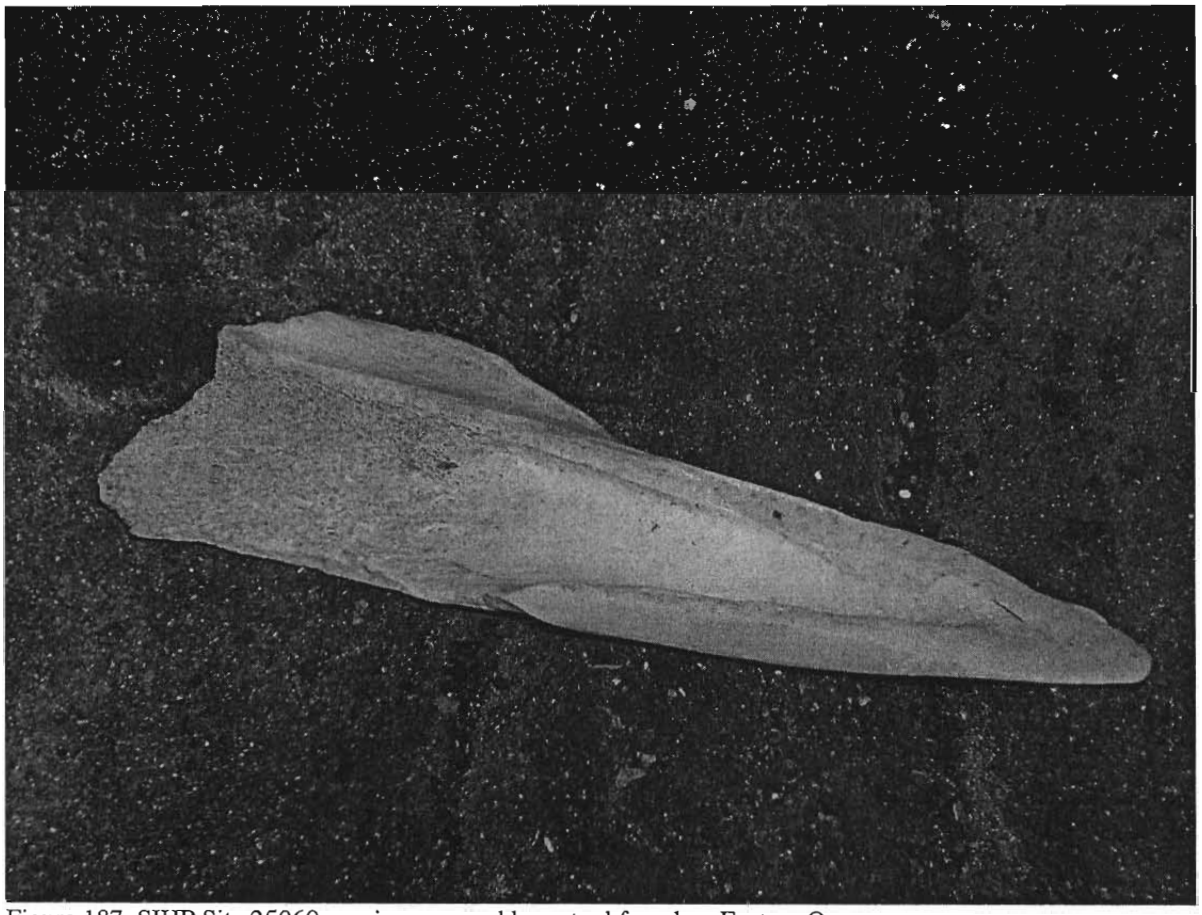


Figure 187. SIHP Site 25060, marine mammal bone tool found on Feature O.

Figure 188. SIHP Site 25060, coconut bowl found on Feature O.

Feature P

Feature P is a platform located 5.5 meters east of the overhang edge (see Figure 186). The feature measures 3 meters (north-south) by 1.5 meters (east-west). The feature is constructed 0.85 meter above the cave floor with boulders stacked up to 3 courses tall on the western side. The northern side consists of piled cobbles up against a fallen ceiling boulder, on the east side, cobble paving and medium to large cobbles slope down to bedrock floor, and on the south side medium to large cobbles gently slope down to the cave wall. The top surface is paved with small cobbles on the north half, and the southern half is covered with jumbled larger cobbles. From the top surface to the tube ceiling is 0.55 meter. A small floor blister is located along the south wall, east of the platform. Peering down the blister to the west with a light reveals small cobbles that could be fill from the base of Feature P, suggesting it was constructed over a blister in the floor. Feature P is a possible burial platform mainly because the area between the top surface of the feature and the ceiling is too small to allow activities to be conducted, and thereby probably did not function as a habitation feature.

Feature Q

Feature Q is a small terrace located just east of Feature M (wall) and west of Feature R (pavement) in the southern half of the cave, 1 meter east of the overhang edge (see Figure 186). The feature measures 1 meter by 1 meter and consists of a paved surface that slopes slightly into the tube (east). The eastern edge of the terraced area is marked by three long upright slabs that retain the pavement on their west side, and stand 0.2 meter above the paved ground surface to the east. The western edge of the small terrace is Feature M, the wall that extends the width of the cave at the entrance. Two boulders mark the southern edge, and on the north end is an upright cobble.

Feature R

Feature R is a level paved surface located east of Feature M, the wall crossing the entrance to the tube, and west of Feature O, a wall extending into the center of the cave from the northern wall (see Figure 186). The paved area measures 6 meters (north-south) by 3.5 meters (east-west); an extension of the pavement exists on the eastern side of Feature O (wall), which, if included, would measure 5.5 meters (east-west). The paved area is level and is composed of uniform small cobbles measuring 3-10 centimeters in size. A cylindrical waterworn cobble 0.28 meter tall by 0.1 meter in diameter is placed upright on the cobble paving in the southwestern corner (Figure 189). Cultural material observed among the small cobble paving include marine shell (*Cellana*), coral (1 abrader and non-utilized pieces), hard wood fragments (one with a utilized point), *kukui* nutshell, charcoal, a bird bone tube rounded from wear on one end, and goat bone (probably recent). On a stack of two slabs in the northern portion of the pavement are three stone tools (Figure 190). They include a smooth, dense basalt cobble with utilization on all surfaces that measures 15 by 8 centimeters; an adze fragment (butt end) that was probably broken during use that measures 2 by 4 centimeters; and a circular, porous basalt abrader with concave sides around the center, and flat ends similar to an hourglass. The paved surface was used for temporary habitation, which is supported by the amount of cultural debris including tools and food remains.

Figure 189. SIHP Site 25060 Feature R, upright cylindrical cobble and pavement, view to the northwest.

Figure 190. SIHP Site 25060 Feature R, pavement (note basalt groundstone on slabs), view to the south.

Feature S

Feature S is a loosely-stacked wall that runs east/west; it is located on the north side of the cave, just east of Feature O (see Figure 86). The wall is composed of large slabs and various sized cobbles, and measures 3 meters long by 0.6 meters wide, and 0.5 meter tall. The floor is paved on the north and south sides of the wall. Two artifacts, an adze and a hammerstone/abrader, were located adjacent to the wall. The adze (Figure 191) was located on the western end, north of the wall; it measures 2.4 centimeters wide by 5.5 centimeters long, by 1.3 centimeters thick. The only damage to the adze is a small fracture on the cutting edge. The hammerstone/abrader is of dense basalt and located on top of the wall on the western end (adjacent to the adze). The wall may have functioned as a divider, segmenting the paved areas in the northern portion of the cave.

Figure 191. SIHP Site 25060, basalt adze found adjacent to Feature S wall, overview.

Feature T

Feature T is a wall located east of Feature P, the small platform (see Figure 186). The wall is constructed of loosely stacked large cobbles, slabs, and small boulders. The wall is 0.6 meter wide by 0.7 meter tall, and runs southeast 3 meters from Feature P toward the southern wall of the cave. The wall is constructed on bedrock, cobbles and boulders, and runs along the eastern edge of the small blister. The wall may have functioned as a protective barrier for preventing pedestrians from falling into the shallow blister to the south.

Feature U

Feature U is a constructed trail segment located in the center of the project area (see Figure 15). It has been included as a feature of Site 25060 because it terminates at the eastern entrance to the lava tube and was clearly feature used as part of this site. The trail has a length of 66 meters (traceable) and runs *mauka-makai.* At its *mauka* end the trail is identifiable where large cobbles line a small cobble filled ramp that emerges from tall fountain grass and trends west onto a small cobble-covered outcrop. At this eastern end of the trail it passes through Site 16107 Features 280, 281, and 282, a cluster of agricultural features including a modified outcrop and cobble mounds. From Site 16107 Features 280, 281, and 282, the trail extends 25 meters to the west over relatively level *pāhoehoe* bedrock ground and is constructed with small to large cobbles with large slab stepping-stones. At 25 meters from its eastern point is a cairn of stacked *pāhoehoe* cobbles 1 meter in diameter by 0.6 meter tall constructed on the north side of the trail (Figure 192). The trail follows the north side of a collapsed lava tube depression for 15 meters west of the cairn and then splits with one trail continuing west along the north side of the collapsed tube, and one trail heading southwest crossing the depression and continuing both south toward Site 16107 Feature 277 and west along the south side of the collapsed tube. The trail that continues to the west is untraceable 15 meters from where it splits on the north side of the collapsed tube. The segment of trail that extends along the north side of the collapsed tube is 1 meter wide and is

composed of stacked slabs and cobbles along the rim of the collapse. At the point where the trail splits on the north side of the collapsed tube, the segment that heads down into the collapsed tube is lined with cobbles but has a steeply sloped bedrock surface to the base of the depression. At the base of the depression there is a step constructed of medium cobbles that lessens the slope and makes traversing the slope easier. Crossing the base of the depression is an L-shaped elevated walkway with stacked edges 0.5 meter tall. The southern portion of the elevated walkway slopes up and is constructed against the steep southern side of the collapsed tube to aid in ascending the 1.5-meter tall, almost vertical bedrock wall. At the top of the south side of the collapsed tube the trail heads south over a bridge constructed of large cobbles that spans a 1 meter deep crevasse in the bedrock (Figure 193). Beyond the bridge toward Site 16107 Feature 277 the ground surface is level *pāhoehoe* bedrock and no trail construction was needed. The trail also heads west along the southern rim of the collapsed tube on top of and between large fractured bedrock boulders. As this section of trail can be traced directly into the eastern entrance of Site 25060 (Figure 194) the entire trail was considered a part of the lava tube site.

Figure 192. SIHP Site 25060 Feature U, eastern end of trail, cairn in foreground, view to the east.

Figure 193. SIHP Site 25060, cobble bridge south of tube depression where trail heads south, view to the southeast.

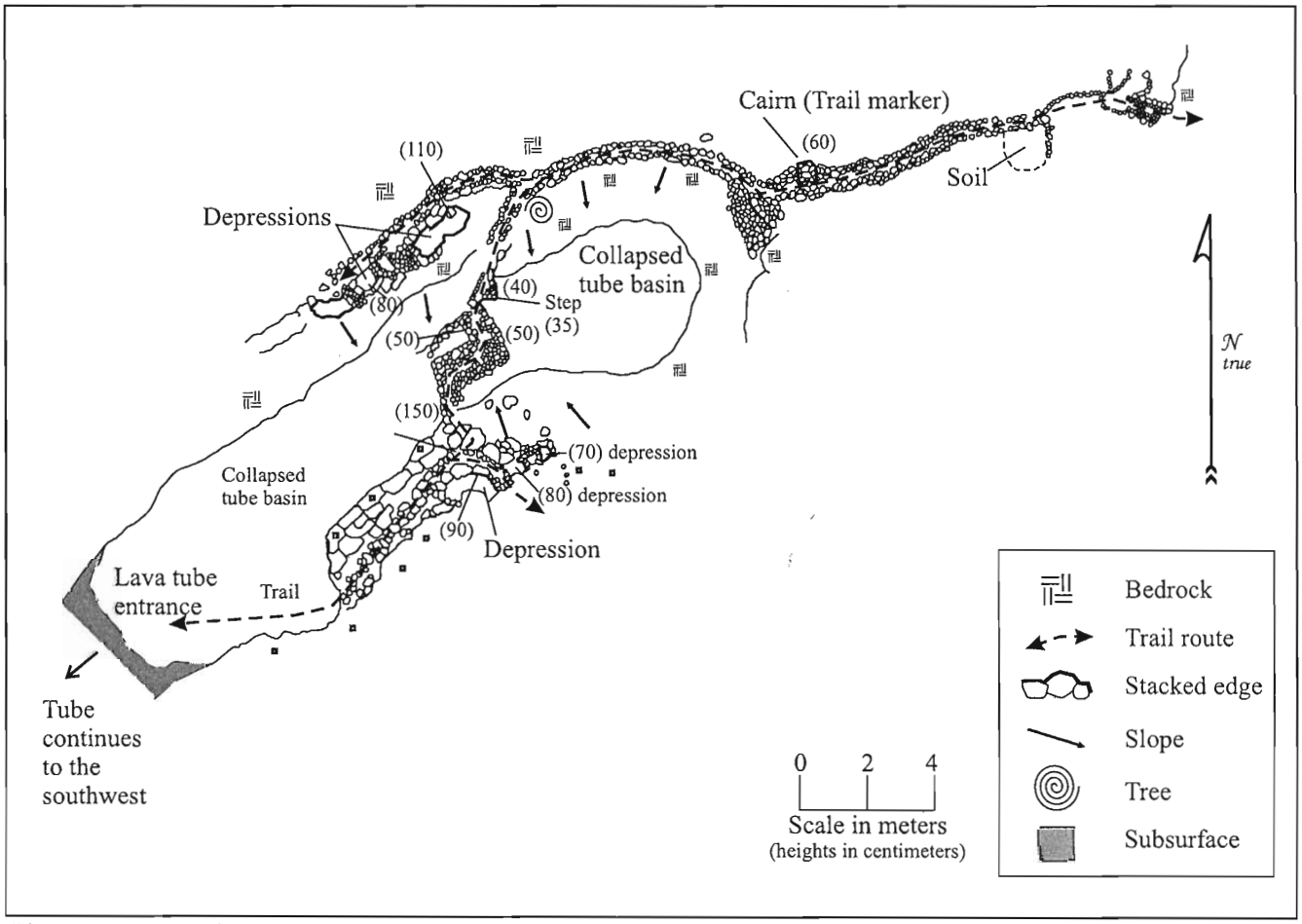


Figure 194. SIHP Site 25060 Feature U plan view.

SIHP Site 25061

SIHP Site 25061 is a modified blister, roughly circular measuring 6 meters in diameter, located in the south central portion of the current study area (see Figure 15). The site, which is in good condition contains three features: Feature A is a modified outcrop near the entrance, Feature B is a cobble-lined depression, and Feature C is modification to the exterior of the blister formation (Figure 195). The blister is a low chamber with a soil floor accessible via a collapsed ceiling opening on the northern side. The subsurface area of the blister measures 5.5 meters (east-west) by 5 meters (north-south) and has a maximum height of 0.95 meter. The edges of the blister are lined with cobbles that were probably cleared from the center that consists of soil with pebbles, *kukui* nutshells, and marine shells including *Cellana, Cypraea,* and, *Nerita.* The entrance is triangular and measures 2 meters by 2 meters, and is approximately 1 meter deep (Figure 196). In the northwestern corner of the collapse, cobbles were piled against the edge probably to function as a ramp for entering and exiting. At the base of the collapse are boulders, likely from the fallen ceiling.

Feature A

Feature A is a modified outcrop along the north edge of the blister formation. Cobbles 1-course high cover an area measuring 3 meters (east-west) by 0.6 meter wide; the north edge of the modification is 0.25 meter above the ground surface. Feature A is probably constructed with cobbles that were taken out of the collapsed entryway and placed outside in an orderly fashion (see Figure 196).

Figure 196. SIHP Site 25061, blister opening (Feature A in foreground), view to the southwest.

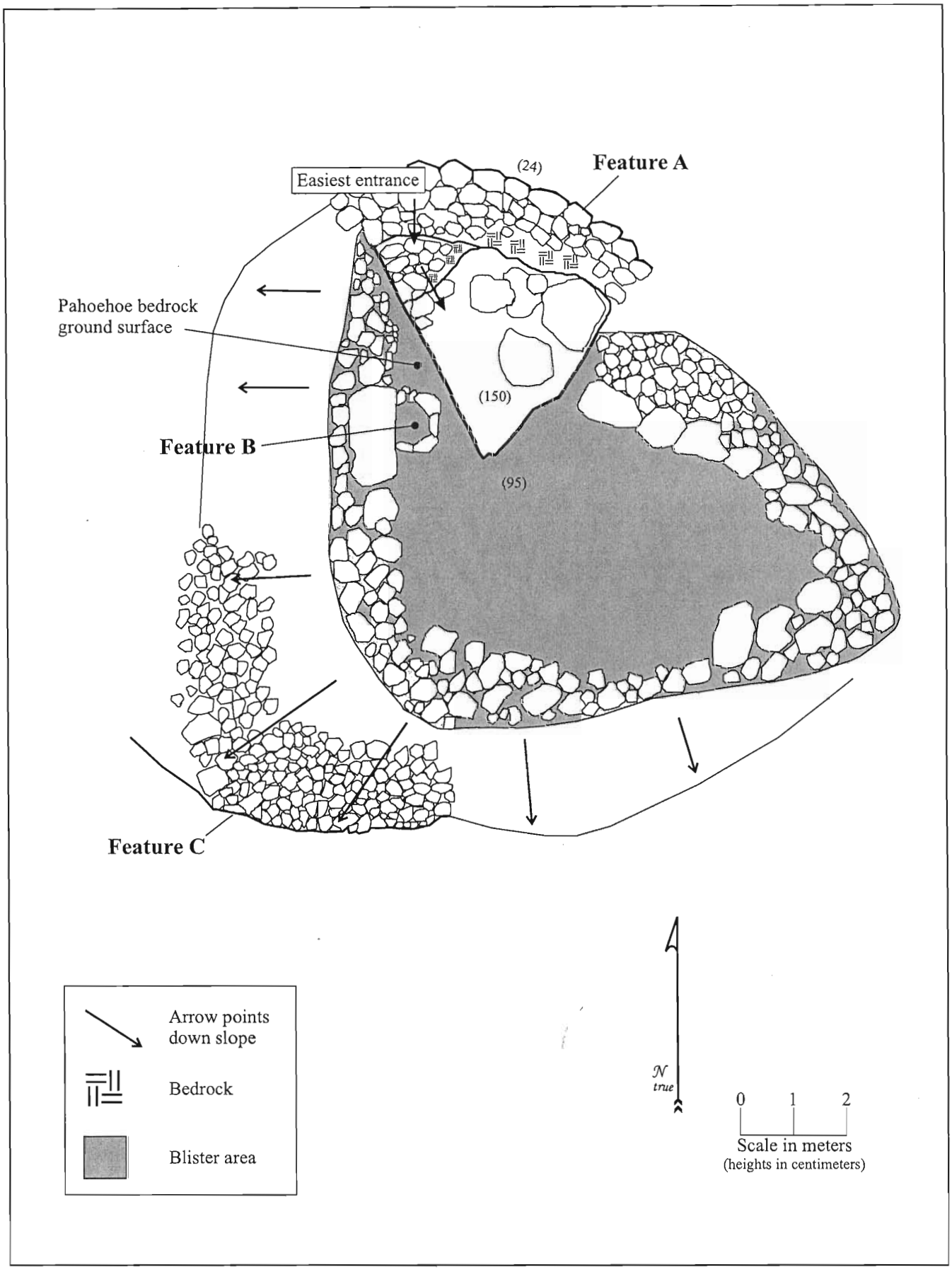


Figure 195. SIHP Site 25061 plan view.

Feature B

Feature B is a cobble-lined depression located in the northwestern portion of the subsurface area, adjacent to a rectangular boulder. The circular cobble lined depression is composed of medium to large cobbles and measures 0.5 meter in diameter (Figure 197). The depression is filled with dark ashy soil that is 15 centimeters below the top of the cobbles. This feature seems to have functioned as a fire ring.

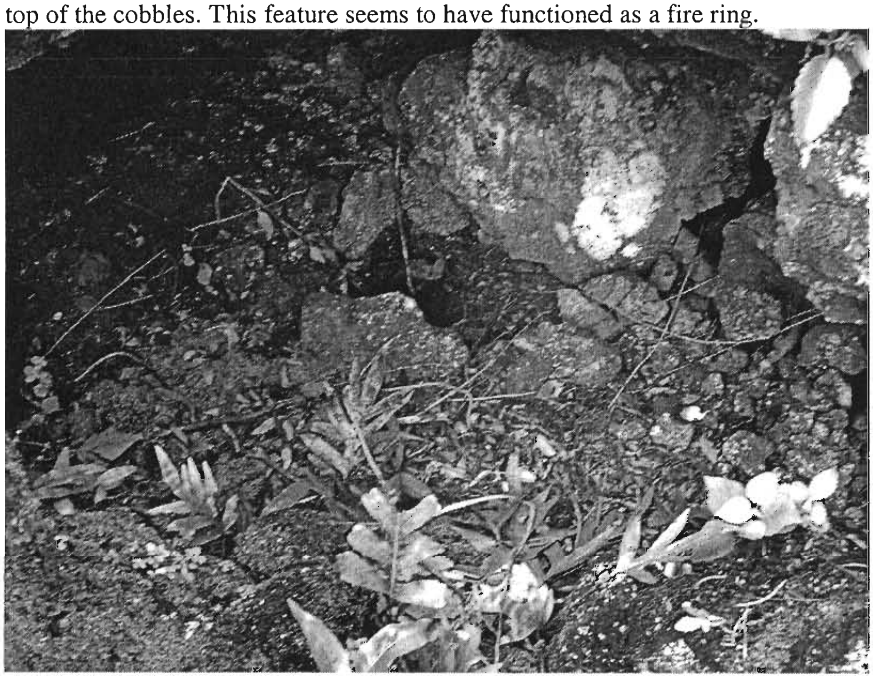


Figure 197. SIHP Site 25061, Feature B, cobble lined depression, view to the southwest.

Feature C

Feature C is a modified area located on the southwestern exterior corner of the ground surface of the blister formation. The modification consists of piled cobbles against the sloped bedrock that cover an area measuring 3 meters by 1 meter (Figure 198).

Figure 198. SIHP Site 25061 Feature C, modified outcrop, view to the north.

SIHP Site 25062

Site 25062 is a lava tube located in the center of the current study area (see Figure 15). This site is the northwestern continuation of Site 25060, a lava tube to the southeast. The site, which is in relatively good condition, contains of four features including a constructed trail (Feature A), a pavement (Feature B), a petroglyph (Feature C), and a water collection ring (Feature D) (Figure 199). Based on the formal attributes of this site and the presence of marine shell and stone tools, it is likely that Site 25062 was used for Precontact habitation purposes, perhaps on a seasonal basis associated with the agricultural pursuits within the current project area. Clusters of goat bones were observed in a few locations within the tube and these appear to have been naturally deposited.

The entrance to the lava tube is 11 meters wide by 1.8 meter tall (maximum) from the ground to the ceiling (Figure 200) and extends eastward from a collapse. The ground surface within the collapse is composed of cobbles that slope west toward the tube entrance. A constructed trail (Feature A) traverses the collapse.

Feature A

Feature A is a trail that crosses the collapse trending northwest/southeast, four meters east of the tube entrance (see Figure 199). The trail is constructed with cobbles, and slabs that are neatly fitted together on the tread surface (Figure 201). The constructed portion of the trail is approximately 1 meter wide and 6 meters long. The trail is sloped down to the southeast from the northwestern edge of the collapse. In the center of the collapse the trail's edges are visible as aligned cobbles. The sides of the trail are not stacked, but taper on the east and west down to the surrounding ground surface. On the south side of the collapse the trail extends to the southeast (toward the collapse of Site 25060). The portion of the trail on the southern side of the collapse runs along a cobble-covered slope, with cobbles lining the on the northern edge and a one meter tall bedrock outcrop along the south edge. Beyond the collapse the trail is not traceable over the heavily vegetated surrounding *pāhoehoe* surface.

Feature B

Feature B is a level paved area that measures 5 meters by 3 meters located one meter in from the tube entrance (see Figure 199) in the center of the cave. The area is paved with mostly small and a few medium sized cobbles. A dense ash concentration covering an area 2.1 meters by 2.6 meters is located on the southern half of the pavement (Figure 202). Artifacts were observed in the ash area including marine shell (*Cellana*), a coral abrader, charcoal, and *kukui*. At the base of the terrace wall east of the ash, other artifacts were observed including two medium sized cobbles with ground surfaces, one hammerstone, and one scoria abrader.

Feature C

Situated along the western edge of Feature B is a flat *pāhoehoe* slab measuring 40 centimeters by 25 centimeters. On this slab is a single petroglyph; an "A" has been etched into the slab. The "A" is 10 centimeters tall by 12 centimeters wide and was made in a serif style. The presence of this feature indicates that the tube was visited and possibly utilized in the early to middle nineteenth century.

Feature D

Toward the western terminus of the tube a natural bedrock wall partition extends 8 meters across the cave from the northern wall creating a chamber that is accessible along the southern tube edge. The chamber floor slopes toward the center. A rock ring that measures 0.6 meter by 0.5 meters is located in the center of the chamber. The oval shaped ring consists of a single course of small cobbles (17 total) (Figure 203). This feature was probably used as a stand for a container to collect water that drips from the tube ceiling.

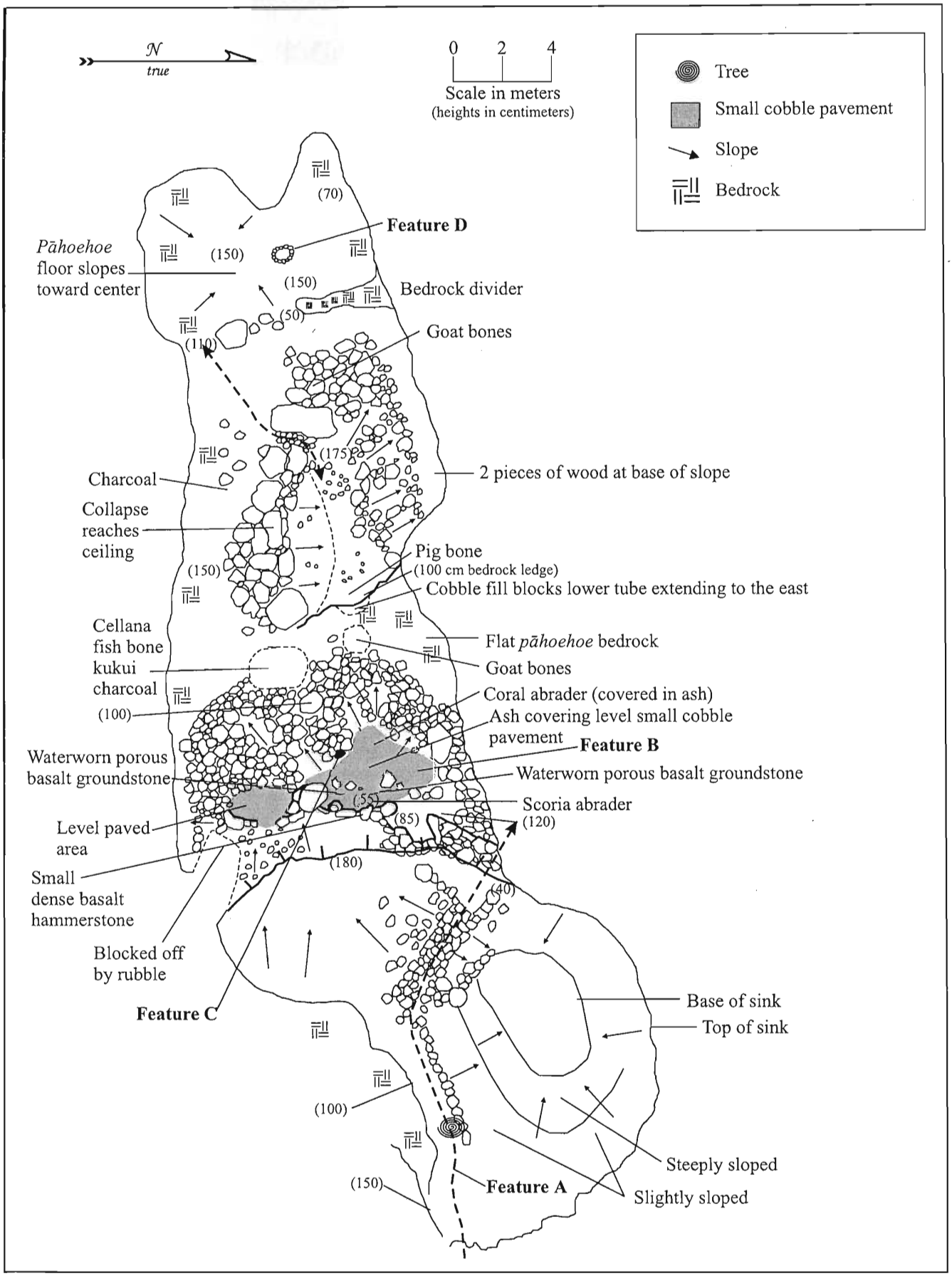


Figure 199. SIHP Site 25062 plan view.

Figure 200. SIHP Site 25062, lava tube entrance, view to the west.

Figure 201. SIHP Site 25062 Feature D, trail that crosses sink, view to the northwest.

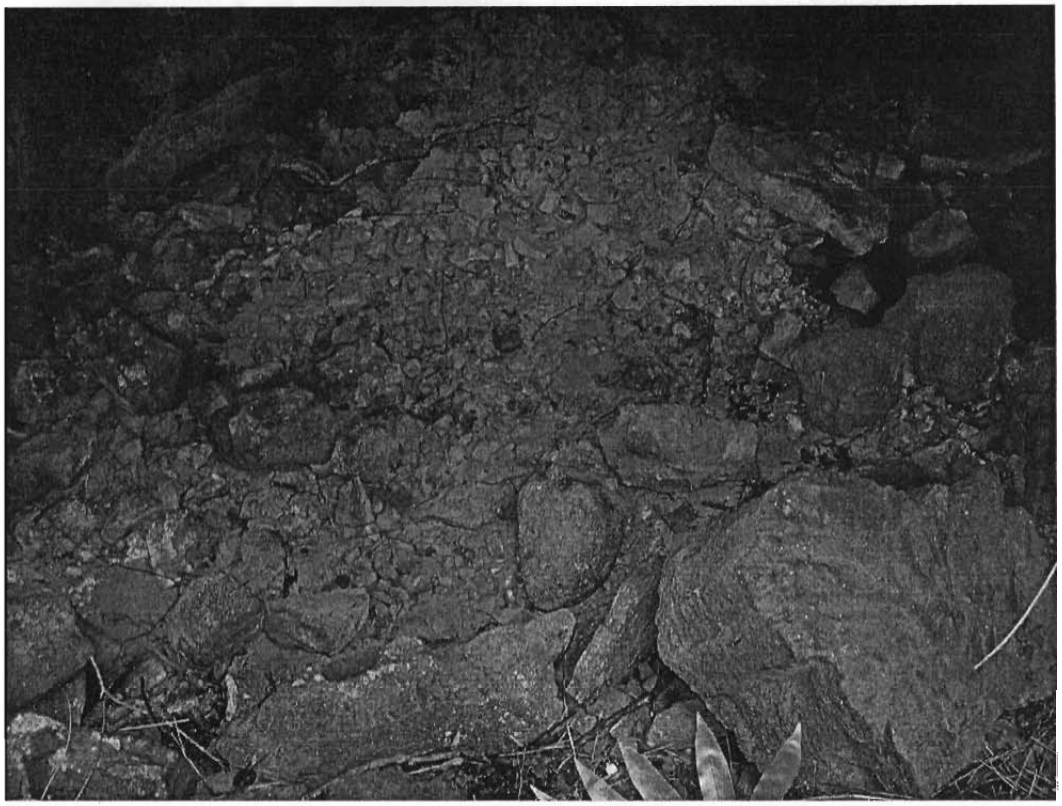


Figure 202. SIHP Site 25062 Feature A, ash concentration, view to the west.

Figure 203. SIHP Site 25062 Feature C, oval rock ring, view to the north.

SIHP Site 25063

Site 25063 is a lava tube located in the center of the project area (see Figure 15). The tube has two entrances via collapsed sections of ceiling that are 26 meters apart. The western collapsed area has a single course of loose stones stacked around the edge of the collapse. The eastern collapsed section has not been modified. The tube runs *mauka-makai* in a northwest/southeast direction for a total length of roughly 76 meters. There is a tremendous amount of roof fall on the floor of this tube, and there appears to have been seven areas within the tube that were modified for either habitation use (Features A, B, and C) or for water catchment (Features D, E, F, G) (Figure 204). This site is in good condition, although the roof collapse appears to be an ongoing condition.

Feature A

Feature A is a cleared smooth *pāhoehoe* bedrock floor area on the southern edge of the lava tube approximately 5 meters from the eastern tube entrance (see Figure 204). The cleared surface measures 1.5 meters by 3.1 meters; collapsed roof materials were piled to the edge of the surface on the east and south sides (Figure 205). The smooth level area provides a comfortable sitting or sleeping area.

Feature B

Feature B is a smooth surfaced natural *pāhoehoe* bedrock shelf (5 meters x 3 meters) that extends out from the north wall of the cave; it is located six meters from the eastern entrance (see Figure 204). The shelf has been cleared of fallen roof cobbles and slabs and on the surface, a scatter of ash, charcoal, and marine shell (*Cypraea*) was observed. This smooth surfaced area provides a comfortable place to conduct work, leisure, or sleep.

Figure 205. SIHP Site 25063 Feature A, cleared bedrock area, view to the southwest.

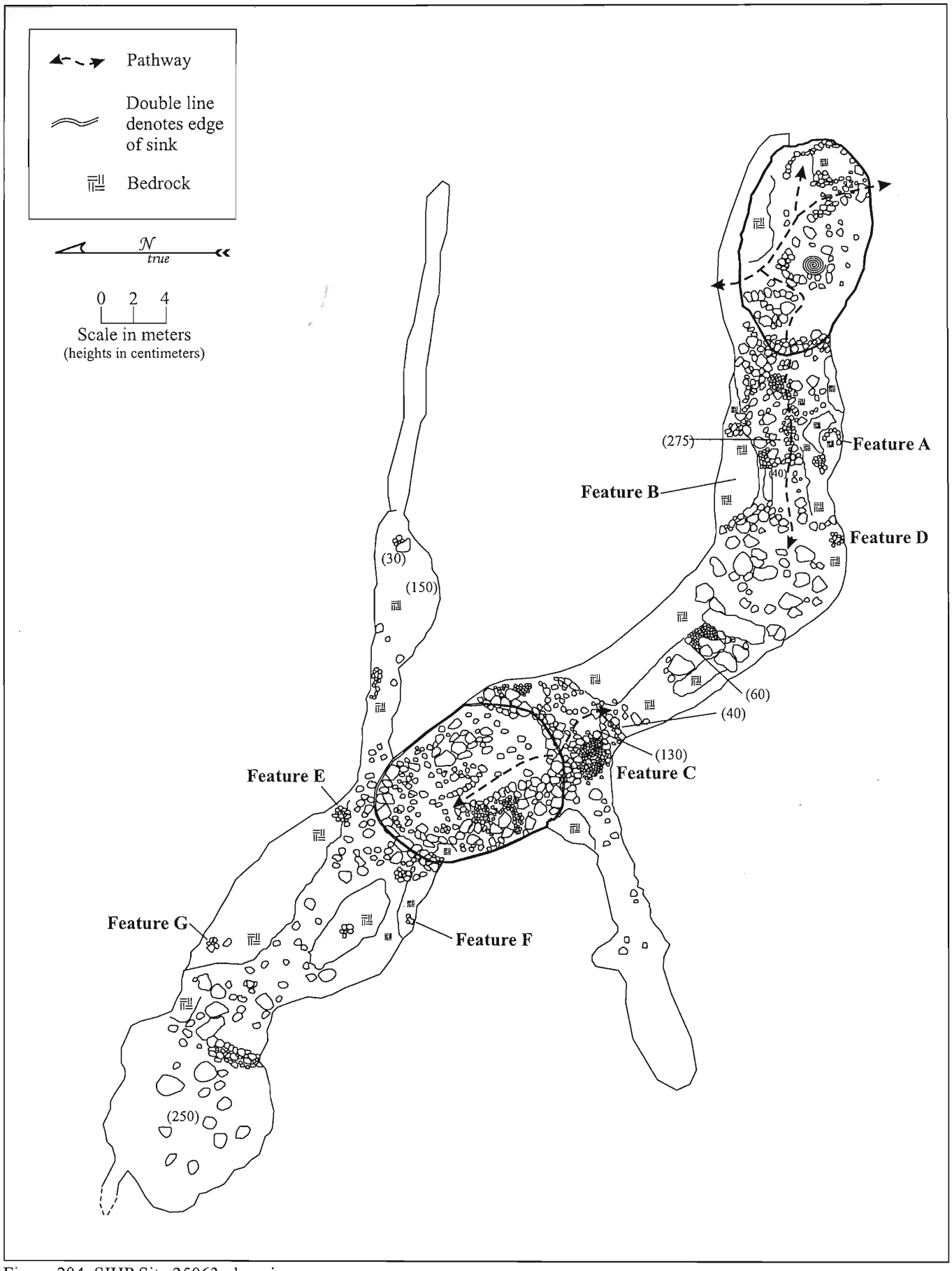


Figure 204. SIHP Site 25063 plan view.

Feature C

Feature C is a level paved area (Figure 206) that extends from the western entrance into the tube a distance of 3.5 meters (see Figure 204). Feature C is 2 meters wide with a stacked southeastern side that is 1.3 meters tall. The stacking is of large cobbles and slabs (roof fall); the top surface of the feature is level and paved with small cobbles. This feature appears to have been constructed to provide a level work or habitation surface.

Figure 206. SIHP Site 25063 Feature C, view to the southeast.

Feature D

Feature D is a roughly circular stacking of rocks located along the southern edge of the cave, 12 meters from the eastern entrance (see Figure 204). This feature is constructed from cobbles and small slabs to a height of 17 centimeters, on smooth bedrock (Figure 207). The feature measures 0.55 meter in diameter, and has an active drip that hits its center. This feature appears to have been used to support a container for water collection purposes.

Figure 207. SIHP Site 25063 Feature D, view to the south.

Feature E

Feature E is a stacked rock feature located on the northern side of the cave 4.5 meters from the western entrance (see Figure 204). The feature consists of about 20 medium *pāhoehoe* cobbles and slabs stacked up against the cave wall is a mounded circular form. The feature measures 1.2 meters tall (extending from the floor to nearly the ceiling), and is 1.7 meters long by 0.65 meter wide at the top. This feature is located at an active water drip; it was probably associated with water collection.

Feature F

Feature F is a small semi-circular rock ring located adjacent to the southern wall of the cave, four meters west of the western entrance (see Figure 204). The feature contains four medium-sized cobbles with the open end against the cave wall. Feature F measures 0.7 meter by 0.5 meter, and likely functioned as a stand for a water collection container, although no active drip was observed from the ceiling above.

Feature G

Feature G is a rock pile located on the northern side of the tube, 12.5 meters northwest of the western tube entrance (see Figure 204). The feature, composed of a somewhat linear arrangement of five large cobbles, measures 0.7 meter by 0.6 meter, and is 0.5 meter tall. The cobble pile is located on top of an elevated bedrock bench (Figure 208). While there was no active water dripping from the ceiling above this pile, it is formally similar to other water catchment features.

Figure 208. SIHP Site 25063 Feature G, view to the northeast.

SIHP SITE 25064

Site 25064 is a lava tube that runs in a north-south direction located 30 meters south of the northern bulldozer road in the northwestern corner of the current study parcel (see Figure 15). The tube is accessed through a collapsed portion of ceiling (Figure 209) down a cobble covered sloped surface with a northern aspect (Figure 210). The entrance height is one meter from floor to ceiling, and approximately four meters wide. Pig bones were observed just outside the entrance on the western side. Inside the tube along the eastern edge is a 10-meter long pile of cobbles that were probably cleared from the center of the tube to facilitate access. At the end of the pile the height from floor to ceiling is 1 meter. In this area, marine shell (*Cypraea* and *Conus*) and more pig bones were observed. Just beyond the terminus of the pile the tube opens up into a wider chamber fairly clear of cobbles that measures 8 meters (north-south) by 6 meters (east-west) with a height of 1.8 meters. A small tube branches off the main tube's western wall 13 meters from the entrance. The small tube is 0.6 meter tall by 2 meters wide; it extends southwest for 6 meters, then heads west for another 6 meters to where it pinches out. North of the large chamber, 19 meters from the entrance, the tube narrows to 0.50 meter tall for 2 meters to a chamber at the northern end of the lava tube. The chamber measures 11 meters (north-south) by 6 meters (east-west) and is 1.4 meter tall. The cleared pathway runs along the west side, and on the east side are large piles of collapsed slabs, cobbles and ceiling boulders. No cultural remains were observed beyond 10 meters from the entrance. The lava tube probably functioned as a temporary habitation; minimal modifications were observed inside the cave relative to other lava tubes in the area.

Figure 209. SIHP Site 25064, lava tube opening, view to the north.

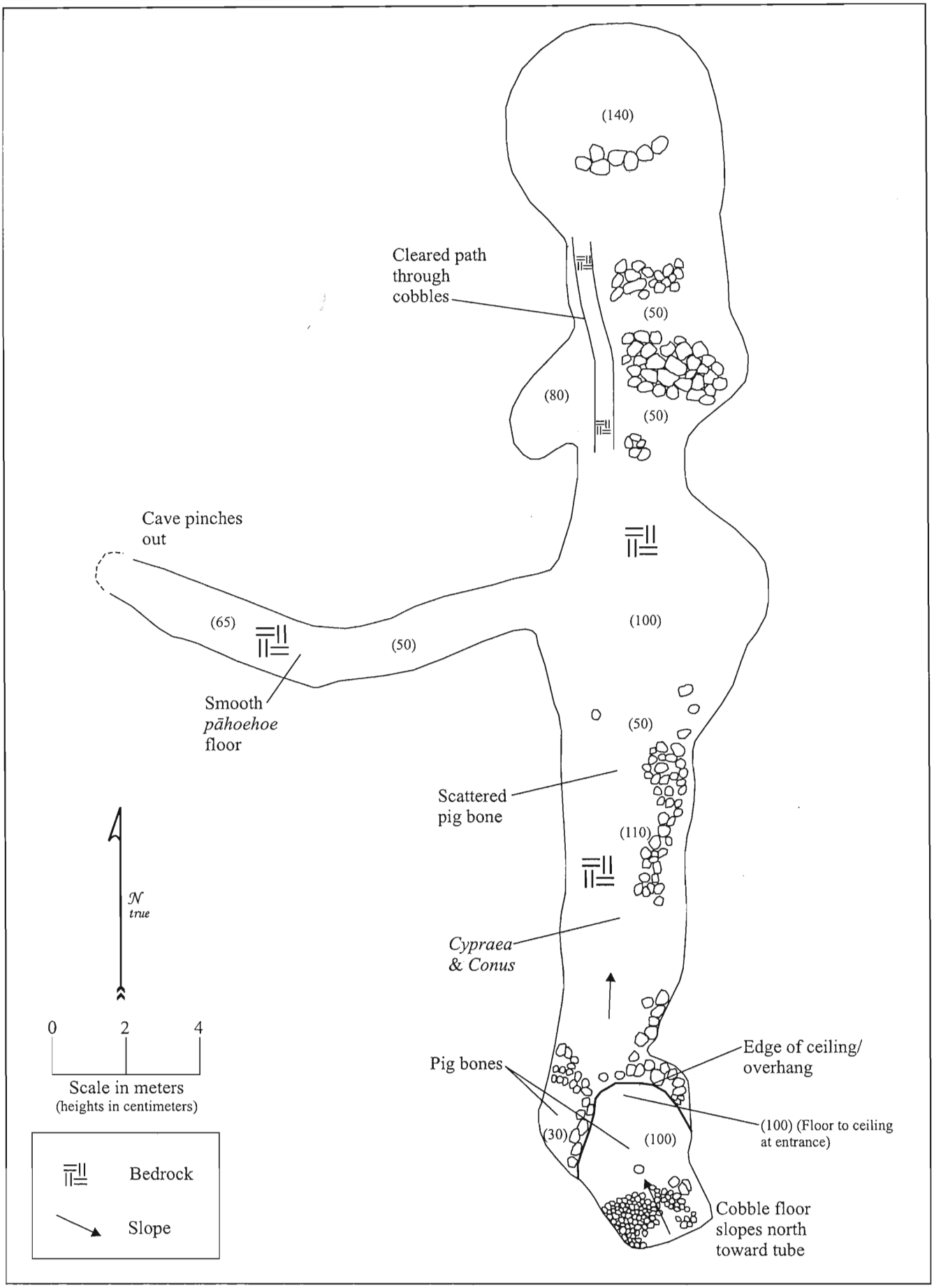


Figure 210. SIHP Site 25064 plan view.

SIHP Site 25065

Site 25065 is a lava tube with a modified collapsed entry sink located in the northwestern corner of the project area, approximately 25 meters east of the western bulldozed road (see Figure 15). Vegetation in the immediate vicinity and in the sink includes Christmas-berry (*Schinus terebinthifolius*), *Ficus* sp., guava (*Psidium guajava*), fountain grass (*Pennisetum setaceum*), lantana (*Lantana camara*), and ferns.

Site 25065 measures 56.5 meters overall and contains four features including the modified entry (Feature A), three cobble walls (Features B, C, and D) (Figure 211). Based on the formal attributes of these features and the presence of cultural debris within the lava tube, it is likely that Site 25065 was used for Precontact habitation purposes, perhaps on a seasonal basis associated with the agricultural pursuits within the current project area. Cultural material observed in the lava tube includes charcoal, bird bone, pig bone, *kukui* nutshell, and a small concentration of burned unidentified mammal bone. This site is undisturbed, and in good condition.

Feature A

Feature A is a modified lava tube collapse, which functions as the only entrance to the lava tube (see Figure 211). The collapsed hole in the ceiling of the tube measures 4 meters (east-west) by 3 meters (north-south) and is on average 1.5 meter deep (below upper ground surface). A constructed entrance into the sink is located on the northern side and consists of piled cobbles that act as a step 0.5 meter below the upper ground surface. The sink area has a bowl-like depression in the center accentuated by a piled cobble berm on the periphery of the depression. The berm is under the drip line of the overhang on the north and east sides, and extends under the overhang 2.5 meters on the south and western sides (Figure 212). The berm is composed of small boulders and large cobbles on the south and east sides, and is relatively level on the top; on the western side it is lower and composed of piled small to large cobbles with slabs placed on top. The cobbles that were piled into a berm were probably cleared from the depressed area in the center of the collapse. The collapsed entrance area lead off to the west, south and east, with another tube segment that extends west from the northeastern corner of the sink (see Figure 211).

Figure 212. SIHP Site 25065 Feature A, modified sink (note berm under overhang), view to the south.

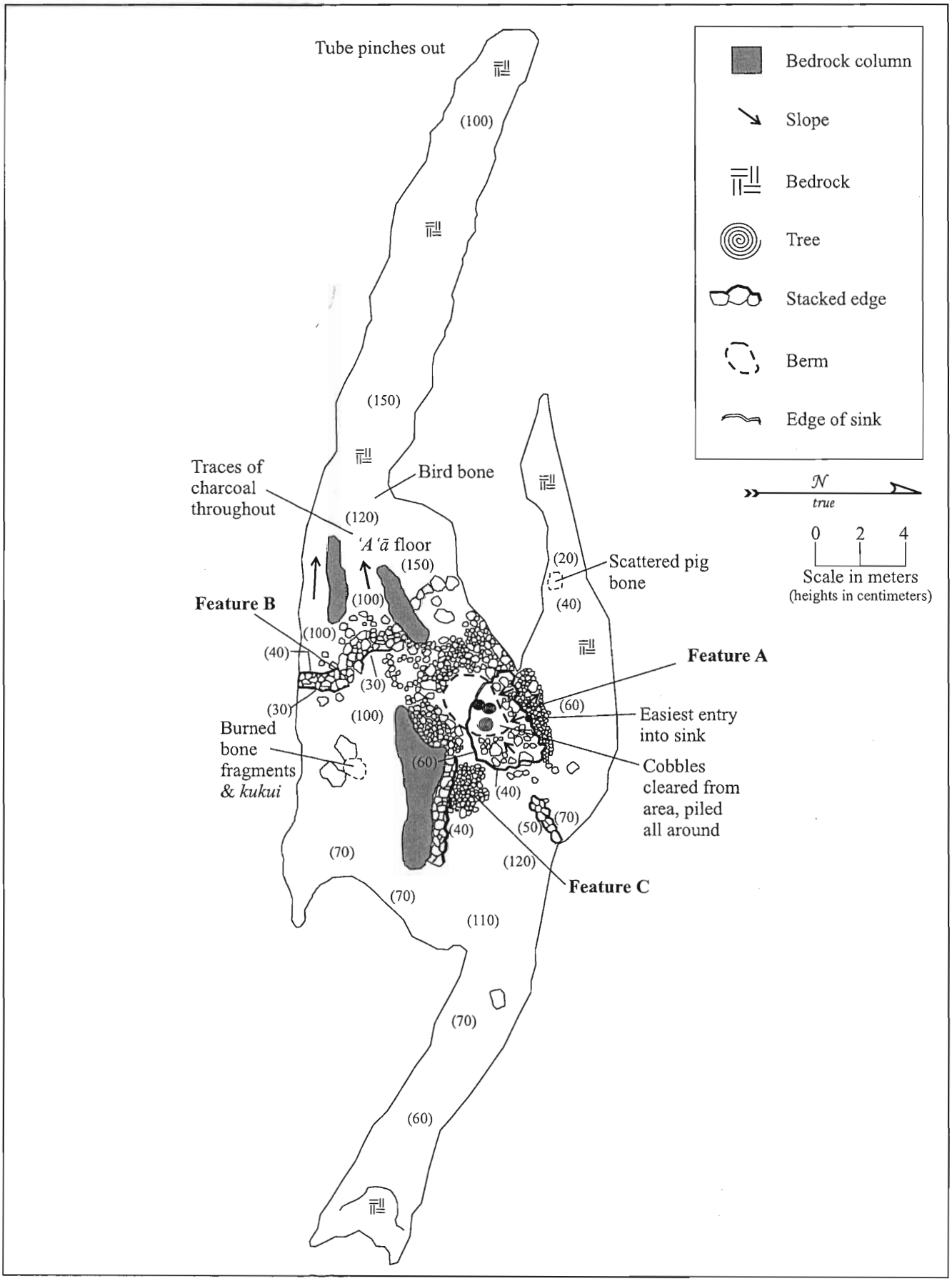


Figure 211. SIHP Site 25065 plan view.

The western entrance descends down the piled cobble berm in the west end under the overhang of the sink (Figure 213). The descent from the top of the berm, 2 meters west of the base of the cobble berm, is a 1.3-meter drop into an *a'ā*-floored chamber 6 meters wide that continues to the west becoming low and continues off property being void of features or artifacts. Trace amounts of charcoal and one bird bone were found near the entrance to the western trending tube.

Figure 213. SIHP Site 25065, western section of lava tube entrance, view to the west.

Feature B

Feature B is a cobble alignment located southwest of the entrance (see Figure 211). The entrance off the south side of the sink is sloped from the piled berm of cobbles and slabs; it drops down into an east/west trending tube segment. Blocking the lava tube to the west is Feature B, a 5-meter long curvilinear wall that is constructed (north-south) from the lava tube wall in the south to a bedrock column on the north. The wall is composed of small to large loosely stacked cobbles and slabs built along the top of a sloped segment of lava tube that descends to the west from the base of the wall. The wall segment is 1 meter wide and 0.4 meter tall on the western side and 0.3 meter tall on the eastern side; there are not sufficient collapsed cobbles lying near the wall to suggest that the wall once blocked the entire 1-meter height of the tube. East of the wall is an area of level *pāhoehoe* floor with a ceiling height of 1 meter. The alignment probably functioned as a protective barrier detouring pedestrians around the steep slope north of the wall. The tube extends east from Feature B and the southern entrance.

Feature C

Feature C is a 5-meter long (east-west) by 0.5 meter wide, by 0.4 meter tall (1-2 courses) stacked wall composed of large cobbles. The wall is bounded on the south by an elongated bedrock pillar. The wall was probably a byproduct of clearing larger cobbles from the entrance area leading into the eastern tube. The entrance area to the north of Feature C is a loose pile of natural cobbles under the drip line of the overhang leaving a wide, but low (only 0.4-meter) gap through which one must crawl to enter the tube (Figure 214).

Figure 214. SIHP Site 25065, eastern entrance from sink, view to the east.

Feature D

Feature D is an alignment on the north side of the small room-like chamber below the eastern entry ramp (see Figure 209). Feature D spans a 2-meter wide, low tube segment that heads west around the northern side of the sink. The wall runs east/west, is 0.5 meter wide, and is 0.7 meter tall on the northern side. The wall was probably constructed to prevent entry to the tube segment; that segment was inspected and no artifacts or features were observed beyond the wall. From this area the tube extends 18 meters to the east and pinches out; no artifacts or features were observed.

SIHP Site 25066

Site 25066 is a lava tube located approximately 10 meters east of the western bulldozer road in the northwestern portion of the project area (see Figure 15). The opening of the tube is located at the top of a boulder-covered slope that is the collapsed western section of the tube (Figure 215). Disturbance from heavy machinery is evident adjacent to the bulldozer road, and may have contributed to the collapsed area of the tube. The entrance measures 0.8 meter wide by 0.6 meter tall; just inside the opening it is 0.4 meter tall, almost too narrow for entry. From the entrance is a narrow, east-sloping ramp that is paved with slabs on the surface, and lined with larger cobbles along both north and south edges. The ramp is 4.4 meters long by 0.8 meter wide; at the base is level *pāhoehoe* bedrock (Figure 216). The tube opens up into a chamber 5.8 meters wide (north-south) with a height of 1.8 meters. To the west the chamber extends 4 meters to where it has collapsed. This side of the chamber consists of rubble that slopes down from the ramp. To the east the chamber extends 7 meters; it becomes narrow and inaccessible. Cultural material observed in the tube included a portion of a pig jaw, observed at the base of the ramp, and *kukui* nutshell fragments, observed on the bedrock floor of the main chamber. This tube may have extended to the west prior to the bulldozing of the western boundary road. Based on the formal attributes of these features and the presence of cultural debris within the lava tube, it is likely that Site 25066 was used for Precontact habitation purposes, perhaps on a seasonal basis associated with the agricultural pursuits within the current project area. Collapse during road construction probably blocked off a segment of tube possibly extending to the west.

Figure 215. SIHP Site 25066, entrance to lava tube, view to the east.

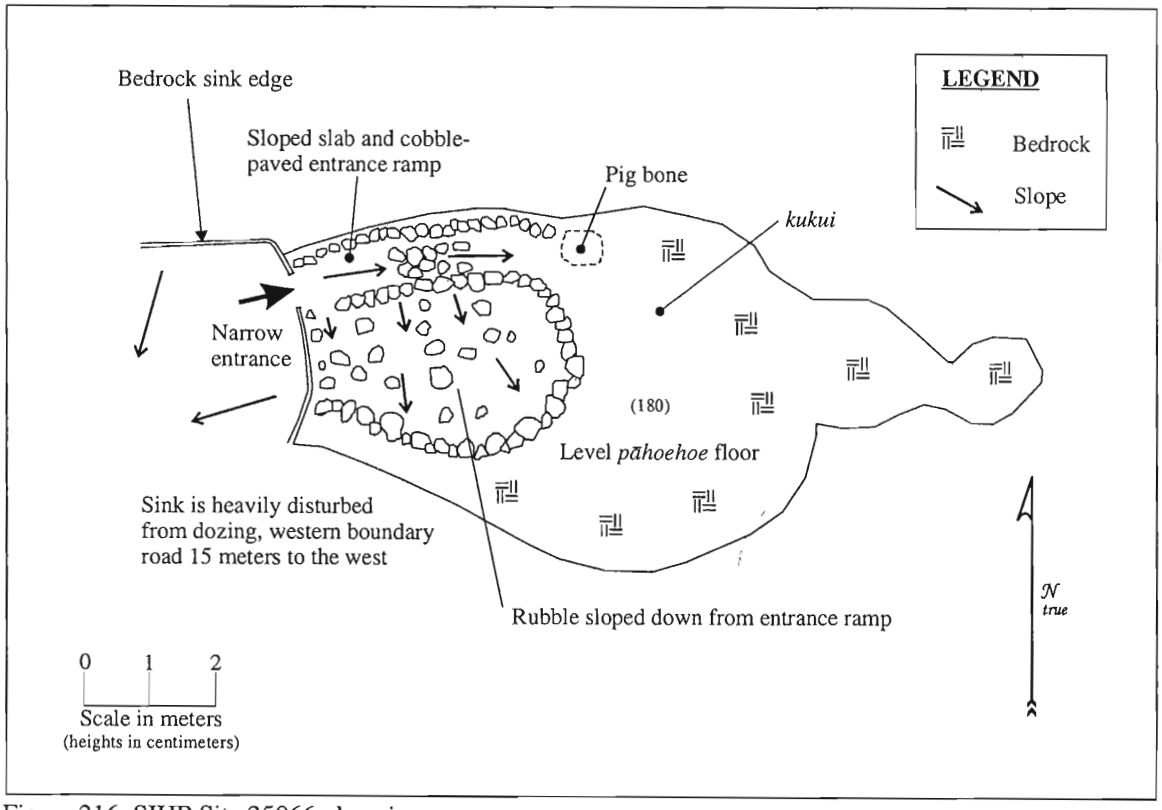


Figure 216. SIHP Site 25066 plan view.

SIHP Site 25067

Site 25067 is a lava tube exhibiting signs of use as a Precontact habitation site located just north of the middle of the western property line, approximately 12 meters from the western bulldozed road (see Figure 15). The site contains an entrance ramp (Feature I), six pavement features (Features A, B, D, E, G, and H), a probable hearth (Feature F), a petroglyph (Feature C), and a substantial amount of cultural material (Figure 217). Vegetation in and adjacent to the collapsed ceiling/entrance to the lava tube consists of Christmas-berry (*Schinus terebinthifolius*), *koa-haole* (*Leucaena leucocephala*), *noni, Ficus* sp., fountain grass (*Pennisetum setaceum*), and ferns. The lava tube extends in a *mauka/makai* direction for roughly 60 meters, and aside for some minor roof fall and recently deposited goat remains, is in an excellent state of preservation. The only entrance to Site 25067 is through the collapsed portion of the tube. The rim of the collapse is circular with overhangs on the east, north and western sides. The southern edge of the collapse exhibits a cobble field creating a natural ramp that runs along the eastern side of the collapse and into the tube. Based on the formal attributes of the recorded features and the presence of cultural material including marine shell, and wooden and stone implements within the lava tube, it is likely that Site 25067 was used for habitation purposes, perhaps on a seasonal basis associated with the agricultural pursuits within the current project area.

Feature A

Feature A is a level paved area located along the northern wall of the sink, in the northeastern corner at the entrance to the lava tube segment that extends east (see Figure 217). The pavement is partially sheltered by the bedrock overhang (roughly one meter above) on the northern half, and exposed to weather on the southern half. The surface measures 2.3 meters (north-south) by 3 meters (north-west); at the eastern edge is a retaining wall composed of upright slabs that are 0.3 meter tall above the feature (Feature B) to the east, and 0.15 meter above Feature A's paved surface (Figure 218). The northern edge of Feature A is constructed up to the bedrock wall of the sink; to the west the it abuts a stacked wall, and the southern edge is obscured by large cobbles spilling onto the terrace surface from the cobble ramp. The surface of the terrace is level, and composed of dark gray charcoal-rich soil intermixed with a small cobble pavement. A thin, intentionally shaped and smoothened wooden implement 16.5 centimeters long, 1.3 centimeters thick at its center, and pointed at both ends, was observed along the northern edge of the terrace (Figure 219); other cultural material observed on the pavement included marine shell, *kukui* nutshell fragments, and charcoal. This feature was probably constructed and utilized for habitation purposes.

Feature B

Feature B is a paved area located across the width of the entrance to the eastern portion of the lava tube (see Figure 217). The feature measures 4.5 meters (north-south) by 4 meters (east-west); the north and south ends are constructed up to the vertical walls of the tube. Its western edge is directly below the drip line of the overhang on the southern end, and on the northern end of the western edge the feature boundary is the eastern edge of Feature A (Figure 220).

The eastern edge of Feature B is defined by a single course alignment of small boulders spanning the 4-meter width of the tube, and reaching a height of 25 centimeters. On the southern third of Feature B is a slightly elevated secondary surface paved with pebbles and lined on the north edge with a faint alignment of medium and large size cobbles. Artifacts observed on top of Feature B include a basalt fragment with smooth abraded and polished surfaces, charcoal, and *kukui* nutshell fragments. A single motif petroglyph (Feature C) (see Figure 220) is located on the northern tube wall above Feature B. The surface of Feature B is grayish charcoal-rich soil mixed with a medium and small cobble pavement. Like Feature A, this feature was also probably constructed to support habitation.

Feature C

Feature C is a petroglyph located on the northern wall of the tube 0.4 meter above the ground surface of Feature B, and three meters from the overhang edge to the southwest (see Figure 217). The image is an anthropomorph that measures 0.35 meter tall by 0.32 meter wide (Figure 221). The head is elongated horizontally with a long neck, and arms extending out and symmetrically hanging down. The long torso is triangular with a line continuing from the neck, through the torso, to the waist. The legs are short and bowed, and the leg to the right has a slight foot articulation included (no foot on the left side). The surface on which the petroglyph was made has thin smooth cortex covering vesicular, scoria-like basalt; vesicles are 1 millimeter and larger. Green fungus is on the eastern corner of the panel, otherwise, the cortex is stained white and orange-beige from leaching of precipitates.

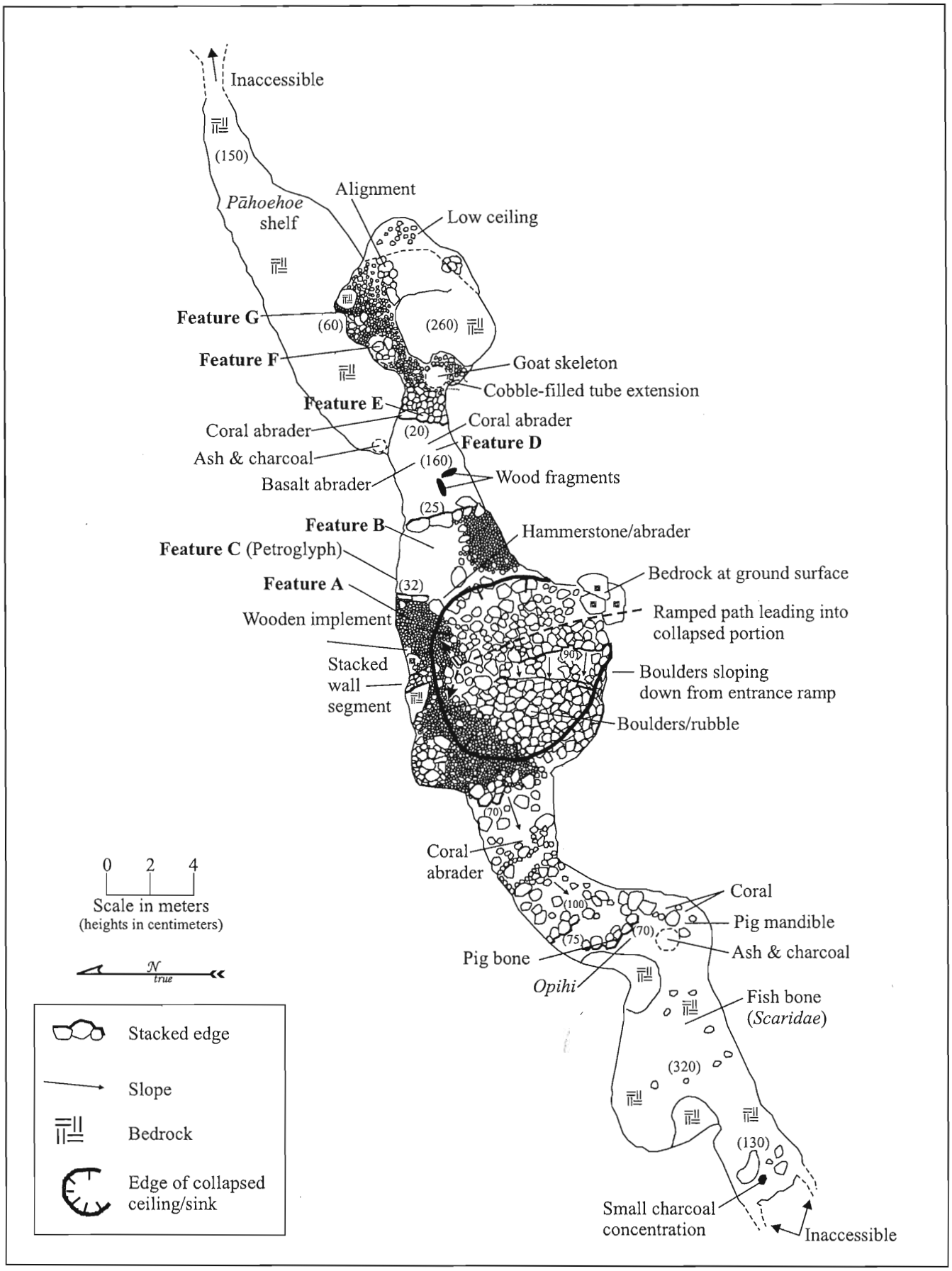


Figure 217. SIHP Site 25067 plan view.

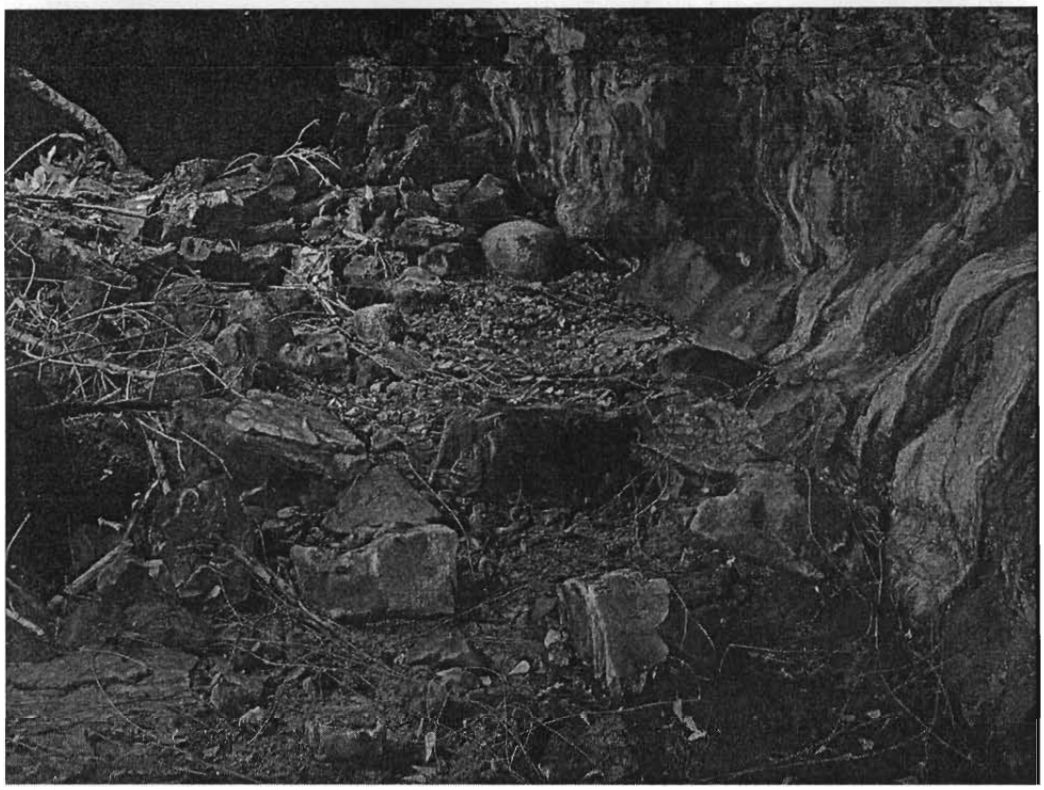


Figure 218. SIHP Site 25067 Feature A (in background) and Feature B, (in foreground), view to the west.

Figure 219. SIHP Site 25067, wooden implement in northwestern corner of Feature A.

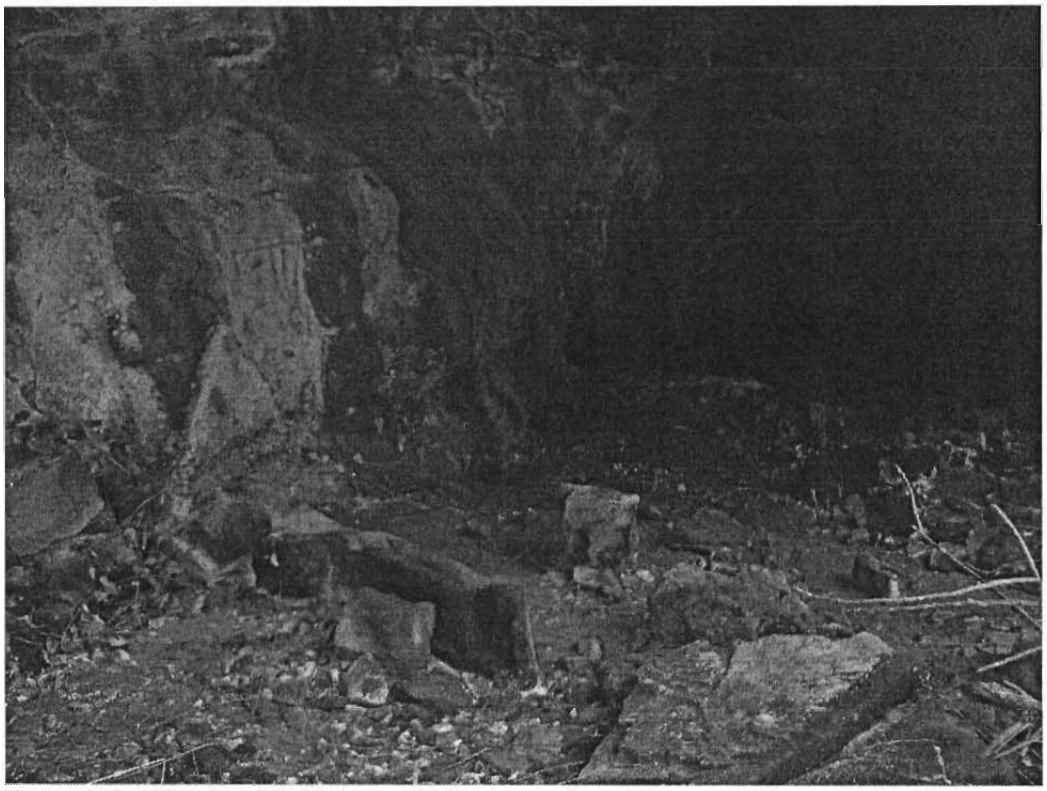


Figure 220. SIHP Site 25067 Feature B (background) and Feature A (foreground) and Feature C, petroglyph on wall above; view to the northeast.

Figure 221. SIHP Site 25067 Feature C, view to the north.

Feature D

Feature D is a paved area of the lava tube east of Feature B, and west of Feature E (see Figure 217). The area measures 4.4 meters long by 3 meters wide. The feature is a level portion of the tube bounded by the single course alignments of Feature B and Feature E. The shared edge with Feature B to the west measures 4 meters long, and is made up of small boulders 0.25 meter tall and the shared edge with Feature E to the east measures 2.3 meters long and is also composed of small boulders 0.25 meter tall. The eastern and western edges of Feature D are built directly below two ends of an elevation drop in the ceiling; thus the floor below the lower ceiling portion was probably cleared of material to create more space between floor and ceiling. The ground surface consists of dark gray charcoal-rich soil with medium size cobbles scattered about; small cobble paving is visible on the surface in the eastern third of the feature and may be covered by the accumulated soil in the other areas. Artifacts observed on Feature D included a basalt abrader, 2 coral abraders, charcoal, marine shell, bird bone, and goat bone (seemingly intrusive). This paved surface was probably constructed and utilized for habitation purposes.

Feature E

Feature E is a paved area 8.5 meters east of the cave entrance (see Figure 217). The western edge is a single course alignment of small *pāhoehoe* boulders and is 0.25 meter above the Feature D ground surface to the west. The alignment spans the 2.3-meter width of the tube; north of the alignment is a natural bench 0.6-meter above the surface of Feature E, which terminates on the north and south sides of the tube along elevated bedrock. The surface of the feature measures 3 meters (east-west) by 3.2 meters (north-south) and consists of large slabs and small to large cobbles creating a level roughly paved area. Artifacts observed on Feature E include marine shell (*Cypraea*, *Nerita*, and *Conus*), pig bone, and two charcoal concentrations: one located on the bedrock bench north of the terrace, and one scattered among surface cobbles in the southeast corner. This pavement provided for a comfortable habitation area.

Feature F

Feature F is a hearth located 12 meters east of the cave entrance, 2 meters east of Feature E (see Figure 217). Feature F consists of two slab and cobble stackings constructed against a 0.6-meter tall natural bench that runs along the northern side of the lava tube. The two stackings are one meter apart. The southern stackings measures 1.1 meters (north-south) by 1 meter (east-west), and the northern stacking measures 1.1 meters (east-west) by 0.9 meter (north-south). A In the center between the two stackings is a depression in the cobble floor with a roughly 80 centimeters diameter concentration of white ash. The feature may have functioned as a roasting spit; a charred pig bone fragment was found among the ash, no other cultural debris was observed.

Feature G

Feature G is a paved area located in the southeastern corner of the same circular chamber that Features E and F occupy (see Figure 217). This paved area measures 2 meters by 0.9 meters, and is contained by single course alignments on the north and south. The ground surface is composed of various sized cobbles and slopes slightly to the east, leading down into a lower level of tube, which is a crawl space and not accessible beyond 4.5 meters. Like Feature E in the area of the tube, Feature G seems to represent a paved living surface.

Feature H

Feature H is a level slab pavement located under the overhang along the northern wall of the sink area, one meter north of the entrance to the western portion of the tube (see Figure 217). The slab pavement is laid out on top of smaller cobbles, and measures 2.1 meters (east-west) by 1.7 meters (north-south) and is 0.15 meter high on the south side. The feature is composed of approximately fifteen slabs with an average surface size of 30 centimeters square, which were carefully fitted together with smaller cobbles and slabs filling in cracks. The surface is level, and on the west and east sides there are two larger unfitted slabs resting on the surface (Figure 222).

Figure 222. SIHP Site 25067 Feature H, view to the west.

Feature I

Feature I is the ramped entrance into Site 25067 (see Figure 217). The ramp slopes from south to north from the rim of the collapse six meters to the tube floor. It measures one meter wide and is roughly paved with medium to small cobbles. Its northern terminus is a stacked wall segment that directs movement to either the *mauka* or *makai* portion of the tube. This wall is 1.1 meters long, 80 centimeters wide, and 85 centimeters tall nearly reaching the ceiling of the overhang portion of the collapse.

SIHP Site 25068

Site 25068 is a modified blister located approximately 60 meters north of the southern bulldozer road in the center of the project area (see Figure 15). The opening measures 1.0 meter by 1.0 meter by 0.85 meters deep, and small upright boulders line the edge of the opening on the north and east sides; the south and west sides are overhangs (Figure 223). To enter requires belly crawling to the southwest, and once inside, the ceiling is tall enough for an adult to sit upright in the center. The blister contains evidence of temporary habitation including marine shell (*Cypraea*), charcoal, *kukui*, and a scoria abrader (Figure 224). The floor of the cave is thin soil on bedrock that is exposed in some areas. It measures roughly four meters by three meters. The interior walls of the small cave taper down from the maximum central ceiling height of 0.8 meter. Cobbles line some portions of the interior edge of the blister along the walls. Just south of the entrance opening is a segment of tube that extends 1.0 meter to the east and pinches out. Based on the presence of cultural debris including marine shell within the lava tube, it is likely that Site 25068 was used for Precontact habitation purposes, perhaps on a seasonal basis associated with the agricultural pursuits within the current project area. This site is in fair condition and it retains integrity of setting.

Figure 223. SIHP Site 25068, modified blister, view to the southwest.

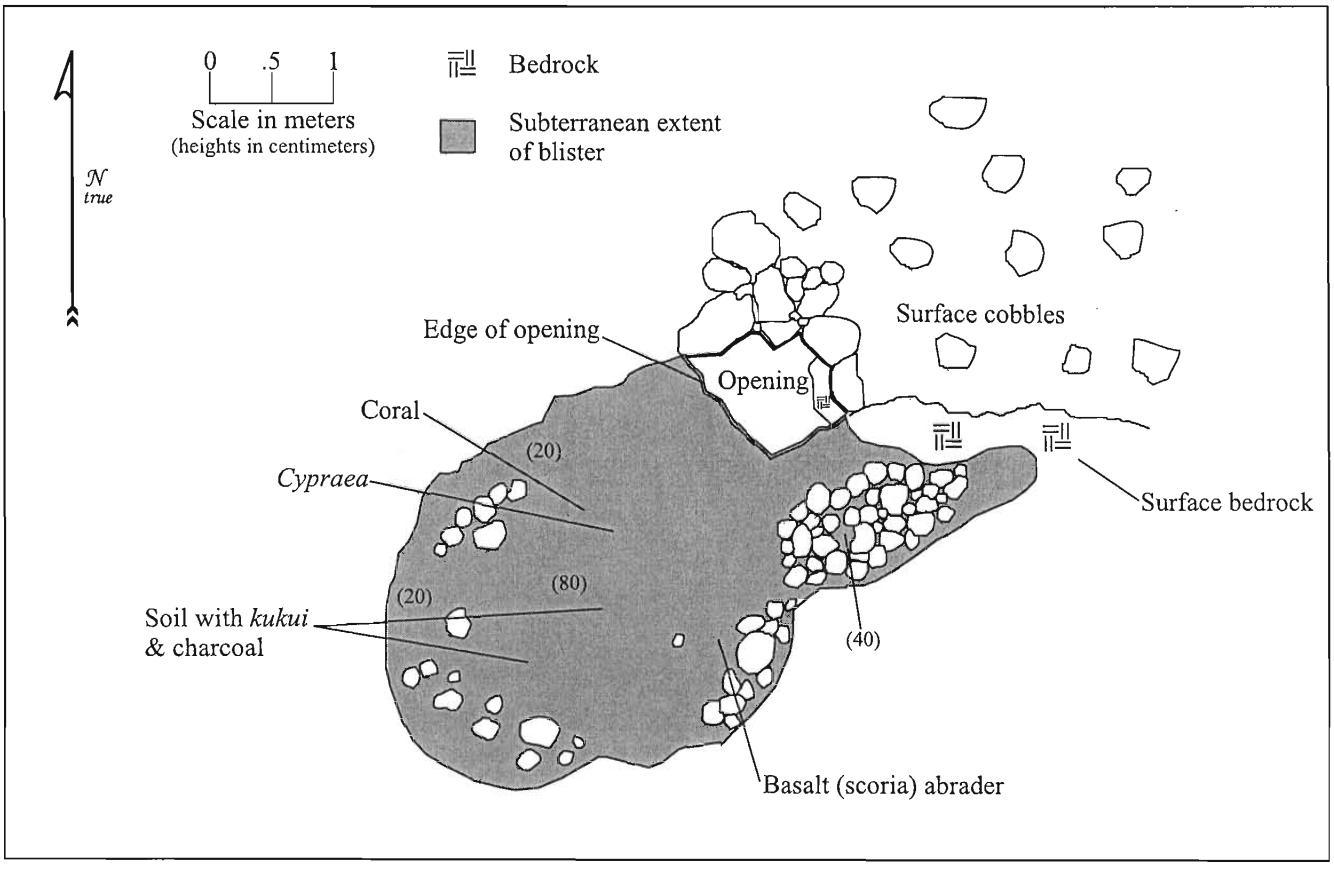


Figure 224. SIHP Site 25068 plan view.

SIHP Site 25069

Site 25069 is a lava tube containing a single burial (Feature O), fourteen water collection features (Features B–N), and a constructed pathway (Feature A). Site 25069 is located in the southwestern corner of the project area; the entrance is approximately 5 meters north of the southern bulldozer road (see Figure 15). From the entrance, the tube runs southwest beyond the current study parcel's western boundary. The lava tube is accessible at its *mauka* end via a collapsed portion of its ceiling, or sink. The sink is 4.5 meters wide (east-west) by 15 meters long (north-south) and averages 1.4 meters below the outer ground surface (Figure 225). Site 25069 was utilized as a burial location, and for water collection purposes.

Feature A

The lava tube entrance is located in the southwestern corner of the sink; it measures 4.5 meters wide (northwest-southeast) by 0.6 meter tall (Figure 226). Inside the entrance is a large cavern 9 meters wide and 3.5 meters tall with a boulder and cobble ground surface that slopes to the southwest. On the southern half of the cavern is a 1-meter wide constructed pathway (Feature A) running down the 11 meters long cobble slope, and continuing for another 16 meters. Cobbles cleared from the path line the edges; the path surface was constructed with cobbles fitted together, and slabs were used for steps in a few places. The cave floor at the base of the cobble slope is flat *pāhoehoe* that slopes gently to the southwest. The pathway continues down the tube over the bedrock surface; from the base of the slope there is a 7-meter gap in the cobble alignments along its edges, then the alignments continue on the edges for 9 meters to the southwest (see Figure 225).

Figure 226. SIHP Site 25069 entrance to lava tube, view to the southwest.

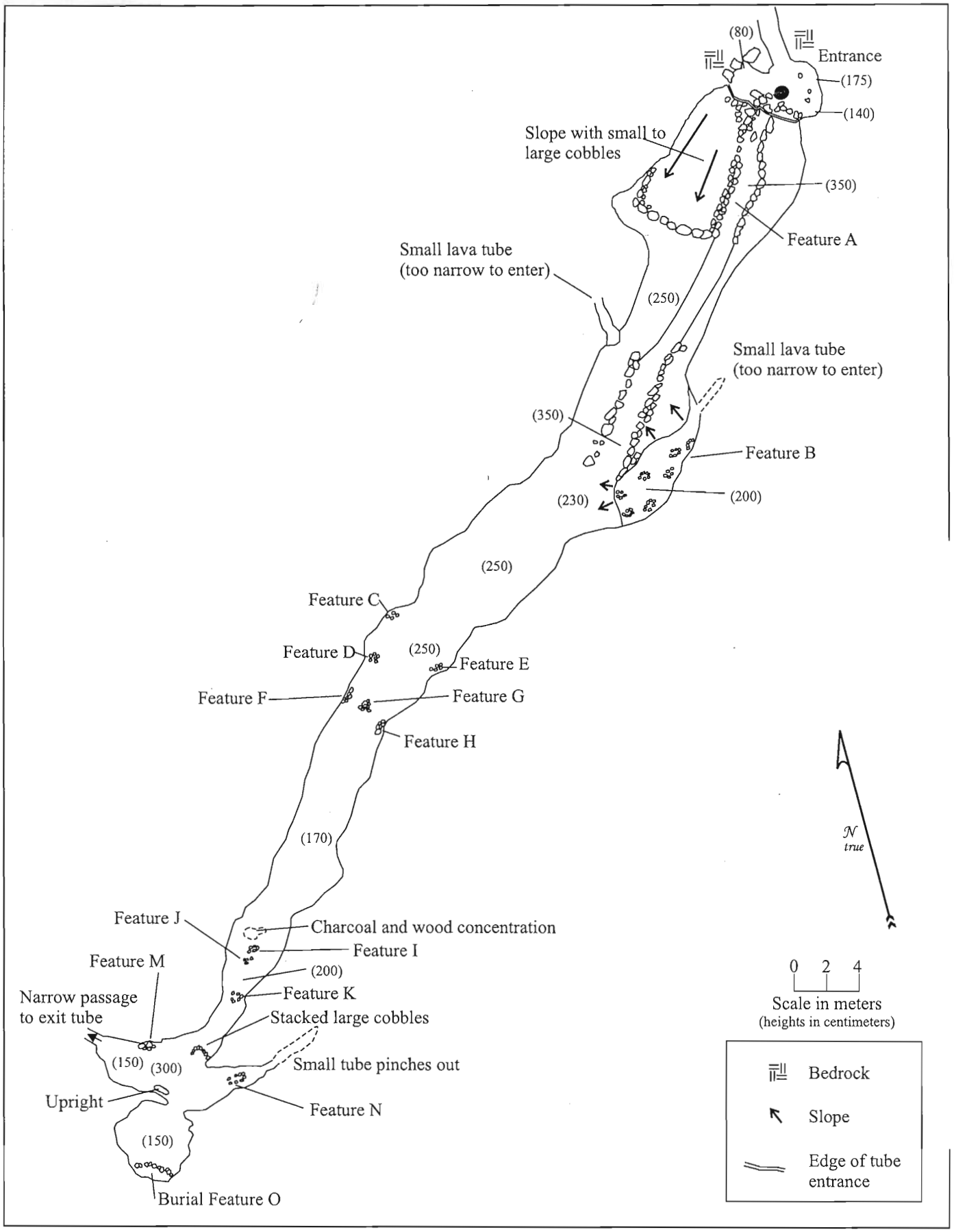


Figure 225. SIHP Site 25069 plan view.

Feature B

Feature B is located 21 meters southwest of the entrance on the southern edge of the lava tube (see Figure 225). This feature is a natural bedrock shelf six meters long (northeast-southwest) by 3.5 meters wide (northwest-southeast) that is elevated two meters above the cave floor. The shelf surface is smooth, damp bedrock with seven oval rings constructed with 1-course of medium sized cobbles. The rock rings average 0.7 meter long by 0.4 meter wide, and are distributed across the elevated shelf (Figure 227). These rock rings appear to have supported large flat containers placed in or on them for water collection purposes. Found among the rings were *kukui* nutshell fragments and charcoal, suggesting that a light source was once used in this area.

Figure 227. SIHP Site 25069 Feature B, typical rock ring on bedrock shelf, view to the southeast.

Features C–N

Beginning 40 meters *makai* of the tube entrance is a series of twelve small rock piles or rings (see Figure 225) that all appear to have functioned as supports for water collection containers. Table 12 lists the metric attributes of these features. In several instances charcoal and burned *kukui* nutshell fragment were found in association with the rock features suggesting that light sources were used.

Table 12. SIHP Site 25069 water collection features.

Feature No.	*Form*	*# of Stones*	*Dimensions (L x W x H in meters)*
C	Pile	12	0.7 x 0.6 x 0.7
D	Pile	6	0.9 x 0.5 x 0.12
E	Pile	15	0.55 x 0.45 x 0.13
F	Pile	7	0.6 x 0.6 x 0.5
G	Pile	9	0.9 x 0.75 x 0.6
H	Pile	6	0.6 x 0.5 x 0.6
I	Ring	5	0.9 x 0.8 x 0.8
J	Ring	6	0.85 x 0.8 x 0.8
K	Ring	7	0.6 x 0.4 x 0.1
L	Pile	11	0.6 x 0.5 x 0.4
M	Pile	8	0.7 x 0.6 x 0.7
N	Ring	8	1.0 x 0.65 x 0.12

Feature O

A chamber containing a single set of human remains is located 70 meters *makai* of the tube entrance (*makai* of the surface projected study area boundary) (see Figure 225). A narrow opening on the southern wall of the tube is 1 meter tall by 0.8 meter wide. Adjacent to the exterior of the opening a large slab has been placed upright. Inside the narrow opening is a small domed chamber, four meters in diameter with a 1.5-meter ceiling height. In the southwestern corner of the chamber are human remains that are loosely enclosed by a single course of medium cobbles.

The tube changes direction west of the burial chamber to a northwest heading, continuing outside of the study area boundary. A narrow passage is located 6 meters northwest of the burial chamber that leads to an exit, and to other subsurface segments of the lava tube system with numerous features and cultural material.

SIHP Site 25070

Site 25070 consists of a platform (Feature A), a lava tube (Feature B), and a modified outcrop (Feature C) (Figure 228) located in the northwestern portion of the current study area (see Figure 15). The site occupies a roughly 25-meter by 25-meter area. Based on the presence of human skeletal remains, Features A and B are considered Precontact burial features. Feature C has been grouped with these features because of its close proximity, its size, and its platform-like appearance. Overall, this site is in fair condition and it retains integrity of setting.

Feature A

Feature A is an irregularly shaped platform (Figure 229) located in the western portion of Site 25070. The platform is situated in a collapsed tube depression with a ground surface of medium sized cobbles. The platform is elevated on all sides above the cobble ground an average of 0.4 meter. The feature measures 2.5 meters (east-west) by 2.5 meters (north-south) with large cobbles and small boulders stacked on the periphery and smaller cobbles used to fill in the center and pave the level surface. A large boulder is located on the eastern corner. A small entrance to a sterile lava tube is located 2.5 meters east of Feature A.

A 1 x 1 meter test unit (TU-1) was excavated at Feature A in the southwestern half of the small platform (Figure 230) to test for the possibility of a burial. Excavation of TU-1 revealed a single stratigraphic layer containing architectural cobbles and a collapsed vaulted burial chamber constructed from *pāhoehoe* slabs. Layer I consisted of small paving cobbles on the surface, with larger cobbles and small boulders. At a depth of 80 centimeters beneath the surface of the unit, a large cap slab covering a constructed vault was removed revealing a collapsed vault. Human skeletal remains were observed in the base of the vault at a depth of 130 centimeters below the surface of the unit. Excavation of TU-1 was terminated upon identification of the burial; the test unit was backfilled with care rebuilding the burial feature as it appeared prior to excavation. DLNR-SHPD was notified of the discovery.

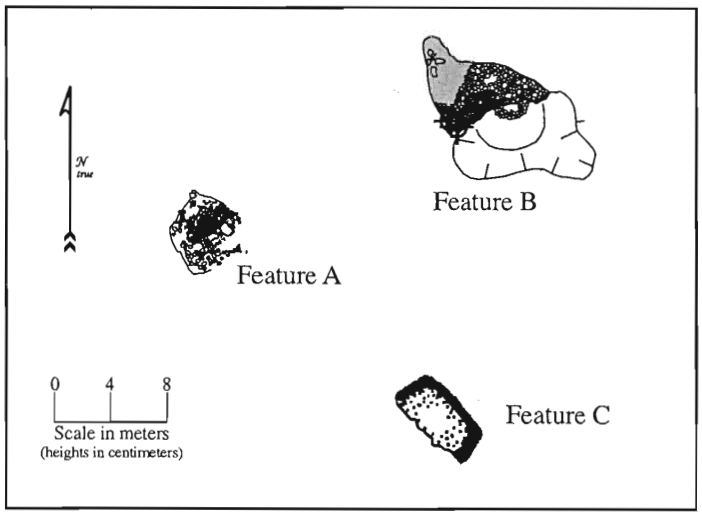


Figure 228. SIHP Site 25070 plan view.

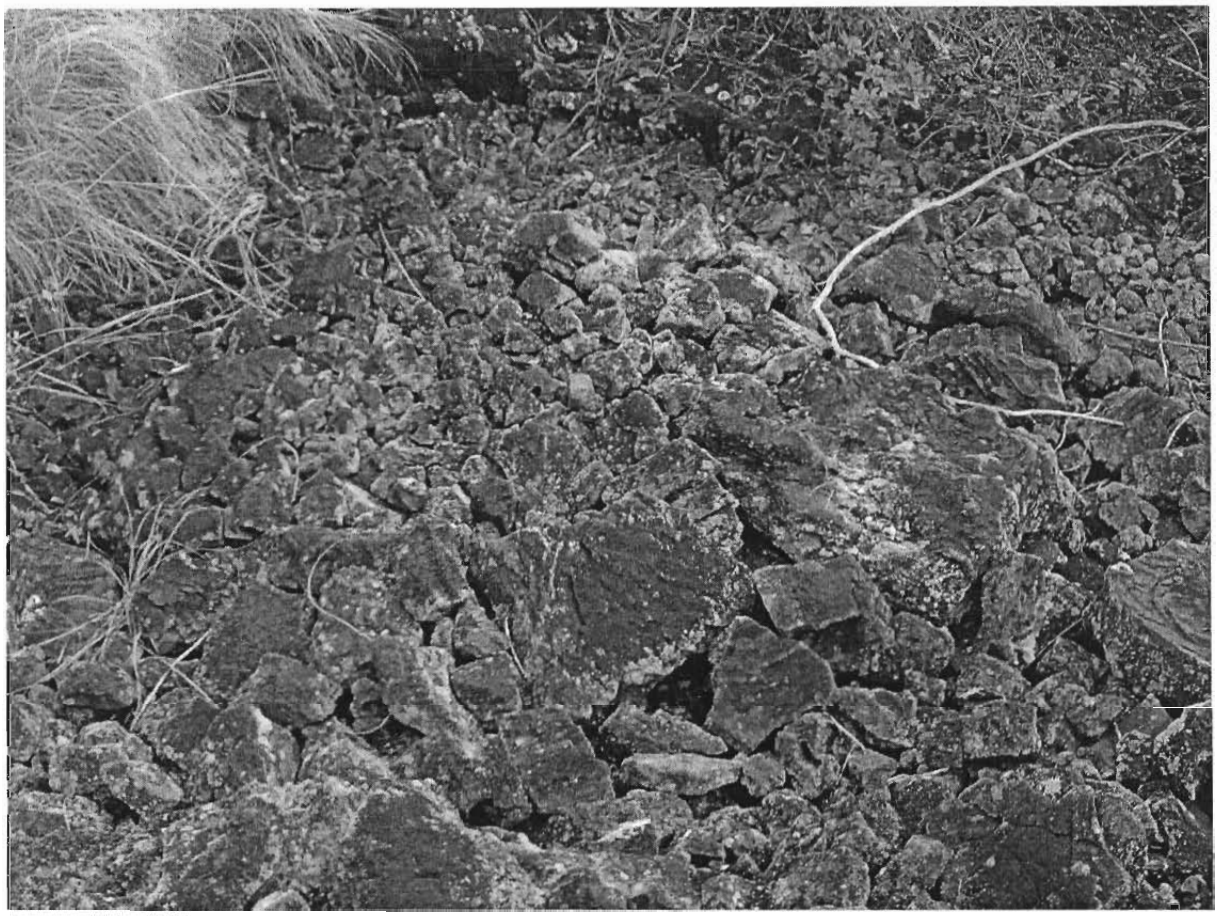


Figure 229. SIHP Site 25070 Feature A, view to the east.

Feature B

Feature B is a lava tube/blister that contains a burial. Feature B is located in the northeastern portion of Site 25070, approximately 15 meters northeast of Feature A (see Figure 15). The blister opening is located on the northern side of a cobble-surface depression created by the collapse of the lava tube's ceiling (Figure 228). The entrance to the tube is from the south; it measures 1 meter wide by 0.4 meter tall (from cobble ground surface to ceiling). Just inside the entrance the cobble-covered ground slopes down 3 meters to the north and northwest to a level bedrock surface. The lava tube consists of a broad chamber yet low ceiling that measures 8.5 meters (east-west) by 6.5 meters (north-south) and has a maximum height of 1.1 meter in the center. In the southwestern corner of the chamber is a jumbled surface of large cobbles and small boulders. In that corner careful inspection of the crevasses between the cobbles and boulders resulted in the discovery of a human skull and pelvis approximately 0.5 meter below the surface of the cobbles. A slab near the remains was possibly part of a constructed burial feature; no other constructed feature was evident in the area. No cultural remains were observed in the lava tube other than the burial. The tube may have beén designated for burial; based on the lack of cultural debris.

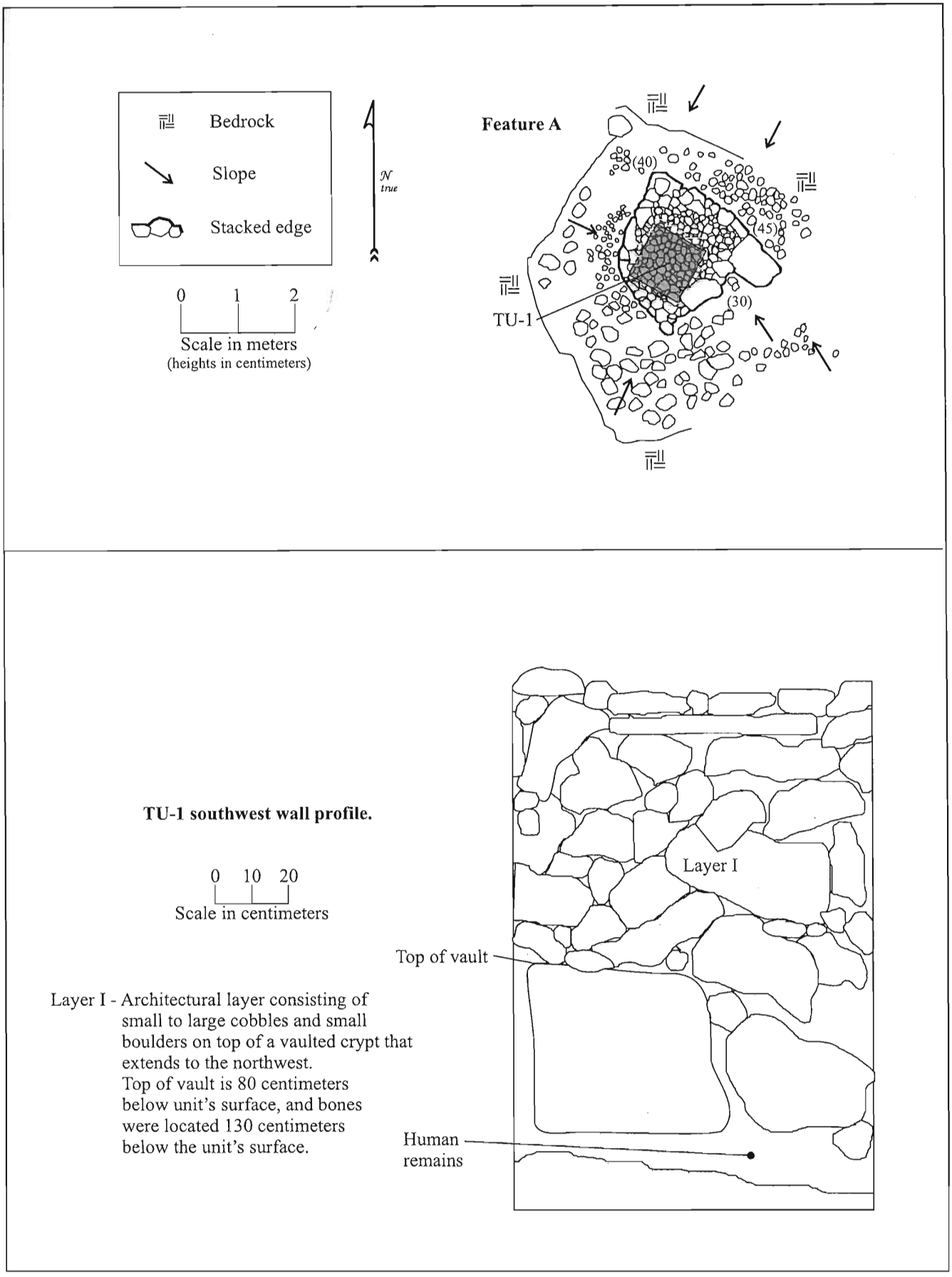


Figure 230. SIHP Site 25070, plan view of Feature A, and southwest wall profile of TU-1.

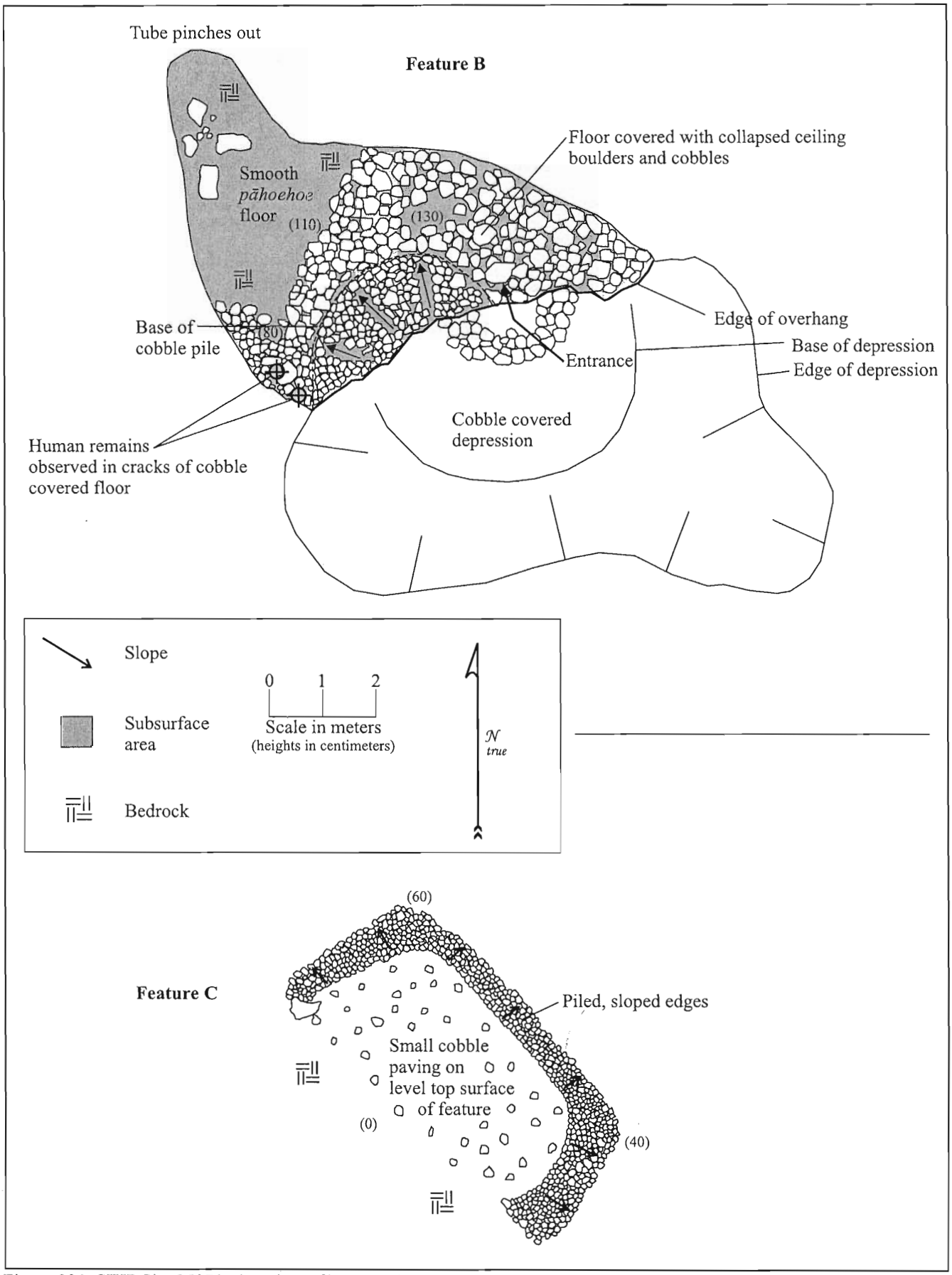


Figure 231. SIHP Site 25070 plan view of Features B and C.

Feature C

Feature C is a modified outcrop located approximately 15 meters east/southeast of Feature A (see Figure 15). The feature consists of medium and large *pāhoehoe* cobbles piled on the northeast side of a bedrock outcrop to create a 5.8-meter (northwest-southeast) by 3-meter (northeast-southwest) level area. The piled edges slope down to the surrounding cobble-covered ground on all sides except the southwestern side that is composed of bedrock (see Figure 231). The top surface is level and paved with small cobbles. The height of Feature C is 0.6 meter along the northern and eastern edges, and it is level on the western side where it is constructed against the bedrock. The modified outcrop was deemed a probable burial due to its close proximity to Features A and B, two known burials, and its formal attributes.

SIHP Site 25071

Site 25071 consists of an upright slab burial monument (Feature A), and two modified outcrops (Features B and C) located in the central portion of the project area just north of Site 25060 (a lava tube) and Site 25056 (a platform) (see Figure 15). Excavation of a test unit (TU-11) at Feature A revealed the presence of human skeletal remains within a soil area denoted by upright slabs. Based on the proximity of the other two features to this feature it is possible that they also contain human skeletal remains and should be considered part of a burial area, perhaps associated with the two aforementioned, nearby habitation sites. Detailed descriptions of the features of Site 25071 follow below.

Feature A

Feature A is a roughly three-meter by two-meter burial feature located at the southern end of Site 25071 (Figure 232). The feature is marked along its western edge by an alignment of four upright slabs (including 2 that are *konane* game board slabs), otherwise the feature is unremarkable and level with the surrounding ground surface. The upright slab alignment is 2.5 meters long (roughly north-south) with an average height of 0.3 meter above ground surface on the east side, and 0.4 meter above ground surface on the west side. The level soil east of the upright slabs measures 2.5 meters (north-south) by 1.4 meters (east-west) and is bordered by a rough piling of slabs and small boulders on the east side; these were probably originally upright and more orderly (Figure 233). In the immediate area 13 other slabs were observed of similar shape as the upright ones and have likely collapsed over time.

The *papamū* slab at the north end is 0.66 meter long by 0.36 meter tall (not including area below ground surface) by 0.16 meter thick (Figure 234). The game board has approximately 40 uniformly pecked depressions approximately 4 centimeters apart. The playing surface is very flat. The *papamū* at the southern end of the alignment is 0.55 meter long by 0.34 meter (not including area below ground surface) by 0.15 meter thick, and is more irregularly shaped (Figure 235). Approximately 25 pecked depressions are visible; the playing surface is undulated and the depressions are less uniform in placement than the game board to the north.

A 1 x 1 meter test unit (TU-11) was excavated at Feature A on the eastern side of the upright slabs, to determine the extent of subsurface deposits. Excavation of TU-11 revealed three stratigraphic layers (Layers I, II, and III) and the presence of a human skeletal remains (Figure 236). Layer I consisted of very dark brown (10 YR 2/2) silt mixed with organic matter on the surface, and 20% gravel content at the base. Layer I terminated at a soil change and large slabs and cobbles 10 centimeters below the unit's surface of Feature A. Layer II consisted of a few large slabs and cobbles haphazardly laid flat, possibly the original surface of the feature. The very dark brown (10YR 2/2) silt in Layer II is mottled with black (10YR 2/1) charcoal-rich silt with 25% gravel content. Layer II terminated at the base of the slabs and cobbles approximately 20 centimeters below the unit's surface. Layer III consists a 30-centimeter thick layer of very dark brown (10YR 2/2) and black (10YR 2/1) mottled, loose silt with 25% gravel content and many roots. Layer III likely was fill material collected from somewhere else and deposited at the feature. Cultural material observed in the fill included coral, marine shell, burnt *kukui*, a basalt abrader, fish bone, volcanic glass and basalt flakes, charcoal, water worn pebbles, *Echinoidea*, and pig teeth. During the excavation of Layer III, human skeletal remains were discovered at a depth of 49 centimeters below surface in the unit's southern half. Upon discovery of the skeletal remains excavation of TU-11 immediately ceased and all artifacts and soil were returned to the unit. The feature was then rebuilt as close to its original specifications as possible, and DLNR-SHPD was notified of the discovery.

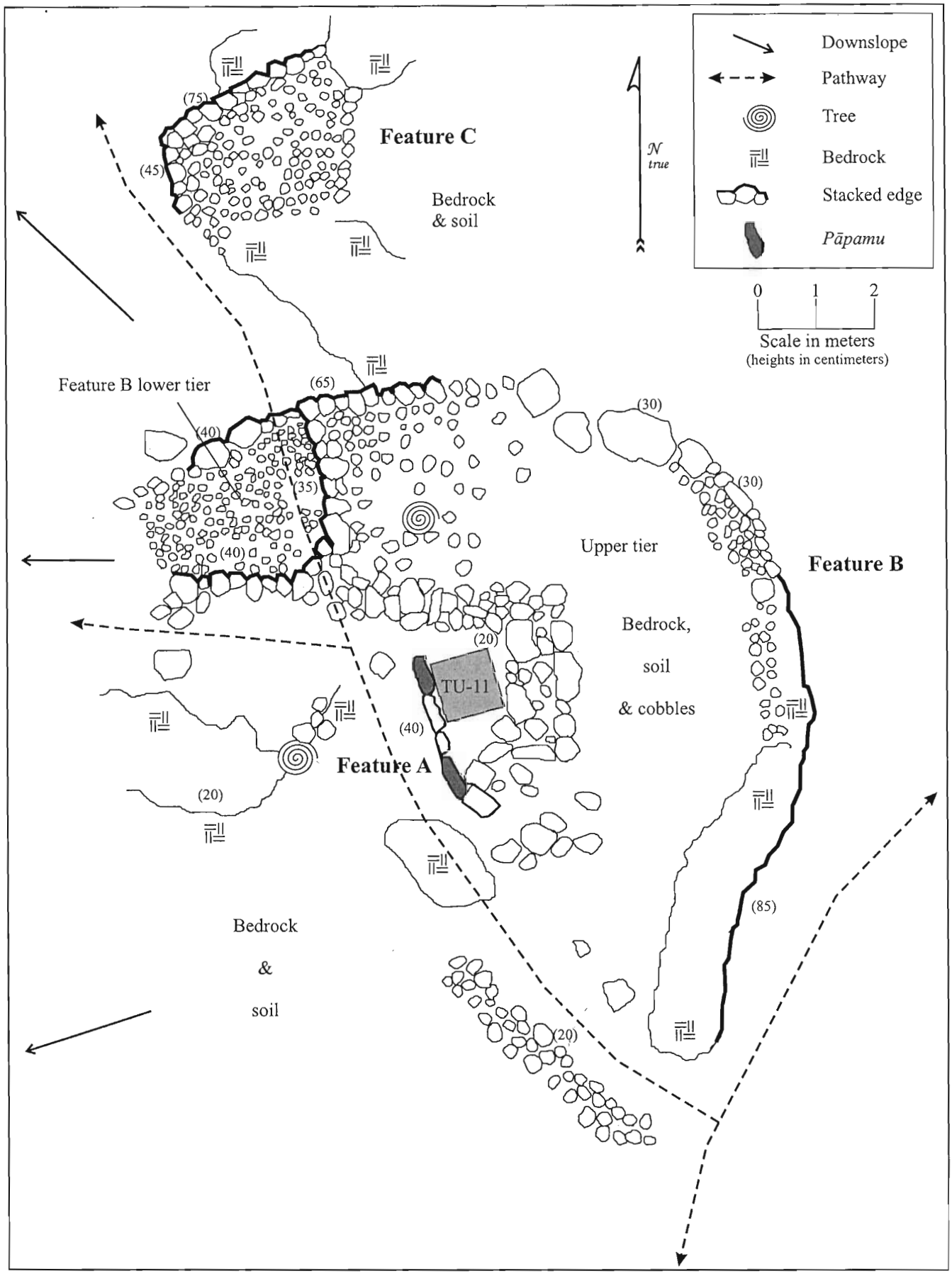


Figure 232. SIHP Site 25071 plan view.

Figure 233. SIHP Site 25071 Feature A, view to the southeast.

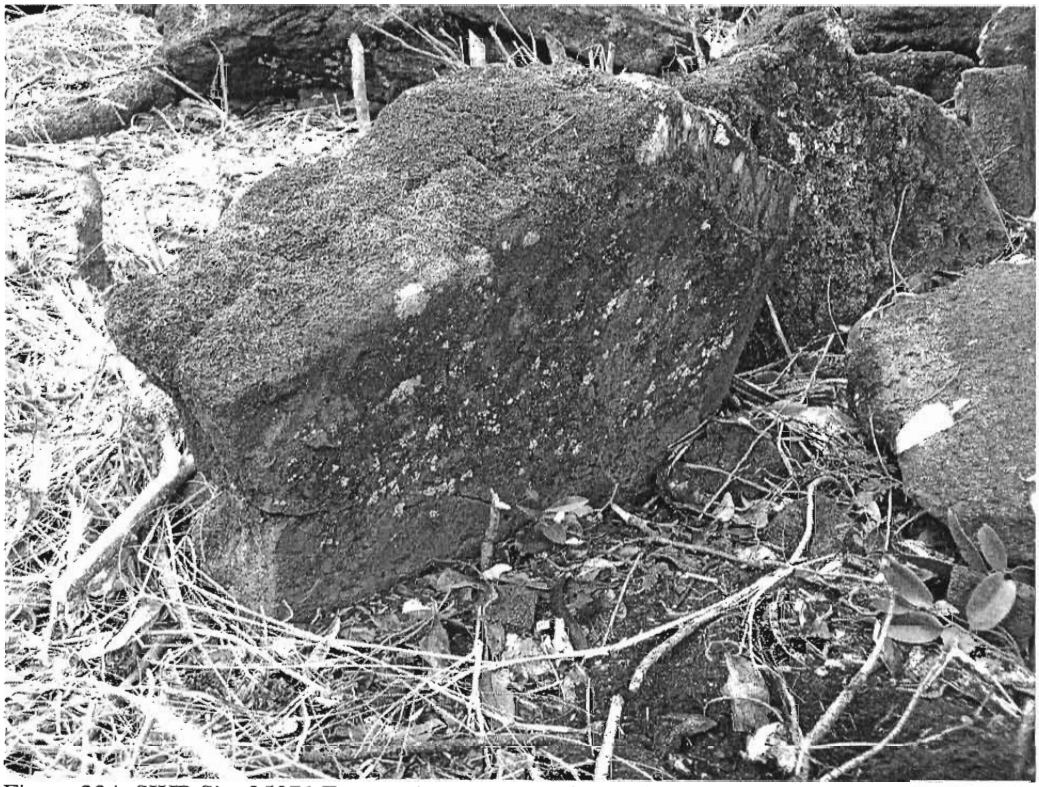


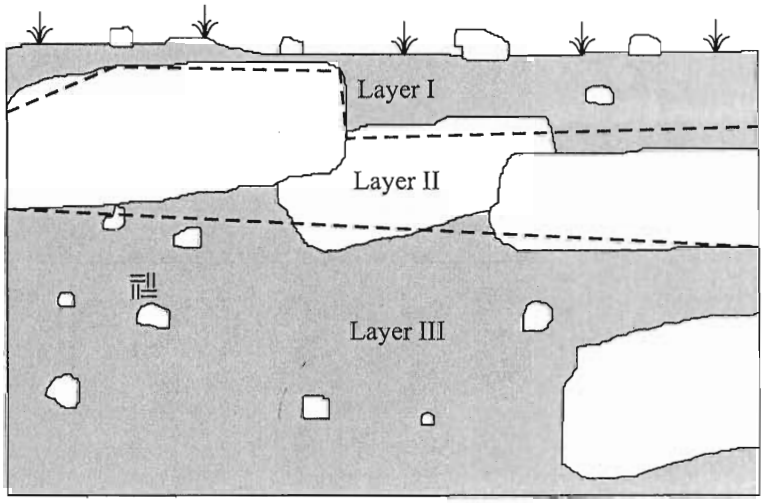
Figure 234. SIHP Site 25071 Feature A, *papamū* to the north, view to the southeast.

Figure 235. SIHP Site 25071 Feature A, *papamū* to the south, view to southeast.

TU-11 south wall profile.

0 10 20

Scale in centimeters



Layer I - Consisted of very dark brown silt (10YR 2/2) mixed with organic matter at the surface, and 20% gravel content at the base.

Layer II - Architectural layer of large slabs with very dark brown (10YR 2/2) and black (10YR 2/1) mottled silt that contained 25% gravel.

Layer III - Burial fill consisting of very dark brown (10YR 2/2) and black (10YR 2/1) mottled silt with 25% gravel content and roots. Burial remains observed at 49 centimeters below the surface of the unit.

Figure 236. SIHP Site 25071 TU-11 south wall profile.

Feature B

Feature B is the modified outcrop that Feature A is constructed upon (see Figure 232). The eastern edge of the outcrop (4 meters east of Feature A) is a mostly unmodified ledge that drops off 0.85 meter. The area between Feature A and the eastern edge is a rough surface of *pāhoehoe* bedrock, soil, and random piles of cobbles. The northeastern corner is built up with 1-course of cobbles and large slabs along the perimeter. The north side consists of 1-2 courses of loosely stacked small boulders and cobbles 0.65 meter above the ground surface at the base of the outcrop (Figure 237). The loose stacking continues around the corner to the south toward Feature A, and has a height of 0.35 meter. The area just north of Feature A consists of a fairly level, rough cobble pavement with a small *kukui* tree in the center. West of the rough pavement is a lower tier with a small cobble and pebble-paved surface measuring 3 meters (east-west) by 2 meters (north-south). Loosely stacked small boulders and cobbles line the north edge 0.4 meter above the ground surface, the west end of the tier is ill-defined, and the southern edge is a loosely stacked alignment of large cobbles 0.4 meter above the paved surface. The area west of Feature A appears unmodified consisting of an uneven surface of (deep) soil and *pāhoehoe* bedrock with slabs, cobbles, and boulders scattered throughout. The area south of Feature A is mostly bedrock and soil similar to the area to the west. An alignment of piled cobbles 4.5 meters (northeast-southwest) long by 0.6 meter wide and 0.2 meter tall lines the south side of a possible pathway that runs from Site 25071 to Site 25056, a platform located approximately six meters east of Site 25071 Feature A. It is possible, based on the discovery of human remains at Feature A, that Feature B may also contain human skeletal remains.

Figure 237. SIHP Site 25071 Feature B, modified outcrop, view to the east.

Feature C

Feature C is a modified outcrop with a paved surface located three meters north of the northern edge of Feature B, and eight meters north of Feature A (see Figure 232). The north edge of Feature C is three courses of stacked boulders standing up to 0.75 meter above the ground surface to the north (Figure 238). The surface of the feature is flat cobble paving that slopes west and measures 2.5 meters (east-west) by 2.0 meters (north-south). Feature C, based on its proximity to Feature A, may also contain human skeletal remains.

Figure 238. SIHP Site 25071 Feature C, modified outcrop, trail passes by near end, view to the east.

SIHP Site 25072

Site 25072 consists of a modified outcrop containing a Precontact burial (Feature A), and 3 adjacent modified outcrops/pavements (Features B, C, and D) (Figure 239) that are considered probable burials due to their similarity in construction and close proximity to the known burial feature. Site 25072 is located in the southeastern corner of the project area (see Figure 15). Site 25072 appears to be a designated area for burying the deceased.

Feature A

Feature A is a square pavement containing a burial located at the northern end of the site (see Figure 239). The feature is constructed between two *pāhoehoe* outcrops over a natural crack. The top surface of the pavement is composed of small cobbles with medium and large cobbles along the periphery (Figure 240). The east side consists of stacked cobbles 0.3 meters above the ground surface between the outcrops, and the *makai* side (west) slopes down to the ground. The south side abuts a bedrock outcrop 0.4 meter in height. The north side of the feature is level with the outlying bedrock surface.

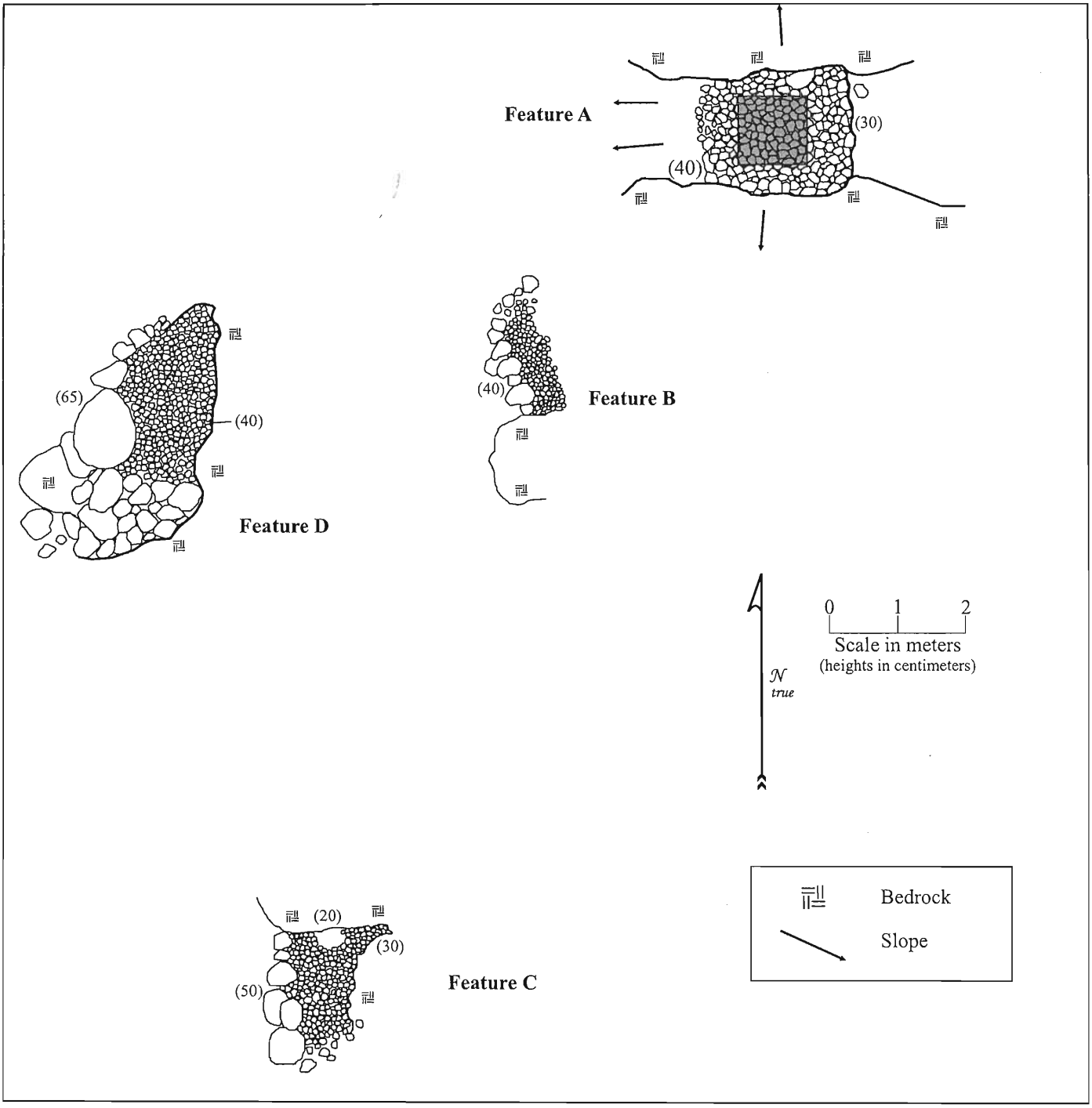


Figure 239. SIHP Site 25072 plan view.

Figure 240. SIHP Site 25072 Feature A, modified outcrop, view to the north.

A 1 x 1 meter test unit (TU-10) was excavated into the center of the Feature A to determine the extent of subsurface deposits and the presence of a human burial (see Figure 239). The excavation of TU-10 revealed 2 distinct layers and a human burial (Figure 241). Layer I, the architectural layer, consisted of mostly small and medium size cobbles with a few large cobbles and one large slab lying flat. Removal of Layer I exposed bedrock on the north and south sides of TU-10, and terminated at 55 centimeters below the surface of the feature with the presence of soil. The soil layer, Layer II, consisted of very dark brown (10YR 2/3) slightly sandy silt mixed with 90% small cobbles and pebbles. During the excavation of Layer II a human molar was discovered and a long bone was observed in situ under a *pāhoehoe* bedrock overhang that became exposed. Excavation of TU-10 was terminated at the location of the burial, 125 centimeters below the surface of the feature. Layer II was burial fill and probably extended for at least another 10 centimeters.

Upon discovery of the skeletal remains excavation of TU-10 immediately ceased. The remains, which were not moved from their original position, were stabilized and reburied with the soil excavated from the unit. The architectural layer was then rebuilt as close to its original specifications as possible, and DLNR-SHPD was notified of the discovery.

Feature B

Feature B is a pavement located 3 meters southwest of Feature A (see Figure 239). The feature measure 1.5 meters long (north-south) by 0.8 meter wide and has a height of 0.4 meter above the down slope ground surface to the west (Figure 242). The top surface is level and paved with small cobbles, to the south is *pāhoehoe* bedrock, and to the north the pavement is level with the surrounding ground surface. Feature B is possibly a burial, given its similar construction to Feature A, and its proximity to the burial feature.

Layer I - Architectural layer composed of small & medium sized cobbles with a few large cobbles & 1 large slab. Exposed bedrock outcrop on the north & south sides.

Layer II - Very dark brown (10YR 2/3) silt with 90% gravel & small cobbles; burial remains observed 125 centimeters below the unit's surface.

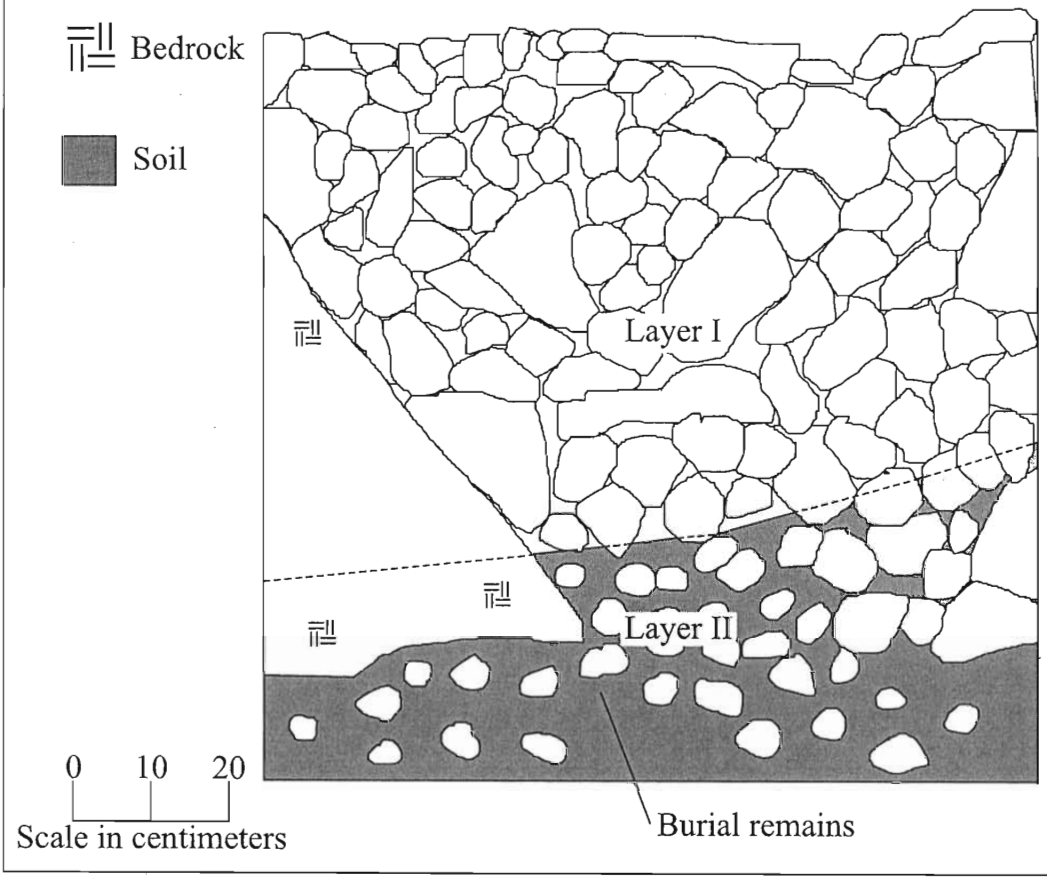


Figure 241. SIHP Site 25072 Feature A TU-10 east wall profile.

Figure 242. SIHP Site 25072 Feature B, modified outcrop, view to the north.

Feature C

Feature C is a pavement in a *pāhoehoe* crack located 8 meters south of Feature B (see Figure 239). The feature's paved area measures 1.5 meters (east-west) by 2 meters (north-south). The *makai* edge is lined with small boulders and is 0.5 meters above the down slope ground surface (Figure 243). To the south the pavement is level with the surrounding ground surface, and to the north is a *pāhoehoe* outcrop. Feature C is possibly a burial given its similar construction to Feature A, and its proximity to the burial feature.

Figure 243. SIHP Site 25072 Feature C, modified outcrop, view to the northeast.

Feature D

Feature D is a pavement filling a crack in *pāhoehoe* bedrock located 5 meters west of Feature B (see Figure 239). The paved area measures 2.5 meters (north-south) by 1.5 meters (east-west) and consists of small cobbles. The western edge has stacked large cobbles and is 0.7 meter above the down slope ground surface. To the east and north the pavement is constructed up to *pāhoehoe* bedrock, and to the south is stacked medium sized cobbles 0.2 meters above the pavement. Feature D is possibly a burial, given its similar construction to Feature A, and its proximity to the burial feature.

SIHP Site 25073

Site 25073 is a complex of interconnected Precontact *mauka-makai* trail segments and cairns located in the northeastern portion of the current study area (see Figure 15). Site 25073 occupies a 120-meter by 40-meter area and contains seven features including a constructed trail intersection with two cairns (Feature A), three other cairns (Features B, C, and E), and three traceable trail segments (Features D, F, and G) that align to reveal a long portion of trail. The trails observed in the current study area are in poor condition and difficult to trace for extended lengths due to the thick grass cover and their degraded integrity. This trail complex was utilized to traverse the terrain, and the cairns were used to mark the route in areas where the trail was not easily recognizable.

Feature A

Feature A is a constructed trail intersection consisting of modified outcrops and two cairns located near the southern end of Site 25073 (Figure 241). A roughly one-meter wide trail descends from the east on western sloping terrain and splits to the northwest and southeast. Just east of the intersection are two cairns with a one-meter gap between them that the trail from the east passes through. The cairn to the south measures 0.7 by 0.5 meters by 0.8 meter tall; it rests on *pāhoehoe* bedrock. The cairn to the north is 0.8 by 0.7 meters by 1.0 meter tall on the *makai* side; it is constructed of flat slabs and boulders. This cairn sits on top of a modified outcrop that measures 1.6 meters wide and extends 5.0 meters to the east (curving to the north at the northeastern end). The modified outcrop is composed of stacked cobbles, boulders and upright slabs along the edges with smaller cobbles used to pave the level, one-meter wide interior; exposed bedrock runs along the eastern side.

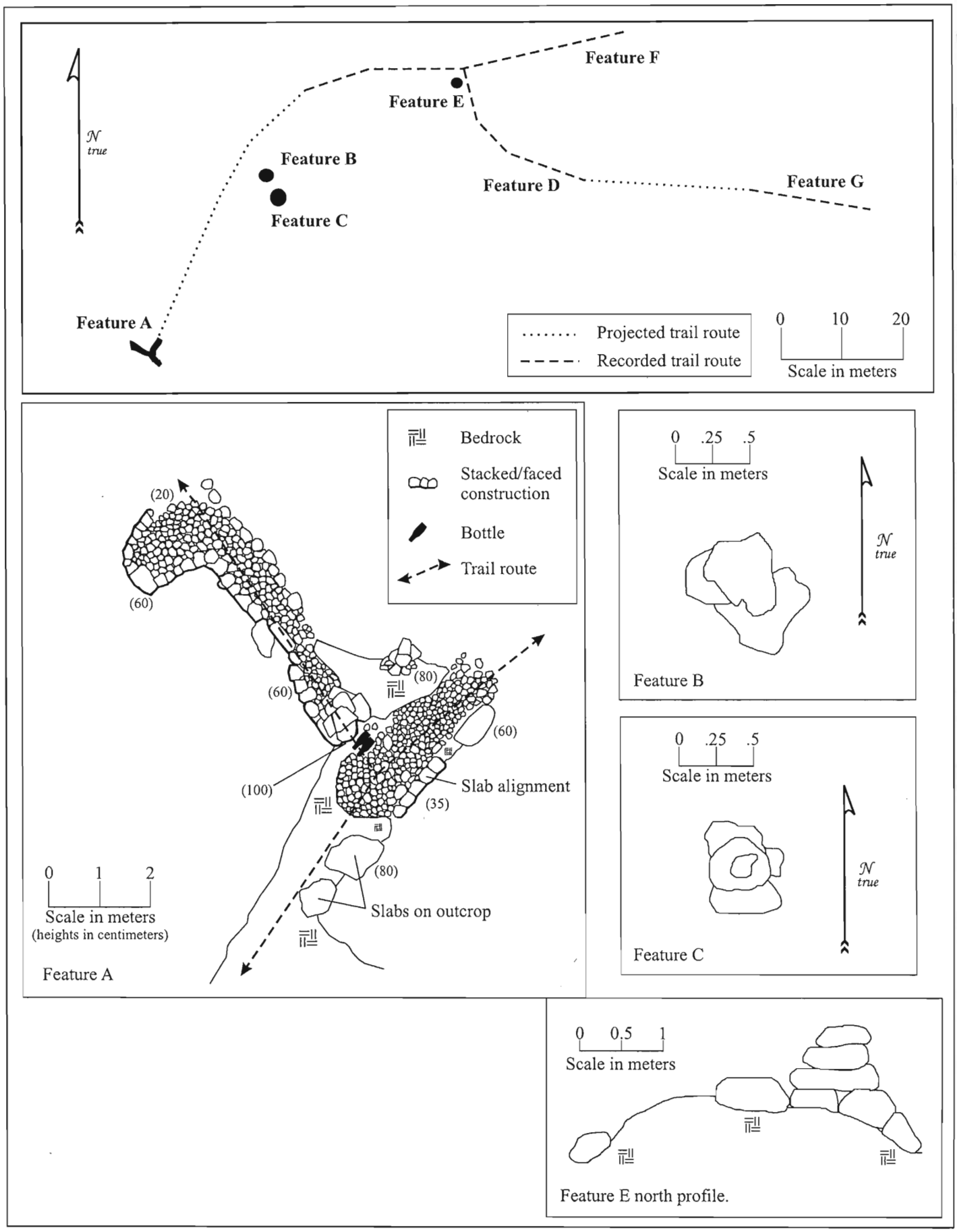


Figure 244. SIHP Site 25073 plan view and plan view diagrams for Features A, B, C, and E.

Feature B

Feature B is a cairn located 2.5 meters north of Feature C, approximately 30 meters northeast of Feature A (see Figure 244). It stands four courses high (0.6 meters) and measures 0.5 meters by 0.5 meters. The cairn is composed of large cobbles and slabs and is constructed on *pāhoehoe* bedrock (Figure 245). The feature probably functioned as a trail marker; it is on the northwest side (opposite Feature C to the south) of a projected trail route in an area where the actual route of the trail is not traceable across the *pāhoehoe* bedrock.

Figure 245. SIHP Site 25073 Feature B, stacked cairn, view to the northeast.

Feature C

Feature C is a cairn located 2.5 meters south of Feature B, approximately 30 meters northeast of Feature A (see Figure 244). It stands three courses (0.5 meters) high and measures 0.7 meters by 0.8 meters. The cairn is composed of large slabs stacked on *pāhoehoe* bedrock in a pyramid shape (Figure 246). The feature probably functioned as a trail marker; it is on the southeast side (opposite Feature B to the north) of a projected trail route in an area where the actual route of the trail is not traceable across the *pāhoehoe* bedrock.

Feature D

Feature D is a trail segment that runs a meandering course southeast/northwest for 50 meters in the central portion of Site 25073 (see Figure 244). The trail is constructed in sections by the leveling of cobbles to create a flat, even walking surface that averages 1.0 meter wide. Feature E (a stacked cairn described below) is located midway along this trail segment on the southwest side; it marks the intersection with Feature F, which runs northeast from Feature D. West of the cairn Feature D traverses *pāhoehoe* bedrock. To the east of the cairn the ground surface consists of more soil and cobbles.

Feature E

Feature E is a cairn marking the intersection of two trails in the central portion of Site 25073 (see Figure 244). The feature measures 1.5 meters (north-south) by 0.6 meters wide with a height of 1.2 meters. The cairn is composed of stacked *pāhoehoe* slabs on a bedrock outcrop (Figure 247).

Figure 246. SIHP Site 25073 Feature C, stacked cairn, view to the south.

Figure 247. SIHP Site 25073 Feature E, stacked cairn, view to the north.

Feature F

Feature F is a trail segment that runs northeast for approximately 30 meters from its intersection with Feature D at the location of Feature E (see Figure 244). Feature D is a more prominent and easily traced path. Feature F runs across an *'a'ā* flow. Its route is marked by the placement of at least 5 *pāhoehoe* slab steppingstones (Figure 248). Other sections of the trail consist of cobbles piled along the edges, and the surface consisting of small cobble pavement and soil that measures up to one meter wide.

Figure 248. SIHP Site 25073 Feature F, stepping stone segment of trail, view to the northwest.

Feature G

Feature G is a trail segment located in the southeastern portion of Site 25073 (see Figure 244). This trail segment runs in the same direction as, and is the same trail as Feature F, but this segment located approximately 30 meters to the northwest of that feature, and the exact route of the trail could not be traced between them. Feature G is an approximately 15 meter long segment of trail composed of stepping stones aligned on a rough *pāhoehoe* cobble ground surface (Figure 249). The Feature G pathway measures approximately one meter wide. This trail segment likely continued *mauka*, but it could not be followed to the east.

Figure 249. SIHP Site 25073 Feature G, trail segment, view to the west.

SIHP Site 25074

Site 25074 is a stepping stone trail located in the southeastern quarter of the project area just south of the center of the project area (see Figure 15). The trail segment is traceable for 7.5 meters going *mauka-makai*, (Figure 250) and has an average width of 1.7 meters wide. The western portion of the trail segment is composed of eroded *pāhoehoe* cobbles and slabs that have been arranged to fit together; the trail surface is flat and straight. The eastern portion of the trail consists of a 2 meter long by 0.8-meter wide area of cleared *pāhoehoe* bedrock that is lined on each side with cobbles. North, west, and south of the trail are thick soil deposits that may have been planting areas. The trail was probably a small section of a larger system of footpaths that lead around to the many features throughout and beyond the current study parcel.

Figure 250. SIHP Site 25074 trail, view to the west.

SIHP Site 25075

Site 25075 is a short trail segment with a low cairn located in the southwestern corner of the project area (see Figure 15). The trail segment 0.5 meter wide runs north-south for 8 meters crossing an *a'ā* cobble and bedrock outcrop; the trail surface is faint but a linear depression along the *a'ā* can be seen with cobbles lining the trail edge in places, and one slab steppingstone placed in the center of the trail (Figure 251). The cairn is located among the *a'ā* outcrop cobbles on the west side of the trail. It is constructed with 1 large slab on the base course, and another on top of that standing 0.25 meter tall by 0.5 meter in diameter. The trail is not traceable beyond the *a'ā* outcrop to the north or the south. The trail was likely a small part of a network that links the various Precontact sites in and beyond the current project area.

Figure 251. SIHP Site 25075, trail and cairn, view to the northeast.

Summary and Conclusions

As a result of the current inventory survey eleven previously recorded archaeological sites (Sites 5699, 16103, 16105, 16106, 16107, 16125, 16126, 16127, 16128, 16131, and 24424) and forty-two newly recorded sites (Sites 25034–225075) were identified on the subject parcel. These sites represent nearly continual use of the study parcel from Precontact times (perhaps as early as the 1400s; Haun and Henry 2003:80) to the 1940s. The most recent sites located on the study parcel include the remains of a Historic Period residential complex (Site 24034) possibly used into the 1930s, and the boundary walls that surround the entire parcel (Sites 5699, 16106, 16125, and 16126). One of these walls is also the southern wall marking the former Homestead Road that was part of a system of roadways provided access to the grant lots in the area. With the exception of the wall along the Homestead road, these sites likely post-date the patenting of the study parcel by Hattie Kinoulu (grandmother of the current landowner), and are primarily related to cattle ranching and homesteading.

The use of at least two sites on the subject parcel may have spanned Precontact and Historic times. One of these sites is the extensive agricultural complex and the other a lava tube (Sites 16107 and 24424). The project area (as reflected in Site 16107) appears to have been used originally cultivated during the Precontact Period, as attested to by the numerous habitation sites dating to the era. We know from oral accounts that traditional cultivation practices, primarily sweet potatoes, on this land continued into the 1940s. Site 24424 appears to have been utilized nearly exclusively for water collection purposes. Several stone constructions were recorded within the tube that were strategically placed at the locations of dripping water. Two broken bottles discovered within Site 24424 are the only definitive evidence of Historic use of the lava tube. Water caves like Site 24424 would have enabled populations to live upon the land and sustain life in the arid environment of North Kona. Precontact peoples undoubtedly would have utilized this valuable resource to its fullest possible extent. Knowledge of the cave's location and value may have dwindled during Historic times as the *kama'āina* moved off the land and the old style of Hawaiian land management was replaced by a western style of land ownership. Use of the cave for water collection would have become obsolete as the Historic era progressed and new water collection and dispersal technology was brought to the island.

During Precontact times habitation areas may have been chosen in large part based on the availability of potable water. In middle-upland areas of North Kona where there was ample rain (especially during the summer months) and access to drinking water, such as the current project area, people would have built residences and cultivated crops such as sweet potato (Cordy et al. 1991:557). The presence of the extensive lava tube (Site 24424) with evidence of water collection would have also been a significant factor in the location of residential sites. Cordy et al. (1991:558) suggest that the nature of habitation generally occurring within the elevational zone of the current project area was temporary, and perhaps recurrent. It seems logical that the use of these habitations may have been seasonal and related to the planting and harvesting cycles.

A significant number of Precontact habitation sites (n=40), many with multiple features, were recorded within the current project area (see Table 1). The density of such sites in this project area is much greater that in surrounding areas, and may be a function of the lack of substantial Historic and modern ground altering activities. Conversely, it may be that this area saw a greater population density in Precontact times than in the surrounding area. The apparent presence of a consistent and reliable water source (Site 24424) may have played a factor in the high density of habitation sites. No matter what the reason, it seems clear that the Precontact residents of these habitation features were likely involved in agricultural pursuits.

Three of the Precontact habitations (Sites 16103, 16105, and 25069), all lava tubes, were also used for burial, perhaps indicating a temporally sensitive pattern in the use of residential space for burial purposes. Three sites (Sites 25070, 25071, and 25072), all surface complexes, were used exclusively for burial purposes.

SIGNIFICANCE EVALUATIONS AND TREATMENT RECOMMENDATIONS

The above-described archaeological resources are assessed for their significance based on criteria established and promoted by the DLNR-SHPD and contained in the Hawai'i Administrative Rules 13§13-284-6. These significance evaluations should be considered as preliminary until DLNR-SHPD provides concurrence. For resources to be considered significant they must possess integrity of location, design, setting, materials, workmanship, feeling, and association and meet one or more of the following criteria:

A. Be associated with events that have made an important contribution to the broad patterns of our history;

B. Be associated with the lives of persons important in our past;

C. Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value;

D. Have yielded, or is likely to yield, information important for research on prehistory or history;

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.

The significance and recommended treatments for the recorded sites are discussed below and listed in Table 14.

Table 14. Site significance and treatment recommendations.

SIHP No.	*Function*	*Temporal Association*	*Significance*	*Recommended Treatment*
5699	Boundary	Historic	D	No further work
16103	Burial	Precontact	D, E	Preservation
16105	Burial	Precontact	D, E	Preservation
16106	Boundary	Historic	D	No further work
16107	Agricultural	Precontact/Historic	D	No further work
16125	Boundary	Historic	D	No further work
16126	Boundary	Historic	A, D	Preservation
16127	Habitation/Agricultural	Precontact	D	Data recovery
16128	Burial	Precontact	D, E	Preservation
16131	Habitation	Precontact	D	Data recovery
24424	Water collection	Precontact	D, E	Preservation
25034	Habitation	Historic	D	No further work
25035	Habitation	Precontact	D	Data recovery
25036	Habitation	Precontact	D	Data recovery
25037	Habitation	Precontact	D	Data recovery
25038	Habitation	Precontact	D	Data recovery
25039	Habitation	Precontact	D	Data recovery

continued on next page

Table 14. continued

SIHP No.	*Function*	*Temporal Association*	*Significance*	*Recommended Treatment*
25040	Habitation	Precontact	D	Data recovery
25041	Habitation	Precontact	D	Data recovery
25042	Habitation	Precontact	D	Data recovery
25043	Habitation	Precontact	D	Data recovery
25044	Habitation	Precontact	D	Data recovery
25045	Habitation	Precontact	D	Data recovery
25046	Habitation	Precontact	D	Data recovery
25047	Habitation	Precontact	D	Data recovery
25048	Habitation	Precontact	D	Data recovery
25049	Habitation	Precontact	D	Data recovery
25050	Habitation	Precontact	D	Data recovery
25051	Habitation	Precontact	D	Data recovery
25052	Habitation	Precontact	D	Data recovery
25053	Habitation	Precontact	D	Data recovery
25054	Habitation	Precontact	D	Data recovery
25055	Habitation	Precontact	D	Data recovery
25056	Habitation	Precontact	D	Data recovery
25057	Habitation	Precontact	D	Data recovery
25058	Habitation	Precontact	D	Data recovery
25059	Habitation	Precontact	D	Data recovery
25060	Habitation	Precontact	C, D	Preservation
25061	Habitation	Precontact	D	Data recovery
25062	Habitation	Precontact	D	Data recovery
25063	Habitation	Precontact	D	Data recovery
25064	Habitation	Precontact	D	No further work
25065	Habitation	Precontact	D	Data recovery
25066	Habitation	Precontact	D	No further work
25067	Habitation	Precontact	D, E	Preservation
25068	Habitation	Precontact	D	No further work
25069	Burial	Precontact	D, E	Preservation
25070	Burial	Precontact	D, E	Preservation
25071	Burial	Precontact	D, E	Preservation
25072	Burial	Precontact	D, E	Preservation
25073	Trail	Precontact	D	No further work
25074	Trail	Precontact	D	No further work
25075	Trail	Precontact	D	No further work

Sites Recommended for Preservation

Eleven sites (Sites 16103, 16105, 16126, 16128, 24424, 25060, 25067, 25069, 25070, 25071, and 25072) are recommended for preservation. All of these have been evaluated as significant for the scientific research potential (Criterion D) and one other criterion. Seven are burial sites and are additionally significant for cultural reasons (Criterion E); one is a lava tube used as a locus for water collection and as such would have held additional traditional cultural value (Criterion E); one is a boundary wall associated with a transportation route that is characteristic of late eighteenth and early nineteenth century regional patterns (Criterion A); and two are habitation sites, one an excellent example of a site type (Criterion C) and one a location of petroglyphs giving the site added cultural significance (Criterion E). For the burial sites, a search for lineal and cultural descendants should be undertaken and a burial treatment plan should be prepared in consultation with any identified descendants and the Hawai'i Island Burial Council. For the non-burial archaeological sites, a preservation plan should be prepared in consultation with DLNR-SHPD.

Sites Recommended for Data Recovery

Thirty-one sites (Sites 16127, 16131, 25035, 25036, 25037, 25038, 25039, 25040, 25041, 25042, 25043, 25044, 25045, 25046, 25047, 25048, 25049, 25050, 25051, 25052, 35053, 25054, 25055, 25056, 25057, 25058, 25059, 25061, 25062, 25063, and 25065) are recommended for data recovery. All are evaluated as significant under Criterion D, and as such this suite of habitation sites collectively represents an excellent opportunity to better understand Precontact settlement in a wetter and more fertile portion of Kekaha. Given the significant modern development that has already occurred in the region and the continued development of this area, these sites provide an ever-increasingly unique opportunity for study of multiple research questions. As these sites still retain the potential for further data collection, and are recommended for data recovery, a data recovery plan should be prepared in consultation with DLNR-SHPD.

Sites Recommended for No Further Work

Eleven sites (Sites 5699, 16106, 16107, 16125, 25034, 25064, 25066, 25068, 25073, 25074, and 25075) have been evaluated as significant under Criterion D, and as a result of the current study, it is argued that the data already collected and presented in the current report is sufficient to mitigate any impacts to these sites that may result from the development of the study parcel.

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APPENDIX A –

Map and descriptions of archaeological sites previously recorded on the current study parcel by Drolet and Schilz (1991).

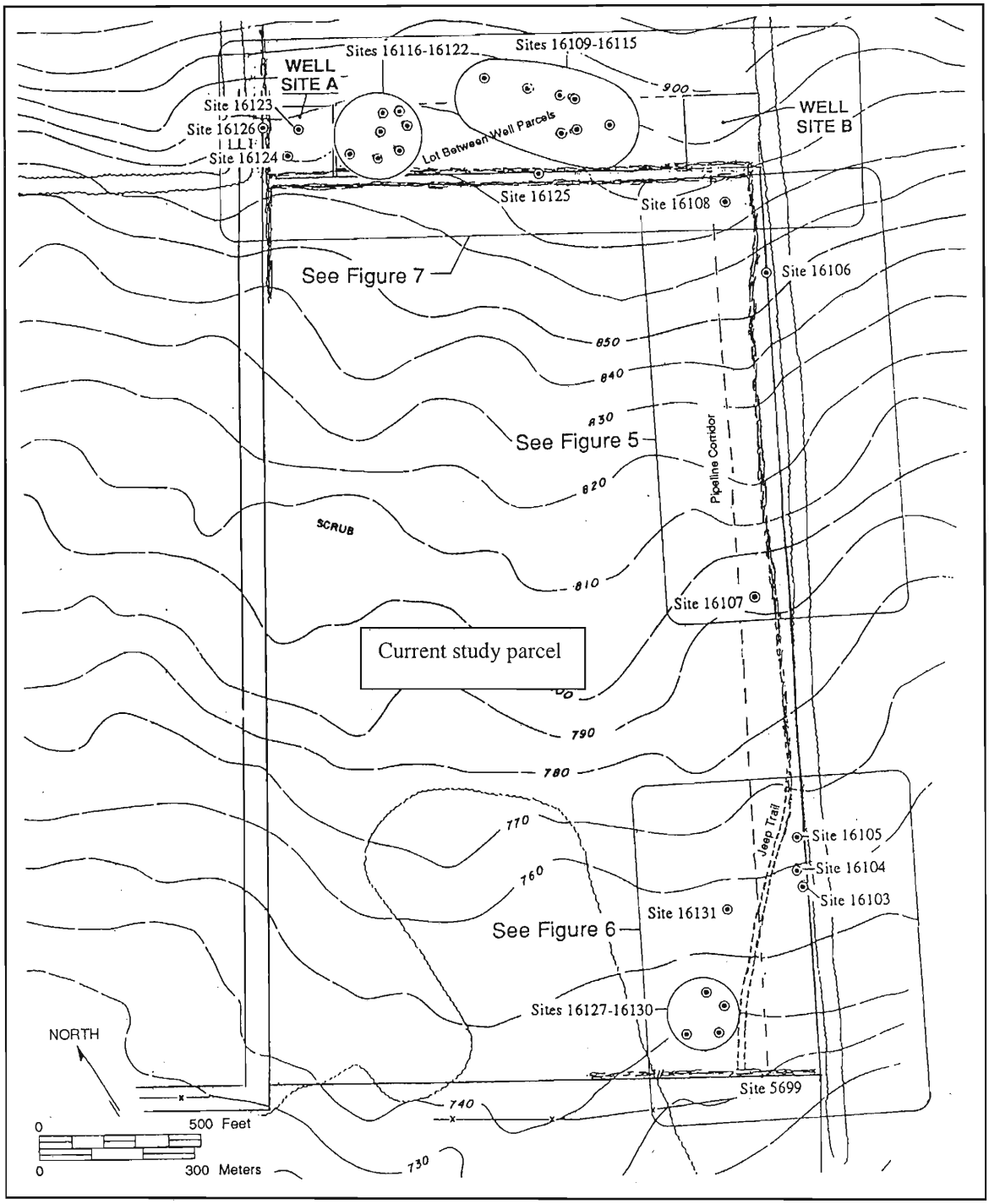
1. PIPELINE CORRIDOR (Figures 4, 5 and 6)

Site 16103 (Field Site 02): Cave Complex: This site complex consists of a depression 2 to 3 meters deep, 10 meters wide and 30 meters long. Two tube openings are located within the depression; these are labeled Tube A and B on the field map. Stone alignments are located on the floor of Tube B, and no observable cultural features are found in Tube A. In addition to the features in Tube B, an area of stone stacking is located outside of the tube openings in the northern half of the depression. This site is situated between stakes 3 and 4 along the corridor baseline.

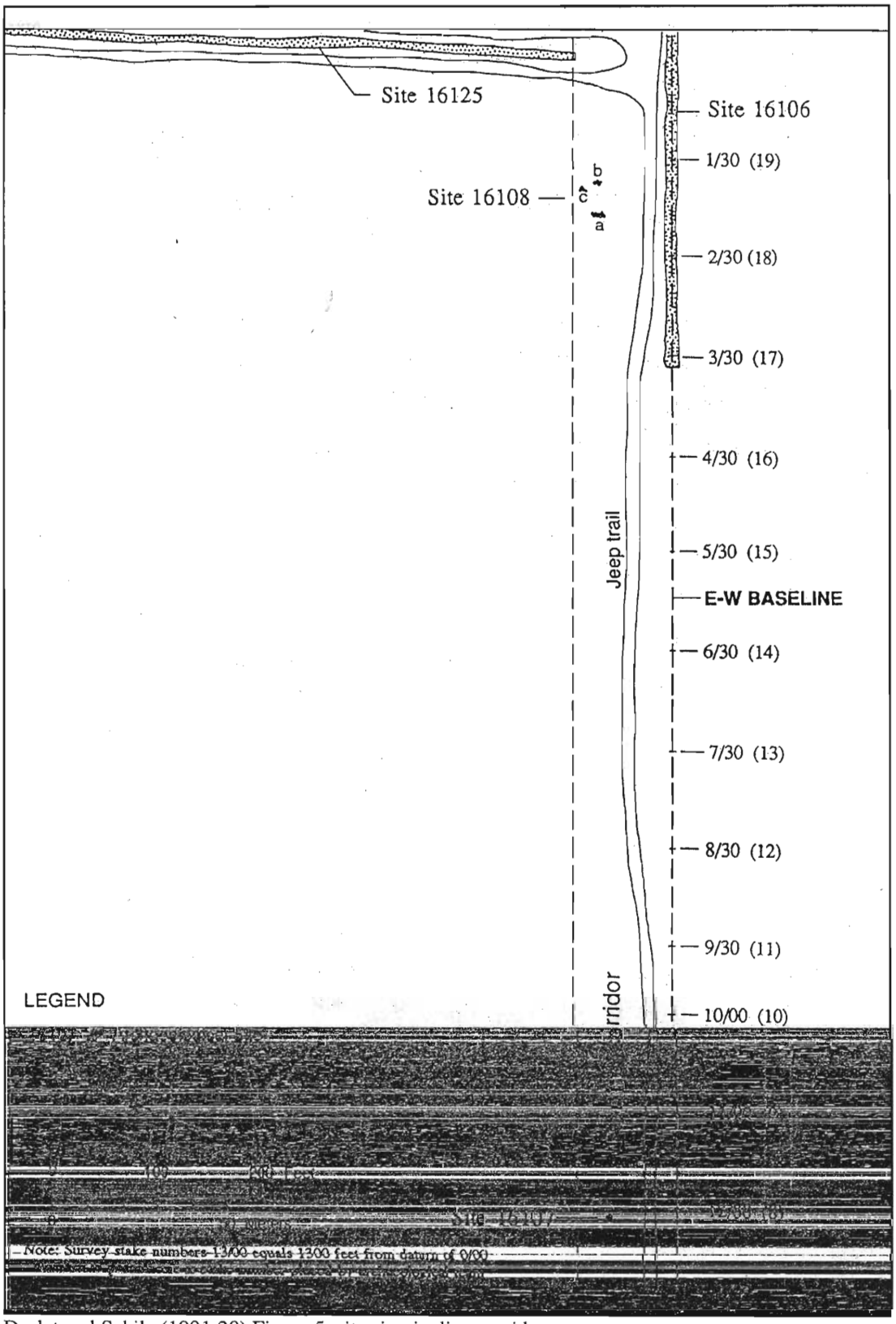
Site 16104 (Field Site 19): Cave Complex. This large, deep depression is located 5 meters north of Site 16103, between stakes 3 and 4. It measures 35 meters long by 12 meters wide by 3 meters deep and contains two principal tube openings. Tube A has stone constructions on the floor. One consists of a single stone high feature forming two parallel lines that connect at one end. Other alignment constructions cluster close to this one, all located inside the mouth of the tube. Tube B also exhibits human use, containing charcoal remains in soil deposits on the floor of the cave. Within the depression between tubes A & B, is a north-south wall 1 meter high. The wall is 0.60 meters wide, and stacked 7 to 8 courses high.

Site 16105 (Field Site 05): Cave Complex. A third cave depression is located between baseline stakes 4 and 5. It measures 20 meters wide by 20 meters long and is 3 meters deep. Three principal tube openings are included. Tube C contains midden on the surface floor and a low wall built at the opening of the tube. A piece of coral was observed outside the cave along a western shelf.

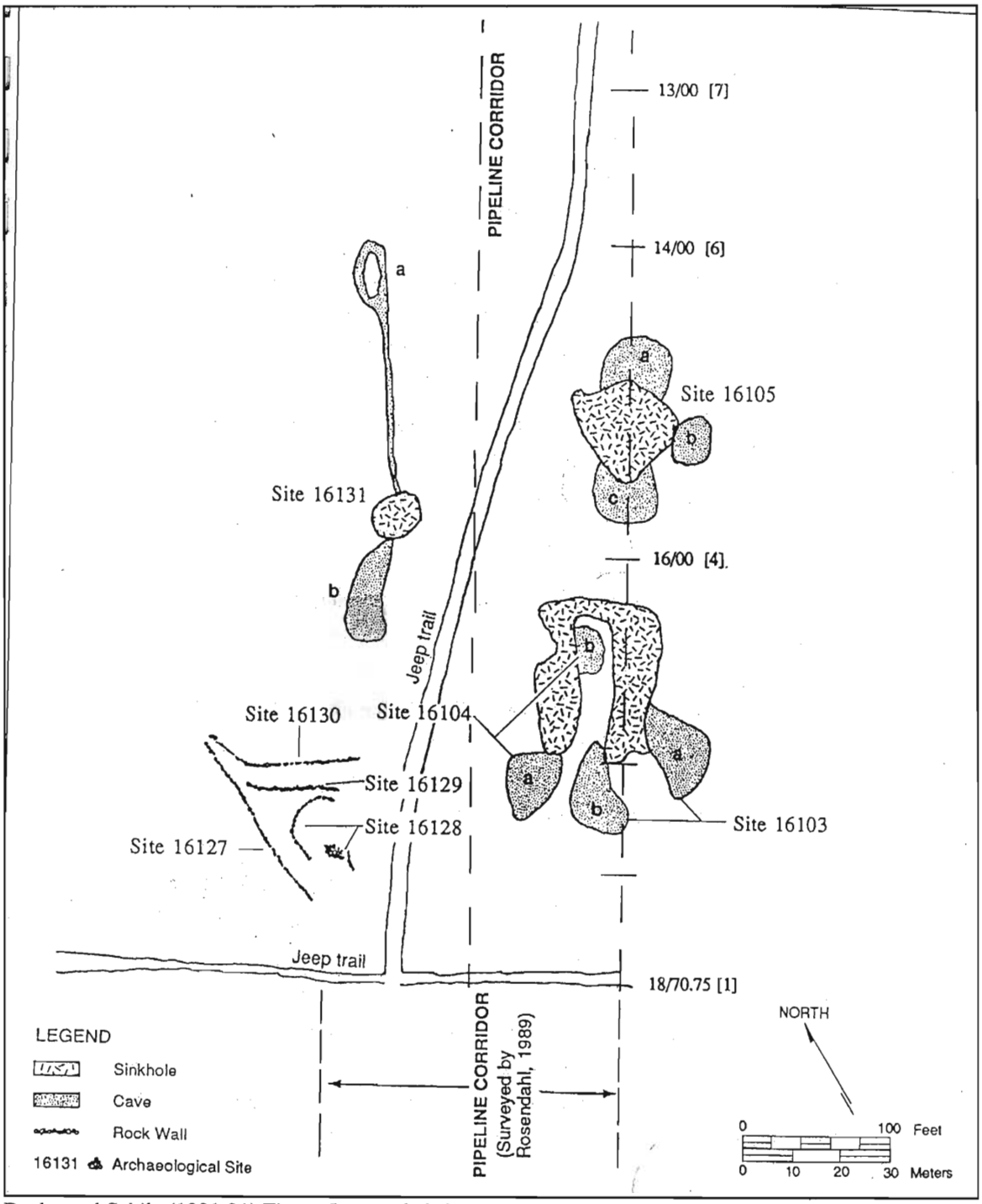
Site 16106 (Field Site 15): Wall. This single feature site feature extends from the upper eastern 1/3 of the corridor and continues outside of the land unit. The first 20 meters has been severely damaged, but it retains much of its original shape. The wall was constructed of stacked pahoehoe cobbles and boulders, and in the well preserved sections, measures 1 meter wide by 0.75m. high.



Drolet and Schilz (1991:19) Figure 4, project area and site locations showing the current study parcel.



Drolet and Schilz (1991:20) Figure 5, sites in pipeline corridor.



Drolet and Schilz (1991:21) Figure 5, extended site survey along jeep trail.

Site 16107 (Field Site 20): Circular Mound. This single feature site is a small, circular mound measuring 2 meters in diameter. It is 60 cm. high and is constructed of pahoehoe cobbles and angular boulders. The feature is located 20 meters from stake 12 on the baseline.

Site 16108 (Field Site 21): Mound Cluster: This site is composed of three small mound features. Together the features cover an area 10 by 5 meters and is located approximately 20 meters north of the baseline.

Mound A: This is a rectangular mound measuring 4 meters in length, 1.75 meters in width, and 70 cm. in height. It is located approximately 20 meters from the base line and is built of pahoehoe cobbles and boulders stacked 5 to 6 courses high.

Mound B: This irregular shaped mound is located 5 meters southeast from Mound C and 10 meters east of Mound A. It is constructed of piled pahoehoe cobbles and boulders aligned in an east/west (*mauka-makai)* direction and measures 3 meters long, 1 meter wide, and 0.5 meters high.

Mound C: This is another irregular shaped mound of similar construction. It measures 3 meters long by 2 meters wide by 0.5 meters high.

Site 16125 (Field Site 43): Wall. This is an historic feature, consisting of one of several local property markers constructed during the 1920's and 1930's in this section of the O`oma 2 *ahupua`a*. In relationship to the baseline and jeep trail that parallel the Well Sites A and B, the wall extends approximately 900 feet (270 meters). Originally, the wall connected with two others, Site 16106 on the southern side and Site 16126 on the northern side. Owing to the construction of jeep trails on both the northern and southern side of the property area, the wall has been cut open on each side. Along the north/south baseline, at stake 1 the wall is 7 meters to the west (*makai*) of the baseline. At stake 5 the wall is located 2 meters to the west (*makai*) and at stake 6 it is 1 meter to the west (*makai*). At stake 7 the wall coincides with the baseline and continues until the last stake, stake 10.

Between stakes 9 and 10, the wall has been disturbed by the east-west (*mauka-makai*) jeep trail. Jeep trails, situated only a few meters away, border both sides of Wall 16125. The wall is fairly well preserved, but collapsed in spots. It ranges from 0.3 to 0.80 meters in height and from 0.7 meters to 1 meter wide.

Site 16126 (Field Site 44): Wall. This historic property marker runs perpendicular to, and was originally attached to Site 16125. It is located at stake 10 the final stake along the north/south base line. This stake is the northwest corner of Well Site A. Wall 16126 measures 1 meter high and 0.8 meters wide. It extends to Site 5699 (Rosendahl 1989) and in its eastern extension, runs several hundred meters to the top of the Lee property line and entry gate. At stake 10 the wall makes a 90 degree turn north for 2 meters, then makes another 90 degree turn east (*mauka*) and continues this direction up the slope. Four meters to the north of Site 16126 there is another stone fence, this is outside the survey limits. One branch parallels Site 16126 up hill to the property gate. Another branch continues parallel to Site 16126 going west (*makai*) and still another branches 90 degrees north from this second wall. Thus, along the northern boundary line of the Lee property, a double stone wall fence was built as part of a larger network of property lines and ranch fences in the local area. The double wall structure may be older than the others and possibly functioned as an access trail through the slope zone during historic times.

2. AREA OF EXTENDED SURVEY ALONG JEEP TRAIL (Figure 6)

Site 16127 (Field Site 38): Low Wall. This site is located between stakes 2 and 3, 15 meters north of the existing jeep trail, 30 meters north of the east-west (*mauka-makai*) baseline, and 15 meters west (*makai*) of the stone wall (Site 5699). The wall is oriented in a north-south direction, having a slightly curving alignment, and continues an undetermined distance into the land area further north. The site is constructed with pahoehoe cobbles and boulders. It is in poor condition and collapsed in most areas. It measured 0.3 to 0.4 meters in height, 1 meter in width; approximately 25 meters of the wall within the corridor was inspected. Along the north side of the wall there exists a deposit of loose pahoehoe stone which is low and flat with only occasional scrub vegetation.

Site 16128 (Field Site 39): This site is a feature cluster that covers a 15 by 10 meter area. It includes an aggregate of related features located 10 meters north of the jeep trail. The site is situated between stakes 2 and 3 along the east-west (*mauka-makai*) base line of the pipeline corridor and is 50 meters north of the base line.

Feature A, Wall: This feature consists of a low wall of 1 to 2 course high pahoehoe stone. It begins 10 meters north of the existing jeep trail and continues north 10 meters until reaching a mound (feature 2). The wall feature is in poor condition and is disturbed in various spots. It measures 0.3-0.4 meters. high and 0.2-0.5 meters in width.

Feature B, Mound: This feature consists of a circular, low mound constructed of pahoehoe cobbles and boulders. The stones are mostly fist-sized cobbles on top of larger boulders. It measures 2.5 meters in diameter and 0.5-0.6 meters high.

Feature C, Rock alignment: This feature is situated directly in back, or to the north, of the above described mound. The alignment is 0.6 meters in height, 0.7 to 2 meters in width and is oval in shape. It continues from the mound feature south, curving slightly until reaching a lava depression close to the existing jeep trail. The depression measures 8 meters by 5 meters, but has been filled in by the construction of the road.

Site 16129 (Field Site 40): Low Wall. This single feature site is located just east (*mauka*) of Site 16128 and runs parallel Feature C. It runs in an west-east (*mauka-makai*) direction and is constructed with pahoehoe stone. The feature extends south from the wall of Site 16127 to the depression mentioned above. The feature is in poor condition and is mostly collapsed, and measures 0.2-0.3 meters high and 0.3-0.4 meters wide. The wall was located 25 meters north of the jeep trail.

Site 16130 (Field Site 41): Low Wall. This site is located just east of Site 16129. It consists of a low wall in good condition, although there are collapsed portions. The wall runs parallel to Site 16129, separated from it by a distance of 8 meters. It measured 0.3 to 0.6 meters in height and from 1 to 1.5 meters in width.

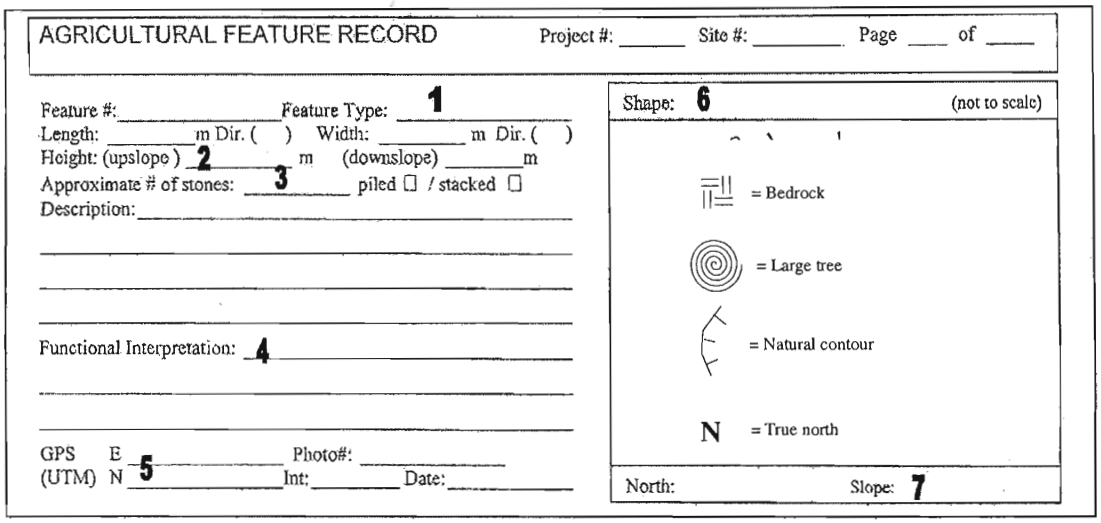
Site 16131 (Field Site 42): Cave Site. This site is located 10 meters from the jeep trail, between stakes 4 and 5 on the baseline in the pipeline corridor. It consists of an open depression, 10 meters in diameter with two principal tubes, one running northwest and another running east. Tube A, located on the eastern side is the largest of the two. It has a lateral extension of over 300 feet (91 meters). The tube averages around 8 meters in width and 6 meters in height. At the opening, there are rectangular constructions built with boulder and cobble lava stone. One of these "room-like" structures measures 3 by 2.5 meters in size while another, on the opposite side of it measures 5 by 2 meters in size. The structures were built with stacked stone walls leading off both side walls of the cave. On the front wall of these units, each contain a single course high cobble construction, while the other sides of each structure are built up higher, containing between 3 and 5 courses of cobbles and larger boulders. The inside "floor" area is flat and contained smaller sized pebbles. In addition, the interior of the units is associated with occasional fragments of shell, kukui nut, and a light midden deposit. Another structure of similar size and construction is located further into the tube, approximately 20 meters inside.

Tube B of Site 16131 is a similar extensive opening, however, somewhat shorter in length than Tube A. At the opening, there is a walled enclosure, similar to that described for Tube A. It measures 5 by 2.5 meters in size and contained walls built up four to five courses high with pahoehoe cobbles and boulders. The interior floor is flat and contains smaller pebble sized stone. Similar to the structures in Tube A, there is scattered, light midden material on the floor. No other modifications or cultural features were found further in the tube.

APPENDIX B –

SIHP Site 16107 agricultural feature records.

Below is an example of the agricultural feature record used by fieldworkers during the current inventory survey. The information contained on these forms was used to generate the feature descriptions for SIHP Site 16107 that follow. The numbers that are present next to some of the data fields correspond to notes (listed below) about the form.


AGRICULTURAL FEATURE RECORD Project #: _____ Site #: _____ Page ____ of ____

Feature #: _____ Feature Type: 1

Length: _____ m Dir. ( ) Width: _____ m Dir. ( )

Height: (upslope) 2 _____ m (downslope) _____ m

Approximate # of stones: 3 _____ piled ☐ / stacked ☐

Description: _____

Functional Interpretation: 4 _____

GPS E _____ Photo#: _____

(UTM) N 5 _____ Int: _____ Date: _____

Shape: 6 (not to scale)

= Bedrock

= Large tree

= Natural contour

N = True north

North: Slope: 7

1. For a discussion of the feature types recorded during the current survey see the description for Site 16107 on page 26 of this report
2. Heights are listed in meters above ground surface. Since the majority of the project area slopes fairly steeply *makai,* these measurements give a fairly accurate idea of the minimum and maximum height attained by the feature.
3. The approximate number of stones encompassed by a feature is solely an estimate by the fieldworkers. This approximation is meant to suggest the amount of labor invested in the construction of a particular feature and aid in comparisons between features (the same is true for piled or stacked). In many cases this category was not attempted due to the lack of accuracy involved.
4. Functional interpretation is a possibility suggested by the fieldworkers that is derived from the feature's formal attributes and the surrounding landscape. The functional interpretations listed below are by no means a certainty. Observable soil areas located nearby a recorded feature are considered possible planting areas, whether they were used for that purpose or not.
5. GPS coordinates use the WGS 84 datum.
6. The quick sketches of the features are meant to show their shape and any unique attributes they might contain. The drawings are not to scale. A legend of the common symbols used in the plan view drawings is shown in the box on the example form.
7. The slope indicator points down slope on all feature descriptions.

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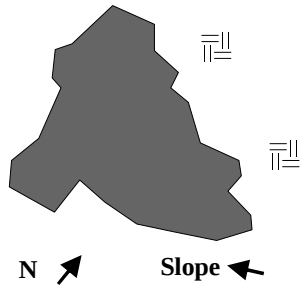
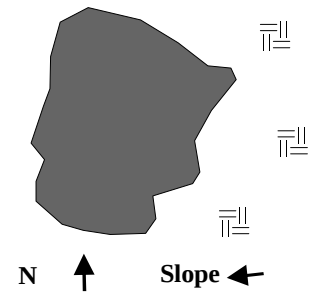
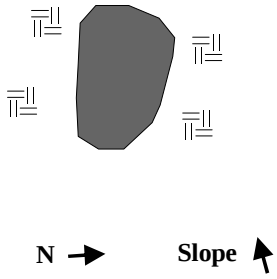
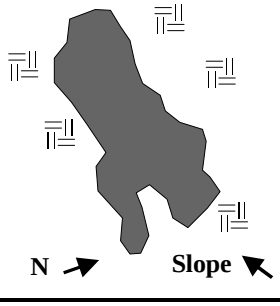
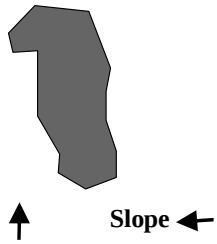
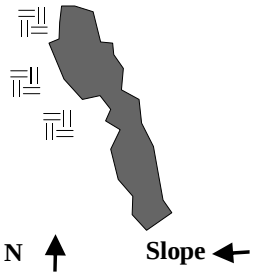
Feature #: **1**	Type: **Mound**		Plan view (not to scale)	View to:
Length (m): **3.2**	Width (m): **2.3**			No photo available
Height (m) (upslope): **.70** (downslope): **.70**	GPS Coordinates	E: **0186702** N: **2181759**		
Description: **Approximately 200 small to large sized cobbles piled on a bedrock ground surface.** **Probable clearing feature.**				

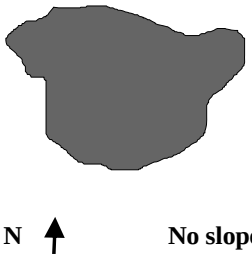
Feature #: **2**	Type: **Modified outcrop**		Plan view (not to scale)	View to:
Length (m): **2.3**	Width (m): **1.5**			No photo available
Height (m) (upslope): **1.0** (downslope): **.57**	GPS Coordinates	E: **0186725** N: **2181787**		
Description: **Approximately 200 small to large sized cobbles and slabs piled on and against a bedrock outcrop.** **Probable clearing feature.**				

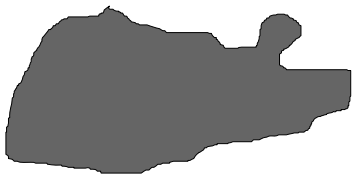
Feature #: **3**	Type: **Modified outcrop**		Plan view (not to scale)	View to:
Length (m): **2.6**	Width (m): **1.6**			No photo available
Height (m) (upslope): **0** (downslope): **.40**	GPS Coordinates	E: **0186729** N: **2181729**		
Description: **Approximately 50 small to large sized cobbles piled on a bedrock outcrop.** **Probable clearing feature.**				

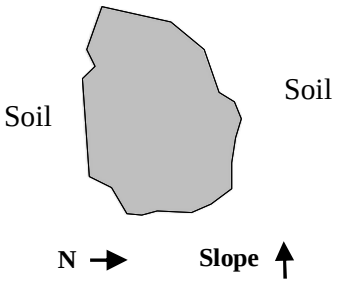
Feature #: **4**	Type: **Modified outcrop**		Plan view (not to scale)	View to:
Length (m): **2.9**	Width (m): **1.4**			No photo available
Height (m) (upslope): **.18** (downslope): **.60**	GPS Coordinates	E: **0186725** N: **2181790**		
Description: **Approximately 150 small to large sized cobbles piled on a bedrock ground surface.** **Probable clearing feature.**				

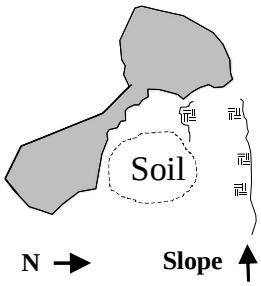
Feature #: **5**	Type: **Mound**		Plan view (not to scale)	View to:
Length (m): **4.5**	Width (m): **1.7**			No photo available
Height (m) (upslope): **.30** (downslope): **.30**	GPS Coordinates	E: **0186727** N: **2181780**		
Description: **Approximately 200 small to large sized cobbles piled in a linear fashion on a bedrock ground surface.** **Probable clearing feature.**				

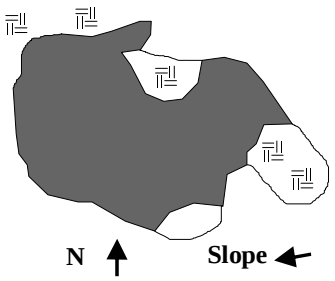
Feature #: **6**	Type: **Modified outcrop**	Plan view (not to scale)	View to:
Length (m): **6.2**	Width (m): **2.7**		No photo available
Height (m) (upslope): **.10** (downslope): **.53**	GPS Coordinates E: **0186735** N: **2181780**		
Description: **Approximately 200 small to large sized cobbles piled on a bedrock outcrop.** **Probable clearing feature.**			

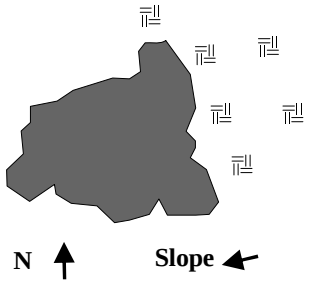
Feature #: **7**	Type: **Mound**	Plan view (not to scale)	View to: **North**
Length (m): **1.8**	Width (m): **1.2**		
Height (m) (upslope): **.30** (downslope): **.30**	GPS Coordinates E: **0186730** N: **2181730**		
Description: **Approximately 150 small to medium sized piled cobbles.** **Probable clearing feature.**			

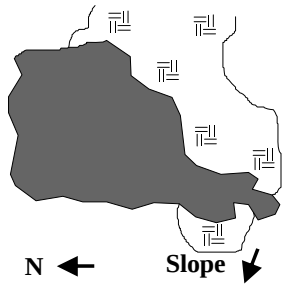
Feature #: **8**	Type: **Mound**	Plan view (not to scale)	View to **East**
Length (m): **2.6**	Width (m): **1.2**		
Height (m) (upslope): **.20** (downslope): **.40**	GPS Coordinates E: **0186726** N: **2181728**		
Description: **Approximately 250 small to medium sized piled cobbles with small cobbles on top of feature.** **Probable clearing feature.**			

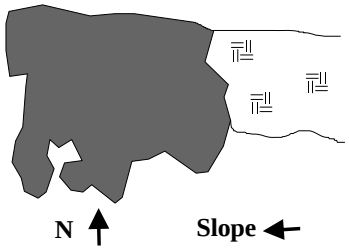
Feature #: **9**	Type: **Mound**	Plan view (not to scale)	View to: **West**
Length (m): **2.4**	Width (m): **1.9**		
Height (m) (upslope): **.10** (downslope): **.40**	GPS Coordinates E: **0186031** N: **2181803**		
Description: **Consists of an oval shaped pile of small to medium sized *pāhoehoe* cobbles constructed on soil.** **Probable clearing pile.**			

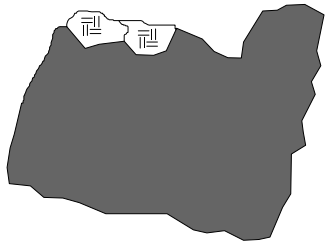
Feature #: **10**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Southeast**
Length (m): **7**	Width (m): **4**		
Height (m) (upslope): **.35** (downslope): **.70**	GPS Coordinates E: **0186032** N: **2181810**		
Description: **Consists of a cobble terrace loosely stacked on the *makai* edge, with soil on the *mauka* side probably used as a planting area. Cobbles are piled taller on the north and south ends than the center of the terrace.** **Probable clearing pile.**			

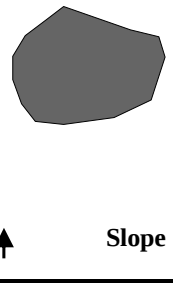
Feature #: **11**	Type: **Modified outcrop**	Plan view (not to scale)	View to:
Length (m): **3.8**	Width (m): **2.2**		No photo available
Height (m) (upslope): **.40** (downslope): **1.0**	GPS Coordinates E: **0185790** N: **2181800**		
Description: **Approximately 300 small to large sized piled cobbles. Bedrock is present on *mauka* and north portion of feature. Possible hollow area below feature to west.** **Probable clearing feature.**			

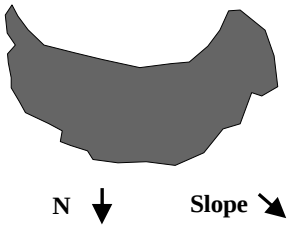
Feature #: **12**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **East**
Length (m): **1.90**	Width (m): **2.4**		
Height (m) (upslope): **0** (downslope): **.30**	GPS Coordinates E: **0185789** N: **2181795**		
Description: **Approximately 125 medium sized cobbles piled against a bedrock outcrop.** **Probable clearing feature.**			

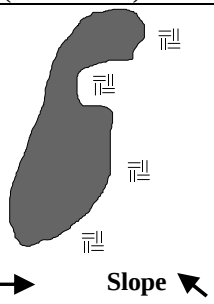
Feature #: **13**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **East**
Length (m): **3.3**	Width (m): **1.7**		
Height (m) (upslope): **.50** (downslope): **.75**	GPS Coordinates E: **0185798** N: **2181799**		
Description: **Approximately 175 medium to large sized piled cobble.** **Probable clearing feature.**			

Feature #: **14**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **North**
Length (m): **2.0**	Width (m): **1.0**		
Height (m) (upslope): **0** (downslope): **.30**	GPS Coordinates E: **0185809** N: **2181795**		
Description: **Approximately 75 medium to large sized piled cobbles, with bedrock to the east.** **Probable clearing feature.**			

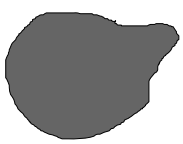
Feature #: **15**	Type: **Mound**	Plan view (not to scale)	View to: **West**
Length (m): **2.8**	Width (m): **2.2**		
Height (m) (upslope): **.90** (downslope): **.80**	GPS Coordinates E: **0185833** N: **2181804**		
Description: **Approximately 500 small-to large sized stacked cobbles. Partial collapse on northeast corner.** **Probable clearing feature.**			

Feature #: **16**	Type: **Mound**		Plan view (not to scale)	View to: **Southeast**
Length (m): **2.7**	Width (m): **2.4**			
Height (m) (upslope): **.60**	GPS	E: **0185799**		
(downslope): **.60**	Coordinates	N: **2181820**		
Description: **Approximately 200 small to medium sized piled cobbles piled.** **Probable clearing feature.**				

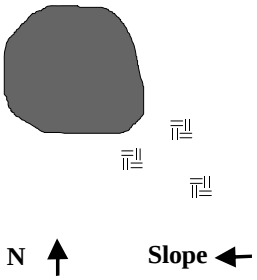
Feature #: **17**	Type: **Mound**		Plan view (not to scale)	View to: **Northeast**
Length (m): **4.3**	Width (m): **2.5**			
Height (m) (upslope): **.20**	GPS	E: **0185792**		
(downslope): **.60**	Coordinates	N: **2181804**		
Description: **Approximately 300 medium cobbles piled against a slope to the east.** **Probable clearing feature.**				

Feature #: **18**	Type: **Modified outcrop**		Plan view (not to scale)	View to **Southwest**
Length (m): **3.0**	Width (m): **1.4**			
Height (m) (upslope): **.25**	GPS	E: **0185795**		
(downslope): **.50**	Coordinates	N: **2181815**		
Description: **Approximately 75 medium to large sized cobbles piled against bedrock.** **Probable clearing feature.**				

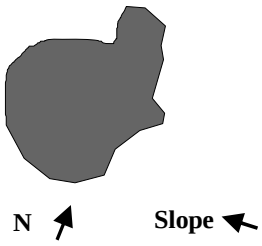
Feature #: **19**	Type: **Mound**		Plan view (not to scale)	View to **West**
Length (m): **1.6**	Width (m): **1.6**			
Height (m) (upslope): **.60**	GPS	E: **0185799**		
(downslope): **.60**	Coordinates	N: **2181812**		
Description: **Approximately 100 small and medium sized piled cobbles.** **Probable clearing feature.**				

Feature #: **20**	Type: **Mound**		Plan view (not to scale)	View to: **West**
Length (m): **1.5**	Width (m): **1.5**			
Height (m) (upslope): **.25**	GPS	E: **0185756**		
(downslope): **.55**	Coordinates	N: **2181812**		
Description: **Approximately 50 small to large sized piled cobbles and slabs.** **Probable clearing feature.**				

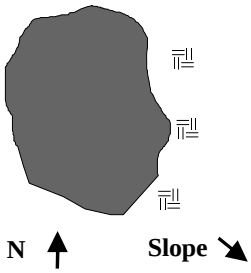
Feature #: **21**	Type: **Mound**	Plan view (not to scale)	View to: **East**
Length (m): **1.3**	Width (m): **1.3**		
Height (m) (upslope): **0** (downslope): **.35**	GPS Coordinates E: **0185745** N: **2181815**		
Description: **Approximately 80 medium sized cobbles piled against a slope. Bedrock is present to the southeast of feature.** **Probable clearing feature.**			



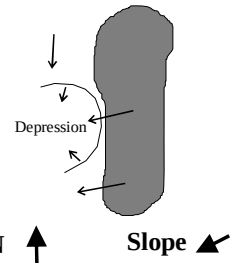
Feature #: **22**	Type: **Mound**	Plan view (not to scale)	View to: **Southwest**
Length (m): **2.0**	Width (m): **1.4**		
Height (m) (upslope): **.40** (downslope): **.60**	GPS Coordinates E: **0185844** N: **2181788**		
Description: **Approximately 150 small to large sized piled cobbles.** **Probable clearing feature.**			



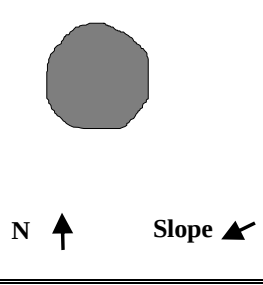
Feature #: **23**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **East**
Length (m): **2.0**	Width (m): **1.4**		
Height (m) (upslope): **.03** (downslope): **.03**	GPS Coordinates E: **0185849** N: **2181760**		
Description: **Approximately 500 small cobbles piled to form a paved area.** **Probable clearing feature.**			



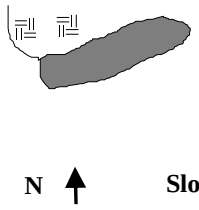
Feature #: **24**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **North**
Length (m): **5.6**	Width (m): **3.9**		
Height (m) (upslope): **30** (downslope): **.40**	GPS Coordinates E: **0185920** N: **2181775**		
Description: **Approximately 400 small to large sized cobbles piled in a linear fashion. The cobbles may have been cleared from the depression just west of the feature** **Probable clearing feature.**			



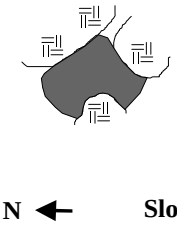
Feature #: **25**	Type: **Mound**	Plan view (not to scale)	View to: **Northeast**
Length (m): **1.9**	Width (m): **1.8**		
Height (m) (upslope): **.55** (downslope): **.55**	GPS Coordinates E: **0186256** N: **2181706**		
Description: **Approximately 200 small to large sized piled cobbles.** **Probable clearing feature.**			



Feature #: **26**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Northeast**
Length (m): **2.8**	Width (m): **2.5**		
Height (m) (upslope): **1.15** (downslope): **0**	GPS Coordinates E: **0186266** N: **2181700**		
Description: **Approximately 100 small to large sized cobbles loosely stacked on a bedrock ground surface.** **Probable clearing feature.**			

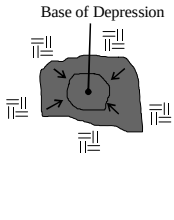


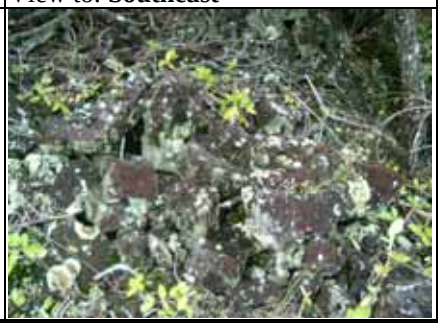
Feature #: **27**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **East**
Length (m): **2.5**	Width (m): **2.5**		
Height (m) (upslope): **0** (downslope): **.50**	GPS Coordinates E: **0186251** N: **2181701**		
Description: **Approximately 300 small to large sized piled cobbles.** **Probable clearing feature with a possible planting area.**			



Feature #: **28**	Type: **Mound**	Plan view (not to scale)	View to: **Northeast**
Length (m): **2.5**	Width (m): **2.3**		
Height (m) (upslope): **.40** (downslope): **.50**	GPS Coordinates E: **0186223** N: **2181704**		
Description: **Approximately 40 small to large sized piled cobbles.** **Probable clearing feature.**			

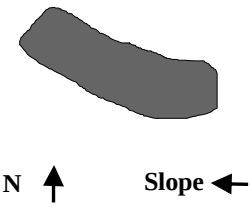
Feature #: **29**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Southeast**
Length (m): **2.3**	Width (m): **1.2**		
Height (m) (upslope): **0** (downslope): **.40**	GPS Coordinates E: **0186253** N: **2181722**		
Description: **Approximately 25 large boulders piled in a hole in the bedrock.** **Probable clearing feature.**			



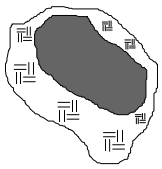


Feature #: **30**	Type: **Mound**	Plan view (not to scale)	View to: **North**
Length (m): **2.5**	Width (m): **1.5**		
Height (m) (upslope): **.30** (downslope): **.80**	GPS Coordinates E: **0186264** N: **2181679**		
Description: **Approximately 500 small to large sized piled cobbles.** **Probable clearing feature.**			

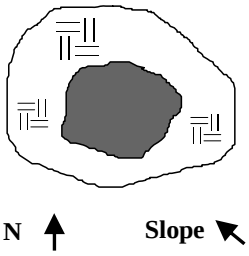
Feature #: **31**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **East**
Length (m): **6.0**	Width (m): **2.0**		
Height (m) (upslope): **.80** (downslope): **0**	GPS Coordinates E: **0186255** N: **2181675**		
Description: **Approximately 500 small to large sized cobbles piled against a bedrock slope.** **Probable clearing feature.**			



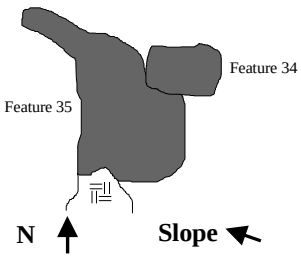
Feature #: **32**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Northeast**
Length (m): **3.0**	Width (m): **2.7**		
Height (m) (upslope): **0.56** (downslope): **.80**	GPS Coordinates E: **0186238** N: **2181678**		
Description: **Approximately 300 small boulders piled on a bedrock outcrop.** **Probable clearing feature.**			



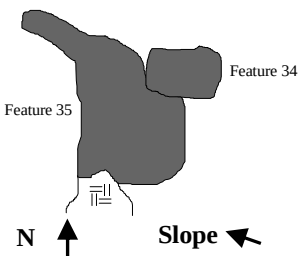
Feature #: **33**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **East**
Length (m): **1.6**	Width (m): **2.7**		
Height (m) (upslope): **.45** (downslope): **.45**	GPS Coordinates E: **0186235** N: **2181679**		
Description: **Approximately 300 small to large sized cobbles and boulders piled on a bedrock outcrop.** **Probable clearing feature.**			



Feature #: **34**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **East**
Length (m): **10**	Width (m): **2.5**		
Height (m) (upslope): **0** (downslope): **.80**	GPS Coordinates E: **0186242** N: **2181669**		
Description: **Approximately 200 small to large sized cobbles and boulders piled and stacked. Stacked portion is 2-3 courses high.** **Probable clearing feature.**			



Feature #: **35**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **North**
Length (m): **5.0**	Width (m): **5.0**		
Height (m) (upslope): **0** (downslope): **.50**	GPS Coordinates E: **0186242** N: **2181669**		
Description: **Approximately 1000 small to large sized cobbles and boulders piled on the west face with soil on eastern portion.** **Probable planting feature.**			



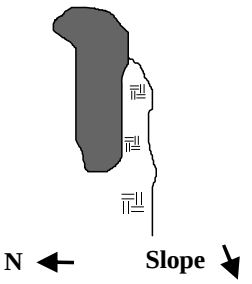
Feature #: **36**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **East**
Length (m): **1.2**	Width (m): **1.9**		
Height (m) (upslope): **.20** (downslope): **.55**	GPS Coordinates E: **0186244** N: **2181660**		
Description: **Approximately 20 small to large sized cobbles and boulders piled on an eroding bedrock outcrop.** **Probable clearing feature.**		N ← Slope ↙	

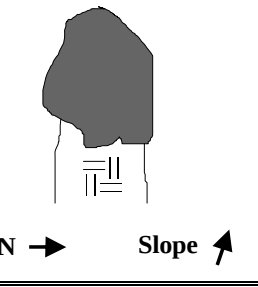
Feature #: **37**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **South**
Length (m): **9.0**	Width (m): **2.7**		
Height (m) (upslope): **0** (downslope): **1.0**	GPS Coordinates E: **0186225** N: **2181667**		
Description: **Approximately 500 small to large sized boulders and cobbles piled and stacked on eroding bedrock. There is a 2m alignment of slabs on the western portion of the feature.** **Probable planting feature.**		N ← Slope ↓	

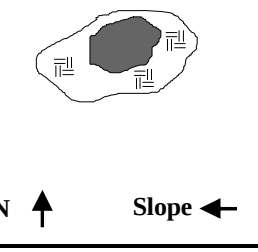
Feature #: **38**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **West**
Length (m): **2.0**	Width (m): **1.8**		
Height (m) (upslope): **.40** (downslope): **.40**	GPS Coordinates E: **0186202** N: **2181652**		
Description: **Approximately 15 small boulders piled in a crack in bedrock.** **Probable clearing feature.**		N ↑ Slope ↖	

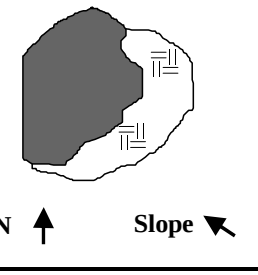
Feature #: **39**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **East**
Length (m): **6.8**	Width (m): **1.0**		
Height (m) (upslope): **0** (downslope): **1.0**	GPS Coordinates E: **0186192** N: **2181653**		
Description: **Approximately 2000 small boulders and cobbles piled on eroding bedrock. On the western portion there are lava blisters that have been filled in.** **Probable clearing feature.**		N ← Slope ↙	

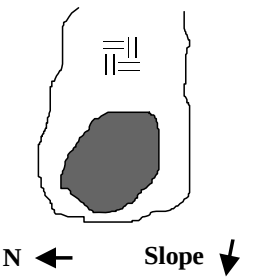
Feature #: **40**	Type: **Mound**	Plan view (not to scale)	View to: **North**
Length (m): **2.4**	Width (m): **1.5**		
Height (m) (upslope): **.30** (downslope): **.50**	GPS Coordinates E: **0186209** N: **2181658**		
Description: **Approximately 200 small to large sized piled cobbles.** **Probable clearing feature.**		N ← Slope ↙	

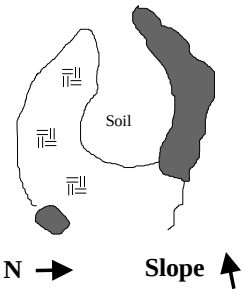
Feature #: **41**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **East**
Length (m): **4.0**	Width (m): **1.4**		
Height (m) (upslope): **.50** (downslope): **.75**	GPS Coordinates E: **0186201** N: **2181680**		
Description: **Approximately 800 small to large sized cobbles and boulders piled and loosely stacked on a bedrock outcrop.** **Probable clearing feature.**			

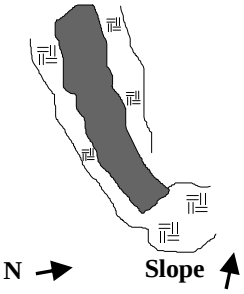
Feature #: **42**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **North**
Length (m): **2.5**	Width (m): **1.0**		
Height (m) (upslope): **0** (downslope): **.40**	GPS Coordinates E: **0186210** N: **2181684**		
Description: **Approximately 100 small to large sized cobbles and small boulders piled on bedrock.** **Probable clearing feature.**			

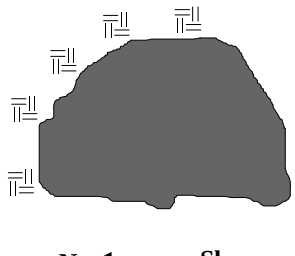
Feature #: **43**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **North**
Length (m): **1.5**	Width (m): **.80**		
Height (m) (upslope): **.30** (downslope): **.50**	GPS Coordinates E: **0186172** N: **2181673**		
Description: **Approximately 50 small to large sized cobbles loosely piled on bedrock.** **Probable clearing feature.**			

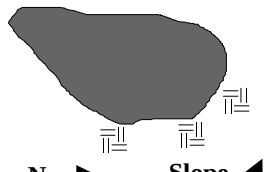
Feature #: **44**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **North**
Length (m): **1.7**	Width (m): **1.2**		
Height (m) (upslope): **.30** (downslope): **.70**	GPS Coordinates E: **0186168** N: **2181680**		
Description: **Approximately 60 small to large sized cobbles and boulders piled on a bedrock ground surface. Boulders form a rough alignment along *makai* edge with smaller cobbles piled behind them.** **Probable clearing feature.**			

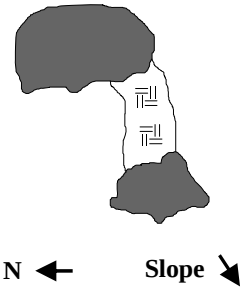
Feature #: **45**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **North**
Length (m): **1.0**	Width (m): **.80**		
Height (m) (upslope): **1.0** (downslope): **.90**	GPS Coordinates E: **0186173** N: **2181651**		
Description: **Approximately 10 small boulders piled on a bedrock outcrop.** **Probable clearing feature.**			

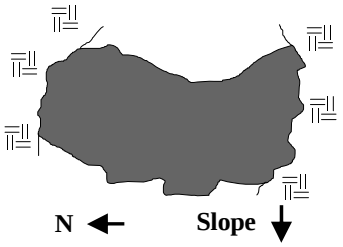
Feature #: **46**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **West**
Length (m): **5.3**	Width (m): **4.0**		No photo available
Height (m) (upslope): **.80** (downslope): **0**	GPS Coordinates E: **0186115** N: **2181667**		
Description: **Approximately 1000 small to large sized cobbles and boulders piled on bedrock to form an enclosure with soil to the west that borders bedrock.** **Probable clearing feature.**			

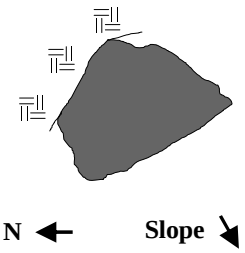
Feature #: **47**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **West**
Length (m): **8.0**	Width (m): **1.2**		
Height (m) (upslope): **.40** (downslope): **.50**	GPS Coordinates E: **0186120** N: **2181667**		
Description: **Approximately 1000 small to medium sized cobbles and boulders piled in a line on bedrock.** **Probable clearing feature.**			

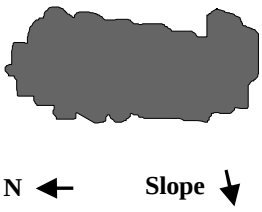
Feature #: **48**	Type: **Modified outcrop**	Plan view (not to scale)	View to **Northeast**
Length (m): **2.25**	Width (m): **2.0**		
Height (m) (upslope): **.10** (downslope): **1.0**	GPS Coordinates E: **0186115** N: **2181642**		
Description: **Approximately 150 small to large sized cobbles and boulders stacked against bedrock. The top of the feature consists of mostly cobbles.** **Probable clearing feature.**			

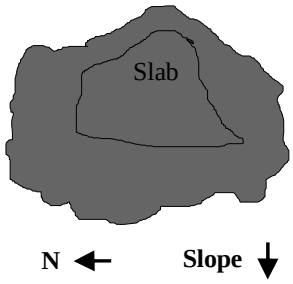
Feature #: **49**	Type: **Mound**	Plan view (not to scale)	View to: **East**
Length (m): **1.8**	Width (m): **.80**		
Height (m) (upslope): **.40** (downslope): **.40**	GPS Coordinates E: **0186108** N: **2181643**		
Description: **Approximately 100 small to large sized cobbles and boulders piled on bedrock. There are small cobbles filling the center of the feature.** **Probable clearing feature.**			

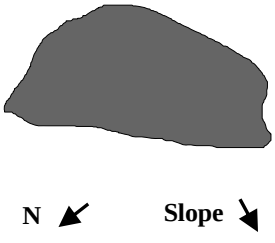
Feature #: **50**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **East**
Length (m): **3.0**	Width (m): **4.0**		No photo available
Height (m) (upslope): **.30** (downslope): **.50**	GPS Coordinates E: **0186150** N: **2181660**		
Description: **Approximately 250 medium to large sized cobbles and boulders piled on bedrock outcrop.** **Probable clearing feature.**			

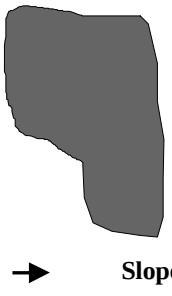
Feature #: **51**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **East**
Length (m): **3.0**	Width (m): **1.5**		No photo available
Height (m) (upslope): **.30** (downslope): **.40**	GPS Coordinates E: **0186143** N: **2181661**		
Description: **Approximately 100 small to large sized cobbles and boulders loosely stacked on bedrock.** **Probable clearing feature.**			

Feature #: **52**	Type: **Mound**	Plan view (not to scale)	View to: **South**
Length (m): **2.3**	Width (m): **2.0**		No photo available
Height (m) (upslope): **.20** (downslope): **1.0**	GPS Coordinates E: **0186130** N: **2181660**		
Description: **Approximately 150 small and medium sized cobbles and boulders stacked on bedrock.** **Probable clearing feature.**			

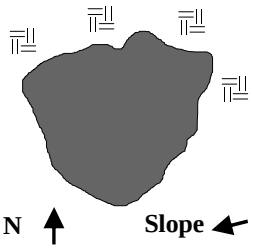
Feature #: **53**	Type: **Mound**	Plan view (not to scale)	View to: **East**
Length (m): **3.0**	Width (m): **1.4**		
Height (m) (upslope): **.50** (downslope): **.65**	GPS Coordinates E: **0186066** N: **2181830**		
Description: **Approximately 500 small to large sized cobbles and boulders neatly stacked.** **Probable clearing feature.**			

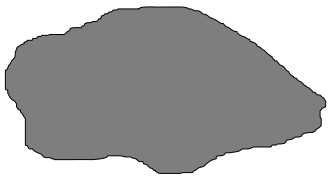
Feature #: **54**	Type: **Mound**	Plan view (not to scale)	View to: **Southeast**
Length (m): **1.10**	Width (m): **1.60**		
Height (m) (upslope): **.30** (downslope): **.50**	GPS Coordinates E: **0186068** N: **2181825**		
Description: **Approximately 150 small to large size stacked cobbles and boulders. There is a large slab on the top of the feature.** **Probable clearing feature.**			

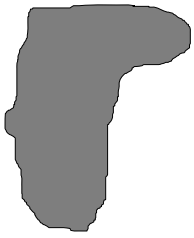
Feature #: **55**	Type: **Mound**	Plan view (not to scale)	View to: **Southeast**
Length (m): **2.0**	Width (m): **3.3**		
Height (m) (upslope): **.80** (downslope): **.40**	GPS Coordinates E: **0186063** N: **2181823**		
Description: **Approximately 250 small-to large sized cobbles and boulders neatly stacked on the edges.** **Probable clearing feature.**			

Feature #: **56**	Type: **Mound**		Plan view (not to scale)	View to: **West**
Length (m): **6.0**	Width (m): **2.8**			
Height (m) (upslope): **.60** (downslope): **.60**	GPS Coordinates	E: **0186062** N: **2181829**		
Description: **Approximately 1000 small to large sized stacked cobbles and boulders.** **Probable clearing feature.**				

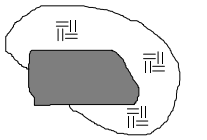
Feature #: **57**	Type: **Mound**		Plan view (not to scale)	View to: **South**
Length (m): **3.2**	Width (m): **2.8**			
Height (m) (upslope): **0** (downslope): **.60**	GPS Coordinates	E: **0186060** N: **2181823**		
Description: **Approximately 500 small and medium sized cobbles and boulders loosely piled on bedrock.** **Probable clearing feature.**				

Feature #: **58**	Type: **Modified outcrop**		Plan view (not to scale)	View to **Southeast**
Length (m): **1.4**	Width (m): **1.3**			
Height (m) (upslope): **0** (downslope): **.70**	GPS Coordinates	E: **0186064** N: **2181820**		
Description: **Approximately 50 small and large sized cobbles and boulders stacked against a bedrock outcrop.** **Probable clearing feature.**				

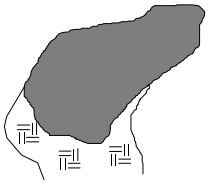
Feature #: **59**	Type: **Mound**		Plan view (not to scale)	View to **East**
Length (m): **4.0**	Width (m): **2.0**			
Height (m) (upslope): **.85** (downslope): **1.0**	GPS Coordinates	E: **0186075** N: **2181820**		
Description: **Approximately 500 small and large sized cobbles and boulders piled 8 courses high.** **Probable clearing feature.**				

Feature #: **60**	Type: **Modified outcrop**		Plan view (not to scale)	View to: **East**
Length (m): **9.0**	Width (m): **2.0**			
Height (m) (upslope): **0** (downslope): **.50**	GPS Coordinates	E: **0186050** N: **2181011**		
Description: **Approximately 200 small and large sized cobbles and boulders piled on bedrock.** **Probable clearing feature.**				

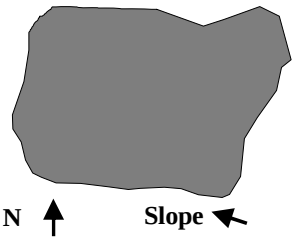
Feature #: **61**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **North**
Length (m): **1.6**	Width (m): **.90**		
Height (m) (upslope): **0** (downslope): **.70**	GPS Coordinates E: **0186067** N: **2181629**		
Description: **Approximately 60 small boulders loosely stacked on bedrock.** **Probable clearing feature.**			



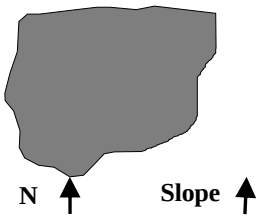
Feature #: **62**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Northeast**
Length (m): **2.3**	Width (m): **1.2**		
Height (m) (upslope): **.20** (downslope): **.60**	GPS Coordinates E: **0186065** N: **2181874**		
Description: **Approximately 50 small to large sized cobbles piled on a lave blister.** **Probable clearing feature.**			



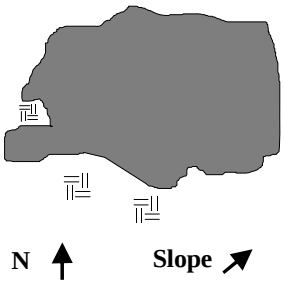
Feature #: **63**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **East**
Length (m): **4.0**	Width (m): **3.9**		
Height (m) (upslope): **.10** (downslope): **.50**	GPS Coordinates E: **0186075** N: **2181875**		
Description: **Approximately 400 small to large sized cobbles and boulders piled on bedrock.** **Probable clearing feature.**			



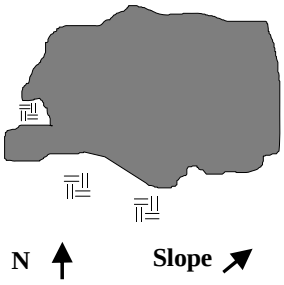
Feature #: **64**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Southeast**
Length (m): **4.0**	Width (m): **3.5**		
Height (m) (upslope): **0** (downslope): **.80**	GPS Coordinates E: **0186084** N: **2181869**		
Description: **Approximately 800 small and large sized cobbles neatly stacked. The northern portion is 4-5 courses high.** **Probable clearing feature.**			



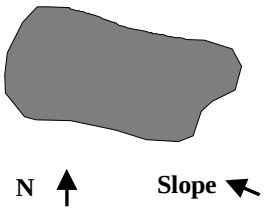
Feature #: **65**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **West**
Length (m): **1.6**	Width (m): **1.0**		
Height (m) (upslope): **0** (downslope): **.50**	GPS Coordinates E: **0186095** N: **2181860**		
Description: **Approximately 50 small boulders and 3 large slabs piled and stacked against bedrock.** **Probable clearing feature.**			



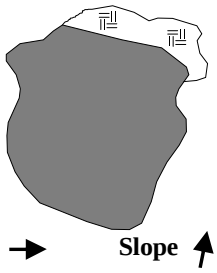
Feature #: **66**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Northeast**
Length (m): **3.3**	Width (m): **2.1**		
Height (m) (upslope): **.45** (downslope): **.70**	GPS Coordinates E: **0186132** N: **2181688**		
Description: **Approximately 200 small to large sized cobbles piled on bedrock outcrop.** **Probable clearing feature.**			



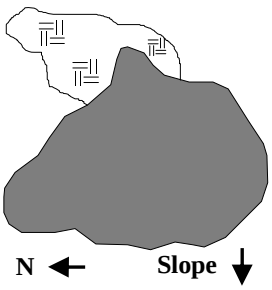
Feature #: **67**	Type: **Mound**	Plan view (not to scale)	View to: **North**
Length (m): **1.5**	Width (m): **2.0**		
Height (m) (upslope): **.60** (downslope): **.45**	GPS Coordinates E: **0186130** N: **2181710**		
Description: **Approximately 350 small and large sized cobbles loosely piled.** **Probable clearing feature.**			



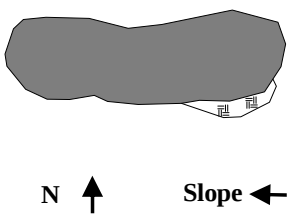
Feature #: **68**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Southeast**
Length (m): **2.0**	Width (m): **3.5**		
Height (m) (upslope): **0** (downslope): **.70**	GPS Coordinates E: **0186144** N: **2181706**		
Description: **Approximately 700 small and large sized cobbles piled on a bedrock outcrop.** **Probable clearing feature.**			



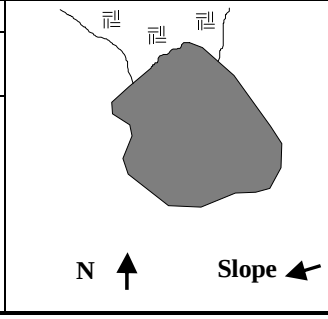
Feature #: **69**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **East**
Length (m): **2.2**	Width (m): **1.9**		
Height (m) (upslope): **0** (downslope): **.60**	GPS Coordinates E: **0186151** N: **2181713**		
Description: **Approximately 250 small and large sized cobbles piled on a bedrock outcrop.** **Probable clearing feature.**			



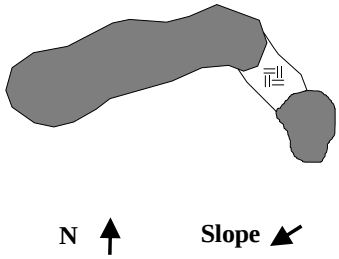
Feature #: **70**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **East**
Length (m): **2.5**	Width (m): **1.6**		
Height (m) (upslope): **0** (downslope): **.50**	GPS Coordinates E: **0186153** N: **2181736**		
Description: **Approximately 350 small to large sized cobbles piled on bedrock.** **Probable clearing feature.**			



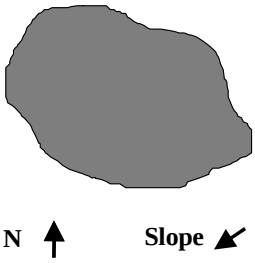
Feature #: **71**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **south**
Length (m): **1.0**	Width (m): **1.0**		
Height (m) (upslope): **0** (downslope): **.50**	GPS Coordinates E: **0186146** N: **2181731**		
Description: **Approximately 75 small to large sized cobbles piled on a bedrock outcrop.** **Probable clearing feature.**			



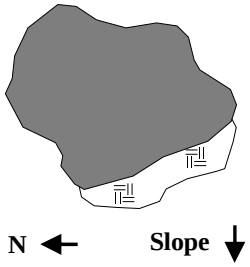
Feature #: **72**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **East**
Length (m): **4.5**	Width (m): **1.5**		
Height (m) (upslope): **.10** (downslope): **.75**	GPS Coordinates E: **0186139** N: **2181753**		
Description: **Approximately 600 small to large sized cobbles piled on a bedrock outcrop.** **Probable clearing feature.**			



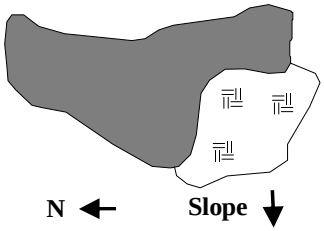
Feature #: **73**	Type: **Mound**	Plan view (not to scale)	View to: **Northeast**
Length (m): **2.5**	Width (m): **.70**		
Height (m) (upslope): **.50** (downslope): **.50**	GPS Coordinates E: **0186141** N: **2181754**		
Description: **Approximately 75 small to large sized cobbles piled on a level cobble ground surface.** **Probable clearing feature.**			

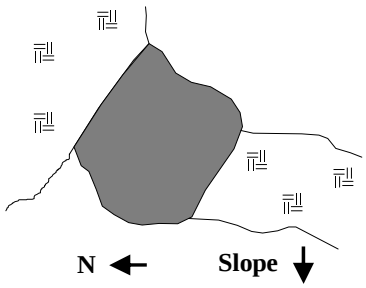


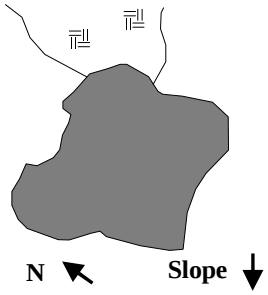
Feature #: **74**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **West**
Length (m): **2.5**	Width (m): **2**		
Height (m) (upslope): **0.45** (downslope): **.80**	GPS Coordinates E: **0186146** N: **2181753**		
Description: **Approximately 350 small to large sized cobbles and boulders piled on bedrock ground surface.** **Probable clearing feature.**			

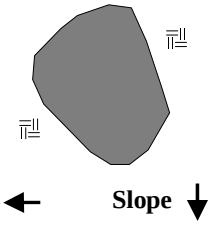


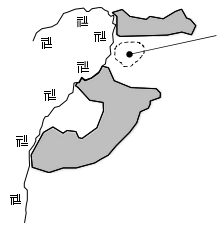
Feature #: **75**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Southeast**
Length (m): **2.4**	Width (m): **2**		
Height (m) (upslope): **0** (downslope): **.70**	GPS Coordinates E: **0186146** N: **2181745**		
Description: **Approximately 350 small to large sized piled against north side of a bedrock outcrop.** **Probable planting feature.**			

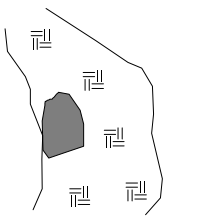


Feature #: **76**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **North**
Length (m): **1**	Width (m): **1**		
Height (m) (upslope): **.30** (downslope): **.60**	GPS Coordinates E: **0186145** N: **2181749**		
Description: **Approximately 60 small to large sized cobbles piled on bedrock ground surface.** **Probable clearing feature.**			

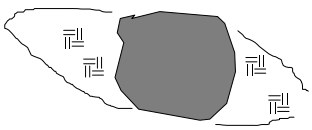
Feature #: **77**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **South**
Length (m): **3.5**	Width (m): **2**		
Height (m) (upslope): **.10** (downslope): **.70**	GPS Coordinates E: **0186140** N: **2181745**		
Description: **Approximately 400 small to large sized boulders and cobbles piled on a bedrock outcrop** **Probable planting feature.**			

Feature #: **78**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Southeast**
Length (m): **2.3**	Width (m): **3**		
Height (m) (upslope): **.10** (downslope): **.80**	GPS Coordinates E: **0186034** N: **2181805**		
Description: **Approximately 150 small boulders and cobbles piled on rubble and eroding bedrock.** **Probable clearing feature.**			

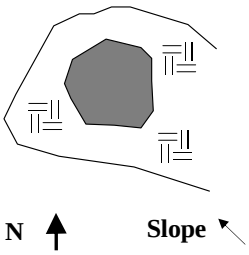
Feature #: **79**	Type: **Enclosure**	Plan view (not to scale)	View to: **Southeast**
Length (m): **5**	Width (m): **3**		
Height (m) (upslope): (downslope):	GPS Coordinates E: **0186134** N: **2181802**		
Description: **Consists of a 3 meter long wall composed of small and medium sized cobbles with soil on the *mauka* side, with a small 3 sided cobble enclosure just to the east. The south side of the enclosure is constructed up to a bedrock outcrop; the interior is a cobble-covered depression. Probable planting features.**			

Feature #: **80**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Northeast**
Length (m): **1.5**	Width (m): **.70**		
Height (m) (upslope): **.25** (downslope): **.50**	GPS Coordinates E: **0186074** N: **2181633**		
Description: **Approximately 25 small boulders and cobbles piled in crack in bedrock.** **Probable clearing feature.**			

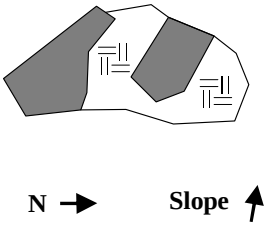
Feature #: **81**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **West**
Length (m): **2.8**	Width (m): **1.7**		
Height (m) (upslope): **.70** (downslope): **.75**	GPS Coordinates E: **0186071** N: **2181639**		
Description: **Approximately 400 small to large sized cobbles and boulders piled on a bedrock outcrop.** **Probable clearing feature.**			



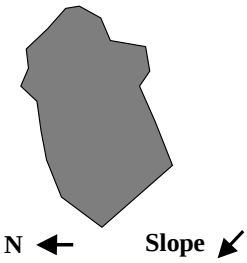
Feature #: **82**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Southwest**
Length (m): **1.4**	Width (m): **1.1**		
Height (m) (upslope): **.30** (downslope): **.50**	GPS Coordinates E: **0186071** N: **2181643**		
Description: **Approximately 80 small to large *pāhoehoe* cobbles piled on a bedrock outcrop.** **Probable planting feature.**			



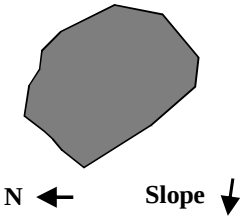
Feature #: **83**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Southeast**
Length (m): **2.5**	Width (m): **2.5**		
Height (m) (upslope): **.30** (downslope): **.30**	GPS Coordinates E: **0186074** N: **2181652**		
Description: **Approximately 300 small boulders and cobbles piled on a *pāhoehoe* bedrock outcrop with loose stacking along the western edge.** **Probable clearing feature.**			

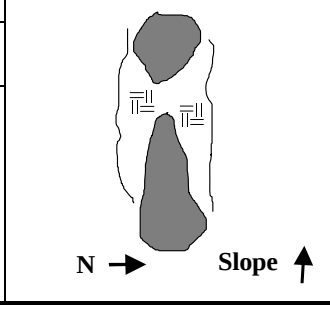


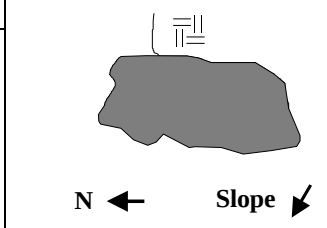
Feature #: **84**	Type: **Mound**	Plan view (not to scale)	View to: **Southwest**
Length (m): **2.3**	Width (m): **1.2**		
Height (m) (upslope): **.30** (downslope): **.40**	GPS Coordinates E: **0186081** N: **2181647**		
Description: **Approximately 100 cobbles of various sizes piled on soil ground surface.** **Probable clearing feature.**			

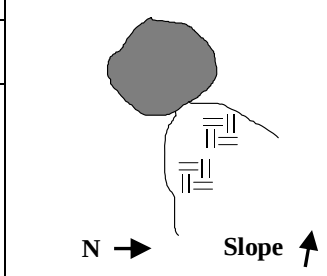


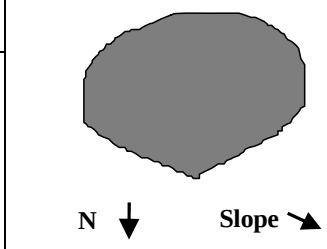
Feature #: **85**	Type: **Mound**	Plan view (not to scale)	View to: **North**
Length (m): **1.8**	Width (m): **1.5**		
Height (m) (upslope): **.20** (downslope): **.45**	GPS Coordinates E: **0186081** N: **2181643**		
Description: **Approximately 300 cobbles on the *mauka* side of a line of small boulders along the *makai* edge.** **Probable clearing feature.**			

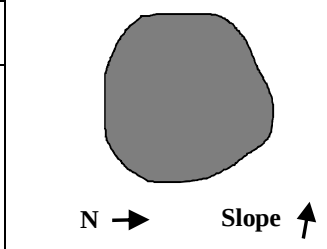


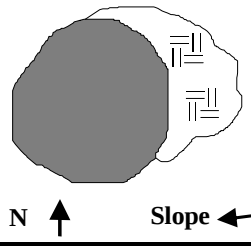
Feature #: **86**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Southeast**
Length (m): **4.2**	Width (m): **.80**		
Height (m) (upslope): (downslope):	GPS Coordinates E: **0186064** N: **2181661**		
Description: **Approximately 100 small boulders and slabs piled on a *pāhoehoe* bedrock outcrop.** **Probable clearing feature.**			

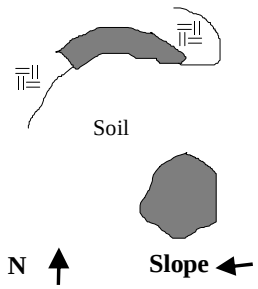
Feature #: **87**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **West**
Length (m): **3.2**	Width (m): **2.9**		
Height (m) (upslope): **.20** (downslope): **.50**	GPS Coordinates E: **0186050** N: **2181639**		
Description: **Approximately 250 small boulders piled adjacent to and on *pāhoehoe* bedrock.** **Probable planting feature.**			

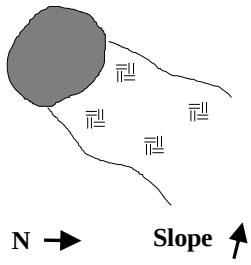
Feature #: **88**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **West**
Length (m): **1.8**	Width (m): **1.8**		
Height (m) (upslope): **.50** (downslope): **.50**	GPS Coordinates E: **0186012** N: **2181621**		
Description: **Approximately 200 small boulders and cobbles piled on eroding rubble and *pāhoehoe* bedrock outcrop.** **Probable clearing feature.**			

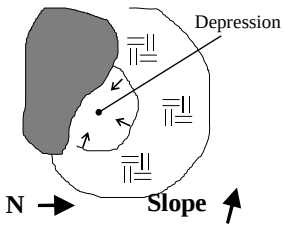
Feature #: **89**	Type: **Mound**	Plan view (not to scale)	View to: **Northwest**
Length (m): **2.3**	Width (m): **2**		
Height (m) (upslope): **.20** (downslope): **.40**	GPS Coordinates E: **0186003** N: **2181619**		
Description: **Approximately 300 piled small cobbles on top of natural rubble and bedrock.** **Probable clearing feature.**			

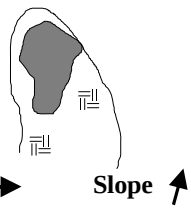
Feature #: **90**	Type: **Mound**	Plan view (not to scale)	View to: **Northeast**
Length (m): **1.7**	Width (m): **1.7**		
Height (m) (upslope): **.40** (downslope): **.50**	GPS Coordinates E: **0186209** N: **2181658**		
Description: **Approximately 200 small to large sized *pāhoehoe* cobbles on natural rubble ground surface.** **Probable clearing feature.**			

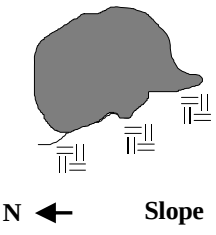
Feature #: **91**	Type: **Mound**		Plan view (not to scale)	View to: **Southeast**
Length (m): **1.5**	Width (m): **1.5**			
Height (m) (upslope): **.30** (downslope): **.70**	GPS Coordinates	E: **0185902** N: **2181691**		
Description: **Approximately 300 small to large sized cobbles and small boulders piled on an eroding bedrock outcrop and natural rubble.** **Probable clearing feature.**				

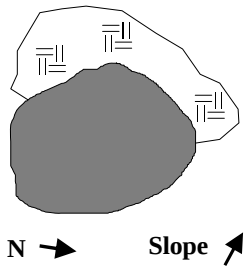
Feature #: **92**	Type: **Modified outcrop**		Plan view (not to scale)	View to: **East**
Length (m): **3**	Width (m): **3**			
Height (m) (upslope): **.40** (downslope): **.40**	GPS Coordinates	E: **0185897** N: **2181683**		
Description: **Approximately 30 boulders, slabs, and cobbles piled on a cobble-covered slope; a possible planting area is to the south.** **Probable planting feature.**				

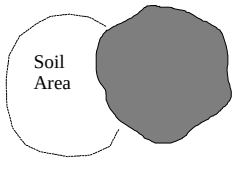
Feature #: **93**	Type: **Modified outcrop**		Plan view (not to scale)	View to: **North**
Length (m): **1.8**	Width (m): **1.3**			
Height (m) (upslope): **.15** (downslope): **.44**	GPS Coordinates	E: **0186098** N: **2181679**		
Description: **Approximately 7 small boulders 1-course tall on the perimeter on top of bedrock, with approximately 50 cobbles filling the interior.** **Probable clearing feature.**				

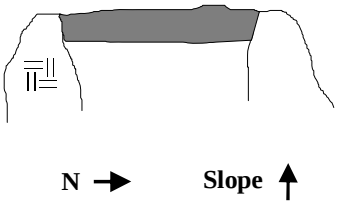
Feature #: **94**	Type: **Modified outcrop**		Plan view (not to scale)	View to: **North**
Length (m): **2.6**	Width (m): **2.2**			
Height (m) (upslope): **.30** (downslope): **.90**	GPS Coordinates	E: **0186108** N: **2181692**		
Description: **Approximately 500 *pāhoehoe* cobbles and small boulders piled on bedrock. A depression is located between bedrock and modification that may have been for planting.** **Probable clearing feature.**				

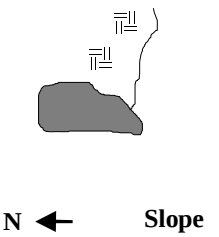
Feature #: **95**	Type: **Modified outcrop**		Plan view (not to scale)	View to: **North**
Length (m): **2.6**	Width (m): **1.2**			
Height (m) (upslope): **0** (downslope): **1.10**	GPS Coordinates	E: **0186112** N: **2181702**		
Description: **Approximately 130 small boulders and cobbles of various sizes piled loosely on bedrock.** **Probable clearing feature.**				

Feature #: **96**	Type: **Pit**	Plan view (not to scale)	View to: **Northeast**
Length (m): **3.8**	Width (m): **4**		
Height (m) (upslope): **.90** (downslope): **.70**	GPS Coordinates E: **0186111** N: **2181679**		
Description: **A depression that was possibly excavated into the crumbling, eroding *ʻāʻa* bedrock. The interior floor of the depression is level.** **Probable planting feature.**			

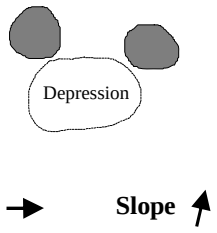
Feature #: **97**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Northeast**
Length (m): **6**	Width (m): **4.2**		
Height (m) (upslope): **.80** (downslope): **.30**	GPS Coordinates E: **0186082** N: **2181682**		
Description: **Approximately 2000+ various sized cobbles piled against the *makai* side of a bedrock outcrop** **Probable clearing feature.**			

Feature #: **98**	Type: **Mound**	Plan view (not to scale)	View to: **Northeast**
Length (m): **3.6**	Width (m): **3.5**		
Height (m) (upslope): **.30** (downslope): **.90**	GPS Coordinates E: **0186076** N: **2181681**		
Description: **Approximately 2000 loosely piled small boulders and cobbles just north of a possible planting soil area.** **Probable clearing and planting feature.**			

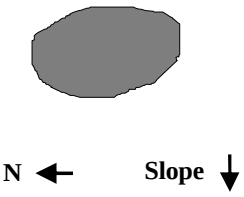
Feature #: **99**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **North**
Length (m): **4**	Width (m): **1.5**		
Height (m) (upslope): **.10** (downslope): **.25**	GPS Coordinates E: **0186041** N: **2181656**		
Description: **Consists of a low linear pile of cobbles that extend between two bedrock outcrop formations forming a terrace.** **Probable planting feature.**			

Feature #: **100**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **North**
Length (m): **3**	Width (m): **1.5**		
Height (m) (upslope): **0** (downslope): **.70**	GPS Coordinates E: **0186027** N: **2181659**		
Description: **Approximately 800, piled small to large sized piled cobbles and small boulders on bedrock.** **Probable clearing feature.**			

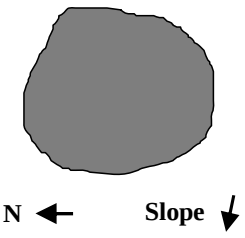
Feature #: **101**	Type: **Pit**	Plan view (not to scale)	View to: **Southeast**
Length (m): **5**	Width (m): **2.2**		
Height (m) (upslope): **0** (downslope): **.70**	GPS Coordinates E: **0186011** N: **2181647**		
Description: **Consists of a possible planting depression (3 meters x 1 meter) *mauka* of 2 clearing piles composed of approximately 2000 small boulders and cobbles.** **Probable planting feature.**			



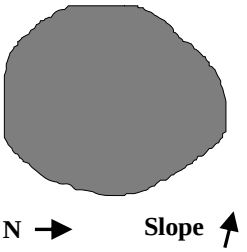
Feature #: **102**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Northeast**
Length (m): **5.5**	Width (m): **5**		
Height (m) (upslope): **0** (downslope): **.90**	GPS Coordinates E: **0186000** N: **2181651**		
Description: **Approximately 1000+ cobbles with small boulders on the *makai* edge of the feature. The top of the feature is fairly level and composed of cobbles and soil.** **Probable planting feature.**			



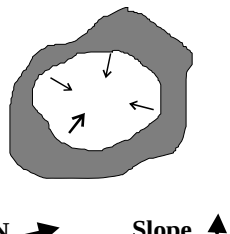
Feature #: **103**	Type: **Mound**	Plan view (not to scale)	View to: **Southeast**
Length (m): **1**	Width (m): **.90**		
Height (m) (upslope): **.30** (downslope): **.50**	GPS Coordinates E: **0186003** N: **2181661**		
Description: **A pile of approximately 80 cobbles and small boulders.** **Probable clearing feature.**			



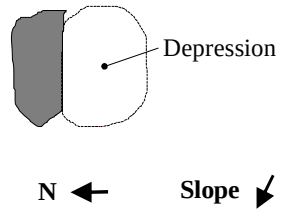
Feature #: **104**	Type: **Mound**	Plan view (not to scale)	View to: **West**
Length (m): **1.8**	Width (m): **1.5**		
Height (m) (upslope): **.50** (downslope): **.70**	GPS Coordinates E: **0186002** N: **2181660**		
Description: **Approximately 700 piled *pāhoehoe* cobbles on soil.** **Probable clearing feature.**			



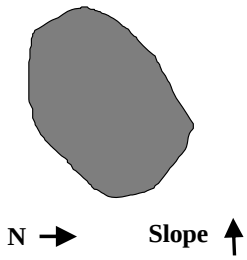
Feature #: **105**	Type: **Pit**	Plan view (not to scale)	View to: **East**
Length (m): **4**	Width (m): **5**		
Height (m) (upslope): **.90** (downslope): **0**	GPS Coordinates E: **0186010** N: **2181659**		
Description: **Possible *pāhoehoe* excavation with excavated cobbles placed around the depression's edge. The interior floor is .09 meter deep and covered with cobbles.** **Probable planting feature.**			



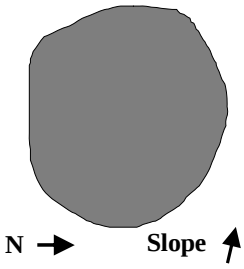
Feature #: **106**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Southeast**
Length (m): **3.5**	Width (m): **3**		
Height (m) (upslope): **.75** (downslope): **0**	GPS Coordinates E: **0186013** N: **2181670**		
Description: **Consists of slabs and small boulders loosely stacked with smaller cobble fill. A possible planting depression is just south of the modified outcrop.** **Probable clearing and planting feature.**			



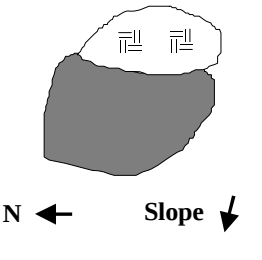
Feature #: **107**	Type: **Mound**	Plan view (not to scale)	View to: **East**
Length (m): **1.7**	Width (m): **1.2**		
Height (m) (upslope): **.40** (downslope): **.60**	GPS Coordinates E: **0186009** N: **2181669**		
Description: **Approximately 200 piled small boulders and cobbles on soil.** **Probable clearing feature.**			



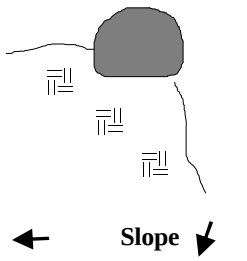
Feature #: **108**	Type: **Mound**	Plan view (not to scale)	View to: **Northwest**
Length (m): **3**	Width (m): **2.5**		
Height (m) (upslope): **1.2** (downslope): **1.4**	GPS Coordinates E: **0186004** N: **2181671**		
Description: **Approximately 3000 piled small boulders and cobbles on soil.** **Probable clearing feature.**			



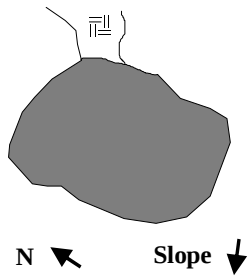
Feature #: **109**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Northwest**
Length (m): **2**	Width (m): **1.8**		
Height (m) (upslope): **.40** (downslope): **.60**	GPS Coordinates E: **0186009** N: **2181663**		
Description: **Approximately 300 various sized cobbles piled on bedrock.** **Probable clearing feature.**			



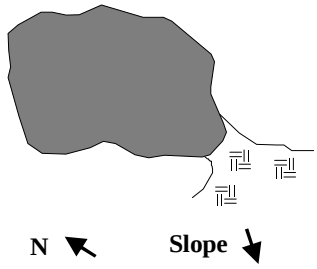
Feature #: **110**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **North**
Length (m): **2**	Width (m): **1.5**		
Height (m) (upslope): **.50** (downslope): **.75**	GPS Coordinates E: **0186014** N: **2181671**		
Description: **Approximately 500 cobbles of various sizes piled on bedrock.** **Probable clearing feature.**			



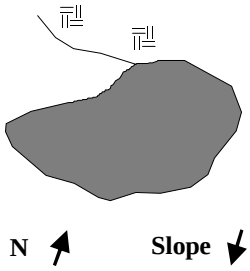
Feature #: **111**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **North**
Length (m): **2.6**	Width (m): **2.1**		
Height (m) (upslope): **.40** (downslope): **1**	GPS Coordinates E: **0186003** N: **2181665**		
Description: **Approximately 400 cobbles piled on bedrock with loose stacking on the southwest side.** **Probable clearing feature.**			



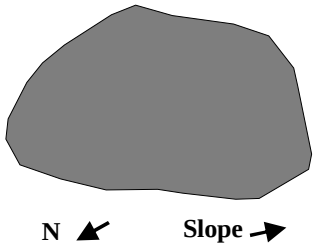
Feature #: **112**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **North**
Length (m): **2.5**	Width (m): **2**		
Height (m) (upslope): **.80** (downslope): **1.2**	GPS Coordinates E: **0186005** N: **2181679**		
Description: **A pile of approximately 800 various sized cobbles piled on bedrock.** **Probable clearing feature.**			



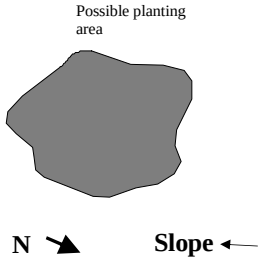
Feature #: **113**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **East**
Length (m): **3**	Width (m): **2.2**		
Height (m) (upslope): **.45** (downslope): **.30**	GPS Coordinates E: **0186000** N: **2181674**		
Description: **Approximately 750 small to large cobbles piled on a bedrock outcrop.** **Probable clearing feature.**			

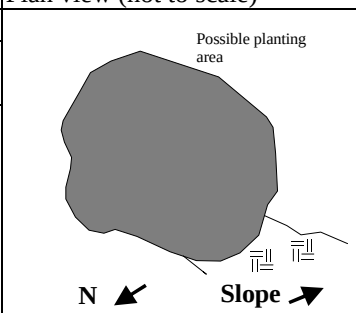


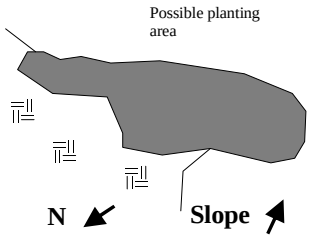
Feature #: **114**	Type: **Mound**	Plan view (not to scale)	View to: **Northeast**
Length (m): **2.7**	Width (m): **2**		
Height (m) (upslope): **.90** (downslope): **1.1**	GPS Coordinates E: **0185997** N: **2181686**		
Description: **Consists of a large mound composed of approximately 1500+ cobbles. All edges are stacked with medium and large cobbles and small cobbles fill in the center. A ramp-like slope is located in the southwest corner.** **Probable clearing feature.**			

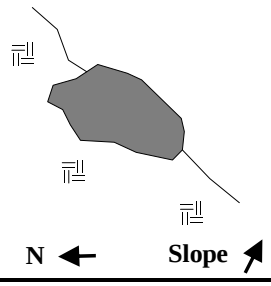


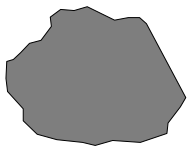
Feature #: **115**	Type: **Mound**	Plan view (not to scale)	View to: **West**
Length (m): **3.2**	Width (m): **2.2**		
Height (m) (upslope): **.40** (downslope): **.65**	GPS Coordinates E: **0185986** N: **2181681**		
Description: **Approximately 475 cobbles piled on soil ground surface with a possible planting area to the west.** **Probable clearing feature.**			

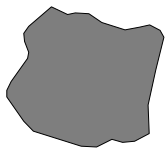


Feature #: **116**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **South**
Length (m): **3**	Width (m): **3**		
Height (m) (upslope): **.40** (downslope): **1.2**	GPS Coordinates E: **0186012** N: **2181682**		
Description: **Approximately 2000 small to large cobbles stacked in places, constructed on a bedrock outcrop.** **Probable clearing feature.**			

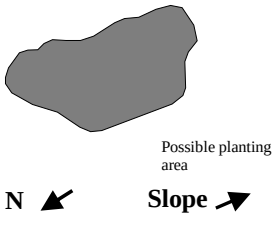
Feature #: **117**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **West**
Length (m): **6.6**	Width (m): **3.2**		
Height (m) (upslope): **0** (downslope): **.80**	GPS Coordinates E: **0186006** N: **2181682**		
Description: **Approximately 3000 cobbles piled up against the southeastern side of a bedrock outcrop. A possible planting area is located to the south.** **Probable clearing feature.**			

Feature #: **118**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **North**
Length (m): **1.6**	Width (m): **1.2**		
Height (m) (upslope): **.40** (downslope): **.80**	GPS Coordinates E: **0186019** N: **2181676**		
Description: **Approximately 200 small to large sized cobbles piled on bedrock.** **Probable clearing feature.**			

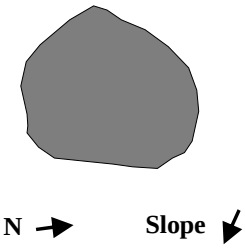
Feature #: **119**	Type: **Mound**	Plan view (not to scale)	View to: **South**
Length (m): **2.2**	Width (m): **1.8**		
Height (m) (upslope): **.50** (downslope): **.30**	GPS Coordinates E: **0186028** N: **2181685**		
Description: **Approximately 350 cobbles of various sizes piled on soil ground surface.** **Probable clearing feature.**			

Feature #: **120**	Type: **Mound**	Plan view (not to scale)	View to: **North**
Length (m): **2**	Width (m): **2.1**		
Height (m) (upslope): **.60** (downslope): **.20**	GPS Coordinates E: **0186033** N: **2181687**		
Description: **Approximately 400 cobbles of various sizes piled on soil ground surface.** **Probable clearing feature.**			

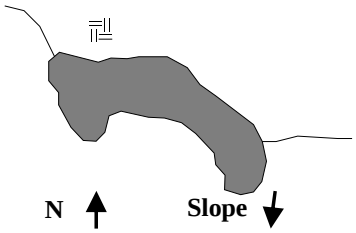
Feature #: **121**	Type: **Mound**	Plan view (not to scale)	View to: **East**
Length (m): **2**	Width (m): **1.6**		
Height (m) (upslope): **.20** (downslope): **.60**	GPS Coordinates E: **0186064** N: **2181698**		
Description: **A pile of approximately 275 small to large cobbles on soil ground surface.** **Probable clearing feature.**			



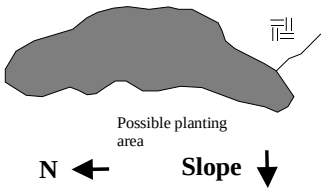
Feature #: **122**	Type: **Mound**	Plan view (not to scale)	View to: **Northwest**
Length (m): **1.8**	Width (m): **2**		
Height (m) (upslope): **.10** (downslope): **.70**	GPS Coordinates E: **0186058** N: **2181688**		
Description: **Approximately 400 cobbles of various sizes piled on soil ground surface.** **Probable clearing feature.**			



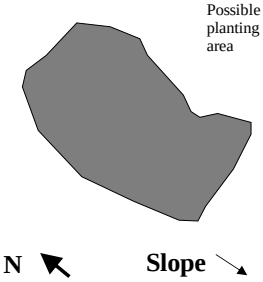
Feature #: **123**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **East**
Length (m): **2**	Width (m): **1.2**		
Height (m) (upslope): **.20** (downslope): **.80**	GPS Coordinates E: **0186084** N: **2181703**		
Description: **Approximately 150 *pāhoehoe* cobbles piled against a bedrock outcrop.** **Probable clearing feature.**			



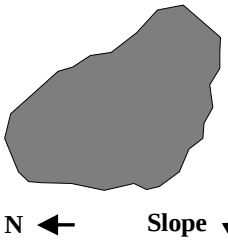
Feature #: **124**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Southeast**
Length (m): **3**	Width (m): **1.5**		
Height (m) (upslope): **0** (downslope): **.85**	GPS Coordinates E: **0186080** N: **2181711**		
Description: **Approximately 800 cobbles of various sizes piled against a bedrock outcrop; a possible planting area is located to the west.** **Probable clearing feature and possible planting feature.**			



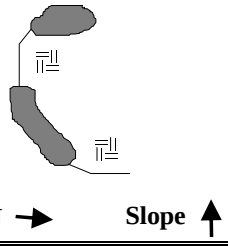
Feature #: **125**	Type: **Mound**	Plan view (not to scale)	View to: **East**
Length (m): **1.9**	Width (m): **1.5**		
Height (m) (upslope): **.55** (downslope): **.50**	GPS Coordinates E: **0186061** N: **2181732**		
Description: **Approximately 400 various sized cobbles piled on soil ground surface.** **Probable clearing feature.**			



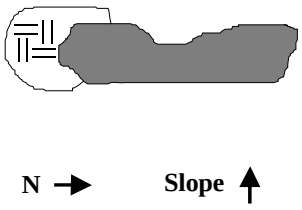
Feature #: **126**	Type: **Mound**	Plan view (not to scale)	View to: **East**
Length (m): **2.4**	Width (m): **1.8**		
Height (m) (upslope): **.60** (downslope): **.30**	GPS Coordinates E: **0186064** N: **2181724**		
Description: **Approximately 475 various sized cobbles piled on soil.** **Probable clearing feature.**			



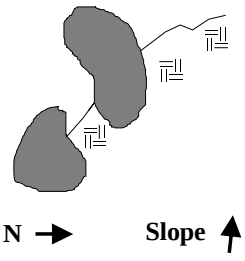
Feature #: **127**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **East**
Length (m): **6.5**	Width (m): **3.5**		
Height (m) (upslope): **.70** (downslope): **.70**	GPS Coordinates E: **0186090** N: **2181714**		
Description: **Approximately 500 cobbles and small boulders piled on the edge of a *pāhoehoe* outcrop.** **Probable clearing feature.**			



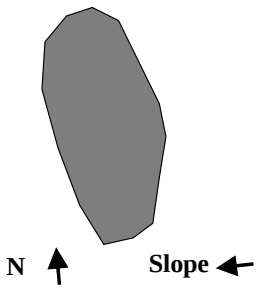
Feature #: **128**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **South**
Length (m): **3.5**	Width (m): **.90**		
Height (m) (upslope): **.40** (downslope): **.50**	GPS Coordinates E: **0186090** N: **2181710**		
Description: **Approximately 200 small boulders and cobbles piled on bedrock.** **Probable clearing feature.**			



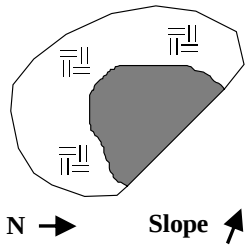
Feature #: **129**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Northeast**
Length (m): **3.5**	Width (m): **1.5**		
Height (m) (upslope): **0** (downslope): **.90**	GPS Coordinates E: **0186088** N: **2181723**		
Description: **Consists of piled small boulders and cobbles on a bedrock outcrop.** **Probable clearing feature.**			



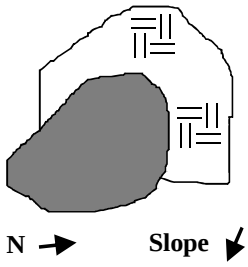
Feature #: **130**	Type: **Mound**	Plan view (not to scale)	View to: **Northeast**
Length (m): **3.5**	Width (m): **1.9**		
Height (m) (upslope): **.60** (downslope): **.80**	GPS Coordinates E: **0186082** N: **2181757**		
Description: **Consists of stacked small boulders and large cobbles on the periphery, with small cobbles filling in the interior.** **Probable clearing feature.**			



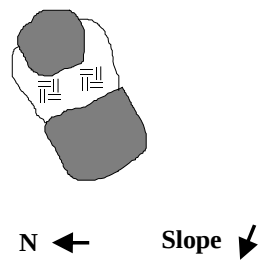
Feature #: **131**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Southeast**
Length (m): **2.5**	Width (m): **2**		
Height (m) (upslope): **.60** (downslope): **.80**	GPS Coordinates E: **0186062** N: **2181773**		
Description: **Consists of small boulders loosely stacked on the north edge, with smaller cobbles piled inside on bedrock.** **Probable clearing feature.**			



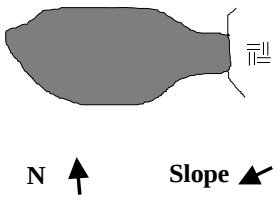
Feature #: **132**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **South**
Length (m): **3.5**	Width (m): **1.5**		
Height (m) (upslope): **.60** (downslope): **.40**	GPS Coordinates E: **0186071** N: **2181771**		
Description: **Consists of small boulders loosely stacked on the north edge, with smaller cobbles piled inside on bedrock.** **Probable clearing feature.**			



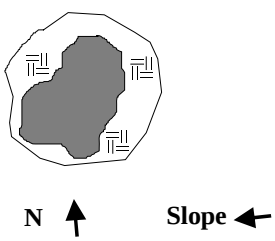
Feature #: **133**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Southeast**
Length (m): **5.5**	Width (m): **2.2**		
Height (m) (upslope): **.05** (downslope): **.60**	GPS Coordinates E: **0186073** N: **2181770**		
Description: **Consists of stacked small boulders on the east, north, and west side of a bedrock outcrop with small cobbles filling in the center on bedrock.** **Probable clearing feature.**			



Feature #: **134**	Type: **Mound**	Plan view (not to scale)	View to: **East**
Length (m): **4.3**	Width (m): **2.3**		
Height (m) (upslope): **.30** (downslope): **.60**	GPS Coordinates E: **0185096** N: **2181796**		
Description: **Consists of a mound with a level top surface composed of small to medium sized cobbles with large cobbles piled along the north edge.** **Probable clearing feature.**			



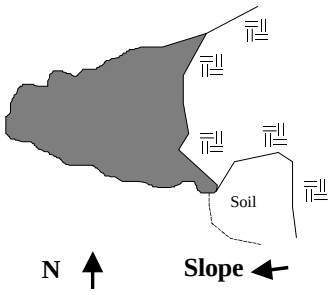
Feature #: **135**	Type: **Mound**	Plan view (not to scale)	View to: **Southeast**
Length (m): **1.1**	Width (m): **.85**		
Height (m) (upslope): **.20** (downslope): **.60**	GPS Coordinates E: **0186001** N: **2181786**		
Description: **Consists of approximately 20 small boulders, and small to large cobbles piled on exposed *pāhoehoe* bedrock.** **Probable clearing feature.**			



Feature #: **136**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **West**
Length (m): **2.2**	Width (m): **1.7**		
Height (m) (upslope): **0** (downslope): **.20**	GPS Coordinates E: **0186033** N: **2181760**		

Description: **Consists of cobbles piled up on the *makai* side of a bedrock outcrop. The surface slopes to the west and is composed of small and medium sized cobbles. A probable planting area is located to the south.**

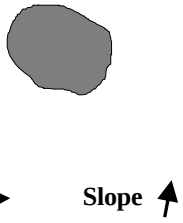
Probable clearing feature with adjacent planting feature.



Feature #: **137**	Type: **Mound**	Plan view (not to scale)	View to: **Northeast**
Length (m): **2.6**	Width (m): **2**		
Height (m) (upslope): **.50** (downslope): **.60**	GPS Coordinates E: **0186084** N: **2181876**		

Description: **Approximately 800 cobbles and small boulders piled on natural rubble covered ground surface.**

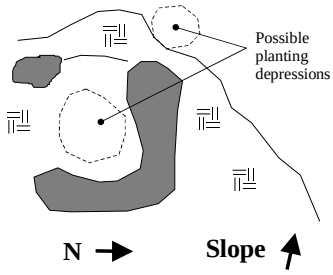
Probable clearing feature.



Feature #: **138**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **East**
Length (m): **5**	Width (m): **3.5**		
Height (m) (upslope): **.40** (downslope): **.50**	GPS Coordinates E: **0186052** N: **2181845**		

Description: **Consists of loosely aligned boulders and cobbles piled on the north and east sides of a bedrock outcrop. Two planting depressions are located in the center of the clearing pile, and northwest of the feature.**

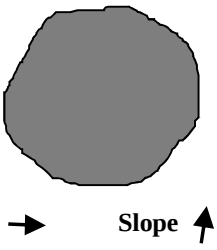
Probable clearing and planting feature.



Feature #: **139**	Type: **Mound**	Plan view (not to scale)	View to: **Northeast**
Length (m): **2.3**	Width (m): **2.3**		
Height (m) (upslope): **.30** (downslope): **.40**	GPS Coordinates E: **0186052** N: **2181850**		

Description: **Consists of approximately 300 cobbles and small boulders piled on natural cobble-covered ground surface.**

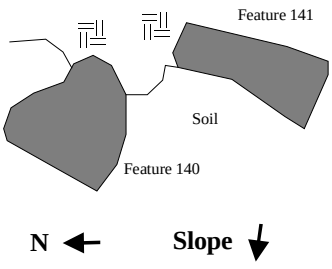
Probable clearing feature.

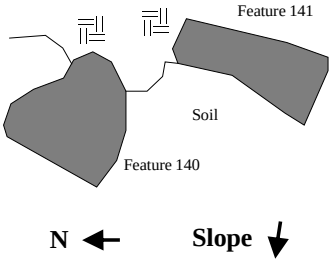


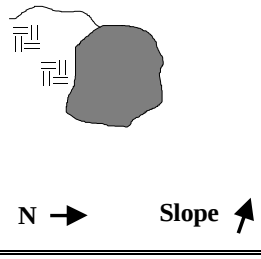
Feature #: **140**	Type: **Mound**	Plan view (not to scale)	View to: **Southeast**
Length (m): **2.5**	Width (m): **2.5**		
Height (m) (upslope): **.35** (downslope): **.70**	GPS Coordinates E: **0186053** N: **2181840**		

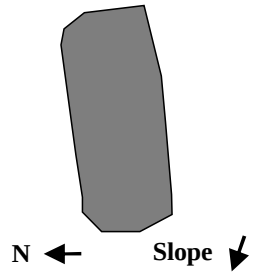
Description: **Consists of neatly stacked slabs and small boulders 2-4 courses tall on the edges, with small cobbles filling in the center. A soil area that may have been for planting is located to the south.**

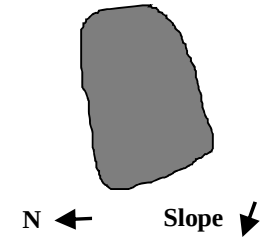
Probable clearing feature.

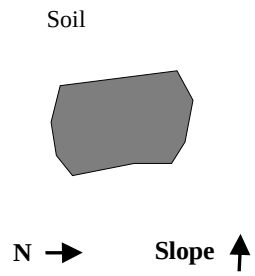


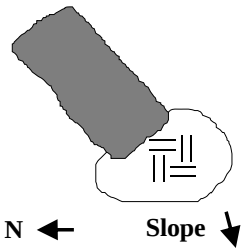
Feature #: **141**	Type: **Mound**	Plan view (not to scale)	View to: **South**
Length (m): **4**	Width (m): **2**		
Height (m) (upslope): **.40** (downslope): **1.1**	GPS Coordinates E: **0186053** N: **2181840**		
Description: **Consists of neatly stacked slabs and small boulders 3-6 courses tall on the edges, with small cobbles filling in the center. A soil area that may have been for planting is located to the east.** **Probable planting feature.**			

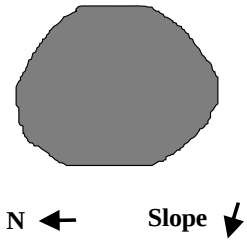
Feature #: **142**	Type: **Mound**	Plan view (not to scale)	View to: **Northeast**
Length (m): **2.2**	Width (m): **1.7**		
Height (m) (upslope): **.30** (downslope): **.50**	GPS Coordinates E: **0186046** N: **2181830**		
Description: **Consists of slabs, boulders, and cobbles piled in a square on *pāhoehoe* bedrock.** **Probable clearing feature.**			

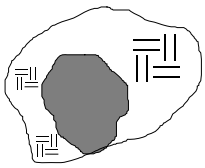
Feature #: **143**	Type: **Mound**	Plan view (not to scale)	View to: **Southeast**
Length (m): **2.6**	Width (m): **1.2**		
Height (m) (upslope): **.30** (downslope): **.60**	GPS Coordinates E: **0186046** N: **2181828**		
Description: **Consists of small boulders and slabs neatly stacked 2-3 courses high on the periphery with small cobbles filling in the interior.** **Probable clearing feature.**			

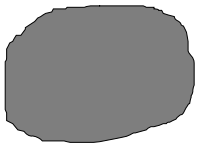
Feature #: **144**	Type: **Mound**	Plan view (not to scale)	View to: **East**
Length (m): **1.8**	Width (m): **1.2**		
Height (m) (upslope): **.60** (downslope): **.80**	GPS Coordinates E: **0186047** N: **2181827**		
Description: **Consists of small boulders and slabs neatly stacked 2-3 courses high on the periphery with small cobbles filling in the interior.** **Probable clearing feature.**			

Feature #: **145**	Type: **Mound**	Plan view (not to scale)	View to: **Northeast**
Length (m): **2.5**	Width (m): **1.5**		
Height (m) (upslope): **0** (downslope): **.70**	GPS Coordinates E: **0186056** N: **2181835**		
Description: **Consists of small boulders and slabs neatly stacked on the western side with the center filled in with small cobbles; the eastern end is level to bedrock.** **Probable clearing feature.**			

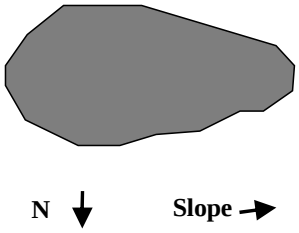
Feature #: **146**	Type: **Mound**		Plan view (not to scale)	View to: **Southeast**
Length (m): **2.5**	Width (m): **1.3**			
Height (m) (upslope): **.40** (downslope): **.40**	GPS Coordinates	E: **0186059** N: **2181832**		
Description: **Consists of 3-courses of small boulders and slabs neatly stacked on the edges; the center is filled in with small cobbles; the southwestern end tapers down to bedrock.** **Probable clearing feature.**				

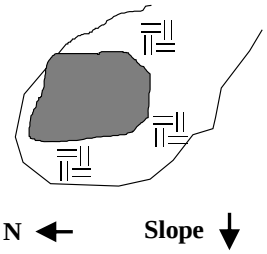
Feature #: **147**	Type: **Mound**		Plan view (not to scale)	View to: **East**
Length (m): **1.7**	Width (m): **1.7**			
Height (m) (upslope): **.70** (downslope): **1**	GPS Coordinates	E: **0186062** N: **2181837**		
Description: **Consists of large cobbles neatly stacked in a circle 5-6 courses tall with small cobbles filling in the interior.** **Probable clearing feature.**				

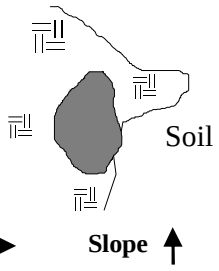
Feature #: **148**	Type: **Modified outcrop**		Plan view (not to scale)	View to: **East**
Length (m): **.90**	Width (m): **.90**			
Height (m) (upslope): **.30** (downslope): **.50**	GPS Coordinates	E: **0186059** N: **2181839**		
Description: **Approximately 15 (3 slabs and 12 cobbles) stacked on a bedrock outcrop.** **Probable clearing feature.**				

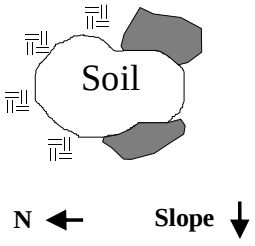
Feature #: **149**	Type: **Mound**		Plan view (not to scale)	View to: **North**
Length (m): **1.6**	Width (m): **1.3**			
Height (m) (upslope): **.50** (downslope): **.50**	GPS Coordinates	E: **0186066** N: **2181836**		
Description: **Consists of stacked small boulders on the periphery 1-3 courses tall, with small cobbles filling the interior.** **Probable clearing feature.**				

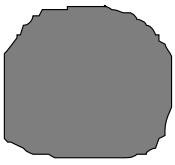
Feature #: **150**	Type: **Mound**		Plan view (not to scale)	View to: **Northeast**
Length (m): **2.3**	Width (m): **.90**			
Height (m) (upslope): **.60** (downslope): **.60**	GPS Coordinates	E: **0186068** N: **2181844**		
Description: **Consists of neatly stacked small slabs and cobbles around the periphery with small cobbles filling the interior.** **Probable clearing feature.**				

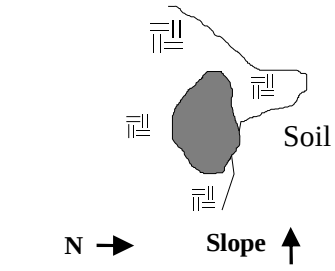
Feature #: **151**	Type: **Mound**	Plan view (not to scale)	View to: **Southeast**
Length (m): **4**	Width (m): **2**		
Height (m) (upslope): **.40** (downslope): **.65**	GPS Coordinates E: **0186043** N: **2181814**		
Description: **Consists of small boulders and large cobbles neatly stacked on the edges 1-3 courses, with small cobbles filling in the interior. Possible planting areas are located to the north and south.** **Probable clearing feature.**			

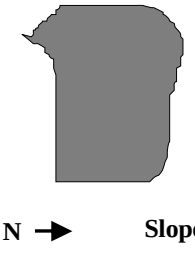
Feature #: **152**	Type: **Mound**	Plan view (not to scale)	View to: East/**Southeast**
Length (m): **1.**	Width (m): **1.4**		
Height (m) (upslope): **.40** (downslope): **.40**	GPS Coordinates E: **0186054** N: **2181816**		
Description: **Consists of 1-2 courses of stacked small boulders on the northern side on top of bedrock, and smaller cobbles piled on the south side. A possible planting area is located to the west.** **Probable clearing feature.**			

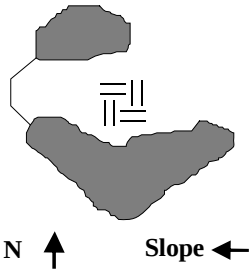
Feature #: **153**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Southeast**
Length (m): **3.5**	Width (m): **2**		
Height (m) (upslope): **.40** (downslope): **.50**	GPS Coordinates E: **0186041** N: **2181813**		
Description: **Approximately 300 piled cobbles on a bedrock outcrop. These cobbles may have been cleared from a possible planting area to the north.** **Probable clearing feature.**			

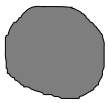
Feature #: **154**	Type: **Pit**	Plan view (not to scale)	View to: **Northeast**
Length (m): **10**	Width (m): **5.8**		
Height (m) (upslope): **0** (downslope): **.80**	GPS Coordinates E: **0186027** N: **2181825**		
Description: **Consists of a natural collapsed bedrock sink containing thick soil, and cobbles piled on the south edge on top of bedrock, probably excavated from the pit.** **Probable clearing and planting feature.**			

Feature #: **155**	Type: **Mound**	Plan view (not to scale)	View to: **Southeast**
Length (m): **1.5**	Width (m): **1.5**		
Height (m) (upslope): **.35** (downslope): **.35**	GPS Coordinates E: **0186003** N: **2181837**		
Description: **Approximately 300 cobbles piled on cobble-covered ground surface.** **Probable clearing feature.**			

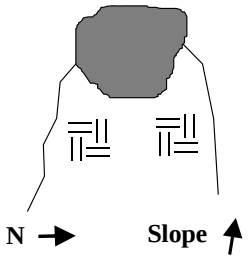
Feature #: **156**	Type: **Mound**		Plan view (not to scale)	View to: **North**
Length (m): **2.5**	Width (m): **2.5**			
Height (m) (upslope): **.20** (downslope): **.35**	GPS Coordinates	E: **0186000** N: **2181840**		
Description: **Consists of cobbles piled on the eastern edge of a sink on top of cobble-covered ground surface.** **Probable clearing feature.**				

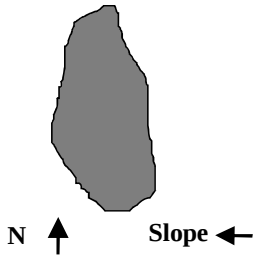
Feature #: **157**	Type: **Mound**		Plan view (not to scale)	View to: **North**
Length (m): **3**	Width (m): **1.3**			
Height (m) (upslope): **0** (downslope): **0**	GPS Coordinates	E: **0186016** N: **2181842**		
Description: **Consists of a curvilinear line of small boulders on the southern edge, with smaller cobbles piled up to them on the north side, and tapering to ground surface to the north.** **Probable clearing feature.**				

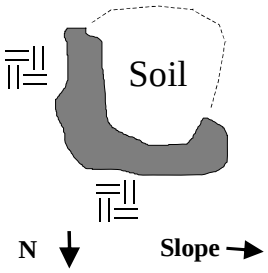
Feature #: **158**	Type: **Modified outcrop**		Plan view (not to scale)	View to: **North**
Length (m): **2.4**	Width (m): **1.6**			
Height (m) (upslope): **0** (downslope): **.40**	GPS Coordinates	E: **0186019** N: **2181843**		
Description: **Consists of an eroding bedrock outcrop that is squared off on the southern end with stacked slabs and small boulders.** **Probable clearing feature.**				

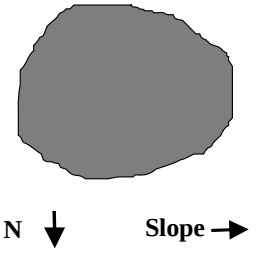
Feature #: **159**	Type: **Mound**		Plan view (not to scale)	View to: **North**
Length (m): **2.8**	Width (m): **2.8**			
Height (m) (upslope): **.60** (downslope): **.60**	GPS Coordinates	E: **0186015** N: **2181846**		
Description: **Consists of approximately 2000+ small to large sized cobbles piled in a circular shaped mound on top of cobble-covered ground surface.** **Probable clearing feature.**				

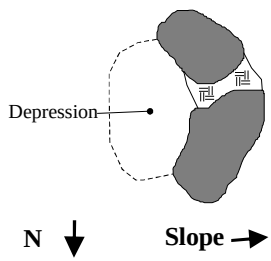
Feature #: **160**	Type: **Mound**		Plan view (not to scale)	View to: **Northeast**
Length (m): **3.4**	Width (m): **2.2**			
Height (m) (upslope): **.20** (downslope): **.60**	GPS Coordinates	E: **0186188** N: **2181839**		
Description: **Consists of piled cobbles and small boulders on a cobble-covered sloping ground surface; a soil area that may have been for planting is located to the south.** **Probable clearing feature.**				

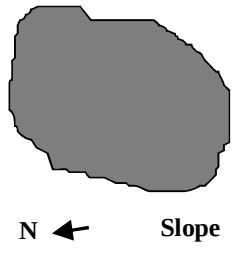
Feature #: **161**	Type: **Modified outcrop**	Plan view (not to scale)	View to:
Length (m): **1.2**	Width (m): **1.2**		No photo available
Height (m) (upslope): **.30** (downslope): **.80**	GPS Coordinates E: **0186170** N: **2181809**		
Description: **Consists of boulders and cobbles piled on the edge of a bedrock outcrop. A soil area that may have been for planting is located to the north.** **Probable clearing feature.**			

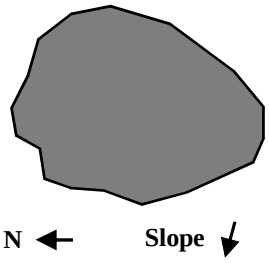
Feature #: **162**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **South**
Length (m): **3.2**	Width (m): **1.5**		
Height (m) (upslope): **.20** (downslope): **.60**	GPS Coordinates E: **0186170** N: **2181801**		
Description: **Approximately 2000+ cobbles piled in a linear shape creating a level terrace; the *mauka* side of the outcrop was probably utilized for planting.** **Probable planting feature.**			

Feature #: **163**	Type: **Enclosure**	Plan view (not to scale)	View to: **Northwest**
Length (m): **4.4**	Width (m): **3**		
Height (m) (upslope): **.65** (downslope): **.65**	GPS Coordinates E: **0186164** N: **2181801**		
Description: **C-shaped feature open to the southwest, composed of small to large piled cobbles, with soil and bedrock on the interior ground surface.** **Probable clearing and planting feature.**			

Feature #: **164**	Type: **Mound**	Plan view (not to scale)	View to: **Southwest**
Length (m): **1.8**	Width (m): **1.8**		
Height (m) (upslope): **.25** (downslope): **.40**	GPS Coordinates E: **0186161** N: **2181799**		
Description: **Consists of approximately 200 piled cobble in a circular mound shape, on *pāhoehoe* bedrock.** **Probable clearing feature.**			

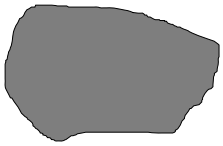
Feature #: **165**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **South/Southwest**
Length (m): **5.8**	Width (m): **1.8**		
Height (m) (upslope): **.40** (downslope): **.60**	GPS Coordinates E: **0186154** N: **2181797**		
Description: **Consists of approximately 1000 small to large cobbles piled on *pāhoehoe* bedrock with a depression on the eastern side.** **Probable clearing feature.**			

Feature #: **166**	Type: **Mound**		Plan view (not to scale)	View to: **Northeast**
Length (m): **3**	Width (m): **2**			
Height (m) (upslope): **.45** (downslope): **.40**	GPS Coordinates	E: **0186153** N: **2181804**		
Description: **Approximately 1000+ various sized cobbles and small boulders piled on bedrock and cobble-covered ground surface.** **Probable clearing feature.**				

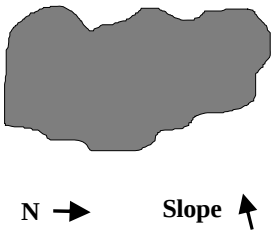
Feature #: **167**	Type: **Mound**		Plan view (not to scale)	View to: **East**
Length (m): **1.8**	Width (m): **1.8**			
Height (m) (upslope): **.40** (downslope): **.50**	GPS Coordinates	E: **0186156** N: **2181798**		
Description: **Consists of approximately 200 small boulders and cobbles piled on cobble-covered ground surface.** **Probable clearing feature.**				

Feature #: **168**	Type: **Mound**		Plan view (not to scale)	View to: **South**
Length (m): **3.5**	Width (m): **1.4**			
Height (m) (upslope): **.30** (downslope): **.50**	GPS Coordinates	E: **0186143** N: **2181799**		
Description: **Consists of approximately 1000 small to large cobbles piled on cobble-covered ground surface. Cleared possible former planting areas are located to the east and west.** **Probable clearing feature.**				

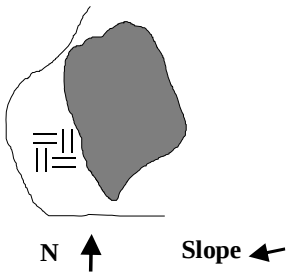
Feature #: **169**	Type: **Modified outcrop**		Plan view (not to scale)	View to: **East**
Length (m): **4**	Width (m): **2.2**			
Height (m) (upslope): **.20** (downslope): **.75**	GPS Coordinates	E: **0186207** N: **2181863**		
Description: **Consists of piled and loosely stacked (on north edge) small to large cobbles on a gentle western slope.** **Probable clearing feature.**				

Feature #: **170**	Type: **Modified outcrop**		Plan view (not to scale)	View to: **Northwest**
Length (m): **2.3**	Width (m): **2**			
Height (m) (upslope): **.40** (downslope): **.75**	GPS Coordinates	E: **0186228** N: **2181856**		
Description: **Consists of 100 piled cobbles and boulders on an eroding bedrock outcrop.** **Probable clearing feature.**				

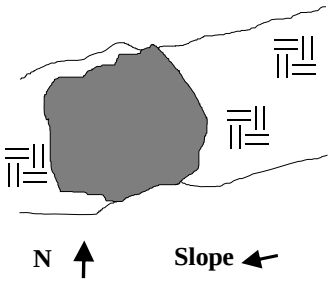
Feature #: **171**	Type: **Mound**	Plan view (not to scale)	View to: **Northeast**
Length (m): **3.3**	Width (m): **1.2**		
Height (m) (upslope): **.20** (downslope): **.40**	GPS Coordinates E: **0186231** N: **2181835**		
Description: **Consists of a linear pile of large cobbles with 2-courses of stacked large and medium sized cobbles on the southern end.** **Probable clearing feature.**			



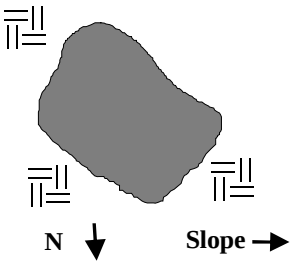
Feature #: **172**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Southeast**
Length (m): **2.8**	Width (m): **2**		
Height (m) (upslope): **0** (downslope): **.90**	GPS Coordinates E: **0186232** N: **2181828**		
Description: **Consists of approximately 200 small to large cobbles piled on a bedrock outcrop.** **Probable clearing feature.**			



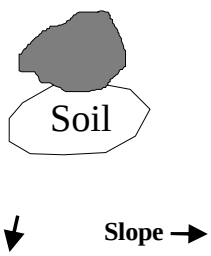
Feature #: **173**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Southeast**
Length (m): **2.5**	Width (m): **1.5**		
Height (m) (upslope): **0** (downslope): **.60**	GPS Coordinates E: **0186235** N: **2181820**		
Description: **Consists of approximately 200 small to large cobbles piled on a bedrock outcrop.** **Probable clearing feature.**			

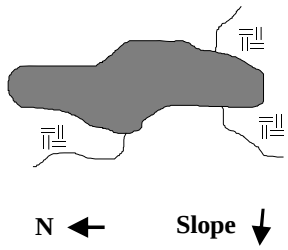


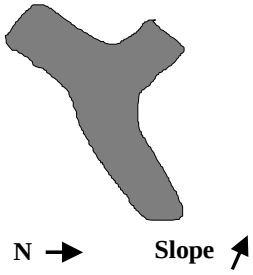
Feature #: **174**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Southeast**
Length (m): **1.5**	Width (m): **1.1**		
Height (m) (upslope): **.10** (downslope): **.60**	GPS Coordinates E: **0186243** N: **2181810**		
Description: **Consists of approximately 100 small to large cobbles piled on a bedrock outcrop.** **Probable clearing feature.**			

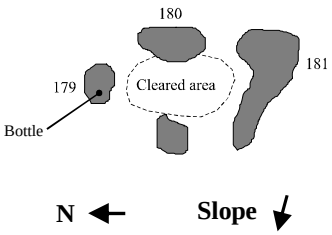


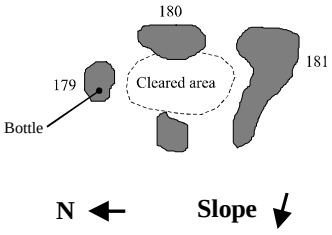
Feature #: **175**	Type: **Mound**	Plan view (not to scale)	View to: **Southeast**
Length (m): **1.9**	Width (m): **2.6**		
Height (m) (upslope): **.40** (downslope): **.60**	GPS Coordinates E: **0186163** N: **2181747**		
Description: **Consists of approximately 700 small to large cobbles, slabs, and small boulders piled on a bedrock outcrop.** **Probable clearing feature.**			

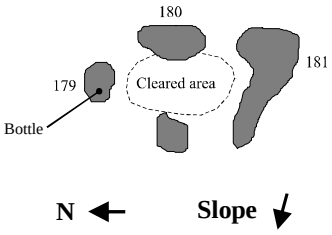


Feature #: **176**	Type: **Modified outcrop**		Plan view (not to scale)	View to: **Southwest**
Length (m): **7.5**	Width (m): **2.7**			
Height (m) (upslope): **.50** (downslope): **.60**	GPS Coordinates	E: **0186165** N: **2181737**		
Description: **Consists of *pāhoehoe* slabs piled on bedrock that were probably cleared from soil areas to the east and west.** **Probable clearing feature.**				

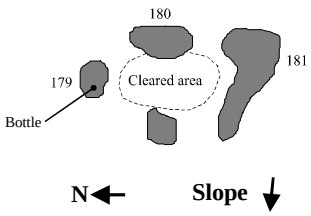
Feature #: **177**	Type: **Modified outcrop**		Plan view (not to scale)	View to: **South**
Length (m): **7**	Width (m): **1.3**			
Height (m) (upslope): **.30** (downslope): **.50**	GPS Coordinates	E: **0186160** N: **2181743**		
Description: **Consists of loosely stacked slabs on the *makai* side, with slabs and cobbles piled up to the *mauka* side of the stacking. This feature is mostly collapsed.** **Probable clearing feature.**				

Feature #: **178**	Type: **Modified outcrop**		Plan view (not to scale)	View to: **West**
Length (m): **3.1**	Width (m): **2.8**			
Height (m) (upslope): **.30** (downslope): **.35**	GPS Coordinates	E: **0186137** N: **2181773**		
Description: **Consists of piled cobbles on *pāhoehoe* bedrock. This feature is one of a few located around a central planting area (179, 180, 181).** **Probable clearing feature.**				

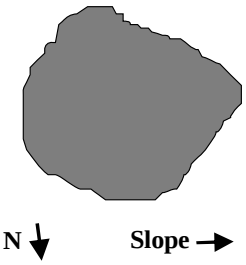
Feature #: **179**	Type: **Mound**		Plan view (not to scale)	View to: **North**
Length (m): **1.6**	Width (m): **3.5**			
Height (m) (upslope): **0** (downslope): **.60**	GPS Coordinates	E: **0186142** N: **2181777**		
Description: **Loosely piled small boulders and cobbles on cobble-covered ground surface. An historic whiskey bottle was located on top of the feature. This feature is one of a few located around a central planting area (178, 180, and 181).** **Probable clearing feature.**				

Feature #: **180**	Type: **Mound**		Plan view (not to scale)	View to: **East**
Length (m): **1.9**	Width (m): **2.6**			
Height (m) (upslope): **.25** (downslope): **.85**	GPS Coordinates	E: **0186146** N: **2181773**		
Description: **Consists of boulders and cobbles loosely piled on top of bedrock ground surface. This feature is one of a few located around a central planting area (178, 179, 181).** **Probable clearing feature.**				

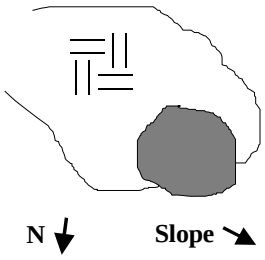
Feature #: **181**	Type: **Mound**	Plan view (not to scale)	View to: **South**
Length (m): **4.1**	Width (m): **1.9**		
Height (m) (upslope): **.50** (downslope): **.85**	GPS Coordinates E: **0186145** N: **2181765**		
Description: **Consists of slabs, boulders, and cobbles loosely piled on bedrock outcrop and cobble-covered ground surface. This feature is one of a few located around a central planting area (178, 179, 180).** **Probable clearing feature.**			



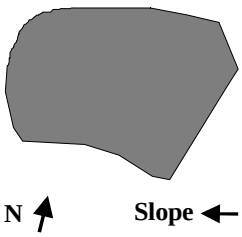
Feature #: **182**	Type: **Mound**	Plan view (not to scale)	View to: **North**
Length (m): **2.5**	Width (m): **2.5**		
Height (m) (upslope): **.55** (downslope): **.70**	GPS Coordinates E: **0186129** N: **2181771**		
Description: **Consists of piled *pāhoehoe* cobbles on cobble-covered ground surface.** **Probable clearing feature.**			



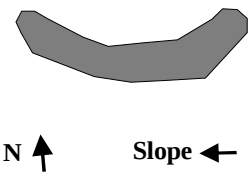
Feature #: **183**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Northeast**
Length (m): **1.3**	Width (m): **1.3**		
Height (m) (upslope): **.20** (downslope): **.25**	GPS Coordinates E: **0186134** N: **2181771**		
Description: **Consists of a circular, loosely piled mound of small to large cobbles on bedrock.** **Probable clearing feature.**			

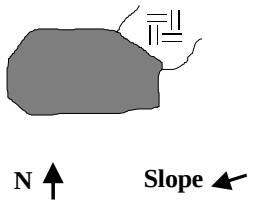


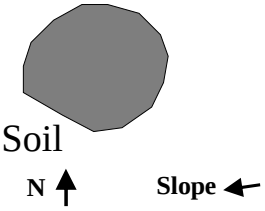
Feature #: **184**	Type: **Mound**	Plan view (not to scale)	View to: **East**
Length (m): **2**	Width (m): **1.9**		
Height (m) (upslope): **.35** (downslope): **.60**	GPS Coordinates E: **0186128** N: **2181765**		
Description: **Consists of a mound of approximately 300 piled large *pāhoehoe* cobbles.** **Probable clearing feature.**			

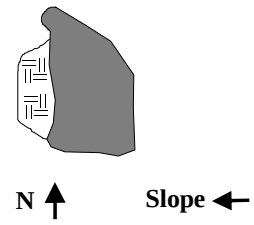


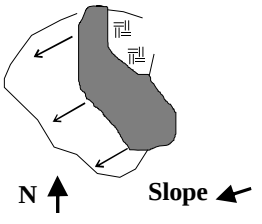
Feature #: **185**	Type: **Mound**	Plan view (not to scale)	View to: **West**
Length (m): **5.1**	Width (m): **1.6**		
Height (m) (upslope): **.30** (downslope): **.60**	GPS Coordinates E: **0186125** N: **2181763**		
Description: **Consists of a curvilinear pile of medium to large sized *pāhoehoe* cobbles oriented *mauka-makai.*** **Probable clearing feature.**			

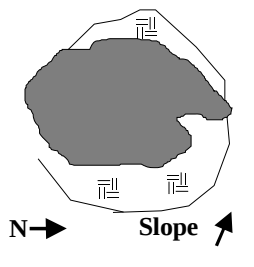


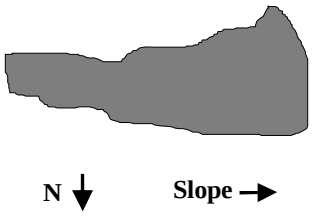
Feature #: **186**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Northwest**
Length (m): **2**	Width (m): **1.4**		
Height (m) (upslope): **.35** (downslope): **.40**	GPS Coordinates E: **0186128** N: **2181766**		
Description: **Consists of medium to large cobbles and one small boulder piled on the west side of a bedrock outcrop, and soil area.** **Probable clearing feature.**			

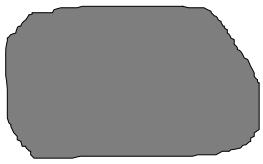
Feature #: **187**	Type: **Mound**	Plan view (not to scale)	View to: **West**
Length (m): **1.6**	Width (m): **1.6**		
Height (m) (upslope): **.30** (downslope): **.45**	GPS Coordinates E: **0186125** N: **2181768**		
Description: **Consists of approximately 100 large cobbles piled on soil.** **Probable clearing feature.**			

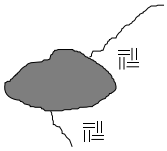
Feature #: **188**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Southwest**
Length (m): **1.9**	Width (m): **1.2**		
Height (m) (upslope): **.20** (downslope): **.70**	GPS Coordinates E: **0186125** N: **2181768**		
Description: **Consists of large cobbles piled on and against the western face of a bedrock outcrop.** **Probable clearing feature.**			

Feature #: **189**	Type: **Modified outcrop**	Plan view (not to scale)	View to:**Northwest**
Length (m): **4.1**	Width (m): **3.3**		
Height (m) (upslope): **.30** (downslope): **.80**	GPS Coordinates E: **0186121** N: **2181769**		
Description: **Consists of small to large cobbles piled on a western sloping bedrock outcrop. The northern edge is loosely stacked, and the top surface of the feature is level but not paved.** **Probable clearing feature.**			

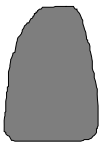
Feature #: **190**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **East**
Length (m): **2.3**	Width (m): **2.3**		
Height (m) (upslope): **.40** (downslope): **.85**	GPS Coordinates E: **0186121** N: **2181777**		
Description: **Consists of loosely stacked small boulders and slabs on the *makai* edge, with smaller cobbles in the interior on top of bedrock.** **Probable clearing feature.**			

Feature #: **191**	Type: **Mound**		Plan view (not to scale)	View to: **Northeast**
Length (m): **4.8**	Width (m): **.80**			
Height (m) (upslope): **.35** (downslope): **.85**	GPS Coordinates	E: **0186114** N: **2181775**		
Description: **Consists of approximately 100, piled small to large cobbles on soil.** **Probable clearing feature.**				

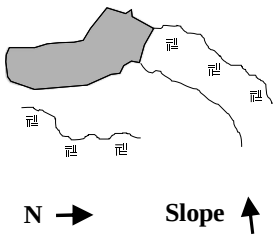
Feature #: **192**	Type: **Mound**		Plan view (not to scale)	View to: **North**
Length (m): **2.3**	Width (m): **1.9**			
Height (m) (upslope): **.30** (downslope): **.60**	GPS Coordinates	E: **0186108** N: **2181783**		
Description: **Consists of small slabs and cobbles piled on cobble-covered ground surface.** **Probable clearing feature.**				

Feature #: **193**	Type: **Modified outcrop**		Plan view (not to scale)	View to: **East**
Length (m): **2.1**	Width (m): **1.5**			
Height (m) (upslope): **.30** (downslope): **.60**	GPS Coordinates	E: **0186108** N: **2181781**		
Description: **Consists of slabs and cobbles piled on a *pāhoehoe* bedrock outcrop.** **Probable clearing feature.**				

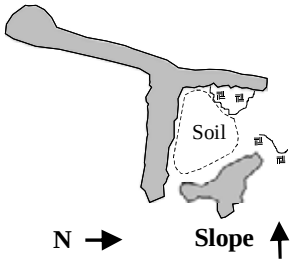
Feature #: **194**	Type: **Mound**		Plan view (not to scale)	View to: **East**
Length (m): **2.8**	Width (m): **1**			
Height (m) (upslope): **.35** (downslope): **.60**	GPS Coordinates	E: **0186109** N: **2181774**		
Description: **Consists of large cobbles on the periphery, with smaller cobbles piled in the interior.** **Probable clearing feature.**				

Feature #: **195**	Type: **Mound**		Plan view (not to scale)	View to:
Length (m): **2.7**	Width (m): **1.3**			No photo available
Height (m) (upslope): **.35** (downslope): **.50**	GPS Coordinates	E: **0186104** N: **2181777**		
Description: **Consists of 1-course of small boulders on the periphery, with smaller cobbles piled in the interior.** **Probable clearing feature.**				

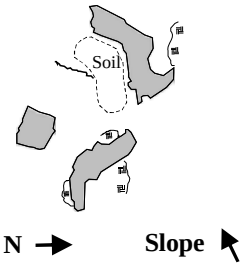
Feature #: **196**	Type: **Mound**	Plan view (not to scale)	View to: **South**
Length (m): **5**	Width (m): **1.5**		
Height (m) (upslope): **0** (downslope): **.35**	GPS Coordinates E: **0186309** N: **2181809**		
Description: **Consists of small cobble pile with stacked large cobbles lining the western edge.** **Probable clearing pile.**			



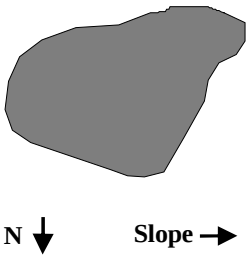
Feature #: **197**	Type: **Enclosure**	Plan view (not to scale)	View to: **West**
Length (m): **12**	Width (m): **6**		
Height (m) (upslope): **0** (downslope): **.50**	GPS Coordinates E: **0186135** N: **2181790**		
Description: **Consists of piled small cobble walls that are low (0.25 meter) and probably composed of cobbles cleared from the center that may have been a planting area. There are small cobbles piled along a bedrock outcrop extends south from the enclosure.** **Probable planting areas.**			



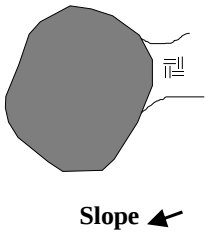
Feature #: **198**	Type: **Modified Outcrop**	Plan view (not to scale)	View to: **Northwest**
Length (m): **10**	Width (m): **10**		
Height (m) (upslope): **0** (downslope): **1**	GPS Coordinates E: **0186125** N: **2181797**		
Description: **Consists of an outcrop surrounding a patch of soil. Cobbles are piled on the outcrop; they were probably cleared from the center soil area.** **Probable clearing feature and planting area.**			

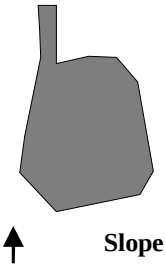


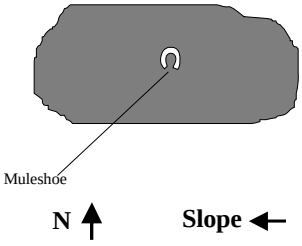
Feature #: **199**	Type: **Mound**	Plan view (not to scale)	View to:
Length (m): **1.8**	Width (m): **1.5**		No photo available
Height (m) (upslope): **.20** (downslope): **.45**	GPS Coordinates E: **0186118** N: **2181764**		
Description: **Consists of small to large cobbles piled on soil.** **Probable clearing feature.**			

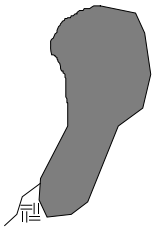


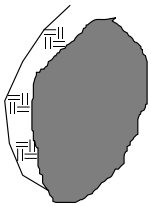
Feature #: **200**	Type: **Mound**	Plan view (not to scale)	View to: **Northeast**
Length (m): **2.8**	Width (m): **2.3**		
Height (m) (upslope): **.70** (downslope): **1.1**	GPS Coordinates E: **0186104** N: **2181710**		
Description: **Consists of small to large cobbles and small boulders piled on bedrock; loose stacking is located on the north side. A soil area to the west may have been a planting area that the cobbles were cleared from.** **Probable clearing feature.**			

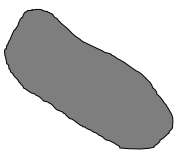


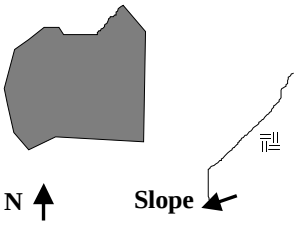
Feature #: **201**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **South**
Length (m): **3.4**	Width (m): **2.5**		
Height (m) (upslope): **.20** (downslope): **.95**	GPS Coordinates E: **0186107** N: **2181719**		
Description: **Consists of small boulders loosely stacked on the north, south and west edges on top of a bedrock outcrop with piled smaller cobbles in the interior.** **Probable clearing feature.**			

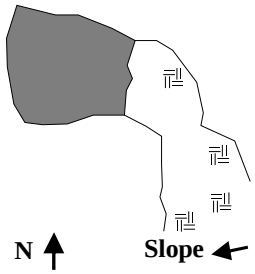
Feature #: **202**	Type: **Mound**	Plan view (not to scale)	View to: **East**
Length (m): **4.4**	Width (m): **2.1**		
Height (m) (upslope): **.50** (downslope): **.60**	GPS Coordinates E: **0186112** N: **2181743**		
Description: **Consists of medium and large sized cobbles piled in an oval shape on sloping soil-covered terrain. A mule shoe (small horseshoe) was observed on top of the mound.** **Probable clearing feature.**			

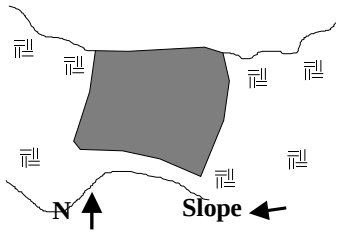
Feature #: **203**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Northeast**
Length (m): **4.6**	Width (m): **1.8**		
Height (m) (upslope): **.45** (downslope): **.35**	GPS Coordinates E: **0186123** N: **2181748**		
Description: **Consists of medium and large cobbles piled on bedrock. Bedrock is exposed on the south end, and the feature is more mounded up on the north end.** **Probable clearing feature.**			

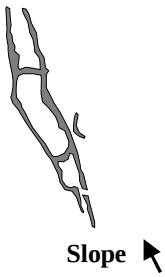
Feature #: **204**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **South**
Length (m): **2**	Width (m): **1.6**		
Height (m) (upslope): **.30** (downslope): **.50**	GPS Coordinates E: **0186125** N: **2181752**		
Description: **Consists of medium and large cobbles with a few thick slabs piled on a bedrock outcrop.** **Probable clearing feature.**			

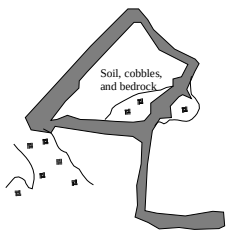
Feature #: **205**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **North**
Length (m): **2.2**	Width (m): **1**		
Height (m) (upslope): **.10** (downslope): **.55**	GPS Coordinates E: **0186136** N: **2181759**		
Description: **Consists of small and medium sized cobbles piled against a bedrock outcrop. The southwest facing edge has loosely stacked medium sized *pāhoehoe* cobbles.** **Probable clearing feature.**			

Feature #: **206**	Type: **Mound**	Plan view (not to scale)	View to: **Northeast**
Length (m): **1.7**	Width (m): **1.2**		
Height (m) (upslope): **.35** (downslope): **.25**	GPS Coordinates E: **0186149** N: **2181770**		
Description: **Consists of collapsing, formerly 2-courses of stacked medium to large *pāhoehoe* cobbles on soil in a roughly rectangular shape.** **Probable clearing feature.**			

Feature #: **207**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Northeast**
Length (m): **2.4**	Width (m): **2.2**		
Height (m) (upslope): **0** (downslope): **.40**	GPS Coordinates E: **0186173** N: **2181717**		
Description: **Consists of small to large *pāhoehoe* cobbles with a few small boulders piled off the western end of a bedrock outcrop. In center of pile is a secondary pile of large cobbles.** **Probable clearing feature.**			

Feature #: **208**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **East**
Length (m): **2**	Width (m): **2.3**		
Height (m) (upslope): **.20** (downslope): **.30**	GPS Coordinates E: **0186054** N: **2181805**		
Description: **Consists of 1-2 courses of small to large cobbles placed in a rectangular formation on top of a bedrock outcrop. The edges are neatly aligned with large cobbles.** **Probable clearing feature.**			

Feature #: **209**	Type: **Modified outcrop**	Plan view (not to scale)	View to:
Length (m): **60**	Width (m): **8**		No photo available
Height (m) (upslope): **1.2** (downslope):	GPS Coordinates E: **0186150** N: **2181830**		
Description: **Consists of a natural linear depression probably formed from a collapsed lava tube. The floor of the depression is level soil and cobbles, and the north and south slopes are modified by piled and loosely stacked cobbles. Two walls are constructed across the gulch with small to large cobbles. Probable planting feature.**			

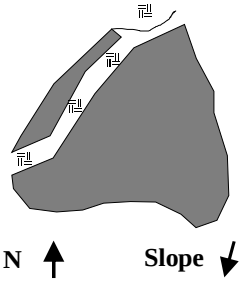
Feature #: **210**	Type: **Enclosure**	Plan view (not to scale)	View to: **Northwest**
Length (m): **17**	Width (m): **17**		
Height (m) (upslope): **1.5** (downslope): **1**	GPS Coordinates E: **0186220** N: **2181880**		
Description: **Consists of an enclosure and attached wall on the southeastern side. Enclosure composed of stacked large cobble walls, on bedrock outcrops, and soil ground surface.** **Probable planting enclosure.**			

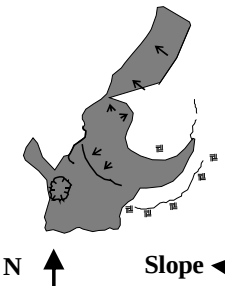
Feature #: **211**	Type: **Wall**		Plan view (not to scale)	View to:
Length (m): **12**	Width (m): **2**		See Figure 40. of this report	
Height (m) (upslope): **.30** (downslope): **0**	GPS Coordinates	E: **0186223** N: **2181855**		
Description: **A low rock alignment composed of small to large *pāhoehoe* cobbles with a few slabs that runs north-south in the northeastern portion of the project area. Soil on the south side and bedrock ground surface on the north side. Probable agricultural field boundary wall remnant.**				

Feature #: **212**	Type: **Wall**		Plan view (not to scale)	View to: **West**
Length (m): **20**	Width (m): **1.8**		See Figure 40. of this report	
Height (m) (upslope): **.50** (downslope): **.50**	GPS Coordinates	E: **0186230** N: **2181830**		
Description: **Consists of a *mauka-makai* wall that is composed of piled *pāhoehoe* cobbles and boulders with some intact stacking at the western end. The wall terminates at the western end near SIHP Site 24424's (lava tube) *mauka* entrance. Probable agricultural field boundary wall remnant.**				

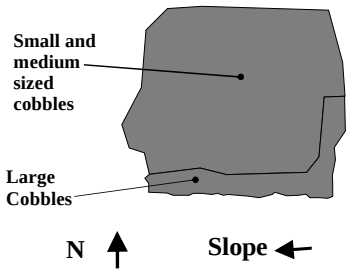
Feature #: **213**	Type: **Wall**		Plan view (not to scale)	View to: **West**
Length (m): **75**	Width (m): **1.5**		See Figure 40. of this report	
Height (m) (upslope): **.60** (downslope): **.60**	GPS Coordinates	E: **0186150** N: **2181755**		
Description: **Consists of a collapsed *mauka-makai* running wall with a few places with intact loose stacking. Wall is composed of medium to large weathered *pāhoehoe* cobbles and boulders. Wall runs parallel to Feature 214. Probable agricultural field boundary wall remnant.**				

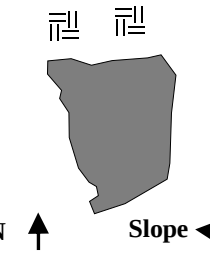
Feature #: **214**	Type: **Wall**		Plan view (not to scale)	View to: **Northwest**
Length (m): **30**	Width (m): **1.4**		See Figure 40. of this report	
Height (m) (upslope): **.40** (downslope): **.40**	GPS Coordinates	E: **0186150** N: **2181760**		
Description: **Consists of a *mauka-makai* running collapsed wall composed of large cobbles and slabs. Wall constructed on slope with bedrock outcrops and soil patches, and many agricultural features close by. Wall runs parallel to Feature 213. Probable agricultural field boundary wall remnant.**				

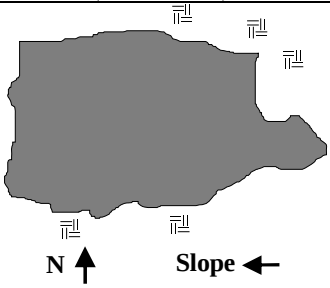
Feature #: **215**	Type: **Modified Outcrop**		Plan view (not to scale)	View to:
Length (m): **2**	Width (m): **2**			
Height (m) (upslope): (downslope):	GPS Coordinates	E: **0185846** N: **2181730**		
Description: **Consists of medium sized *pāhoehoe* cobbles piled on and against a bedrock outcrop to create a level surface.** **Probable agricultural staging surface and/or clearing feature.**				

Feature #: **216**	Type: **Modified Outcrop**	Plan view (not to scale)	View to: **West**
Length (m): **7**	Width (m): **4**		
Height (m) (upslope): **0** (downslope): **.50**	GPS Coordinates E: **0186160** N: **2181774**		
Description: **Consists of a crescent-shaped mound on a cobble covered ground surface. The mound is composed of small to large *pāhoehoe* cobbles; bedrock outcrops to the east; no soil observed nearby.** **Probable clearing feature.**			

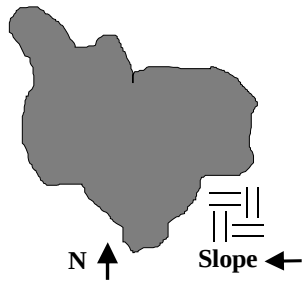
Feature #: **217**	Type: **Wall**	Plan view (not to scale)	View to:
Length (m): **34**	Width (m): **2**	See Figure 40. of this report	No photo available
Height (m) (upslope): **.40** (downslope): **.40**	GPS Coordinates E: **0185800** N: **2181710**		
Description: **Consists of a *mauka-makai* piled wall that runs in a relatively straight line. The wall is composed of cobbles slabs and boulders, possibly cleared from adjacent soil planting areas. The wall runs into Feature G of SIHP Site 25052 on its western end. Probable agricultural field boundary wall remnant.**			

Feature #: **218**	Type: **Pavement**	Plan view (not to scale)	View to: **North**
Length (m): **1.8**	Width (m): **1.8**		
Height (m) (upslope): **.20** (downslope): **.25**	GPS Coordinates E: **0185885** N: **2181657**		
Description: **Consists of a level, slightly elevated square pavement composed of small and medium sized *pāhoehoe* cobbles with large cobbles lining the south and partial east sides. The pavement probably functioned as a level work surface associated with agricultural activities.**			

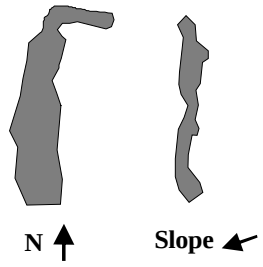
Feature #: **219**	Type: **Mound**	Plan view (not to scale)	View to:
Length (m): **1.4**	Width (m): **1.1**		
Height (m) (upslope): **.35** (downslope): **.40**	GPS Coordinates E: **0185970** N: **2181772**		
Description: **Consists of a pile of small and medium sized *ʻaʻā* cobbles with bedrock to the north, constructed on an *ʻaʻā* cobble-covered ground surface. An upright slab is located at the southern end of the mound, although the crude construction of the feature does not appear to be a burial. Probable clearing feature.**			

Feature #: **220**	Type: **Mound**	Plan view (not to scale)	View to: **Southwest**
Length (m): **1.6**	Width (m): **1.4**		
Height (m) (upslope): **.50** (downslope): **.50**	GPS Coordinates E: **0185845** N: **2181723**		
Description: **Consists of small to large cobbles that are stacked on the north and west edges. Bedrock to the south and east.** **Probable clearing feature.**			

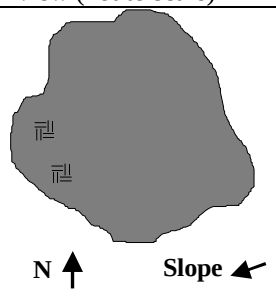
Feature #: **221**	Type: **Mound**	Plan view (not to scale)	View to: **East**
Length (m): **1.4**	Width (m): **1.0**		
Height (m) (upslope): **.15** (downslope): **.40**	GPS Coordinates E: **0185856** N: **2181712**		
Description: **Consists of a few *pāhoehoe* boulders stacked on the western end, with smaller cobbles piled on the eastern side against the stacking.** **Probable clearing feature.**			



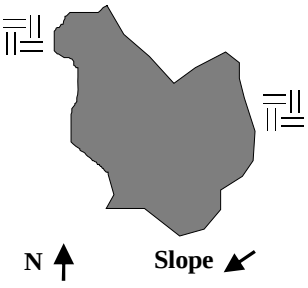
Feature #: **222**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **North**
Length (m): **2.5**	Width (m): **1.5**		
Height (m) (upslope): **0** (downslope): **.25**	GPS Coordinates E: **0185849** N: **2181720**		
Description: **Consists of 8-10 stacked *pāhoehoe* slabs (north-south) on the *makai* edge, with small cobbles creating a level area. Soil has accumulated *mauka* of the level area.** **Probable planting feature.**			



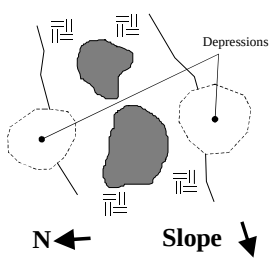
Feature #: **223**	Type: **Mound**	Plan view (not to scale)	View to: **North**
Length (m): **1.7**	Width (m): **1.2**		
Height (m) (upslope): **.20** (downslope): **.30**	GPS Coordinates E: **0185843** N: **2181729**		
Description: **Consists of approximately 100 piled cobbles and small boulders on bedrock.** **Probable clearing feature.**			

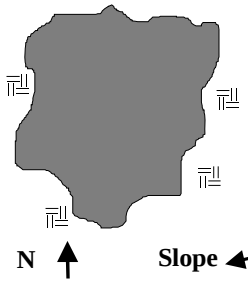


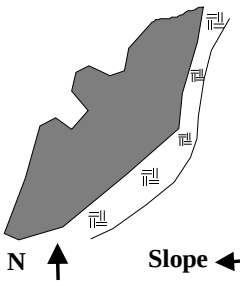
Feature #: **224**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Southeast**
Length (m): **1.7**	Width (m): **.80**		
Height (m) (upslope): **.20** (downslope): **.50**	GPS Coordinates E: **0185866** N: **2181717**		
Description: **Consists of piled large *pāhoehoe* slabs and cobbles along the *makai* edge, with medium sized slabs and cobble fill on the *mauka* side. Constructed partially over a natural depression.** **Probable clearing feature.**			

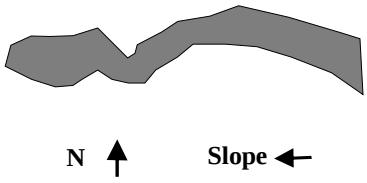


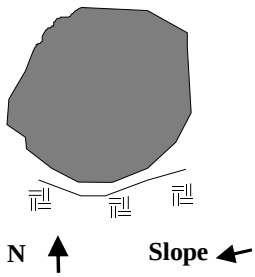
Feature #: **225**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **North**
Length (m): **2.3**	Width (m): **1.1**		
Height (m) (upslope): **.45** (downslope): **.45**	GPS Coordinates E: **0185834** N: **2181703**		
Description: **Consists of slabs and small cobbles piled on bedrock. Outcrop has 2 openings into a small blister possibly used for storage.** **Probable storage feature.**			

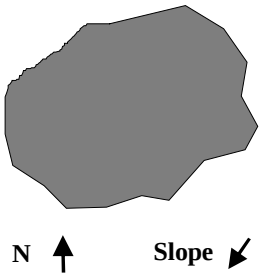


Feature #: **226**	Type: **Modified outcrop**	Plan view (not to scale)	View to:
Length (m): **1.4**	Width (m): **1.7**		
Height (m) (upslope): **.30** (downslope): **.40**	GPS Coordinates E: **0185831** N: **2181696**		
Description: **Consists of *pāhoehoe* boulders and cobbles piled in an irregular shape on a bedrock outcrop.** **Probable clearing feature.**			

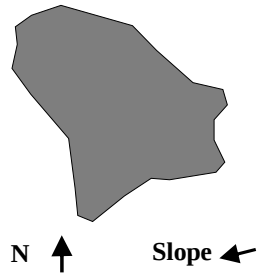
Feature #: **227**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Northeast**
Length (m): **2.4**	Width (m): **1.1**		
Height (m) (upslope): **.45** (downslope): **.60**	GPS Coordinates E: **0185859** N: **2181698**		
Description: **Consists of medium and large cobbles and small boulders piled on a bedrock outcrop.** **Probable clearing feature.**			

Feature #: **228**	Type: **Mound**	Plan view (not to scale)	View to: **East/Northeast**
Length (m): **12**	Width (m): **1.4**		
Height (m) (upslope): **0** (downslope): **.65**	GPS Coordinates E: **0185859** N: **2181698**		
Description: **Consists of a *mauka-makai* running curvilinear mound composed of small to large cobbles and a few small boulders with stacking at the western end.** **Probable clearing feature.**			

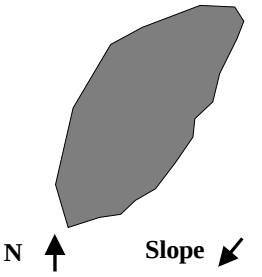
Feature #: **229**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Northeast**
Length (m): **1.8**	Width (m): **1.4**		
Height (m) (upslope): **.40** (downslope): **.50**	GPS Coordinates E: **0185847** N: **2181697**		
Description: **Consists of piled *pāhoehoe* cobbles on soil with a large slab placed flat on top.** **Probable clearing feature.**			

Feature #: **230**	Type: **Mound**	Plan view (not to scale)	View to: **North**
Length (m): **1.6**	Width (m): **1.6**		
Height (m) (upslope): **0** (downslope): **0**	GPS Coordinates E: **0185839** N: **2181703**		
Description: **Consists of a circular pile of various sized *pāhoehoe* cobbles on soil ground surface.** **Probable clearing feature.**			

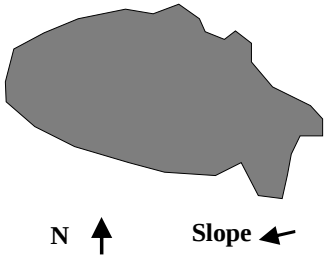
Feature #: **231**	Type: **Mound**	Plan view (not to scale)	View to: **North**
Length (m): **1.4**	Width (m): **1.2**		
Height (m) (upslope): **.45** (downslope): **.65**	GPS Coordinates E: **0185836** N: **2181710**		
Description: **Consists of *pāhoehoe* cobbles of various sizes and 2 large slabs piled on soil.** **Probable clearing feature.**			



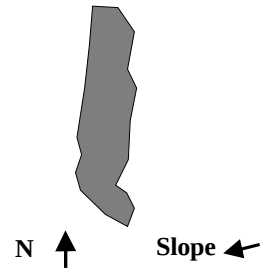
Feature #: **232**	Type: **Mound**	Plan view (not to scale)	View to: **Southeast**
Length (m): **2.1**	Width (m): **1.2**		
Height (m) (upslope): **.35** (downslope): **.55**	GPS Coordinates E: **0185822** N: **2181708**		
Description: **Consists of small to large *pāhoehoe* cobbles piled in an oval shape on soil.** **Probable clearing feature.**			



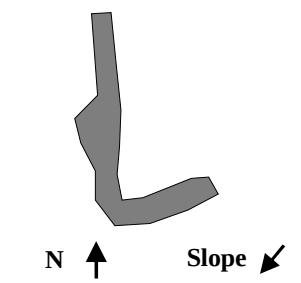
Feature #: **233**	Type: **Mound**	Plan view (not to scale)	View to: **East**
Length (m): **3**	Width (m): **1.8**		
Height (m) (upslope): **.30** (downslope): **.55**	GPS Coordinates E: **0185820** N: **2181700**		
Description: **Consists of small to large *pāhoehoe* cobbles with a few small boulders at the base of the pile. Mound constructed on soil ground surface.** **Probable clearing feature.**			

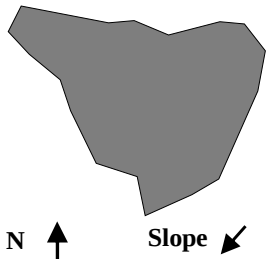


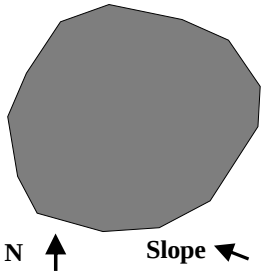
Feature #: **234**	Type: **Mound**	Plan view (not to scale)	View to: **Northwest**
Length (m): **3.3**	Width (m): **1.1**		
Height (m) (upslope): **.60** (downslope): **.25**	GPS Coordinates E: **0185821** N: **2181697**		
Description: **Consists of small and medium *pāhoehoe* cobbles, and one large slab, piled on a bedrock outcrop.** **Probable clearing feature.**			

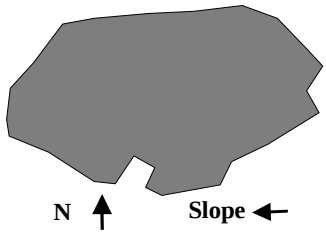


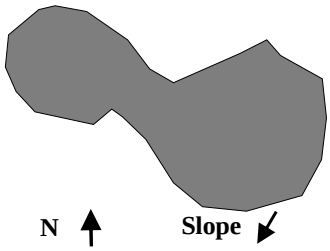
Feature #: **235**	Type: **Mound**	Plan view (not to scale)	View to: **North**
Length (m): **3.4**	Width (m): **1.9**		
Height (m) (upslope): **.30** (downslope): **.20**	GPS Coordinates E: **0185823** N: **2181692**		
Description: **Consists of loosely stacked *pāhoehoe* slabs and cobbles in an L-shaped mound. Soil has accumulated on the upslope side** **Probable clearing feature.**			

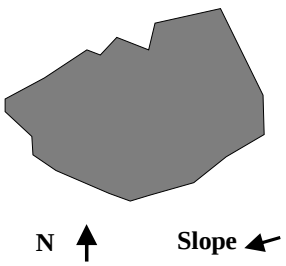


Feature #: **236**	Type: **Mound**	Plan view (not to scale)	View to: **West**
Length (m): **1.5**	Width (m): **1.1**		
Height (m) (upslope): **.25** (downslope): **.65**	GPS Coordinates E: **0185818** N: **2181690**		
Description: **Consists of an irregular shaped pile of small to large *pāhoehoe* cobbles with one small boulder on soil ground surface.** **Probable clearing feature.**			

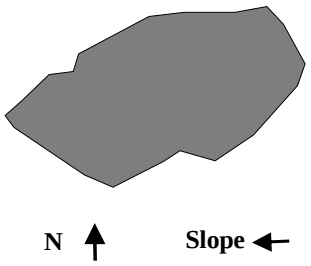
Feature #: **237**	Type: **Mound**	Plan view (not to scale)	View to: **West**
Length (m): **1.1**	Width (m): **1.1**		
Height (m) (upslope): **.45** (downslope): **.50**	GPS Coordinates E: **0185820** N: **2181686**		
Description: **Consists of a circular pile of small to large *pāhoehoe* cobbles with 1 large slab on soil ground surface.** **Probable clearing feature.**			

Feature #: **238**	Type: **Mound**	Plan view (not to scale)	View to: **South**
Length (m): **2.1**	Width (m): **1.6**		
Height (m) (upslope): **.15** (downslope): **.40**	GPS Coordinates E: **0185813** N: **2181704**		
Description: **Consists of small to large *pāhoehoe* cobbles and small slabs piled in an irregular shape on a sloping bedrock outcrop.** **Probable clearing feature.**			

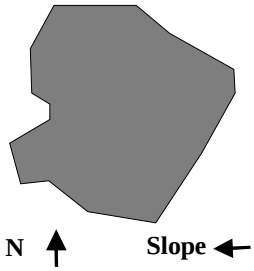
Feature #: **239**	Type: **Mound**	Plan view (not to scale)	View to: **South**
Length (m): **3.1**	Width (m): **1.2**		
Height (m) (upslope): **0** (downslope): **.45**	GPS Coordinates E: **0185810** N: **2181702**		
Description: **Consists of two connected piles composed of small to large cobbles with a few small boulders on a soil ground surface.** **Probable clearing feature.**			

Feature #: **240**	Type: **Mound**	Plan view (not to scale)	View to: **Southwest**
Length (m): **2.1**	Width (m): **1.5**		
Height (m) (upslope): **.30** (downslope): **.20**	GPS Coordinates E: **0185008** N: **2181698**		
Description: **Consists of small to large *pāhoehoe* cobbles and large slabs piled in an irregular shape on soil ground surface.** **Probable clearing feature.**			

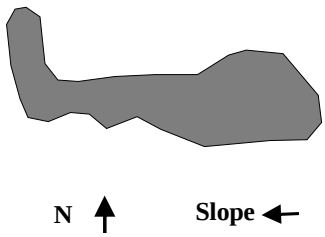
Feature #: **241**	Type: **Mound**	Plan view (not to scale)	View to: **North**
Length (m): **2.6**	Width (m): **.90**		
Height (m) (upslope): **.45** (downslope): **.20**	GPS Coordinates E: **0185806** N: **2181702**		
Description: **Consists of small to large *pāhoehoe* cobbles and slabs piled on soil ground surface.** **Probable clearing feature.**			



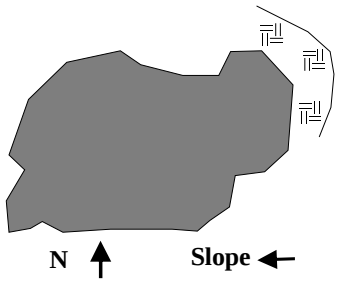
Feature #: **242**	Type: **Mound**	Plan view (not to scale)	View to: **East**
Length (m): **1.2**	Width (m): **1.1**		
Height (m) (upslope): **.30** (downslope): **.55**	GPS Coordinates E: **0185811** N: **2181734**		
Description: **Consists of large *pāhoehoe* cobbles piled on top of smaller cobbles on soil ground surface.** **Probable clearing feature.**			



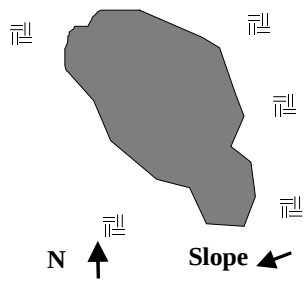
Feature #: **243**	Type: **Mound**	Plan view (not to scale)	View to: **Northwest**
Length (m): **10.3**	Width (m): **1.2**		
Height (m) (upslope): **.40** (downslope): **.60**	GPS Coordinates E: **0185822** N: **2181730**		
Description: **Consists of a long pile of small to large *pāhoehoe* cobbles and small boulders. The eastern end is wider than the western end; the mound is constructed on soil and bedrock ground surface.** **Probable clearing feature.**			

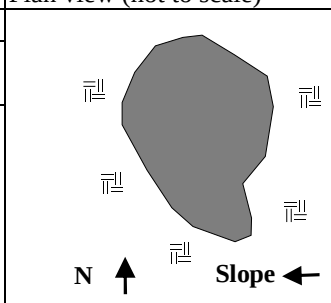


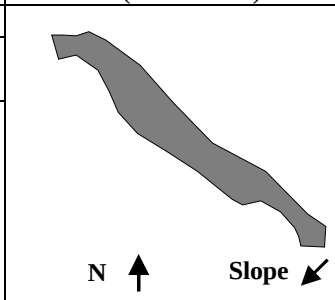
Feature #: **244**	Type: **Mound**	Plan view (not to scale)	View to: **East**
Length (m): **1.7**	Width (m): **1.1**		
Height (m) (upslope): **.25** (downslope): **.30**	GPS Coordinates E: **0185759** N: **2181725**		
Description: **Consists of small to large *pāhoehoe* cobbles and small boulders piled on a west-sloping bedrock outcrop.** **Probable clearing feature.**			

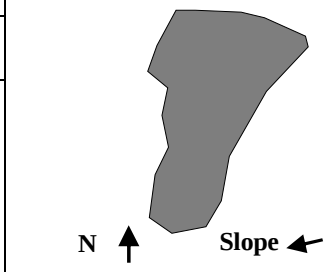


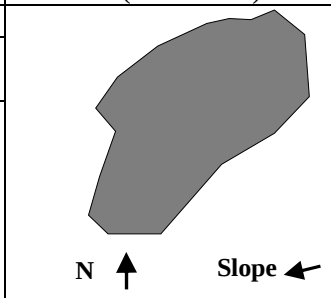
Feature #: **245**	Type: **Mound**	Plan view (not to scale)	View to: **Northwest**
Length (m): **2.5**	Width (m): **.40**		
Height (m) (upslope): **.40** (downslope): **.40**	GPS Coordinates E: **0185725** N: **2181663**		
Description: **Consists of small to large *pāhoehoe* cobbles piled on a bedrock outcrop.** **Probable clearing feature.**			

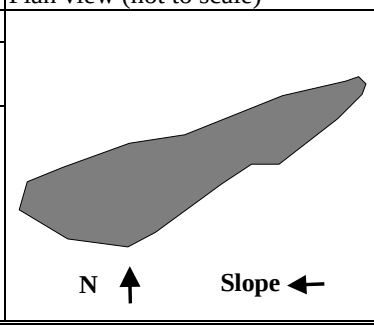


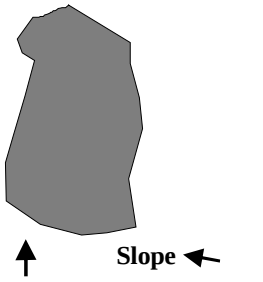
Feature #: **246**	Type: **Mound**		Plan view (not to scale)	View to: **West**
Length (m): **1.2**	Width (m): **.80**			
Height (m) (upslope): **.20** (downslope): **.50**	GPS Coordinates	E: **0185729** N: **2181661**		
Description: **Consists of small to medium *pāhoehoe* cobbles piled on bedrock with one large slab placed on top.** **Probable clearing feature.**				

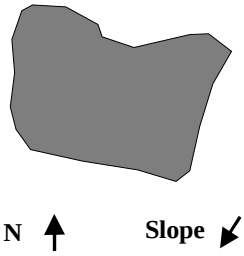
Feature #: **247**	Type: **Mound**		Plan view (not to scale)	View to: **West**
Length (m): **5.5**	Width (m): **1.5**			
Height (m) (upslope): **.60** (downslope): **.45**	GPS Coordinates	E: **0185728** N: **2181659**		
Description: **Consists of a long pile of small to large *pāhoehoe* cobbles on sloping soil ground surface.** **Probable clearing feature.**				

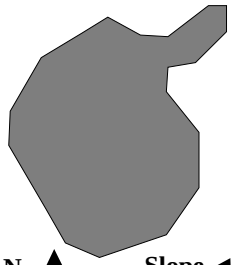
Feature #: **248**	Type: **Mound**		Plan view (not to scale)	View to: **North**
Length (m): **2.5**	Width (m): **1**			
Height (m) (upslope): **0** (downslope): **0**	GPS Coordinates	E: **0185737** N: **2181671**		
Description: **Consists of small to large *pāhoehoe* cobbles piled on a *pāhoehoe* bedrock outcrop.** **Probable clearing feature.**				

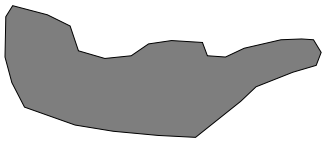
Feature #: **249**	Type: **Mound**		Plan view (not to scale)	View to: **Northeast**
Length (m): **2.7**	Width (m): **1.3**			
Height (m) (upslope): **.40** (downslope): **.60**	GPS Coordinates	E: **0185732** N: **2181671**		
Description: **Consists of an oval shaped pile of small to large *pāhoehoe* cobbles with a few large slabs on soil ground surface.** **Probable clearing feature.**				

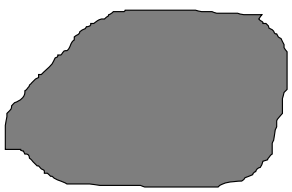
Feature #: **250**	Type: **Mound**		Plan view (not to scale)	View to: **Southeast**
Length (m): **3.1**	Width (m): **1.7**			
Height (m) (upslope): **.50** (downslope): **.40**	GPS Coordinates	E: **0185732** N: **2181678**		
Description: **Consists of a long pile of small to large *pāhoehoe* cobbles on soil ground surface.** **Probable clearing feature.**				

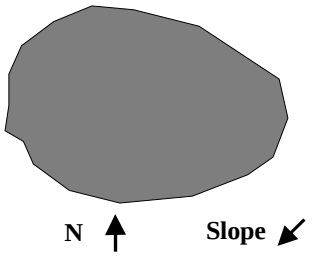
Feature #: **251**	Type: **Mound**		Plan view (not to scale)	View to: **North**
Length (m): **2.7**	Width (m): **1.1**			
Height (m) (upslope): **.25** (downslope): **.35**	GPS Coordinates	E: **0185749** N: **2181682**		
Description: **Consists of small to large *pāhoehoe* cobbles with a few small boulders piled on soil ground surface.** **Probable clearing feature.**				

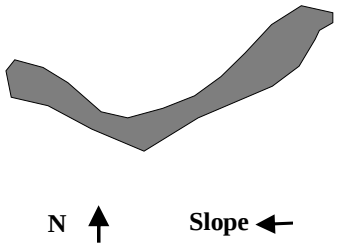
Feature #: **252**	Type: **Mound**		Plan view (not to scale)	View to: **Northeast**
Length (m): **2.2**	Width (m): **1.2**			
Height (m) (upslope): **.40** (downslope): **.40**	GPS Coordinates	E: **0185752** N: **2181682**		
Description: **Consists of small to large *pāhoehoe* cobbles piled on soil ground surface with loose stacking on the *makai* (west) edge of the mound.** **Probable clearing feature.**				

Feature #: **253**	Type: **Mound**		Plan view (not to scale)	View to: **North**
Length (m): **1.8**	Width (m): **1.5**			
Height (m) (upslope): **.20** (downslope): **.25**	GPS Coordinates	E: **0185751** N: **2181678**		
Description: **Consists of small to large *pāhoehoe* cobbles and slabs piled on soil ground surface.** **Probable clearing feature.**				

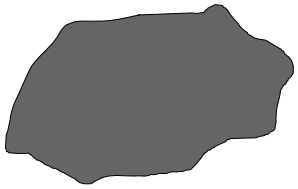
Feature #: **254**	Type: **Mound**		Plan view (not to scale)	View to: **South**
Length (m): **5.2**	Width (m): **1.3**			
Height (m) (upslope): **0** (downslope): **.30**	GPS Coordinates	E: **0185752** N: **2181676**		
Description: **Consists of small to large *pāhoehoe* cobbles piled in a curvilinear shape on soil ground surface.** **Probable clearing feature.**				

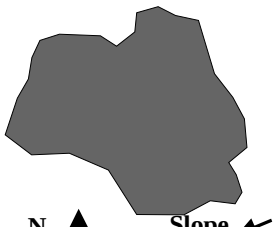
Feature #: **255**	Type: **Mound**		Plan view (not to scale)	View to: **Northeast**
Length (m): **1.9**	Width (m): **1.3**			
Height (m) (upslope): **.20** (downslope): **.20**	GPS Coordinates	E: **0185759** N: **2181673**		
Description: **Consists of small to large *pāhoehoe* cobbles piled on soil.** **Probable clearing feature.**				

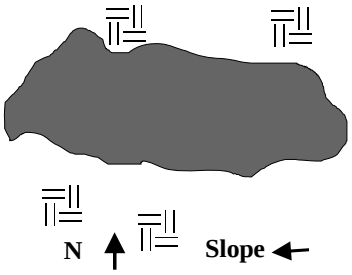
Feature #: **256**	Type: **Mound**		Plan view (not to scale)	View to: **West**
Length (m): **3.2**	Width (m): **2.8**			
Height (m) (upslope): **.40** (downslope): **.50**	GPS Coordinates	E: **0185776** N: **2181660**		
Description: **Consists of mostly small *pāhoehoe* cobbles with a few medium and large cobbles on the top surface piled in a circle on soil ground surface.** **Probable clearing feature.**				

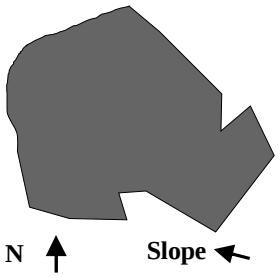
Feature #: **257**	Type: **Wall**		Plan view (not to scale)	View to: **Northwest**
Length (m): **18**	Width (m): **1**			
Height (m) (upslope): **.40** (downslope): **.65**	GPS Coordinates	E: **0185770** N: **2181663**		
Description: **Consists of a *mauka-makai* running wall composed of large cobbles and boulders. Its western end is intact with stacking up to 6-courses high and its eastern end is collapsed. Feature 258 (south) probably intersected with this wall, but currently has a gap between them. Probable agricultural field boundary.**				

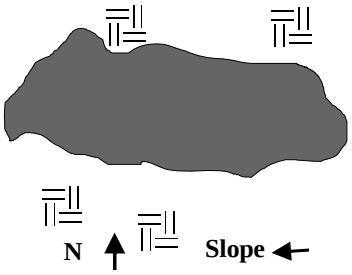
Feature #: **258**	Type: **Wall**		Plan view (not to scale)	View to: **East**
Length (m): **37**	Width (m): **.80**		See Figure 40 of this report.	
Height (m) (upslope): **.60** (downslope):	GPS Coordinates	E: **0185771** N: **2181650**		
Description: **Consists of a north-south running wall composed of small to large cobbles and boulders that are stacked on the north end, and collapsed on the southern end. This feature probably once intersected with Feature 257 to the north. Probable agricultural field boundary wall.**				

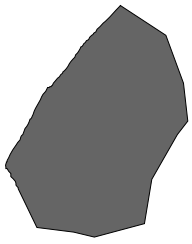
Feature #: **259**	Type: **Mound**		Plan view (not to scale)	View to: **North**
Length (m): **1.6**	Width (m): **1**			
Height (m) (upslope): **.30** (downslope): **.35**	GPS Coordinates	E: **0185769** N: **2181653**		
Description: **Consists of small to large cobbles, mostly medium sized, with a few large slabs, piled on a *pāhoehoe* bedrock outcrop. Top of mound is .75 meter tall above ground surface at the peak in the center.** **Probable clearing feature.**				

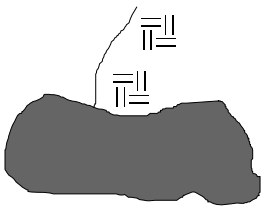
Feature #: **260**	Type: **Mound**		Plan view (not to scale)	View to: **West**
Length (m): **1.8**	Width (m): **1.4**			
Height (m) (upslope): **.10** (downslope): **.50**	GPS Coordinates	E: **0185768** N: **2181652**		
Description: **Consists of mostly medium and large piled *pāhoehoe* cobbles and a few small boulders on sloping soil ground surface.** **Probable clearing feature.**				

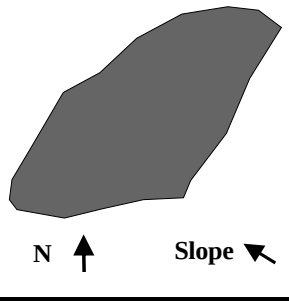
Feature #: **261**	Type: **Mound**	Plan view (not to scale)	View to: **North**
Length (m): **2.4**	Width (m): **1.1**		
Height (m) (upslope): **.55** (downslope): **.35**	GPS Coordinates E: **0185760** N: **2181645**		
Description: **Consists of mostly medium sized *pāhoehoe* cobbles, with a few small boulders on the top, piled on a bedrock outcrop.** **Probable clearing feature.**			

Feature #: **262**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **West**
Length (m): **1.9**	Width (m): **1.5**		
Height (m) (upslope): **.55** (downslope): **.25**	GPS Coordinates E: **0185753** N: **2181643**		
Description: **Consists of piled and loosely stacked small and medium *pāhoehoe* cobbles with many small boulders in a roughly circular shape on top of a bedrock outcrop.** **Probable clearing feature.**			

Feature #: **263**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **North**
Length (m): **2.7**	Width (m): **2.3**		
Height (m) (upslope): **.45** (downslope): **.40**	GPS Coordinates E: **0185753** N: **2181635**		
Description: **Consists of piled and loosely stacked small and medium *pāhoehoe* cobbles with many small boulders in a roughly circular shape on top of a bedrock outcrop.** **Probable clearing feature.**			

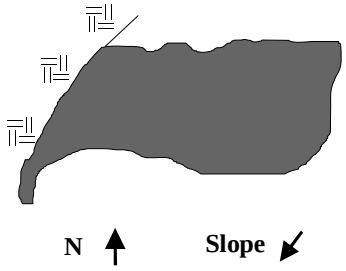
Feature #: **264**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Northwest**
Length (m): **1.8**	Width (m): **1.4**		
Height (m) (upslope): **.20** (downslope): **.40**	GPS Coordinates E: **0185749** N: **21817635**		
Description: **Consists of stacked and piled small to large *pāhoehoe* cobbles and small boulders on top of a bedrock outcrop.** **Probable clearing feature.**			

Feature #: **265**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Northeast**
Length (m): **2.7**	Width (m): **1.2**		
Height (m) (upslope): **.40** (downslope): **.40**	GPS Coordinates E: **0186742** N: **2181617**		
Description: **Consists of large *pāhoehoe* cobbles loosely stacked along the periphery on top of bedrock, with the center filled in with piled small and medium sized cobbles. Rectangular shape.** **Probable clearing feature.**			

Feature #: **266**	Type: **Mound**		Plan view (not to scale)	View to: **Northwest**
Length (m): **2.9**	Width (m): **2.4**			
Height (m) (upslope): **.45** (downslope): **.50**	GPS Coordinates	E: **0185811** N: **2181589**		

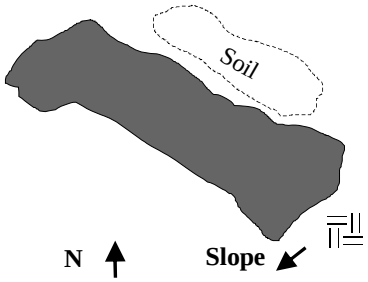
Description: **Consists of small to large *pāhoehoe* cobbles in a linear pile perpendicular to a moderate slope.**

Probable clearing feature.

Feature #: **267**	Type: **Modified outcrop**		Plan view (not to scale)	View to: **East**
Length (m): **4.9**	Width (m): **2.5**			
Height (m) (upslope): **0** (downslope): **.80**	GPS Coordinates	E: **0185817** N: **2181601**		

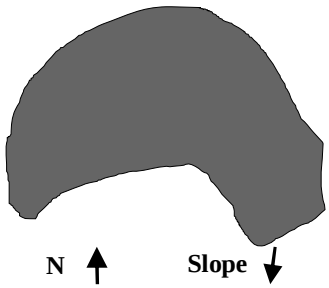
Description: **Consists of small to large *pāhoehoe* cobbles loosely stacked on bedrock outcrop on the southern and eastern edges, with cobbles piled up to the stacking on the north side.**

Probable clearing feature.

Feature #: **268**	Type: **Modified outcrop**		Plan view (not to scale)	View to: **Northwest**
Length (m): **3.5**	Width (m): **1.7**			
Height (m) (upslope): **.40** (downslope): **.50**	GPS Coordinates	E: **0185841** N: **2181608**		

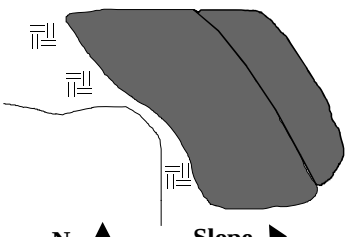
Description: **Consists of small to large *pāhoehoe* cobbles and slabs piled on a bedrock outcrop, some stacking on the northwestern end. East of the feature is a cleared soil area that may have been for planting.**

Probable clearing and planting feature.

Feature #: **269**	Type: **Mound**		Plan view (not to scale)	View to: **East**
Length (m): **3.5**	Width (m): **1.8**			
Height (m) (upslope): **.45** (downslope): **.70**	GPS Coordinates	E: **0185829** N: **2181622**		

Description: **Consists of medium sized *ʻaʻā* and *pāhoehoe* cobbles piled in a arc shape on soil ground surface.**

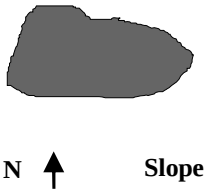
Probable clearing feature.

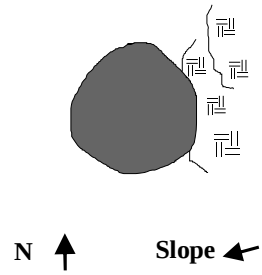
Feature #: **270**	Type: **Modified outcrop**		Plan view (not to scale)	View to: **East**
Length (m): **2.6**	Width (m): **1.5**			
Height (m) (upslope): **.40** (downslope): **.20**	GPS Coordinates	E: **0185870** N: **2181598**		

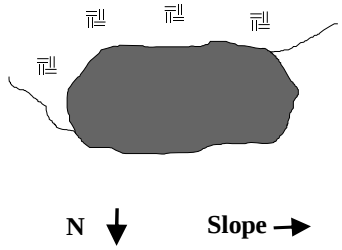
Description: **Consists of small and medium sized *pāhoehoe* cobbles piled on a bedrock outcrop. An alignment of small boulders is on top of the piled cobbles.**

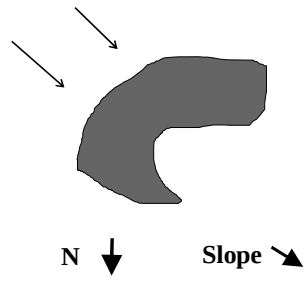
Probable clearing feature.

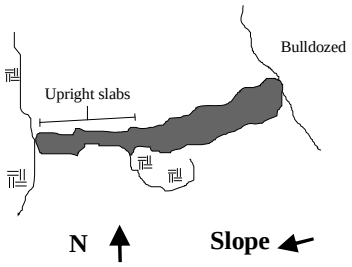
Feature #: **271**	Type: **Wall**		Plan view (not to scale)	View to: **West**
Length (m): **24**	Width (m): **1.7**		See Figure 40 of this report.	
Height (m) (upslope): **.40** (downslope): **.40**	GPS Coordinates	E: **0186187** N: **2181818**		
Description: **Consists of a wall composed piled small to large *pāhoehoe* cobbles in a relatively linear *mauka-makai* direction.** **Probable agricultural field boundary wall remnant.**				

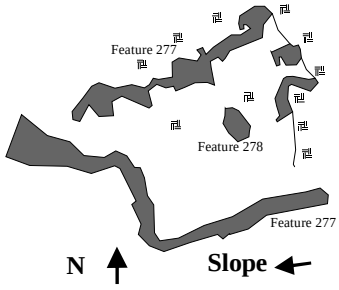
Feature #: **272**	Type: **Mound**		Plan view (not to scale)	View to: **Southeast**
Length (m): **2.2**	Width (m): **1.5**			
Height (m) (upslope): **.60** (downslope): **.50**	GPS Coordinates	E: **0185957** N: **2181767**		
Description: **Consists of loosely stacked large cobbles on the periphery with small and medium sized cobbles piled on the top. Possibly piled on bedrock, but none visible.** **Probable clearing feature.**				

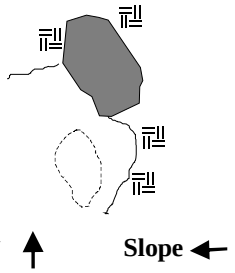
Feature #: **273**	Type: **Mound**		Plan view (not to scale)	View to: **Northwest**
Length (m): **1.9**	Width (m): **1.9**			
Height (m) (upslope): **.40** (downslope): **1.0**	GPS Coordinates	E: **0185931** N: **2181720**		
Description: **Consists of medium to large *pāhoehoe* cobbles piled in a circular shape on a soil and bedrock slope.** **Probable clearing feature.**				

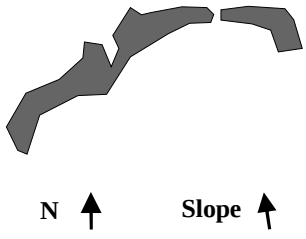
Feature #: **274**	Type: **Modified outcrop**		Plan view (not to scale)	View to: **West**
Length (m): **2.9**	Width (m): **1.4**			
Height (m) (upslope): **.20** (downslope): **.70**	GPS Coordinates	E: **0185811** N: **2181660**		
Description: **Consists of small to large *pāhoehoe* cobbles piled against the north side of a north/south running bedrock outcrop.** **Probable clearing feature.**				

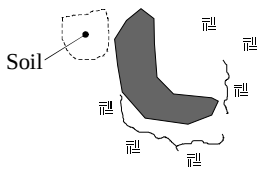
Feature #: **275**	Type: **Mound**		Plan view (not to scale)	View to: **Northeast**
Length (m): **3.1**	Width (m): **1**			
Height (m) (upslope): **.20** (downslope): **.75**	GPS Coordinates	E: **0185880** N: **2181845**		
Description: **Consists of an arc shape open to the west composed of piled small to large *ʻaʻā* cobbles. Feature is located at the base of a steep *ʻaʻā* cobble slope north of the northern bulldozer road in the western portion of the project area.** **Probable clearing feature.**				

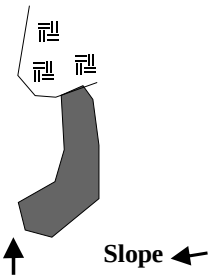
Feature #: **276**	Type: **Wall**		Plan view (not to scale)	View to: **Southeast**
Length (m): **8**	Width (m): **.80**			
Height (m) (upslope): **.60** (downslope): **.50**	GPS Coordinates	E: **0186065** N: **2181640**		
Description: **Consists of a remnant of a wall that was bulldozed at the eastern end. The western end is composed of aligned upright slabs set in soil, and the eastern end is composed of piled large cobbles. Western end abuts a bedrock outcrop. This may have continued to the east where dozing occurred. Function probably agricultural, but unknown due to disturbances.**				

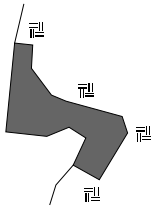
Feature #: **277**	Type: **Enclosure**		Plan view (not to scale)	View to: **Southeast**
Length (m): **33**	Width (m): **16**			
Height (m) (upslope): **0** (downslope): **1.0**	GPS Coordinates	E: **0186003** N: **2181702**		
Description: **North and east sides composed of modified outcrops, west and south sides composed of stacked walls. Interior is bedrock and patches of soil.** **Probable clearing and planting feature.**				

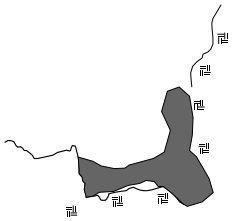
Feature #: **278**	Type: **Modified Outcrop**		Plan view (not to scale)	View to: **West**
Length (m): **4**	Width (m): **2**			
Height (m) (upslope): **.10** (downslope): **.50**	GPS Coordinates	E: **0186011** N: **2181711**		
Description: **Consists of a paved area between 2 low *pāhoehoe* outcrops. *Makai* edge is loosely stacked, southern edge 1-course of aligned cobbles, and the north and east edges are level with outcrops. Surface of feature is paved with small cobbles. Probable agricultural work surface, probably composed of cleared cobbles from planting areas. Soil to the south. Possible clearing pile.**				

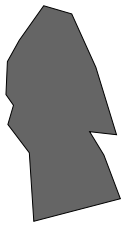
Feature #: **279**	Type: **Modified Outcrop**		Plan view (not to scale)	View to: **West**
Length (m): **30**	Width (m): **1.0-4.0**			
Height (m) (upslope): **.30** (downslope): **.50**	GPS Coordinates	E: **0186000** N: **2181747**		
Description: **Consists of an east-west running pile of small to large *pāhoehoe* cobbles on the edge of a sloping bedrock formation. To the south is level bedrock cleared of cobbles, and to the north is sloping bedrock.** Probable clearing feature.				

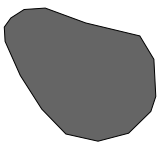
Feature #: **280**	Type: **Mound**		Plan view (not to scale)	View to: **Northwest**
Length (m): **7**	Width (m): **2**			
Height (m) (upslope): **.30** (downslope): **1.0**	GPS Coordinates	E: **0186035** N: **2181742**		
Description: **Consists of small to large cobbles piled in a curvilinear berm-like mound. Pile is among a cobble-covered ground surface, with bedrock on all sides except to the north. A cleared soil area is located west of the north end.** **Probable clearing feature.**				

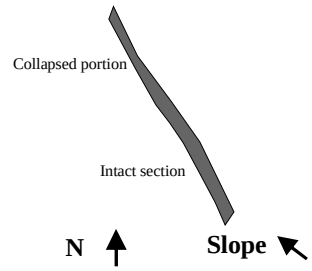
Feature #: **281**	Type: **Mound**		Plan view (not to scale)	View to: **North**
Length (m): **4**	Width (m): **1.5**			
Height (m) (upslope): **.25** (downslope): **.65**	GPS Coordinates	E: **0186037** N: **2181750**		
Description: **Consists of piled *pāhoehoe* cobbles in a berm-like linear mound. North end constructed up to an outcrop, the western edge slopes down to cobble-covered ground surface.** **Probable clearing feature.**				

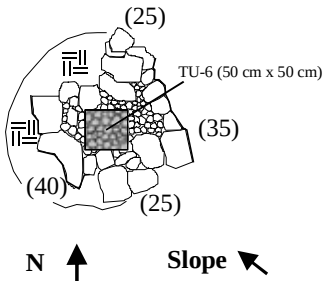
Feature #: **282**	Type: **Modified Outcrop**		Plan view (not to scale)	View to: **Northeast**
Length (m): **6**	Width (m): **5**			
Height (m) (upslope): **0** (downslope): **1.1**	GPS Coordinates	E: **0186046** N: **2181757**		
Description: **Consists of loosely stacked *pāhoehoe* large cobbles along the west and south edges, with cobbles piled on and against bedrock on the north side.** **Probable clearing feature.**				

Feature #: **283**	Type: **Modified outcrop**		Plan view (not to scale)	View to: **Southwest**
Length (m): **2**	Width (m): **0.5**			
Height (m) (upslope): **0** (downslope): **1.1**	GPS Coordinates	E: **0185722** N: **2181747**		
Description: **Consists of large cobbles, slabs, and boulders stacked against a bedrock outcrop.** **Probable clearing feature.**				

Feature #: **284**	Type: **Modified outcrop**		Plan view (not to scale)	View to: **South**
Length (m): **4.7**	Width (m): **3.2**			
Height (m) (upslope): **0** (downslope): **.20**	GPS Coordinates	E: **0185737** N: **2181242**		
Description: **Consists of small cobbles piled on a slope; large cobbles line the eastern edge.** **Probable clearing feature.**				

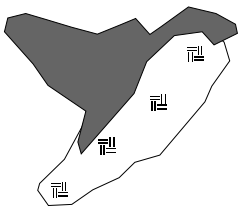
Feature #: **285**	Type: **Mound**		Plan view (not to scale)	View to: **Northwest**
Length (m): **3.4**	Width (m): **1.8**			
Height (m) (upslope): **.30** (downslope): **.70**	GPS Coordinates	E: **0185731** N: **2181735**		
Description: **Consists of small to large cobbles piled in an oval on bedrock and cobble covered ground surface.** **Probable clearing pile.**				

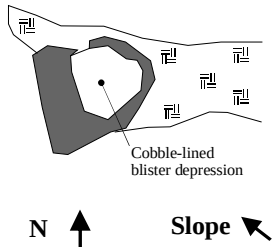
Feature #: **286**	Type: **Wall**		Plan view (not to scale)	View to: **East**
Length (m): **35**	Width (m): **1.2**			
Height (m) (upslope): **.90** (downslope): **.90**	GPS Coordinates	E: **0185910** N: **2181680**		
Description: **Consists of a northwest-southeast trending wall that is stacked 3-5 courses on the southern end, and collapsed on the northern end. Constructed on soil and cobble covered ground surface. The wall probably functioned as an agricultural field boundary.**				

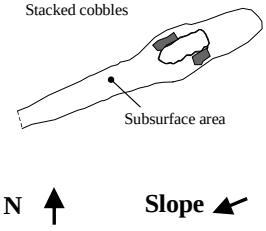
Feature #: **287**	Type: **Mound**		Plan view (not to scale)	View to: **North**
Length (m): **1.8**	Width (m): **1.5**			
Height (m) (upslope): **.35** (downslope): **.40**	GPS Coordinates	E: **0186099** N: **2181690**		
Description: **Consists of large *pāhoehoe* cobbles on the perimeter on a bedrock outcrop, with smaller cobbles in the center up to the top of the larger cobbles' top surface. A 0.5 x 0.5 meter test unit (TU-6) was excavated in the center to test for the possibility of a concealed blister entrance (see TU-6 description). Probable clearing feature. Possible clearing pile.**				

Feature #: **288**	Type: **Wall**		Plan view (not to scale)	View to:
Length (m): **46**	Width (m): **1.3**		See Figure 40 of this report	No photo available
Height (m) (upslope): **.50** (downslope): **.50**	GPS Coordinates	E: **0185700** N: **2181782**		
Description: **Consists of an east-west trending wall composed of small to large *pāhoehoe* cobbles and small boulders. The wall is stacked on both sides in places, and it also is constructed on the south side of a long bedrock outcrop at the eastern end. Wall truncated on the western end from bulldozing. The wall probably functioned as an agricultural field boundary wall. Possible clearing pile.**				

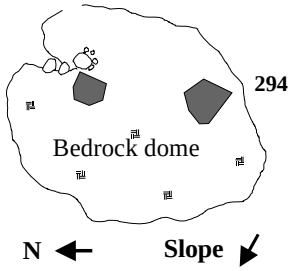
Feature #: **289**	Type: **Wall**		Plan view (not to scale)	View to:
Length (m): **8**	Width (m): **.90**		See Figure 40 of this report	No photo available
Height (m) (upslope): **.30** (downslope): **.30**	GPS Coordinates	E: **0185705** N: **2181785**		
Description: **Consists of a north-south running wall segment that was probably obliterated on the northern end by bulldozing. Its southern end intersects with Feature 288. The wall is low, and mostly collapsed. The wall probably functioned as an agricultural field boundary wall. Possible clearing pile.**				

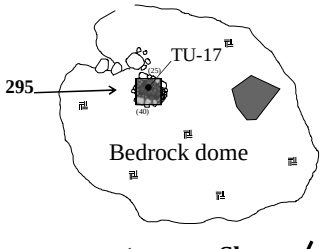
Feature #: **290**	Type: **Modified outcrop**		Plan view (not to scale)	View to: **Southeast**
Length (m): **5.7**	Width (m): **3**			
Height (m) (upslope): **.10** (downslope): **.55**	GPS Coordinates	E: **0185702** N: **2181747**		
Description: **Consists of small to large *pāhoehoe* cobbles and large slabs constructed on the *makai* side of a bedrock outcrop. Slabs placed flat like stepping stones, but no trail observed in the vicinity.** **Probable clearing feature.**				

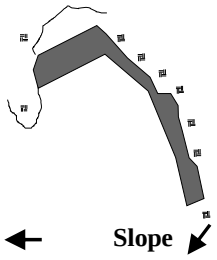
Feature #: **291**	Type: **Modified Outcrop**	Plan view (not to scale)	View to: **Northeast**
Length (m): **3**	Width (m): **2**		
Height (m) (upslope): **.80** (downslope): **.15**	GPS Coordinates E: **0186260** N: **2181727**		
Description: **Consists of a partial blister that is lined with stacked cobbles. Measures 2 meters in diameter. The western edge is a stacked wall that closes in the depression. Interior depth is approximately 1 meter.** **Probable planting feature.**			

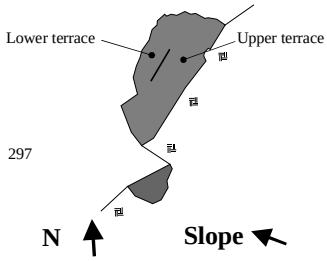
Feature #: **292**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **North**
Length (m): **10**	Width (m): **3**		
Height (m) (upslope): (downslope):	GPS Coordinates E: **0186209** N: **2181743**		
Description: **Consists of a blister with an opening that measures 3 meters by 1.2 meters. South and northwest of the opening are cobbles stacked 2 courses. Blister is 0.95 meter below ground surface; too narrow for habitation. Blister probably functioned as a storage area pertaining to agriculture.**			

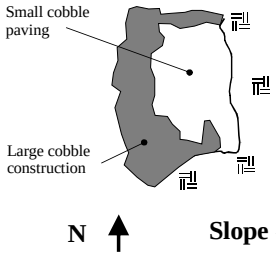
Feature #: **293**	Type: **Wall**	Plan view (not to scale)	View to: **East**
Length (m): **50**	Width (m): **2**	See Figure 40 of this report	
Height (m) (upslope): **.50** (downslope): **.80**	GPS Coordinates E: **0186200** N: **2181686**		
Description: **Consists of a *mauka-makai* wall composed of large cobbles and boulders. Formerly stacked, intact in a few places, mostly collapsed. Probably functioned as an agricultural field boundary.**			

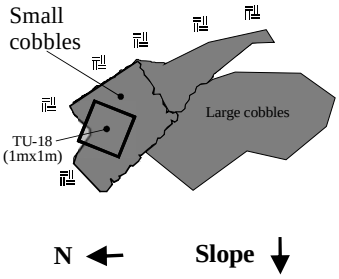
Feature #: **294**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **Northeast**
Length (m): **2**	Width (m): **1.5**		
Height (m) (upslope): **.20** (downslope): **.35**	GPS Coordinates E: **0185114** N: **2181644**		
Description: **Consists of large cobbles on the periphery in an irregular shape, with smaller cobbles in the interior creating a level surface. Constructed on the southern side of a bedrock dome formation. Probably functioned as a level surface for conducting agricultural activities upon. Possible clearing pile.**			

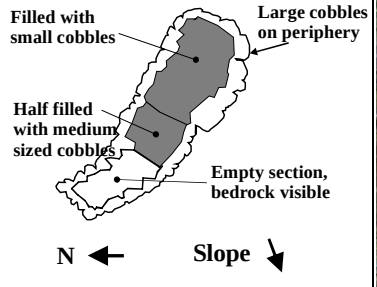
Feature #: **295**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **North**
Length (m): **1.5**	Width (m): **.50**		
Height (m) (upslope): **.20** (downslope): **.40**	GPS Coordinates E: **0186114** N: **2181647**		
Description: **Consists of large cobbles on the periphery in an irregular shape, with medium sized cobbles in the interior creating a level surface. Constructed on the northern side of a bedrock dome formation. A 1 x 1 meter test unit (TU-17) was excavated in the surface to test for the possibility of a human burial (see TU-17 description). Probable agricultural feature.**			

Feature #: **296**	Type: **Modified outcrop**		Plan view (not to scale)	View to: **Northeast**
Length (m): **9**	Width (m): **.80**			
Height (m) (upslope): **0** (downslope): **.40**	GPS Coordinates	E: **0185117** N: **2181653**		
Description: **Consists of aligned small boulders and large cobbles along a natural outcrop. Planting area to the north of the linear feature, and clearing pile on bedrock on the eastern end of the feature, which probably functioned as a planting area, modified outcrop probably the result of clearing cobbles from the planting area.**				

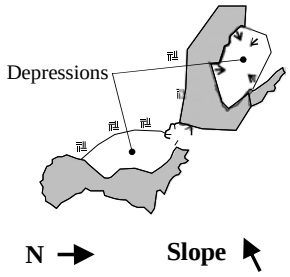
Feature #: **297**	Type: **Modified Outcrop**		Plan view (not to scale)	View to: **South**
Length (m): **11**	Width (m): **3.5**			
Height (m) (upslope): **0** (downslope): **.90**	GPS Coordinates	E: **0186076** N: **2181837**		
Description: Consists of a larger modified outcrop 1.5 meters north of a smaller modification on the same outcrop. The larger portion has 2 tiers and a level top surface. The features are composed of small and medium sized cobbles, with large cobbles stacked on the *makai* edges. Probable clearing pile.				

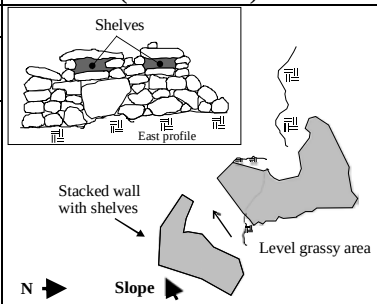
Feature #: **298**	Type: **Enclosure**		Plan view (not to scale)	View to: **North**
Length (m): **4.5**	Width (m): **3.5**			
Height (m) (upslope): **0** (downslope): **.80**	GPS Coordinates	E: **0186030** N: **2181636**		
Description: **Consists of piled cobbles on the western and northern sides, with bedrock along the eastern and southern edges. The interior floor is level and paved with small cobbles.** **Probable agricultural staging feature.**				

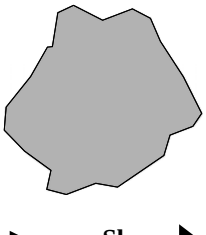
Feature #: **299**	Type: **Modified outcrop**		Plan view (not to scale)	View to: **Northeast**
Length (m): **3.5**	Width (m): **2**			
Height (m) (upslope): **0** (downslope): **.85**	GPS Coordinates	E: **0186074** N: **2181703**		
Description: **Consists of a filled crack in a bedrock outcrop. Possible *pāhoehoe* excavation, with loose stacking to the south, and along the *makai* edge. Large cobbles piled to the south. A 1 x 1 meter test unit was excavated in the northern portion of Feature 299 (see TU-18 description). The feature probably functioned as an agricultural related work surface.**				

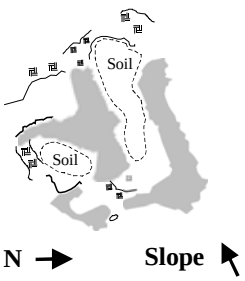
Feature #: **300**	Type: **Mound**		Plan view (not to scale)	View to: **Northwest**
Length (m): **6**	Width (m): **2.2**			
Height (m) (upslope): **.70** (downslope): **.40**	GPS Coordinates	E: **0186063** N: **2181847**		
Description: **Consists of a mound with stacked large cobbles and boulders on the periphery, then filled with medium cobbles with small cobbles on the top. The feature was not completed on the north end, it is void of cobble fill, and bedrock is visible inside the periphery cobble. Probable clearing feature.**				

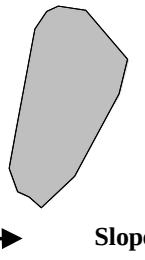
Feature #: **301**	Type: **Wall**		Plan view (not to scale)	View to: **West**
Length (m): **15**	Width (m): **1.3**		See Figure 40 of this report	
Height (m) (upslope): **.60** (downslope): **.60**	GPS Coordinates	E: **0186040** N: **2181822**		
Description: **Consists of an east-west running wall with stacked large cobbles on the edges, and filled in the interior with small cobbles creating a level top surface. The wall is low, and neatly constructed similar to clearing mounds in the vicinity.** **Probable field boundary.**				

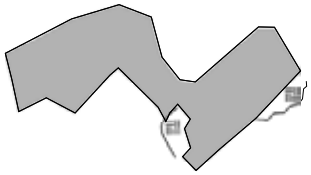
Feature #: **302**	Type: **Enclosure**		Plan view (not to scale)	View to: **South**
Length (m): **13**	Width (m): **5**			
Height (m) (upslope): **.55** (downslope): **0**	GPS Coordinates	E: **0186095** N: **2181804**		
Description: **Consists of 2 depressions with loose cobble stacking along the edges. Terrain consists of many cobbles and bedrock ground surface, with patches of soil in the area.** **Probable planting area.**				

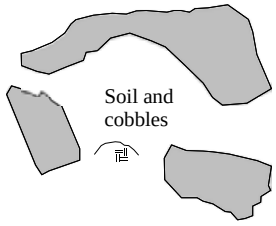
Feature #: **303**	Type: **Modified outcrop**		Plan view (not to scale)	View to: **East**
Length (m): **7**	Width (m): **3**			
Height (m) (upslope): **.50** (downslope): **.80**	GPS Coordinates	E: **0186100** N: **2181805**		
Description: **Consists of a stacked wall with shelves at the western end, with modifications to a bedrock slope to the north. The feature probably functioned as a storage feature (shelves) and clearing feature.**				

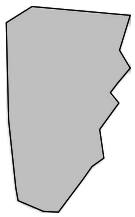
Feature #: **304**	Type: **Mound**		Plan view (not to scale)	View to: **South**
Length (m): **1.2**	Width (m): **1**			
Height (m) (upslope): **.30** (downslope): **.40**	GPS Coordinates	E: **0186089** N: **2181805**		
Description: **Consists of a pile of medium to large *pāhoehoe* cobbles and slabs on bedrock ground surface.** **Probable clearing pile.**				

Feature #: **305**	Type: **Enclosure**		Plan view (not to scale)	View to: **West**
Length (m): **10**	Width (m): **10**			
Height (m) (upslope): **.10** (downslope): **.50**	GPS Coordinates	E: **0185093** N: **2181810**		
Description: **Consists of piled small to large cobbles in linear, low walls on bedrock, cobble, and soil ground surface. Areas of cleared soil are located inside the enclosure. Enclosure was probably composed of cobbles cleared from planting areas inside.** **Probable clearing and planting feature.**				

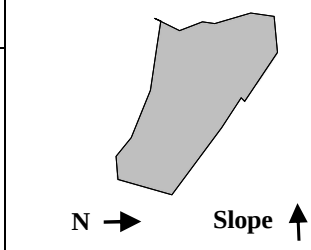
Feature #: **306**	Type: **Mound**		Plan view (not to scale)	View to: **Northeast**
Length (m): **2.5**	Width (m): **1.4**			
Height (m) (upslope): **.30** (downslope): **.40**	GPS Coordinates	E: **0186103** N: **2181810**		
Description: **Consists of large *pāhoehoe* cobbles on the periphery, with smaller cobbles piled on top. Constructed on bedrock.** **Probable clearing pile.**				

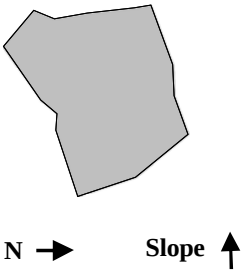
Feature #: **307**	Type: **Mound**		Plan view (not to scale)	View to: **South**
Length (m): **7**	Width (m): **4**			
Height (m) (upslope): **.35** (downslope): **.65**	GPS Coordinates	E: **0186107** N: **2181807**		
Description: **Consists of a Z-shape pile of small to medium sized *pāhoehoe* cobbles with a few slabs and large cobbles. Feature constructed on bedrock and soil ground surface.** **Probable clearing pile.**				

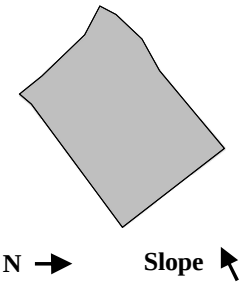
Feature #: **308**	Type: **Enclosure**		Plan view (not to scale)	View to: **Northeast**
Length (m): **7**	Width (m): **5**			
Height (m) (upslope): **.10** (downslope): **.60**	GPS Coordinates	E: **0186105** N: **2181800**		
Description: **Consists of a wall on the western edge, with modified outcrops on the eastern side that enclose a soil and cobble covered area. Loose stacking on the *makai* edge of the feature, composed of large *pāhoehoe* cobbles. Probable clearing and planting feature.**				

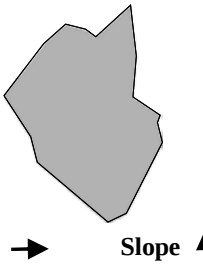
Feature #: **309**	Type: **Mound**		Plan view (not to scale)	View to: **Southwest**
Length (m): **3**	Width (m): **2**			
Height (m) (upslope): **0** (downslope): **.45**	GPS Coordinates	E: **0186105** N: **2181795**		
Description: **Consists of a crescent shaped pile of small to large *pāhoehoe* cobbles on a cobble covered ground surface.** **Probable clearing pile.**				

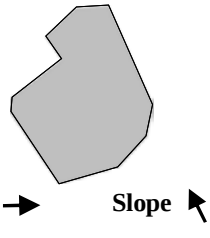
Feature #: **310**	Type: **Wall**		Plan view (not to scale)	View to: **West**
Length (m): **28**	Width (m): **1.5**			
Height (m) (upslope): **.30** (downslope): **.30**	GPS Coordinates	E: **0186120** N: **2181800**		
Description: **Consists of a low, mounded wall composed of mostly small to medium sized cobbles with a few large cobbles. Feature probably composed of material cleared from planting areas.** **Probable clearing feature.**				

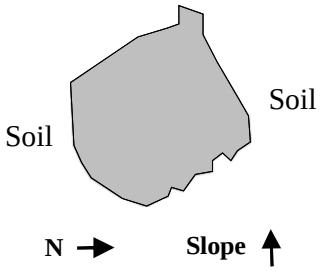
Feature #: **311**	Type: **Mound**	Plan view (not to scale)	View to: **West**
Length (m): **3**	Width (m): **1.3**		
Height (m) (upslope): **.45** (downslope): **.25**	GPS Coordinates E: **0186112** N: **2181800**		
Description: **Consists of stacked *pāhoehoe* cobbles on the periphery 1-2 courses, with smaller cobbles piled in the interior.** **Probable clearing pile.**			

Feature #: **312**	Type: **Mound**	Plan view (not to scale)	View to: **South**
Length (m): **2**	Width (m): **1.2**		
Height (m) (upslope): **.10** (downslope): **.20**	GPS Coordinates E: **0186115** N: **2181803**		
Description: **Consists of small to medium sized cobbles piled in a rectangular shape constructed on cobble and soil ground surface.** **Probable clearing pile.**			

Feature #: **313**	Type: **Mound**	Plan view (not to scale)	View to: **South**
Length (m): **1.3**	Width (m): **.90**		
Height (m) (upslope): **.25** (downslope): **.35**	GPS Coordinates E: **0186115** N: **2181803**		
Description: **Consists of loosely stacked medium to large cobbles in a rectangular shape constructed partially on a bedrock outcrop.** **Probable clearing pile.**			

Feature #: **314**	Type: **Modified outcrop**	Plan view (not to scale)	View to: **South**
Length (m): **2**	Width (m): **1**		
Height (m) (upslope): **.20** (downslope): **.50**	GPS Coordinates E: **0186116** N: **2181797**		
Description: **Consists of small to large cobbles piled on and against bedrock. A soil area may have been for planting to the west.** **Probable clearing pile.**			

Feature #: **315**	Type: **Modified Outcrop**	Plan view (not to scale)	View to: **Northeast**
Length (m): **2**	Width (m): **2**		
Height (m) (upslope): **.25** (downslope): **.50**	GPS Coordinates E: **0186123** N: **2181797**		
Description: **Consists of small to large cobbles and slabs stacked on *pāhoehoe* bedrock. An upright slab was utilized for retaining smaller cobbles on the western edge. Small cobbles are piled on the top.** **Probable clearing pile.**			

Feature #: **316**	Type: **Mound**	Plan view (not to scale)	View to: **East**
Length (m): **2**	Width (m): **2**		
Height (m) (upslope): **.20** (downslope): **.40**	GPS Coordinates E: **0186029** N: **2181803**		
Description: **Consists of a roughly square pile of small to medium sized *pāhoehoe* cobbles with a few large cobbles on bedrock ground surface. Soil area that may have been for planting are located all around this feature.** **Probable clearing pile.**			

Appendix J

RC-0427

An Archaeological Inventory Survey of a Proposed Holoholo Street Extension Across State-Owned Land (TMK:3-7-3-009:008 por.)

ʻOʻoma 2nd Ahupuaʻa
North Kona District
Island of Hawaiʻi

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ARCHAEOLOGICAL, CULTURAL, AND HISTORICAL STUDIES

An Archaeological Inventory Survey of a Proposed Holoholo Street Extension Across State-Owned Land (TMK:3-7-3-009:008 por.)

‘O‘oma 2nd Ahupua‘a
North Kona District
Island of Hawai‘i

RECHTMAN CONSULTING

EXECUTIVE SUMMARY

At the request of Brian Rupp of The Shopoff Group, Rechtman Consulting, LLC conducted an archaeological inventory survey of a road corridor for the proposed extension of Holoholo Street across State-owned land (TMK:3-7-3-009:008 por.) located in ʻOʻoma 2nd Ahupuaʻa, North Kona District, Island of Hawaiʻi (Figures 1 and 2). The parcel that the current survey corridor crosses was former Lot 58 of the ʻOʻoma Homesteads, a grant parcel that was applied for by Jno. Kainuku during the latter part of the nineteenth century. Historic records indicate, however, that the parcel was never patented, and thus has remained in the hands of the government up to the present day (Rechtman and Maly 2003). Four archaeological sites were recorded within the survey corridor as a result of the current study. The recorded sites include two core-filled boundary walls (Sites 23834 and 25527), an agricultural complex (Site 25528), and a Precontact habitation enclosure (Site 25529).

By far the most numerous features (n=24) present within the current project area are features of Site 25528. The features of Site 25528 appear, for the most part, to be clearing piles, but some could have been used as planting mounds. It is likely that Site 25528 was used primarily for the planting of sweet potato. The agricultural use of this area likely began during Precontact times and may have continued into Historic times (Clark and Rechtman 2005b). A single, small Precontact habitation site (Site 25529) was also recorded to the south of Site 25528. Site 25529 consists of a double enclosure with low rock walls that may have supported a roofed structure. The nature of the habitation that occurred at this site may have been short-term and recurrent, and primarily related to the agricultural use of the project area (Clark and Rechtman 2005b). The most recently constructed sites within the survey corridor consist of two historic walls (Sites 23834 and 25527) located along the northern and southern boundaries of TMK:3-7-3-0009:008. These sites are both core-filled boundary walls related to the historic use of parcels within the ʻOʻoma Homesteads.

Sites 23834, 25527, 25528, and 25529 are all considered significant under Criterion D for information they have yielded, and are likely to yield, relative to past life ways. Site 25527 is a historic boundary wall that is also the northern boundary wall of a historic ʻOʻoma Homestead road. Given its association with the homestead road the site is considered additionally significant under Criterion A. Site 23834 has a previously approved treatment from Haun and Henry (2003) of no further work, which is also the treatment recommended as a result of the current study. At Sites 25528 and 25529 the potential for further data collection remains, and as such, they are recommended for data recovery, and a data recovery plan should be prepared in consultation with DLNR-SHPD. Site 25527's association with a potential public right-of-way makes it a good candidate for preservation, which is the recommended treatment. An allowance must be made for a breach in the wall, however, as the extension of Holoholo Street would not be possible without crossing Site 25527.

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TABLES

INTRODUCTION

At the request of Brian Rupp of The Shopoff Group, Rechtman Consulting, LLC conducted an archaeological inventory survey of a road corridor for the proposed extension of Holoholo Street across State-owned land (TMK:3-7-3-009:008 por.) located in ʻOʻoma 2nd Ahupuaʻa, North Kona District, Island of Hawaiʻi (Figures 1 and 2). The parcel that the current survey corridor crosses was former Lot 58 of the ʻOʻoma Homesteads, a grant parcel that was applied for by Jno. Kainuku during the latter part of the nineteenth century. Historic records indicate, however, that the parcel was never patented, and thus has remained in the hands of the government up to the present day (Rechtman and Maly 2003). Four archaeological sites were recorded within the survey corridor as a result of the current study. This survey was performed in accordance with the Rules Governing Minimal Standards for Archaeological Inventory Surveys and Reports as contained in Hawaiʻi Administrative Rules 13§13–284. The current project was undertaken in compliance with both the historic preservation review process requirements of the Department of Land and Natural Resources-State Historic Preservation Division (DLNR-SHPD) and the County of Hawaiʻi Planning Department.

This report contains background information outlining the project area's physical and cultural contexts, a presentation of previous archaeological work in the immediate vicinity of the parcel, and current survey expectations based on that previous work. Also presented is an explanation of the project's methods, detailed description of the archaeological resources encountered, interpretation and evaluation of those resources, and treatment recommendations for all of the documented sites.

Project Area Description

The current project area consists of a portion of TMK:3-7-3-009:008, a 44.97-acre parcel owned by the State of Hawaiʻi, that is located in ʻOʻoma 2nd Ahupuaʻa, North Kona District, Island of Hawaiʻi (see Figures 1 and 2). The study area consists of a 60 to 130 meter wide corridor that runs from the southern termination of Holoholo Street (at the northern boundary of the State-owned parcel) across the entire parcel for a distance of approximately 330 meters. The project area is located at an elevation of slightly below 800 feet above sea level. Thin soil, described as Punuluʻu extremely rocky peat (rPYD), a black peat about four inches thick that overlies lava bedrock (Sato et al. 1973), is present in pockets over the entire project area. This soil has developed over weathered *pāhoehoe* and *ʻaʻā* lava flows that originated from Hualālai between 3,000 and 5,000 years ago (Wolfe and Morris 1996). Two distinct patterns of vegetation were noted within the project area (Figure 3): (1) vegetation over a large portion of the survey corridor consisted of open grassland with fountain grass and scattered small Christmas-berry (*Schinus terebinthifolius*) covering smooth *pāhoehoe* bedrock; and (2) pockets of vegetation in the extreme northern and southern portions of the survey corridor consisted of forestland with floral species that included silver oak (*Gravillea robusta*), *koa-haole* (*Leucaena leucocephala*), weeping fig (*Ficus benjamina*), *kukui* (*Aleurites moluccana*), guava (*Psidium guajava*), and Christmas-berry (*Schinus terebinthifolius*), air plants (*Bryophyllum pinnatum*) along with various other vines, grasses, shrubs, ferns, and weeds covering low-lying *pāhoehoe* and *ʻaʻā* lava flows.

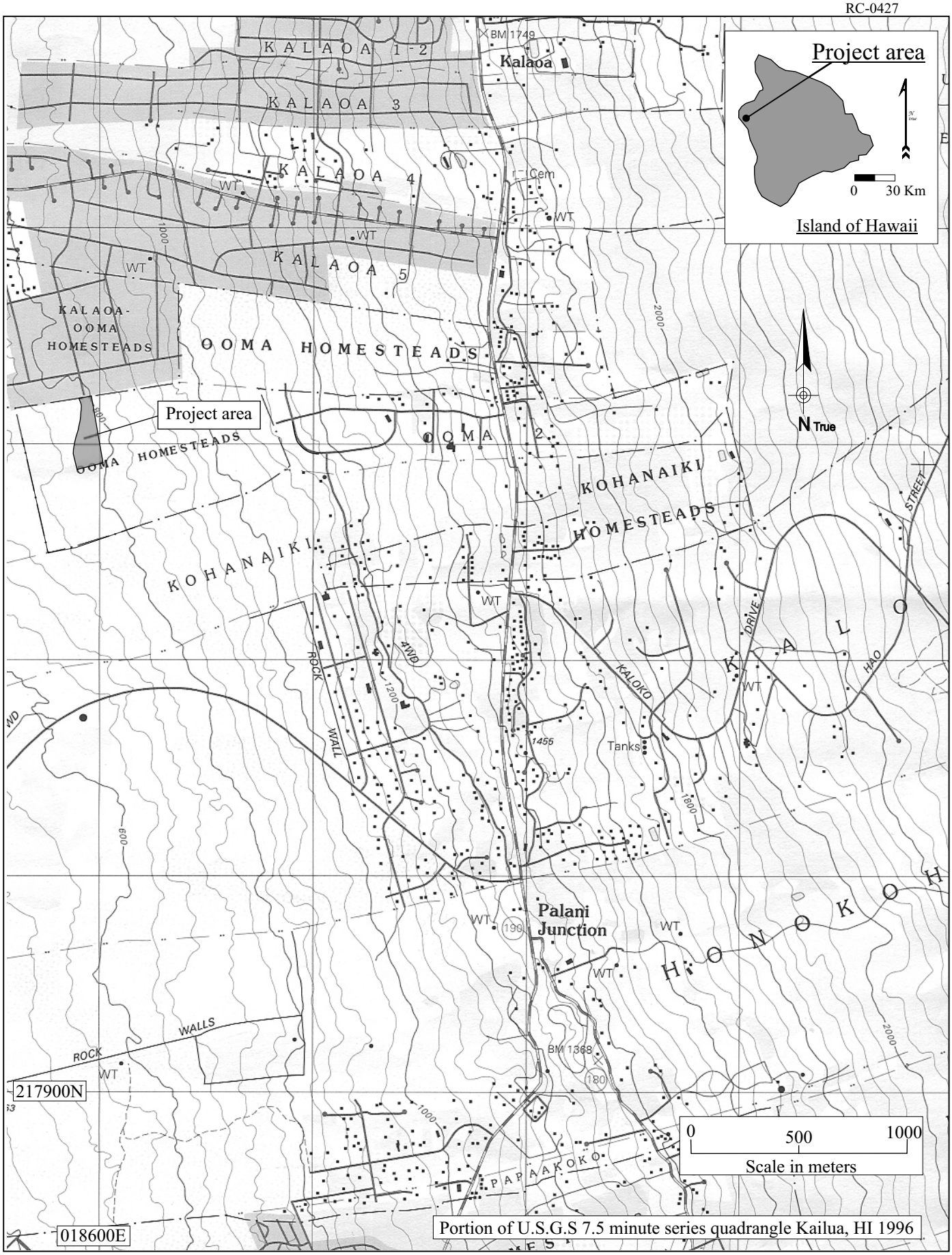

Figure 1. Project area location.

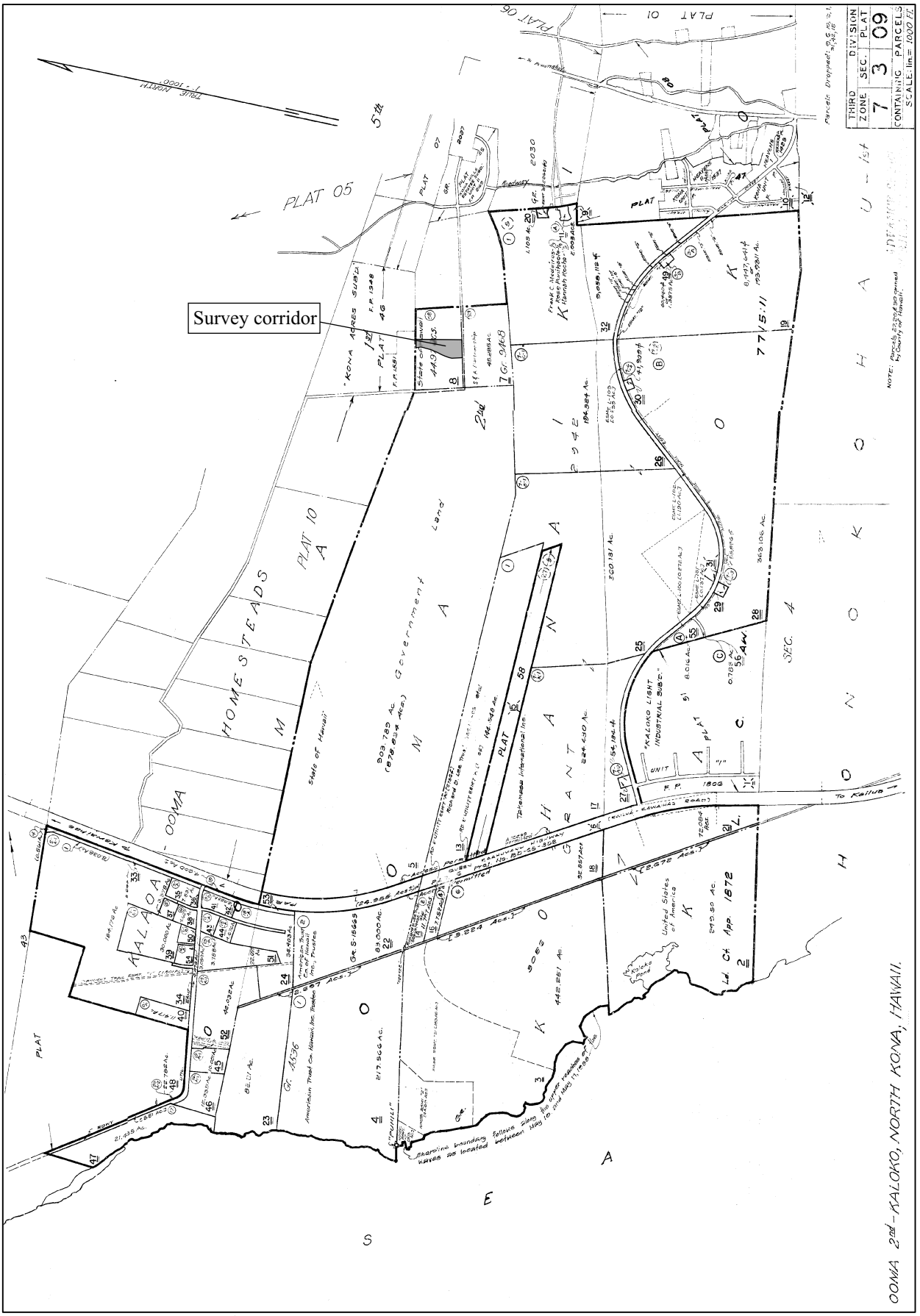

Figure 2. Tax Map Key (TMK):3-7-3-009 showing the current survey corridor across Parcel 008.

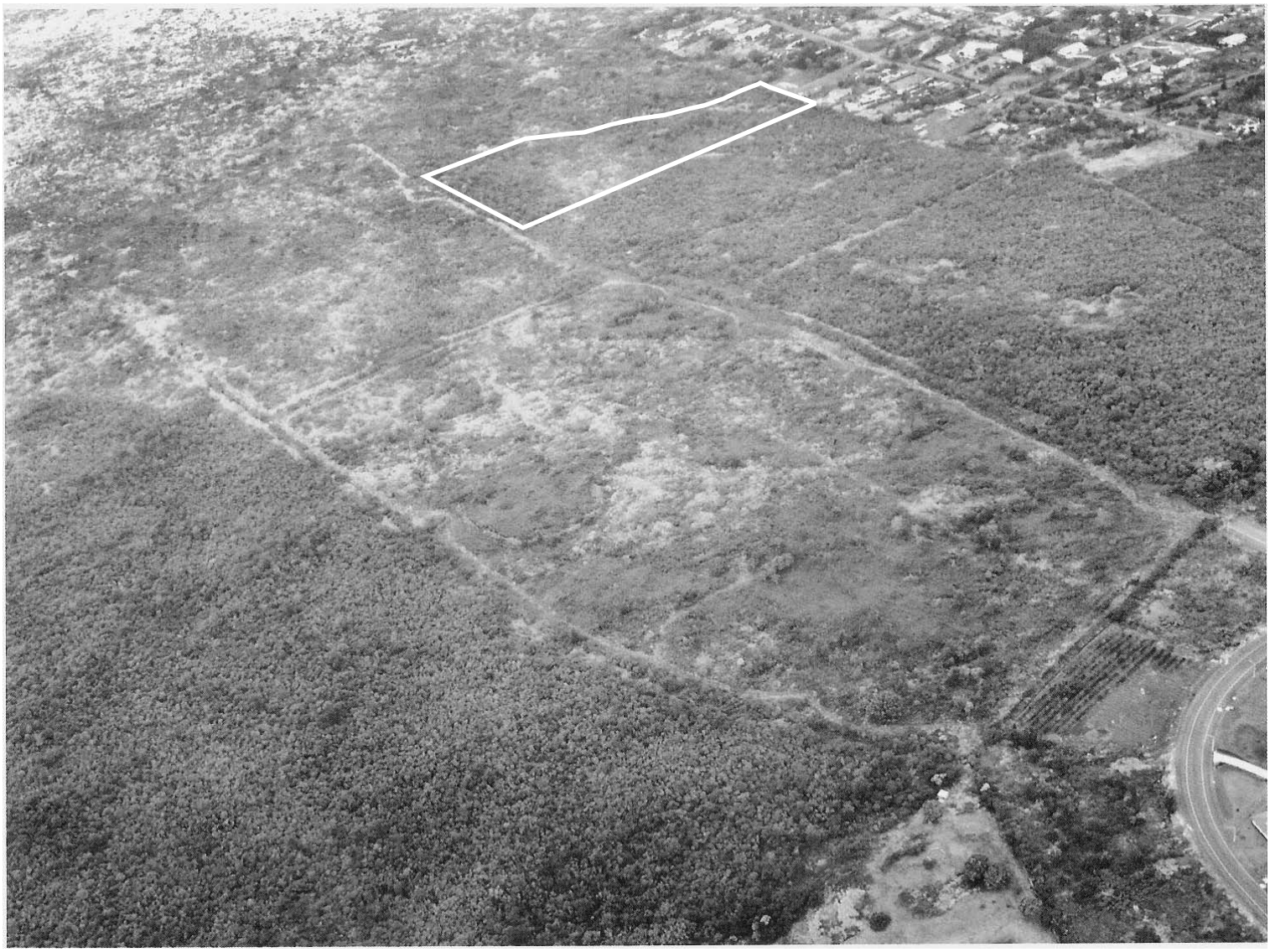

Figure 3. Aerial view of the project area to the northwest.

BACKGROUND

To generate set of expectations regarding the nature of archaeological resources that might be encountered on the study parcel, and to establish an environment within which to assess the significance of any such resources, previous archaeological studies relative to the project area and a historical context for the general North Kona region are presented.

Previous Archaeological Research

Thrum (1908) compiled the earliest systematic report on archaeological features—*heiau* or ceremonial sites—on the island of Hawai'i. Thrum's work was the result of literature review and field visits spanning several decades. Unfortunately, Thrum's work did not take him into ʻOʻoma, and his documentation on *heiau* ends at Lanihau, south of the study area; and picks up to the north, in the Puʻu Anahulu vicinity. Likewise, the 1906-1907, J.F.G. Stokes detailed field survey of *heiau* on the island of Hawaiʻi for the B. P. Pauahi Bishop Museum (Stokes and Dye 1991) stopped short of doing comprehensive work in the Kekaha region, and no sites were recorded in ʻOʻoma.

In 1929-1930, the Bishop Museum contracted John Reinecke to conduct a survey of Hawaiian sites in West Hawaiʻi, including ʻOʻoma and the Kekaha region (Reinecke n.d.). A portion of Reinecke's survey fieldwork extended north from Kailua as far as Kalāhuipuaʻa. His work being the first attempt at a survey of sites of varying function, ranging from ceremonial to residency and resource collection.

During his study, Reinecke traveled along the shore of Kekaha, documenting near-shore sites. Where he could, he spoke with the few native residents he encountered. Among his general descriptions of the Kekaha region, Reinecke observed:

> This coast formerly was the seat of a large population. Only a few years ago Keawaiki, now the permanent residence of one couple, was inhabited by about thirty-five Hawaiians. Kawaihae and Puako were the seat of several thousands, and smaller places numbered their inhabitants by the hundreds. Now there are perhaps fifty permanent inhabitants between Kailua and Kawaihae–certainly not over seventy-five.
>
> When the economy of Hawaii was based on fishing this was a fairly desirable coast; the fishing is good; there is a fairly abundant water supply of brackish water, some of it nearly fresh and very pleasant to the taste; and while there was no opportunity for agriculture on the beach, the more energetic Hawaiians could do some cultivation at a considerable distance *mauka*.
>
> The scarcity of remains is therefore disappointing. This I attribute to four reasons: (1) those simply over looked, especially those a short distance mauka, must have been numerous; (2) a number must have been destroyed, as everywhere, by man and by cattle grazing; (3) the coast is for the most part low and storm-swept, so that the most desirable building locations, on the coral beaches, have been repeatedly swept over and covered with loose coral and lava fragments, which have obscured hundreds of platforms and no doubt destroyed hundreds more; (4) many of the dwellings must have been built directly on the sand, as are those of the family at Kaupulehu, and when the posts have been pulled up, leave no trace after a very few years.
>
> The remains on this strip of coast have some special characteristics differentiating them from the rest in Kona. First, there is an unusual number of petroglyphs and papamu, especially about Kailua and at Kapalaoa. Second, probably because of the strong winds,

> there are many walled sites, both of houses and especially of temporary shelters… (Reinecke n.d.:1-2)

The following site descriptions are quoted from Reinecke's draft manuscript of fieldwork conducted between Pūhili Point on the Kohanaiki-ʻOʻoma 2nd boundary, and into Kalaoa 5th. In the site descriptions below, Reinecke references the occurrence of at least—6-house sites; 7 enclosures and pens (one of which is an "old cattle pen"); 11 terraces and platforms (one of which he felt was a "*heiau*"); 2 caves; 2 ahu; 1 stepping stone trail; 3 waterholes and a well; and 11 shelters. Apparently, no one was residing in the area at the time of his field survey.

Reinecke's site descriptions, south to north, across ʻOʻoma 2nd and ʻOʻoma 1st included:

> Site 66. Very doubtful dwelling site. Then a row of sand-covered platforms at the border of the sand and the beach lava, enough for 6-10 homes. Remains of an old, large pen.
>
> Site 67. Dry well on the crest of the beach.
>
> Site 68. Water hole, two small platforms, four or more shelters, pens with very small platform.
>
> Site 69. Large cattle pen. Doubtful old, rough platform at its north end. Remains of two old platforms by an ahu to the north.
>
> Site 70. Walled platform, S.E. corner terraced, badly broken down. Platform mauka. The walls of this and of Site 73 are built of thin places of pahoehoe surface lava, rather unusual in appearance. [Reinecke n.d.:15]
>
> Site 71. A knob partly walled on its slopes, with house site. Adjoining it on the south is a rough platform with three smooth boulders – heiau and kuula? Back of this a house platform and a platform about a fine shelter cave. Another platform and wall are about a slight natural depression filled with bones, including those of a whale.
>
> Site 72. Ruins of a pen.
>
> Site 73. Apparently a modern dwelling site of unusual construction; two terraces of pebbles, the upper 29x25x2 in front and 4-5' high elsewhere; the lower 19x10x25x3, with a three-sided pen at N.E.; surrounded by a carefully laid wall.
>
> Site 74. A shelter about a shallow cave; remains of another shelter; an ahu.
>
> Site 75. Trace of site; house platform; enclosure on shore. There are many faint traces of sites on this strip of coast. Toward the north is an unmistakable small site.
>
> Site 76. Modern shelter pen; house or shelter site; shelter mauka by kiawe tree.
>
> Site 77. Platform; tiny pen; sites of some kind marked by stones in lines on the pahoehoe flow.
>
> Site 78. Slightly brackish springs and pools; house site, shelters, stepping stone path leading to the walled house site… [Reinecke n.d.:16]

In more recent times, Haun and Henry (2003:8) indicate that 40 archaeological surveys and excavation projects have been conducted in ʻOʻoma Ahupuaʻa and the adjacent (to the north) *ahupuaʻa* of Kalaoa. These studies identified (not including the Haun and Henry study) "53 permanent habitations, 379 temporary habitations, 3,736 agricultural features, 25 burials, 17 ritual features, 34 trail segments, 65 *ahu*, and 18 petroglyphs," and, "two hundred and twenty-one habitation features [that] were not categorized by residential permanence" (2003:13). According to Haun and Henry (2003:13), dates from these studies indicate initial settlement of the area by A.D. 1400, with gradual increase in population during the 15th century, and the most intensive use from the 1600's through the early Historic period.

Ten previous archaeological studies, conducted at proximate locations to the current project area, are discussed in detail below. One of these studies, an assessment survey, crossed a portion of the current project area (Henry et al. 1993). Four studies were conducted in ʻOʻoma 2nd Ahupuaʻa to the south and east of the current project area (Clark and Rechtman 2005a, 2005b; Nelson et al. 2006; Drolet and Schilz 1991). Two other studies were conducted *makai* of the current project area within ʻOʻoma 2nd Ahupuaʻa (Rosendahl 1989; Walker and Rosendahl 1990). One study was conducted in ʻOʻoma 1st Ahupuaʻa to the northeast of the current project area (Haun and Henry 2003). Two studies were conducted in Kohanaiki Ahupuaʻa to the south of the current project area (Barrera 1991; Clark and Rechtman 2002). The findings of each of these studies is presented in chronological order below and their locations are depicted in Figure 4.

Rosendahl (1989) conducted an inventory survey of a 200-foot wide corridor in ʻOʻoma 2nd Ahupuaʻa for a proposed Kohana-Iki Resort water development project. The project area extended along the southern boundary of ʻOʻoma 2nd Ahupuaʻa from Queen Kaʻahumanu Highway (at approximately 80 feet above sea level) to approximately 760 feet above sea level (see Figure 4). As a result of that survey four archaeological sites were recorded. The sites included two *pāhoehoe* excavations located just above the highway (Site 5696), a ceremonial/habitation complex with an alignment, a cave, a rock shelter, two terraces, an enclosing wall, and a *papamū* located at 280 feet above sea level (Site 5697), a mound located at 440 feet above sea level (Site 5698), and a Historic boundary wall located at approximately 760 feet above sea level (Site 5699).

Walker and Rosendahl (1990) also conducted an inventory survey in ʻOʻoma 2nd Ahupuaʻa for the same proposed water development project. Their project area consisted of a 2,600-foot long by 300-foot wide corridor that extended from the Rosendahl (1989) corridor north along the 700-foot contour across the entire *ahupuaʻa* (see Figure 4). Walker and Rosendahl (1990) identified 13 sites that encompassed more than 27 features. Although the report is described as an inventory survey, only temporary site numbers were assigned and no detailed recording was undertaken. They did note, however, that:

> The principal types of sites and features identified were mounds of varying sizes possibly related to agricultural activities. Several caves (one containing human burial remains), enclosures, cairns, a trail segment, a boulder alignment, and a terrace were also noted. In addition to agriculture, functional feature types encountered include boundary, habitation, transportation, burial, and marker. (Walker and Rosendahl 1990:4)

A third inventory survey for the proposed water development project within ʻOʻoma 2nd was conducted by Drolet and Schilz (1991). Their survey area consisted of a 100-foot wide corridor that ran from the termination of the Rosendahl (1989) corridor at approximately 760 feet above sea level, along the northern boundary of Kohanaiki Ahupuaʻa, to approximately 900 feet above sea level. The corridor then turned north, widened to 200 feet and crossed the *makai* portion of the Clark and Rechtman (2005a) study area, terminating at the southern boundary of the Clark and Rechtman (2005b) study area (see Figure 4). This survey area encompassed approximately 8.8 acres and 29 archaeological sites containing 41 distinct features were recorded within its boundaries. Drolet and Schilz conclude that:

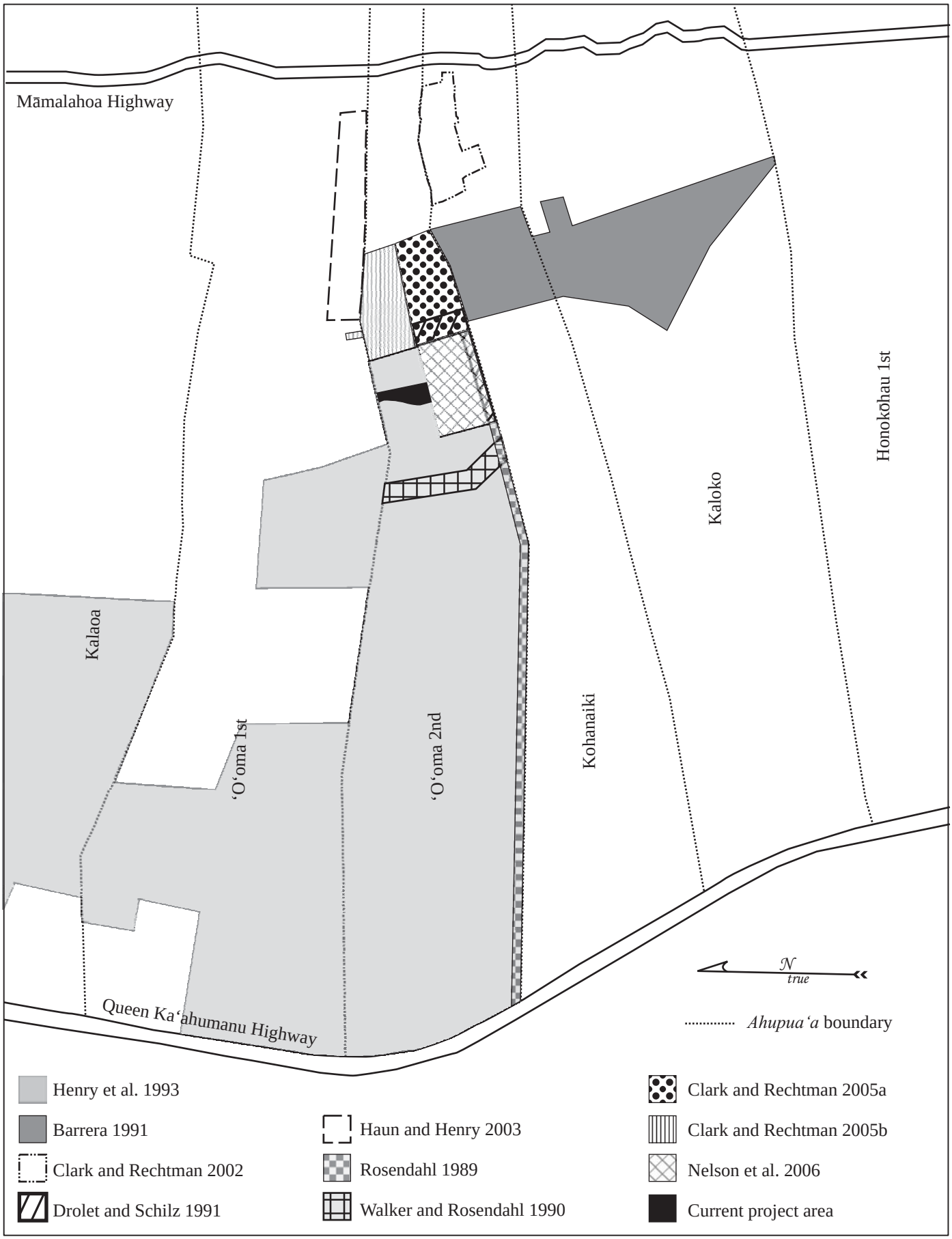

Figure 4. Previous archaeological studies in the vicinity of the current project area.

> The most common features found were cobble mounds. A total of 22 were found that included circular, oval, and linear forms. The mounds were presumably were constructed for agricultural use and suggest seasonal cropping of tuber plants such as sweet potato. Other types of features included one modified outcrop, one stone alignment, and two platforms, which appear to be associated with the agricultural mounds. There were four shelters located, each with evidence of temporary residence, and five enclosures, that also indicate habitation units. Four of the five enclosures were located within the cave sites. Finally, the last category of identified features included walls, nine of which were recorded. These were both high and low constructions. The presence of this latter type of wall construction suggests field divisions and possibly water diversion systems built during prehistoric occupation to facilitate agricultural development.
>
> All but three of the archaeological sites located appear to form a cluster of features dating to the late prehistoric period. The exceptions are Sites 16106, 16125, and 16126 that are historic walls reportedly built 60 to 70 years ago….
>
> There appears to be an important relationship between the cave complexes and the agricultural features found during the current survey. The lava tubes within the five clustered cave complexes located served as principal occupation sites, and the shallow midden deposits and limited structural constructions within these tubes suggest only temporary occupation and probably seasonal use. The dry farming garden features surrounding the caves also point to a seasonal cropping pattern. Clearly, the lack of soil build up within this zone, along with the deep lava deposits and lack of permanent water supply, had to have been factors that influenced the type of land use patterns evidenced in the archaeological record. (1991:30-32)

Barrera (1991) conducted an archaeological inventory survey and data recovery effort at two parcels (TMK: 3-7-3-09:1 and 17) within Kohanaiki and Kaloko *ahupua‘a* to the southeast of the current project area (see Figure 4). Barrera's study area ranged from 800 to 1,100 feet above sea level. As a result of the study, Barrera identified 140 archaeological sites that were located primarily within Kohanaiki Ahupua‘a. He attributed the scarcity of sites within Kaloko Ahupua‘a to "extensive recent land clearing that occurred there." Sixty-one of the sites were determined to lie within the boundaries of the Kohanaiki Homesteads, a collection of combined agricultural and residential lots (located to the south of the current project area) that were settled in the late 1800s. The majority of the remaining sites were determined to be components of the Kona Field System. These sites consisted primarily of *kuaiwi*, cross-walls, terraces, and mounds. Also several permanent and temporary habitations were identified, along with a single small *heiau* or men's house. Barrera (1991:63) suggests that human occupation of the project area began in the last quarter of the fifteenth century and continued unabated into the eighteenth century at which point there is a no residential population for nearly 150 years until the settlement of the Kohanaiki Homesteads.

Henry et al. (1993) conducted an archaeological assessment of approximately 2,640 acres of state owned lands in Makaula, Hale‘ohi‘u, Hamanamana, Kalaoa 1st-5th, and ‘O‘oma 1st and 2nd *ahupua‘a* (see Figure 4). The scope of work for the Henry et al. (1993) assessment included background research, variable coverage surface survey consisting of 6 roughly 100 meter wide *mauka*/*makai* transects that spanned the width of the project area at various intervals, and variable coverage helicopter survey. As a result of the study Henry et al. (1993) identified 42 sites within the 6 surface survey transects, 23 sites during the aerial survey, and an additional 32 sites that had been previously recorded during other studies. The sites included feature types such as lava tubes, alignments, cairns, walls, enclosures, *pāhoehoe* excavations, mounds, modified outcrops, terraces, platforms, trails, pavements, and petroglyphs that were interpreted as being used for agriculture, habitation, transportation, rock art, boundary marker, quarry, and ranching. All of the sites were plotted on a map of the project area. One of the 100-meter wide ground survey transects crossed the current project area, but no archaeological sites were recorded by Henry et al. (1993) nearby the current survey corridor.

Clark and Rechtman (2002) conducted an inventory survey of a fifty-two acre property (TMK: 3-7-3-7:27 and 50) in Kohanaiki Ahupua‘a to the southeast of the current project area (see Figure 4). As a result of that survey five archaeological sites were recorded, including an enclosure remnant (Site 23628), two stone terraces (Sites 23629 and 23630), and two sets of historic boundary walls (one set surrounding each parcel; Sites 23631 and 23632). Clark and Rechtman (2002:10) note that nearly the entire study area had been mechanically cleared to accommodate coffee cultivation, and that an interconnected series of old bulldozed access roads spanned the entire larger parcel (TMK: 3-7-3-7:50). In addition to this, several rusted 50-gallon metal drums (perhaps as many a 100) were noted over the entire project area. These drums were typically found in groups and, more often then not, they were located near one of the old bulldozed access roads. There was also ample evidence of more recent agricultural pursuits on the study parcels—*pakalolo* (*Cannabis*) cultivation. Clark and Rechtman (2002:10) identified a number of recently constructed rock rings (perhaps as many as 50) containing soil mixed with vermiculite and often associated with modern artifacts (i.e. fertilizer bags, rubber hose, plastic bottles, etc.). These rock rings varied widely in size and shape, but were all certainly of modern construction, and at least one was observed to be under cultivation.

Haun and Henry (2003) conducted an inventory survey of a roughly 41-acre parcel (TMK:3-7-3-7:40) in ‘O‘oma 1st Ahupua‘a to the northeast of the current project area (see Figure 4). The project area ranged in elevation from 980 to 1,280 feet above sea level. As a result of that survey twenty-one archaeological sites were recorded with an estimated 2,046 features. Haun and Henry report that:

> The sites are comprised of 14 single feature sites and eight complexes of features. The features consist of an estimated 1,105 modified outcrops and 788 mounds, 41 enclosures, 36 *kuaiwi*, 29 platforms, 21 terraces, ten walls, nine caves and seven field boundaries. Functionally, the features consist of agriculture (n=1,984), permanent habitation (n=32), livestock control (n=14), historic habitation (n=8), temporary habitation (n=6) storage (1), and burial (n=1). (2003:15)

Although the entire project area was subject to intensive pedestrian survey, Haun and Henry explain that:

> Hundreds of agricultural features, primarily mounds and modified outcrops, were identified throughout the parcel during the initial survey transects. A sample of these features was recorded in a 10 m wide transect extending across the entire parcel from east to west. Agricultural features within the transect were subjected to limited recording . . . Feature density values from the transect were used to estimate the total number of mounds and modified outcrops in the project area. Non-agricultural sites were subjected to detailed recording…(2003:4)

Of the non-agricultural sites, the six temporary habitations consisted exclusively of caves. Seven radiocarbon dates, ranging from A.D. 1400 to A.D. 1800, were obtained from these caves, with five of the dates falling between the 1400s to the mid-1600s (Haun and Henry 2003:80). Six Precontact permanent habitation sites and two Historic habitation sites were also recorded. The Precontact permanent habitations all included from one to three structure foundations consisting of terraces, platforms, and enclosures. Three of these sites were enclosed by walled yards. The Historic habitation sites both included significant amounts of Historic debris. Five Historic ranching walls were also recorded. The one burial site discovered during the inventory survey (Site 23826) consisted of a large rectangular platform with stacked sides. In addition to this, several more burials were inadvertently discovered within concealed lava blisters during the initial grubbing of the parcel.

In 2005, Rechtman Consulting, LLC (Clark and Rechtman 2005a) completed a study of a roughly 43-acre parcel (TMK:3-7-3-7:38; former Lot 57 of the ‘O‘oma Homesteads) located southeast of the current

project area within ʻOʻoma 2nd Ahupuaʻa (see Figure 4). As a result of that study three archaeological sites previously recorded by Drolet and Schilz (1991) (Sites 16106, 16125, and 16126) and twelve newly recorded sites (Sites 24413–24424) were identified on the subject parcel. Drolet and Schilz (1991) had recorded nineteen sites on the subject parcel, but due to widespread mechanical clearing of the property in 1994, only three were remaining (all boundary walls) at the time of the Clark and Rechtman (2005a) study.

Clark and Rechtman (2005a) noted that the fifteen sites recorded on TMK:3-7-3-7:38 represented nearly continual use of the parcel from Precontact times (perhaps as early as the 1400s; Haun and Henry 2003:80) to the 1940s. Historic sites located on the study parcel included the remains of a former residence that was occupied until ca. 1939 (Site 24422), the boundary walls that surrounded the entire parcel (Sites 16106, 16125, 16126, and 24423), a small enclosure of undetermined homesteading function (Site 24415), a large enclosure that may have functioned as a goat pen (Site 24414), and several core-filled wall segments that may have once formed several large enclosures on the property (Site 24416). Precontact sites recorded on the study parcel included a burial platform containing a slab-lined crypt with articulated human skeletal remains (Site 24413), a three-sided habitation enclosure (Site 24417), a modified outcrop (Site 24418), a stepping stone trail segment (Site 24419), a lava tube system containing four habitation areas near openings (Site 24420), two mounds (Site 24421), and a large lava tube that was used for water collection (Site 24424).

Clark and Rechtman (2005a) also suggested that the widespread mechanical clearing that occurred on the study parcel in 1994 drastically altered the earlier cultural landscape of the property. They cite earlier archaeological studies by Drolet and Schilz (1991) and Haun and Henry (2003), and historical research and oral interviews compiled by Rechtman and Maly (2003), that overwhelmingly indicate that the project area was likely blanketed by Precontact agricultural features prior to the land clearing. The extent and type of these potential features, however, could only be surmised based on the findings of these other studies.

Also in 2005, Rechtman Consulting, LLC (Clark and Rechtman 2005b) conducted an archaeological inventory survey of a 39.36 acre parcel (TMK:3-7-3-07:39) located in ʻOʻoma 2nd Ahupuaʻa, and an adjoining 43,706 square foot parcel (TMK:3-7-3-46:105) located in ʻOʻoma 1st Ahupuaʻa (see Figure 4). The larger parcel was formerly referred to as Lot 56 of the ʻOʻoma Homesteads. It was originally sold to E. M. Paiwa in 1898 as Grant 4273. The smaller parcel is a lot within the Kona Palisades Subdivision. These parcels are located to the east of the current study parcel and adjacent to the north of the Clark and Rechtman (2005a) study area.

As a result of the Clark and Rechtman (2005b) inventory survey seventeen archaeological sites were recorded on TMK:3-7-3-7:39 and a single archaeological site was recorded on TMK:3-7-3-46:105. The recorded sites included seven Historic walls (Sites 23834, 24759, 24769, 24770, 24771, 24772, and 24774), one Historic enclosure (Site 24760), a probable Historic roadway (Site 24775), two trail segments (Sites 24761 and 24763), a modified outcrop used for Precontact habitation purposes (Site 24762), a terrace used for Precontact habitation purposes (Site 24764), three Precontact lava blister habitations (Sites 24765, 24766, and 24767), one human burial within a lava blister (Site 24768), a Precontact habitation complex containing five features (Site 24773), and a large agricultural complex that spanned the entire larger parcel of the project area (Site 24776). Sixteen 1 x 1 meter test units were excavated at four of the recorded sites (Sites 24762, 24764, 24773, and 24776). Clark and Rechtman noted that:

> By far the most numerous features present [on TMK:3-7-3-7:39] are features of Site 24776. These features blanket the landscape and record the history of agricultural pursuits that occurred on the study parcels. Features of this site are found in loosely arranged fields over the entire project area, except in locales where it has been previously bulldozed or where no soil is present. All of the fields correspond to soil areas within the current project area and most are delineated by rough walls that run along their boundaries. The features of Site 24776 appear, for the most part, to be clearing piles, and

> it is likely that the fields were used primarily for the planting of sweet potatoes. The use of these fields likely began during Precontact times and continued into Historic times…
>
> Several small Precontact habitation sites are interspersed among the agricultural features of Site 24776. These sites include, a modified outcrop (Site 24762), a terrace (Site 24764), four lava blisters (Sites 24765, 24766, 24767, and 24768), and a complex containing five features (Site 24773). The nature of the habitation that occurred at these sites appears to have been short term and recurrent, and primarily related to the agricultural use of the project area. The four lava blisters are all small with cleared floors, each containing a few fragments of marine shell. These blisters would have offered shelter from rain or sun, but are not comfortable, and would likely have been utilized solely on a nightly, daily, or as needed basis. One of the lava blisters (Site 24768) also contained human skeletal remains and appears to have been used both for habitation and burial. The three remaining Precontact habitation sites are all above ground cobble constructions. Based on the findings of subsurface testing at these sites it is likely that the nature of habitation that occurred at them was of longer duration, or more frequent, than at the lava blisters. However, the use of these sites was also likely related to the Precontact agricultural use of the current project area.
>
> Two trail segments (Sites 24761 and 24763) that appear to date to the Precontact Period were also recorded on the study parcels. These trails likely accessed a network of trails that connected the people living and farming in this middle-upland area to other resource and habitation areas further *mauka* and *makai*. They also likely connected habitation areas to agricultural fields and other habitation areas. Unfortunately, only small sections of each trail could be traced across the *pāhoehoe* bedrock landscape of the current project area, making interpretation of discrete associations between these sites and other sites extremely difficult.
>
> The most recently constructed sites located on the study parcels include seven Historic walls (Sites 23834, 24759, 24769, 24770, 24771, 24772, and 24774), one Historic enclosure (Site 24760), and a probable Historic roadway (Site 24775). These sites are all likely related to the homesteading use of the current project area. E. M. Paiwa purchased the larger parcel of the current project area in 1898 as Grant 4273 (Lot 56 of the ʻOʻoma Homesteads), and the smaller parcel was a portion of Grant 1590 to Kauhini (Lot 43 of the ʻOʻoma Homesteads) in 1855 that was never perfected. Four of the Historic walls run along the boundaries of the larger parcel, while the remaining three are present within the confines of the larger parcel. The presence of these walls, along with the Historic enclosure, suggests that cattle ranching may have occurred on the study parcels at some point during Historic times. The Historic roadway may have accessed the current project area at some point in the past, but interpretation of this site is made difficult by the fact that it has been bulldozed at both ends and very little of the roadway remains. (2005b:131-132)

In 2006, Rechtman Consulting, LLC conducted an archaeological inventory survey of a roughly 45-acre parcel (TMK:3-7-3-009:007) located in ʻOʻoma 2nd Ahupuaʻa at an elevation of approximately 760 feet to 870 feet above sea level (Nelson et al. 2006). The parcel is located directly south of the current project area (see Figure 4), and was formerly referred to as Lot 59 of the ʻOʻoma Homesteads (Grant No. 9468). As a result of the survey Nelson et al. (2006) identified eleven archaeological sites previously recorded by Drolet and Schilz (1991), Rosendahl (1989), and Clark and Rechtman (2005a) (Sites 5699, 16103, 16105, 16106, 16107, 16125, 16126, 16127, 16128, 16131, 24424). They also recorded forty-two new sites (Sites 25034 to 25075). The recorded sites included one Historic habitation complex (Site 25034) and four Historic boundary walls (Sites 5699, 16106, 16125, and 16126), 24 above ground Precontact

habitation sites including nineteen complexes and five single feature sites (Sites 25035 to 25057), 2 Precontact habitation lava blisters (Sites 25061 and 25068), 12 Precontact lava tube habitation sites (Sites 16103, 16105, 16131, and 25059, 25060, 25062 to 25067, and 25069), 3 of which contained burials (Sites 16103, 16105, and 25069), 3 burial complexes (Sites 25070, 25071, and 25072), one burial platform (Site 16128), 3 trail segments (Sites 25073, 25074, and 25075), one large Precontact enclosure of uncertain function (Site 25058), a Precontact complex of uncertain function (Site 16127), one lava tube used exclusively for Precontact and Historic water collection purposes (Site 24424), and a large agricultural complex that spanned the entire project area (Site 16107). Nineteen test units were excavated at sixteen of the recorded sites.

Nelson et al. (2006) summarize their findings thusly:

> The most recent sites located on the study parcel include the remains of a Historic Period residential complex (24034) possibly used into the 1930s, and the boundary walls that surround the entire parcel (Sites 5699, 16106, 16125, and 16126). One of these walls is also the southern wall marking the former Homestead Road that was part of a system of roadways provided access to the grant lots in the area. With the exception of the wall along the Homestead road, these sites likely post-date the patenting of the study parcel by Hattie Kinoulu (grandmother of the current landowner), and are primarily related to cattle ranching and homesteading.
>
> The use of at least two sites on the subject parcel may have spanned Precontact and Historic times. One of these sites is the extensive agricultural complex and the other a lava tube (Sites 16107 and 24424). The project area (as reflected in Site 16107) appears to have been originally cultivated during the Precontact Period, as attested to by the numerous habitation sites dating to the era. We know from oral accounts that traditional cultivation practices, primarily sweet potatoes, on this land continued into the 1940s. Site 24424 appears to have been utilized nearly exclusively for water collection purposes. Several stone constructions were recorded within the tube that were strategically placed at the locations of dripping water. Two broken bottles discovered within Site 24424 are the only definitive evidence of Historic use of the lava tube. Water caves like Site 24424 would have enabled populations to live upon the land and sustain life in the arid environment of North Kona. Precontact peoples undoubtedly would have utilized this valuable resource to its fullest possible extent. Knowledge of the cave's location and value may have dwindled during Historic times as the *kama'āina* moved off the land and the old style of Hawaiian land management was replaced by a western style of land ownership. Use of the cave for water collection would have become obsolete as the Historic era progressed and new water collection and dispersal technology was brought to the island.
>
> During Precontact times habitation areas may have been chosen in large part based on the availability of potable water. In middle-upland areas of North Kona where there was ample rain (especially during the summer months) and access to drinking water, such as the current project area, people would have built residences and cultivated crops such as sweet potato (Cordy et al. 1991:557). The presence of the extensive lava tube (Site 24424) with evidence of water collection would have also been a significant factor in the location of residential sites. Cordy et al. (1991:558) suggest that the nature of habitation generally occurring within the elevational zone of the current project area was temporary, and perhaps recurrent. It seems logical that the use of these habitations may have been seasonal and related to the planting and harvesting cycles.
>
> A significant number (n=40) of Precontact habitation sites were recorded within the current project area (see Table 1). The density of such sites in this project area is much greater that in surrounding areas, and may be a function of the lack of substantial Historic and modern

ground altering activities. Conversely, it may be that this area saw a greater population density in Precontact times than in the surrounding area. The apparent presence of a consistent and reliable water source (Site 24424) may have played a factor in the high density of habitation sites. No matter what the reason, it seems clear that the Precontact residents of these habitation features were likely involved in agricultural pursuits.

Three of the Precontact habitations (Sites 16103, 16105, and 25069), all lava tubes, were also used for burial, perhaps indicating a temporally sensitive pattern in the use of residential space for burial purposes. Three sites (Sites 25070, 25071, and 25072), all surface complexes, were used exclusively for burial purposes. (2006:305)

Cultural and Historical Background

While the physical study area is limited to a portion of ʻOʻoma 2nd Ahupuaʻa that crosses TMK:3-7-3-009:008, in an effort to provide a comprehensive and holistic understanding of the current project area, this section of the report examines the entire *ahupuaʻa* and its relationship to neighboring lands within the larger Kekaha region. In 2003, Rechtman Consulting, LLC prepared a Cultural Impact Assessment for the proposed development of TMK:3-7-3-09:22 within coastal ʻOʻoma 2nd Ahupuaʻa (Rechtman and Maly 2003). Extensive research for that study was conducted by Kepā Maly of Kumu Pono Associates, and it included a review of archival-historical literature from both Hawaiian and English language sources, including an examination of Hawaiian Land Commission Award records from the *Māhele ʻĀina* (Land Division) of 1848; survey records of the Kingdom and Territory of Hawaiʻi; and historical texts authored or compiled by D. Malo (1951), J.P. Iʻi (1959), S. M. Kamakau (1961, 1964, 1976, and 1991), Wm. Ellis (1963), A. Fornander (1916-1919 and 1996), T. Thrum (1908), J.F.G. Stokes and T. Dye (1991), M. Beckwith (1970), Reinecke (n.d.); and Handy and Handy with Pukui (1972). That study also included several native accounts from Hawaiian language newspapers (compiled and translated from Hawaiian to English, by Kepā Maly), and historical narratives authored by eighteenth and nineteenth century visitors to the region. The information was presented within thematic categories by ordered chronological by the date of publication.

The archival-historical resources were located in the collections of the Hawaiʻi State Archives (HSA), State Land Division (LD), State Survey Division (SD), and State Bureau of Conveyances (BoC); the Bishop Museum Archives (BPBM); Hawaiian Historical Society (HHS); University of Hawaiʻi-Hilo Moʻokini Library; private family collections; and in the collection of Kumu Pono Associates.

Over the last ten years, Kepā Maly of Kumu Pono Associates has researched and prepared several detailed studies—in the form of review and translation of accounts from Hawaiian language newspapers, historical accounts recorded by Hawaiian and non-Hawaiian residents, and government land use records—for lands in the Kekaha region of which ʻOʻoma is a part. Kepā Maly has also conducted a number of detailed oral history interviews with elder *kamaʻāina* documenting their knowledge of the Kekaha region (including ʻOʻoma), and he undertook new interviews and further consultation as a part of the 2003 study. All of the interview participants (both past and present) shared their personal knowledge of the land and practices of the families who lived in ʻOʻoma and vicinity. One additional oral-historical interview with Mrs. Elizabeth (Kahananui) Lee was conducted by Clark and Rechtman (2005a) and it too is summarized below for the purposes of the current study.

As the information collected by Rechtman and Maly (2003) was so complete, this report presents only a slightly modified version of the cultural and historical background for ʻOʻoma Ahupuaʻa and the Kekaha region than was already generated. It is a comprehension of this background information that facilitates a more complete understanding of the potential significance of the resources that exist within the current study area.

Natural and Cultural Resources in a Hawaiian Context

In Hawaiian society, natural and cultural resources are one and the same. Native traditions describe the formation (the literal birth) of the Hawaiian Islands and the presence of life on and around them in the context of genealogical accounts. All forms in the natural environment, from the skies and mountain peaks, to the watered valleys and lava plains, and to the shoreline and ocean depths were believed to be embodiments of Hawaiian deities. One Hawaiian genealogical account, records that Wākea (the expanse of the sky–father) and Papa-hānau-moku (Papa—Earth-mother who gave birth to the islands)—also called Haumea-nui-hānau-wā-wā (Great Haumea—Woman-earth born time and time again)—and various gods and creative forces of nature, gave birth to the islands. Hawai‘i, the largest of the islands, was the first-born of these island children. As the Hawaiian genealogical account continues, we find that these same god-beings, or creative forces of nature who gave birth to the islands, were also the parents of the first man (Hāloa), and from this ancestor, all Hawaiian people are descended (cf. Beckwith 1970; Malo 1951:3; Pukui and Korn 1973). It was in this context of kinship, that the ancient Hawaiians addressed their environment and it is the basis of the Hawaiian system of land use.

An Overview of Hawaiian Settlement

Archaeologists and historians describe the inhabiting of these islands in the context of settlement that resulted from voyages taken across the open ocean. For many years, researchers have proposed that early Polynesian settlement voyages between Kahiki (the ancestral homelands of the Hawaiian gods and people) and Hawai‘i were underway by A.D. 300, with long distance voyages occurring fairly regularly through at least the thirteenth century. It has been generally reported that the sources of the early Hawaiian population—the Hawaiian Kahiki—were the Marquesas and Society Islands (Cordy 2000; Emory in Tatar 1982:16-18).

For generations following initial settlement, communities were clustered along the watered, windward (*ko‘olau*) shores of the Hawaiian Islands. Along the *ko‘olau* shores, streams flowed and rainfall was abundant, and agricultural production became established. The *ko‘olau* region also offered sheltered bays from which deep sea fisheries could be easily accessed, and near shore fisheries, enriched by nutrients carried in the fresh water, could be maintained in fishponds and coastal waters. It was around these bays that clusters of houses where families lived could be found (McEldowney 1979:15). In these early times, Hawai‘i’s inhabitants were primarily engaged in subsistence level agriculture and fishing (Handy et al. 1972:287).

Over a period of several centuries, areas with the richest natural resources became populated and perhaps crowded, and by about A.D. 900 to 1100, the population began expanding to the *kona* (leeward side) and more remote regions of the island (Cordy 2000:130). In Kona, communities were initially established along sheltered bays with access to fresh water and rich marine resources. The primary “chiefly” centers were established at several locations—the Kailua (Kaiakeakua) vicinity, Kahalu‘u-Keauhou, Ka‘awaloa-Kealakekua, and Hōnaunau. The communities shared extended familial relations, and there was an occupational focus on the collection of marine resources. By the fourteenth century, inland elevations to around the 3,000-foot level were being turned into a complex and rich system of dryland agricultural fields (today referred to as the Kona Field System). By the fifteenth century, residency in the uplands was becoming permanent, and there was an increasing separation of the chiefly class from the common people. In the sixteenth century the population stabilized and the *ahupua‘a* land management system was established as a socioeconomic unit (see Ellis 1963; Handy et al. 1972; Kamakau 1961; Kelly 1983; and Tomonari-Tuggle 1985).

In Kona, where there were no regularly flowing streams to the coast, access to potable water (*wai*), was of great importance and played a role in determining the areas of settlement. The waters of Kona were found in springs and caves (found from shore to the mountain lands), or procured from rain catchments and dewfall. Traditional and historic narratives abound with descriptions and names of water sources, and also

record that the forests were more extensive and extended much further seaward than they do today. These forests not only attracted rains from the clouds and provided shelter for cultivated crops, but also in dry times drew the *kēhau* and *kēwai* (mists and dew) from the upper mountain slopes to the low lands (see also traditional-historical narratives and oral history interviews in this study).

In the 1920s-1930s, Handy et al. (1972) conducted extensive research and field interviews with elder native Hawaiians. In lands of North and South Kona, they recorded native traditions describing agricultural practices and rituals associated with rains and water collection. Primary in these rituals and practices was the lore of Lono—a god of agriculture, fertility, and the rituals for inducing rainfall. Handy et al., observed:

> The sweet potato and gourd were suitable for cultivation in the drier areas of the islands. The cult of Lono was important in those areas, particularly in Kona on Hawai‘i . . . there were temples dedicated to Lono. The sweet potato was particularly the food of the common people. The festival in honor of Lono, preceding and during the rainy season, was essentially a festival for the whole people, in contrast to the war rite in honor of Ku which was a ritual identified with Ku as god of battle. (Handy et al. 1972:14)

Handy et al. (1972) noted that the worship of Lono was centered in Kona. Indeed, it was while Lono was dwelling at Keauhou, that he is said to have introduced taro, sweet potatoes, yams, sugarcane, bananas, and *‘awa* to Hawaiian farmers (Handy et al. 1972:14). The rituals of Lono "The father of waters" and the annual *Makahiki* festival, which honored Lono and which began before the coming of the *kona* (southerly) storms and lasted through the rainy season (the summer months), were of great importance to the native residents of this region (Handy et al. 1972: 523). The significance of rituals and ceremonial observances in cultivation and indeed in all aspects of life was of great importance to the well being of the ancient Hawaiians, and cannot be overemphasized, or overlooked when viewing traditional sites of the cultural landscape.

Hawaiian Land Use and Resource Management Practices

Over the generations, the ancient Hawaiians developed a sophisticated system of land and resources management. By the time ‘Umi-a-Līloa rose to rule the island of Hawai‘i in ca. 1525, the island (*moku-puni*) was divided into six districts or *moku-o-loko* (cf. Fornander 1973–Vol. II:100-102). On Hawai‘i, the district of Kona is one of six major *moku-o-loko* within the island. The district of Kona itself, extends from the shore across the entire volcanic mountain of Hualālai, and continues to the summit of Mauna Loa, where Kona is joined by the districts of Ka‘ū, Hilo, and Hāmākua. One traditional reference to the northern and southern-most coastal boundaries of Kona tells us of the district's extent:

> *Mai Ke-ahu-a-Lono i ke ‘ā o Kani-kū, a hō‘ea i ka ‘ūlei kolo o Manukā i Kaulanamauna e pili aku i Ka‘ū!*—From Keahualono [the Kona-Kohala boundary] on the rocky flats of Kanikū, to Kaulanamauna next to the crawling (tangled growth of) ‘ūlei bushes at Manukā, where Kona clings to Ka‘ū! (*Ka‘ao Ho‘oniua Pu‘uwai no Ka-Miki* in *Ka Hōkū o Hawai‘i*, September 13, 1917; Translated by Kepā Maly)

Kona, like other large districts on Hawai‘i, was further divided into ‘okana or kalana (regions of land smaller than the *moku-o-loko*, yet comprising a number of smaller units of land). In the region now known as Kona ‘akau (North Kona), there are several ancient regions (*kalana*) as well. The southern portion of North Kona was known as "Kona kai ‘ōpua" (interpretively translated as: Kona of the distant horizon clouds above the ocean), and included the area extending from Lanihau (the present-day vicinity of Kailua Town) to Pu‘uohau (now known as Red Hill). The northern-most portion of North Kona was called "Kekaha" (descriptive of an arid coastal place). Native residents of the region affectionately referred to their home as *Kekaha-wai-‘ole o nā Kona* (Waterless Kekaha of the Kona District), or simply as the *āina kaha*. It is within this region of Kekaha, that the lands of ‘O‘oma are found.

The *ahupua‘a* were also divided into smaller individual parcels of land (such as the *‘ili, kō‘ele, māla*, and *kīhāpai*, etc.), generally oriented in a *mauka-makai* direction, and often marked by stone alignments (*kuaiwi*). In these smaller land parcels the native tenants tended fields and cultivated crops necessary to sustain their families, and the chiefly communities with which they were associated. As long as sufficient tribute was offered and *kapu* (restrictions) were observed, the common people, who lived in a given *ahupua‘a* had access to most of the resources from mountain slopes to the ocean. These access rights were almost uniformly tied to residency on a particular land, and earned as a result of taking responsibility for stewardship of the natural environment, and supplying the needs of the *ali‘i* (see Kamakau 1961:372-377 and Malo 1951:63-67).

Entire *ahupua‘a*, or portions of the land were generally under the jurisdiction of appointed *konohiki* or lesser chief-landlords, who answered to an *ali‘i-‘ai-ahupua‘a* (chief who controlled the *ahupua‘a* resources). The *ali‘i-‘ai-ahupua‘a* in turn answered to an *ali‘i ‘ai moku* (chief who claimed the abundance of the entire district). Thus, *ahupua‘a* resources supported not only the *maka‘āinana* and *‘ohana* who lived on the land, but also contributed to the support of the royal community of regional and/or island kingdoms. This form of district subdividing was integral to Hawaiian life and was the product of strictly adhered to resources management planning. In this system, the land provided fruits and vegetables and some meat in the diet, and the ocean provided a wealth of protein resources. Also, in communities with long-term royal residents, divisions of labor (with specialists in various occupations on land and in procurement of marine resources) came to be strictly adhered to. It is in this cultural setting that we find ‘O‘oma and the present study area.

The *ahupua‘a* of ‘O‘oma (historically, ‘O‘oma 1st and 2nd) are two of some twenty ancient *ahupua‘a* within the *‘okana* of Kekaha-wai-‘ole. The place name ‘O‘oma can be literally translated as concave. To date, no tradition explaining the source of the place name has been located, though it is possible that the name refers to the indentation of the shoreline fronting a portion of ‘O‘oma. A few place names within ‘O‘oma were discussed in traditional accounts, thus we have some indication of the histories associated with this land.

While there are only limited native accounts that have been recorded about ‘O‘oma, we do know that the land was so esteemed, that during the youth of Kauikeaouli (later known as Kamehameha III), the young prince—son of Kamehameha I and his sacred wife Keōpūolani—was taken to be raised near the shore of ‘O‘oma under the care of his stewards from infancy until he was five years old (Kamakau 1961:263-264). Again, this is a significant part of the history of this land, as great consideration went into all aspects of the young king’s upbringing (see I‘i 1959 and Kamakau 1961).

The Environmental Setting of ‘O‘oma

The *ahupua‘a* of ‘O‘oma cross several environmental zones that are generally called *wao* in the Hawaiian language. These environmental zones include the near-shore fisheries and shoreline strand (*kahakai*) and the *kula kai/kula uka* (shoreward/inland plains). These regional zones were greatly desired as places of residence by the natives of the land.

While the *kula* region of ‘O‘oma and greater Kekaha is now likened to a volcanic desert, native and historic accounts describe or reference groves of native hardwood shrubs and trees such as *‘ūlei* (*Osteomeles anthyllidifolia*), *ēlama* (*Diospyros ferrea*), *uhiuhi* (*Caesalpina kavaiensis*), and *ohe* (*Reynoldsia sandwicensis*) extending across the land and growing some distance shoreward. The few rare and endangered plants found in the region, along with small remnant communities of native dryland forest (Char 1991) give an indication that there was a significant diversity of plants growing upon the *kula* lands prior to the introduction of ungulates.

The lower *kula* lands receive only about 20 inches of rainfall annually, and it is because of their dryness, the larger region of which ‘O‘oma is a part, is known as “Kekaha.” While on the surface, there appears to be little or no potable water to be found, the very lava flows which cover the land contain many

underground streams that are channeled through subterranean lava tubes which feed the springs, fishponds and anchialine ponds on the *kula kai* (coastal flats). Also in this region, on the flat lands, about a half-mile from the shore, is the famed *Alanui Aupuni* (Government Trail), built in 1847, at the order of Kamehameha III. This trail or government roadway, was built to meet the needs of changing transportation in the Hawaiian Kingdom, and in many places it overlays the older near shore *ala loa* (ancient foot trail that encircled the island).

Continuing into the *kula uka* (inland slopes), the environment changes as elevation increases. Based on historic surveys, it appears that ʻOʻoma ends at a survey station named Kuhiaka, 2,145 feet above sea level (cf. Register Map No. 1449). This zone is called the *wao kanaka* (region of man) and *wao nahele* (forest region). Rainfall increases to 30 or 40 inches annually, and taller forest growth occurred. This region provided native residents with shelter for residential and agricultural uses, and a wide range of natural resources that were of importance for religious, domestic, and economic purposes. In ʻOʻoma, this region is generally between the 1,200 to 2,200 foot elevation, and is crossed by the present-day Māmalahoa Highway. The highway is situated not far below the ancient *ala loa*, or foot trail, also known as Ke-alaʻehu, and was part of a regional trail system passing through Kona from Kaʻū and Kohala.

The ancient Hawaiians saw (as do many Hawaiians today) all things within their environment as being interrelated. That which was in the uplands shared a relationship with that which was in the lowlands, coastal region, and even in the sea. This relationship and identity with place worked in reverse as well, and the *ahupuaʻa* as a land unit was the thread which bound all things together in Hawaiian life. In an early account written by Kihe (in *Ka Hōkū o Hawaiʻi*, 1914-1917), with contributions by John Wise and Steven Desha Sr., the significance of the dry season in Kekaha and the custom of the people departing from the uplands for the coastal region is further described:

> *…ʻOia ka wā e neʻe ana ka lā iā Kona, hele a maloʻo ka ʻāina i ka ʻai kupakupa ʻia e ka lā, a o nā kānaka, nā liʻi o Kona, pūheʻe aku la a noho i kahakai kāhi o ka wai e ola ai nā kānaka* – It was during the season, when the sun moved over Kona, drying and devouring the land, that the chiefs and people fled from the uplands to dwell along the shore where water could be found to give life to the people. (*Ka Hōkū o Hawaiʻi*, April 5, 1917)

It appears that the practice of traveling between upland and coastal communities in the ʻOʻoma *ahupuaʻa* greatly decreased by the middle nineteenth century. Indeed, the only claimant for *kuleana* land in ʻOʻoma, during the *Māhele ʻĀina* of 1848—when native tenants were allowed to lay claim to lands on which they lived and cultivated—noted that he was the only resident in ʻOʻoma at the time (see *Helu* 9162 to Kahelekahi, in this study). This is perhaps explained by the fact that at time of the *Māhele* there was a significant decline in the Hawaiian population, and changes in Hawaiian land tenure led to the relocation of many individuals from various lands.

Native Traditions and Historical Accounts of ʻOʻoma and the Kekaha Region

This section of the study presents *moʻolelo*—native traditions and historical accounts (some translated from the original Hawaiian by Kepā Maly)—of the Kekaha region that span several centuries. There are very few accounts that have been found to date, that specifically mention ʻOʻoma. Thus, narratives that describe neighboring lands within the Kekaha region help provide an understanding of the history of ʻOʻoma, describing features and the use of resources that were encountered on the land.

It may be, that the reason there are so few accounts for ʻOʻoma, is that it may have been considered a marginal settlement area, occupied only after the better situated lands of Kekaha—those lands with the sheltered bays, and where fresh water could be easily obtained—were populated. As the island population

grew, so too did the need to expand to more remote or marginal lands. This thought is found in some of the native traditions and early historic accounts below. However, as people populated the Kekaha lands, they came to value its fisheries—those of the deep sea, near shore, and inland fishponds.

The native account of Punia (also written Puniaiki – cf. Kamakau 1964), is perhaps among the earliest accounts of the Kekaha area, and in it is found a native explanation for the late settlement of Kekaha. The following narratives are paraphrased from Fornander's *Hawaiian Antiquities and Folklore* (Fornander 1959):

Punia: A Tale of Sharks and Ghosts of Kekaha

Punia was born in the district of Kohala, and was one of the children of Hina. One day, Punia desired to get lobster for his mother to eat, but she warned him of Kaiʻaleʻale and his hoards of sharks who guarded the caves in which lobster were found. These sharks were greatly feared by all who lived along, and fished the shores of Kohala for many people had been killed by the sharks. Heeding his mother's warning, Punia observed the habits of the sharks and devised a plan by which to kill each of the sharks. Setting his plan in motion, Punia brought about the deaths of all the subordinate sharks, leaving only Kaiʻaleʻale behind. Punia tricked Kaiʻaleʻale into swallowing him whole. Once inside Kaiʻaleʻale, Punia rubbed two sticks together to make a fire to cook the sweet potatoes he had brought with him. He also scraped the insides of Kaiʻaleʻale, causing great pain to the shark. In his weakened state, Kaiʻaleʻale swam along the coast of Kekaha, and finally beached himself at Alula, near the point of Maliu in the land of Kealakehe. The people of Alula, cut open the shark and Punia was released.

At that time Alula was the only place in all of Kekaha where people could live, for all the rest of the area was inhabited by ghosts. When Punia was released from the shark, he began walking along the trail, to return to Kohala. While on this walk, he saw several ghosts with nets all busy tying stones for sinkers to the bottom of the nets, and Punia called out in a chant trying to deceive the ghosts and save himself:

Auwe no hoi kuu makuakane	Alas, O my father of these coasts!
	o keia kaha e!
Elua wale no maua lawaia o keia wahi.	We were the only two fishermen of this place (Kaha).
Owau no o koʻu makuakane,	Myself and my father,
E hoowili aku ai maua i ka ia o ianei,	Where we used to twist the fish up in the nets,
O kala, o ka uhu, o ka palani,	The kala, the uhu, the palani,
O ka ia ku o ua wahi nei la,	The transient fish of this place.
Ua hele wale ia no e maua keia kai la!	We have traveled over all these seas,
Pau na kuuna, na lua, na puka ia.	All the different place, the holes, the runs.
Make koʻu makuakane, koe au.	Since you are dead, father, I am the only one left.

Hearing Punia's wailing, the ghosts said among themselves, "Our nets will be of some use now, since here comes a man who is acquainted with this place and we will not be letting down our nets in the wrong place." They then called out to Punia, "Come here." When Punia went to the ghosts, he explained to them, the reason for his lamenting; "I am crying because of my father, this is the place where we used to fish. When I saw the lava rocks, I thought of him." Thinking to trick Punia and learn where all the kuʻuna (net fishing grounds) were, the ghosts told Punia that they would work under him. Punia

> went into the ocean, and one-by-one and two-by-two, he called the ghosts into the water with him, instructing them to dive below the surface. As each ghost dove into the water, Punia twisted the net entangling the ghosts. This was done until all but one of the ghosts had been killed. That ghost fled and Kekaha became safe for human habitation (Fornander 1959:9-17).

One of the earliest datable accounts that describes the importance of the Kekaha region fisheries comes from the mid-sixteenth century, following ʻUmi-a-Līloa's unification of the island of Hawaiʻi under his rule. Writing in the 1860s, native historian, Samuel Mānaiakalani Kamakau (1961) told readers about the reign of ʻUmi, and his visits to Kekaha:

> ʻUmi-a-Liloa did two things with his own hands, farming and fishing...and farming was done on all the lands. Much of this was done in Kona. He was noted for his skill in fishing and was called Puʻipuʻi a ka lawaiʻa (a stalwart fisherman). Aku fishing was his favorite occupation, and it often took him to the beaches (Ke-kaha) from Kalahuipuaʻa to Makaula[1]. He also fished for ʻahi and kala. He was accompanied by famed fishermen such as Pae, Kahuna, and all of the chiefs of his kingdom. He set apart fishing, farming and other practices… (Kamakau 1961:19-20)

In his accounts of events at the end of ʻUmi's life, Kamakau (1961) references Kekaha once again. He records that Koʻi, one of the faithful supporters and a foster son of ʻUmi, sailed to Kekaha, where he killed a man who resembled ʻUmi. Koʻi then took the body and sailed to Makaʻeo in the *ahupuaʻa* of Keahuolu. Landing at Makaʻeo in the night, Koʻi took the body to the cave where ʻUmi's body lay. Replacing ʻUmi's body with that of the other man, Koʻi then crossed the lava beds, returning to his canoe at Makaʻeo. From there, ʻUmi's body was taken to its' final resting place… (Kamakau 1961:32-33).

As a child in ca. 1812, Hawaiian historian John Papa Iʻi passed along the shores of Kekaha in a sailing ship, as a part of the procession by which Kamehameha I returned to Kailua-Kona from his residency on Oʻahu. In his narratives, Iʻi described the shiny lava flows and fishing canoe fleets of the "Kaha" (Kekaha) lands:

> The ship arrived outside of Kaelehuluhulu, where the fleet for aku fishing had been since the early morning hours. The sustenance of those lands was fish.
>
> When the sun was rather high, the boy [Iʻi] exclaimed, "How beautiful that flowing water is!" Those who recognized it, however, said, "That is not water, but pahoehoe. When the sun strikes it, it glistens, and you mistake it for water…"
>
> Soon the fishing canoes from Kawaihae, the Kaha lands, and Ooma drew close to the ship to trade for the paʻiʻai (hard poi) carried on board, and shortly a great quantity of aku lay silvery-hued on the deck. The fishes were cut into pieces and mashed; and all those aboard fell to and ate, the women by themselves.
>
> The gentle Eka sea breeze of the land was blowing when the ship sailed past the lands of the Mahaiulas, Awalua, Haleohiu, Kalaoas, Hoona, on to Oomas, Kohanaiki, Kaloko, Honokohaus, and Kealakehe, then around the cape of Hiiakanoholae… (Iʻi 1959:109-110)

[1] Kalāhuipuaʻa is situated in the district of Kohala, bounding the northern side of Puʻuanahulu in Kekaha. Makaʻula is situated a few *ahupuaʻa* north of ʻOʻoma.

Ka-Lani-Kau-i-ke-Aouli (Kamehameha III)

In ca. 1813, Ka-lani Kau-i-ke-aouli, who grew up to become Kamehameha III, was born. S.M. Kamakau (1961) tells us that the baby appeared to be still-born, but that shortly after birth, he was revived. Upon the revival of the baby, he was given to the care of Ka-iki-o-ʻewa, who with Keawe-a-mahi and family, raised the child in seclusion at ʻOʻoma for the first five years of the young king's life. Kauikeaouli apparently held some interest in the land of ʻOʻoma 2nd through the Māhele ʻĀina, as he originally claimed ʻOʻoma 2nd as his personal property. Though he subsequently gave it up to the Kingdom (Government) later during the Division (see records of *Māhele ʻĀina* in this study).

Kamakau provides us with the following description of Kauikeaouli's birth and early life at ʻOʻoma:

> Ka-lani-kau-i-ke-aouli was the second son of Ke-opu-o-lani by Kamehameha, and she called him Kiwalaʻo after her own father. She was the daughter of Kiwalaʻo and Ke-kuʻi-apo-iwa Liliha, both children of Ka-Iola Pupuka-o-Hono-ka-wai-lani, and hence she [Ke-opu-o- lani] was a niʻaupiʻo and a naha chiefess, and the niʻaupiʻo rank descended to her children and could not be lost by them. While she was carrying the child [Kau-i-ke-aouli] several of the chiefs begged to have the bringing up of the child, but she refused until her kahu, Ka-lua-i-konahale, known as Kua-kini, came with the same request. She bade him be at her side when the child was born lest some one else get possession of it. He was living this side of Keauhou in North Kona, and Ke-opu-o-lani lived on the opposite side.
>
> On the night of the birth the chiefs gathered about the mother. Early in the morning the child was born but as it appeared to be stillborn Kua-kini did not want to take it. Then came Ka-iki-o-ʻewa from some miles away, close to Kuamoʻo, and brought with him his prophet who said, "The child will not die, he will live." This man, Ka-malo-ʻihi or Ka-pihe by name, came from the Napua line of kahunas descended from Makua-kau-mana whose god was Ka-ʻonohi-o-ka-la (similar to the child of God). The child was well cleaned and laid upon a consecrated place and the seer (kaula) took a fan (peʻahi), fanned the child, prayed, and sprinkled it with water, at the same time reciting a prayer addressed to the child of God, something like that used by the Roman Catholics—
>
> "He is standing up, he is taking a step, he walks" (*Kulia-la, kaʻina-la, hele ia la*).
>
> Or another—
>
> | | |
> |---|---|
> | *Huila ka lani i ke Akua,* | The heavens lighten with the god, |
> | *Lapalapa ka honua i ke keiki* | The earth burns with the child, |
> | *E ke keiki e, hooua i ka punohu lani,* | O son, pour down the rain that brings the rainbow, [page 263] |
> | *Aia i ka lani ka Haku e,* | There in heaven is the Lord. |
> | *O kuʻu ʻuhane e kahe mau,* | Life flows through my spirit, |
> | *I laʻa i kou kanawai.* | Dedicated to your law. |
>
> The child began to move, then to make sounds, and at last it came to life. The seer gave the boy the name of "The red trail" (Ke-aweawe-ʻula) signifying the roadway by which the god descends from the heavens.
>
> Ka-iki-o-ʻewa became the boy's guardian and took him to rear in an out-of-the-way place at ʻOʻoma, Kekaha. Here Keawe-a-mahi, the lesser chiefs, the younger brothers and sisters of Ka-iki-o-ʻewa, and their friends were permitted to carry the child about and hold him on their laps (uha). Ka-pololu was the chief who attended him; Koʻi-

> pepeleleu and Ulu-nui's mother [were] the nurses who suckled him. Later Ka-ʻai-kane gave him her breast after she had given birth to Ke-kahu-puʻu. Here at ʻOʻoma he was brought up until his fifth year, chiefly occupied with his toy boats rigged like warships and with little brass cannon loaded with real powder mounted on [their] decks. The firing off of these cannon amused him immensely. He excelled in foot races. On one occasion when the bigger boys had joined in the sport, a [rascal] boy named Ka-hoa thought to play a practical joke by smearing with mud the stake set up to be grasped by the one who first reached the goal. He expected one of the larger boys to be the winner, but it was the little prince who first caught the stick and had his hands smeared. "You will be burnt alive for dirtying up the prince. We are going to tell Ka-pololu on you!" the boys threatened; but the prince objected, saying, "Anyone who tells on him shall never eat with me again or play with me and I will never give him anything again." Kau-i-ke-aouli was a splendid little fellow. He loved his playmates and never once did them any hurt, and he was kind and obedient to his teachers… [Kamakau 1961:264]

It is not until the early twentieth century, that we find a few detailed native accounts which tell of traditional features and residents of ʻOʻoma and vicinity. The writings of John Whalley Hermosa Isaac Kihe, a native son of Kekaha, in Hawaiian language newspapers (recently translated by Kepā Maly from the original Hawaiian texts), share the history of the land and sense the depth of attachment that native residents felt for ʻOʻoma and the larger Kekaha-wai-ʻole-o-nā-Kona.

Kihe (who also wrote under the name of Ka-ʻohu-haʻaheo-i-nā-kuahiwi-ʻekolu) was born in 1853, his parents were native residents of Honokōhau and Kaloko (his grandfather, Kuapāhoa, was a famed kahuna of the Kekaha lands). During his life, Kihe taught at various schools in the Kekaha region; served as legal counsel to native residents applying for homestead lands in ʻOʻoma and vicinity; worked as a translator on the Hawaiian Antiquities collections of A. Fornander; and was a prolific writer himself. In the later years of his life, Kihe lived at Puʻu Anahulu and Kalaoa, and he is fondly remembered by elder kamaʻāina of the Kekaha region. Kihe, who died in 1929, was also one of the primary informants to Eliza Maguire, who translated some of the writings of Kihe, publishing them in abbreviated form in her book "Kona Legends" (Maguire 1926).

Writers today have varying opinions and theories pertaining to the history of Kekaha, residency patterns, and practices of the people who called Kekaha-wai-ʻole-o-nā-Kona home. For the most part, our interpretations are limited by the fragmented nature of the physical remains and historical records, and by a lack of familiarity with the diverse qualities of the land. As a result, most of us only see the shadows of what once was, and it is difficult at times, to comprehend how anyone could have carried out a satisfactory existence in such a rugged land.

Kihe and his co-authors provide readers with several references to places and events in the history of ʻOʻoma and neighboring lands. Through the narratives, we learn of place name origins, areas of ceremonial significance, how resources were managed and accessed, and the practices of those native families who made this area their home.

One example of the rich materials recorded by native writers, is found in "*Kaʻao Hoʻoniua Puʻuwai no Ka-Miki*" (The Heart Stirring Story of Ka-Miki). This tradition is a long and complex account, that was published over a period of four years (1914-1917) in the weekly Hawaiian-language newspaper *Ka Hōkū o Hawaiʻi*. The narratives were primarily recorded for the paper by Hawaiian historians John Wise and J.W.H.I. Kihe.

While "*Ka-Miki*" is not an ancient account, the authors used a mixture of local stories, tales, and family traditions in association with place names to tie together fragments of site-specific histories that had been handed down over the generations. Also, while the personification of individuals and their associated place

names may not be entirely "ancient," such place name-person accounts are common throughout Hawaiian (and Polynesian) traditions. The English translations below are a synopsis of the Hawaiian texts, with emphasis upon the main events and areas being discussed. Diacritical marks and hyphenation have been placed to help with pronunciation of certain words.

"Kaao Hooniua Puuwai no Ka-Miki" (The Heart stirring Story of Ka-Miki)

This *moʻolelo* (tradition) is set in the 1300s (by association with the chief Pili-a-Kaʻaiaea), and is an account of two supernatural brothers, Ka-Miki (The quick, or adept, one) and Ma-Kaʻiole (Rat [squinting] eyes). The narratives describe the birth of the brothers, their upbringing, and their journey around the island of Hawaiʻi along the ancient *ala loa* and *ala hele* (trails and paths) that encircled the island. During their journey, the brothers competed alongside the trails they traveled, and in famed *kahua* (contest fields) and royal courts, against *ʻōlohe* (experts skilled in fighting or in other competitions, such as running, fishing, debating, or solving riddles, that were practiced by the ancient Hawaiians). They also challenged priests whose dishonorable conduct offended the gods of ancient Hawaiʻi. Ka-Miki and Ma-Kaʻiole were empowered by their ancestress Ka-uluhe-nui-hihi-kolo-i-uka (The great entangled growth of uluhe fern which spreads across the uplands), who was one of the myriad of body forms of the goddess Haumea, the earth-mother, creative force of nature who was also called Papa or Hina. Among her many nature-form attributes were manifestations that caused her to be called upon as a goddess of priests and competitors (people, places named for them, and other place names are marked below with underlining):

> …Kūmua was the husband of Ka-uluhe-nui-hihi-kolo-i-uka. The place that is named for Kūmua is in the uplands of Kohanaiki, an elevated rise from where one can look towards the lowlands. The shore and deep sea are all clearly visible from this place. The reason that Kūmua dwelt there was so that he could see the children and grandchildren of he and his wife.
>
> Wailoa, a daughter, was the mother of Kapaʻihilani, also called Kapaʻihi. There is a place in the uplands of Kohanaiki, below Kūmua, to the northwest, a hidden water hole, that is called Kapaʻihi. Wailoa is a pond there on the shore of Kohanaiki. Because Wailoa married Kahunakalehu, a native of the area, she lived and worked there. Thus the name of that pond is Wailoa, and it remains so to this day.
>
> Pipipiʻapoʻo was another daughter of Kūmua and Ka-uluhe-nui-hihi-kolo-i-uka. She married Haleolono, one who cultivated sweet potatoes upon the ʻilima covered flat lands of Nānāwale, also called Nāhiʻahu (Nāwahʻiahu), as it has been called from before and up to the present time. Cultivating the land was the skill of this youth Haleolono, and because he was so good at it, he was able to marry the beauty, Pipipiʻapoʻo.
>
> Pipipiʻapoʻo's skill was that of weaving pandanus mats, and there are growing many pandanus trees there, even now. The grove of pandanus trees and a nearby cave, is called Pipipiʻapoʻo to this day, and you may ask the natives of Kohanaiki to point it out to you.
>
> Kapukalua was a son of Kūmua and Kaʻuluhe. He was an expert at aku lure fishing, and all other methods of fishing of those days gone by. He married Kauhiʻonohua a beauty with skin as soft as the blossoms of the hīnano, found in the pandanus grove of ʻOʻoma. This girl was pleasingly beautiful, and because of her fame, Kapukalua, the exceptionally skilled son of the sea spray of ʻApoʻula, secured her as his wife. Here, we shall stop speaking of the elders of Ka-Miki… [January 8, 1914]

The tradition continues, recounting the training of the brothers, and preparations of their *hālau aliʻi* (royal compound) at Kohanaiki. At the dedication ceremonies it was revealed that one of the *kahuna* of the

Kaha lands, had taken up the habit of killing people, and that he had also thought to take the lives of Ka-Miki and Ma-Kaʻiole. We revisit the story here, and learn the name of a priest of ʻOʻoma and Kohanaiki—

> …The sun broke forth and the voices of the roosters and the ʻelepaio of the forests were heard resonating and rising upon the mountain slopes. The day became clear, with no clouds to be seen, it was calm. So too, the ocean was calm and the shore of Laʻi a ʻEhu (Kona) was calm. The flowers of the upland forest reddened and unfolded, and nodded gently in the kēhau breezes.
>
> The priests gathered together to discuss these events and prepared to apologize to the children of the chief, asking for their forgiveness. They selected ʻElepaio, Pūhili, Kaluaʻōlapa, and Kalua-ʻōlapa-uwila to go before the brothers for this purpose.
>
> ʻElepaio was the high priest of Honokōhau. The place where he dwelt bears the name ʻElepaio [an ʻili on the boundary of Honokōhau nui & iki]. It is in the great grove of *ʻulu (kaulu ʻulu)* on the boundary between Honokōhau-nui and Honokōhau-iki… [April 23, 1914]
>
> Pūhili was the high priest of ʻOʻoma and Kohanaiki, the place where he lived is on the plain of Kohanaiki, at the shore, and bears his name to this day. It is on the boundary between Kohanaiki and ʻOʻoma.
>
> Kaluaʻōlapa was the high priest of Haleʻōhiʻu and Kamāhoe, that is the waterless land of Kalaoa (Kalaoa wai ʻole). The place where he lived was in the uplands of Maulukua on the plain covered with *ʻilima* growth. This place bears his name to this day.
>
> Kalua-ʻōlapa-uwila was the high priest of Kealakehe and Keʻohuʻolu (Keahuolu), and it was he who built the *heiau* named Kalua-ʻōlapa-uwila, which is there along the shore of Kealakehe, next to the road that goes to Kailua. The nature of this priest was that of a shark and a man. The shark form was named Kaiwi, and there is a stone form of the shark that can be seen near the *heiau* to this day.
>
> These priests all went to the door of the house and presented the offerings of the black pig, the red fish, the black *ʻawa*, the white rooster, the *malo* (loin clothes), and all things that had been required of their class of priests. They also offered their prayers and asked forgiveness for their misspoken words. They then called for their prayers to be freed and the *kapu* ended… [April 30, 1914]

Through the 1920s, up to the time of his death in 1929, J.W.H.I. Kihe continued to submit traditional accounts and commentary on the changing times to the paper, *Ka Hōkū o Hawaiʻi*. In 1923, Kihe penned a series of articles, some of which formed the basis of Eliza Maguire's *Kona Legends* (1926). One of the accounts, "*Ka Punawai o Wawaloli*" (The Pond of Wawaloli), describes that the pond of Wawaloli, on the shore of ʻOʻoma, was named for a supernatural ocean being, who could take the form of the *loli* (sea cucumber) and of a handsome young man. Through this account it is learned that people regularly traveled between the uplands and shore of ʻOʻoma; the *kula* lands were covered with *ʻilima* growth; and that a variety of fish, seaweeds, and shellfish were harvested along the shore. Also, the main figures in the tradition are memorialized as places on the lands of ʻOʻoma, Kalaoa, and neighboring *ahupuaʻa*. These individuals and places include Kaluaʻōlapa (a hill on the boundary of Hāmanamana and Haleohiʻu), Wawaloli (a bay between ʻOʻoma and Kalaoa), Hoʻohila (on the boundary of Kaū and Puʻukala), Pāpaʻapoʻo (a cave site in Hāmanamana), Kamakaoiki and Malumaluiki (locations unknown). The following narratives were translated by Kepā Maly from the original Hawaiian texts published in *Ka Hōkū o Hawaiʻi* (September 23rd, October 4th & 11th, 1923):

*Ka Punawai o Wawaloli (*The Pond of Wawaloli*)*

The place of this pond (Wawaloli) is set there on the shore of the ‘O‘oma near Kalaoa. It is a little pond, and is there to this day. It is very close to the sandy shore, and further towards the shore there is also a pond in which one can swim. There is a tradition of this pond, that is held dearly in the hearts of the elders of this community.

Wawaloli is the name of a loli (sea cucumber) that possessed dual body forms (kino pāpālua), that of a loli, and that of a man!

Above there on the ‘ilima covered flat lands, there lived a man by the name of Kalua‘ōlapa and his wife, Kamakaoiki, and their beautiful daughter, Malumaluiki.

One day the young maiden told her mother that she was going down to the shore to gather limu (seaweeds), ‘ōpihi (limpets), and pupu (shellfish). Her mother consented, and so the maiden traveled to the shore. Upon reaching the shore, Malumaluiki desired to drink some water, so she visited the pond and while she was drinking she saw a reflection in the rippling of the water, standing over her. She turned around and saw that there was a handsome young man there, with a smile upon his face. He said… [September 27, 1923] “…Pardon me for startling you here as we meet at this pond, in the afternoon heat which glistens off of the pāhoehoe.”

She responded, “What is the mistake of our meeting, you are a stranger, and I am a stranger, and so we have met at this pond.” The youth, filled with desire for the beautiful young maiden, answered “I am not a stranger here along this shore, indeed, I am very familiar with this place for this is my home. And when I saw you coming here, I came to meet you.”

These two strangers, having thus met, then began to lay out their nets to catch kala, uhu, and pālani, the native fish of this land. And in this way, the beauty of the plains of Kalaoa was caught in the net of the young man who dwelt in the sea spray of ‘O‘oma.

These two strangers of the long day also fished for hīnālea, and then for kawele‘ā. It was during this time, that their lines became entangled like those of the fishermen of Wailua (a poetic reference to those who become entangled in a love affair).

The desire for the limu, ‘ōpihi, and pūpū was completely forgotten, and the fishing poles bent as the lines were pulled back in the sea spray. The handsome youth was moistened in the rains that fell, striking the land and the beloved shore of the land. The sun drew near, entering the edge of the sea and was taken by Lehua Island. Only then did these two fishers of the long day take up their nets.

Before the young maiden began her return to the uplands, she told the youth, “Tell me your name.” He answered her, “The name by which I am known by, is Wawa. But my name, when I go and dwell in the pond here, is Loli. And when you return, you may call to me with the chant:

E Loli nui kīkewekewe[2]	Oh great Loli moving back and forth
I ka hana ana kīkewekewe	Doing your work moving back and forth
I ku‘u piko kīkewekewe	You are in my mind moving back and forth

[2] “Kīkewekewe” is translated by Eliza Maguire (1926) as “charmer.” Kepā Maly was unfamiliar with this meaning of the word. It is most commonly used in the refrain of a song, and is here translated as “moving back and forth,” as the word is used in the spoken language. Kewe also means concave, similar to the place name ‘O‘oma.

A ka makua kīkewekewe	The parents moving back and forth
I hana ai kīkewekewe	Are at their work moving back and forth
E pi‘i mai ‘oe kīkewekewe	Won’t you arise moving back and forth
Ka kaua puni kīkewekewe	To that which we two desire moving back and forth
Puni kauoha kīkewekewe	Your command is desired moving back and forth

Having finished their conversation, the maiden then went to the uplands. It was dark, and the kukui lamps had been lit in the house. Malumaluiki’s parents asked her, “Where are your limu, ‘ōpihi and pūpū?” She replied, “It is proper that you have asked me, for when I went to the shore it was filled with people who took all there was? Thus I was left with nothing, not even a fragment of limu or anything else. So I have returned up here.”

Well, the family meal had been made ready, so they all sat to eat together. But after a short while the maiden stood up. Her parents inquired of this, and she said she was no longer hungry, and that her feet were sore from traveling the long path. So the maiden went to sleep. She did not sleep well though, and felt a heat in her bosom, as she was filled with desire, thus she had no sleep that night.

With the arrival of the first light of day, the Malumaluiki went once again down to the shore. Upon arriving at the place of the pond, she entered the water and called out as described above. Then, a loli appeared and turned into the handsome young man. They two then returned to their fishing for the kala, uhu and pālani, the native fish the land.

So it was that the two lovers met regularly there on the shore of ‘O‘oma. Now Malumaluiki’s parents became suspicious because of the actions of the daughter, and her regular trips to the shore. So they determined that they should secretly follow her and spy on her.

One day, the father followed her to the shore, where he saw his daughter sit down by the side of the pond. He then heard her call out —

E Loli nui kīkewekewe	Oh great Loli moving back and forth
I ka hana ana kīkewekewe	Doing your work moving back and forth
I ku‘u piko kīkewekewe	You are the center of my life moving back and forth
Piko maika‘i kīkewekewe	It is good moving back and forth
A ka makua kīkewekewe	The parents moving back and forth
I hana ai kīkewekewe	Are at their work moving back and forth
E pi‘i mai ‘oe kīkewekewe	Won’t you arise moving back and forth
Ka kaua puni kīkewekewe	To that which we two desire moving back and forth
Puni kauoha kīkewekewe	Your command is desired moving back and forth

[October 4, 1923]

“O Loli, here is your desire, the one you command, Malumaluiki, who’s eyes see nothing else.”

Her father then saw a loli coming up from the pond, and when it was up, it turned into the youth. He watched the two for a while, unknown to them, and saw that his daughter

and the youth of the two body forms (kino pāpālua), took their pleasure in one another.

The father returned to the uplands and told all of this to her mother, who upon hearing it, was filled with great anger, because of the deceitfulness of her daughter. But then she learned that the man with whom her daughter slept was of dual body forms. Kamakaoiki then told Kaluaʻōlapa that he should "Go down and capture the loli, and beat it to death," to which he agreed.

One day, Kaluaʻōlapa went down early, and hid, unseen by the two lovers. Malumaluiki arrived at the pond and called out, and he then memorized the lines spoken by his daughter. When she left, returning to the uplands, he then went to the pond and looked closely at it. He then saw a small circular opening near the top of the water in the pond. He then understood that that was where the loli came up from. He then slept that night and in the early morning, he went to the pond and set his net in the water. He then began to call out as his daughter had done with the above words.

When he finished the chant, the loli began to rise up through the hole, and was ensnared in the net. Kaluaʻōlapa then carried him up onto the kula, walking to the uplands. On his way, he saw his daughter coming down, and he hid until she passed him by.

When the daughter arrived at the pond, she called out in the chant as she always did. She called and called until the sun was overhead, but the loli did not appear in the pond, nor did he come forward in his human form. Thus, she thought that he had perhaps died, and she began to wail and mourn for the loss of her lover. Finally as evening came, the beautiful maiden stood, and ascended the kula to her home.

Now, let us look back to the Kaluaʻōlapa. He went up to his house and showed the loli to his wife. Seeing the loli, she told her husband, "Take it to the kahuna, Pāpaʻapoʻo who lives on the kula of Hoʻohila." So he went to the kahuna and explained everything that had occurred to him, and showed him the loli in his net. Seeing this and hearing of all that had happened, Pāpaʻapoʻo told the father to build an imu in which to kālua the great loli that moves back and forth (loli kīkewekewe). He said, "When the loli is killed, then your daughter will be well, so too will be the other daughters of the families of the land." Thus, the imu was lit and the supernatural loli cooked.

When the daughter returned to her home, her eyes were all swollen from crying. Her mother asked her, "What is this, that your eyes are puffy from crying, my daughter?" She didn't answer, she just kneeled down, giving no response. At that time, her father returned to the house and saw his daughter kneeling down, and he said "Your man, with whom you have been making love at the beach has been taken by the kahuna Pāpaʻapoʻo. He has been cooked in the imu that you may live, that all of the girls who this loli has loved may live."

That pond is still there on the shore, and the place with the small round opening is still on the side of that pond to this day. It is something to remember those things of days gone by, something that should not be forgotten by those of today and in time to come. [October 11, 1923]

*Ka Loko o Paaiea (*The fishpond of Pāʻaiea*)*

The tradition of *Ka loko o Paaiea* (The fishpond of Pāʻaiea) was written by J.W.H.I. Kihe, and printed in *Ka Hōkū o Hawaiʻi* in 1914 and 1924. The narratives describe traditional life and practices in various *ahupuaʻa* of Kekaha, and specifically describes the ancient fishpond Pāʻaiea. The following excerpts from Kihe's *moʻolelo*, include references to Wawaloli, on the shore of ʻOʻoma and Kalaoa. Pāʻaiea, was

destroyed by the Hualālai lava flows of 1801, reportedly as a result of the pond overseer's refusal to give the goddess Pele—traveling in human form—any fish from the pond:

> Pāʻaiea was a great fishpond, something like the ponds of Wainānāliʻi and Kīholo, in ancient times. At that time the high chiefs lived on the land, and these ponds were filled with fat awa, ʻanae, āhole, and all kinds of fish that swam inside. It is this pond that was filled by the lava flows and turned into pāhoehoe, that is written of here. At that time, at Hoʻonā. There was a Konohiki (overseer), Kepaʻalani, who was in charge of the houses (hale papaʻa) in which the valuables of the King [Kamehameha I] were kept. He was in charge of the King's food supplies, the fish, the hālau (long houses) in which the fishing canoes were kept, the fishing nets and all things. It was from there that the King's fishermen and the retainers were provisioned. The houses of the pond guardians and Konohiki were situated at Kaʻelehuluhulu and Hoʻonā.
>
> In the correct and true story of this pond, we see that its boundaries extended from Kaʻelehuluhulu on the north, and on the south, to the place called Wawaloli (between ʻOʻoma and Kalaoa). The pond was more than three miles long and one and a half miles wide, and today, within these boundaries, one can still see many water holes.
>
> While traveling in the form of an old woman, Pele visited the Kekaha region of Kona, bedecked in garlands of the *koʻokoʻolau* (*Bidens* spp.). Upon reaching Pāʻaiea at Hoʻonā, Pele inquired if she might perhaps have an *ʻamaʻama*, young *āholehole*, or a few *ʻōpae* (shrimp) to take home with her. Kepaʻalani, refused, "they are *kapu*, for the King." Pele then stood and walked along the *kuapā* (ocean side wall) of Pā'aiea till she reached Kaʻelehuluhulu. There, some fishermen had returned from aku fishing, and were carrying their canoes up onto the shore…
>
> …Now because Kepaʻalani was stingy with the fishes of the pond Pāʻaiea, and refused to give any fish to Pele, the fishpond Pāʻaiea and the houses of the King were all destroyed by the lava flow. In ancient times, the canoe fleets would enter the pond and travel from Kaʻelehuluhulu to Hoʻonā, at Uaʻuʻālohi, and then return to the sea and go to Kailua and the other places of Kona. Those who traveled in this manner would sail gently across the pond pushed forward by the *ʻEka* wind, and thus avoid the strong currents which pushed out from the point of Keāhole
>
> It was at Hoʻonā that Kepaʻalani dwelt, that is where the houses in which the chiefs valuables (*hale papaʻa*) were kept. It was also one the canoe landings of the place. Today, it is where the light house of America is situated. Pelekāne (in Puʻukala) is where the houses of Kamehameha were located, near a stone mound that is partially covered by the *pāhoehoe* of Pele. If this fishpond had not been covered by the lava flows, it would surely be a thing of great wealth to the government today… [J.W.H.I. Kihe in *Ka Hoku o Hawaii*; compiled and translated by Maly, from the narratives written February 5-26, 1914 and May 1-15, 1924].

Na Hoʻomanao o ka Manawa (The Recollections of a Native Son)

Later in 1924, Kihe, described the changes which had occurred in the Kekaha region since his youth. In the following article, titled *Na Hoʻomanao o ka Manawa* (in *Ka Hōkū o Hawaiʻi* June 5th & 12th 1924), Kihe wrote about the villages that were once inhabited throughout Kekaha, identifying families, practices, and schools of the historic period (ca. 1860-1924). In the two part series (translated by Maly), he also shared his personal feelings about the changes that had occurred, including the demise of the families and the abandonment of the coastal lands of Kekaha.

There has arisen in the mind of the author, some questions and thoughts about the nature, condition, living, traveling, and various things that bring pleasure and joy. Thinking about the various families and the many homes with their children, going to play and strengthening their bodies.

In the year 1870, when I was a young man at the age of 17 years old, I went to serve as the substitute teacher at the school of Honokōhau. I was teaching under William G. Kanakaʻole who had suffered an illness (maʻi-lolo, a stroke).

In those days at the Hawaiian Government Schools, the teachers were all Hawaiian and taught in the Hawaiian language. In those days, the students were all Hawaiian as well, and the books were in Hawaiian. The students were all Hawaiian… There were many, many Hawaiian students in the schools, no Japanese, Portuguese, or people of other nationalities. Everyone was Hawaiian or part Hawaiian, and there were only a few part Hawaiians.

The schools included the school house at Kīholo where Joseph W. Keala taught, and later J.K. Kaʻailuwale taught there. At the school of Makalawena, J. Kaʻelemakule Sr., who now resides in Kailua, was the teacher. At the Kalaoa School, J.U. Keaweʻake was the teacher. There were also others here, including myself for four years, J. Kainuku, and J.H. Olohia who was the last one to teach in the Hawaiian language. At Kaloko, Miss Kaʻaimahuʻi was the last teacher before the Kaloko school was combined as one with the Honokōhau school where W.G. Kanakaʻole was the teacher. I taught there for two years as well... [Kihe includes additional descriptions on the schools of Kona]

It was when they stopped teaching in Hawaiian, and began instructing in English, that significant changes took place among our children. Some of them became puffed up and stopped listening to their parents. The children spoke gibberish (English) and the parents couldn't understand (*nā keiki namu*). Before that time, the Hawaiians weren't marrying too many people of other races. The children and their parents dwelt together in peace with the children and parents speaking together… [June 5, 1924]

…Now perhaps there are some who will not agree with what I am saying, but these are my true thoughts. Things which I have seen with my own eyes, and know to be true…In the year 1870 when I was substitute teaching at Honokōhau for W.G. Kanakaʻole, I taught more than 80 students. There were both boys and girls, and this school had the highest enrollment of students studying in Hawaiian at that time [in Kekaha]. And the students then were all knowledgeable, all knew how to read and write.

Now the majority of those people are all dead. Of those things remembered and thought of by the people who yet remain from that time in 1870; those who are here 53 years later, we cannot forget the many families who lived in the various (*ʻāpana*) land sections of Kekaha.

From the lands of Honokōhau, Kaloko, Kohanaiki, the lands of ʻOʻoma, Kalaoa, Haleʻohiʻu, Makaʻula, Kaū, Puʻukala-ʻŌhiki, Awalua, the lands of Kaulana, Mahaiʻula, Makalawena, Awakeʻe, the lands of Kūkiʻo, Kaʻūpūlehu, Kīholo, Keawaiki, Kapalaoa, Puʻuanahulu, and Puʻuwaʻawaʻa. These many lands were filled with people in those days.

There were men, women, and children, the houses were filled with large families. Truly there were many people [in Kekaha]. I would travel around with the young men and women in those days, and we would stay together, travel together, eat together, and

spend the nights in homes filled with aloha.

The lands of Honokōhau were filled with people in those days, there were many women and children with whom I traveled with joy in the days of my youth. Those families are all gone, and the land is quiet. There are no people, only the rocks remain, and a few scattered trees growing, and only occasionally does one meet with a man today [1924]. One man and his children are all that remain.

Kaloko was the same in those days, but now, it is a land without people. The men, the women, and the children are all gone, they have passed away. Only one man, J.W. Haʻau, remains. He is the only native child (keiki kupa) besides this author, who remains.

At Kohanaiki, there were many people on this land between 1870 and 1878. These were happy years with the families there. In those years Kaiakoili was the haku ʻāina (land overseer)...

Now the land is desolate, there are no people, the houses are quiet. Only the houses remain standing, places simply to be counted. I dwelt here with the families of these homes. Indeed it was here that I dwelt with my kahu hānai (guardian), the one who raised me. All these families were closely related to me by blood. On my fathers' side, I was tied to the families of Kaloko [J.W.H.I. Kihe's father was Kihe, his grandfather was Kuapāhoa, a noted kahuna of Kaloko]. I am a native of these lands.

The lands of ʻOʻoma, and Kalaoa, and all the way to Kaulana and Mahaiʻula were also places of many people in those days, but today there are no people. At Mahaiʻula is where the great fishermen of that day dwelt. Among the fishermen were Poʻokoʻai mā, Pāʻaoʻao senior, Kaʻao mā, Kaiʻa mā, Kaʻāʻīkaula mā, Pāhia mā, and John Kaʻelemakule Sr., who now dwells at Kailua.

Kaʻelemakule moved from this place [Mahaiʻula] to Kailua where he prospered, but his family is buried there along that beloved shore (kapakai aloha). He is the only one who remains alive today… At Makalawena, there were many people, men, women, and their children. It was here that some of the great fishermen of those days lived as well. There were many people, and now, they are all gone, lost for all time.

Those who have passed away are Kahaʻialiʻi mā, Mamaʻe mā, Kapehe mā, Kauaionuʻuanu mā, Hopulāʻau mā, Kaihemakawalu mā, Kaomi, Keoni Aihaole mā, and Pahukula mā. They are all gone, there only remains the son-in-law of Kauaionuʻuanu, J.H. Mahikō, and Jack Punihaole, along with their children, living in the place where Kauaionuʻuanu and Ahu once lived.

At Kūkiʻo, not one person remains alive on that land, all are gone, only the ʻaʻā remains. It is the same at Kaʻūpūlehu, the old people are all gone, and it is all quiet… [June 12, 1924]

*Ko Keoni Kaelemakule Moolelo Ponoi – Kakau ponoi ia mai no e ia (*The True Story of John Ka‘elemakule – Actually written by him[3]*)*

In the period between 1928 and 1930, John Ka‘elemakule Sr., who was a native of Kekaha, living at Mahai‘ula, Kaulana and Kohanaiki, wrote a series of articles that were published in serial form in *Ka Hōkū o Hawai‘i*. The story is a rich account of life in Kekaha between 1854 and 1900. Ka‘elemakule’s texts introduce us to the native residents of Kekaha, and include descriptions of the practices and customs of the families who resided there. In the following excerpts from Ka‘elemakule’s narratives (translated by Kepā Maly), we find reference once again to ‘O‘oma and neighboring lands, and the practices associated with procuring water in this region:

> *“Kekaha Wai Ole o na Kona”* (Waterless Kekaha of Kona)
>
> …We have seen the name “Kekaha wai ole o nā Kona” since the early part of my story in *Ka Hōkū o Hawai‘i*, and we have also seen it in the beautiful tradition of Mākālei. An account of the boy who dwelt in the uplands of Kekaha wai ‘ole, that was told by Ka-‘ohu-ha‘aheo-i-nā-kuahiwi-‘ekolu [the penname used by J.W.H.I. Kihe]. I think that certain people may want to know the reason and meaning of this name. So it is perhaps a good thing for me to explain how it came about. The source of it is that in this land of Kekaha even in the uplands, between Kaulana in the north and ‘O‘oma in the south, there was no water found even in the ancient times. For a little while, I lived in the uplands of Kaulana, and I saw that this land of Kekaha was indeed waterless.
>
> The water for bathing, washing one’s hands or feet, was the water of the banana stump (*wai pūma‘ia*). The *pūmai‘a* was grated and squeezed into balls to get the juice. The problem with this water is that it makes one itchy, and one does not really get clean. There were not many water holes, and the water that accumulated from rain dried up quickly. Also there would be weeks in which no rain fell… The water which the people who lived in the uplands of Kekaha drank, was found in caves. There are many caves from which the people of the uplands got water… [September 17, 1929:3]
>
> …The *kūpuna* had very strict *kapu* (restrictions) on these water caves. A woman who had her menstrual cycle could not enter the caves. The ancient people kept this as a sacred *kapu* from past generations. If a woman did not know that her time was coming and she entered the water cave, the water would die, that is, it would dry up. The water would stop dripping. This was a sign that the *kapu* of Kāne-of-the-water-of-life (Kaneikawaiola) had been desecrated. Through this, we learn that the ancient people of Kekaha believed that Kāne was the one who made the water drip from within the earth, even the water that entered the sea from the caves. This is what the ancient people of Kekaha wai ‘ole believed, and there were people who were *kia‘i* (guardians) who watched over and cleaned the caves, the house of Kāne… [September 24, 1929:3]
>
> When the *kapu* of the water cave had been broken, the priest was called to perform a ceremony and make offerings. The offerings were a small black pig; a white fish, and

[3] This account was published in serial form in the Hawaiian newspaper *Ka Hōkū o Hawai‘i*, from May 29, 1928 to March 18, 1930. The translated excerpts in this section include narratives that describe Mahai‘ula and nearby lands in Kekaha with references to families, customs, practices, ceremonial observances, and sites identified in text. The larger narratives also include further detailed accounts of Ka‘elemakule’s life, and business ventures. A portion of the narratives pertaining to fishing customs (November 13, 1928 to March 12, 1929), and canoeing practices (March 19 to May 21, 1929) were translated by M. Kawena Pukui, and may be viewed in the Bishop Museum-Hawaiian Ethnological Notes (BPBM Archives).

āholehole; young taro leaves; and *awa*. When the offering was prepared, the priest would chant to Kane:

E Kane i uka, e Kane i kai,	O Kane in the uplands, O Kāne at the shore,
E Kane i ka wai, eia ka puaa,	O Kane in the water, here is the pig,
Eia ka awa, eia ka luau,	Here is the ʻawa, here are the taro greens,
Eia ka ia kea.	Here is the white fish.

Then all those people of the uplands and coast joined together in this offering, saying:

He mohai noi keia ia oe e Kane,	This is a request offering to you o Kāne,
E kala i ka hewa o ke kanaka i hana ai,	Forgive the transgression done by man,
A e hoomaemae i ka hale wai,	Clean the water house (source),
A e hoonui mai i ka wai o ka hale,	Cause the water to increase in the house,
I ola na kanaka,	That the people may live,
Na ohua o keia aina wai ole.	Those who are dependent on this waterless land.
Amama.	It is finished…

[October 1, 1929:3; Kepā Maly, translator]

It is not surprising today, when we hear of caves in which cultural materials are found. Along trails, near residences, and in once remote areas, a wide range of uses occurred. Caves in the Kekaha lands were used to store items, keep planting shoots cool and fresh for the next season, to hide or take shelter in, to catch water, and as burial sites.

Land Tenure in ʻOʻoma and Vicinity

Through the traditions and early historical accounts cited above, we see that there are descriptions of early residences and practices of the native families on the lands of ʻOʻoma and within greater Kekaha. Importantly, we find chiefly associations with the land of ʻOʻoma 2nd, as documented by the residency of the chiefs Kaikioʻewa, Keaweamahi, their families and retainers, while they were serving as the guardians of the young king, Kauikeaouli (Kamehameha III in ca. 1813-1818; Kamakau 1961 and Gov. Kapeau, 1847 in this study). Among the earliest government records documenting residency in ʻOʻoma and vicinity, are those of the *Māhele ʻĀina* (Land Division), Interior and Taxation Departments, Roads and Public Works, and the Government Survey Division.

This section of the study describes land tenure (residency and land use) and identifies families associated with ʻOʻoma and its neighboring lands. The documentation is presented in chronologically within the following subsections, The *Māhele ʻĀina* (1848): Disposition of ʻOʻoma, Land Grants in ʻOʻoma and Vicinity (1855-1864), The Government Homesteading Program in Kekaha, Field Surveys of J.S. Emerson (1882-1889), and Trails and Roads of Kekaha (Governmental Communications).

A review of the records below reveals that none of the claims by native tenants made during the *Māhele*, or any of the applications for Royal Patent Grants, included lands that are a part of the current development area.

The *Māhele ʻĀina* (1848): Disposition of ʻOʻoma

In Precontact Hawaiʻi, all land, ocean, and natural resources were held in trust by the high chiefs (*aliʻi ʻai ahupuaʻa* or *aliʻi ʻai moku*). The use of land, fisheries and other resources were given to the *hoaʻāina*

(native tenants) at the prerogative of the *aliʻi* and their representatives or land agents (*konohiki*), who were considered lesser chiefs. By 1845, the Hawaiian system of land tenure was being radically altered, and the foundation for implementing the *Māhele ʻĀina* was set in place, system of fee-simple right of ownership.

As the *Māhele* evolved, it defined the land interests of Kauikeaouli (King Kamehameha III), some 252 high-ranking *Aliʻi* and *Konohiki*, and the Government. As a result of the *Māhele*, all land in the Kingdom of Hawaiʻi came to be placed in one of three categories: (1) Crown Lands (for the occupant of the throne); (2) Government Lands; and (3) *Konohiki* Lands (cf. Indices of Awards 1929). The "Enabling" or "*Kuleana Act*" of the *Māhele* (December 21, 1849) further defined the frame work by which *hoaʻāina* (native tenants) could apply for, and be granted fee-simple interest in "*Kuleana*" lands (cf. Kamakau in *Ke Au Okoa* July 8 & 15, 1869; 1961:403-403). The *Kuleana Act* also reconfirmed the rights of *hoaʻāina* to access, subsistence and collection of resources necessary to their life upon the land in their given *ahupuaʻa* ("Enabling Act"[4], August 6, 1850 – HSA DLNR 2-4).

In the *Buke Kakau Paa no ka Mahele Aina* (Land Division Book), between Kamehameha III and his supporters, we learn that by the time of the *Māhele ʻĀina*, ʻOʻoma was divided into two *ahupuaʻa*, ʻOʻoma 1st and 2nd. ʻOʻoma 1st was claimed by Moses Kekūāiwa (brother of Kamehameha IV and V, and Victoria Kamāmalu), one of the children of Kīnaʻu and M. Kekūanaoʻa, thus, a grandson of Kamehameha I. ʻOʻoma 2nd was held by Kamehameha III (*Buke Māhele*, January 27, 1848:13-14). On March 8, 1848, Kamehameha III assigned his interest in ʻOʻoma 2nd to the Government land inventory (*Buke Māhele*, 1848:183).

Moses Kekūāiwa died on November 24, 1848, and his father, Mataio Kekūanaoʻa, administrator of the estate, relinquished in commutation, his rights to ʻOʻoma 1st, giving the land over to the Government land inventory (Foreign Testimony Volume 3:408). Thus, both ʻOʻoma 1st and 2nd were assigned to the Government Land inventory (Government Lands - Indices of Awards 1929:10).

In 2000, the Kumu Pono Associates digitized the entire collection of handwritten records from the *Māhele ʻĀina*. Most of the records are in the Hawaiian language, and to-date have not been accurately indexed. An extensive review of all the records identifies only one native tenant who filed a claim of residency and land use in ʻOʻoma during the *Māhele*. The claim—Helu 9162, by Kahelekahi—was not awarded, and except for an entry in Native Register Volume 8 (Figure 5), there is no further record of the claim. Below, is a copy of the original Hawaiian text from the Native Register. The account is of particular interest as Kahelekahi reported that in 1848, he was the only resident in ʻOʻoma:

> ***Kahelekahi – Helu 9162***
> ***Kailua, Hawaii February 9, 1848***
> Greetings to all of you commissioner who quiet land titles, I hereby tell you of my claim for land. I have an entire ahupuaa situated there in Kona, it's name is Ooma 2. It is an old land gotten by me from Koomoa, and held to this time. For 15 years, I have been the only one residing on this land, there are no other people, only me. I am the only one, there is no one living here to help from one year to the next year. Kamehameha III is the one above, who has this land, and W.P. Leleiohoku is below him, and I am the one man dwelling there. The survey of the length and width of this land is not accurately completed. That is what I have to tell you.
>
> Done by me, Kahelekahi
> [Native Register Vol. 8:543; translated by Kepā Maly]

[4] See also *"Kanawai Hoopai Karaima no ko Hawaii Pae Aina"* (Penal Code) 1850.

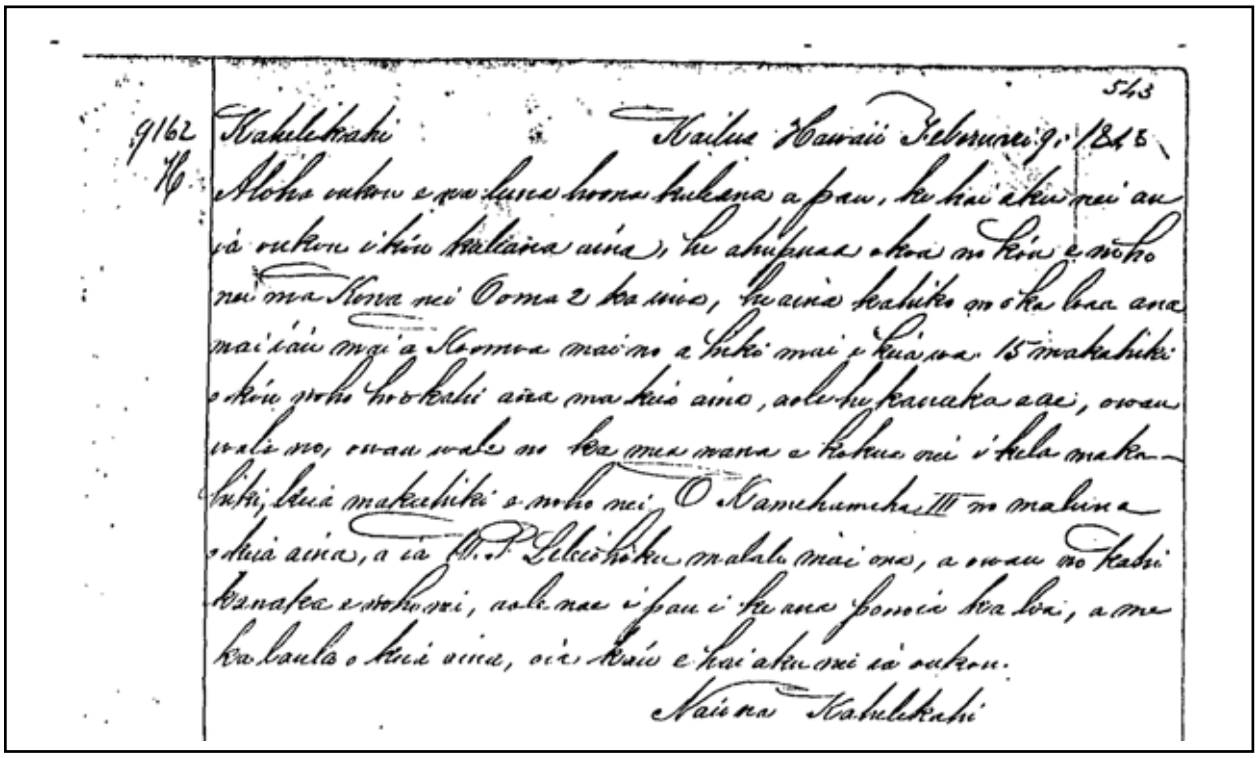

Figure 5. Copy of Native Register Vol. 8:543 Helu 9162, claim of Kahelekahi for *kuleana* at ‘O‘oma.

In 1849, S. Haanio, Tax Assessor of North Kona, submitted a report to the Board of Education regarding those individuals who were subject to the Tuesday Tax Laws (*Poalua*), to be worked as a part of the School Tax requirements of the time. At the time of Haanio’s report, three individual families were identified as residents of ‘O‘oma. Residents in the neighboring lands of Kalaoa and Kohanaiki were also listed, they were:

> Kalaoa: 1. Kila, 2. Piena, 3. Nakuala, 4. Kupono, 5. Loa, 6. Kaeha, 7. Keliipuipui, 8. Kapuolokai, 9. Kaainoa, 10. Paina, 11. Kalimaonaona, 12. Kaikeleaukai, 13. Kanahele, 14. Kukaani, 15. Kupuai, and 16. Helekahi[5]
>
> Ooma: 1. Kalua, 2. Kamaka and 3. Mamali
>
> Kohanaiki: 1. Hulikoa, 2. Kaoeno, 3. Honolii and 4. Awa [HSA – Series 262, Hawaii 1849].

Unfortunately, there is no indication of where Kalua, Kamaka, and Mamali were living in ‘O‘oma at the time. Based on traditional patterns of residency in the region, it is likely that they had primary residences in the uplands, near sheltered *māla ‘ai* (agricultural fields), and kept near shore residences for seasonal fishing, collection of salt, and other resources of the coastal zone. Of the three names given for ‘O‘oma, descendants of the Kalua and Kamaka lines are known to still be residing in the Kekaha region.

[5] Helekahi or Kahelekahi – the one who made a claim for a kuleana in ‘O‘oma during the Māhele (Helu 9162).

Land Grants in ʻOʻoma and Vicinity (1855-1864)

In conjunction with the *Māhele*, the King also authorized the issuance of Royal Patent Grants to applicants for tracts of land, larger than those generally available through the Land Commission. The process for applications was set forth by the "Enabling Act" of August 6, 1850, which set aside portions of government lands for grants.

> Section 4. Resolved that a certain portion of the Government lands in each Island shall be set apart, and placed in the hands of special agents to be disposed of in lots of from one to fifty acres in fee simple to such natives as may not be otherwise furnished with sufficient lands at a minimum price of fifty cents per acre. [HSA – "Enabling Act" Series DLNR 2-4]

The Kingdoms' policy of providing land grants to native tenants was further clarified in a communication from Interior Department Clerk, A. G. Thurston, on behalf of Keoni Ana (John Young), Minister of the Interior; to J. Fuller, Government Land Agent-Kona:

> *February 23, 1852*
> …His Highness the Minister of the Interior instructs me to inform you that he has and does hereby appoint you to be Land Agent for the District of Kona, Hawaii. You will entertain no application for the purchase of any lands, without first receiving some part, say a fourth or fifth of the price; then the terms of sale being agreed upon between yourself and the applicant you will survey the land, and send the survey, with your report upon the same to this office, for the Approval of the Board of Finance, when your sales have been approved you will collect the balance due of the price; upon the receipt of which at this office, the Patent will be forwarded to you.
>
> Natives who have no claims before the Land Commission have no Legal rights in the soil.
>
> They are therefore to be allowed the first chance to purchase their homesteads. Those who neglect or refuse to do this, must remain dependant upon the mercy of whoever purchases the land: as those natives now are who having no kuleanas are living on lands already Patented, or belonging to Konohikis.
>
> Where lands have been granted, but not yet Patented, the natives living on the land are to have the option of buying their homesteads, and then the grant be located, provided this can be done so as not to interfere with them.
>
> No Fish Ponds are to be sold, neither any landing places.
>
> As a general thing you will charge the natives but 50 cents pr. acre, not exceeding 50 acres to any one individual.
>
> Whenever about to survey land adjoining that of private individuals, notice must be given them or their agents to be present and point out their boundaries… [Interior Department Letter Book 3:210-211]

Between 1855 and 1864, at least six applications were made for land in the *ahupuaʻa* of ʻOʻoma, and four of them were patented. The applications were made by:

Grant	Applicant	Land	Acreage	Book and Year
1590	Kauhini	Hamanamana, Kalaoa and Ooma 1	1,816	8:1855 (canceled)
1599	J. Hall	Ooma 2	101.33	8:1855 (canceled)
1600	Kaakau	Ooma 2	58.5	8:1855
2027	Kameheu	Ooma 2	101.33	11:1856 (same area as Grant 1599)
2031	Koanui	Ooma 1	24.5	11:1856
2972	Kaakau & Kama	Kalaoa 5 & Ooma 1	515	14:1864

["Index of all Grants Issued…Previous to March 31, 1886;" 1887]

The grants to Ka‘akau and Kameheu in ‘O‘oma 2nd were patented by 1859, as recorded in the following letter:

> *April 8, 1859*
> *S. Spencer, Interior Department Clerk;*
> *to Lot Kamehameha, Minister of the Interior;*
> Lands in Puaa and Ooma 2 in Kona, Hawaii which were sold by the Government Agent:
>
> | | |
> |---|---|
> | Royal Patent 1600, Kaakau 58 50/100 acres in Ooma | $29.25 |
> | Royal Patent 2027, Kameheu, 101 33/100 acres in Ooma | $38.00 |
>
> [HSA – Interior Department, Lands]

In the years following issuance of the first Royal Patents in ‘O‘oma and vicinity, native tenants and others continued to express interest in the lands of ‘O‘oma and neighboring *ahupua‘a*. Applications were made to either lease or purchase portions of the remaining government lands. In 1865, Government Surveyor and Land Agent, S.C. Wiltse, wrote to the Minister of the Interior, describing the condition and status of the lands remaining to the government.

> *September 5, 1865*
> *S.C. Wiltse, Government Surveyor and Land Agent;*
> *to F.W. Hutchinson, Minister of the Interior.*
> Kona Hawaii. Government Lands in this District not Sold;
> also those Sold and Not Patented:
>
> …"Kalaoa 5th"
> Not in the Mahele book but believed to be Gov't. land. This land above the Govt. Road has been sold and Patented. Below the road I have surveyed 515 acres which was sold by Sheldon to "Kaakau" & "Kama" who payed him $165.00. As no valuation was made of this land per acre by Sheldon I afterwards valued it myself as follows, 300 Ac. at 50 cts. per acre, 215 at 25 cts. per Ac. The balance due according to this valuation including Patent was $42.75 which was payed to me in March 1864 and forwarded by me to your office. The survey of this land is in your office. If the payments made are satisfactory, these men would be very glad to get their Patent.
>
> This is a piece of 3rd rate land, used only as goat pasture, no improvements on it. Makai of this survey is about 400 Ac. remaining to the Govt., but of very little value.
>
> "Ooma 1st & 2nd"
> The best part of these lands have been sold, there remains to the Govt. the forest part, 2 or 300 Ac., and the makai part some 1500 Ac., about 500 of which is 3rd rate land, the balance rocks.

> "Kohanaiki"
> The forest part of this land is all that remains to the Gov't., this is extensive, extending to the mauka side of the forest. It may contain 1500 to 2000 Ac.
>
> The makai part of this land containing 220 Ac. has been sold both by Sheldon and myself. In April 1863 I was surveying in Kona when "Nahuina" (who lives on the adjoining land of "Kaloko") applied to me to survey the makai part of the Gov't. land Kohanaiki which he wished to purchase. I inquired whether he had applied to Sheldon for this lands (Sheldon was then in Honolulu) he told me that he had not, but would do so immediately, if it was necessary he would go to Honolulu for that purpose. I told him that I was then writing to Sheldon and I would make the application for him which I did, but never got an answer. I wrote several times to him about that time, for information about Gov't. lands, but he declined to answer my letters.
>
> On the 30th of May following, I surveyed said piece of land for "Nahuina." When I was making this survey "Kapena" (who bought this land from Sheldon) was present, and afterwards went to Honolulu and payed Sheldon for this land.
>
> "Nahuina" had the money then to pay for this land, and I told him to keep it until he knew who he was paying it to. I was perfectly satisfied then that Sheldon's transaction as Gov't. land Agt. was not honest. Mr. Sheldon had then been away from Kona nearly three months, he had previous to this resigned his office as Judge and taken up his residence permanently in Honolulu. Afterwards when requested by Mr. S. Spencer to act as land Agt. for Kona, "Nahuina" payed me for this land at 25 cents per Acre. Its only value is for a place for a residence on the beach.
>
> I have been thus particular in giving you the history of this affair, so that you might be able to decide which of the parties were intitled to said land… [HSA – Interior Department, Lands]

Historical records document that the primary use of the *kula* – lowlands in the Kekaha region, was for goat ranching, with limited cattle ranching. Throughout the 1800s, most of the cattle ranching occurred on the *mauka* slopes nearer the old upper government road.

Summary of Land Tenure Described in Grant Records

Grant No.'s 1600 (for Kaakau) and 2031 (for Koanui) are situated on the *mauka* side of the Alanui Aupuni (the Upper Government Road, near present-day Māmalahoa Highway) in ʻOʻoma 2nd and 1st.

Grant No. 1599 (surveyed for Kauhini), was situated across the *kula* lands from Oʻoma 1st in the south, to Hāmanamana, in the north. Communications from the 1880s, indicate that the parcel was never patented, though Kauhini had lived in ʻOʻoma 1st, through the time of his death (before 1888). J.S. Emerson's Register Map No. 1449, identifies a Triangulation Station in ʻOʻoma 1st as "Kauhini." At almost the same time that Kauhini's grant was surveyed, other grants in Kalaoa and ʻOʻoma covering a portion of the area described under Kauhini's grant were patented to Kakau and Kama (Royal Patent Grant No. 2972). In 1888, this confusing situation was brought to the government's attention in a letter from more than 70 native residents of ʻOʻoma and the larger Kekaha region, when the Minister of the Interior was developing homestead lots for applicants (see communications below).

Grant No. 2027 (for Kameheu), situated in ʻOʻoma 2nd, extends from the *makai* edge of the Upper Government Road, to a short distance below the historic Homestead Road between Kaloko and Kalaoa, at about 900 feet above sea level (see Register Map No. 1449).

‘O‘oma grantee Kaakau (Grant No. 1600), also held an interest in Grant No. 2972 in the land of Kalaoa 5th and ‘O‘oma 1st, which he shared with his relative, Kama. Historic survey records (in Register Maps and Survey Field Books) do identify “Kama’s house” near the Wawaloli pond (Register Map No. 1449) in ‘O‘oma 2nd. The same house is later identified as “Keoki Mao’s House” (Register Map No. 1280).

In 1888, government surveyor J.S. Emerson identified Kama as a resident in ‘O‘oma, near the mauka government road (see communication below). This Kama is identified in oral history interviews as being an elder of the Kamaka line, from whom the often-mentioned Palakiko Kamaka and others descend. A temporary beach shelter—in the vicinity of “Kama’s House” marked near the shore of ‘O‘oma 2nd on Register Maps 1449 and 1280—remained in use by family members at least until the outbreak of World War II (see interviews with Peter Kaikuaana Park, Geo. Kinoulu Kahananui, and Valentine K. Ako in Rechtman and Maly 2003).

While no formal awards or grants of land appear to have been made for the near shore *kula* or beach lands, it is logical to assume that families living in the uplands of the ‘O‘oma and Kalaoa-Kohanaiki *ahupua‘a*, made regular visits to the near shore lands. The practice of continued travel between upland residences and near-shore shelters, is also described by *kupuna* Peter K. Park, who was born and raised in the *mauka* section of ‘O‘oma, and by other *kupuna* from neighboring lands.

No records indicating that the above Royal Patent Grantees had applied for coastal parcels as a part of their original claims were found while conducting the present research. A further review of the *Māhele* records was also made to determine if any of the grant applicants had been *Māhele* claimants (as is sometimes the case). Their names did not appear in the Register or Testimony volumes for the area.

Ka ‘Āina Kaha–(A Native’s Perspective)

In 1875, J.P Puuokupa, a native resident of Kalaoa wrote a letter to the editor of the Hawaiian newspaper, *Ku Okoa*, responding to a letter which had been previously published in the paper (written by a visitor to Kona). The first account apparently described the Kekaha region as a hard land that presented many difficulties to the residents. It was also reported that a drought on Hawai‘i had significantly impacted crop production, and that a “famine” was occurring. Puuokupa, responded to the account and described the situation as he knew it, from living upon the land. His letter is important as it provides us with an explanation as to why people of the region—including ‘O‘oma—lived mostly in the uplands, for it was there that the rich soils enabled residents to cultivate the land and sustain themselves.

> *Mai Kailua a hiki i Kiholo*–(From Kailua to Kiholo)
> …The people who live in the area around Kailua are not bothered by the famine. They all have food. There are sweet potatoes and taro. These are the foods of these lands. There are at this time, breadfruit bearing fruit at Honokohau on the side of Kailua, and at Kaloko, Kohanaiki, Ooma and the Kalaoas where lives J.P. [the author]. All of these lands are cultivated. There is land on which coffee is cultivated, where taro and sweet potatoes are cultivated, and land livestock is raised. All of us living from Kailua to Kalaoa are not in a famine, there is nothing we lack for the well being of our bodies.
>
> Mokuola[6] is seen clearly upon the ocean, like the featherless back of the *‘ukeke* (shore bird). So it is in the uplands where one may wander gathering what is needed, as far as Kiholo which opens like the mouth of a long house into the wind. It is there that the bow of the boats may safely land upon the shore. The livelihood of the people there is fishing and the raising of livestock. The people in the uplands of Napuu are farmers, and as is the custom of those people of the backlands, they all eat in the morning and then go to

[6] *Moku-ola* — literally: Island of life — is a poetic reference to a small island in Hilo Bay which was known as a place of sanctuary, healing, and life. By poetic inference, the Kekaha region was described as a place of life and well-being.

> work. So it is with all of the native people of these lands, they are a people that are well off.
>
> …As was said earlier, coffee is the plant of value on these lands, and so, is the raising of livestock. From the payments for those products, the people are well off, and they have built wooden houses. If you come here you shall see that it is true. Fish are also something which benefits the people. The people who make the *pai ai* on Maui bring it to Kona and trade it. Some people also trade their *poi* for the coffee of the natives here… (J.P. Puuokupa, in *Ku Okoa* November 27, 1875; translated by Kepā Maly)

The Government Homesteading Program in Kekaha

Following the *Māhele* and Grant programs of the middle 1800s, it was found that many native tenants still remained on lands for which they had no title. In 1884, the Hawaiian Kingdom initiated a program to create Homestead lots on Government lands—a primary goal being to get more Hawaiian tenants in possession of fee-simple property (Homestead Act of 1884). The Homestead Act allowed applicants to apply for lots of up to 20 acres in size, and required that they own no other land.

On Hawai‘i, several lands in the Kekaha region of North Kona, were selected and a surveying program was authorized to subdivide the lands. Initially, those lands extended from Kohanaiki to Kūki‘o. Because it was the intent of the Homestead Act to provide residents with land upon which they could cultivate crops or graze animals, most of the lots were situated near the *mauka* road (near the present-day Māmalahoa Highway) that ran between Kailua and ‘Akāhipu‘u.

Early in the process, native residents of Kekaha soon began writing letters to the Minister of the Interior, observing that 20 acre parcels were insufficient “to live on in every respect.” They noted that because of the rocky nature of the land, goats were the only animals that they could raise, and thus, try to make their living (cf. State Archives–Land File, December 26, 1888, and Land Matters Document No. 255; and communications below).

During the first years of the Homestead Program, all of the remaining government lands in the Kekaha region, from Kohanaiki to Kūki‘o 2nd, had been leased to King David Kalākaua for grazing purposes. The following lease was issued, with the notation that should portions of the land be desired for Homesteading purposes, the King would relinquish his lease:

> *August 2nd 1886*
> *General Lease 364*
> *Between His Majesty Kalakaua;*
> *and Walter M. Gibson, Minister of the Interior*
> [Lease of unencumbered government lands between Kealakehe to Kukio 2nd]:
>
> …Oma [Ooma] No. 1 & 2 – yearly rent Ten dollars…
> Each and every of the above mentioned lands are let subject to the express condition that at any time during the term of this lease, the Minister of the Interior may at his discretion peaceably enter upon, take possession, and dispose of such piece or pieces of land included in the lands hereby demised, as may be required for the purposes of carrying out the terms and intent of the Homestead Laws now in force, or that may be hereafter be enacted during the term of this lease… [State Land Division Lease Files]

By 1889, the demand for homestead lots in ‘O‘oma and other Kekaha lands was so great that King Kalākaua gave up his interest in the lands:

January 22, 1889
J.W. Robertson, Acting Chamberlain;
to J.A. Hassinger, Chief Clerk, Interior Department
[Regarding termination of Lease No. 364 for lands from Kukio to Kohanaiki]:

…I have the honor to acknowledge the receipt of your communication, of the 17th, instant, informing me that you are directed, by His Excellency the Minister of the Interior, to say, that he desires to take possession of the lands, described in Government Lease No. 364, for Homestead purposes, and requests the surrender of the lease.

His Majesty the King, is willing, for the purpose of assisting in carrying out the Homestead Act, to accede to the terms of the lease, so far as to give up only such portions of the lands, as are suitable to be apportioned off for Homestead purposes.

It has come to the knowledge of His Majesty, that several of the applicants for portions of the above lands, are already in possession of lands elsewhere, and living in comfortable homes. They are not poor people, nor are they entitled to the privilege of obtaining lands under the Homestead Act, but are desirous of obtaining more of such property, for the purpose of selling or leasing to the Chinese, which class is beginning to outnumber the natives in nearly every district…

His Majesty is desirous of retaining the balance of lands, that may be left after the apportionment has been completed; and also desires to lease remnants of other Government lands in that section of the Island…

Reply attached – Dated January 22, 1889:
The lands of Kohanaiki and Kalaoa and Makaula have been divided up into Homestead lots, and taken up.
Lands marked * are in Emerson's List of lands to be sold. Emerson's List attached.

His Majesty has paid rent to Aug. 22, 1889. Another rent is due in adv. from this date…

* Kukio 2	* Maniniowali
* Mahaiula	* Kaulana
* Awalua	Puukala
+ Makaula	+ Kalaoa 1, 2, 3, 4 & 5
* Oma 1 & 2	+ Kohanaiki

Lease cancelled by order – Minister of Int. August 2, 1889 [HSA – Interior Department, Lands]

One of the significant issues that arose with the development of homesteads in the Kekaha region, involved the lands of ʻOʻoma, Kalaoa and Hāmanamana, which had been surveyed for Kauhini in 1855, under Grant No. 1590. The grant was apparently never patented, and questions regarding the government's authority to divide portions of the ʻOʻoma-Kalaoa-Hāmanamana lands into Homestead lots were raised. Adding to the confusion, in 1888, John A. Maguire was also making his move from Kohala to Kona, and in the process of establishing his Huehue Ranch. One of the lands he reportedly purchased was covered under the unperfected Grant No. 1590. Thus, homestead applicants and program managers met with a wide range of challenges during the program's history.

Homestead Communications

There are a number of letters between native residents (applicants for Homestead lands) and government agents, documenting the development of the homesteading program and residency in Kekaha. Tracts of land

in Kohanaiki, ʻOʻoma, Kalaoa and neighboring *ahupuaʻa* were let out to native residents, and eventually to non-native residents as well. Those lands which were not sold to native tenants were sold or leased to ranching interests—most of which came under John A. Maguire of Huehue Ranch.

One requirement of the Homestead Program was that lots which were to be sold as homesteads to the applicants, needed to be surveyed. J.S. Emerson, one of the most knowledgeable and best-informed surveyors to work in Kona, began surveying the Kekaha region homestead lots in 1888. Emerson's letters to Surveyor General, W. D. Alexander, provide valuable historical documentation about the community and land. Writing from ʻOʻoma in April 1888, Emerson spoke highly of the Hawaiian families living on the land; he also described land conditions and weather at the time. In the letter, we find that questions regarding the status of several lands in Kona had arisen, and that John A. Maguire was planning to "settle" in Kona (see communications in Part 4 of this section of the study). Emerson's letters along with those below from the native tenants of the land, provide first hand accounts of the land development of the communities in Kekaha. The following communications are among those found in the collection of the Hawaiʻi State Archives (HSA).

May 1888
J.W.H. Isaac Kihe, Jr., et al.; to L.A. Thurston, Minister of the Interior
[Petition with 71 signatures, regarding discrepancy in land grant to Kauhini in Kalaoa and Ooma; and desires that said land be divided into Homestead Lots for applicants]:

…We, the undersigned, subjects residing within the boundaries of Kekaha, from Kohanaiki to Makalawena, and Whereas, the land said to belong to Kauhini is within the boundaries above set forth; Whereas, some doubt and hesitancy has come into our minds concerning the things relating to said land of Kauhini, and that it is proper that a very careful investigation be made, because, we have never known said Kauhini to have lands in the Kalaoas and Ooma 1, and because of such doubt, the Government sold some pieces in said land of 687 acres to Kama, Kaakau and Hueu, and they have been living with all the rights for 20 years and over, on pieces that were acquired by them. Therefore, we leave this request before your Excellency, the honorable one, with the grounds of this request:

First: The said land of Kauhini is not a land that is clear in every way, so that it can be shown truthfully and clearly that it belongs to Kauhini and his heirs – said kuleana.

Second: The land said to belong to Kauhini was only surveyed, but the money was not paid, that is the price for the land, only the payment for the survey was paid. We are ready with witnesses to prove this ground, as well as other grounds.

Third: Because of Kama and Kaakau and Hueu's knowing that Kauhini had no true interest in the land, therefore, they bought from the Government some acres of in the piece which Kauhini had surveyed, and the Government readily agreed to sell to them. This is real proof that said land was not conveyed to Kauhini, and the second is that Kauhini was living right there and he made no protest against the sale by the Government of those 687 acres to Kama (k), Kaakau (k) and Hueu (k), up to the time of his death, and only now has the question been raised through the plat of the survey, and thereby basing the claim that Kauhini had some land.

…We ask your honor that this matter be traced in the Government Departments, so as to find out the truth, there is much trouble and uncertainty about this land.

And our inquiry to be based upon these great questions. Does the land belong to Kauhini? Or to the Government?… [HSA – Interior Department, Lands]

May 16, 1888
Interior Department Clerk; to J.W.H. Isaac Kihe, Jr.:
…I have been directed by the Honorable Minister of the Interior, to say, that your request asking that Kauhini's interest in the lands of Kalaoa & Ooma 1 be investigated, and to let you know the you are wanted to send, or to bring here to Honolulu, 2 or 3 good witnesses, and all the papers found by you or them, concerning this land of Kauhini… [HSA Interior Department Lands]

May 16, 1888
J.F. Brown, Government Surveyor; to L.A. Thurston, Minister of the Interior
[Regarding disposition of Grant No. 1590, to Kauhini for Lands in Hamanamana, Kalaoa, and Ooma; Figure 6]:

…With reference to the letter of inquiry of numerous natives in N. Kona, Hawaii, I beg to report:

That as regards the land belonging to Kauhini, I find that Grant 1590 on record and signed in due form, assigned to Kauhini something over 1800 acres shown in sketch by yellow tinted boundary line. At the bottom of the page however and in different handwriting is the following remark "Memo – this to be cancelled" S.S. (Stephen Spencer)?

Later the grants shown in sketch by blue lines were issued to the parties indicated in the sketch, and this fact together with the memo attached to the Grant, and the statements and beliefs of the natives leads me to think that the Grant to Kauhini was actually cancelled, but of this I have not yet obtained further proof than I have here given… [HSA – Interior Department, Lands]

May 1888 - J.W.H.I. Kihe, Jr.; to L.A. Thurston, Minister of the Interior:
…Oh honorable one, I am ready with the right witnesses to come when I receive the order, and if you agree, oh honorable one, to help with the fares for us on the vessel, and for our support while staying there and coming back.

Proofs are ample to prove that the land belongs to the Government, when I arrive with the witnesses, according to what you wish to be done… [HSA – Interior Department, Lands]

[Applying to purchase remnant lands from Makaula to Ooma 2nd, as a native Hui; and that land not be sold to outsiders.]

…We the undersigned, kamaaina (old residents) who reside from "Makaula" to "Ooma 2," joining "Kohanaiki," hereby petition and we also file this petition with you, and for you to consider and conferring with the Minister of the Interior, whether to consent or refuse the petition which we humbly file, and at the same time setting forth the nature of the land and the boundaries desired.

We ask that all be sold to us as a Hui, that the remnants of all the Government lands from "Hamanamana" to "Ooma 2 (two)," that is from the Government remnant of "Hamanamana, Kalaoa 1, 2, 3, 4, 5, Ooma 1 & 2" running until it meets the sea. Being the remnants remaining from the "Homesteads" lately, and remaining after the sale of the lands formerly sold by the Government, these are the remnants which we wish to buy as a "HUI." If you consent, and also the "Minister of the Interior," for these reasons:

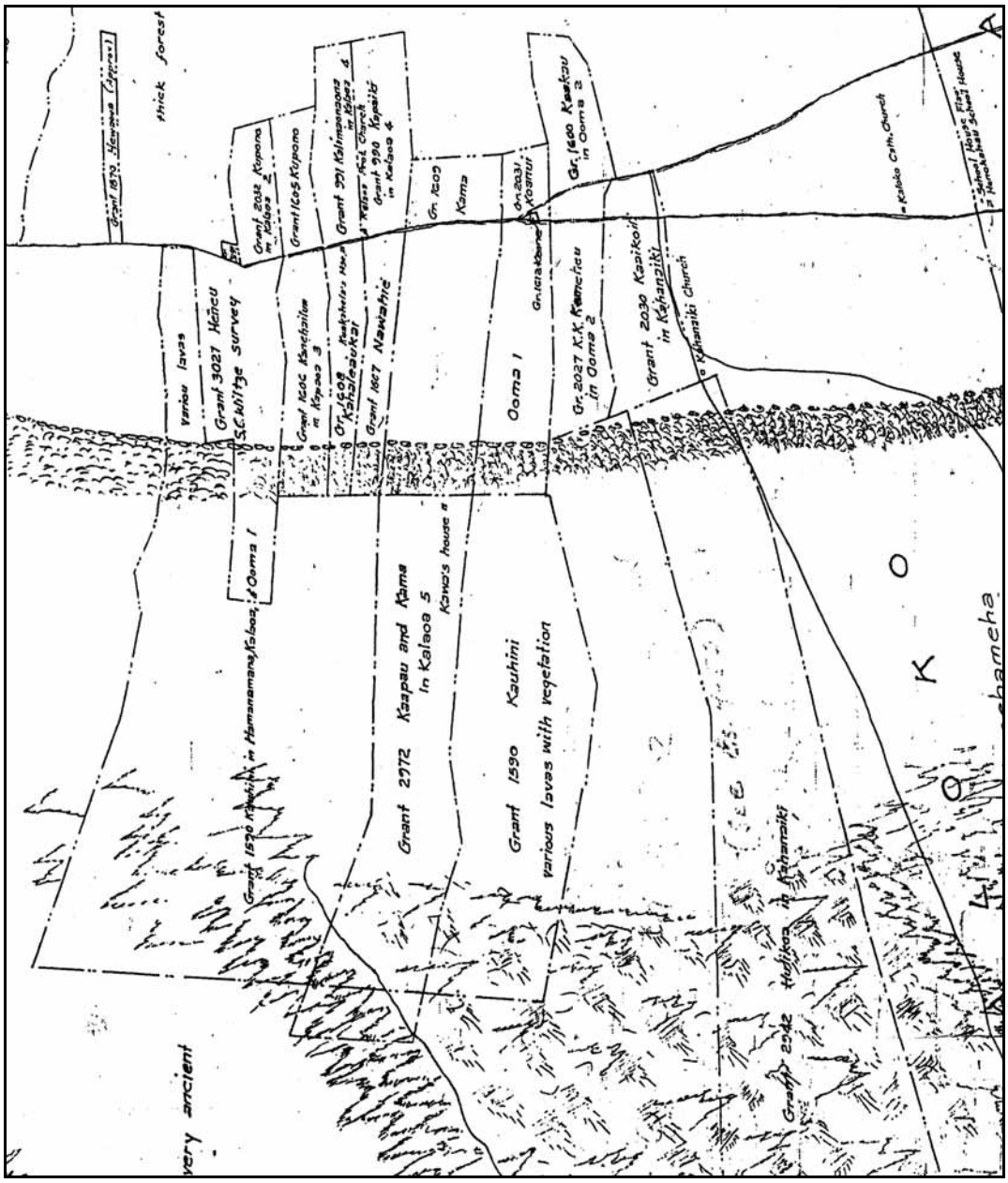

Figure 6. Portion of 1882 Register Map No. 1280 showing original boundaries of Grant No. 1590, to Kauhini.

1. The "remnants of Government lands" aforesaid, join our land kuleanas and were lately surveyed, and for that reason we believe it proper that they be sold to us.

2. The "kuleanas" that were surveyed for us are not sufficient to live on in every respect, they are too small, and are not in accordance with the law, that is one hundred acres, (Laws 1888).

3. Because of our belonging to, and being old residents of said places, is why we ask that consent be granted us for the sale to us and not to any one from other places, or we may be put to trouble in the future.

With these reasons, we leave this with you, and for you to approve, and we also adhere

to our first offer per acre, and the explanations in regards to said offer.

FIRST: The price per acre to be 10 cents per acre.

SECOND: The nature of the land is rocky and lava stones in all from one and to the other, and there is only one kind of animal which can roam thereon, and it is goats, and that is the only thing to make anything out of, and to benefit us if we acquire it.

THIRD: If this land is acquired by others, they will probably cause us trouble, because the kuleanas which we have got are very small and not enough, not 20 acres of the land were acquired by us; very few of the lots reach 20 acres or more.

And because of these reasons and the explanations herein, we leave before your Excellency for the granting of the consent or not… [HSA – Interior Department, Lands]

ca. February 1889
Petition of J.W.H. Isaac Kihe, Jr. and 21 others;
to L.A. Thurston, Minister of the Interior
[Transmitting first payment for Homestead Land from Makaula to Kohanaiki]:

…We, the ones whose names are below, persons who but for the pieces of "Homestead" lands from Makaula to Kohanaiki, present to you documents of proof and money as first payment of ten ($10.00) dollars in the hands of J. Kaelemakule, the Agent appointed for the "Homestead" lands in North Kona, Hawaii.

We ask that the Agreements be sent up, with the Government for five years to J. Kaelemakule, the Agent here, in number the same as there are names below…

1. J.W.H. Isaac Kihe, Jr.	9. P. Nahulanui	17. Keawehawaii
2. S. Mahauluae	10. Kaukaliinea	18. D. Kaninau
3. D.P. Manuia	11. Kamahiai (w)	19. Mokuaikai
4. S.M. Kaawa	12. C.K. Kapa	20. Nuuanau
5. H.P. Ku	13. P.K. Kanuha	21. S. Kaimuloa
6. W.N. Kailiino	14. J. Haau	22. J. Kaloa
7. Z. Kawainui	15. G. Mao	
8. Kikane	16. J. Pule	

[HSA – Interior Department Document No. 227]

February 18, 1889
J. Kaelemakule, Land Agent; to L.A. Thurston, Minister of the Interior:
I am sending the correct report of the applicants for homestead lands here in North Kona, and their respective names, and the amount they have paid for their initial deposits in order that the agreements will be made correctly…

Pule $10.	Keoki Mao $10.	Mahuluae $10.	Haau $10.
Nuuanu $10.	Manuia $10.	Kaukaliinea $10.	Kamahiai (w) $10.
Kaawa $10.	Kaninau $10.	J. Kaelemakule $10.	Kawainui $10.
Mokuaikai $10.	Keawehawaii $10.	Nahulanui $10.	Kaloa $10.
Haiha $10.	Kapa $10.	Kaumuloa $10.	Isaac Kihe $10.
Kailiino $10.	Kanuha $10.	Ku $10.	Kikane $10.

[HSA – Interior Department, Lands]

October 7, 1889
J. Kaelemakule, Land Agent; to L.A. Thurston, Minister of the Interior:
…The applications of Kahinu and Lilinoe which were sent down during the month of August, please have the lots changed, because the map of Ooma has arrived with new numbers, as follows: Kahinu, Lot 51; Lilinoe, Lot 49, in Ooma 1st … [HSA – Interior Department, Lands]

October 10, 1889
J.W.H. Isaac Kihe, Secretary; to L.A. Thurston, Minister of the Interior:
…I leave some more names who make applications for homestead lands here in North Kona… The places wanted by those named are:

Pika Kaninau at Ooma 1
Kahinu at Ooma 2
Keaweiwi at Ooma 2… [HSA – Interior Department, Lands]

October 28, 1889
J. Kaelemakule, Land Agent; to L.A. Thurston, Minister of the Interior:
…The eight lots in Ooma have all been taken, none are left… These lots have been very quickly taken by the bidders, before the issuance of the notice from the Minister… Bear in mind the agreements for Kahinu and Lilinoe… [HSA – Interior Department, Lands]

December 31, 1890
J.W.H.I. Kihe, Jr.; to C.N. Spencer, Minister of the Interior:
We, the undersigned, who are without homes, and are destitute and have no place to live on, and whereas, the government has permitted all the people who have no lands, and that they receive homesteads, and for that reason, your humble servants make application that our application may be speedily granted which we now place before Your Excellency, that the Government land which was divided and surveyed by Joseph S. Emerson, be immediately sub-divided, the same being portions of Kalaoa 5 and Ooma, on the mauka side of Kama (k), Koanui (k), to the junction with Ooma of Kaakau (k), containing an area of one hundred and fifteen acres (115), and it is those acres which your applicants are applying for before Your Excellency, and where as your applicants are native Hawaiians by birth, residing at Kalaoa, North Kona, Island of Hawaii. And the minds of your servants hope and desire to have a place to live on in the future, and to have a home for all time, and Your Excellency, your servants humbly place their petition with the hope that you will grant this application...

M.E. Kuluwaimaka (k)
H. Hanawahine (k)
D.W. Kanui (k)
Mr. Kahumoku (k)
[HSA – Interior Department, Lands]

July 30, 1890
Petition of Kaihemakawalu and 63 native residents of Kekaha;
to C.N. Spencer, Minister of the Interior
[Requesting that lands available for Homesteading be sub-divided and granted to applicants]:

…We, the undersigned, old-timers living from Kealakehe to Kapalaoa, who are subject to taxes, and who have the right to vote in the District of Kona, Hawaii, and ones who

are really without lands, and who wish to place this application before Your Excellency, that all of these Government lands here in North Kona, be given to the native Hawaiians who are destitute and poor, being the lots which were sub-divided by the Government which are lying idle and for which no Agreements have been given out, and also the lots which were granted Agreements and issued in the time when Lorrin A. Thurston was Minister of the Interior, and also the lots which still remain undivided. All of these Government lands are what we are now again asking that the dividing and sub-dividing be continued in these remnants of Government lands, until all of the poor and needy ones are provided for.

Your Excellency, we ask that no consent whatever be given to permitting lands to be acquired by the rich through sale at auction, or by lease, and if there is to be any lease, then to be leased to the poor ones, if they are supplied with homes.

Your Excellency, we ask that you immediately send copies of all agreements of the Government lands which were cut up and sub-divided, which are remaining and have no documents for those lots. And we also ask that a surveyor be sent now to again survey and sub-divide the remaining Government lands, being the Government lands of Kaulana, Mahaiula, Kukio 1 & 2, mauka of the Government Road, and Kalaoa 5 & Ooma 1, mauka of the Government Road, joining Kama's and Koanui's.

And now, Your Excellency, we also ask that all of the pieces of Government land lying idle outside of these lands which have been sub-divided, and lands which are to be sub-divided, applied for above, to be allowed to be leased to use for five cents per acre, because, they are rocky and pahoehoe lands only left, and the number of acres being about three thousand and over, thereby giving the Government some income from these which have been lying idle and without any value… [HSA – Interior Department, Lands]

June 22, 1893
J. Kaelemakule, Land Agent; to J.A. King, Minister of the Interior:
…I am forwarding you with this, the copy of the agreement of Wm. Harbottle, and some applications as herein below set forth (Figure 7):

107, Kalua (w), for Lot # 59, Map 6, Ooma;
108, G.M. Paiwa, for Lot # 56, Map 6, Ooma;
109, Namakaokalani, for Lot # 58, Map 6, Ooma;
110, Pika Kaninau, for Lot # 57, Map 6, Ooma.

Lot # 57 above set forth, was formerly agreed with D. Kealoha Hoopii, but this applicant left altogether and lived a long time in Kohala, and has done nothing towards the land, and has never signed the agreement to this day. As two years have gone by, I thought it would be better to give the lands to the new applicant… [HSA – Interior Department, Lands]

August 31, 1898
Statement of Leases of Public Lands
Under Control of the Commissioner of Public Lands…
…Ooma (mauka) 1160 acres – Coffee, wood lands & grazing
Lease No. 432 – Annual rent $60. – Expires August 1st, 1906…
Reservation in lease by which the Gov't. may take up portions suited to settlement. [HSA – F.O. & Ex, 1898 – Public Lands]

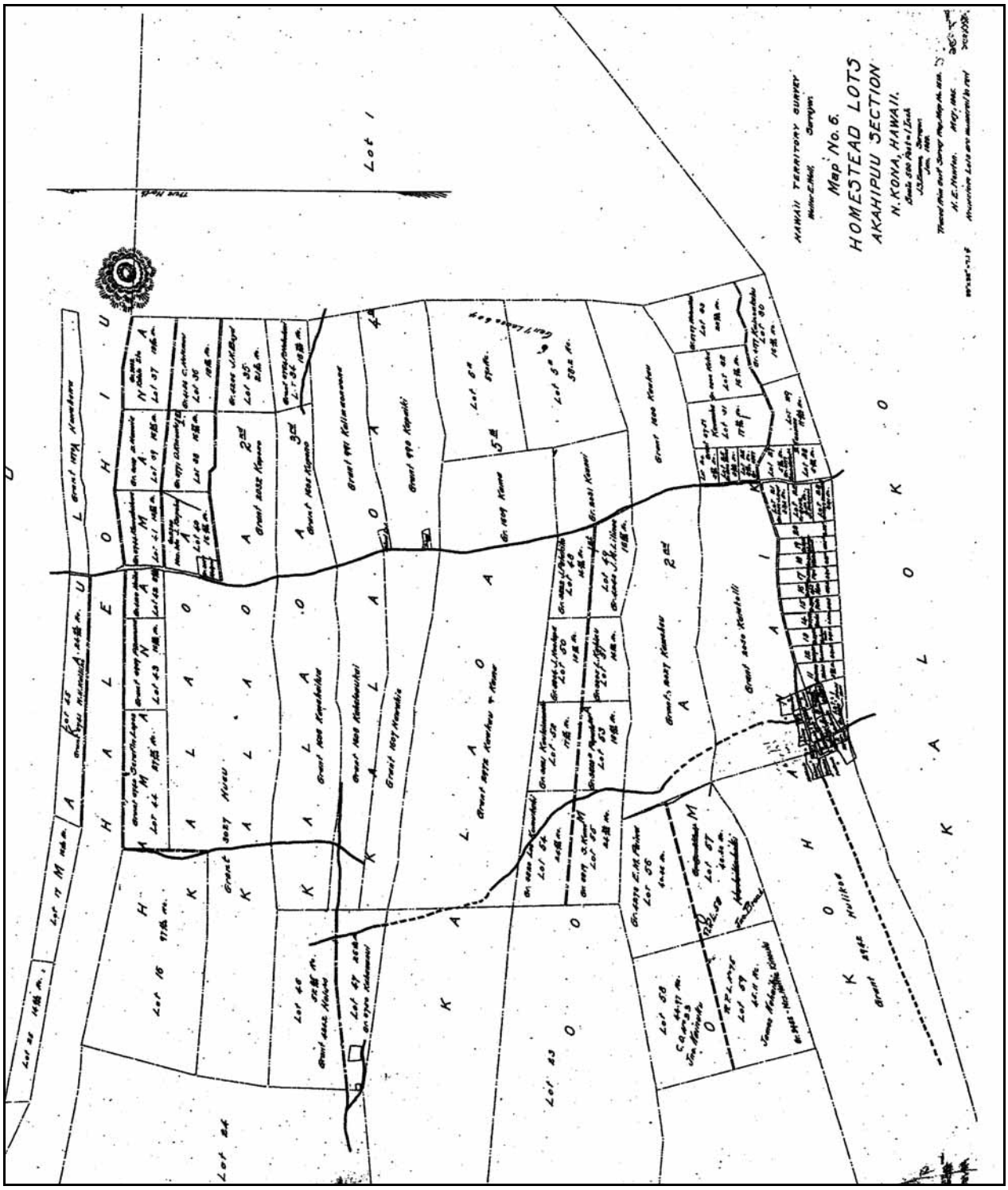

Figure 7. 1902 homestead map No. 6 showing Ooma-Kalaoa Homestead Lots (State Survey Division).

In May 1902, the Territorial Survey Office issued Register Map No. 2123, depicting a portion of the Kalaoa-Ooma Homesteads. ‘O‘oma 1st had been divided into 25 lots extending from near the shore (excluding the shore line) to the upper limits of the ahupua‘a; also excluding the early Royal Patent Grant parcels previously sold to native tenants.

Applicants for land in ‘O‘oma 1st (from *maka*i to *mauka*) included:

- Kanealii – Right of Purchase Lease # 30; Lot 4-B (cancelled);
  Kanealii’s parcel was just mauka of the shore line exclusion.

- Wm. Keanaaina – Right of Purchase Lease #33; Lot 13 (Patented by Grant No. 5472);
  The makai end of Wm. Nuuanu Keanaaina’s Grant 5472, is situated at approximately 325 feet above sea level.

- J. Maiola – Right of Purchase Lease # 28; Lot 14 (cancelled);
  J. Maiola’s parcel was situated about 525 feet above sea level.

- K. Kama Jr. – Right of Purchase Lease #27; Lot 15
  (Patented by Grant No. 5046).
  The makai end of K. Kama’s Grant No. 5046, is situated at approximately 725 feet above sea level.

Territorial Survey Map No. 6 (Homestead Lots, Akahipuu Section), surveyed by J.S. Emerson in 1889, depicts the eight original homestead lots sold to applicants. The lots are in the area extending from 1,022 feet above sea level to the old Māmalahoa Highway. The lots contained approximately 15 to 25 acres each, and were (*makai* to mauka) sold to:

- S. Kane – Grant No. 3819, Lot 55;
- Loe Kumukahi – Grant No. 3820, Lot 54;
- Papala (w) – Grant No. 3820 B, Lot 53;
- Kaulainamoku – Grant No. 3821, Lot 52
- L. Kahinu – Grant No. 3805, Lot 51
- J. Hoolapa – Grant No. 3804, Lot 50
- J.M. Lilinoe – Grant No. 4343, Lot 49
- J. Palakiko – Grant No. 3822, Lot 48

Except for the Homestead parcels and the two lots patented to Keanaaina and Kama (totaling ten parcels of the available 25 parcels), no other land in ‘O‘oma 1st was sold during this time. The land was retained by the government and portions leased out for grazing (see General Lease No.’s 590 and 604).

‘O‘oma 2nd was also divided into homestead parcels, but only six lots were made in the subdivision (see Register Map No. 2123). The two *makai* lots consisted of approximately 1,333 acres—the first lot from above the shore to the 1847 *Alanui Aupuni*, containing approximately 302 acres, and the other lot running *mauka* from the same *Alanui Aupuni*, to about the 800 foot elevation (containing approximately 1,031 acres). In 1899, John A. Maguire, founder of Huehue Ranch applied for a Patent Grant on both of the *makai* lots, but he only secured Grant No. 4536, for the lower parcel of 302 acres, in ‘O‘oma 2nd. Maguire’s Huehue Ranch did hold General Lease No.’s 1001 and 590 for grazing purposes on the remaining government lands—both below and above the *mauka* highway—in ‘O‘oma 2nd.

Between 700 and 1,100 feet elevation, four Homestead lots were subdivided, containing 40.50 to 45 acres each. Applicants for the lots (*makai* to *mauka*) were:

- James Kuhaiki – Right of Purchase Lease # 75, Lot 59
  (Patented to Mrs. Hattie Kinoulu);
- Jno. Kainuku – C.O. No. 33, Lot 58 (not granted by 1902);
- Holokahiki – C.O. No. 11, Lot 57
  (cancelled; R.P.L. # 59 to Jno. Broad); and
- E.M. Paiwa – Grant No. 4273, Lot 56.

The notes of survey from Maguire's Grant No. 4536 describes the near shore parcel in 'O'oma 2nd (Figure 8). Of particular interest, it also references one of the prominent cultural-historical features on the boundary between 'O'oma 2nd and Kohanaiki, an "old 'Kahua hale' on white sand…" The "kahua hale" is an old house site. The notes of survey read:

> Grant No. 4536
> To J.A. Maguire
> Purchase Price $351.00
> A Portion of Ooma 2nd, N. Kona, Hawaii Applied for by J.C. Lenhart, June 8, 1899.
> Beginning at Puhili Gov't. trig. St. on the boundary between Kohanaiki and Ooma marked by a drill hole in stone 9 feet South of the South corner of an old "Kahua hale" on white sand at a point from which
> Akahipuu Gov't. trig. Sta. is N 55º 27' 39" E true 32634.7 feet
> Keahole Gov't. Trig. Sta. is N 21º 52' 36" W true 9310.5 ft.
> Keahuolu Gov't Trig. Sta. is S 22º 24' 36" E true 20,141.8 ft., and running —
> 1. S. 79º 26' W. true 298.0 feet along Gr. 3086 Kapena, to a large [mark] on solid pahoehoe by the sea at Puhili Point, thence continuing the same line to the sea shore and along the sea shore to a point whose direct bearing and distance is:
> 2. N. 4º 54' W. true 4192.0 feet;
> 3. Due east true 2920.0 feet along Ooma 1st;
> 4. S. 31º 30' E. true 3920.0 feet along reservation for Gov't. Road 30 feet wide;
> 5. S 790º 45' W. true 4387.0 feet along Grant 3086 Kapena, to initial point and including an area of 302 acres.
>
> J.S. Emerson, Surveyor
> Oct. 10, 1901.

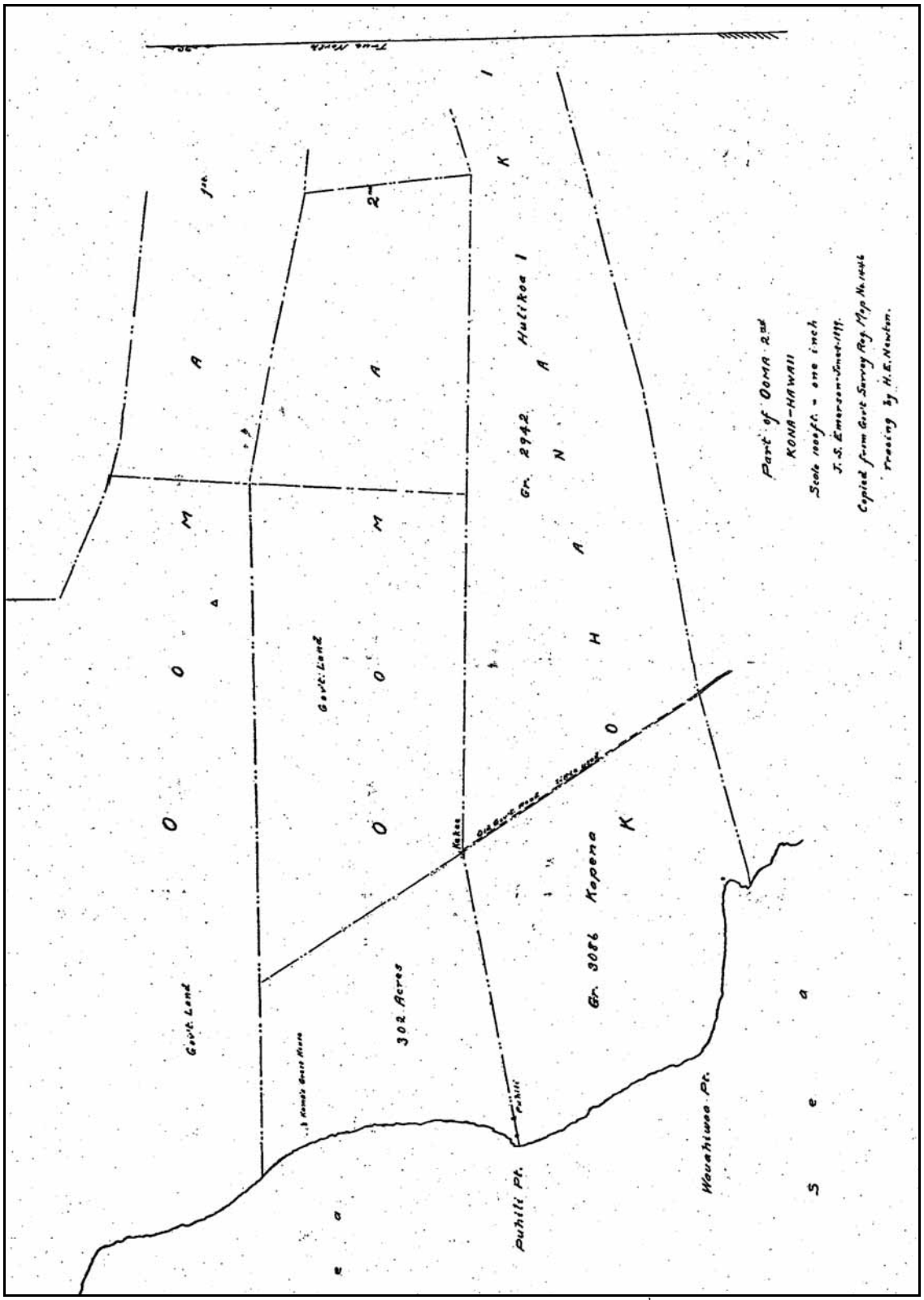

Figure 8. 1899 Grant Map No. 4536 showing *makai* portion of ʻOʻoma 2nd to John A. Maguire.

Field Surveys of J.S. Emerson (1882-1889)

Among the most interesting historic Government records of the study area—in the later nineteenth century—are the communications and field notebooks of Kingdom Surveyor, Joseph S. Emerson. Born on O‘ahu, J.S. Emerson (like his brother, Nathaniel Emerson, a compiler of Hawaiian history) had the ability to converse in Hawaiian, and he was greatly interested in Hawaiian beliefs, traditions, and customs. As a result of this interest, his letters and field notebooks record more than coordinates for developing maps. While in the field, Emerson also sought out knowledgeable native residents of the lands he surveyed, as guides. Thus, while he was in the field he also recorded their traditions of place names, residences, trails, and various features of the cultural and natural landscape (including the extent of the forest and areas impacted by grazing). Among the lands that Emerson worked in was the greater Kekaha region of North Kona, including the lands of ‘O‘oma and vicinity.

One of the unique facets of the Emerson field notebooks is that his assistant J. Perryman, was also a sketch artist. While in the field, Perryman prepared detailed sketches that help to bring the landscape of the period to life. In a letter to W.D. Alexander, Surveyor General, Emerson described his methods and wrote that he took readings off of:

> …every visible hill, cape, bay, or point of interest in the district, recording its local name, and the name of the *Ahupuaa* in which it is situated. Every item of local historical, mythological or geological interest has been carefully sought & noted. Perryman has embellished the pages of the field book with twenty four neatly executed views & sketches from the various trig stations we have occupied… [Emerson to Alexander, May 21, 1882; HSA – DAGS 6, Box 1]

Discussing the field books, Emerson also wrote to Alexander, reporting “I must compliment my comrade, Perryman, for his very artistic sketches in the field book of the grand mountain scenery…” (HSA – HGS DAGS 6, Box 1; Apr. 5, 1882). Later he noted, “Perryman is just laying himself out in the matter of topography. His sketches deserve the highest praise…” (ibid. May 5, 1882). Field book sketches and the Register Maps that resulted from the fieldwork provide a glimpse of the country side of more than 100 years ago.

Field Notebooks and Correspondence from the Kekaha Region

The following documentation is excerpted from the field notebooks and field communications of J. S. Emerson. Emerson undertook his original surveys of lands in the Kekaha region in 1882-1883 (producing Register Maps No. 1278 and 1280). Subsequently, in 1888-1889, Emerson returned to Kekaha to survey out the lots to be developed into Homesteads for native residents of ‘O‘oma and vicinity (see above, The Government Homesteading Program in Kekaha). Through Emerson’s letters and notes taken while surveying, we learn about the people who lived on the land—some of them identified in preceding parts of the study—and about places on the landscape. The numbered sites and place names cited from the field books coincide with sketches prepared by Perryman, which are shown as figures in the current study.

> *J.S. Emerson Field Notebook Vol. 111 Reg. No. 253*
> *West Hawaii Primary Triangulation, Kona District*
> *Akahipuu; May 27, 1882*
> (Figures 9 and 10)
>
> *Site # and Comment:*
> …6 – Koanui’s frame house. E.G. In Honokohau – nui.
> 7 – Aimakapaa Cape. Extremity. In Honokohau-nui.
> 11 – Beniamina’s house (frame). N.G. In Aiopio. In Honokohau-nui.

12 – Beniamina's house No. 2. E.G. In Honokohau-nui.

18 – Lae o Palaha. Between Kaloko and Honokohau-nui.

19 – Awanuka Bay (Haven of rest) Retreat during storms in this dist.

20 – Kealiihelepo's (frame house). N.G. In Kaloko.

21 – Lae Maneo. From the "Maneo" fish in Kaloko.

22 – Kohanaiki Bay. By sea wall of fish pond.

23 – Kaloko-nui fish pond. Tang. S. end by Nuuanu's grass house.

24 – Wall between fish pond of Kaloko nui and iki.

25 – Kaloko iki fish pond. Tang. N. extremity.

Kaloko nui was originally a bay, shut off from the sea by a wall by Kamehameha 1st order.

26 – Kawaimaka's frame house. In Kohanaiki.

27 – Lae o Wawahiwaa. Rock cape. In Kohanaiki.

28 – Keoki Mao's grass house. In Ooma.

29 – Pahoehoe hill. Between Ooma and Kalaoa 5.

30 – Lae o Keahole. Extremity. In Kalaoa 5.

31 – Lae o Kukaenui. Resting place for boats.

32 – Makolea Bay.

33 – Lae o Unualoha.

34 – Pohaku Pelekane.

35 – Lae o Kahekaiao. Kahe-ka-iao – place of the "iao" which abound there.
[Notebook 253:33,35]

…Keahole Bay.

Lae o Kalihi in Kalaoa 5.

Wawaloli Bay in Kalaoa 5.

Lae o Kekaaiki.

Limu Koko in Ooma 1.

Lae o Puhili in Kohanaiki.

Lae o Kealakehe in Kealakehe.

Hueu's frame house in Kalaoa 4, makai side of Gov't. Road.

Kuakahela's frame house in Kalaoa 5.

Protestant Church Steeple in Kalaoa 5.

Kama's frame house, N. gable in Ooma 1.

While taking sightings from Keāhole, Perryman prepared additional sketches of the landscape. One sketch on page 69 of the field book (Figure 11) depicts the view up the slope of Hualālai. Dated June 4, 1882, the sketch is of importance as it also depicts Kalaoa Village and church; the upper Government road; Kohanaiki Village; and two trails to the coast, one trail to Honokōhau, and the other near the Kaloko-Kohanaiki boundary. Use of these trails continued through the 1950s.

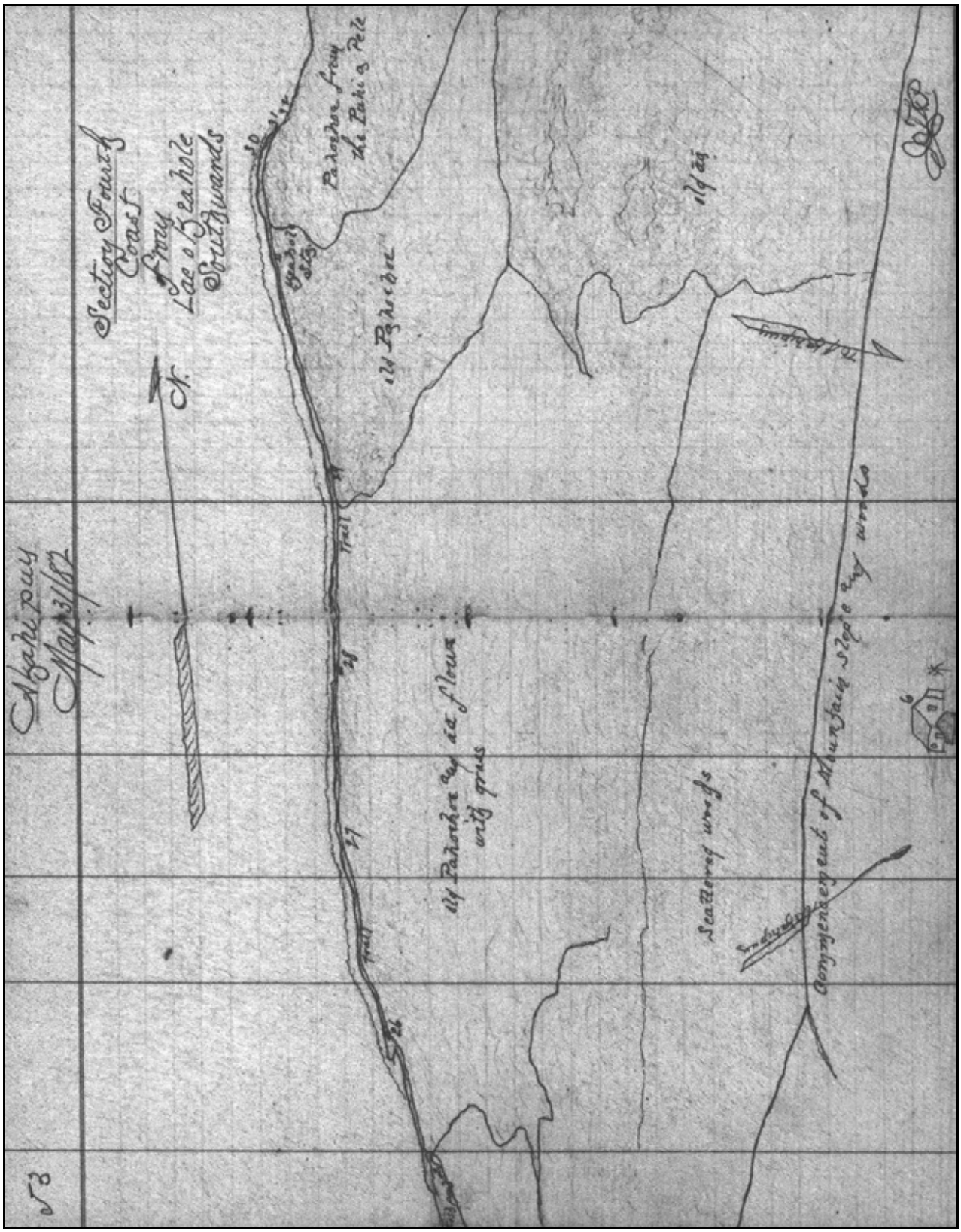

Figure 9. J. S. Emerson, field notebook map, Book 253:53 (State Survey Division).

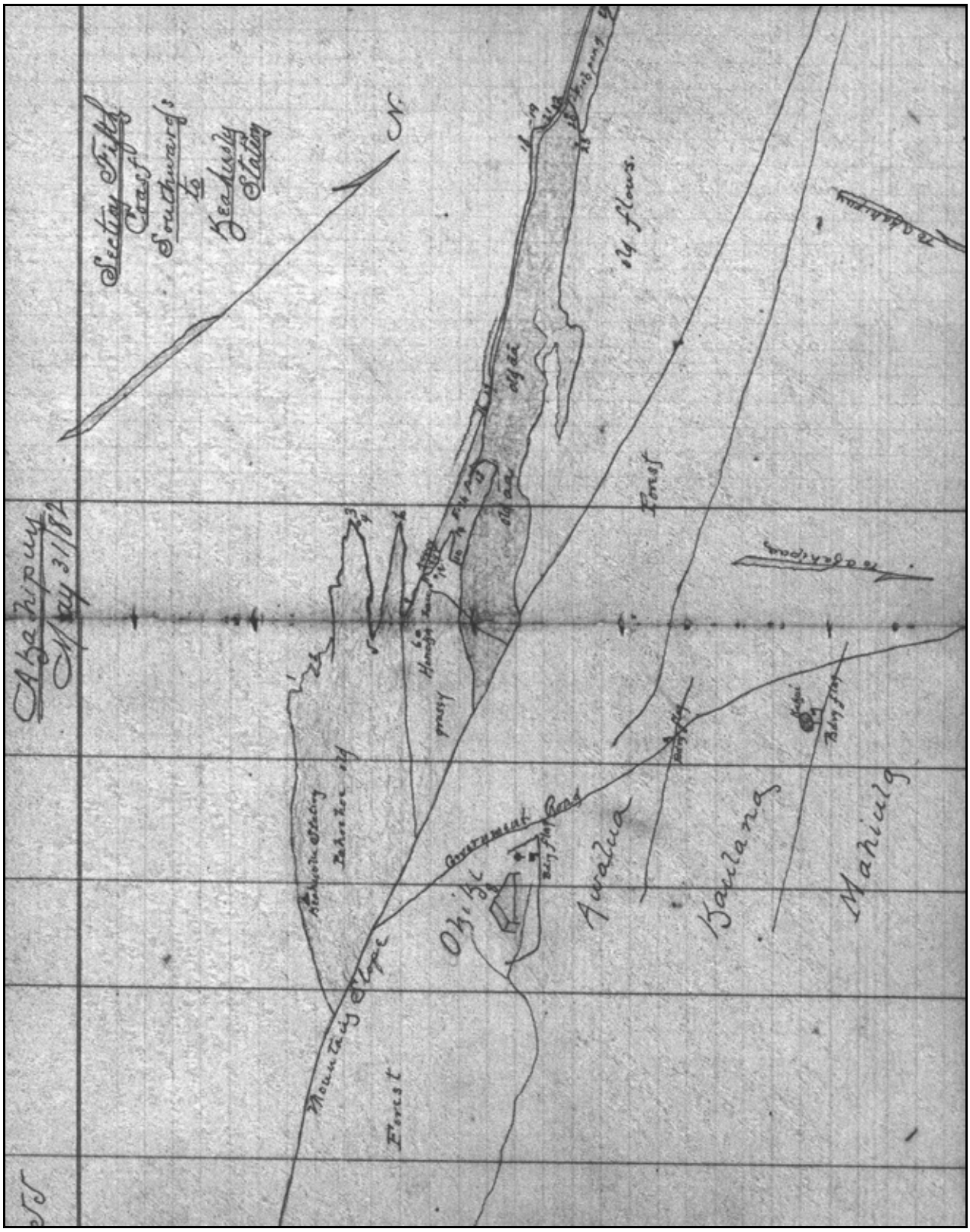

Figure 10. J. S. Emerson, field notebook map, Book 253:55 (State Survey Division).

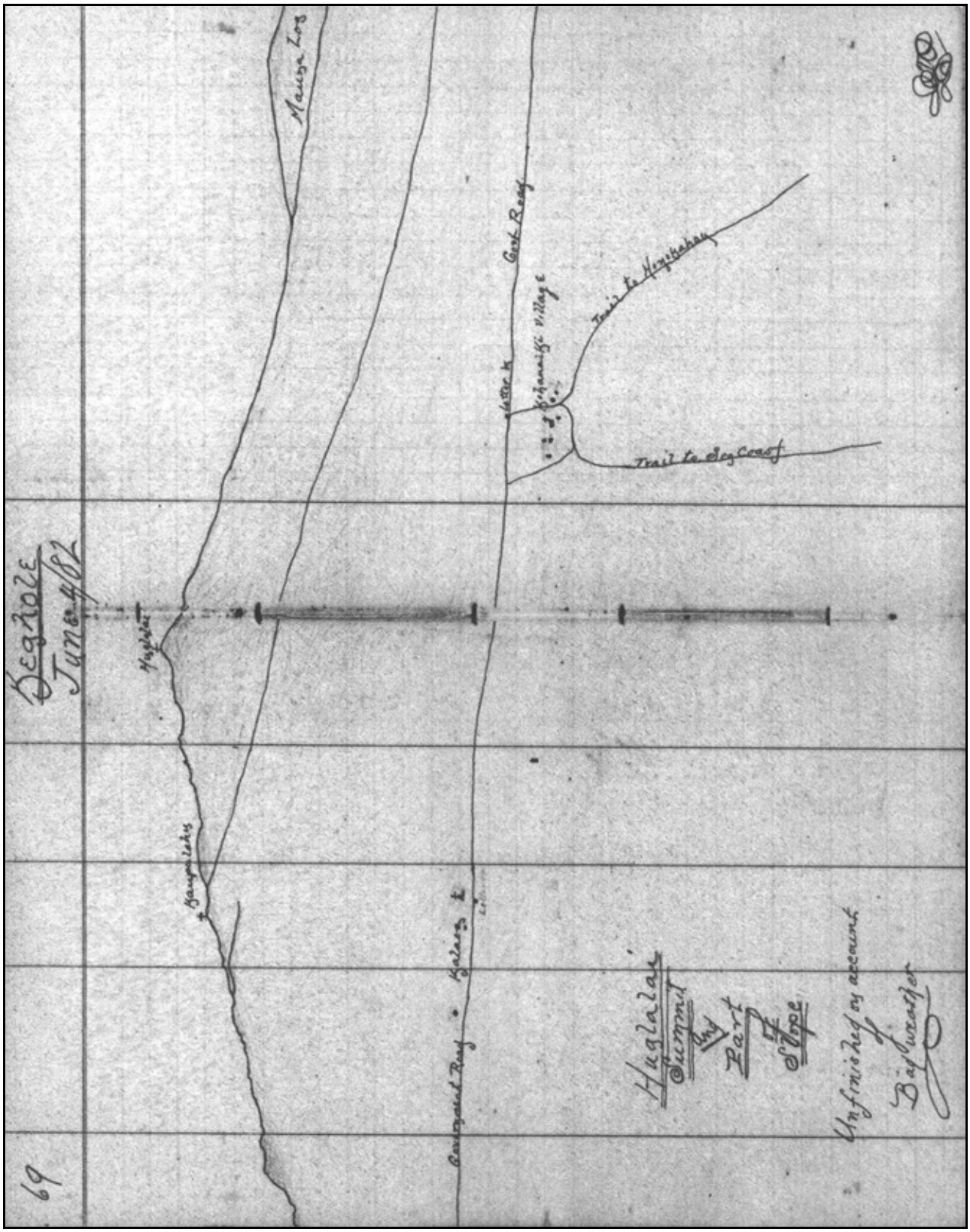

Figure 11. J. S. Emerson, field notebook map, Book 253:69 (State Survey Division).

The other sketch on page 73 of the field book (dated June 8, 1882) depicts the coastline south from Keāhole, to an area beyond Keauhou (Figure 12). Of interest, we see only the near-shore "Trail" in the foreground, with no trail on the *kula* lands. Then a short distance south, a house is depicted on the shore, in the ʻOʻoma vicinity (identified as the house of Kama or Keoki Mao on Emerson's Register Maps). And a little further beyond (south) the house, two trails are indicated—presumably the *Alanui Aupuni* on the *kula* lands to ʻOʻoma, and the near shore trail, seen coming in from Honokōhau.

While surveying the uplands on Hualālai in August 1882, Perryman drew a sketch of the Keāhole-Honokōhauiki coastal lands. This sketch (Figure 13) from field Book No. 254 shows the reverse view of Figure 12. Noting again, that the only trail given at that time, was the near shore trail, running out of Honokōhau-Kaloko, Kohanaiki, ʻOʻoma and on to Keāhole.

While surveying the ʻOʻoma and vicinity homestead lots in 1888-1889, Emerson camped near Kama's house in ʻOʻoma 1st. The following communications were sent by Emerson to W.D. Alexander, and tell us more about the people of the land, their beliefs, and commentary on then current events in the Kingdom. Of interest, we also find that J.W.H. Isaac Kihe, whose writing of traditions, and as a representative of the native families in the land application process—which have been cited extensively in this study—is also mentioned in Emerson's narratives.

(Underlining, italics and brackets are inserted to draw attention to certain passages.)

> *April 8, 1888*
> …Our tent is pitched in Ooma on the *mauka* Govt. road at a convenient distance from Kama's fine cistern which supplies us with the water we need. The pasturage is excellent and fire wood abundant. As I write 4:45 P.M. the thermometer is 71º, barometer 28.78. The entire sky is overcast with black storm clouds over the mountains. The rainy season comes late to Kona this year and has apparently just begun. We have had about three soaking rains with a good deal of cloud & drizzle. We are now having a gentle rain which gladdens the residents with water for their cisterns… We have set a large number of survey signals and identified many important corners of Gov't. lands etc. from Puhiapele on the boundary of Kaupulehu to the boundary line of Kaloko. The natives welcome us and do a great deal to help the work along. Tomorrow I expect to go to Kuili station with a transit and make a few observations & reset the old signal... The Kamaainas tell me that Awakee belongs to the Gov't. though I see it put down as LCA 10474 Namauu no Kekuanaoa.

They also tell me that the heirs of Kanaina estate still receive rent for the Ahupuaa of Kaulana, though I have recorded as follows in my book, Kaulana ½ Gov't. per civil Code 379, ½ J. Malo per Mahele Bk. Title not perfected; all Gov't. Please examine into the facts about Kaulana and instruct me as to what I shall do about it. Kealoha Hopulaau rents it and if it is Gov't. land the Gov't. should receive the rent or sell it off as homesteads. It is a desirable piece of land, a part of it at least… [HSA – HGS DAGS 6, Box 2]

April 17, 1888
...The work is being pushed rapidly and steadily forward. The natives render me most valuable assistance and find all the important corners for me as fast as I can locate them. It is hard getting around on account of the rocks & stones, to say nothing of trees etc., but there is a great deal of really fine land belonging to the Government, admirably adapted to coffee etc. The more I see of it the better it appears.

As to Kaulana, if I hear nothing to the contrary from you, I will leave it all as Gov't. land.

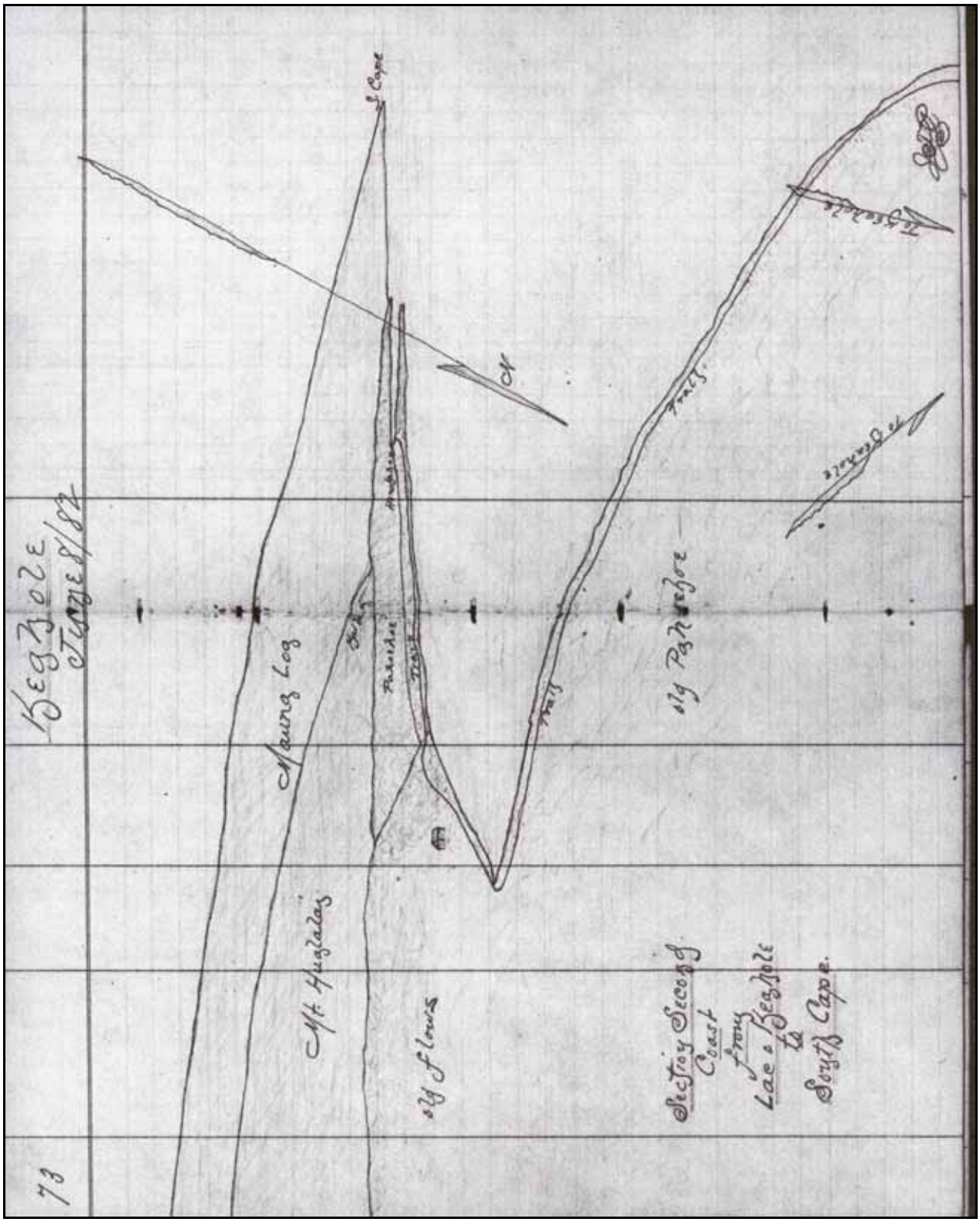

Figure 12. J. S. Emerson, field notebook map, Book 253:73 (State Survey Division).

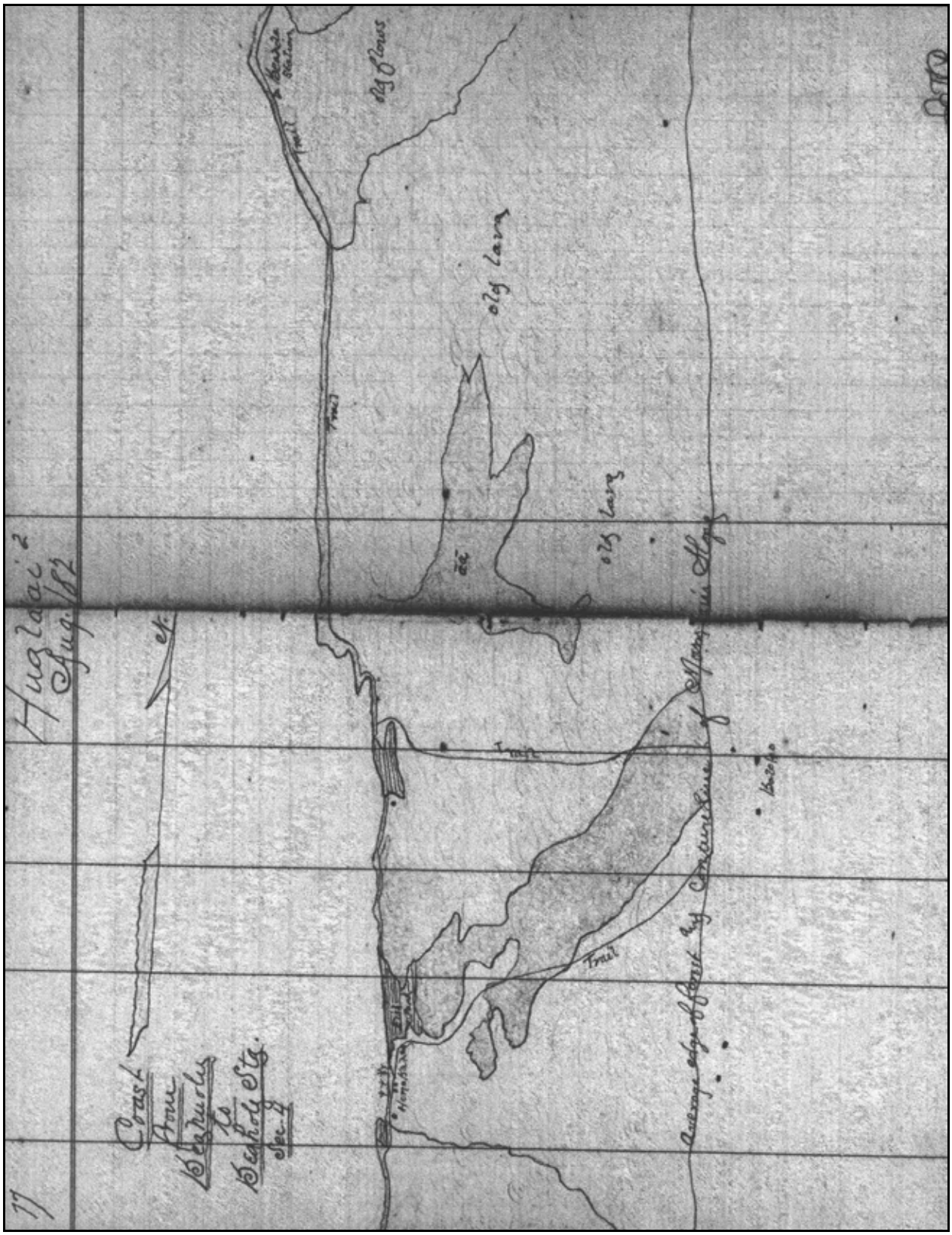

Figure 13. J. S. Emerson, field notebook map, Book 254:77 (State Survey Division).

> Mr. McGuire [sic] of Kohala, the representative for that district, proposes to settle in Kona. He has bought Grant 1590, Kauhine, in Ooma, Kalaoa etc. and wants the Gov't. to make good to him the amount taken from him by Grants 2972, Kaakau & Kama, and 3027, Hueu, which occupy portions of the same land granted to Kauhine. If his title is good, would it not be just to leave Kaakau & Kama as well as Hueu in possession of their lots where they have lived for over 20 years, and give McGuire an area in adjoining lands equal to that taken from him by these two grants.
>
> It is said that Chas. Achi has written to the natives that Grant 1590, Kauhine, has been cancelled. Will you learn the true state of the case and be so kind as to inform me… [HSA – HGS DAGS 6, box 2 Jan.-Apr. 1888]

In his field book notes, on May 1st, 1888, Emerson noted that he had placed the "Pulehu" station on the "ground by ahu, about 4 feet makai of Kama's goat pen, on the iwi aina between Kalaoa 5 and Ooma 1…" (J.S. Emerson Field Book 291:83).

In the same field book on May 19th, 1888, while surveying the area near the boundary of 'O'oma 1st and 2nd, at the 325 foot elevation, Emerson cited off of a station named "Kahokukahi." The point is "on the entrance of the cave, Kahokukahi… The above is the vertical entrance of a famous *ana kaua*, which extends for a long distance to the E. and to the W…" (J.S. Emerson Field Book 291:137). An "ana kaua" would be a place, where during times of war, people could hide and fortify themselves. Emerson's description indicates that the cave runs some distance *mauka* and *makai* of "Kahokukahi."

On May 23, 1888, Emerson surveyed Pūhili, the boundary between Kohanaiki and 'O'oma 2nd. He observed, "Large [mark] on solid pahoehoe, on bound. bet. Kohanaiki & Ooma, by the sea, near the end of a cape… Station mark, drill hole in stone, 9 ft. S. of the S. corner of an old "kahua hale" on white sand…" (J.S. Emerson Field Book 291:151).

Returning to his "old camp Ooma," in August 1888, Emerson submitted the following letter to Alexander:

> *August 25th, 1888*
> …I have to report that the very intricate and irregular remainder of Gov't. land situated in Kealakehe is cut up into homesteads, ready for the committee to estimate its values. The job has been made unusually long & tedious by the absurd arrangement of the old kuleanas scattered around at random. I have also run out the boundaries of Papaakoko, ready for fencing. Thursday P.M. I made my way through a heavy rain to this place and set up tent in the storm. It rained a good deal every day since and is raining now. In spite of the weather the work of cutting up Ooma 1st goes bravely on. I have a huge umbrella to camp under while it rains. I propose to finish up Ooma 1st & return to Honolulu by the next trip of the *Hall*.
>
> Kailua beach is the great rendezvous for men & asses from all parts of the country when the steamer arrives from Honolulu. It has in consequence become the natural place to tell and hear gossip & news. Here, the sand-lot orator, mounted on a packing box, can address the largest crowd. T.N. Simeona, who stole the church money, keeps the pound and takes care of the court house wanting to make a speech, repaired to the beach last Wednesday morning and is reported to have made a windy harangue to the effect that the King was hewa and that the Ministers were pono! Up to that time he had always been the contemptible too of the King's party and was loud in his denunciation of the Government. I explain this change in his talk by his wish to retain his Gov't. billets & his desire to avoid arrest as a rebel.

> A native man told me the other day (Wednesday) that the Cabinet was hewa in two things viz.
>
> 1st They taxed chickens, banana trees and many other things that had not been heretofore taxed.
>
> 2nd They arrested and sent to Molokai many who were not lepers. For these reasons many justified Wilcox for trying to out the ministers.
>
> There is a sturdy old native living at Kaloko named Kealiihelepo, whom I greatly respect. Said he to me "When King Kalakaua returned from his foreign trip he made a speech at Kailua and said that 'in foreign lands the foreign God was losing his power. His former worshippers were deserting him. That the old Hawaiian Gods were still mana and them he would worship.'" But said Kealiihelepo "The King was mistaken. Our old Gods were once mighty, but the coming of the foreigner with his Gods has robbed them of their strength. Therefore the King has made the mistake to oppose the God who is now in power, and Jehovah is opposing him. Hence the King's pilikia."
>
> You are entirely justified in calling Kona "that heathen district." [HSA – HGS DAGS 6, box 2 Jan.-Apr. 1888]

On October 14th 1888, Emerson wrote to Alexander, briefing him on conversations he was having with J.W.H. Isaac Kihe, his "encyclopedia," "the son of a famous sorcerer." Later, Emerson used many of the notes taken during his conversations with Kihe, to develop his paper on Hawaiian religion (Emerson 1892). J.W.H. Isaac Kihe, was the son of Kihe, who was the son of Kuapahoa, of Kaloko (notes of J.S. Emerson, September 25, 1915; in collection of the Hawaiian Historical Society). While at 'O'oma, Kihe described the various nature forms taken by the deceased, and their role in the spiritual practices. On October 14th Kihe named for him some of the gods called upon by those who practiced the Kahuna Kuni sorcery.

> *Ooma*
> *October 14, 1888*
> *J.S. Emerson; to W.D. Alexander:*
> …I have just been having a chat with a son of a famous sorcerer, with the following for a summary of what he said.
>
> There are four gods worshipped by murders and sorcerers viz:
>
> (1). Kui-a-Lua, the god of the Lua, Mokomoko, Haihai and other forms of violence.
>
> (2). Uli, the god of the Anaana, Kuni, Hoopiopio and Lawe Maunu.
>
> (3). Kalaipahoa, god of the Hoounauna, Hookomokomo and Hooleilei.
>
> (4). Hiiaka-i-ka-poli-o-Pele, the goddess of the Poi uhane, Apo leo, Pahiuhiu and Hoonoho uhane… [J.S. Emerson, in collection of the Hawaiian Historical Society]

Trails and Roads of Kekaha (Governmental Communications)

Alahele (trails and byways) and *alaloa* (regional thoroughfares) are an integral part of the cultural landscape of Hawai'i. The *alahele* provided access for local and regional travel, subsistence activities, cultural and religious purposes, and for communication between extended families and communities. Trails were, and still remain important features of the cultural landscape.

Traditional and historical accounts (cited in this study) describe at least two traditional trails that were of regional importance which pass through the lands of ʻOʻoma. One trail is the *alaloa*—parts of which were modified in the 1840s and later, into what is now called the *Alanui Aupuni* (Government Road) or Māmalahoa Trail or King's Highway—that crosses the *makai* (near shore) lands, linking royal centers, coastal communities, and resources together. The other major thoroughfare of this region is "*Kealaehu*" (The path of Ehu), which passes through the uplands, generally a little above the *mauka* Government Road or old Māmalahoa Highway, out to the ʻAkāhipuʻu vicinity, and then cuts down to Kīholo in Puʻu Waʻawaʻa. From Kīholo, the *makai alaloa* and Kealaehu join together as the *Alanui Aupuni*, and into Kohala, passing through Kawaihae and beyond. The *mauka* route provided travelers with a zone for cooler traveling, and access to inland communities and resources. It also allowed for more direct travel between the extremities of North and South Kona (cf. Malo 1951; Iʻi 1959; Kamakau 1961; Ellis 1963; and *Māhele* and Boundary Commission Testimonies).

In addition to the *alahele* and *alaloa*, running laterally with the shore, there are another set of trails that run from the shore to the uplands. By nature of traditional land use and residency practices, every *ahupuaʻa* also included one or more *mauka-makai* trail. In native terminology, these trails were generally known as—*ala piʻi uka* or *ala piʻi mauna* (trails that ascend to the uplands or mountain). Some of these trails are described in native accounts and oral history interviews cited in this study.

Along the trails of the Kekaha region of which ʻOʻoma is a part, are found a wide variety of cultural resources, including, but not limited to residences (both permanent and temporary), enclosures and exclosures, wall alignments, agricultural complexes, resting places, resource collection sites, ceremonial features, *ilina* (burial sites), petroglyphs, subsidiary trails, and other sites of significance to the families who once lived in the vicinity of the trails. The trails themselves also exhibit a variety of construction methods, generally determined by the environmental zone and natural topography of the land. "Ancient" trail construction methods included the making of worn paths on *pāhoehoe* or *ʻaʻā* lava surfaces, curbstone and coral-cobble lined trails, or cobble stepping stone pavements, and trails across sandy shores and dry rocky soils.

Following the early nineteenth century, western contact brought about changes in the methods of travel (horses and other hoofed animals were introduced). By the mid-nineteenth century, wheeled carts were also being used on some of the trails. In the Kona region portions of both near shore and upland *ala hele-ala loa* were realigned (straightened out), widened, and smoothed over, while other sections were simply abandoned for newer more direct routes. In establishing modified trail—and early road-systems—portions of the routes were moved far enough inland so as to make a straight route, thus, taking travel away from the shoreline.

It was not until 1847, that detailed communications regarding road construction on Hawaiʻi began to be written and preserved. It was also at that time that the ancient trail system began to be modified and the alignments became a part of a system of "roads" called the "*Alanui Aupuni*" or Government Roads. Work on the roads was funded in part by government appropriations, and through the labor or financial contributions of area residents and prisoners working off penalties (see communications below). Where the *Alanui Aupuni* crosses the lands of ʻOʻoma, the alignment includes several construction methods, such as being lined with curbstones; elevated; and with stone filled "bridges" in areas that level out the contour of the roadway.

The following letters provide readers with a historical overview of the *Alanui Aupuni*, and travel through ʻOʻoma and the Kekaha region. Of particular interest to the lands of ʻOʻoma, are those communications addressing the lower Government Road which passes through the proposed development area.

(Underlining, italics, and square brackets have been added.)

June 26, 1847
George L. Kapeau to Keoni Ana
I have received your instructions, that I should explain to you about the *alaloa* (roadways), *alahaka* (bridges), lighthouses, markets, and animal pounds. I have not yet done all of these things. I have thought about where the *alanui heleloa* (highways) should be made, from Kailua to Kaawaloa and from Kailua to Ooma, where our King was cared for [7], and then afterwards around the island. It will be a thing of great value, for the roads to be completed. Please instruct me which is the proper thing for me to do about the *alaloa*, *alahaka*, and the laying out of the *alaloa*… [HSA – Interior Department Misc., Box 142; Kepā Maly, translator)

August 13, 1847
Governor of Hawaii, George L. Kapeau; to
Premier and Minister of Interior, Keoni Ana
Aloha oe e ka mea Hanohano –
I have a few questions which I wish to ask you. Will the police officers be required to pay, when they do not attend the Tuesday (*Poalua*) labor days? How about parents who have several children? What about school teachers and school agents? Are they not required to work like all other people when there is Government work on the roads and highways?

I believe that school agents, school teachers and parents who have several children, should only go and work on the weeks of the public, and not on the *konohiki* days…

…The roads from Kailua and down the pali of Kealakekua, and from Kailua to Honokohau, Kaloko, Ooma, at the places that were told our King, and from thence to Kaelehuluhulu [at Kaulana in Kekaha], are now being surveyed. When I find a suitable day, I will go to Napoopoo immediately, to confer with the old timers of that place, in order to decide upon the proper place to build the highway from Napoopoo to Honaunau, and Kauhako, and thence continue on to meet the road from Kau. The road is close to the shore of Kapalilua…

The width of the highways around Hawaii, is only one fathom, but, where it is suitable to widen where there is plenty of dirt, two fathoms and over would be all right… If the roads are put into proper condition, there are a lot of places for the strangers to visit when they come here. The Kilauea volcano, and the mountains of Maunaloa, Maunakea, Hualalai.

There is only one trouble to prevent the building of a highway all around, it is the steep gulches at Waipio and Pololu, but this place can be left to the very last… [HSA – Roads, Hawaii]

March 29, 1848
Governor Kapeau; to Minister of the Interior, Keoni Ana:
[Acknowledging receipt of communication and answering questions regarding construction methods used in building the roads.]

…I do not know just what amount of work has been done, but, I can only let you know what has come under my notice.

[7] For the first five years of his life (till ca. 1818), Kauikeaouli was raised at ʻOʻoma, by Ka-iki-o-ʻewa and Keawe-a-mahi *mā* (see Kamakau 1961; and this study).

The highway has been laid from Kailua to Kaloko, and running to the North West, about four miles long, but it is not completely finished with dirt. The place laid with dirt and in good condition is only 310 fathoms.

The highway from Kealakekua to Honaunau has been laid, but is not all finished, and are only small sections… [HSA – Roads, Hawaii]

July 9, 1873
R.A. Lyman; to
E.O. Hall, Minister of the Interior.
Notifies Minister that *the road from Kiholo to Kailua needs repairing*. [HSA – Interior Department – Land Files]

August 14, 1873
R.A. Lyman; to
E.O. Hall, Minister of the Interior:
I have just reached here [Kawaihae] from Kona. I have seen most of the roads in N. Kona, and they are being improved near where the people live. If there is any money to be expended on the roads in N. Kona, I would say that the place where it is most needed is from Kiholo to Makalawena, or the Notch on Hualalai.

This is the main road around the island and is in very bad condition. Hardly anyone lives there, and there are several miles of road across the lava there, that can only be worked by hiring men to do it. There is also a road across a strip of Aa a mile & a half or 2 in length in the south end of S. Kohala next to the boundary of N. Kona, that needs working, and then the road from here [Kawaihae] to Kona will be quite passable… [HSA – Roads, Hawaii]

November 4, 1880
J.W. Smith, Road Supervisor, North Kona; to
A.P. Carter, Minister of the Interior:
…Heretofore I have been paying one dollar per day, but few natives will work for that, they want $1.50 per day. Thus far I have refused to pay more than $1.00 and have been getting men for that sum.

The most urgent repairs are needed on the main road from Kaupulehu to Kiholo, and north of Kiholo to the Kohala boundary, a distance of about 20 miles… [HSA – Roads, Hawaii]

Kailua Nov. 19th, 1880
Geo. McDougall; to
A.P. Carter, Minister of the Interior —
…I noticed among the appropriation passed by the last Legislature, an item of $5000 for Roads in North Kona Hawaii — as I am very much interested about roads in this neighbourhood, I take the liberty to express my opinions what is wanted to put the roads in good repair and give the most satisfaction to all concerned.

The Road from Kailua going north for about eight miles to where it joins the upper Road, has never been made, it is only a mule track winding through the lava. It could cost to make it a good cart road, fully two thousand dollars. And from Kailua to where it joins the South Kona road, about 12 miles was made by Gov. Adams, and is in pretty much the same state as he left it, only a little worse of the ware of 20 years or more, it

could cost to make it in good repair about 15 hundred dollars. Then we could have 20 miles of good road… [HSA – Interior Department Letters]

March 21st, 1885
C.N. Arnold, Road Superintendent-in-Chief, Hawaii; to
Charles Gulick, Minister of Interior:
…In accordance with your instructions I beg to hand you the following list of names as being those I would select for Supervisors in the different Road Districts under my charge:

… Judge J.K. Hoapili, North Kona District…

Hoping these parties may meet with your approval… [HSA – Roads, Hawaii]

March 1886
Petition to Charles Gulick, Minister of the Interior:
[Signed by 53 residents of North Kona, asking that the appropriated funds be expended for the Kailua-Kohanaiki Road]:

We the people whose names are below, subjects of the King, residing in North Kona, Island of Hawaii:

The funds have been appropriated by the Legislature for the opening of the road from Kailua to Kohanaiki, therefore, we humbly request that the road be made there. The length of this road being thought of is about five miles more or less. The road that is there at the present time is not fit for either man nor beast.

Your people have confidence that as so explained, you will kindly grant our request, and end this trouble in our District…

[those signing included names of individuals known to have ties to the ʻOʻoma vicinity]: …J. Kamaka, Kuakahela, Kahulanui, & Palakiko… [HSA – Roads Hawaii; Maly, translator]

March 9th, 1887
C.N. Arnold, Road Superintendent-in-Chief, Hawaii; to
Chas. Gulick, Minister of the Interior:
[Arnold provides documentation of the early native trail from Kailua to the upper Kohanaiki region, and its' ongoing use at the time. He also notes that McDougall (resident at Honokōhau) and others are presently in the business of dairy ranching]:

…The enclosed petition [cited above] has just come to hand from North Kona. The petitioners are mistaken when they say that any special appropriation has been made for this road as there has never been a Government road in this part of the District. There is however an old native trail which has always been used as a short cut, from the lower part of the district between Keahou [sic] and Kailua, by persons who were traveling to Kawaihae and Waimea. The opening of a good road here would be a great convenience to the traveling public and also a great accommodation to a great many people who live on, or nearly on the line of it. I may mention among the number, Messrs. McDougall and Clark who are engaged in dairy ranching near the head of the proposed line. I may also mention that I, with Mr. Smith, made a preliminary survey of it, at the request of His Majesty the King, who is also interested in the opening of this road, as it opens up all of

His Kailua lands for settlement. I regard the road as necessary for the above reasons.

From the preliminary survey made, I estimate that a wagon road 12 feet wide will cost from Kailua to the *mauka* Govt. road at Kohanaiki $6000. The length of the road is 5 ¾ miles. The elevation of highest point (*mauka* Road) is 1600 feet above tide at Kailua. Mr. Smith Supt. of Public Works has all the notes of the survey, and can give you full information in regard to this matter… [HSA – Roads, Hawaii]

July 14th, 1887
C.N. Arnold, Road Superintendent-in-Chief, Hawaii; to
L.A. Thurston, Minister of the Interior:
…In obedience to your request I beg to hand you the following list of the District Supervisors under my jurisdiction:

…North Kona – Hon. J.K. Nahale; Native… [HSA – Roads Hawaii]

March 8, 1888
J. Kaelemkule; Supervisor, North Kona Road Board; to
L.A. Thurston, Minister of the Interior.
[Ka‘elemakule provides Thurston with an overview of work on the roads of North Kona, and describes the Government roads (*Ala nui Aupuni* or *Ala loa*) which pass through the Kekaha region]:

The road that runs from Kailua to Kohanaiki, on the north of Kailua, perhaps 6 miles. It is covered with aa stone, and is perhaps one of the worst roads here. The Road Board of North Kona has appropriated $200 for work in the worst areas, and that work has been undertaken and the road improved. The work continues at this time. This is one of the important roads of this district, and it is one of the first roads that should be worked on.

The government road or ala loa from upland Kainaliu (that is the boundary between this district of South Kona) [Kealaehu], runs straight down to Kiholo and reaches the boundary of the district adjoining South Kohala, its length is 20 and 30 miles. With a troubled heart I explain to your Excellency that from the place called Kapalaoa next to South Kohala until Kiholo – this is a very bad section of about 8 miles; This place is always damaged by the animals of the people who travel along this road. The pahoehoe to the north of Kiholo called Ke A. hou, is a place that it is justified to work quickly without waiting. Schedule A, attached, will tell you what is proposed to care for these bad places…

Schedule A: [Appropriations needed]
The road from Kailua to Kohanaiki, and then joining with the inland Government Road – $500.

The upland Road from Kainaliu to the boundary adjoining S. Kohala – $1,500.00. [HSA – Roads Hawaii; Kepā Maly, translator]

September 30, 1889
Thos. Aiu, Secretary, North Kona Road Board (for J. Kaelemakule); to
L.A. Thurston, Minister of the Interior.
[Provides Thurston with an overview of work on the roads of North Kona, and identifies individuals who are responsible for road maintenance (cantoniers) in various portions of the district; several of the individuals named were also old residents and applicants for

Homestead lots. Of interest, Kaelemakule's report indicates that maintenance of the Alanui Aupuni which crossed into the kula lands of ʻOʻoma, had not been assigned to anyone. (see report of Dec. 22, 1890)]:

1. In that section of the road which proceeds from Kailua near the shore to Kohanaiki, Mano is the cantonier.
2. That section of the road from Kukuiooohiwai to Keahuolono, Paiwa is the cantonier…
3. That section of road from Kailua to the shore of Honokohau, Keaweiwi is the cantonier …
4. That section of road from Kukuioohiwai to Lanihau along the upland road, Isaac Kihe is the caretaker…

The work done along these sections is the cutting of brush – guava, lantana and such – which trouble the road, and the removal of bothersome stones… [HSA – Roads Hawaii; Kepā Maly, translator]

December 22, 1890
J. Kaelemkule; Supervisor, North Kona Road Board; to
C.N. Spencer, Minister of the Interior
[Reports on the cantoniers assigned to road work in various sections of North Kona. As in 1889, apparently no one was assigned to the lower Alanui Aupuni through the ʻOʻoma kula lands. Though Kaelemakule did include the road section on the land, extending through Kalaoa, on his attached diagram]:

…I forward to you the list of names of the cantoniers who have been hired to work on the roads of this district, totaling 15 sections; showing the alignment of the road and the length of each of the sections. The monthly pay is $4.00 per month, at one day of work each week. The board wanted to increase it to two days a week, but if that was done, there would not have been enough money as our road tax is only $700.00 for this district… You will receive here the diagram of the roads of North Kona. [HSA – Roads Hawaii; Kepā Maly, translator] (Figure 14)

Twentieth Century Travel in ʻOʻoma and Neighboring Lands of Kekaha

Kamaʻāina who have participated in oral history interviews (Rechtman and Maly 2003), describe on-going travel between the uplands and coastal lands of ʻOʻoma and other *ahupuaʻa* in Kekaha. The primary method of travel between 1900 and 1947, was by foot or on horse or donkey, and those who traveled the land, were generally residents of the ʻOʻoma, Kalaoa, Kohanaiki Homesteads and other lands in the immediate vicinity. The old ʻOʻoma Homestead road that borders the current project area to the south, was used during this time. After World War II, retired military vehicles became available to the public, after that time, the *Alanui Aupuni* and some of the smaller trails along the shore were modified for vehicular traffic.

The primary routes of travel through the 1960s, descended from upland Kohanaiki and Kaloko, or came out of Kailua. In the 1950s, Huʻehuʻe Ranch bulldozed a jeep road to the shore at Kaloko. The ranch, and some individuals who went to the shore either as a part of their ranch duties, or for leisure fishing along the coast, used this jeep road. The *Alanui Aupuni* was modified from Kailua, to at least as far as Honokōhau and Kaloko, and remained in use through the 1970s. It was not until the Queen Kaʻahumanu Highway was opened (ca. 1973) that travel across the *kula kai* (shoreward plains) of ʻOʻoma was once again made possible for the general public.

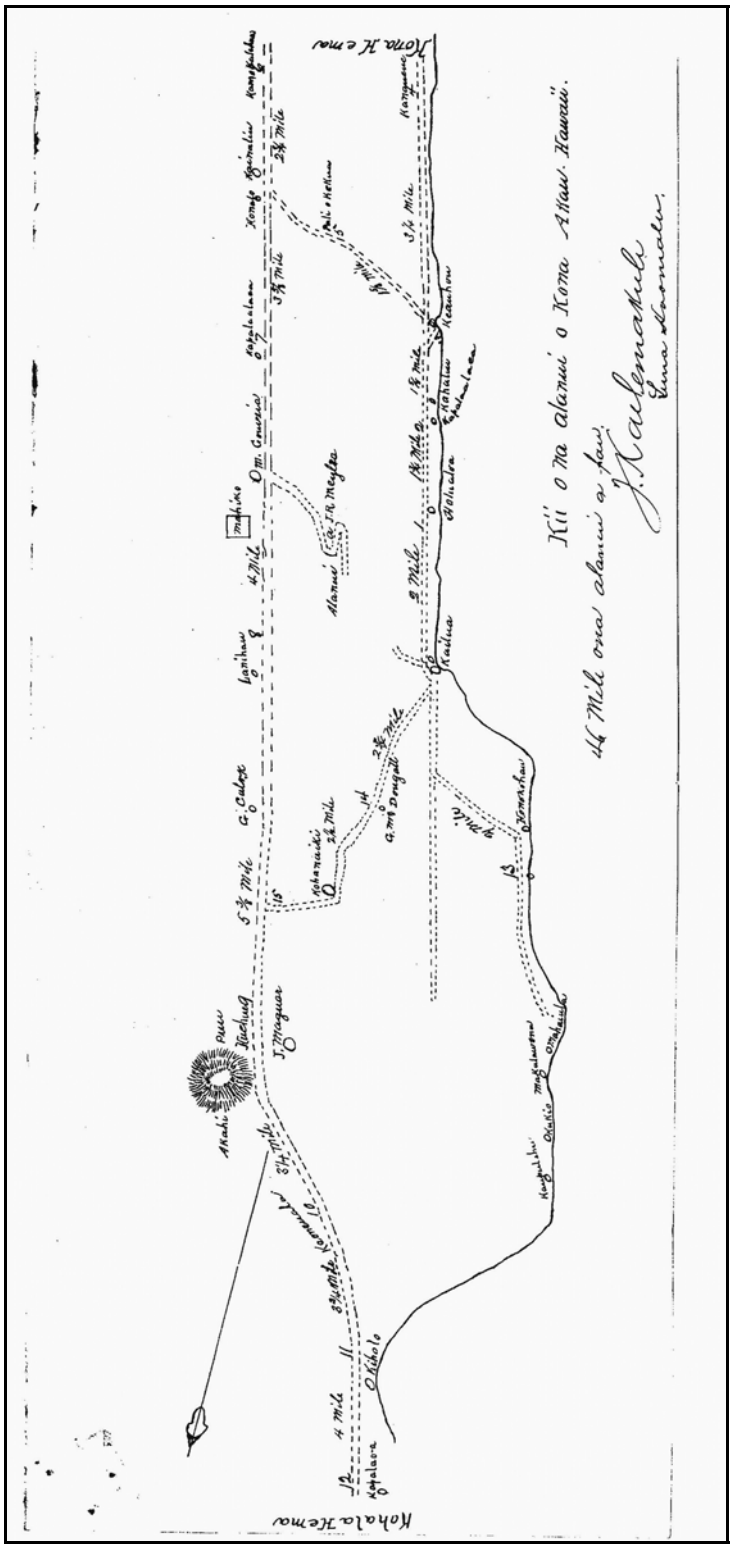

Figure 14. *Kii o na alanui o Kona Akau* (diagram of the roads of North Kona); J. Kaelemakule Sr., Road Supervisor (HSA – Roads, Hawaii; December 22, 1890).

Summary of Oral-Historical Information

In Rechtman and Maly (2003:Volume II) elder kama‘āina of the Kekaha region, tell much the same story as that described in the communications from the period of homestead development, and in the accounts given by J. Puuokupa in 1875 and J.W.H. Isaac Kihe in 1924. By the late 1800s, only a few permanent residence remained along the ‘O‘oma (and Kekaha) coastline. Primary residences were in the uplands, in the vicinity of the old Māmalahoa Highway. In that region, people were able to cultivate a wide range of crops—both native staples and new introductions—with which to sustain themselves, and in some case even as cash crops.

By the middle to late 1800s, the *kula* lands, from around the 900-foot elevation to shore, were primarily used for goat, cattle, and donkey pasturage. The families of the uplands regularly traveled to the coast via trails. This was usually done to go fishing, or to round up cattle, goats, or donkeys. During periods of extreme dry weather, when water resources dried up, the families relied on the brackish water ponds in the near-shore lands. In ‘O‘oma, near Wawaloli, the area marked on J.S. Emerson’s Register Maps 1280 (see Figure 6), as Kama’s or Keoki Mao’s house, families still took shelter, and drank the water from the spring, through the 1940s. Such was the case at various locations of the coast, between Kohanaiki, ‘O‘oma, Kalaoa, Ho‘onā, Kaulana, and lands further north to Kapalaoa.

An additional oral interview was conducted with *kama‘āina* Elizabeth Maluihi Ako Lee (Auntie Elizabeth) for the Clark and Rechtman (2005a) study of TMK:3-7-3-7:38. Auntie Elizabeth was born in 1929 and was raised by her *hanai* family, Kahananui, in upland ‘O‘oma. As a child she walked the upland trails and cultivated sweet potatoes on her family land on a parcel located directly south of the current study area. Her family also owned a parcel to the southeast of the current project area, which they used to graze cattle. Auntie Elizabeth recalled a Korean man living on that parcel during the 1930s. The man had a house that burned down ca. 1939 when his *akolehau* still exploded. Auntie Elizabeth did not recall any specific information that related to the current study area.

AHUPUA‘A SETTLEMENT PATTERNS AND CURRENT SURVEY EXPECTATIONS

Archaeological studies undertaken within the greater North Kona District indicate that initial prehistoric settlement was concentrated primarily along the coast (Cordy 1981, Cordy et al. 1991). As coastal populations increased, so did the development of agricultural fields in the upland areas, reaching their greatest extent in the late 1700s. As the fields expanded so did native populations in the upland resource areas. By the sixteenth century temporary and permanent habitations were found at higher elevations within the upland agricultural areas (Barrera 1991).

In Historic times, with the shift to a market economy and a western style of land ownership in Hawai‘i, populations shifted from the coast to the upland areas. Much of the old style of agriculture was abandoned in favor of coffee farms and cattle ranches, which have had a significant impact on the Precontact archaeological record.

Based on the Historical information collected by Rechtman and Maly (2003) and the findings of the archaeological inventory surveys previously conducted nearby the current study parcel (Clark and Rechtman 2005a, 2005b; Haun and Henry 2003; Nelson et al. 2006) a fairly detailed set of project area expectations can be arrived at. Precontact use of the project area is likely to be marked by numerous and diverse agricultural features (including modified outcrops, mounds, enclosures, terraces and perhaps *kuaiwi*) and associated habitation sites. The habitation sites could include platforms, enclosures, modified outcrops, terraces, pavements, or lava tubes. A network of trails would have connected these upland agricultural and habitation areas to each other and to the coast and to more *mauka* resource areas. Remnants of this trail network may be present within the current project area. If burials are present, they are expected to be found within platforms, lava tubes, or concealed lava blisters.

Historic use of the study area is likely to be marked by ranching and habitation related sites. Historic feature types could include core-filled walls, enclosures, roads, or house pads. Historic records indicate that the parcel that the current survey corridor crosses was former Lot 58 of the ʻOʻoma Homesteads, a grant parcel that was applied for by Jno. Kainuku during the latter part of the nineteenth century, but which was never patented (Rechtman and Maly 2003; see Figure 7).

FIELDWORK

Fieldwork for this inventory survey was conducted on June 21 and 22, 2006 by Matthew R. Clark, B.A., Mark J. Winburn B.A., Christopher S. Hand, B.A., Lizabeth A. Hauaniʻo, and Michael K. Vitousek under the direction by Robert B. Rechtman, Ph.D.

Methods

During the intensive survey of the study area, the entire corridor was subject to north/south pedestrian transects with fieldworkers spaced at 10-meter intervals. When archaeological resources were encountered, they were plotted on a map of the study parcel using Garmin 76s handheld GPS technology, and then cleared of vegetation, mapped using tape and compass, photographed, and described using standardized site record forms.

Findings

As a result of the fieldwork, four archaeological sites were recorded within the survey corridor. The recorded sites include two core-filled boundary walls (Sites 23834 and 25527), an agricultural complex (Site 25528), and a Precontact habitation enclosure (Site 25529). Each of these archaeological sites is described in detail below and their locations are shown in Figure 15.

SIHP Site 23834

Site 23834 is a core-filled wall that runs along the northern boundary of the parcel that the current survey corridor crosses (see Figure 15). This wall was originally recorded by Haun and Henry (2003:50) as the southern boundary wall of TMK:3-7-3-7:40; a western extension of the wall was then recorded by Clark and Rechtman (2005b) as the northern boundary wall of TMK:3-7-3-7:39 (located directly east of the current study area). This historic boundary wall may have been built by Kauhini, who applied for Grant 1590 in 1855, or later by Kaakau and Kama who purchased Grant 2972, a portion of former Grant 1590, in 1864. Both of these grants parcels occupy the same space directly north of the current study area. Grant 1590 was never patented to Kauhini, but was divided into smaller parcels, one of which was Grant 2972. It is unlikely that the wall was constructed by Jno. Kainuku who originally applied for Lot 58 of the ʻOʻoma Homesteads (the current study parcel), as the wall continues beyond the boundaries of the parcel and likely belonged to one the aforementioned earlier grants (Clark and Rechtman 2005b).

Only a sixty-meter long section of Site 23834 is present along the northern boundary of the current study area at the southern termination of Holoholo Street. The wall continues west beyond the current study area for an undetermined distance. To the east, as recorded by Haun and Henry (2003) and Clark and Rechtman (2005b), the wall continues nearly to Māmalahoa Highway. Site 23834 is constructed of stacked *pāhoehoe* cobbles, with intact sections standing up to 1.0 meter (six courses) tall by 0.9 meters wide. The wall is nearly completely collapsed at the termination of Holoholo Street (Figure 16), the collapse continues to the west from the street, but to the east it appears as though the wall has been more recently restacked and repaired (Figure 17). This is likely due to the presence of a landscaped property located along the northern edge of the wall to the east of Holoholo Street. Site 23834 was likely originally constructed as a boundary wall delineating the southern boundary of one of the two aforementioned grant parcels. As a secondary function, it may have served to control the movement of livestock such as goats or cattle.

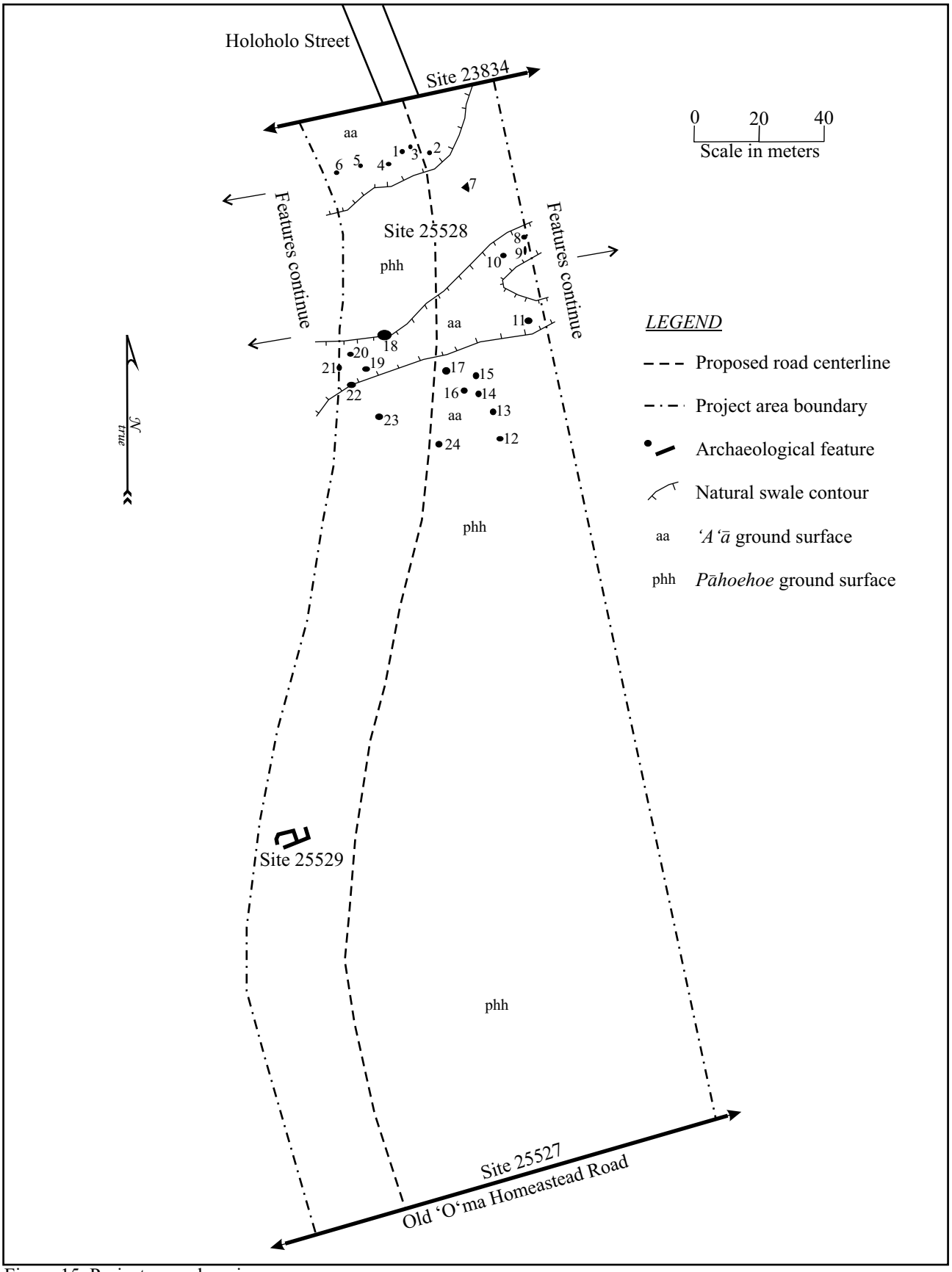

Figure 15. Project area plan view.

Figure 16. SIHP Site 23834 at the termination of Holoholo Street, view to south.

Figure 17. SIHP Site 23834 at the termination of Holoholo Street, expanded view to south (note restacked portion of the wall at the left of the photograph).

SIHP Site 25527

Site 25527 is a core-filled wall that runs along the southern boundary of the parcel that the current survey corridor crosses (see Figure 15). Site 25527 also borders the northern edge of an old ʻOʻoma Homestead road, and a second wall (Site 16126) is present along the southern edge of the road (on TMK:3-7-3-9:7) approximately three meters distant (Nelson et al. 2006). A separate wall (Site 24774) is present along the southern boundary of TMK:3-7-3-7:39 located directly east of the current study parcel. As recorded by Clark and Rechtman (2005b), Site 25527 is offset from Site 24774 in the southwestern corner of that parcel, and it appears that these two walls were constructed during separate episodes by the individual homestead owners. That means that this historic boundary wall was possibly built sometime during the latter half of the nineteenth century when Jno. Kainuku applied for Lot 58 of the ʻOʻoma Homesteads.

A 130-meter section of Site 25527 is present at the southern termination of the current survey corridor. The wall continues both east and west of the current project area along the southern boundary of TMK:3-7-3-009:008, to the southeastern and southwestern corners that parcel (observations by Clark and Rechtman 2005b and Nelson et al. 2006). Within the current project area the wall stands up to 1.3 meters tall by 0.8 meters wide. Site 25527 is constructed of neatly stacked *pāhoehoe* cobbles that have collapsed in only a few locations (Figures 18 and 19).

The old Homestead road that Site 25527 borders was discussed in oral interviews with Kepā Maly as a route that was taken from the uplands to the coast by *kupuna* Peter Keikuaʻana Park, who was born in ʻOʻoma in 1918 (Rechtman and Maly 2003:II-31). In a side note Rechtman and Maly describe the route of the road thusly:

> The road as described by *kupuna* starts *mauka* in ʻOʻoma 2nd, goes *makai* between Homestead lots 58 and 59 [see Figure 7], held for Kuhaiki and Kainuku; then runs north across ʻOʻoma 1st, into Kalaoa and the old Kamaka House, from where it then cuts *makai* to the shore (see Register map No. 2123). (2003:II-32)

Figure 18. SIHP Site 25527, view to south of wall's northern edge.


Figure 19. SIHP Site 25527, close-up of wall's northern edge, view to south.

SIHP Site 25528

Site 25528 consists of twenty-four crudely constructed agricultural features located in the northern portion of the current survey corridor (see Figure 15). The recorded features of Site 25528 include twenty mounds and four modified outcrops (Appendix A). Formal feature definitions for the agricultural complex recorded by Clark and Rechtman (2005b) on a parcel directly east of the current study area were used as criteria for separating the features of Site 25528 into formal categories (i.e. mound or modified outcrop). Clark and Rechtman define each of these formal feature types thusly:

> A mound is collection of stones with an irregular surface. Mounds range considerably in size, shape, method of construction, and type of stone used. They are constructed from as few as four stones or as many as the topography and the effort of the individual(s) constructing them allow. The shape of a mound varies considerably depending on the terrain and the individual purpose of construction. However, all mounds, as dictated by gravity, have sloped sides. Mounds are either piled or stacked, or a combination of both. Stacked mounds usually contain a fill of piled stones with an outside layer stacked around the edges. The type of stone used in mound construction is a reflection of the immediately available source material. The size of stone used is also a function of material availability. A mound can have a different function depending on its temporal and spatial associations. Mounds observed within the current project area are thought to have functioned primarily as clearing features, but may also have been utilized as planting features. (2005b:100)
>
> A modified outcrop is a natural bedrock formation with an associated collection of stones placed against and supported by it. Unlike a mound, the stone collection is not freestanding and depends on the bedrock formation for support, although it may rise above the level of the outcrop itself. The type and size of the stones used is a function of

> the immediately available source materials. The stones are either stacked, piled, or a combination of both, but the size of the stone collection must be significantly smaller than the size of the bedrock formation, otherwise the feature is considered a mound. The surface of a modified outcrop is always irregular with sloped sides and incorporated bedrock. Occasionally, if the stones are stacked against a vertical bedrock formation, the stacked edges will also approach vertical. Modified outcrops observed within the current project area are thought to have functioned primarily as clearing features, but some may also have been utilized as planting features. (2005b:102)

Generally, the features of Site 25528 are confined to two low-lying swales with nearly vertical sides that bisect the northern portion of the survey corridor from east to west (see Figure 15). Features are also present both *mauka* and *makai* of the survey corridor within these swales (features outside the project area were not recorded). The swales contain *ʻaʻā* bedrock and some soil development, as does an area to the south of the southern swale where agricultural features are also present. Terrain between the two swales, and to the south of the southern swale where the *ʻaʻā* bedrock ceases, consists of *pāhoehoe* bedrock with almost no soil development. The presence of soil in these *ʻaʻā* bedrock areas is undoubtedly the reason why agricultural features are also present. The *pāhoehoe* bedrock areas are unsuited for agriculture, as little to no soil development has occurred. Clark and Rechtman (2005b) noted a similar pattern of agricultural feature distribution on a parcel directly east of the current survey corridor, where agricultural features were confined to areas that contained soil.

In the case of Site 25528, nearly all of the features consist of small rock piles on the loose cobble and soil ground surface (see Appendix A). Four of the features are piled on and against exposed bedrock outcrops, generally along the vertical edges of the swales. It appears that most of the features of Site 25528 represent clearing piles that were created as a by-product of clearing cobbles from soil areas, but the piles located on soil ground surface could have been created as planting mounds. In the case of planting mounds, the cobbles would have been piled over sweet potato rootstock to protect them from foraging pigs and to aid in the retention of moisture (Handy and Handy 1972). Detailed descriptions of each of the features of Site 25528 are presented in Appendix A.

Along the northern boundary of the survey corridor near Site 23834, agricultural features are conspicuously absent; features closest to the boundary wall may have been dismantled during historic times and used to construct Site 23834, as the terrain is suitable for agricultural use and should contain features similar to other areas. Modern use of the area for the cultivation of *pakalolo* (*Cannabis* sp.) has also had an effect on the earlier agricultural landscape. Modern debris such as grow bags, pots, plastic bottles, fertilizer bags, hand tools, rubber hoses, buckets, and various other trash was present on ground surface at various locations throughout the site area (Figure 20).

At least two of the features of Site 25528 (Features 6 and 7) may have had their origins in modern times, or were modified from their original forms during modern times. Feature 6, a rock pile, is located next to one such debris pile and a three course high by a single rock wide wall that stretches between two Christmas-berry trees is present next to it. The wall was obviously constructed within the last ten years, and was meant to shield a *pakalolo* growing area. The mound, Feature 6, may have been preexisting, but was utilized for this modern agricultural endeavor as well. Feature 7, a modified outcrop with stacked edges, the only feature recorded on a *pāhoehoe* flow, contained several modern beer bottles and a pressure treated 2” x 6” board with galvanized nails in it on its surface. This feature may represent a solely modern construction, as it is not placed in an agriculturally productive area. The purpose of its construction, however, is not at all clear based on its formal attributes.

Figure 20. A concentration of modern debris on ground surface at Site 25528, view to east.

Discussion of Agricultural Practices within the Current Project Area

The current project area lies within what has been termed the Kona Field System (Cordy 1995; Newman 1970; Schilt 1984). This area of dryland agricultural fields extends north from Hoʻokena Ahupuaʻa to at least Kaū Ahupuaʻa and east from the coastline all the way to the forested slopes of Hualālai (Cordy 1995). A large portion of the field system is designated in the Hawaiʻi State Inventory of Historic Places (SIHP) as Site 50-10-37-6601 and has been determined eligible for inclusion in the National Register of Historic Places. The basic characteristics of this agricultural/residential system as presented in Newman (1970) have been confirmed and elaborated on by ethnohistorical investigations (Kelly 1983) and summarized by Cordy (1995). The construct is based on the Hawaiian terms for the major vegetation zones, which are used to define and segregate space within the region's *ahupuaʻa*. These zones are bands roughly parallel to the coast that mark changes in elevation and rainfall (Table 1).

Table 1. Traditional Hawaiian agricultural zones*.

Zone	*Annual Rainfall*	*Description*	*Elevation*	*Primary Crops*
Kula	c. 30-50 in (0.8-1.2 m)	Plain, open country inland from the coast	Coast-500 ft (0-150 m)	*Wauke*, gourd, and sweet potato
Kalu or *Kalu'ulu*	c. 40-55 in. (1.00-1.35 m)	Luxuriant, cultivable zone	500-1,000 ft. (150-300 m)	Breadfruit, *wauke*, sweet potato, mountain apple, some taro
'Āpa'a	c. 55-80 in. (1.35-2.00 m)	Dryland cultivation zone	1,000-2,500 ft (300-750 m)	Taro, sweet potato, sugar cane, *kī*, and banana
'Ama'u	c. 80 in. (2.0 m)	Upland/fern zone	2,000-3,000 ft (600-900 m)	Banana and *'ama'u* (fern)

*Based on Cordy's (1995) summary of land zones and agricultural patterns in Central Kona.

The Cordy (1995) model for traditional Hawaiian agricultural zones summarized above in Table 1 is meant to describe the Precontact land use patterns for Central Kona; an area to the south of the current project area. In fact, these zones were first described in the context of the entire Kona Field System by Newman (1974) who was looking at the area above Kealakekua Bay. As Cordy (1995:10) relates several types of variations have been noted in the fields of central Kona since the Newman (1974) study. These variations include localized lava flow and soil patterns which can have a considerable impact on soil depth and coverage and accordingly on field patterns (Cordy 1995). Localized variations in the amount of rainfall would have also had a considerable impact on field patterns.

The current project area is located to the north of the area described in the Cordy (1995) model, near the northern extent of the Kona Field System. The further north one travels along the Kona coast, the more arid the environment becomes. It stands to reason that as the amount of rainfall decreases near the coast the elevational bands that define the traditional agricultural zones begin to shift inland, as dictated by the localized rainfall patterns. Indeed, as Cordy (1995:18) notes the pattern is somewhat different in the North Kona *ahupua'a* north of Kailua. Although the Kona fields extend into this area, he relates that, "the rainfall lines pull further up the mountain", and that although similar, "the zones are at different distances from the shore and at different elevations than in Central Kona" (Cordy 1995:18). Keeping this in mind, based on the formal attributes of the agricultural features recorded at Site 25528 and the amount of annual rainfall the area receives (ca. 750 mm; Giambelluca et al. 1980:99), it appears that the current project area, despite its elevation (ca. 800 ft. above sea level), falls within the upper *kula* zone of North Kona.

The *kula* zone is traditionally associated with the cultivation of sweet potatoes (*'uala*), but paper mulberry (*wauke*) and gourds (*ipu*) were also grown in this zone. According to Cordy, agricultural ruins often cover much of the ground surface within the *kula*, and formal feature types usually include "mounds, short and irregular terrace facings without soil behind, small clearings in which stones have been removed, small enclosures with soil inside, and pits sometimes with soil and sometimes not" (1995:6). Cordy also notes that localized soils in the *kula* zone have resulted in the variations in field types, that "if soils are present, sometimes low and irregular terraces are present", and that "if soils are more limited, mounds and small clearings are common" (1995:10).

As was recorded by countless early European visitors to Kona, these soil areas would have been planted to the greatest possible extent, primarily in sweet potatoes. For example, Lt. King who traveled with Captain Cook to Kealakekua Bay in 1779, wrote of the near shore *kula*, "the Sweet Potatoe grows everywhere" (in Beaglehole 1967:608) and further inland, "for the first 2½ miles [the ground] is composed of burnt loose stone, & yet almost the hole surface beginning a little at the back of the town, is made to yield Sweet potatoes & the cloth plant" (in Beaglehole 1967:521).

Handy and Handy note that "Sweet potatoe culture was secondary in Hawaii to that of taro, the preferred dietary item, but owing to the exigencies of terrain and climate it was nevertheless widespread and attended by systematic care, both horticultural and ritualistic" (1972:124). They go on to describe that the planters of old Hawai'i were adept at the selection and adaptation of particular sweet potato varieties to varying localities, and that many different names and rituals existed for the various aspects of the sweet potato and its cultivation. Handy and Handy (1972:127) relate that sweet potato was more valuable than taro in three main ways: (1) it could be grown in much less favorable localities with respect to sun and soil; (2) it matured more rapidly (within three to six months); and (3) in terms of planting and care of cultivation, it was much less labor intensive.

The time factor regulating the planting of sweet potato is somewhat variable and depends upon weather rather than the regular seasons (Handy and Handy 1972:128). In dry areas such as the current project area, Precontact farmers would wait until the ground had received several good soakings before planting. In Kona, where precipitation at lower elevations is always generally low, planting generally took place during the summer months (Handy and Handy 1972:128). Sweet potatoes were always propagated from cuttings and never from seeds (Handy and Handy 1972:129). Soil planting areas were prepared by burning off grasses and shrubs, removing any stubble, and then turning over the soil. Patches in rocky places were called *makaili*; these patches often consisted of small pockets of semi decomposed lava into which the sweet potato cuttings were placed and then fertilized "with rubbish [mulch] and by heaping up of fine gravel and stones around the vines" (Handy and Handy 1972:129). Handy and Handy relate that the yields of *makaili* patches were said to be rather tasteless and rigid or wrinkled.

The Hawaiian Newspaper *Ka Nupepa Kuʻokoʻa* for March 24, 1922 contained the following account of another method of Precontact Hawaiian planting:

> Rocky lands in the olden days were walled up all around with the big and small stones of the patch until there was a wall about 2 feet high and in the enclosure were put weeds of every kind, *ʻamaʻu* tree ferns and so on, and then topped with soil taken from the patch itself, to enrich it, or in other words to rot the rubbish and weeds and make soil.
>
> After several long months, the rotted weeds were truly converted into soil of the best grade. The farmer waited for the time when he knew that the rains would fall, then he made the patch ready for planting. If for sweet potatoes, he made mounds for them and for taro too, on some places on Hawaii.
>
> In planting his sweet potato slips or taro, his work ended when the rain fell. When the rains came the farmer's heart was gladdened because it gave the slips a start, the roots began to creep and his troubles were all over. (in Handy and Handy 1972:131)

As illustrated in the above article and reiterated by Handy and Handy (1972:132-133), cultivation of sweet potatoes after planting was minimal. During the growth of the tubers soil was occasionally mounded up around the roots for protection from pests such as rats and weevils and for the continued presence of need soil nutrients. Small unhealthy tubers were generally removed from the patch so that the larger healthy ones could flourish, and unwanted weeds were also occasionally removed. The vines were not allowed to grow out of control or to get too wet. When the potatoes were ready, only enough were harvested to supply the immediate needs of the farmer, the plants were never dug out completely (Handy and Handy 1972:133). This ensured that further food and cutting stock would be available on an as needed basis. All aspects of sweet potato cultivation were accompanied by ritual to help ensure a bountiful harvest (c.f. Handy and Handy 1972:136-149).

SHIP Site 25529

Site 25529 consists of the remains of a double enclosure located in the west-central portion of the current project area (see Figure 15). It is situated at the base of a fairly steep, north-facing bedrock and cobble rubble slope. The area at the top of the slope, approximately 10 meters south of and three vertical meters above the feature itself, offers expansive views of the coast. Overall Site 25529 measures roughly ten meters east/west by five meters north/south, but it is segmented into two contiguous enclosures (Figure 21).

The westernmost enclosure is roughly rectangular in shape and measures 7.0 meters long by 4.6 meters wide (Figure 22). The southern edge of the enclosure is formed by the aforementioned natural slope, while the remaining three sides consist of low-lying stone alignments that attain a maximum height of 0.5 meters above the surrounding ground surface and measure 0.8 to 1.6 meters wide. These walls appear to have been formerly stacked, but are now mostly collapsed. The interior of the enclosed area consists of thin soil with some exposed bedrock present. Cobbles cleared from this area were likely used to construct the enclosure walls. A 1.5-meter wide opening in the southwest corner of the enclosure may have been used as an entrance.

A second enclosure is present directly to the east of the first (see Figure 21). This enclosure opens to the north, and shares its western wall with the eastern wall of the other enclosure. It too abuts the aforementioned natural slope along its southern edge. The eastern wall measures 5.4 meters long by 1.6 meters wide. It consists of formerly stacked, now mostly collapsed, cobbles that attain a maximum height of 0.9 meters above the surrounding ground surface. The area between this wall and the eastern wall of the other enclosure has been cleared of loose cobbles, leaving an interior of thin soil.

No cultural debris was observed on ground surface at Site 25529. A large number of *kukui* nuts were present within the enclosures, but these are likely naturally occurring at the site and not culturally introduced. Several cow bones were discovered on ground surface ten meters west of Site 25529, but again these seem unrelated to the use of the site, and were most likely deposited naturally at their present location. Based on the formal attributes of the enclosures themselves, however, it appears that Site 25529 was used for precontact habitation purposes. The enclosures may have supported a roofed structure that would have been used for temporary or recurrent short-term habitation (Clark and Rechtman 2005b). It is likely that the use of this site was related to the use of Site 25528, or the use of other agricultural areas in the vicinity of Site 25529 that have not yet been recorded.

Figure 21. SIHP Site 25529, view to east.

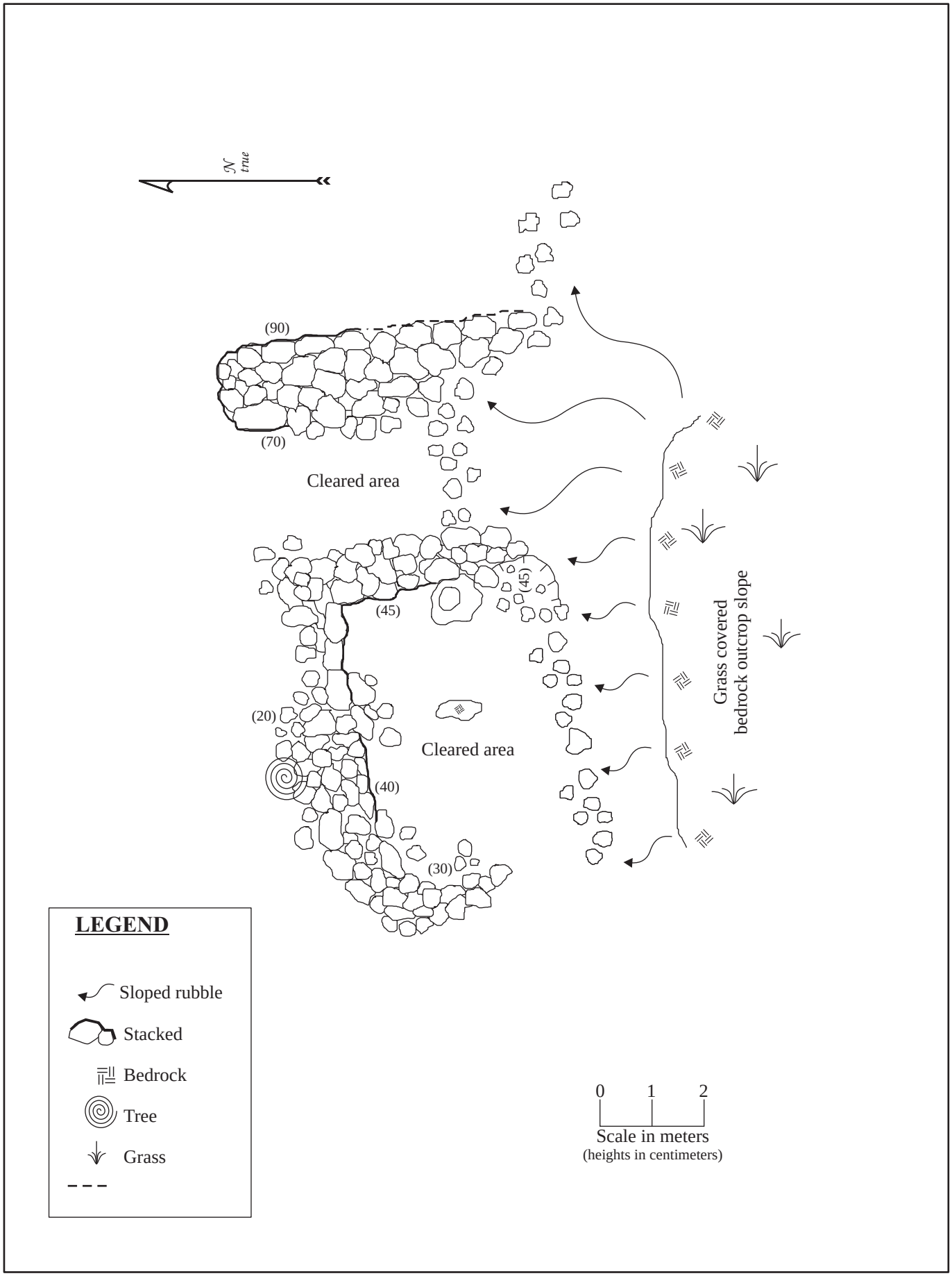

Figure 22. SIHP Site 25529 plan view.

Summary and Conclusions

As a result of the current inventory survey one previously recorded archaeological site (Site 23834) and three newly recorded sites (Sites 25527, 25528, and 25529) were identified within the survey corridor. By far the most numerous features (n=24) present within the current project area are features of Site 25528. These agricultural features are located primarily within two swales containing *ʻaʻā* bedrock in the northern portion of the survey corridor. Terrain throughout the remainder of the corridor consists of *pāhoehoe* bedrock that is unsuitable for agriculture. The features of Site 25528 appear, for the most part, to be clearing piles, but some could have been used as planting mounds. It is likely that Site 25528 was used primarily for the planting of sweet potato. The agricultural use of this area likely began during Precontact times and may have continued into Historic times (Clark and Rechtman 2005b). All of the features of Site 25528 within the study corridor were recorded in detail (see Appendix A).

A single, small Precontact habitation site (Site 25529) was also recorded to the south of Site 25528. Site 25529 consists of a double enclosure with low rock walls that may have supported a roofed structure. The nature of the habitation that occurred at this site may have been short-term and recurrent, and primarily related to the agricultural use of the project area (Clark and Rechtman 2005b). It is possible that the site sits along the route of old trail, which is no longer traceable across the landscape.

The most recently constructed sites within the survey corridor consist of two historic walls (Sites 23834 and 25527) located along the northern and southern boundaries of TMK:3-7-3-0009:008. These sites are both core-filled boundary walls related to the historic use of parcels within the ʻOʻoma Homesteads. Site 23834 may have been built by Kauhini, who applied for Grant 1590 in 1855, or later by Kaakau and Kama who purchased Grant 2972, a portion of former Grant 1590, in 1864. Both of these grants parcels occupy the same space directly north of the current study area. Grant 1590 was never patented to Kauhini, but was divided into smaller parcels, one of which was Grant 2972. Site 25527 was possibly built sometime during the latter half of the nineteenth century when Jno. Kainuku applied for the parcel that the current survey corridor crosses (Lot 58 of the ʻOʻoma Homesteads). The presence of scattered cow bones in the vicinity of Site 25529, and elsewhere within the project area, suggests that cattle ranching may have occurred on the parcels during historic times.

SIGNIFICANCE EVALUATION AND TREATMENT RECOMMENDATIONS

The above-described archaeological resources are assessed for their significance based on criteria established and promoted by the DLNR-SHPD and contained in the Hawaiʻi Administrative Rules 13§13-284-6. These significance evaluations should be considered as preliminary until DLNR-SHPD provides concurrence. For resources to be considered significant they must possess integrity of location, design, setting, materials, workmanship, feeling, and association and meet one or more of the following criteria:

A. Be associated with events that have made an important contribution to the broad patterns of our history;

B. Be associated with the lives of persons important in our past;

C. Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value;

D. Have yielded, or is likely to yield, information important for research on prehistory or history;

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.

The significance and recommended treatments for the recorded sites are discussed below and listed in Table 2.

Table 2. Site significance and treatment recommendations.

SIHP No.	*Function*	*Temporal Association*	*Significance*	*Recommended Treatment*
23834	Boundary	Historic	D	No further work*
25527	Boundary	Historic	A, D	Preservation
25528	Agriculture	Precontact	D	Data recovery
25529	Habitation	Precontact	D	Data recovery

*Previously approved DLNR-SHPD treatment (Haun and Henry 2003).

Sites 23834 and 25527 are both historic core-filled boundary walls that were likely constructed during the latter part of the nineteenth century. Site 23834 is considered significant under Criterion D for information it has yielded relative to 19th and 20th Century land use of the current survey corridor. It is argued that research already conducted at this Historic site has successfully mitigated any potential impacts resulting from the proposed extension of Holoholo Street. Site 23834 has a previously approved treatment from Haun and Henry (2003) of no further work. The authors of the current study concur with this treatment recommendation. Site 25527 is a historic boundary wall that is also the northern boundary wall of a historic ʻOʻoma Homestead road. It is considered significant under Criterion A and D because of its dual function of marking the property boundary and lining the historic roadway. The wall's association with a potential public right-of-way makes it a good candidate for preservation. An allowance must be made for a breach in the wall, however, as the extension of Holoholo Street would not be possible without crossing Site 25527. The Historic wall on the opposite side of the ʻOʻoma Homestead road (Site 16126) was also recommended for preservation (Clark and Rechtman 2005a, Nelson et al. 2006).

Site 25529 is an enclosure that was utilized for Precontact habitation purposes. It is considered significant under Criterion D for information it has yielded, and is likely to yield, relative to Precontact life ways. No subsurface testing was conducted at Site 25529 during the current study, and the potential for further data collection remains at the site. As such, Site 25529 is recommended for data recovery. A data recovery plan should be prepared in consultation with DLNR-SHPD.

Site 25528 consists of an agricultural complex located in the northern portion of the current project area. Site 25528 is considered significant under Criterion D for information it has yielded, and is likely to yield, relative to past life ways. Only twenty-four features of Site 25528 were recorded within the project area, and numerous other features are present outside the survey corridor. The features recorded during the current study are recommended for data recovery, in the form of subsurface testing, which should be adequate to mitigate the site form any potential impacts resulting from the proposed extension of Holoholo Street. A data recovery plan should be prepared in consultation with DLNR-SHPD.

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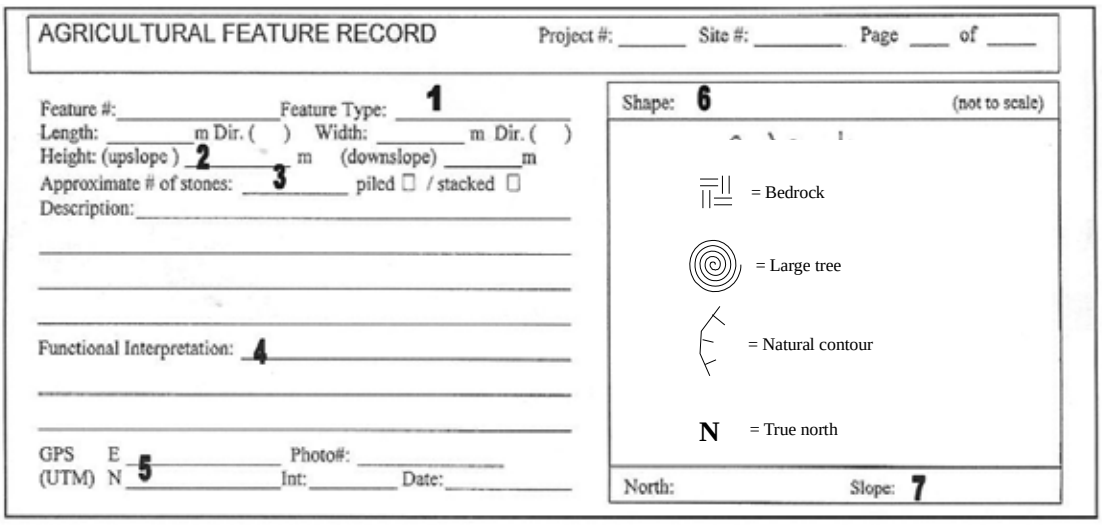
APPENDIX A

SIHP Site 25528 agricultural feature records.

Below is an example of the agricultural feature record used by fieldworkers during the current inventory survey. The information contained on these forms was used to generate the feature descriptions for SIHP Site 25528 that follow. The numbers that are present next to some of the data fields correspond to notes (listed below) about the form.



1. For a discussion of the feature types recorded during the current survey see the description for Site 25528 in this report.

2. Heights are listed in meters above ground surface. Since the majority of the project area slopes fairly steeply *makai*, these measurements give a fairly accurate idea of the minimum and maximum height attained by the feature.

3. The approximate number of stones encompassed by a feature is an estimate by the fieldworkers. This approximation is meant to suggest the amount of labor invested in the construction of a particular feature and aid in comparisons between features (the same is true for piled or stacked).

4. Functional interpretation is a possibility suggested by the fieldworkers that is derived from the feature's formal attributes and the surrounding landscape. The functional interpretations listed below are by no means a certainty. Observable soil areas located nearby a recorded feature are considered possible planting areas, whether they were used for that purpose or not.

5. GPS coordinates use the WGS 84 datum.

6. The quick sketches of the features are meant to show their shape and any unique attributes they might contain. The drawings are not to scale. A legend of the common symbols used in the plan view drawings is shown in the box on the example form.

7. The slope indicator points down slope on all feature descriptions.

Appendix K

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

October 6, 2006

Dr. Robert Rechtman
Rechtman Consulting, LLC
HC 1 P.O. Box 4149
Kea'au, Hawaii 96749

LOG NO: 2006.3284
DOC NO: 0610JT25
Archaeology

Dear Dr. Rechtman:

SUBJECT: **Chapter 6E-42 Historic Preservation Review–**
No Historic Properties Affected Request
'O'oma 1st & 2nd Ahupua'a, North Kona District, Island of Hawai'i
TMK: (3) 7-3-006: 022. 037 & 7-3-007:042, 043

Thank you for your letter on behalf of Brian Rupp of The Shopoff Group requesting that we evaluate the parcels referenced above for any effect on historic properties.

We believe that **no historic properties will be affected** by this undertaking because:

- ☐ a) intensive cultivation has altered the land
- ☒ b) residential development/urbanization has altered the land
- ☒ c) previous grubbing/grading has altered the land
- ☐ d) an acceptable archaeological assessment or inventory survey found no historic properties
- ☐ e) this project has gone through the historic review process, and mitigation has been completed
- ☒ f) other: *As reported in your letter RC-0422, no historic properties are present.*

In the event that historic resources, including human skeletal remains, are identified during the construction activities, all work needs to cease in the immediate vicinity of the find, the find needs to be protected from additional disturbance, and the State Historic Preservation Division, Hawai'i Section, needs to be contacted immediately at (808) 327-3691.

Aloha,

Melanie Chinen, Administrator
State Historic Preservation Division

JT:jen:gvf

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

July 31, 2006

Dr. Robert B. Rechtman
Rechtman Consulting, LLC
HC 1 Box 4149
Kea'au, HI 96749

LOG NO: 2006.2399
DOC NO: 0607JT50
Archaeology

Dear Dr. Rechtman:

SUBJECT: Chapter 6E-42 Historic Preservation Review –
An Archaeological Inventory Survey
'O'oma 2nd Ahupua'a, North Kona District, Island of Hawai'i
TMK: (3) 7-3-007:038

Thank you submitting the revised report by Clark & Rechtman (2005), which we received June 23, 2006. The report summarizes the findings of an archaeological inventory survey of 43.35 acres in which 3 previously identified sites were re-located, and 12 newly identified sites were documented. Due to mechanical clearing in 1994, 16 previously identified sites could not be re-located. The project was conducted at the request of Stacy Dickensen of 'O'oma Plantation. A combination of no further work, data recovery and preservation was recommended as treatment for the sites.

The revised report has addressed our concerns expressed in our earlier letter. Based on the information provided in the report, we have determined that sites 50-10-16106, -16125, as previously determined by SHPD, and -24414 through -24423 are significant for the information they contain (criterion d); that sites -24413 and -24424 are significant under criteria d and e; and that site -16126 is significant under criteria a and d. We agree, as previously approved, that no further work is necessary at sites -16106 and -16125. We also agree that sites -24414-24416, -24419, and -24421-24423 have been sufficiently documented such that no further work is required. We agree to preservation for sites -16126, -24413 and -24424, and data recovery to collect additional information about sites -24417, -24418, and -24420.

We look forward to receiving a data recovery plan, preservation plan, and burial treatment plan for our review. Please contact Dr. Julie Taomia at 808-327-3691 if you have questions or concerns.

Aloha,

Melanie Chinen, Administrator
State Historic Preservation Division

JT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

July 31, 2006

Dr. Robert B. Rechtman
Rechtman Consulting, LLC
HC 1 Box 4149
Kea'au, HI 96749

LOG NO: 2006.2399
DOC NO: 0607JT50
Archaeology

Dear Dr. Rechtman:

SUBJECT: **Chapter 6E-42 Historic Preservation Review –**
An Archaeological Inventory Survey
'O'oma 2nd Ahupua'a, North Kona District, Island of Hawai'i
TMK: (3) 7-3-007:038

Thank you submitting the revised report by Clark & Rechtman (2005), which we received June 23, 2006. The report summarizes the findings of an archaeological inventory survey of 43.35 acres in which 3 previously identified sites were re-located, and 12 newly identified sites were documented. Due to mechanical clearing in 1994, 16 previously identified sites could not be re-located. The project was conducted at the request of Stacy Dickensen of 'O'oma Plantation. A combination of no further work, data recovery and preservation was recommended as treatment for the sites.

The revised report has addressed our concerns expressed in our earlier letter. Based on the information provided in the report, we have determined that sites 50-10-16106, -16125, as previously determined by SHPD, and -24414 through -24423 are significant for the information they contain (criterion d); that sites -24413 and -24424 are significant under criteria d and e; and that site -16126 is significant under criteria a and d. We agree, as previously approved, that no further work is necessary at sites -16106 and -16125. We also agree that sites -24414-24416, -24419, and -24421-24423 have been sufficiently documented such that no further work is required. We agree to preservation for sites -16126, -24413 and -24424, and data recovery to collect additional information about sites -24417, -24418, and -24420.

We look forward to receiving a data recovery plan, preservation plan, and burial treatment plan for our review. Please contact Dr. Julie Taomia at 808-327-3691 if you have questions or concerns.

Aloha,

Melanie Chinen, Administrator
State Historic Preservation Division

JT

LINDA LINGLE
GOVERNOR OF HAWAII

PETER T. YOUNG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
DEPUTY DIRECTOR - LAND

DEAN NAKANO
ACTING DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

September 7, 2006

Dr. Robert Rechtman
Rechtman Consulting, LLC
HC 1 Box 4149
Keaau, HI 96749

LOG NO: 2006.3068
DOC NO: 0608JT72
Archaeology

Dear Dr. Rechtman:

SUBJECT: Chapter 6E-8 Historic Preservation Review –
An Archaeological Inventory Survey of a Proposed Holoholo Street Extension Across State-Owned Land
'O'oma 2nd Ahupua'a, North Kona District, Island of Hawai'i
TMK: (3) 7-3-009:008 Por.

Thank you for submitting the above referenced report by Clark & Rechtman (2006), your report RC-0427, for review, which we received July 20, 2006. The report summarizes the results of an archaeological inventory survey conducted for the proposed extension of Holoholo Street on State-owned land. Four archaeological sites were identified during the project. All sites were assessed by Rechtman Consulting LLC as significant under criterion D for their information potential, and one was additionally assessed as significant under criterion A. One site that had previously been recommended for no further work is again recommended for no further work here. Two sites were recommended for data recovery, and one for preservation, with an allowance for a breach of the wall.

The report is generally of good quality. The Historical and Cultural Background section covers extensive material. However, before we can accept the report as final, please address the following issues:

1. Please ensure that site boundaries are clearly identified both in the text and on the site maps. If subsurface deposits are present at the site, testing should be conducted to establish the extent of these deposits and their boundaries.

2. For site 25527, please clarify if the old 'O'oma Homestead road will be affected by this project. If it will, please contact Na Ala Hele for comment on the old 'O'oma Homestead road and a determination of whether they have any interest in the road.

3. The recommendation to preserve site 25527, but to allow a breach, raises something of a contradiction, and possible future issues. Breaches of trails and other lineal features have been the basis for arguments that these features have lost their integrity. Therefore some discussion of how such a breach would not lessen the integrity of the feature is required. As this would be an adverse effect on the feature, some form of mitigation will be necessary to allow for such a

breach. One possible form of mitigation would be to establish the current and historic extent of this wall, and of the Homestead road as well.

4. Please discuss the reason for the grouping of the agricultural features into a single site, 25528, when there is clearly spatial separation between the features. If the soil appears to be continuous across the area, the soil should be discussed in the text.

Thank you for your attention to these matters. We look forward to reviewing the revised report. Please contact Dr. Julie Taomia at 808-327-3691 if you have questions or concerns.

Aloha,

Melanie Chinen, Administrator
State Historic Preservation Division

JT:gvf

LINDA LINGLE
GOVERNOR OF HAWAII

PETER T. YOUNG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
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LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

July 13, 2006

Dr. Robert Rechtman
HC 1 Box 4149
Kea'au, HI 96749-9710

LOG NO: 2006.2198
DOC NO: 0607JT04
Archaeology

Dear Dr. Rechtman:

SUBJECT: Chapter 6E-42 Historic Preservation Review –
Archaeological Inventory Survey
Ooma 2nd Ahupua'a, North Kona District, Island of Hawai'i
TMK: (3) 7-3-009:007

Thank you for submitting the above referenced report for review (Nelson, Clark & Rechtman 2006), your report number RC-0312, which we received on May 23, 2006. The report summarizes the results of an archaeological inventory survey of 45.285 acres at the request of Mr. Robert E. Lee, Jr. Eleven previously recorded archaeological sites were relocated and forty-two new sites were identified.

The report has an extensive background historical section, which provides good context for the discussion of the archaeological findings. The report is generally of good quality. However, before we can accept it and make site determinations, please address the following concerns:

1. Please make an effort to edit the report for grammar. For example, on p. 139, the last sentence in the description of Feature B does not use proper grammar. This is not the first example, nor the last, and in many cases the wording confuses the description of the subject matter.

2. Please make an effort to produce photographs that are in focus and in which the subject matter is discernable. Archaeological sites and features are notoriously difficult to photograph, but it is possible to do so. Scales should also be included in all photos.

3. Archaeological sites are the loci of past human activity. This is not restricted to architectural constructions. When recording surface remains, all physical remains, be they portable or non-portable, merit description and discussion. This includes distribution of faunal remains and artifacts across surfaces that are not otherwise modified. This is particularly notable in the lava tube descriptions in this report, where feature numbers/letters are assigned to architectural features, and evidence of activities between these features are glossed over with very little discussion. Please rectify this oversight. (See particularly sites 25061 and 25062.)

4. Please provide basic information about artifacts recovered during the project, such as length and width. For lithics this should also include information such as primary, secondary or tertiary

flakes. Your colleagues in other CRM firms provide this information in inventory level reports. Weight is not a particularly useful analytical measure of lithics and other artifacts.

5. Please explain why no radiocarbon analysis was conducted on charcoal or other organic material collected during the project.

6. Please evaluate site integrity and condition for each site as part of the site description, whether specifically noted below or not.

7. Please elaborate on the proposed use of broad leaves for water collection, including the type of leaf used and support for this. This reviewer is familiar with many types of containers made by Polynesians from leaves for various purposes, but water collection is not one of these uses.

8. Please include a discussion of soil type, or lack thereof, in this area in the Project Area Description section.

9. If sites have been entered in the inventory, please do not modify the site numbers unless you have formally removed the old ones from the inventory.

10. The recording forms reproduced in Appendix B provide basic information about the many agricultural mounds encountered in the project. Additional useful information , to be added if possible in this report and considered in future projects, includes the nature of the mound's top (flat, irregular, etc.), the nature of the are around the mound (clear of rocks, rocky, etc.).

11. Site 16103: Please consider assigning feature numbers as you would to any surface area and using these feature numbers in the site description and plan map. It's a bit difficult to keep track of all of the directions. Labeling the tubes does help, but the feature descriptions in Sink 2 are a bit difficult to follow as they stand right now. Also, the fact that not all of the tubes discussed are given letters contributes to the confusion for the reader.

12. p. 74: There are no measurements provided for this unlabeled tube with an entrance on the southern edge of the northern half of Sink 2.

13. p. 84: please include a width, or an average width, for the terrace/trail at the entrance of the western section of Tube G. Please also provide length and width measurements for the terrace at the base of the entrance ramp (0.4 m high, but no other measurements included).

14. p. 92. Please indicate a possible time period and cultural association for Site 16106. The Drolet & Schilz (1991) description of the wall as stacked pahoehoe; please confirm if this is still evident.

15. p. 95 Please correct the sentence under "Terraces" that begins "It many a few cases..." so that the reader can understand the point that is being made.

16. The effort made to provide formal definitions for features of an agricultural landscape under the Site 16107 description is commendable, and many of the points are well made and will hopefully be considered by future researchers. The comments here refer to areas where the logic is somewhat questionable. The definitions for mounds and modified outcrops identify these features as possibly having been used as planting features. Both are defined as constructed solely of rock. However, in the definition of terraces, a planting function is dismissed on the basis that most do not have soil. It is not clear what the difference is between terraces and pavements, as pavements "are generally constructed against or into sloping terrain" and terraces are "built in to the natural

slope of the terrain." Both seem to have the same effect, to create a level surface. The definition of terrace is also a bit problematic in the wider context of Polynesian archaeology. A terrace is generally a flat area in an otherwise sloping landscape, and in many parts of Polynesia these are simply cut and fill earthen terraces in ridge slopes. On Western Hawai'i Island they have taken on unique forms which merit discussion, but should not preclude recognition of this general act of leveling out the land. If these are to be general, stand-alone definitions, then an explanation of how *kua'iwi* function and why the term is only applied to *mauka/makai* walls is needed. The description also mentions cross-slope walls between *kua'iwi*, but it is not evident in the map of the site (figure 40) that there are any such walls at this site. There are clearly some walls that run north-south, but they are not in association with *kua'iwi* and therefore do not result in the lattice appearance that the text description indicates.

17. p. 96, 4 pavements and 3 pavements are reported separately as having been recorded in the project area. Please correct. Please elaborate on the characteristics that would differentiate historic era agricultural features at this site from prehistoric era agricultural features. Please also specify here in the text the features that are thought to be historic, and provide information about their spatial proximity to each other and other historic sites in the project area. Please provide a summary of the site that presents the supporting arguments for why it should be determined significant, time period and ethnicity associations, evaluate the integrity of the site and its condition, and assess the soil deposit across the site, particularly in association with clearing features, as the historical information provided indicates that these should be adjacent to areas that are good for planting.

18. Site 16127: The site map included from the Drolet & Schilz 1991 report differs significantly from the depiction of this site on Figure 15. Please elaborate on the correlation between the two maps. A plan map of site 16127 in its current condition in the field might assist in illustrating the relationship between the features depicted on the two maps.

19. p. 107 Site 16128:

- Please describe cultural materials identified during excavation before location of the human remains.
- If the level soil areas to either side of Feature B may have been used for planting, these should be included in the site description, including the area of the site and an evaluation of any cultural materials

20. p. 114 Site 16131

- There are some pairings of features (Features I and J each consist of two features adjacent to each other in the tube); please provide supporting evidence for considering them to be a single feature. If they are considered to be two separate features, rather than a single feature bisected by a trail, it is not clear why they are included in the same feature number.
- Feature F: Please elaborate on this feature description. Most features in lava tubes that are identified as "water collection features" are similar to Feature C described earlier, rock rings. The description leaves many questions in the mind of the reader (0.5 meters wide, or away from the cave wall? 2 m long, parallel to the cave wall? Does it form a rectangle with the cave wall?); please clarify.
- A detail of the western end of this lava tube would clarify the site descriptions; given that solid black is used to depict portions of this area, it is difficult on this figure to trace out trails and to locate where the many lines that point from labels to features actually end.
- Feature H: It is not clear what the feature is raised above ("Feature H is a raised, level enclosure..."), since it is described as being below Feature G. If it is an enclosure, please provide the heights of the enclosing walls above the interior surface. Please also provide

information about where the breaks in the enclosing walls are made for the trail that passes through. Also, is the trail given a feature number? This should be used in the Feature H description so that the trail description can be easily sought in the text.

- It is not clear if the raised trail that bisects Feature I is considered to be part of Feature I or not.
- Please include verbal descriptions of the walls that enclose Feature I; only one is currently described in the text.
- Please also provide a better description of the possible water collection feature in the northern enclosure, including shape, height (as it is described as "stacked slabs and cobbles").
- If there is good reason to identify the two pavements of Feature J as a single feature, please provide information about the distance between the two, why they are described separately instead of as one continuous feature, and rationale behind including them in a single feature designation rather than as separate features.
- Feature K: please describe the north wall of the enclosure (does the northern wall of the lava tube make up the northern wall of the enclosure? This is implied but not stated). Please also describe the eastern and southern edges of the terrace that forms the eastern boundary of the enclosure: is it easily accessible from the surface of the lava tube, or does it require a step up to access? How might this terrace have functioned?
- All of the water collection features should be recorded as to position and measurements, similar to that provided for site 24424.
- Please provide sufficient description to indicate what is meant by "a well-developed trail", including length and width measurements.
- Please indicate if the lava tube collapses happened after people began using the cave or before.
- Please assess the condition and integrity of this site as a whole.

21. Site 24424:

- Please provide a plan map of the area west of the tube entrance, including the locations of features 24-31. Contrary to the information in the text, these features are not depicted on Figure 63.
- It is not clear if Feature 11 pre- or post-dates ceiling collapse, as mention is made of apparent steps over collapse and the suggestion is put forth that some of the trail may have been covered by ceiling collapse; please clarify.
- Feature 25: Please clarify the color of the small cobbles that make up this platform; the use of red has important connotations in traditional Polynesian cultures. The fact that this terrace is physically above the other two (features 26 and 27) may reinforce those connotations of sacredness and rank. The function of this feature should be re-evaluated. Also, the colors of the rocks used for features 26 and 27 should also be reported, as the comparison among the three may be relevant to feature interpretations.
- Features 30, 31: What about these features makes them more likely to have been used for water collection than for some other function, such as storage of unknown materials?

22. Site 25034:

- Please include an evaluation of soil deposits and portable cultural material across the area covered by this site.
- Please evaluate the overall site condition and integrity.
- In the opening paragraph, Feature A would probably be better described as a 3-sided core-filled walled enclosure; it is not a wall with three sides (which would be triangular).
- Please provide information about the amethyst bottle on Feature A wall, including possible temporal associations.

- Please include a verbal description of the ground surface on the northern side of Feature A. Figure 67 indicates that there are scattered cobbles. Please clarify if these form a possible pavement, or if they are from the collapsed walls. Please also indicate if there is evidence of mechanical activity in this area, as suggested for the cause of the wall collapse.
- If the bedrock on the northern side of Feature B has been modified, then Feature B is not actually L-shaped, but and open-sided enclosure that consists of an L-shaped wall and a portion of modified bedrock to form a feature that is the same as Feature A in shape, though of a different orientation (at right angles to it).
- With reference to Feature C, please describe the ground surface in the site area; would it have been necessary to quarry rock material? Do the blocks used in the construction of the features show evidence of quarrying?
- Please report the sizes of each of the Feature C pits, as well as distances between them.
- Figure 67 indicates differences in the nature of the three pits, with no indication of bedrock in the area of the eastern pit and the appearance of stones ringing the perimeter.
- Multiple artifacts are referred to in the overall site description, but only one is partially described. Please describe the other historic artifacts at this site, and indicate if any of them provide temporal information.

23. Site 25035:

- Please evaluate overall site condition and integrity
- You should consider the possibility that this entire site is a ceremonial space. All of the raise walkways and ramps indicate formal preparation of passageways and possible easing of placement of figures such as *ki'i*. Leveled areas may have been prepared for sitting rather than for work areas, or for work related to ritual activities. The features are simply too unusual to easily fit with an interpretation of agriculture and/or habitation.
- The wire fencing on the surface of the site and the bulldozed areas should be discussed in the general paragraph introducing the site as more recent disturbances to this site.

Feature A

- Please provide length and width measurements for the small shelf on the western side of Feature A.
- Please include a description of the post hole noted on Figure 70 of feature A.
- Please also provide some discussion of a possible function for the depressions in the surface of the platform, as well as the mound at the edge of the larger depression.
- Please evaluate these aspects of this feature in the light of the proposed function as a habitation feature rather than a *heiau*.
- Please provide measurements for Feature D, both of the flat top surface and of the entire structure.
- Feature F: The description is not entirely clear. This appears to be because this in and of itself is a complex feature that is composed of smaller, spatially associated features.
- Please provide measurements for the pavement at the western end of the enclosed area.
- The description states that at the southeastern corner of the enclosure (i.e., adjacent to the 7 x 4 m paved modified outcrop) a ramp leads to a paved trail; however, no such paved trail (or any trail) is identified in this area on the figure. Please either correct the text or the figure.
- Please provide length and width measurements for the modified outcrop on the southern side of the enclosure west of the gap. It is not clear in the figure where the natural bedrock wall section in this stretch of the southern wall is.
- Please clarify if the trail along the western side of the enclosure is on top of the western wall. The statement is made that this trail may be the result of humans and animals

walking along the former fence line; please indicate where this fence line was. If it was a fence line, the presumption is that it was an historic fence line. However, the description notes that cobbles are piled up to create a trail; this description implies a more formal feature than is implied by human and animal foot traffic following a fence line. Figure 70 appears to depict this trail following along the northern side of the enclosure as well, but it is not clear from the text that this is the case.

- The description of the northern wall of the enclosure notes that it ends at "the platform-like feature"; however, no platform-like feature is described here.
- It is not clear with ramps, breaks, and bedrock that the structures at this feature would actually have kept animals at bay. Also, please indicate whether the interior surface of the enclosure is level, or variable, even across the paved area, the exposed bedrock, and the soil patch.
- Feature G: Figure 70 depicts a wall-like structure extending southeast from the main portion of this feature. This is not discussed in the text. There also appears to be an area of densely packed pavement on a slope between features G and H that is not discussed in the text. The same symbol is used for this area as for areas noted as paved in other features, giving the impression that this area is paved. Please either describe this, or use a different symbol if this is not a paved area.
- Feature H: Please provide a length measurement for this feature.
- Feature I: Please describe the soil in the areas around the feature so that the reader can better evaluate the possibility that this was a clearing mound.
- Feature J: Directions seem to be confused in the following sentence. Please correct. "The south edge is stacked on the east half, … , and on the north half the cobbles are level to a bedrock outcrop." If the first part of the sentence discusses the east half of a southern edge, the second half of the sentence would be expected to discuss the western half, and it is puzzling what the north half of a southern edge would be.

24. Site 25036:
    - Please evaluate the integrity and condition of the site.
    - Please explain why the cairn Feature B was grouped with Feature A as a single site, and what information supports the idea that this was likely a cairn leading to the Feature A enclosure.

25. Site 25037: Please evaluate the overall site integrity and condition. The verbal description of Feature B does not match well with Figure 76. Please include the width measurement for the terrace in the southeastern corner. The entire southern area merits a fuller verbal description. The current description indicates a wall, but the figure shows a broad area covered with small stones, either a very wide wall (for which no length or width measurements are given) or a terrace area. The apparently faced and paved area extending from the center of this area toward the north is not described in the text either. Please correct the grammar in the final sentence so that a proposed function (or proposed functions) is clear. Please describe the surrounding surface area so that the reader can evaluate the proposal that these modified outcrops were created to clear soil for agricultural activities.

26. Site 25038: Again, the description does not match the figure.
    - Please evaluate overall site integrity and condition.
    - Feature A: "The north side is bedrock except for a cobble-filled gap in the northwest corner…" On figure 79, the north side of Feature A appears to be lined with cobbles placed against or on bedrock, with a cobble constructed wall or terrace in the northwest

corner. Please clarify whether pavement is evident in the interior of Feature A. If this cannot be determined because the fountain grass was not cleared and the soil obscures it, requiring test excavations to verify pavement,

- Please formally describe the foot path noted (length, width, any constructed attributes), and indicate if it is likely to be contemporary with the other features of this site or more recent.
- Feature B: Please include width measurements for the enclosing walls on the northeast and northwest sides of the outcrop.
- Feature C: The heavy black line along the rocks indicates to most archaeologists a faced side, and in combination with a flat surface this indicates a more likely function of some sort of seating or living space rather than simple expedient clearing of the footpath. Please reconsider the functional interpretation of this feature.

27. Site 25039:

- Please evaluate integrity and condition for the entire site.
- Please describe the north and east walls of the enclosure in terms of their height above the interior surface.
- Please use the symbol for "path route" in figure 85 to indicate the full extent of the paved pathway.
- Please include a description of the apparent void in the western end of the trail.

28. Site 25040: Please indicate the edges of the outcrop on Figure 86.

29. Site 25041:

- The site is identified as a modified outcrop, but the description reads "The feature consists of 3 constructed sides with a level surface in the center, built on the side of western sloping terrain." Such a description was used earlier in the report to describe terraces.
- Please indicate whether soil overlies the cobbles, thus indicating that there is a likelihood of pavement beneath the soil, or not.
- Please evaluate site integrity and condition.

30. Site 25042:

- Please evaluate site integrity and condition.
- Please provide measurements of the small c-shaped alignment and include it in the plan map of the site.

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31. Site 25043:

- Please evaluate the condition and integrity of the entire site.
- Please fully describe the features. Figure 92 shows depressions on the surface of Feature A, but no mention is made of them in the text. These should be fully reported, including measurements and depth below the surrounding surface.
- Please explain why features A and B are identified as platforms if they are built up against an outcrop; other features with similar descriptions in this report are identified as modified outcrops or terrace. Platforms are generally free-standing structures with no natural support.
- Please indicate whether the depressions exhibit any indications of quarrying activity.

remove all depressions, they are not present (natural)

32. Site 25044:

- Please evaluate the entire site condition and integrity.

- Please describe the nature of the soil around this site to allow the reader to evaluate the reasonableness of the proposition that the mound (Feature C) was created while clearing the land around it for cultivation.

33. Site 25045:
- Please evaluate the entire site integrity and condition.
- Please provide measurements for the cleared area in Feature E.

34. Site 25046:
- Please provide overall site measurements.
- Please evaluate site integrity and condition.
- Please provide overall measurements for Feature A.
- Please provide measurements for Feature B.

35. Site 25047:
- Please evaluate the entire site for integrity and condition.
- Please specifically discuss the nature of the Feature B surface and explain why this feature, larger in area than Feature A, is thought to be a clearing mound rather than another structure related to habitation. Please also describe the ground surface around these features to provide sufficient information for the reader to evaluate the proposed function of these features.
- Please clearly label Feature C on Figure 112.
- Please provide measurements for the paved area on the southern part of the enclosure. There appears to be a break in the enclosure wall of Feature C; please indicate if this is a possible entrance. There is also a broader area of wall adjacent to this break, which is not described in the text.
- Please indicate if any cultural materials were present on Feature C or in the small blister 6 meters southwest of the enclosure.

36. Site 25048:
- Please provide overall site measurements and explain the reasoning behind grouping these features together as a single site..
- Please evaluate the integrity and condition of the site.
- Please discuss further the presence of branch coral in a site for which the proposed function is habitation (Feature A).
- Please expand the description of the paved area to the east of Feature A. The verbal description leaves the impression that this is a linear feature, when in fact it is more complicated than that.
- Feature C: The depiction in the figure appears to indicate a wall on the eastern side of the feature, although a careful reading of the text indicates that this area is level with the surrounding ground surface. No mention is made in the text description of the extension at the northwest corner of the feature, extending to the west.
- Please also describe the ground surface around Feature D to provide sufficient information for the reader to evaluate the proposed function of this feature.

37. Site 25049:
- Please provide overall measurements for the entire site.
- Please evaluate site integrity and condition.

- Please explain why Features A and C are considered platforms rather than a modified outcrops or terraces, since one side of each is against an outcrop.
- Please modify the arrows on Figure 124 to reflect the information in the text that indicates that the northern and western sides of the cobbled area of Feature B are relatively level. Please also describe the ground surface around Feature B to provide sufficient information for the reader to evaluate the proposed function of this feature.

38. Site 25050:

- Please provide overall site dimensions.
- Please evaluate site integrity and condition.
- Please provide heights for the piled cobble areas around the edges of Feature A.
- Feature B: Please indicate if the area to the south of the wall is soil level with the height of the wall; this would confirm, or add weight to, the proposed function. Please provide width measurement for the earthen terrace, assuming one is present, to the south of the wall. Without a terrace, a wall is simply a wall, not a terrace wall.
- Please provide measurements for the wall that extends to the southeast of the outcrop area at Feature C. The wall appears to curve around and enclose an area between the outcrop and the eastern extent of the wall. Please describe this apparently enclosed area, as well as the area around the entire feature to provide sufficient information for the reader to evaluate the proposed function of this feature.
- Please explain why Feature D is considered a mound rather than a modified outcrop, as the text description notes that it is built up against an outcrop. Please also describe the surface of the mound, and the area around the mound to provide sufficient information for the reader to evaluate the proposed function of this feature.

39. Site 25051:

- Please provide overall site dimensions.
- Please evaluate the site for integrity and condition.
- Feature B: The description indicates terraces, though none are defined on the site plan Figure 127. Please specify if the northern side is 2 meters wide as is the east side, to which it is compared. "Terraced enclosure" brings to mind terraces with an enclosure wall around them. Please provide a description that accurately represents the feature to people who cannot visit the site.
- Please describe the floor of Feature C.

40. Site 25052:

- Please evaluate the site for integrity and condition.
- Please describe soil and any portable cultural materials across the site.
- Please provide a key that identifies all symbols used in Figure 136.
- Please provide wall width measurement for the north wall of Feature A.
- Please provide measurements for the two ramps in Feature A.
- The symbol that is used for paving (grayed area) is used on Feature A in both figures 136 and 137; please describe this in the text.
- Figure 137 indicates a possible trail through Figure A, but this is not discussed in the text. Please describe the evidence for this trail.
- A possible subterranean cavity is noted on Figure 137 adjacent to the eastern side of Figure A; please discuss this in the text. Also, there are a large number of notes on the figure that would be better removed from the figure and placed, with expanded discussion, in the text description of the site.

- Please include wall height and thickness for Feature B.
- Please provide expanded description, including measurements, of the paved surfaces in Feature C. Also please provide information about the height of the overhang above the surface.
- Feature D: "In the southeastern corner of the feature is a depression in the pavement lined by 4 cobbles..." Please clarify which part of the feature this is referring to, as three were discussed immediately prior to this sentence (the southern paved half of Feature D, the eastern paved portion of Feature D, and the enclosure area of Feature D). The measurements appear to indicate that this is the "Post-hole like depression" from Figure 137; if so, please use the same terminology in the text so that it is clear that this refers to the same feature. If none of the walls around the sunken pavement extend above the level of the surrounding paved surface, perhaps a different term would be better to describe this area rather than "enclosure", which is better applicable to Features A and B.
- Feature F: Please specify what type of material the slab is. Please provide some information regarding possible activities that might have resulted in the pecked and ground characteristics of the slab surface.
- Feature G: Please provide height measurements for the north and south sides of the platform. Please also explain why this is considered a platform rather than a modified outcrop, since the east side appears to be built up against an outcrop on the eastern side. Please also discuss whether the ground surface on the northern side differs significantly from the ground surface on the other two sides, and whether this may be the result of human modification. Please indicate if any portable cultural materials were present at this feature, either on the platform or adjacent to it.
- Feature H: Please provide measurements for the soil area on the south side of the pavement at this feature. Do large pahoehoe cobbles line the area of the soil patch as well, just like the paved area? Please address this.
- Feature I: Please provide information to support the supposition that the soil in the interior overlies a paved surface. There appears to be a paved area at the southern end of the west wall, outside of the wall, that is not described in the text. The description of the eastern side of the enclosure appears to be incorrect, as Feature C is far to the north of this cluster of features (G-I). The last three sentences of the Feature I description appear to have been misplaced from the Feature C description. Please correct, and include a description of the eastern perimeter of Feature I. Please also provide length measurements for the 2 m wide wall that encompasses the northwestern portion of Feature I, the measurement along the northern part of the western wall and the measurement along the western part of the north wall.

41. Site 25053:

- Please evaluate the site for integrity and condition.
- Please assess soil and portable cultural remains across the site as a whole.
- Please include a key that defines the symbols used in Figure 148.
- Please ensure that all symbols used in Figure 149 are included in the key; several areas appear to represent paving or densely packed rocks/stones, but no comparable symbol definition appears in the key.
- P. 206: Please clarify what is meant by the sentence "A second area was excavated 5 meters to the east." It is not clear if this refers to excavation with hand tools or removal of rocks, as was discussed at the conclusion of the previous paragraph. Please also clearly indicate all "excavated" areas on the plan map, and provide information about the area (in square meters) excavated. Please further describe the "dry crumbly organic conglomeration" – color, texture, quantity, etc.

- Feature B: Please indicate whether it is possible to tell if the "interior" wall dividing the two portions of this feature abuts the east and west walls of the enclosures to provide information that could indicate if this is a central dividing wall. Figure 153 appears to represent this as a double enclosure.
- Please clearly identify the depression in the southeast portion of Feature C on Figure 153. Please indicate if the pavement is flush with the surrounding ground surface, or stands at some height above it (and indicate this height).
- Feature E: The text states that mammal bone was identified in the excavation of Layer I, but Table 9 lists unidentified fish bone in this layer. Please correct the error, and list all culturally deposited materials found in the excavations in the table.
- Feature F: "A 3-meter alignment..." Please indicate if this is 3 meters tall, long, and wide.
- Figure 159 caption reads "SIHP Site 25053 Feature F, enclosure, view to the northwest", but the text description does not describe an enclosure. Figure 158 is somewhat ambiguous with regard to this issue, as stones are shown around an area on the west side of the feature, though they do not completely enclose it. The eastern line of these stones constitutes the slab alignment described in the text. The stones on the western side are not discussed in the verbal description. Please discuss in the text whether these stones constitute an alignment that forms an enclosure of sorts, or are simply larger stones that are part of the overall pavement.
- Feature H: Please describe the ground surface around this modified outcrop to provide the reader with sufficient information to evaluate the suggested function as a clearing pile.
- Feature I: Please describe the surrounding ground surface to provide the reader with sufficient information to evaluate the suggested function as a clearing pile.

42. Site 25054:
    - Please evaluate site condition and integrity.
    - Please assess soil and portable cultural material across the site.
    - Feature A: "Multi-tiered platform" is generally a term that is used to describe a free-standing structure in which the successive tiers are each set within the one below, and each successive tier is smaller than the one below it. This feature appears rather to be a series of terraces, although since there is no information on either the figure or in the text description about the surrounding terrain it is not possible to confidently determine this. Please indicate the length of the wall along the northern side of the tiers, as well as its height above the tiers. In Figure 164, it is not apparent that the wall bifurcates, although the text indicates this. Rather, the figure appears to show a second wall that runs along the western side of the lowest tier, and then turns to the northwest. A complete length measurement of this western portion of the wall should be included in the report.
    - Feature B: The southern part of Feature B is described as a rectangular platform, and the northern part as a C-shaped wall with northern and eastern walls. An extension is mentioned northwest from the platform, but no measurements are given, nor is it clear if this is the area in which the two portions of this feature connect. The depression noted on Figure 164 is also not described in the text, nor is what appears to be a wall on the southern portion of the C-shaped wall that connects to the platform.
    - Finally, there is an apparent paved area to the southwest of the westernmost area described for Feature A, and a pile or wall segment between that and Feature B, which are not described in the text. Please include these features in the text description of the site.

43. Site 25055:

- Please evaluate site condition and integrity.
- Please assess soil and portable material culture across the site.
- Feature A is described as a platform, but in other places in this report similar features would have been described as modified outcrops. Please explain why this feature is identified as it is. It is also identified as a "terraced platform"; generally, when a feature is referred to as terraced it is internally terraced.
- Feature B: Please describe the surrounding ground surface to provide the reader with sufficient information to evaluate the suggested function as a clearing pile.
- The text description of Feature E and the visual depiction in Figure 165 do not match. There is no indication in the figure of bedrock immediately adjacent to the feature on the north and east sides, as is described in the text. Also, please explain why this is called a platform if it is built up against and level with bedrock.
- Figure 165 shows several features that are not discussed in the text. There is a protrusion on the northern side of Feature A that is not mentioned in the text. There appear to be two areas of rock work between Features A and C, and south of Feature B, that are not discussed in the text either. Please include these if they are likely human creations.
- Feature F: "Feature F is pavement and wall located northeast of Feature E..." Figure 165 shows Feature F northwest of Feature E. Please correct.
- In the text, the wall that continues southeast of Feature D is identified as SIHP site 25061, but Figure 165 identifies it as SIHP Site 16107 Feature 286. Please correct.
- Feature G: Please provide information about surrounding soil areas to provide the reader with sufficient information to evaluate the suggested function as a clearing pile.

44. Site 25056:

- Figure 173 shows an additional slab south of the three that form the U-shaped feature that is discussed in the text, as well as what appears to be a lined and separately paved area immediately east of this slab originating at the eastern wall of the platform. Please include these features (and any others of note) in the text description of this site.

45. Site 25057:

- p. 231 Feature A description, final sentence: "The small sheltered enclosure was possibly a storage area associated with the habitation feature (Feature A) to the east." There appears to be an error here, please correct.
- Feature A: Please provide a measurement of the area under the overhang.
- Feature C: Please provide measurements for the paved area. Please provide length and width measurements for the eastern stacked cobbles. Please indicate length and width measurements for the remnant stacking on the southern side. Please describe the nature of the northern boundary (modified with built up cobbles, natural edge of the rock shelter wall, etc.). Please provide measurements for the paved area east of the east stacked wall.
- Figures 178 and 179 are identical photos, whereas the captions indicate that these should be different photos.

46. Site 25059:

- Please evaluate the site integrity and condition.
- Please indicate whether the level cobble covered area in the sink may have been constructed by humans. If this is likely, please provide measurements for this area.
- Please provide a depth measurement for the sink (average is fine).
- Please indicate if cultural materials were collected from this site. If they were, please provide basic analytical information about them.

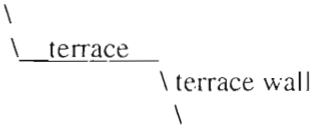
- Please indicate if the goat bones in Feature B appeared to have been butchered or if they are more likely the result of a natural death. This is important, as the presence of goat bones could contradict the proposed period of use, Precontact. Also, please indicate what type of bones were in the ash deposit in Feature A.

47. Site 25060
    - Please ensure that all symbols used in Figure 182 appear in the legend.
    - Please evaluate site integrity and condition. Please also propose a likely period of use, supported by the material remains recorded at the site.
    - Please provide a width measurement for the Feature A staircase.
    - Please be consistent in labeling features; is the *makai* entrance discussed on p. 240 the same as the western entrance discussed on p. 238? If this entrance will be referred to as the *makai* entrance, this should be indicated when it is first introduced in a manner that makes this clear (i.e., "The eastern entrance (also referred to below as the *makai* entrance)..."). The same should be done for the *mauka* entrance.
    - Please provide length and width measurements for the trail in the *makai* lava tube.
    - Feature J: It is unclear from the description if feature J includes a terrace, or if the terrace wall on the eastern side fronts a terrace that extends further to the east. The plan map provided that includes Feature J (Figure 182) does not show the terrace wall, or the terrace. Please provide height measurements for the overhang.
    - Please specify in the text which lava tube Feature K is located in.
    - Please indicate which direction the opening of Feature L faces. Please describe the nature of the enclosed area. Please provide length, width and height measurements for Feature L.
    - Please specify which lava tube features M-T are located in. Also, please include in the description of the lava tube how far back the "overhang" extends, and where the "tube" begins. The area in which M-T are located appears to still be referred to as the "overhang".
    - Figure 186 should be oriented in the same way as Figure 182. The current orientation (180° from each other) is both confusing and makes comparison difficult.
    - Figure 186: There is a solid line in the southeastern portion of the figure that is identified as "Line represents edge of level surface of Feature D". According to the text, Feature D is a water collection feature in the other lava tube. Please correct.
    - Artifacts should be formally described, including length and width measurements, as well as other descriptions appropriate for the type of artifact.
    - P. 244 "Feature M is a terrace wall that separates the upper sink ground level with the ..." proper grammatical usage would be "... separates .... from". Please correct.
    - Figure 186 does not indicate that the Feature M wall is continuous, but the text description as a "wall" does indicate this. Please ensure that the two correspond.
    - Feature M: Please provide a width measurement for both the wall and the terrace as a whole. If the ramp-like surface that descends from the sink into the tube does not have a separate feature number, please describe as part of Feature M, including length and width. Please indicate if the slabs on the top course of the wall are vertical or horizontal. Please describe the artifacts found on the surface adjacent to the feature, and where they were found ("adjacent" implies to the east of the terrace wall, but this is not explicitly stated).
    - Feature N: Please indicate if the small cobbles are likely to have been level with the top of the large cobbles lining the periphery before the collapse of the southeast corner.
    - Feature O: Please clarify if all artifacts were found in the wall, or adjacent to it.
    - Please indicate the edges of Feature Q on Figure 186.

- Feature R: Location is given as east of both features M and O. This would make the location of the label on Figure 186 incorrect. Please correct the error. This also exacerbates the uncertainty of the boundaries of the feature, even when looking at Figure 186. Please clarify.
- p. 246: The hafting end of the adze is called the butt or the poll. Standard archaeological practice for reporting adzes includes length, width, cross-section shape (lenticular, trapezoidal, etc.), and a description of the butt end treatment if present (tanged, etc.). The extent of polishing is also reported.
- The trail (Feature U) should be given a separate site number, as it is not simply confined to the lava tube and traverses several sites. The majority of the trail is outside of site 25060. NO, clearly linked to site

48. Site 25061:
    - Please provide overall site measurements.
    - Please evaluate the site for integrity and condition.
    - Please provide a plan view of the site. The photographs are not of sufficient quality to replace a map of the site.
    - Feature B: Please indicate if there is evidence of burning to support the proposed function as a fire ring.
    - Since the edges of the blister have clearly been modified, and the blister floor contains marine shell obviously transported by humans, that the blister itself is a feature of this site and should be assigned a feature number as a locus of human activity. Please indicate if there is evidence of an opening in the blister in the vicinity of Feature C. The blister is the site!!
    - Please include descriptions of all areas with indications of human activity, whether they include architectural features or not. This was done well in the Site 25063 description.

49. Site 25062:
    - Please include descriptions of all areas with indications of human activity, whether they include architectural features or not. This was done well in the Site 25063 description.
    - Please evaluate site integrity and condition.
    - Please clarify if this area involves an overhang, or a lava tube. Overhangs are generally pieces of rock that provide shelter but are not enclosed on all sides. The description here indicates that this is a lava tube with a distinct entrance.
    - Feature A: It is not at all clear where the terrace is. The description mentions a terrace wall that lines the base of a slope from the east, and then discusses as part of Feature A a flat area west of the terrace wall. This area should probably be discussed as a separate feature; on figure 198 it is this area that is identified as Feature A. Please clarify if there is any cultural material on the terrace itself. If not, it might be more accurate to identify the wall as a retaining wall. Standard archaeological terminology for terraces follows the schematic below (a cross-section of a terrace)



    - Please discuss the goat bones associated with Feature A to provide enough information to evaluate whether they are more likely a natural deposit or remains of human activity.

- Please discuss the ends of the trail Feature D, and whether it can be traced beyond the area identified (6 m), and if not, what impedes further delimiting the trail.

50. Site 25063:

- Please evaluate overall site condition and integrity.
- Please provide overall site measurements.
- Please ensure that all symbols used in Figure 204 are identified in the legend.
- Please provide measurements for the trail with ramps in Feature A.
- Please specify what materials were piled on the east and south sides of Feature B, and describe these clearing piles (?). Figure 204 indicates that the cleared material forms a C-shape; if so this is an interesting transfer of a common structural type into a setting where protection from the wind is not required. And this would be the second such transfer noted in this report, the first noted earlier in another lava tube. Please provide measurements for the cleared material.
- It appears from Figure 204 that the ramped trail discussed as part of Feature A has several branches, one of which appears to traverse Feature C. The trail is lengthy enough and traverses enough features that it should probably has a feature designation of its own to simplify and clarify description.
- The description of Feature C is not clear. It is described as being constructed between two natural shelves on either side of the lava tube (i.e., north and south sides), 2.5 m wide (no directional indication), and extends 2.5 meters east of the wall on the western face. Does this mean that the east-west measurement is 2.5 meters? The surface of the terrace is not described. The height of the eastern side is not described either.
- Detail plan maps of sections of the tube would better represent the features discussed. For example, in Figure 204, Feature B appears C-shaped but is not described as such in the text, and Feature D appears irregularly shaped, but is described as C-shaped in the text. However, the figure is not presented at sufficient scale to provide a detailed documentation of these features.
- Please provide measurements for Feature E. Please also indicate if the charcoal and ash are scattered, concentrated in an area to indicate a hearth, or in some other configuration. Please identify the marine shell present at this feature.
- Feature G: Please describe the east and south edges. The location of this feature is not specified on Figure 204, the label is simply to one side of the lava tube, and therefore the representation of the feature on this figure cannot be evaluated.
- Feature H: Please describe the northeastern and southwestern sides of the terrace. Unless otherwise specified, terraces are generally assumed to be rectangular in shape.
- Please describe the edge of the terrace on the west and north sides: does it slope down to meet the existing ground surface, is there evidence of a wall built up on those sides, does it abut bedrock or the tube wall, etc.?
- Figure 204 indicates a pathway through the sink area of the *makai* sink area, but none is mentioned in the text. The pathway that leads into the cave is not clear on the figure. Please ensure that the description and the figure correspond, and consider assigning separate feature designations to all trails, as this would help with the description. Please provide measurements for the path in the sink.
- Feature K: Please indicate a shape for the feature, and if the interior is filled with cobbles or if it is an outline of rock.
- Feature L: Please indicate a shape for the feature, and clarify if the interior is filled with cobbles.
- Feature O: Please indicate a shape for the pile, and how many courses high it is.

- Feature Q: The southern edge is defined as resting against the tube wall, but the other three sides are not identified. A terrace wall is mentioned, but there is no indication of which side it is on. Please clarify.

51. Site 25064:
    - Please depict the trail that provides access to the lava tube on Figure 265, as well as all trails within the tube, and provide length and width measurements.
    - Please identify the types of marine shell and mammal bones found in the cave, or clarify that they were unidentifiable.

52. Site 25065:
    - Please evaluate site integrity and condition.
    - Please provide overall site measurements.
    - Please label the features on Figure 213.
    - Feature B: Please provide a width measurement.
    - Feature C: Please provide measurements for the ramp.
    - Please fully describe all cultural materials identified in the lava tube, including the surface animal bone, charcoal and *kukui* shells. These areas are as much loci of human activity, and therefore archaeological features, as are the structural remains described in the report.

53. Site 25066:
    - "Site 25066 is a lava tube located approximately 10 meters east of the western bulldozer in the ..." Unfortunately, no bulldozer was identified in the introduction to the report to allow for this to be used as a locational marker in describing site locations. Please correct the sentence.
    - Please fully describe the pig bone found in this tube, including the number of bones present, elements if identifiable, etc. Pig was a high status food often reserved for feasts or offerings in traditional Hawaiian culture, so to find pig bone in a tube, and without other cultural materials, may indicate that this was an offering of some sort.

54. Site 25067:
    - Please evaluate site integrity and condition.
    - Please provide overall site measurements.
    - Please assign a feature label to the modified collapsed sink and the ramp that provides access into it.
    - Please provide full measurements for the ramp, the sink and any other modifications made within this area.
    - Please provide information about the height of the overhang above Feature A.
    - Please provide additional information about the wooden implement collected from Feature A including diameter and any information that can support the hypothesis that it is an implement and not simply a stick. Please include information about the species of marine shell on the feature and the quantity.
    - Feature D: Please provide basic artifact information (measurements, etc.) as well as information about the faunal material. Among other things, if the contention is that the goat bone is recent while the bird bone and marine shell are precontact, sufficient information should be provided to support these arguments. If the goat bone is deposited in a manner similar to the bird bone, then perhaps they are contemporaneous (as

contemporary as any cultural remains at an archaeological site) and recent use of the tube should be considered.

- Feature E: Please identify the types of marine shell, and fully describe the pig bone identified including number of pieces and elements present. Please describe the east edge of the terrace.
- Feature F: Please provide dimensions for the white ash concentration. Please provide information about the spatial relationship between the two cobble features that make up this feature; Figure 219 only indicates a single feature. Provide a distance measurement between them.
- Feature G: Please provide a measurement for the entire feature. Please provide measurements for the stacked stones against the south wall of the chamber.
- Figure 219 indicates goat bones in the chamber that contains features E-G; please discuss in the text.
- Feature H: "The feature is composed of 15 slabs that average 0.3 meters in size..." It appears that either the word "squared" is missing here, another measurement, or an indication of whether this measure is thickness, length or width. Please provide measurements for the large slab, and indicate if this could be considered an upright slab.
- Feature I: Please indicate on which side of the terrace the "terrace wall" is found (based on Figure 219 it could be one of two), and describe the other sides as well.
- Please ensure that all symbols used in Figure 219 are identified in the legend. Feature J is identified as a paved area, but symbols to represent paving comparable to that used for Feature I are not used for Feature J, which appears to consist in the figure of a series of alignments.
- Feature J: If there is a terrace and terrace wall on the western edge of Feature J, please provide complete measurements for these sub features (length and width of the terrace wall, width of the terrace, height of the terrace wall in centimeters).
- Feature K: Please provide measurements for the terrace itself. Please provide measurements of the charcoal and ash concentration. Insufficient information about the depositional nature of the dog and goat bones is provided to distinguish whether it is likely that one is more recent than the other.

55. Site 25068:

- Please identify the type of marine shell noted in the lava tube.
- Please evaluate site integrity and condition.
- Please provide overall site measurements.

56. Site 25069:

- Please provide overall site measurements.
- Please evaluate site integrity and condition.
- Please clearly mark all features discussed in the text on Figure 228. For instance, it is not clear where the 1.6 m x 0.7 m x 0.85 m piled large *pahoehoe* cobble trail marker is on the figure. Please also ensure that all symbols used on the figure are identified in the legend.
- Please clearly state the total length of the trail.
- Please provide measurements for each of the rock rings on the shelf, and the height of the tube ceiling above the shelf.
- Please provide distances between the rock ring at 44 m southwest of the tube entrance
- Figure 228 notes a charcoal and wood concentration, a cairn, and a variety of cobble constructions with or without charcoal that are not clearly identified and discussed in the text. Please ensure that all features are described.

57. Site 25070:
- Please provide an overall site plan map of this site.
- Please provide overall site measurements.
- Please evaluate site integrity and condition.
- p. 285 please correct site number in Feature B description ("...it appears that Site 16128 was not utilized as a habitation.")
- Please provide additional support for the proposal that Feature C is a burial based on proximity to Features A and B; Features 5 and 6 of Site 16107 appear to be in comparable proximity to these two features of site 25070, and are of comparable size, but are identified as agricultural features.

58. Site 25071:
- Feature A: "The level soil west of the upright slabs ... and is bordered by a rough piling of slabs and small boulders on the east side ..." There appears to be a directional problem in this sentence. Based on Figure 25071, the level soil area appears to be on the east side of the upright slabs, and the entire area appears to have been enclosed by stones, though this is not clear from the text. "In the immediate area 13 other slabs were observed...and have likely crumbled over time." If they have crumbled then it would be difficult to tell that they were slabs similar in size to the uprights. Perhaps a better word would be collapsed? Or some synonym. Please indicate what side the playing surface is on the slabs – top, side facing the level soil area, etc.
- Please provide overall measurements for Feature A and indicate if the overall feature is raised above the surrounding ground surface, or any other aspects that set it apart from the rest of Feature B.
- Please clearly identify the lower tier of Feature B on Figure 234.
- Please clarify if the trail that passes through this site has been given a separate site number or discussed under a different site. If not, it should be addressed here, complete with length and width measurements and descriptions of modification of the area to create the trail.

59. Site 25073:
- Please provide overall measurements for this site.
- Please evaluate site integrity and condition.
- Please provide measurements for the constructed trail portions of Feature A.
- Features B, C: Please specify why the trail is not traceable near this cairn.
- Please ensure that the features of site 25073 are clearly marked on Figure 15.
- Please include an average width for Feature D.
- Please provide width measurements for Feature F, and ensure that the description is complete.
- Please provide width measurement for Feature G.

60. Please ensure that scaled plan maps are provided of all sites for which no further work is recommended. The assumption is that this will be the last opportunity to record these sites, and if accurate plan maps are not made at this time, information that could be applied to answer questions not obvious to us at this time will not be collected.

61. Before going so far as to project population density based on the results of this study, please recall that at many sites, features were designated as "habitation or agricultural processing". In addition, a household in the traditional Hawaiian period would have used potentially several structures. Ideal models of a traditional Hawaiian household include sleeping house, men's house,

and menstrual house, as well as a variety of work areas outside of formal structures. It is therefore premature to link sites identified as "habitation", which could have supported any number of activities performed by members of a single household or groups of households in a domestic setting, with population levels. To pursue such an exercise, greater care must be taken in identifying activities that took place at these sites, clearly identifying sleeping houses, as well as trying to sort out chronological use of the sites which could have been serial as well as contemporaneous. (reference to p. 305 fourth paragraph)

62. Regarding the placement of burials, the burials found in the lava tubes are all spatially removed from most of the evidence of habitation activities, and are generally in as close proximity as are the surface burial sites, which have been assigned site numbers separate from agriculture and habitation sites on the basis of function. It is not apparent that these purported patterns are anything more than an artifact of site number assignations.

63. Significance evaluations: A boundary wall associated with a transportation route characteristic of late eighteenth and early nineteenth century regional patterns is an example of a type (C), as no specific events are identified in association with this property (required for criterion A). For some criteria and site types the association between significance and the site is relatively intuitive, such as the cultural significance of burials and the information potential in most archaeological sites. However, further elaboration is needed for other sites, such as the identification of events that properties are associated for criterion A eligibility, and cultural factors that would make a water collection site significant for traditional cultural value. The arguments can be made, but they should not be left implicit.

With the additional information provided in the revised report, we anticipate that we will be able to make significance determinations as recommended in the report, and agree to proposed treatments. We look forward to receiving the revised report. Please contact Dr. Julie Taomia at 808-327-3691 if you have questions or concerns.

Aloha,

Melanie Chinen, Administrator
State Historic Preservation Division

JT

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ARCHAEOLOGICAL, CULTURAL, AND HISTORICAL STUDIES

September 26, 2006 RC-0422

Julie Taomia, Ph.D.
Hawai'i Island Archaeologist
DLNR-SHPD
74-383 Kealakehe Parkway
Kailua-Kona, HI 96740

Dear Julie:

On behalf of Brian Rupp of The Shopoff Group, Rechtman Consulting, LLC has prepared this request for determination of "no historic properties affected" with respect to the proposed development of an off-site water system associated with the development of an approximately 140 acre project area in 'O'oma 1st and 2nd *ahupua'a*, North Kona District, Island of Hawai'i. The current project area incorporates the proposed location of a water well and reservoir site with associated delivery system that incorporates portions of four different parcels (TMKs:3-7-3-06:022, 37, 3-7-3-07:42, 43). Elevation within this area ranges from about 1,000 feet to 1,900 feet above sea level (Figures 1 and 2).

Soils within the project area are described as Puna Extremely Stony Muck, Kaimu Extremely Stony Peat, and Punaluu Extremely Rocky Peat (Sato et al. 1973). These soils formed over 3,000 to 5,000 year old *pāhoehohe* and *'a'ā* flows that emanated from Hualālai (Wolfe and Morris 1996). For the most part, all of the project area is within already developed or graded properties with sparse vegetation consisting of grasses and scattered trees and shrubs (Figures 3-10; arranged from *mauka* to *makai* across the entire study area). The existing vegetation pattern supports the assertion that the study area has undergone substantial alteration in the past including, but not limited to, mechanized clearing and earth moving.

There have been numerous archaeological studies within the 'O'oma *ahupua'a* at elevations just *makai* of the current study area (Clark and Rechtman 2005; Clark and Rechtman 2006a; Clark and Rechtman 2006b; Drolet and Schilz 1991; Haun and Henry 2003; Nelson et al. 2006; Rechtman 2006; Walker and Rosendahl 1990). Collectively these sites document intensive Precontact use for agricultural, habitation, burial, and water collection purposes. This latter activity was a significant one, as the overall region (Kekaha) is renown for its dryness and lack of water sources. The water sources associated with the major lava tube system (SIHP Site 24424) were no doubt a key factor that led to the establishment of and sustained the numerous habitation and associated burial sites, and agricultural activities in the area. The agricultural features documented are both Precontact and Historic in origin, while the many boundary walls all date from the Homesteading Period. For comprehensive discussions of the culture-historical background for this area the reader is directed to Rechtman (2006) and Rechtman and Maly (2003).

Between May and August 2006, Robert B, Rechtman, Ph.D., Matthew R. Clark, B.A., J. David Nelson, B.A., and Christopher Hand, B.A., conducted intensive on-foot archaeological surveys of the portions of the parcels that form the current project area. A thorough examination of the surface of the project area revealed no archaeological resources; and given the history of land use on the properties, the likelihood of subsurface resources is extremely remote. Based on these negative findings, on behalf of our client, we are requesting that DLNR-SHPD issue a written determination of "no historic properties affected" in accordance with HAR 13§13-284-5(b)1.

Should you require further information, or wish to visit the parcel, please contact me directly.

Respectfully,

Bob Rechtman, Ph.D.
Principal Archaeologist

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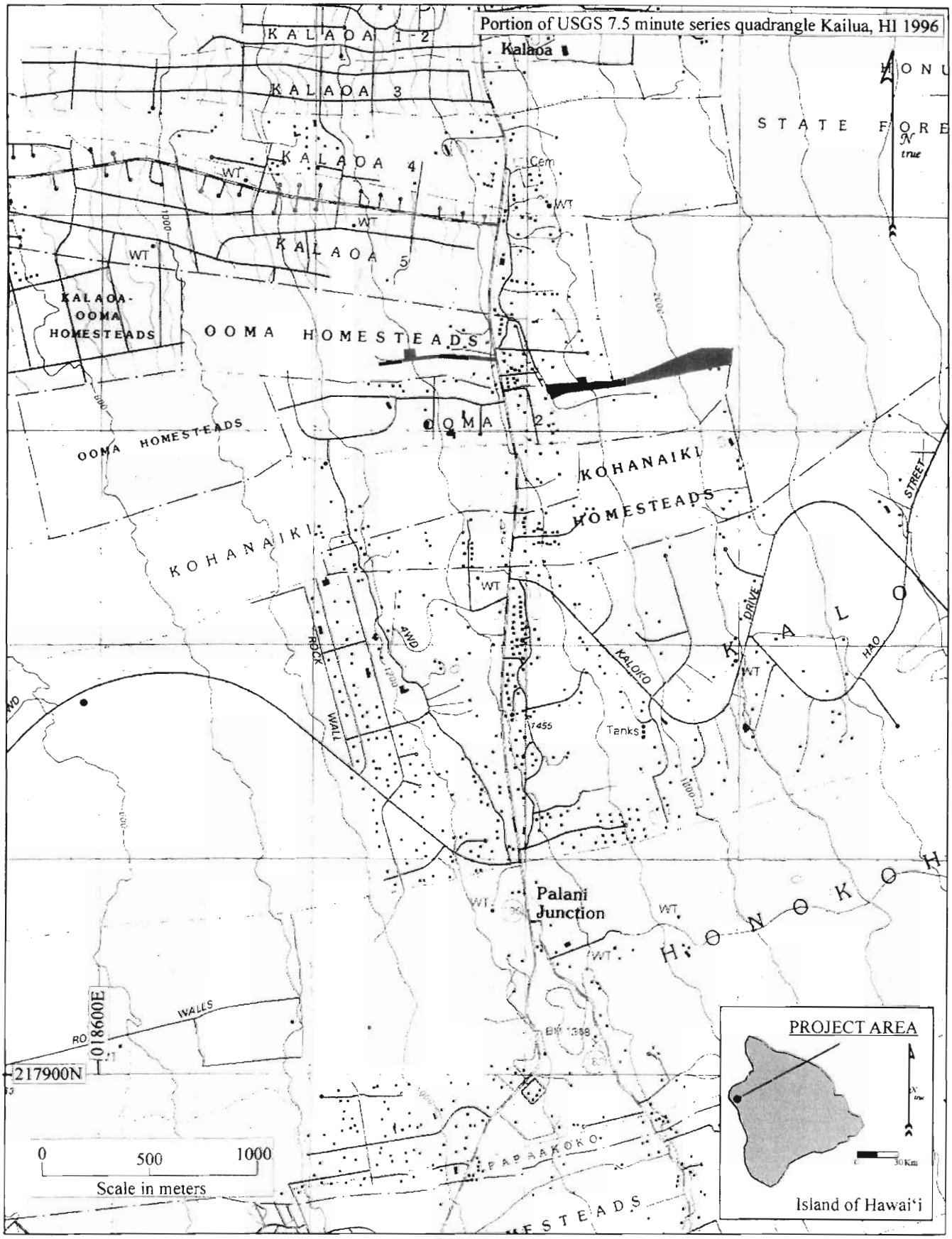

Figure 1. Portion of USGS 7.5 minute series, Kailua, HI 1996 current study areas shown in red.

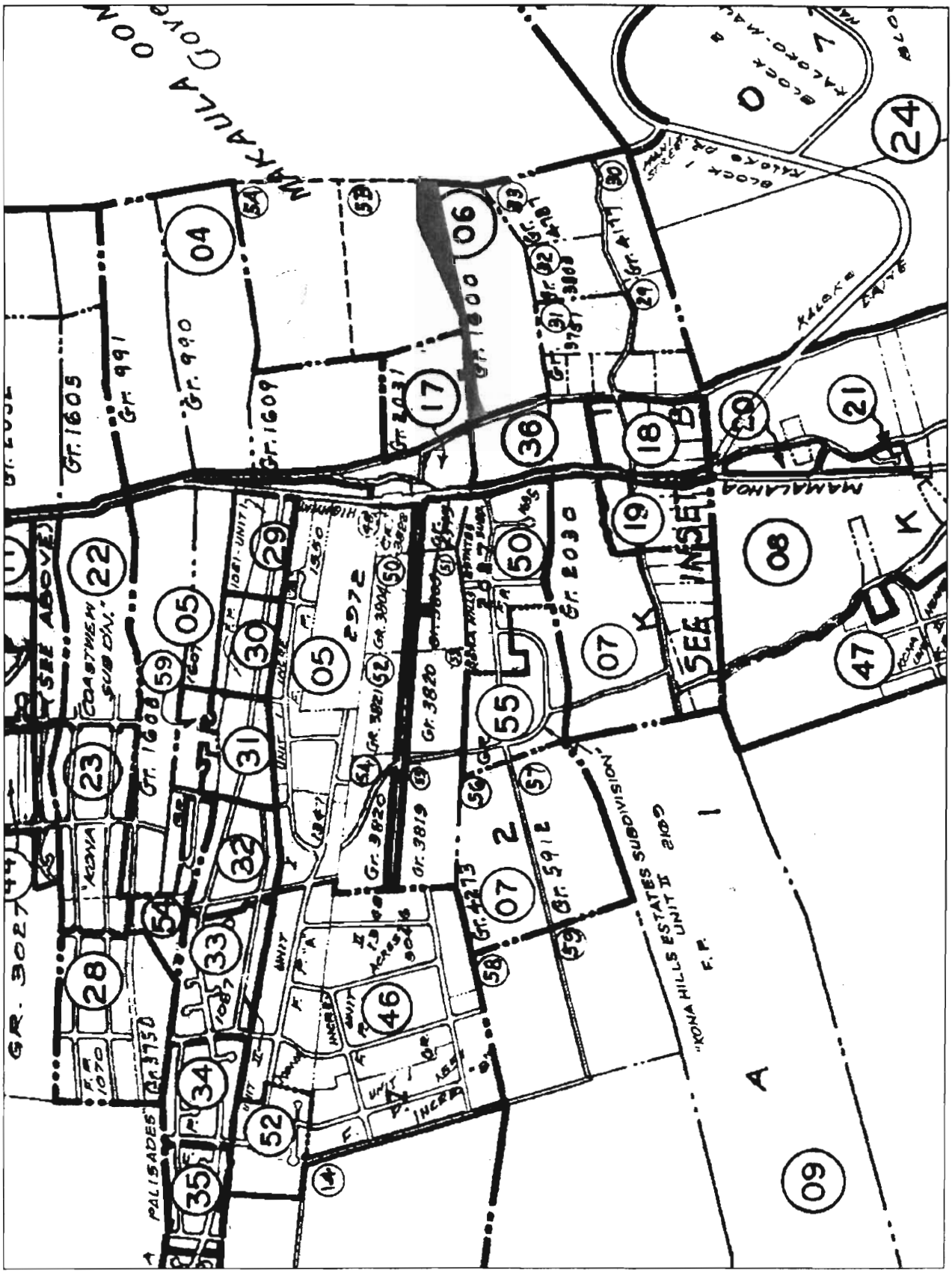

Figure 2. Portion of Tax Map Key:3-7-3 current study areas shown in red.

Figure 3. *Mauka* portion of Parcel 3-7-3-06:22.

Figure 4. Central portion of Parcel 3-7-3-06:22.

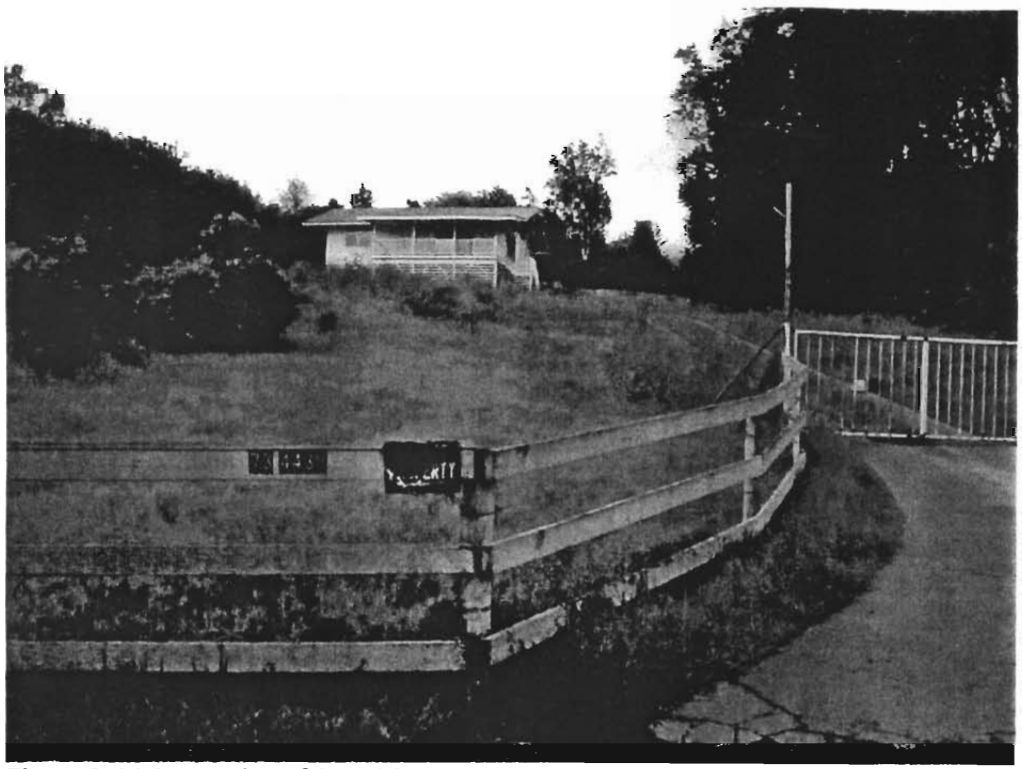

Figure 5. *Makai* portion of Parcel 3-7-3-06:22.

Figure 6. Study area on Parcel 3-7-3-06:37 (house in background is on Parcel 22).

Figure 7. Gated access road leading from bottom of Parcel 37 to Old Government Road.

Figure 8. Access road below Parcel 37.

Figure 9. *Mauka* portion of Parcel 3-7-3-07:43.

Figure 10. *Makai* portion of Parcel 3-7-3-07:42.

Appendix L

RC-0389

Cultural Impact Assessment for the Kula Nei Project Area

(TMKs: 3-7-3-07:038, 039, 42 por, 43 por., 3-7-3-09:007, 008 por. 3-7-3-046:105, 3-7-3-06:022, 037 por.)

‘O‘oma 1st and 2nd *ahupua‘a*
North Kona District
Island of Hawai‘i

PREPARED BY:

Robert B. Rechtman, Ph.D.

PREPARED FOR:

Brian Rupp
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951 Reasearch Drive
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September 2006

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ARCHAEOLOGICAL, CULTURAL, AND HISTORICAL STUDIES

RC-0389

Cultural Impact Assessment for the Kula Nei Project Area

(TMKs: 3-7-3-07:038, 039, 042 por., 043 por., 3-7-3-09:007, 008 por., 3-7-3-046:105, 3-7-3-06:022, 037 por.)

‘O‘oma 1st and 2nd *ahupua‘a*
North Kona District
Island of Hawai‘i

RECHTMAN CONSULTING

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INTRODUCTION

At the request of Belt Collins Hawaii, on behalf of The Shopoff Group, Rechtman Consulting, LLC has prepared this Cultural Impact Assessment associated with the development of an approximately 140 acre project area in ʻOʻoma 1st and 2nd *ahupuaʻa*, North Kona District, Island of Hawaiʻi (TMKs: 3-7-3-09:007, 008 por., 3-7-3-07:038, 039, 42 por., 43 por., 3-7-3-046:105, 3-7-3-06:022, 37 por) (Figure 1). This report is intended to accompany an Environmental Assessment (EA) compliant with Chapter 343 HRS, as well as fulfilling the requirements of the County of Hawaiʻi Planning Department and the Department of Land and Natural Resources (DLNR) with respect to permit approvals for land-altering and development activities. This study has been prepared pursuant to Act 50, approved by the Governor on April 26, 2000; and in accordance with the Office of Environmental Quality Control (OEQC) *Guidelines for Assessing Cultural Impact*, adopted by the Environmental Council, State of Hawaiʻi, on November 19, 1997.

The archival-historical research and oral-historical interviews that were conducted for this study were performed in a manner consistent with Federal and State laws and guidelines for such studies. Among the pertinent laws and guidelines are the National Historic Preservation Act (NHPA) of 1966, as amended in 1992 (36 CFR Part 800); the Advisory Council on Historic Preservation's "Guidelines for Consideration of Traditional Cultural Values in Historic Preservation Review" (ACHP 1985); National Register Bulletin 38, "Guidelines for Evaluating and Documenting Traditional Cultural Properties" (Parker and King 1990); the Hawaiʻi State Historic Preservation Statue (Chapter 6E), which affords protection to historic sites, including traditional cultural properties of on-going cultural significance; the criteria, standards, and guidelines currently utilized by the Department of Land and Natural Resources-State Historic Preservation Division (DLNR-SHPD) for the evaluation and documentation of cultural sites (cf. 13§13-275-8; 276-5); and the November 1997 guidelines for cultural impact assessment studies, adopted by the Office of Environmental Quality Control.

While the physical study area is limited to portions of ʻOʻoma 1st and 2nd *ahupuaʻa* that lie *mauka* of the Queen Kaʻahumanu Highway and *makai* of Māmalahoa Highway, in an effort to provide a comprehensive and holistic understanding of the current study area, this report examines the entire *ahupuaʻa* and its relationship to neighboring lands within the larger Kekaha region. Archival-historical literature from both Hawaiian and English language sources was reviewed, including an examination of Hawaiian Land Commission Award records from the *Māhele ʻĀina* (Land Division) of 1848; survey records of the Kingdom and Territory of Hawaiʻi; and historical texts authored or compiled by D. Malo (1951), J.P. Iʻi (1959), S. M. Kamakau (1961, 1964, 1976, and 1991), Wm. Ellis (1963), A. Fornander (1916-1919 and 1996), T. Thrum (1908), J.F.G. Stokes and T. Dye (1991), M. Beckwith (1970), Reinecke (n.d.); and Handy and Handy with Pukui (1972). Importantly, the current study also includes several native accounts from Hawaiian language newspapers (compiled and translated from Hawaiian to English, by Kepā Maly), and historical narratives authored by eighteenth and nineteenth century visitors to the region. This information is presented within thematic categories and ordered chronological by the date of publication.

The archival-historical resources were located in the collections of the Hawaiʻi State Archives (HSA), State Land Division (LD), State Survey Division (SD), and State Bureau of Conveyances (BoC); the Bishop Museum Archives (BPBM); Hawaiian Historical Society (HHS); University of Hawaiʻi-Hilo Moʻokini Library; private family collections; and in the collection of Kumu Pono Associates.

Over the last twelve years, Kepā Maly of Kumu Pono Associates has researched and prepared several detailed studies—in the form of review and translation of accounts from Hawaiian language newspapers, historical accounts recorded by Hawaiian and non-Hawaiian residents, and government land use records—for lands in the Kekaha region of which ʻOʻoma is a part. Kepā Maly has also conducted a number of detailed oral history interviews with elder *kamaʻāina* documenting their knowledge of the Kekaha region (including ʻOʻoma). As part of the current study, a couple of new informal interviews were conducted. All of the interview participants (both past and present) have shared their personal knowledge of the land and practices of the families who lived in ʻOʻoma and vicinity.

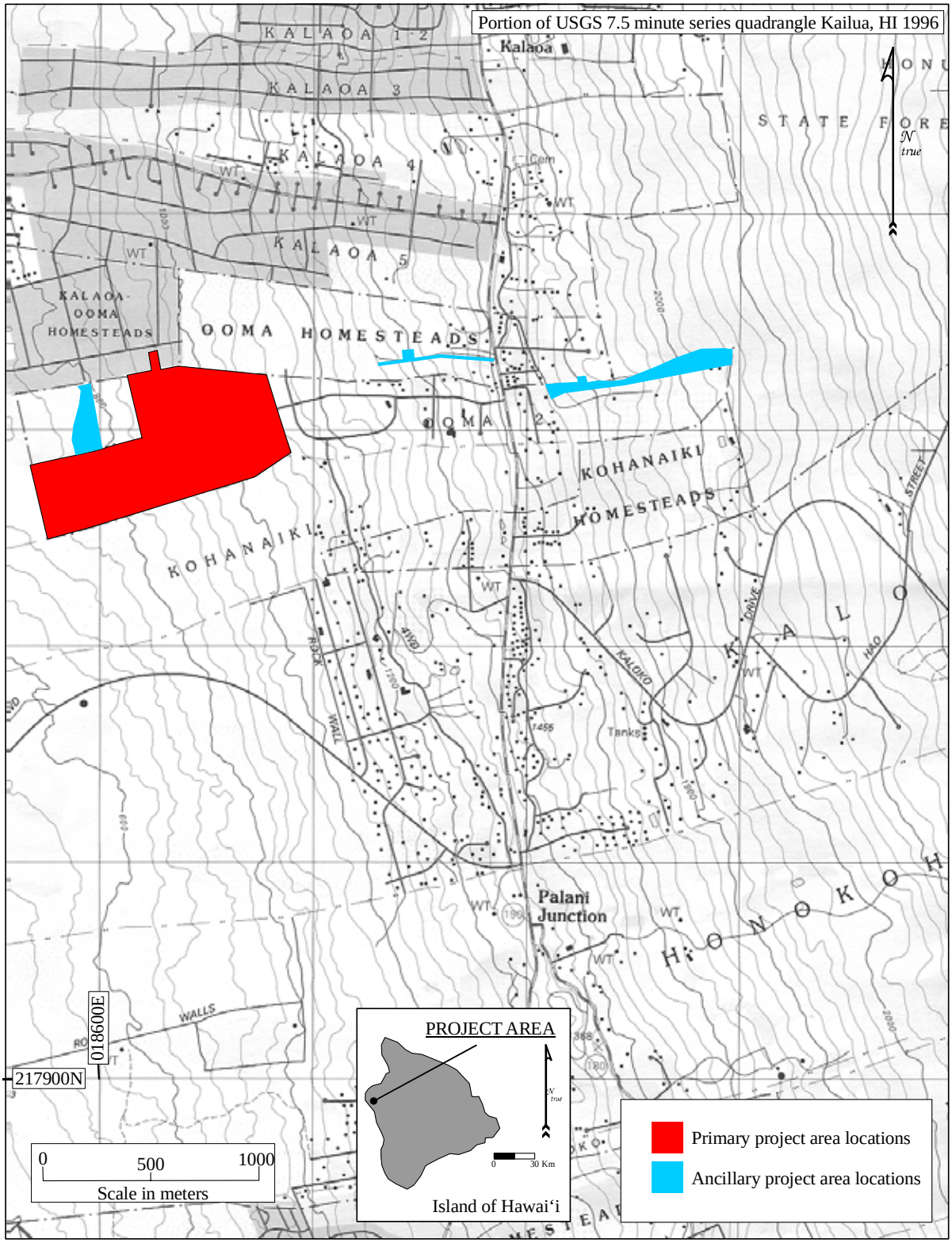

Figure 1. Portion of USGS 7.5 minute series Keahole Point, HI 1996 showing project area location.

This report begins with a description of the general project area and the proposed development activities. This is followed by a presentation of the archaeological background for the specific study area. A discussion of the cultural and historical background for ʻOʻoma Ahupuaʻa and the Kekaha region was generated based on detailed archival research. It is a comprehension of this background information that facilitates a more complete understanding of the potential significance any resources that might exist within the study area. Information from both prior and newly conducted oral-historical interviews is presented and summarized. While no traditional or on-going cultural practices, or traditional cultural properties have been identified, prior archaeological studies (Clark and Rechtman 2005a; Clark and Rechtman 2005b; Nelson et al. 2006) have documented numerous significant archaeological resources within the study area, several of which merit preservation. These resources are described, potential impacts are discussed, and appropriate mitigation measures are outlined.

PROJECT AREA DESCRIPTION AND PROPOSED DEVELOPMENT ACTIVITIES

The project area is roughly 140 acres in ʻOʻoma 1st and 2nd *ahupuaʻa*, North Kona District, Island of Hawaiʻi and consists of four current Tax Map parcels (the primary project area) (TMK:3-7-3-09:007, 3-7-3-07:38, 39, and 3-7-3-46:105) and portions of five additional parcels (the ancillary project area) (TMK:3-7-3-09:008, TMKs:3-7-3-06:022, 37, 3-7-3-07:42, 43) (Figure 2). Elevation across the primary project area ranges from 760 to 1,120 feet above sea level, and the terrain is characterized by weathered *pāhoehoe* and *ʻaʻā* flows that eminated from Hualālai between 3,000 and 5,000 years ago (Wolfe and Morris 1996). This area is blanketed by a dense growth of vegetation. Identified floral species included mango (*Mangifera indica*), silver oak (*Gravillea robusta*), Christmas-berry (*Schinus terebinthifolius*) *koa-haole* (*Leucaena Leucocephala*), weeping fig (*Ficus benjamina*), *kukui* (*Aleurites moluccana*), guava (*Psidium guajava*), autograph trees (*Clusia rosea*), ti (*Cordyline fruticosa*), and fountain grass (*Pennisetum setaceum*), along with various other non-native vines, grasses, shrubs, and weeds. Jeep roads that run along the perimeters of the individual parcels facilitate access through the primary project area. The development plans for the primary project area includes subdivision into single-family residential lots ranging from 7,500 square feet to greater than 20,000 square feet, associated infrastructure (roading, utilities, wastewater), an affordabale housing component, and parks and open spaces (Figure 3).

The ancillary project area includes a 60 to 130 meter wide corridor that runs for a distance of approximately 330 meters across TMK:3-7-3-09:008 for the purposes of extending HoloHolo Street, and a water well and reservoir site with associated delivery system that involves portions of four different parcels (TMKs:3-7-3-06:022, 37, 3-7-3-07:42, 43). Elevation within this ancillary area ranges from about 800 feet to 1,900 feet above sea level. Terrain and vegetation on TMK:3-7-3-09:008 was similar to that of the primary project area; the other four pacel had been graded and developed.

ARCHAEOLOGICAL BACKGROUND

Thrum (1908) compiled the earliest systematic report on archaeological features—*heiau* or ceremonial sites—on the island of Hawai'i. Thrum's work was the result of literature review and field visits spanning several decades. Unfortunately, Thrum's work did not take him into ʻOʻoma, and his documentation on *heiau* ends at Lanihau, south of the study area; and picks up to the north, in the Puʻu Anahulu vicinity. Likewise, the 1906-1907, J.F.G. Stokes detailed field survey of *heiau* on the island of Hawaiʻi for the B. P. Pauahi Bishop Museum (Stokes and Dye 1991) stopped short of doing comprehensive work in the Kekaha region, and no sites were recorded in ʻOʻoma.

In 1929-1930, the Bishop Museum contracted John Reinecke to conduct a survey of Hawaiian sites in West Hawaiʻi, including ʻOʻoma and the Kekaha region (Reinecke n.d.). A portion of Reinecke's survey fieldwork extended north from Kailua as far as Kalāhuipuaʻa. His work being the first attempt at a survey of sites of varying function, ranging from ceremonial to residency and resource collection.

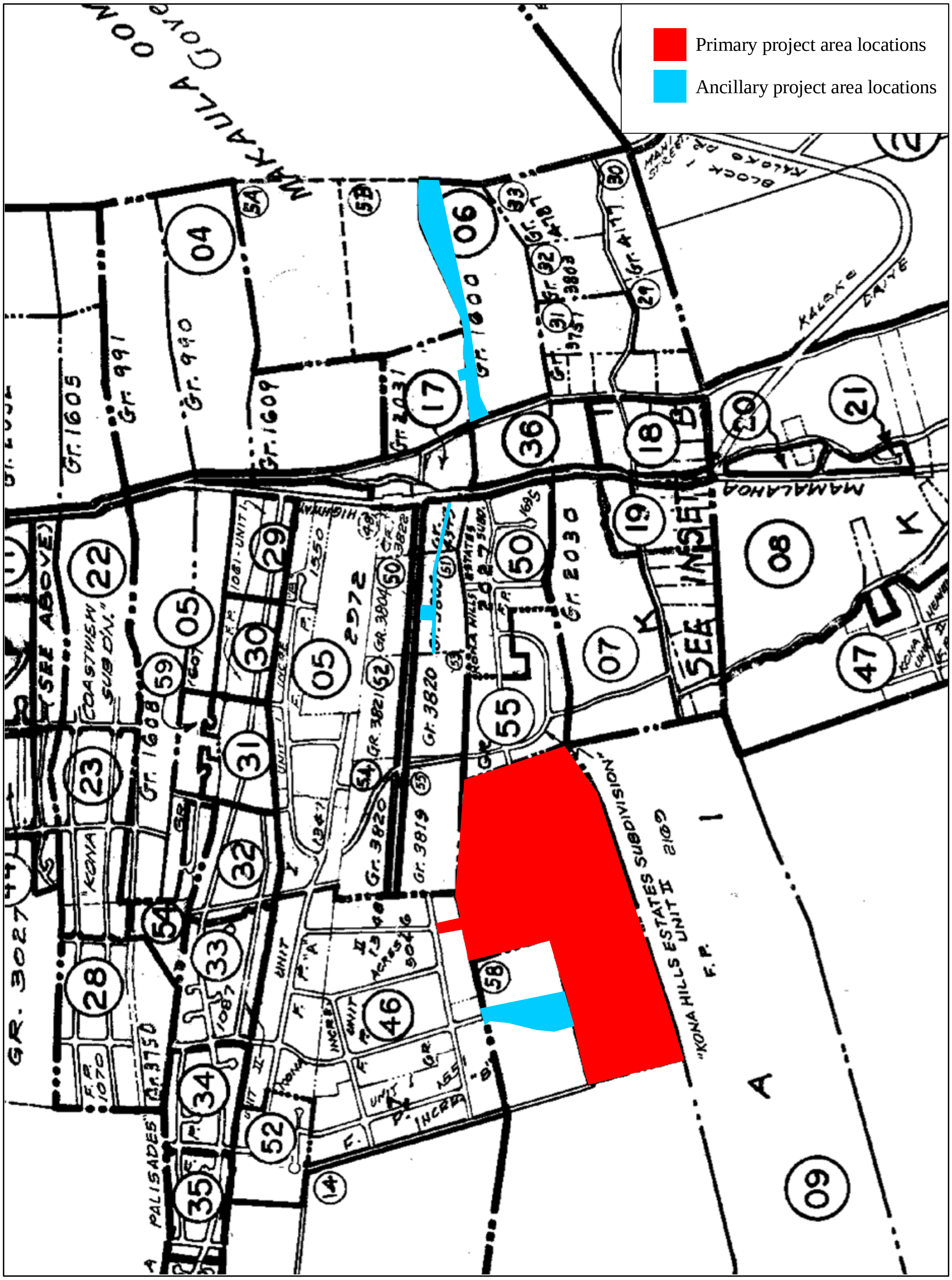

Figure 2. Portion of Tax Map Key 3-7-3 showing current project areas.

During his study, Reinecke traveled along the shore of Kekaha, documenting near-shore sites. Where he could, he spoke with the few native residents he encountered. Among his general descriptions of the Kekaha region, Reinecke observed:

> This coast formerly was the seat of a large population. Only a few years ago Keawaiki, now the permanent residence of one couple, was inhabited by about thirty-five Hawaiians. Kawaihae and Puako were the seat of several thousands, and smaller places numbered their inhabitants by the hundreds. Now there are perhaps fifty permanent inhabitants between Kailua and Kawaihae–certainly not over seventy-five.
>
> When the economy of Hawaii was based on fishing this was a fairly desirable coast; the fishing is good; there is a fairly abundant water supply of brackish water, some of it nearly fresh and very pleasant to the taste; and while there was no opportunity for agriculture on the beach, the more energetic Hawaiians could do some cultivation at a considerable distance *mauka*.
>
> The scarcity of remains is therefore disappointing. This I attribute to four reasons: (1) those simply over looked, especially those a short distance mauka, must have been numerous; (2) a number must have been destroyed, as everywhere, by man and by cattle grazing; (3) the coast is for the most part low and storm-swept, so that the most desirable building locations, on the coral beaches, have been repeatedly swept over and covered with loose coral and lava fragments, which have obscured hundreds of platforms and no doubt destroyed hundreds more; (4) many of the dwellings must have been built directly on the sand, as are those of the family at Kaupulehu, and when the posts have been pulled up, leave no trace after a very few years.
>
> The remains on this strip of coast have some special characteristics differentiating them from the rest in Kona. First, there is an unusual number of petroglyphs and papamu, especially about Kailua and at Kapalaoa. Second, probably because of the strong winds, there are many walled sites, both of houses and especially of temporary shelters… (Reinecke n.d.:1-2)

The following site descriptions are quoted from Reinecke's draft manuscript of fieldwork conducted between Pūhili Point on the Kohanaiki-'O'oma 2nd boundary, and into Kalaoa 5th (Figure 3). In the site descriptions below, Reinecke references the occurrence of at least—6-house sites; 7 enclosures and pens (one of which is an "old cattle pen"); 11 terraces and platforms (one of which he felt was a "*heiau*"); 2 caves; 2 *ahu*; 1 stepping stone trail; 3 waterholes and a well; and 11 shelters. Apparently, no one was residing in the area at the time of his field survey.

Reinecke's site descriptions, south to north, across 'O'oma 2nd and 'O'oma 1st included:

> Site 66. Very doubtful dwelling site. Then a row of sand-covered platforms at the border of the sand and the beach lava, enough for 6-10 homes. Remains of an old, large pen.
>
> Site 67. Dry well on the crest of the beach.
>
> Site 68. Water hole, two small platforms, four or more shelters, pens with very small platform.
>
> Site 69. Large cattle pen. Doubtful old, rough platform at its north end. Remains of two old platforms by an ahu to the north.
>
> Site 70. Walled platform, S.E. corner terraced, badly broken down. Platform mauka. The walls of this and of Site 73 are built of thin pieces of pahoehoe surface lava, rather unusual in appearance. [Reinecke n.d.:15]
>
> Site 71. A knob partly walled on its slopes, with house site. Adjoining it on the south is a rough platform with three smooth boulders – heiau and kuula? Back of this a house platform and a platform about a fine shelter cave. Another platform and wall are about a slight natural depression filled with bones, including those of a whale.

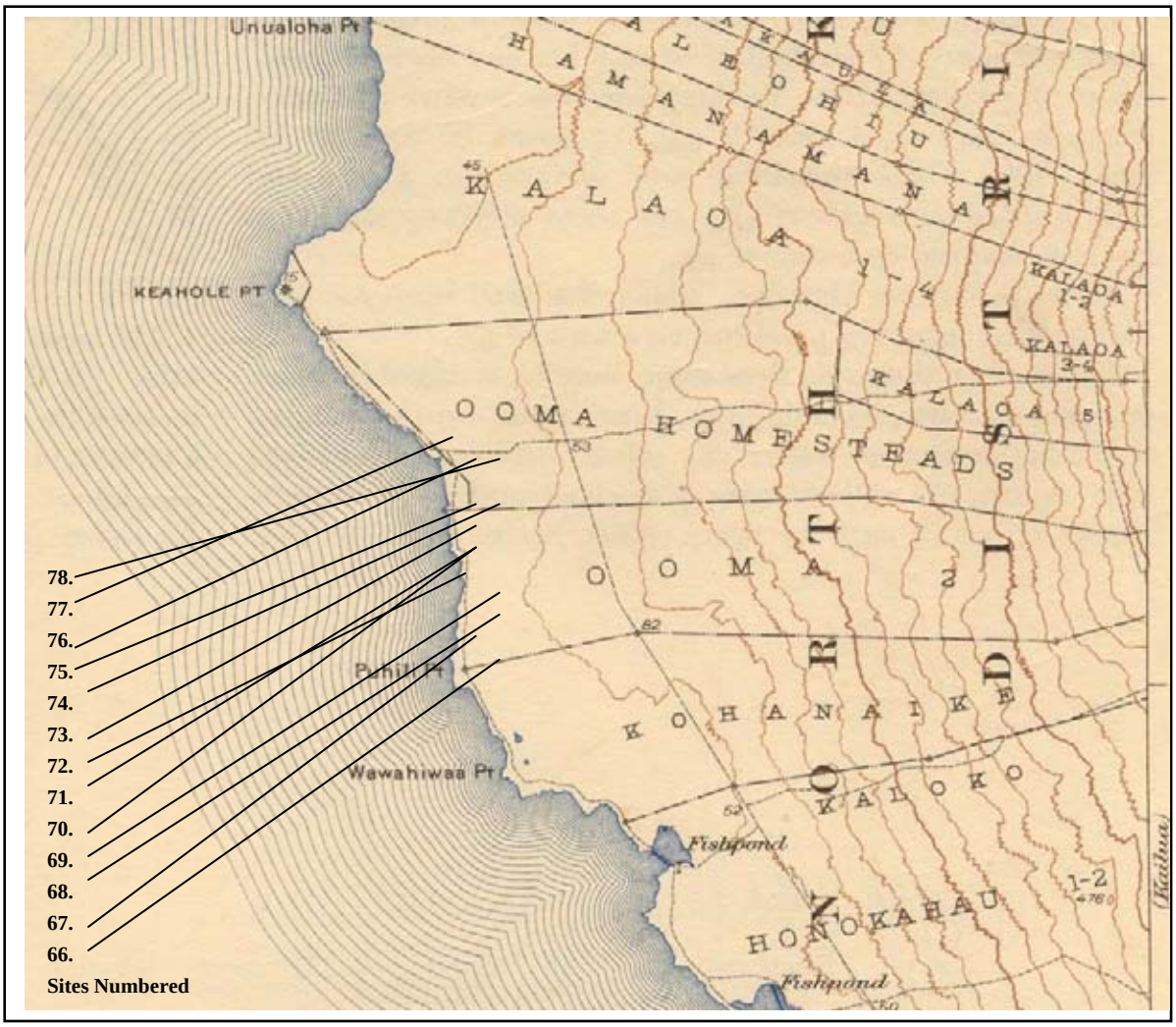

Figure 3. Approximate locations of sites described by Reinecke (n.d.:37) projected on USGS Keahole Quad, 1928.

> Site 72. Ruins of a pen.
>
> Site 73. Apparently a modern dwelling site of unusual construction; two terraces of pebbles, the upper 29x25x2 in front and 4-5' high elsewhere; the lower 19x10x25x3, with a three-sided pen at N.E.; surrounded by a carefully laid wall.
>
> Site 74. A shelter about a shallow cave; remains of another shelter; an ahu.
>
> Site 75. Trace of site; house platform; enclosure on shore. There are many faint traces of sites on this strip of coast. Toward the north is an unmistakable small site.
> Site 76. Modern shelter pen; house or shelter site; shelter mauka by kiawe tree.
>
> Site 77. Platform; tiny pen; sites of some kind marked by stones in lines on the pahoehoe flow.
>
> Site 78. Slightly brackish springs and pools; house site, shelters, stepping stone path leading to the walled house site… [Reinecke n.d.:16]

The current project area has been subject to intensive archaeological study (Clark and Rechtman 2005; Clark and Rechtman 2006a; Clark and Rechtman 2006b; Drolet and Schilz 1991; Nelson et al. 2006, Rechtman 2006). As a result of the archaeological inventory surveys (Clark and Rechtman 2005; Clark and Rechtman 2006a; Clark and Rechtman 2006b; Nelson et al. 2006) a total of 83 sites were recorded within the primary project area and the HoloHolo Street extension area (Figure 4) No sites were identified within the ancillary project area associated with the water system (Rechtman 2006). The following table lists these sites, their significance, and the DLNR-SHPD approved treatments.

Table 1. Archaeological Sites recorded within the project area.

SIHP No.	*Function*	*Temporal Association*	*Significance*	*Recommended Treatment*
5699	Boundary	Historic	D	No further work
16103	Burial	Precontact	D, E	Preservation
16105	Burial	Precontact	D, E	Preservation
16106	Boundary	Historic	D	No further work
16107	Agricultural	Precontact/Historic	D	No further work
16125	Boundary	Historic	D	No further work
16126	Boundary	Historic	A, D	Preservation
16127	Habitation/Agricultural	Precontact	D	Data recovery
16128	Burial	Precontact	D, E	Preservation
16131	Habitation	Precontact	D	Data recovery
23834	Boundary	Historic	D	No further work*
24413	Burial	Precontact	D, E	Preservation
24414	Ranching	Historic	D	No further work
24415	Homesteading	Historic	D	No further work
24416	Ranching	Historic	D	No further work
24417	Habitation	Precontact	D	Data recovery
24418	Agriculture/clearing	Precontact	D	Data recovery
24419	Trail	Precontact	D	No further work
24420	Habitation	Precontact/Historic	D	Data recovery
24421	Agriculture/clearing	Precontact	D	No further work
24422	Homesteading	Historic	D	No further work
24423	Boundary	Historic	D	No further work
24424	Water collection	Precontact	D, E	Preservation
24759	Ranching	Historic	D	No further work
24760	Homesteading	Historic	D	No further work
24761	Trail	Precontact	D	No further work
24762	Habitation	Precontact	D	Data recovery
24763	Trail	Precontact	D	No further work
24764	Habitation	Precontact	D	Data recovery
24765	Habitation	Precontact	D	No further work
24766	Habitation	Precontact	D	No further work
24767	Habitation	Precontact	D	No further work
24768	Burial/Habitation	Precontact	D, E	Preservation
24769	Ranching	Historic	D	No further work
24770	Ranching	Historic	D	No further work
24771	Boundary	Historic	D	No further work
24772	Boundary	Historic	D	No further work
24773	Habitation	Precontact	D	Data Recovery
24774	Boundary	Historic	A, D	Preservation
24775	Road	Historic/modern	D	No further work
24776	Agriculture	Precontact	D	Data recovery
25034	Habitation	Historic	D	No further work
25035	Habitation	Precontact	D	Data recovery
25036	Habitation	Precontact	D	Data recovery
25037	Habitation	Precontact	D	Data recovery
25038	Habitation	Precontact	D	Data recovery
25039	Habitation	Precontact	D	Data recovery
25040	Habitation	Precontact	D	Data recovery
25041	Habitation	Precontact	D	Data recovery
25042	Habitation	Precontact	D	Data recovery
25043	Habitation	Precontact	D	Data recovery

continued on next page

Table 1. Cont.

SIHP No.	*Function*	*Temporal Association*	*Significance*	*Recommended Treatment*
25044	Habitation	Precontact	D	Data recovery
25045	Habitation	Precontact	D	Data recovery
25046	Habitation	Precontact	D	Data recovery
25047	Habitation	Precontact	D	Data recovery
25048	Habitation	Precontact	D	Data recovery
25049	Habitation	Precontact	D	Data recovery
25050	Habitation	Precontact	D	Data recovery
25051	Habitation	Precontact	D	Data recovery
25052	Habitation	Precontact	D	Data recovery
25053	Habitation	Precontact	D	Data recovery
25054	Habitation	Precontact	D	Data recovery
25055	Habitation	Precontact	D	Data recovery
25056	Habitation	Precontact	D	Data recovery
25057	Habitation	Precontact	D	Data recovery
25058	Habitation	Precontact	D	Data recovery
25059	Habitation	Precontact	D	Data recovery
25060	Habitation	Precontact	C, D	Preservation
25061	Habitation	Precontact	D	Data recovery
25062	Habitation	Precontact	D	Data recovery
25063	Habitation	Precontact	D	Data recovery
25064	Habitation	Precontact	D	No further work
25065	Habitation	Precontact	D	Data recovery
25066	Habitation	Precontact	D	No further work
25067	Habitation	Precontact	D, E	Preservation
25068	Habitation	Precontact	D	No further work
25069	Burial	Precontact	D, E	Preservation
25070	Burial	Precontact	D, E	Preservation
25071	Burial	Precontact	D, E	Preservation
25072	Burial	Precontact	D, E	Preservation
25073	Trail	Precontact	D	No further work
25074	Trail	Precontact	D	No further work
25075	Trail	Precontact	D	No further work

Collectively these sites document intensive Precontact use the primary project area for habitation, burial, and water collection activities. This latter activity was a significant one, as the overall region (Kekaha) is reknown for its dryness and lack of water sources. The water sources associated with the major lava tube system (SIHP Site 24424) were no doubt a key factor that led to the establishment of and sustained the numerous habitation sites (n=46) and associated burial sites (n=9) in the area. The agricultural features found throughout the primary project area are both Precontact and Historic in origin, while the boundary walls all date from the Homesteading Period. Another significant landscape feature that dates to the Historic Period is the Homestead Road that runs a *mauka/makai* course through the center of the primary project area.

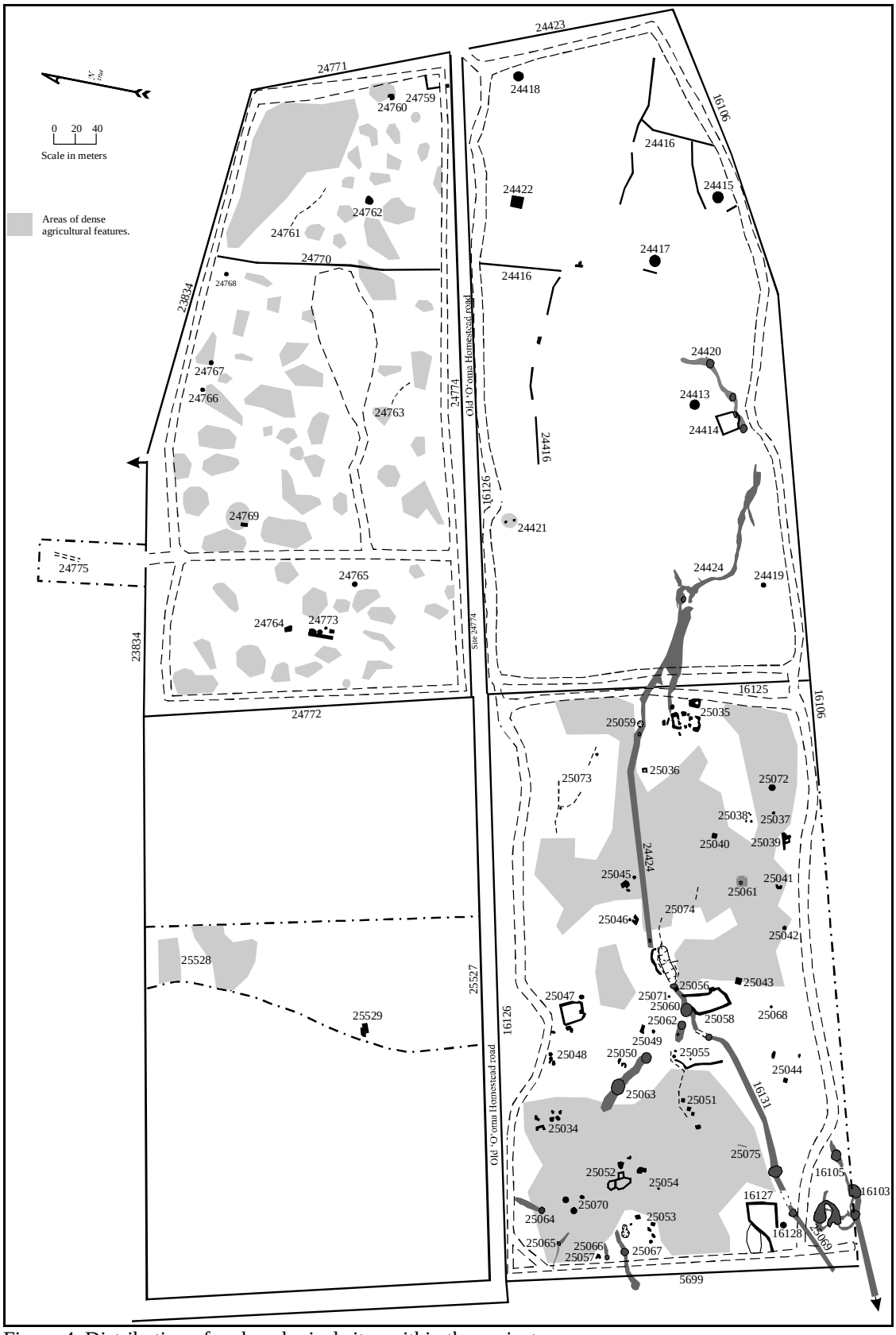

Figure 4. Distribution of archaeological sites within the project area.

CULTURAL AND HISTORICAL BACKGROUND

Natural and Cultural Resources in a Hawaiian Context

In Hawaiian society, natural and cultural resources are one and the same. Native traditions describe the formation (the literal birth) of the Hawaiian Islands and the presence of life on and around them in the context of genealogical accounts. All forms in the natural environment, from the skies and mountain peaks, to the watered valleys and lava plains, and to the shoreline and ocean depths were believed to be embodiments of Hawaiian deities. One Hawaiian genealogical account, records that Wākea (the expanse of the sky–father) and Papa-hānau-moku (Papa—Earth-mother who gave birth to the islands)—also called Haumea-nui-hānau-wā-wā (Great Haumea—Woman-earth born time and time again)—and various gods and creative forces of nature, gave birth to the islands. Hawai‘i, the largest of the islands, was the first-born of these island children. As the Hawaiian genealogical account continues, we find that these same god-beings, or creative forces of nature who gave birth to the islands, were also the parents of the first man (Hāloa), and from this ancestor, all Hawaiian people are descended (cf. Beckwith 1970; Malo 1951:3; Pukui and Korn 1973). It was in this context of kinship, that the ancient Hawaiians addressed their environment and it is the basis of the Hawaiian system of land use.

An Overview of Hawaiian Settlement

Archaeologists and historians describe the inhabiting of these islands in the context of settlement that resulted from voyages taken across the open ocean. For many years, researchers have proposed that early Polynesian settlement voyages between Kahiki (the ancestral homelands of the Hawaiian gods and people) and Hawai‘i were underway by A.D. 300, with long distance voyages occurring fairly regularly through at least the thirteenth century. It has been generally reported that the sources of the early Hawaiian population—the Hawaiian Kahiki—were the Marquesas and Society Islands (Cordy 2000; Emory in Tatar 1982:16-18).

For generations following initial settlement, communities were clustered along the watered, windward (*ko‘olau*) shores of the Hawaiian Islands. Along the *ko‘olau* shores, streams flowed and rainfall was abundant, and agricultural production became established. The *ko‘olau* region also offered sheltered bays from which deep sea fisheries could be easily accessed, and near shore fisheries, enriched by nutrients carried in the fresh water, could be maintained in fishponds and coastal waters. It was around these bays that clusters of houses where families lived could be found (McEldowney 1979:15). In these early times, Hawai‘i’s inhabitants were primarily engaged in subsistence level agriculture and fishing (Handy et al. 1972:287).

Over a period of several centuries, areas with the richest natural resources became populated and perhaps crowded, and by about A.D. 900 to 1100, the population began expanding to the *kona* (leeward side) and more remote regions of the island (Cordy 2000:130). In Kona, communities were initially established along sheltered bays with access to fresh water and rich marine resources. The primary “chiefly” centers were established at several locations—the Kailua (Kaiakeakua) vicinity, Kahalu‘u-Keauhou, Ka‘awaloa-Kealakekua, and Hōnaunau. The communities shared extended familial relations, and there was an occupational focus on the collection of marine resources. By the fourteenth century, inland elevations to around the 3,000-foot level were being turned into a complex and rich system of dryland agricultural fields (today referred to as the Kona Field System). By the fifteenth century, residency in the uplands was becoming permanent, and there was an increasing separation of the chiefly class from the common people. In the sixteenth century the population stabilized and the *ahupua‘a* land management system was established as a socioeconomic unit (see Ellis 1963; Handy et al. 1972; Kamakau 1961; Kelly 1983; and Tomonari-Tuggle 1985).

In Kona, where there were no regularly flowing streams to the coast, access to potable water (*wai*), was of great importance and played a role in determining the areas of settlement. The waters of Kona were found in springs and caves (found from shore to the mountain lands), or procured from rain catchments and dewfall. Traditional and historic narratives abound with descriptions and names of water sources, and also record that the forests were more extensive and extended much further seaward than they do today. These forests not only attracted rains from the clouds and provided shelter for cultivated crops, but also in dry times drew the *kēhau* and *kēwai* (mists and dew) from the upper mountain slopes to the low lands (see also traditional-historical narratives and oral history interviews in this study).

In the 1920s-1930s, Handy et al. (1972) conducted extensive research and field interviews with elder native Hawaiians. In lands of North and South Kona, they recorded native traditions describing agricultural practices and rituals associated with rains and water collection. Primary in these rituals and practices was the lore of Lono—a god of agriculture, fertility, and the rituals for inducing rainfall. Handy et al., observed:

> The sweet potato and gourd were suitable for cultivation in the drier areas of the islands. The cult of Lono was important in those areas, particularly in Kona on Hawai‘i . . . there were temples dedicated to Lono. The sweet potato was particularly the food of the common people. The festival in honor of Lono, preceding and during the rainy season, was essentially a festival for the whole people, in contrast to the war rite in honor of Ku which was a ritual identified with Ku as god of battle. (Handy et al. 1972:14)

Handy et al. (1972) noted that the worship of Lono was centered in Kona. Indeed, it was while Lono was dwelling at Keauhou, that he is said to have introduced taro, sweet potatoes, yams, sugarcane, bananas, and *‘awa* to Hawaiian farmers (Handy et al. 1972:14). The rituals of Lono “The father of waters” and the annual *Makahiki* festival, which honored Lono and which began before the coming of the *kona* (southerly) storms and lasted through the rainy season (the summer months), were of great importance to the native residents of this region (Handy et al. 1972: 523). The significance of rituals and ceremonial observances in cultivation and indeed in all aspects of life was of great importance to the well being of the ancient Hawaiians, and cannot be overemphasized, or overlooked when viewing traditional sites of the cultural landscape.

Hawaiian Land Use and Resource Management Practices

Over the generations, the ancient Hawaiians developed a sophisticated system of land and resources management. By the time ‘Umi-a-Līloa rose to rule the island of Hawai‘i in ca. 1525, the island (*moku-puni*) was divided into six districts or *moku-o-loko* (cf. Fornander 1973–Vol. II:100-102). On Hawai‘i, the district of Kona is one of six major *moku-o-loko* within the island. The district of Kona itself, extends from the shore across the entire volcanic mountain of Hualālai, and continues to the summit of Mauna Loa, where Kona is joined by the districts of Ka‘ū, Hilo, and Hāmākua. One traditional reference to the northern and southern-most coastal boundaries of Kona tells us of the district’s extent:

> *Mai Ke-ahu-a-Lono i ke ‘ā o Kani-kū, a hō‘ea i ka ‘ūlei kolo o Manukā i Kaulanamauna e pili aku i Ka‘ū!*—From Keahualono [the Kona-Kohala boundary] on the rocky flats of Kanikū, to Kaulanamauna next to the crawling (tangled growth of) ‘ūlei bushes at Manukā, where Kona clings to Ka‘ū! (*Ka‘ao Ho‘oniua Pu‘uwai no Ka-Miki in Ka Hōkū o Hawai‘i*, September 13, 1917; Translated by Kepā Maly)

Kona, like other large districts on Hawai‘i, was further divided into ‘okana or kalana (regions of land smaller than the *moku-o-loko*, yet comprising a number of smaller units of land). In the region now known as Kona ‘akau (North Kona), there are several ancient regions (*kalana*) as well. The southern portion of North Kona was known as “Kona kai ‘ōpua” (interpretively translated as: Kona of the distant horizon clouds above the ocean), and included the area extending from Lanihau (the present-day vicinity of Kailua Town) to Pu‘uohau (now known as Red Hill). The northern-most portion of North Kona was called “Kekaha” (descriptive of an arid coastal place). Native residents of the region affectionately referred to their home as *Kekaha-wai-‘ole o nā Kona* (Waterless Kekaha of the Kona District), or simply as the *āina kaha*. It is within this region of Kekaha, that the lands of ‘O‘oma are found.

The *ahupua‘a* were also divided into smaller individual parcels of land (such as the *‘ili, kō‘ele, māla*, and *kīhāpai*, etc.), generally oriented in a *mauka-makai* direction, and often marked by stone alignments (*kuaiwi*). In these smaller land parcels the native tenants tended fields and cultivated crops necessary to sustain their families, and the chiefly communities with which they were associated. As long as sufficient tribute was offered and *kapu* (restrictions) were observed, the common people, who lived in a given *ahupua‘a* had access to most of the resources from mountain slopes to the ocean. These access rights were almost uniformly tied to residency on a particular land, and earned as a result of taking responsibility for stewardship of the natural environment, and supplying the needs of the *ali‘i* (see Kamakau 1961:372-377 and Malo 1951:63-67).

Entire *ahupua‘a*, or portions of the land were generally under the jurisdiction of appointed *konohiki* or lesser chief-landlords, who answered to an *ali‘i-‘ai-ahupua‘a* (chief who controlled the *ahupua‘a* resources). The *ali‘i-‘ai-ahupua‘a* in turn answered to an *ali‘i ‘ai moku* (chief who claimed the abundance of the entire district). Thus, *ahupua‘a* resources supported not only the *maka‘āinana* and *‘ohana* who lived on the land, but also contributed to the support of the royal community of regional and/or island kingdoms. This form of district subdividing was integral to Hawaiian life and was the product of strictly adhered to resources management planning. In this system, the land provided fruits and vegetables and some meat in the diet, and the ocean provided a wealth of protein resources. Also, in communities with long-term royal residents, divisions of labor (with specialists in various occupations on land and in procurement of marine resources) came to be strictly adhered to. It is in this cultural setting that we find ‘O‘oma and the present study area.

The *ahupua‘a* of ‘O‘oma (historically, ‘O‘oma 1st and 2nd) are two of some twenty ancient *ahupua‘a* within the *‘okana* of Kekaha-wai-‘ole. The place name ‘O‘oma can be literally translated as concave. To date, no tradition explaining the source of the place name has been located, though it is possible that the name refers to the indentation of the shoreline fronting a portion of ‘O‘oma. A few place names within ‘O‘oma were discussed in traditional accounts, thus we have some indication of the histories associated with this land.

While there are only limited native accounts that have been recorded about ‘O‘oma, we do know that the land was so esteemed, that during the youth of Kauikeaouli (later known as Kamehameha III), the young prince—son of Kamehameha I and his sacred wife Keōpūolani—was taken to be raised near the shore of ‘O‘oma under the care of his stewards from infancy until he was five years old (Kamakau 1961:263-264). Again, this is a significant part of the history of this land, as great consideration went into all aspects of the young king’s upbringing (see I‘i 1959 and Kamakau 1961).

The Environmental Setting of ‘O‘oma

The *ahupua‘a* of ‘O‘oma cross several environmental zones that are generally called *wao* in the Hawaiian language. These environmental zones include the near-shore fisheries and shoreline strand (*kahakai*) and the *kula kai/kula uka* (shoreward/inland plains). These regional zones were greatly desired as places of residence by the natives of the land.

While the *kula* region of ‘O‘oma and greater Kekaha is now likened to a volcanic desert, native and historic accounts describe or reference groves of native hardwood shrubs and trees such as *‘ūlei* (*Osteomeles anthyllidifolia*), *ēlama* (*Diospyros ferrea*), *uhiuhi* (*Caesalpina kavaiensis*), and *ohe* (*Reynoldsia sandwicensis*) extending across the land and growing some distance shoreward. The few rare and endangered plants found in the region, along with small remnant communities of native dryland forest (Char 1991) give an indication that there was a significant diversity of plants growing upon the *kula* lands prior to the introduction of ungulates.

The lower *kula* lands receive only about 20 inches of rainfall annually, and it is because of their dryness, the larger region of which ‘O‘oma is a part, is known as “Kekaha.” While on the surface, there appears to be little or no potable water to be found, the very lava flows which cover the land contain many underground streams that are channeled through subterranean lava tubes which feed the springs, fishponds and anchialine ponds on the *kula kai* (coastal flats). Also in this region, on the flat lands, about a half-mile from the shore, is the famed *Alanui Aupuni* (Government Trail), built in 1847, at the order of Kamehameha III. This trail or government roadway, was built to meet the needs of changing transportation in the Hawaiian Kingdom, and in many places it overlays the older near shore *ala loa* (ancient foot trail that encircled the island).

Continuing into the *kula uka* (inland slopes), the environment changes as elevation increases. Based on historic surveys, it appears that ‘O‘oma ends at a survey station named Kuhiaka, 2,145 feet above sea level (cf. Register Map No. 1449). This zone is called the *wao kanaka* (region of man) and *wao nahele* (forest region). Rainfall increases to 30 or 40 inches annually, and taller forest growth occurred. This region provided native residents with shelter for residential and agricultural uses, and a wide range of natural resources that were of importance for religious, domestic, and economic purposes. In ‘O‘oma, this region is generally between the 1,200 to 2,200 foot elevation, and is crossed by the present-day Māmalahoa Highway. The highway is situated

not far below the ancient *ala loa*, or foot trail, also known as Ke-alaʻehu, and was part of a regional trail system passing through Kona from Kaʻū and Kohala.

The ancient Hawaiians saw (as do many Hawaiians today) all things within their environment as being interrelated. That which was in the uplands shared a relationship with that which was in the lowlands, coastal region, and even in the sea. This relationship and identity with place worked in reverse as well, and the *ahupuaʻa* as a land unit was the thread that bound all things together in Hawaiian life. In an early account written by Kihe (in *Ka Hōkū o Hawaiʻi*, 1914-1917), with contributions by John Wise and Steven Desha Sr., the significance of the dry season in Kekaha and the custom of the people departing from the uplands for the coastal region is further described:

> *…ʻOia ka wā e neʻe ana ka lā iā Kona, hele a maloʻo ka ʻāina i ka ʻai kupakupa ʻia e ka lā, a o nā kānaka, nā liʻi o Kona, pūheʻe aku la a noho i kahakai kāhi o ka wai e ola ai nā kānaka* – It was during the season, when the sun moved over Kona, drying and devouring the land, that the chiefs and people fled from the uplands to dwell along the shore where water could be found to give life to the people. (*Ka Hōkū o Hawaiʻi*, April 5, 1917 translated by Kepā Maly)

It appears that the practice of traveling between upland and coastal communities in the ʻOʻoma *ahupuaʻa* greatly decreased by the middle nineteenth century. Indeed, the only claimant for *kuleana* land in ʻOʻoma, during the *Māhele ʻĀina* of 1848—when native tenants were allowed to lay claim to lands on which they lived and cultivated—noted that he was the only resident in ʻOʻoma at the time (see *Helu* 9162 to Kahelekahi, in this study). This is perhaps explained by the fact that at time of the *Māhele* there was a significant decline in the Hawaiian population, and changes in Hawaiian land tenure led to the relocation of many individuals from various lands.

Native Traditions and Historical Accounts of ʻOʻoma and the Kekaha Region

This section of the study presents *moʻolelo*—native traditions and historical accounts (some translated from the original Hawaiian by Kepā Maly)—of the Kekaha region that span several centuries. There are very few accounts that have been found to date, that specifically mention ʻOʻoma. Thus, narratives that describe neighboring lands within the Kekaha region help provide an understanding of the history of ʻOʻoma, describing features and the use of resources that were encountered on the land.

It may be, that the reason there are so few accounts for ʻOʻoma, is that it may have been considered a marginal settlement area, occupied only after the better situated lands of Kekaha—those lands with the sheltered bays, and where fresh water could be easily obtained—were populated. As the island population grew, so too did the need to expand to more remote or marginal lands. This thought is found in some of the native traditions and early historic accounts below. However, as people populated the Kekaha lands, they came to value its fisheries—those of the deep sea, near shore, and inland fishponds.

The native account of Punia (also written Puniaiki – cf. Kamakau 1968), is perhaps among the earliest accounts of the Kekaha area, and in it is found a native explanation for the late settlement of Kekaha. The following narratives are paraphrased from Fornander's *Hawaiian Antiquities and Folklore* (Fornander 1959):

> *Punia: A Tale of Sharks and Ghosts of Kekaha*
>
> Punia was born in the district of Kohala, and was one of the children of Hina. One day, Punia desired to get lobster for his mother to eat, but she warned him of Kaiʻaleʻale and his hoards of sharks who guarded the caves in which lobster were found. These sharks were greatly feared by all who lived along, and fished the shores of Kohala for many people had been killed by the sharks. Heeding his mother's warning, Punia observed the habits of the sharks and devised a plan by which to kill each of the sharks. Setting his plan in motion, Punia brought about the deaths of all the subordinate sharks, leaving only Kaiʻaleʻale

behind. Punia tricked Kaiʻaleʻale into swallowing him whole. Once inside Kaiʻaleʻale, Punia rubbed two sticks together to make a fire to cook the sweet potatoes he had brought with him. He also scraped the insides of Kaiʻaleʻale, causing great pain to the shark. In his weakened state, Kaiʻaleʻale swam along the coast of Kekaha, and finally beached himself at Alula, near the point of Maliu in the land of Kealakehe. The people of Alula, cut open the shark and Punia was released.

At that time Alula was the only place in all of Kekaha where people could live, for all the rest of the area was inhabited by ghosts. When Punia was released from the shark, he began walking along the trail, to return to Kohala. While on this walk, he saw several ghosts with nets all busy tying stones for sinkers to the bottom of the nets, and Punia called out in a chant trying to deceive the ghosts and save himself:

Auwe no hoi kuu makuakane o keia kaha e! *Alas, O my father of these coasts!*
Elua wale no maua lawaia o keia wahi. *We were the only two fishermen of this place (Kaha).*
Owau no o koʻu makuakane, *Myself and my father,*
E hoowili aku ai maua i ka ia o ianei, *Where we used to twist the fish up in the nets,*
O kala, o ka uhu, o ka palani, *The kala, the uhu, the palani,*
O ka ia ku o ua wahi nei la, *The transient fish of this place.*
Ua hele wale ia no e maua keia kai la! *We have traveled over all these seas,*
Pau na kuuna, na lua, na puka ia. *All the different place, the holes, the runs.*
Make koʻu makuakane, koe au. *Since you are dead, father, I am the only one left.*

Hearing Punia's wailing, the ghosts said among themselves, "Our nets will be of some use now, since here comes a man who is acquainted with this place and we will not be letting down our nets in the wrong place." They then called out to Punia, "Come here." When Punia went to the ghosts, he explained to them, the reason for his lamenting; "I am crying because of my father, this is the place where we used to fish. When I saw the lava rocks, I thought of him." Thinking to trick Punia and learn where all the kuʻuna (net fishing grounds) were, the ghosts told Punia that they would work under him. Punia went into the ocean, and one-by-one and two-by-two, he called the ghosts into the water with him, instructing them to dive below the surface. As each ghost dove into the water, Punia twisted the net entangling the ghosts. This was done until all but one of the ghosts had been killed. That ghost fled and Kekaha became safe for human habitation (Fornander 1959:9-17).

One of the earliest datable accounts that describes the importance of the Kekaha region fisheries comes from the mid-sixteenth century, following ʻUmi-a-Līloa's unification of the island of Hawaiʻi under his rule. Writing in the 1860s, native historian, Samuel Mānaiakalani Kamakau (1961) told readers about the reign of ʻUmi, and his visits to Kekaha:

ʻUmi-a-Liloa did two things with his own hands, farming and fishing...and farming was done on all the lands. Much of this was done in Kona. He was noted for his skill in fishing and was called Puʻipuʻi a ka lawaiʻa (a stalwart fisherman). Aku fishing was his favorite occupation, and it often took him to the beaches (Ke-kaha) from Kalahuipuaʻa to Makaula[1]. He also fished for ʻahi and kala. He was accompanied by famed fishermen such as Pae, Kahuna, and all of the chiefs of his kingdom. He set apart fishing, farming and other practices… (Kamakau 1961:19-20)

In his accounts of events at the end of ʻUmi's life, Kamakau (1961) references Kekaha once again. He records that Koʻi, one of the faithful supporters and a foster son of ʻUmi, sailed to Kekaha, where he killed a man who resembled ʻUmi. Koʻi then took the body and sailed to Makaʻeo in the *ahupuaʻa* of Keahuolu.

[1] Kalāhuipuaʻa is situated in the district of Kohala, bounding the northern side of Puʻuanahulu in Kekaha. Makaʻula is situated a few *ahupuaʻa* north of ʻOʻoma.

Landing at Makaʻeo in the night, Koʻi took the body to the cave where ʻUmi's body lay. Replacing ʻUmi's body with that of the other man, Koʻi then crossed the lava beds, returning to his canoe at Makaʻeo. From there, ʻUmi's body was taken to its' final resting place… (Kamakau 1961:32-33).

As a child in ca. 1812, Hawaiian historian John Papa Iʻi passed along the shores of Kekaha in a sailing ship, as a part of the procession by which Kamehameha I returned to Kailua-Kona from his residency on Oʻahu. In his narratives, Iʻi described the shiny lava flows and fishing canoe fleets of the "Kaha" (Kekaha) lands:

> The ship arrived outside of Kaelehuluhulu, where the fleet for aku fishing had been since the early morning hours. The sustenance of those lands was fish.
>
> When the sun was rather high, the boy [Iʻi] exclaimed, "How beautiful that flowing water is!" Those who recognized it, however, said, "That is not water, but pahoehoe. When the sun strikes it, it glistens, and you mistake it for water…"
>
> Soon the fishing canoes from Kawaihae, the Kaha lands, and Ooma drew close to the ship to trade for the paʻiʻai (hard poi) carried on board, and shortly a great quantity of aku lay silvery-hued on the deck. The fishes were cut into pieces and mashed; and all those aboard fell to and ate, the women by themselves.
>
> The gentle Eka sea breeze of the land was blowing when the ship sailed past the lands of the Mahaiulas, Awalua, Haleohiu, Kalaoas, Hoona, on to Oomas, Kohanaiki, Kaloko, Honokohaus, and Kealakehe, then around the cape of Hiiakanoholae… (Iʻi 1959:109-110)

Ka-Lani-Kau-i-ke-Aouli (Kamehameha III)

In ca. 1813, Ka-lani Kau-i-ke-aouli, who grew up to become Kamehameha III, was born. S.M. Kamakau (1961) tells us that the baby appeared to be still-born, but that shortly after birth, he was revived. Upon the revival of the baby, he was given to the care of Ka-iki-o-ʻewa, who with Keawe-a-mahi and family, raised the child in seclusion at ʻOʻoma for the first five years of the young king's life. Kauikeaouli apparently held some interest in the land of ʻOʻoma 2nd through the Māhele ʻĀina, as he originally claimed ʻOʻoma 2nd as his personal property. Though he subsequently gave it up to the Kingdom (Government) later during the Division (see records of *Māhele ʻĀina* in this study).

Kamakau provides us with the following description of Kauikeaouli's birth and early life at ʻOʻoma:

> Ka-lani-kau-i-ke-aouli was the second son of Ke-opu-o-lani by Kamehameha, and she called him Kiwalaʻo after her own father. She was the daughter of Kiwalaʻo and Ke-kuʻi-apo-iwa Liliha, both children of Ka-Iola Pupuka-o-Hono-ka-wai-lani, and hence she [Ke-opu-o- lani] was a niʻaupiʻo and a naha chiefess, and the niʻaupiʻo rank descended to her children and could not be lost by them. While she was carrying the child [Kau-i-ke-aouli] several of the chiefs begged to have the bringing up of the child, but she refused until her kahu, Ka-lua-i-konahale, known as Kua-kini, came with the same request. She bade him be at her side when the child was born lest some one else get possession of it. He was living this side of Keauhou in North Kona, and Ke-opu-o-lani lived on the opposite side.
>
> On the night of the birth the chiefs gathered about the mother. Early in the morning the child was born but as it appeared to be stillborn Kua-kini did not want to take it. Then came Ka-iki-o-ʻewa from some miles away, close to Kuamoʻo, and brought with him his prophet who said, "The child will not die, he will live." This man, Ka-malo-ʻihi or Ka-pihe by name, came from the Napua line of kahunas descended from Makua-kau-mana whose god was Ka-ʻonohi-o-ka-la (similar to the child of God). The child was well cleaned and laid upon a consecrated place and the seer (kaula) took a fan (peʻahi), fanned the child, prayed, and sprinkled it with water, at the same time reciting a prayer addressed to the child of God, something like that used by the Roman Catholics—

"He is standing up, he is taking a step, he walks" (*Kulia-la, ka‘ina-la, hele ia la*).

Or another—

Huila ka lani i ke Akua,
Lapalapa ka honua i ke keiki
E ke keiki e, hooua i ka punohu lani,
Aia i ka lani ka Haku e,
O ku‘u ‘uhane e kahe mau,
I la‘a i kou kanawai.

The heavens lighten with the god,
The earth burns with the child,
O son, pour down the rain that brings the rainbow,
There in heaven is the Lord.
Life flows through my spirit,
Dedicated to your law.

The child began to move, then to make sounds, and at last it came to life. The seer gave the boy the name of "The red trail" (Ke-aweawe-‘ula) signifying the roadway by which the god descends from the heavens.

Ka-iki-o-‘ewa became the boy's guardian and took him to rear in an out-of-the-way place at ‘O‘oma, Kekaha. Here Keawe-a-mahi, the lesser chiefs, the younger brothers and sisters of Ka-iki-o-‘ewa, and their friends were permitted to carry the child about and hold him on their laps (uha). Ka-pololu was the chief who attended him; Ko‘i-pepeleleu and Ulu-nui's mother [were] the nurses who suckled him. Later Ka-‘ai-kane gave him her breast after she had given birth to Ke-kahu-pu‘u. Here at ‘O‘oma he was brought up until his fifth year, chiefly occupied with his toy boats rigged like warships and with little brass cannon loaded with real powder mounted on [their] decks. The firing off of these cannon amused him immensely. He excelled in foot races. On one occasion when the bigger boys had joined in the sport, a [rascal] boy named Ka-hoa thought to play a practical joke by smearing with mud the stake set up to be grasped by the one who first reached the goal. He expected one of the larger boys to be the winner, but it was the little prince who first caught the stick and had his hands smeared. "You will be burnt alive for dirtying up the prince. We are going to tell Ka-pololu on you!" the boys threatened; but the prince objected, saying, "Anyone who tells on him shall never eat with me again or play with me and I will never give him anything again." Kau-i-ke-aouli was a splendid little fellow. He loved his playmates and never once did them any hurt, and he was kind and obedient to his teachers… [Kamakau 1961:264]

It is not until the early twentieth century, that we find a few detailed native accounts which tell of traditional features and residents of ‘O‘oma and vicinity. The writings of John Whalley Hermosa Isaac Kihe, a native son of Kekaha, in Hawaiian language newspapers (recently translated by Kepā Maly from the original Hawaiian texts), share the history of the land and sense the depth of attachment that native residents felt for ‘O‘oma and the larger Kekaha-wai-‘ole-o-nā-Kona.

Kihe (who also wrote under the name of Ka-‘ohu-ha‘aheo-i-nā-kuahiwi-‘ekolu) was born in 1853, his parents were native residents of Honokōhau and Kaloko (his grandfather, Kuapāhoa, was a famed kahuna of the Kekaha lands). During his life, Kihe taught at various schools in the Kekaha region; served as legal counsel to native residents applying for homestead lands in ‘O‘oma and vicinity; worked as a translator on the Hawaiian Antiquities collections of A. Fornander; and was a prolific writer himself. In the later years of his life, Kihe lived at Pu‘u Anahulu and Kalaoa, and he is fondly remembered by elder kama‘āina of the Kekaha region. Kihe, who died in 1929, was also one of the primary informants to Eliza Maguire, who translated some of the writings of Kihe, publishing them in abbreviated form in her book "Kona Legends" (1926).

Writers today have varying opinions and theories pertaining to the history of Kekaha, residency patterns, and practices of the people who called Kekaha-wai-‘ole-o-nā-Kona home. For the most part, our interpretations are limited by the fragmented nature of the physical remains and historical records, and by a lack of familiarity with the diverse qualities of the land. As a result, most of us only see the shadows of what once was, and it is difficult at times, to comprehend how anyone could have carried out a satisfactory existence in such a rugged land.

Kihe and his co-authors provide readers with several references to places and events in the history of ʻOʻoma and neighboring lands. Through the narratives, we learn of place name origins, areas of ceremonial significance, how resources were managed and accessed, and the practices of those native families who made this area their home.

One example of the rich materials recorded by native writers, is found in "*Kaʻao Hoʻoniua Puʻuwai no Ka-Miki*" (The Heart Stirring Story of Ka-Miki). This tradition is a long and complex account, that was published over a period of four years (1914-1917) in the weekly Hawaiian-language newspaper *Ka Hōkū o Hawaiʻi*. The narratives were primarily recorded for the paper by Hawaiian historians John Wise and J.W.H.I. Kihe.

While "*Ka-Miki*" is not an ancient account, the authors used a mixture of local stories, tales, and family traditions in association with place names to tie together fragments of site-specific histories that had been handed down over the generations. Also, while the personification of individuals and their associated place names may not be entirely "ancient," such place name-person accounts are common throughout Hawaiian (and Polynesian) traditions. The English translations below are a synopsis of the Hawaiian texts, with emphasis upon the main events and areas being discussed. Diacritical marks and hyphenation have been placed to help with pronunciation of certain words.

"Kaao Hooniua Puuwai no Ka-Miki" (The Heart stirring Story of Ka-Miki)

This *moʻolelo* (tradition) is set in the 1300s (by association with the chief Pili-a-Kaʻaiaea), and is an account of two supernatural brothers, Ka-Miki (The quick, or adept, one) and Ma-Kaʻiole (Rat [squinting] eyes). The narratives describe the birth of the brothers, their upbringing, and their journey around the island of Hawaiʻi along the ancient *ala loa* and *ala hele* (trails and paths) that encircled the island. During their journey, the brothers competed alongside the trails they traveled, and in famed *kahua* (contest fields) and royal courts, against *ʻōlohe* (experts skilled in fighting or in other competitions, such as running, fishing, debating, or solving riddles, that were practiced by the ancient Hawaiians). They also challenged priests whose dishonorable conduct offended the gods of ancient Hawaiʻi. Ka-Miki and Ma-Kaʻiole were empowered by their ancestress Ka-uluhe-nui-hihi-kolo-i-uka (The great entangled growth of uluhe fern which spreads across the uplands), who was one of the myriad of body forms of the goddess Haumea, the earth-mother, creative force of nature who was also called Papa or Hina. Among her many nature-form attributes were manifestations that caused her to be called upon as a goddess of priests and competitors (people, places named for them, and other place names are marked below with underlining):

> …Kūmua was the husband of Ka-uluhe-nui-hihi-kolo-i-uka. The place that is named for Kūmua is in the uplands of Kohanaiki, an elevated rise from where one can look towards the lowlands. The shore and deep sea are all clearly visible from this place. The reason that Kūmua dwelt there was so that he could see the children and grandchildren of he and his wife.
>
> Wailoa, a daughter, was the mother of Kapaʻihilani, also called Kapaʻihi. There is a place in the uplands of Kohanaiki, below Kūmua, to the northwest, a hidden water hole, that is called Kapaʻihi. Wailoa is a pond there on the shore of Kohanaiki. Because Wailoa married Kahunakalehu, a native of the area, she lived and worked there. Thus the name of that pond is Wailoa, and it remains so to this day.
>
> Pipipiʻapoʻo was another daughter of Kūmua and Ka-uluhe-nui-hihi-kolo-i-uka. She married Haleolono, one who cultivated sweet potatoes upon the ʻilima covered flat lands of Nānāwale, also called Nāhiʻahu (Nāwahʻiahu), as it has been called from before and up to the present time. Cultivating the land was the skill of this youth Haleolono, and because he was so good at it, he was able to marry the beauty, Pipipiʻapoʻo.
>
> Pipipiʻapoʻo's skill was that of weaving pandanus mats, and there are growing many pandanus trees there, even now. The grove of pandanus trees and a nearby cave, is called Pipipiʻapoʻo to this day, and you may ask the natives of Kohanaiki to point it out to you.
>
> Kapukalua was a son of Kūmua and Kaʻuluhe. He was an expert at aku lure fishing, and all

> other methods of fishing of those days gone by. He married Kauhiʻonohua a beauty with skin as soft as the blossoms of the hīnano, found in the pandanus grove of ʻOʻoma. This girl was pleasingly beautiful, and because of her fame, Kapukalua, the exceptionally skilled son of the sea spray of ʻApoʻula, secured her as his wife. Here, we shall stop speaking of the elders of Ka-Miki… [January 8, 1914]

The tradition continues, recounting the training of the brothers, and preparations of their *hālau aliʻi* (royal compound) at Kohanaiki. At the dedication ceremonies it was revealed that one of the *kahuna* of the Kaha lands, had taken up the habit of killing people, and that he had also thought to take the lives of Ka-Miki and Ma-Kaʻiole. We revisit the story here, and learn the name of a priest of ʻOʻoma and Kohanaiki—

> …The sun broke forth and the voices of the roosters and the ʻelepaio of the forests were heard resonating and rising upon the mountain slopes. The day became clear, with no clouds to be seen, it was calm. So too, the ocean was calm and the shore of Laʻi a ʻEhu (Kona) was calm. The flowers of the upland forest reddened and unfolded, and nodded gently in the kēhau breezes.
>
> The priests gathered together to discuss these events and prepared to apologize to the children of the chief, asking for their forgiveness. They selected ʻElepaio, Pūhili, Kaluaʻōlapa, and Kalua-ʻōlapa-uwila to go before the brothers for this purpose.
>
> ʻElepaio was the high priest of Honokōhau. The place where he dwelt bears the name ʻElepaio [an ʻili on the boundary of Honokōhau nui & iki]. It is in the great grove of *ʻulu (kaulu ʻulu)* on the boundary between Honokōhau-nui and Honokōhau-iki… [April 23, 1914]
>
> Pūhili was the high priest of ʻOʻoma and Kohanaiki, the place where he lived is on the plain of Kohanaiki, at the shore, and bears his name to this day. It is on the boundary between Kohanaiki and ʻOʻoma.
>
> Kaluaʻōlapa was the high priest of Haleʻōhiʻu and Kamāhoe, that is the waterless land of Kalaoa (Kalaoa wai ʻole). The place where he lived was in the uplands of Maulukua on the plain covered with *ʻilima* growth. This place bears his name to this day.
> Kalua-ʻōlapa-uwila was the high priest of Kealakehe and Keʻohuʻolu (Keahuolu), and it was he who built the *heiau* named Kalua-ʻōlapa-uwila, which is there along the shore of Kealakehe, next to the road that goes to Kailua. The nature of this priest was that of a shark and a man. The shark form was named Kaiwi, and there is a stone form of the shark that can be seen near the *heiau* to this day.
>
> These priests all went to the door of the house and presented the offerings of the black pig, the red fish, the black *ʻawa*, the white rooster, the *malo* (loin clothes), and all things that had been required of their class of priests. They also offered their prayers and asked forgiveness for their misspoken words. They then called for their prayers to be freed and the *kapu* ended… [April 30, 1914]

Through the 1920s, up to the time of his death in 1929, J.W.H.I. Kihe continued to submit traditional accounts and commentary on the changing times to the paper, *Ka Hōkū o Hawaiʻi*. In 1923, Kihe penned a series of articles, some of which formed the basis of Eliza Maguire's *Kona Legend*s (1926). One of the accounts, "*Ka Punawai o Wawaloli*" (The Pond of Wawaloli), describes that the pond of Wawaloli, on the shore of ʻOʻoma, was named for a supernatural ocean being, who could take the form of the *loli* (sea cucumber) and of a handsome young man. Through this account it is learned that people regularly traveled between the uplands and shore of ʻOʻoma; the *kula* lands were covered with *ʻilima* growth; and that a variety of fish, seaweeds, and shellfish were harvested along the shore. Also, the main figures in the tradition are memorialized as places on the lands of ʻOʻoma, Kalaoa, and neighboring *ahupuaʻa*. These individuals and places include Kaluaʻōlapa (a hill on the boundary of Hāmanamana and Haleohiʻu), Wawaloli (a bay between ʻOʻoma and Kalaoa), Hoʻohila

(on the boundary of Kaū and Puʻukala), Pāpaʻapoʻo (a cave site in Hāmanamana), Kamakaoiki and Malumaluiki (locations unknown). The following narratives were translated by Kepā Maly from the original Hawaiian texts published in *Ka Hōkū o Hawaiʻi* (September 23rd, October 4th & 11th, 1923):

Ka Punawai o Wawaloli (The Pond of Wawaloli)

The place of this pond (Wawaloli) is set there on the shore of ʻOʻoma near Kalaoa. It is a little pond, and is there to this day. It is very close to the sandy shore, and further towards the shore there is also a pond in which one can swim. There is a tradition of this pond that is held dearly in the hearts of the elders of this community.

Wawaloli is the name of a loli (sea cucumber) that possessed dual body forms (kino pāpālua), that of a loli, and that of a man!

Above there on the ʻilima covered flat lands, there lived a man by the name of Kaluaʻōlapa and his wife, Kamakaoiki, and their beautiful daughter, Malumaluiki.

One day the young maiden told her mother that she was going down to the shore to gather limu (seaweeds), ʻōpihi (limpets), and pupu (shellfish). Her mother consented, and so the maiden traveled to the shore. Upon reaching the shore, Malumaluiki desired to drink some water, so she visited the pond and while she was drinking she saw a reflection in the rippling of the water, standing over her. She turned around and saw that there was a handsome young man there, with a smile upon his face. He said… [September 27, 1923] "…Pardon me for startling you here as we meet at this pond, in the afternoon heat which glistens off of the pāhoehoe."

She responded, "What is the mistake of our meeting, you are a stranger, and I am a stranger, and so we have met at this pond." The youth, filled with desire for the beautiful young maiden, answered "I am not a stranger here along this shore, indeed, I am very familiar with this place for this is my home. And when I saw you coming here, I came to meet you."

These two strangers, having thus met, then began to lay out their nets to catch kala, uhu, and pālani, the native fish of this land. And in this way, the beauty of the plains of Kalaoa was caught in the net of the young man who dwelt in the sea spray of ʻOʻoma.

These two strangers of the long day also fished for hīnālea, and then for kawaleʻā. It was during this time, that their lines became entangled like those of the fishermen of Wailua (a poetic reference to those who become entangled in a love affair).

The desire for the limu, ʻōpihi, and pūpū was completely forgotten, and the fishing poles bent as the lines were pulled back in the sea spray. The handsome youth was moistened in the rains that fell, striking the land and the beloved shore of the land. The sun drew near, entering the edge of the sea and was taken by Lehua Island. Only then did these two fishers of the long day take up their nets.

Before the young maiden began her return to the uplands, she told the youth, "Tell me your name." He answered her, "The name by which I am known is Wawa. But my name, when I go and dwell in the pond here, is Loli. And when you return, you may call to me with the chant:

E Loli nui kīkewekewe[2]	*Oh great Loli moving back and forth*
I ka hana ana kīkewekewe	*Doing your work moving back and forth*
I kuʻu piko kīkewekewe	*You are in my mind moving back and forth*

[2] "Kīkewekewe" is translated by Eliza Maguire (1926) as "charmer." Kepā Maly was unfamiliar with this meaning of the word. It is most commonly used in the refrain of a song, and is here translated as "moving back and forth," as the word is used in the spoken language. Kewe also means concave, similar to the place name ʻOʻoma.

A ka makua kīkewekewe	*The parents moving back and forth*
I hana ai kīkewekewe	*Are at their work moving back and forth*
E pi‘i mai ‘oe kīkewekewe	*Won’t you arise moving back and forth*
Ka kaua puni kīkewekewe	*To that which we two desire moving back and forth*
Puni kauoha kīkewekewe	*Your command is desired moving back and forth*

Having finished their conversation, the maiden then went to the uplands. It was dark, and the kukui lamps had been lit in the house. Malumaluiki’s parents asked her, “Where are your limu, ‘ōpihi and pūpū?” She replied, “It is proper that you have asked me, for when I went to the shore it was filled with people who took all there was? Thus I was left with nothing, not even a fragment of limu or anything else. So I have returned up here.”

Well, the family meal had been made ready, so they all sat to eat together. But after a short while the maiden stood up. Her parents inquired of this, and she said she was no longer hungry, and that her feet were sore from traveling the long path. So the maiden went to sleep. She did not sleep well though, and felt a heat in her bosom, as she was filled with desire, thus she had no sleep that night.

With the arrival of the first light of day, the Malumaluiki went once again down to the shore. Upon arriving at the place of the pond, she entered the water and called out as described above. Then, a loli appeared and turned into the handsome young man. They two then returned to their fishing for the kala, uhu and pālani, the native fish the land.

So it was that the two lovers met regularly there on the shore of ‘O‘oma. Now Malumaluiki’s parents became suspicious because of the actions of the daughter, and her regular trips to the shore. So they determined that they should secretly follow her and spy on her.

One day, the father followed her to the shore, where he saw his daughter sit down by the side of the pond. He then heard her call out —

E Loli nui kīkewekewe	*Oh great Loli moving back and forth*
I ka hana ana kīkewekewe	*Doing your work moving back and forth*
I ku‘u piko kīkewekewe	*You are the center of my life moving back and forth*
Piko maika‘i kīkewekewe	*It is good moving back and forth*
A ka makua kīkewekewe	*The parents moving back and forth*
I hana ai kīkewekewe	*Are at their work moving back and forth*
E pi‘i mai ‘oe kīkewekewe	*Won’t you arise moving back and forth*
Ka kaua puni kīkewekewe	To that which we two desire *moving back and forth*
Puni kauoha kīkewekewe	*Your command is desired moving back and forth*
[October 4, 1923]	

“O Loli, here is your desire, the one you command, Malumaluiki, who’s eyes see nothing else.”

Her father then saw a loli coming up from the pond, and when it was up, it turned into the youth. He watched the two for a while, unknown to them, and saw that his daughter and the youth of the two body forms (kino pāpālua), took their pleasure in one another.

The father returned to the uplands and told all of this to her mother, who upon hearing it, was filled with great anger, because of the deceitfulness of her daughter. But then she learned that the man with whom her daughter slept was of dual body forms. Kamakaoiki then told Kalua‘ōlapa that he should “Go down and capture the loli, and beat it to death,” to which he agreed.

> One day, Kaluaʻōlapa went down early, and hid, unseen by the two lovers. Malumaluiki arrived at the pond and called out, and he then memorized the lines spoken by his daughter. When she left, returning to the uplands, he then went to the pond and looked closely at it. He then saw a small circular opening near the top of the water in the pond. He then understood that that was where the loli came up from. He then slept that night and in the early morning, he went to the pond and set his net in the water. He then began to call out as his daughter had done with the above words.
>
> When he finished the chant, the loli began to rise up through the hole, and was ensnared in the net. Kaluaʻōlapa then carried him up onto the kula, walking to the uplands. On his way, he saw his daughter coming down, and he hid until she passed him by.
>
> When the daughter arrived at the pond, she called out in the chant as she always did. She called and called until the sun was overhead, but the loli did not appear in the pond, nor did he come forward in his human form. Thus, she thought that he had perhaps died, and she began to wail and mourn for the loss of her lover. Finally as evening came, the beautiful maiden stood, and ascended the kula to her home.
>
> Now, let us look back to the Kaluaʻōlapa. He went up to his house and showed the loli to his wife. Seeing the loli, she told her husband, "Take it to the kahuna, Pāpaʻapoʻo who lives on the kula of Hoʻohila." So he went to the kahuna and explained everything that had occurred to him, and showed him the loli in his net. Seeing this and hearing of all that had happened, Pāpaʻapoʻo told the father to build an imu in which to kālua the great loli that moves back and forth (loli kīkewekewe). He said, "When the loli is killed, then your daughter will be well, so too will be the other daughters of the families of the land." Thus, the imu was lit and the supernatural loli cooked.
>
> When the daughter returned to her home, her eyes were all swollen from crying. Her mother asked her, "What is this, that your eyes are puffy from crying, my daughter?" She didn't answer, she just kneeled down, giving no response. At that time, her father returned to the house and saw his daughter kneeling down, and he said "Your man, with whom you have been making love at the beach has been taken by the kahuna Pāpaʻapoʻo. He has been cooked in the imu that you may live, that all of the girls who this loli has loved may live."
>
> That pond is still there on the shore, and the place with the small round opening is still on the side of that pond to this day. It is something to remember those things of days gone by, something that should not be forgotten by those of today and in time to come. [October 11, 1923]

Ka Loko o Paaiea (The fishpond of Pāʻaiea)

The tradition of *Ka loko o Paaiea* (The fishpond of Pāʻaiea) was written by J.W.H.I. Kihe, and printed in *Ka Hōkū o Hawaiʻi* in 1914 and 1924. The narratives describe traditional life and practices in various *ahupuaʻa* of Kekaha, and specifically describes the ancient fishpond Pāʻaiea. The following excerpts from Kihe's *moʻolelo*, include references to Wawaloli, on the shore of ʻOʻoma and Kalaoa. Pāʻaiea, was destroyed by the Hualālai lava flows of 1801, reportedly as a result of the pond overseer's refusal to give the goddess Pele—traveling in human form—any fish from the pond:

> Pāʻaiea was a great fishpond, something like the ponds of Wainānāliʻi and Kīholo, in ancient times. At that time the high chiefs lived on the land, and these ponds were filled with fat awa, ʻanae, āhole, and all kinds of fish that swam inside. It is this pond that was filled by the lava flows and turned into pāhoehoe, that is written of here. At that time, at Hoʻonā. There was a Konohiki (overseer), Kepaʻalani, who was in charge of the houses (hale papaʻa) in which the valuables of the King [Kamehameha I] were kept. He was in charge of the King's food supplies, the fish, the hālau (long houses) in which the fishing canoes were kept, the fishing nets and all things. It was from there that the King's fishermen and the retainers were provisioned. The houses of the pond guardians and Konohiki were situated at Kaʻelehuluhulu and Hoʻonā.

> In the correct and true story of this pond, we see that its boundaries extended from Kaʻelehuluhulu on the north, and on the south, to the place called Wawaloli (between ʻOʻoma and Kalaoa). The pond was more than three miles long and one and a half miles wide, and today, within these boundaries, one can still see many water holes.
>
> While traveling in the form of an old woman, Pele visited the Kekaha region of Kona, bedecked in garlands of the *koʻokoʻolau* (*Bidens* spp.). Upon reaching Pāʻaiea at Hoʻonā, Pele inquired if she might perhaps have an *ʻamaʻama*, young *āholehole*, or a few *ʻōpae* (shrimp) to take home with her. Kepaʻalani, refused, "they are *kapu*, for the King." Pele then stood and walked along the *kuapā* (ocean side wall) of Pāʻaiea till she reached Kaʻelehuluhulu. There, some fishermen had returned from aku fishing, and were carrying their canoes up onto the shore…
>
> …Now because Kepaʻalani was stingy with the fishes of the pond Pāʻaiea, and refused to give any fish to Pele, the fishpond Pāʻaiea and the houses of the King were all destroyed by the lava flow. In ancient times, the canoe fleets would enter the pond and travel from Kaʻelehuluhulu to Hoʻonā, at Uaʻuʻālohi, and then return to the sea and go to Kailua and the other places of Kona. Those who traveled in this manner would sail gently across the pond pushed forward by the *ʻEka* wind, and thus avoid the strong currents which pushed out from the point of Keāhole
>
> It was at Hoʻonā that Kepaʻalani dwelt, that is where the houses in which the chiefs valuables (*hale papaʻa*) were kept. It was also one the canoe landings of the place. Today, it is where the light house of America is situated. Pelekāne (in Puʻukala) is where the houses of Kamehameha were located, near a stone mound that is partially covered by the *pāhoehoe* of Pele. If this fishpond had not been covered by the lava flows, it would surely be a thing of great wealth to the government today… [J.W.H.I. Kihe in *Ka Hoku o Hawaii*; compiled and translated by Kepā Maly, from the narratives written February 5-26, 1914 and May 1-15, 1924].

Na Hoʻomanao o ka Manawa (The Recollections of a Native Son)

Later in 1924, Kihe, described the changes which had occurred in the Kekaha region since his youth. In the following article, titled *Na Hoʻomanao o ka Manawa* (in *Ka Hōkū o Hawaiʻi* June 5th & 12th 1924), Kihe wrote about the villages that were once inhabited throughout Kekaha, identifying families, practices, and schools of the historic period (ca. 1860-1924). In the two part series (translated by Kepā Maly), he also shared his personal feelings about the changes that had occurred, including the demise of the families and the abandonment of the coastal lands of Kekaha.

> There has arisen in the mind of the author, some questions and thoughts about the nature, condition, living, traveling, and various things that bring pleasure and joy. Thinking about the various families and the many homes with their children, going to play and strengthening their bodies.
>
> In the year 1870, when I was a young man at the age of 17 years old, I went to serve as the substitute teacher at the school of Honokōhau. I was teaching under William G. Kanakaʻole who had suffered an illness (maʻi-lolo, a stroke).
>
> In those days at the Hawaiian Government Schools, the teachers were all Hawaiian and taught in the Hawaiian language. In those days, the students were all Hawaiian as well, and the books were in Hawaiian. The students were all Hawaiian… There were many, many Hawaiian students in the schools, no Japanese, Portuguese, or people of other nationalities. Everyone was Hawaiian or part Hawaiian, and there were only a few part Hawaiians.

The schools included the school house at Kīholo where Joseph W. Keala taught, and later J.K. Kaʻailuwale taught there. At the school of Makalawena, J. Kaʻelemakule Sr., who now resides in Kailua, was the teacher. At the Kalaoa School, J.U. Keaweʻake was the teacher. There were also others here, including myself for four years, J. Kainuku, and J.H. Olohia who was the last one to teach in the Hawaiian language. At Kaloko, Miss Kaʻaimahuʻi was the last teacher before the Kaloko school was combined as one with the Honokōhau school where W.G. Kanakaʻole was the teacher. I taught there for two years as well... [Kihe includes additional descriptions on the schools of Kona]

It was when they stopped teaching in Hawaiian, and began instructing in English, that significant changes took place among our children. Some of them became puffed up and stopped listening to their parents. The children spoke gibberish (English) and the parents couldn't understand (*nā keiki namu*). Before that time, the Hawaiians weren't marrying too many people of other races. The children and their parents dwelt together in peace with the children and parents speaking together… [June 5, 1924]

…Now perhaps there are some who will not agree with what I am saying, but these are my true thoughts. Things which I have seen with my own eyes, and know to be true…In the year 1870 when I was substitute teaching at Honokōhau for W.G. Kanakaʻole, I taught more than 80 students. There were both boys and girls, and this school had the highest enrollment of students studying in Hawaiian at that time [in Kekaha]. And the students then were all knowledgeable, all knew how to read and write.

Now the majority of those people are all dead. Of those things remembered and thought of by the people who yet remain from that time in 1870; those who are here 53 years later, we cannot forget the many families who lived in the various (*ʻāpana*) land sections of Kekaha.

From the lands of Honokōhau, Kaloko, Kohanaiki, the lands of ʻOʻoma, Kalaoa, Haleʻohiʻu, Makaʻula, Kaū, Puʻukala-ʻŌhiki, Awalua, the lands of Kaulana, Mahaiʻula, Makalawena, Awakeʻe, the lands of Kūkiʻo, Kaʻūpūlehu, Kīholo, Keawaiki, Kapalaoa, Puʻuanahulu, and Puʻuwaʻawaʻa. These many lands were filled with people in those days.

There were men, women, and children, the houses were filled with large families. Truly there were many people [in Kekaha]. I would travel around with the young men and women in those days, and we would stay together, travel together, eat together, and spend the nights in homes filled with aloha.

The lands of Honokōhau were filled with people in those days, there were many women and children with whom I traveled with joy in the days of my youth. Those families are all gone, and the land is quiet. There are no people, only the rocks remain, and a few scattered trees growing, and only occasionally does one meet with a man today [1924]. One man and his children are all that remain.

Kaloko was the same in those days, but now, it is a land without people. The men, the women, and the children are all gone, they have passed away. Only one man, J.W. Haʻau, remains. He is the only native child (keiki kupa) besides this author, who remains.

At Kohanaiki, there were many people on this land between 1870 and 1878. These were happy years with the families there. In those years Kaiakoili was the haku ʻāina (land overseer)...

Now the land is desolate, there are no people, the houses are quiet. Only the houses remain standing, places simply to be counted. I dwelt here with the families of these homes. Indeed it was here that I dwelt with my kahu hānai (guardian), the one who raised me. All these families were closely related to me by blood. On my fathers' side, I was tied to the families of Kaloko [J.W.H.I. Kihe's father was Kihe, his grandfather was Kuapāhoa, a noted kahuna of Kaloko]. I am a native of these lands.

> The lands of ‘O‘oma, and Kalaoa, and all the way to Kaulana and Mahai‘ula were also places of many people in those days, but today there are no people. At Mahai‘ula is where the great fishermen of that day dwelt. Among the fishermen were Po‘oko‘ai mā, Pā‘ao‘ao senior, Ka‘ao mā, Kai‘a mā, Ka‘ā‘īkaula mā, Pāhia mā, and John Ka‘elemakule Sr., who now dwells at Kailua.
>
> Ka‘elemakule moved from this place [Mahai‘ula] to Kailua where he prospered, but his family is buried there along that beloved shore (kapakai aloha). He is the only one who remains alive today… At Makalawena, there were many people, men, women, and their children. It was here that some of the great fishermen of those days lived as well. There were many people, and now, they are all gone, lost for all time.
>
> Those who have passed away are Kaha‘iali‘i mā, Mama‘e mā, Kapehe mā, Kauaionu‘uanu mā, Hopulā‘au mā, Kaihemakawalu mā, Kaomi, Keoni Aihaole mā, and Pahukula mā. They are all gone, there only remains the son-in-law of Kauaionu‘uanu, J.H. Mahikō, and Jack Punihaole, along with their children, living in the place where Kauaionu‘uanu and Ahu once lived.
>
> At Kūki‘o, not one person remains alive on that land, all are gone, only the ‘a‘ā remains. It is the same at Ka‘ūpūlehu, the old people are all gone, and it is all quiet… [June 12, 1924]

Ko Keoni Kaelemakule Moolelo Ponoi – Kakau ponoi ia mai no e ia (The True Story of John Ka‘elemakule – Actually written by him[3])

In the period between 1928 and 1930, John Ka‘elemakule Sr., who was a native of Kekaha, living at Mahai‘ula, Kaulana and Kohanaiki, wrote a series of articles that were published in serial form in *Ka Hōkū o Hawai‘i*. The story is a rich account of life in Kekaha between 1854 and 1900. Ka‘elemakule’s texts introduce us to the native residents of Kekaha, and include descriptions of the practices and customs of the families who resided there. In the following excerpts from Ka‘elemakule’s narratives (translated by Kepā Maly), we find reference once again to ‘O‘oma and neighboring lands, and the practices associated with procuring water in this region:

> *“Kekaha Wai Ole o na Kona”* (Waterless Kekaha of Kona)
>
> …We have seen the name “Kekaha wai ole o nā Kona” since the early part of my story in *Ka Hōkū o Hawai‘i*, and we have also seen it in the beautiful tradition of Mākālei. An account of the boy who dwelt in the uplands of Kekaha wai ‘ole, that was told by Ka-‘ohu-ha‘aheo-i-nā-kuahiwi-‘ekolu [the penname used by J.W.H.I. Kihe]. I think that certain people may want to know the reason and meaning of this name. So it is perhaps a good thing for me to explain how it came about. The source of it is that in this land of Kekaha even in the uplands, between Kaulana in the north and ‘O‘oma in the south, there was no water found even in the ancient times. For a little while, I lived in the uplands of Kaulana, and I saw that this land of Kekaha was indeed waterless.
>
> The water for bathing, washing one’s hands or feet, was the water of the banana stump (*wai pūma‘ia*). The *pūmai‘a* was grated and squeezed into balls to get the juice. The problem with this water is that it makes one itchy, and one does not really get clean. There were not many water holes, and the water that accumulated from rain dried up quickly. Also there would be weeks in which no rain fell… The water which the people who lived in the

[3] This account was published in serial form in the Hawaiian newspaper *Ka Hōkū o Hawai‘i*, from May 29, 1928 to March 18, 1930. The translated excerpts in this section include narratives that describe Mahai‘ula and nearby lands in Kekaha with references to families, customs, practices, ceremonial observances, and sites identified in text. The larger narratives also include further detailed accounts of Ka‘elemakule’s life, and business ventures. A portion of the narratives pertaining to fishing customs (November 13, 1928 to March 12, 1929), and canoeing practices (March 19 to May 21, 1929) were translated by M. Kawena Pukui, and may be viewed in the Bishop Museum-Hawaiian Ethnological Notes (BPBM Archives).

uplands of Kekaha drank, was found in caves. There are many caves from which the people of the uplands got water… [September 17, 1929:3]

…The *kūpuna* had very strict *kapu* (restrictions) on these water caves. A woman who had her menstrual cycle could not enter the caves. The ancient people kept this as a sacred *kapu* from past generations. If a woman did not know that her time was coming and she entered the water cave, the water would die, that is, it would dry up. The water would stop dripping. This was a sign that the *kapu* of Kāne-of-the-water-of-life (Kaneikawaiola) had been desecrated. Through this, we learn that the ancient people of Kekaha believed that Kāne was the one who made the water drip from within the earth, even the water that entered the sea from the caves. This is what the ancient people of Kekaha wai ʻole believed, and there were people who were *kiaʻi* (guardians) who watched over and cleaned the caves, the house of Kāne… [September 24, 1929:3]

When the *kapu* of the water cave had been broken, the priest was called to perform a ceremony and make offerings. The offerings were a small black pig; a white fish, and *āholehole*; young taro leaves; and *awa*. When the offering was prepared, the priest would chant to Kane:

E Kane i uka, e Kane i kai,	*O Kane in the uplands, O Kāne at the shore,*
E Kane i ka wai, eia ka puaa,	*O Kane in the water, here is the pig,*
Eia ka awa, eia ka luau,	*Here is the ʻawa, here are the taro greens,*
Eia ka ia kea.	*Here is the white fish.*

Then all those people of the uplands and coast joined together in this offering, saying:

He mohai noi keia ia oe e Kane,	*This is a request offering to you o Kāne,*
E kala i ka hewa o ke kanaka i hana ai,	*Forgive the transgression done by man,*
A e hoomaemae i ka hale wai,	*Clean the water house (source),*
A e hoonui mai i ka wai o ka hale,	*Cause the water to increase in the house,*
I ola na kanaka,	*That the people may live,*
Na ohua o keia aina wai ole.	*Those who are dependent on this waterless land.*
Amama.	*It is finished…*

[October 1, 1929:3; Kepā Maly, translator]

It is not surprising today, when we hear of caves in which cultural materials are found. Along trails, near residences, and in once remote areas, a wide range of uses occurred. Caves in the Kekaha lands were used to store items, keep planting shoots cool and fresh for the next season, to hide or take shelter in, to catch water, and as burial sites.

Land Tenure in ʻOʻoma and Vicinity

Through the traditions and early historical accounts cited above, we see that there are descriptions of early residences and practices of the native families on the lands of ʻOʻoma and within greater Kekaha. Importantly, we find chiefly associations with the land of ʻOʻoma 2nd, as documented by the residency of the chiefs Kaikioʻewa, Keaweamahi, their families and retainers, while they were serving as the guardians of the young king, Kauikeaouli (Kamehameha III in ca. 1813-1818; Kamakau 1961 and Gov. Kapeau, 1847 in this study). Among the earliest government records documenting residency in ʻOʻoma and vicinity, are those of the *Māhele ʻĀina* (Land Division), Interior and Taxation Departments, Roads and Public Works, and the Government Survey Division.

This section of the study describes land tenure (residency and land use) and identifies families associated with ʻOʻoma and it's neighboring lands. The documentation is presented in chronologically within the following subsections, The *Māhele ʻĀina* (1848): Disposition of ʻOʻoma, Land Grants in ʻOʻoma and Vicinity (1855-1864), The Government Homesteading Program in Kekaha, Field Surveys of J.S. Emerson (1882-1889), and Trails and Roads of Kekaha (Governmental Communications).

A review of the records below reveals that none of the claims by native tenants made during the *Māhele*, or any of the applications for Royal Patent Grants, included lands that are a part of the current development area.

The *Māhele ʻĀina* (1848): Disposition of ʻOʻoma

In Precontact Hawaiʻi, all land, ocean, and natural resources were held in trust by the high chiefs (*aliʻi ʻai ahupuaʻa* or *aliʻi ʻai moku*). The use of land, fisheries and other resources were given to the *hoaʻāina* (native tenants) at the prerogative of the *aliʻi* and their representatives or land agents (*konohiki*), who were considered lesser chiefs. By 1845, the Hawaiian system of land tenure was being radically altered, and the foundation for implementing the *Māhele ʻĀina* was set in place, system of fee-simple right of ownership.

As the *Māhele* evolved, it defined the land interests of Kauikeaouli (King Kamehameha III), some 252 high-ranking *Aliʻi* and *Konohiki*, and the Government. As a result of the *Māhele*, all land in the Kingdom of Hawaiʻi came to be placed in one of three categories: (1) Crown Lands (for the occupant of the throne); (2) Government Lands; and (3) *Konohiki* Lands (cf. Indices of Awards 1929). The "Enabling" or "*Kuleana Act*" of the *Māhele* (December 21, 1849) further defined the frame work by which *hoaʻāina* (native tenants) could apply for, and be granted fee-simple interest in "*Kuleana*" lands (cf. Kamakau in *Ke Au Okoa* July 8 & 15, 1869; 1961:403-403). The *Kuleana Act* also reconfirmed the rights of *hoaʻāina* to access, subsistence and collection of resources necessary to their life upon the land in their given *ahupuaʻa* ("Enabling Act"[4], August 6, 1850 – HSA DLNR 2-4).

In the *Buke Kakau Paa no ka Mahele Aina* (Land Division Book), between Kamehameha III and his supporters, we learn that by the time of the *Māhele ʻĀina*, ʻOʻoma was divided into two *ahupuaʻa*, ʻOʻoma 1st and 2nd. ʻOʻoma 1st was claimed by Moses Kekūāiwa (brother of Kamehameha IV and V, and Victoria Kamāmalu), one of the children of Kīnaʻu and M. Kekūanaoʻa, thus, a grandson of Kamehameha I. ʻOʻoma 2nd was held by Kamehameha III (*Buke Māhele*, January 27, 1848:13-14). On March 8, 1848, Kamehameha III assigned his interest in ʻOʻoma 2nd to the Government land inventory (*Buke Māhele*, 1848:183).

Moses Kekūāiwa died on November 24, 1848, and his father, Mataio Kekūanaoʻa, administrator of the estate, relinquished in commutation, his rights to ʻOʻoma 1st, giving the land over to the Government land inventory (Foreign Testimony Volume 3:408). Thus, both ʻOʻoma 1st and 2nd were assigned to the Government Land inventory (Government Lands - Indices of Awards 1929:10).

In 2000, Kumu Pono Associates digitized the entire collection of handwritten records from the *Māhele ʻĀina*. Most of the records are in the Hawaiian language. An extensive review of all the records identifies only one native tenant who filed a claim of residency and land use in ʻOʻoma during the *Māhele*. The claim—*Helu* 9162, by Kahelekahi—was not awarded, and except for an entry in Native Register Volume 8 (Figure 5), there is no further record of the claim. Below, is a copy of the original Hawaiian text from the Native Register. The account is of particular interest as Kahelekahi reported that in 1848, he was the only resident in ʻOʻoma:

[4] See also *"Kanawai Hoopai Karaima no ko Hawaii Pae Aina"* (Penal Code) 1850.

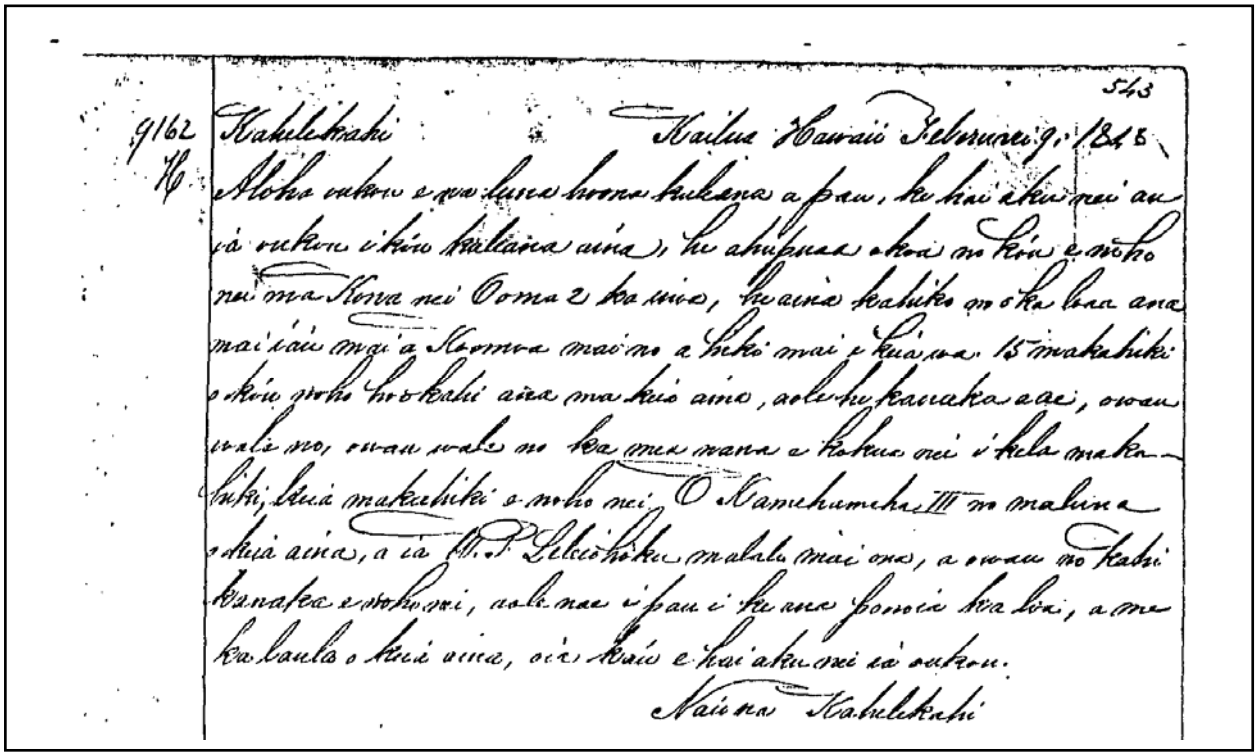

Figure 5. Copy of Native Register Vol. 8:543 Helu 9162, claim of Kahelekahi for *kuleana* at ‘O‘oma.

Kahelekahi – Helu 9162
Kailua, Hawaii February 9, 1848

Greetings to all of you commissioner who quiet land titles, I hereby tell you of my claim for land. I have an entire ahupuaa situated there in Kona, it’s name is Ooma 2. It is an old land gotten by me from Koomoa, and held to this time. For 15 years, I have been the only one residing on this land, there are no other people, only me. I am the only one, there is no one living here to help from one year to the next year. Kamehameha III is the one above, who has this land, and W.P. Leleiohoku is below him, and I am the one man dwelling there. The survey of the length and width of this land is not accurately completed. That is what I have to tell you.

Done by me, Kahelekahi
[Native Register Vol. 8:543; translated by Kepā Maly]

In 1849, S. Haanio, Tax Assessor of North Kona, submitted a report to the Board of Education regarding those individuals who were subject to the Tuesday Tax Laws (*Poalua*), to be worked as a part of the School Tax requirements of the time. At the time of Haanio’s report, three individual families were identified as residents of ‘O‘oma. Residents in the neighboring lands of Kalaoa and Kohanaiki were also listed, they were:

Kalaoa: 1. Kila, 2. Piena, 3. Nakuala, 4. Kupono, 5. Loa, 6. Kaeha, 7. Keliipuipui, 8. Kapuolokai, 9. Kaainoa, 10. Paina, 11. Kalimaonaona, 12. Kaikeleaukai, 13. Kanahele, 14. Kukaani, 15. Kupuai, and 16. Helekahi[5]

Ooma: 1. Kalua, 2. Kamaka and 3. Mamali

Kohanaiki: 1. Hulikoa, 2. Kaoeno, 3. Honolii and 4. Awa [HSA – Series 262, Hawaii 1849].

[5] Helekahi or Kahelekahi – the one who made a claim for a *kuleana* in ‘O‘oma during the Māhele (Helu 9162).

Unfortunately, there is no indication of where Kalua, Kamaka, and Mamali were living in ʻOʻoma at the time. Based on traditional patterns of residency in the region, it is likely that they had primary residences in the uplands, near sheltered *māla ʻai* (agricultural fields), and kept near shore residences for seasonal fishing, collection of salt, and other resources of the coastal zone. Of the three names given for ʻOʻoma, descendants of the Kalua and Kamaka lines are known to still be residing in the Kekaha region.

Land Grants in ʻOʻoma and Vicinity (1855-1864)

In conjunction with the *Māhele*, the King also authorized the issuance of Royal Patent Grants to applicants for tracts of land, larger than those generally available through the Land Commission. The process for applications was set forth by the "Enabling Act" of August 6, 1850, which set aside portions of government lands for grants.

> Section 4. Resolved that a certain portion of the Government lands in each Island shall be set apart, and placed in the hands of special agents to be disposed of in lots of from one to fifty acres in fee simple to such natives as may not be otherwise furnished with sufficient lands at a minimum price of fifty cents per acre. [HSA – "Enabling Act" Series DLNR 2-4]

The Kingdoms' policy of providing land grants to native tenants was further clarified in a communication from Interior Department Clerk, A. G. Thurston, on behalf of Keoni Ana (John Young), Minister of the Interior; to J. Fuller, Government Land Agent-Kona:

> *February 23, 1852*
> …His Highness the Minister of the Interior instructs me to inform you that he has and does hereby appoint you to be Land Agent for the District of Kona, Hawaii. You will entertain no application for the purchase of any lands, without first receiving some part, say a fourth or fifth of the price; then the terms of sale being agreed upon between yourself and the applicant you will survey the land, and send the survey, with your report upon the same to this office, for the Approval of the Board of Finance, when your sales have been approved you will collect the balance due of the price; upon the receipt of which at this office, the Patent will be forwarded to you.
>
> Natives who have no claims before the Land Commission have no Legal rights in the soil.
>
> They are therefore to be allowed the first chance to purchase their homesteads. Those who neglect or refuse to do this, must remain dependant upon the mercy of whoever purchases the land: as those natives now are who having no kuleanas are living on lands already Patented, or belonging to Konohikis.
>
> Where lands have been granted, but not yet Patented, the natives living on the land are to have the option of buying their homesteads, and then the grant be located, provided this can be done so as not to interfere with them.
>
> No Fish Ponds are to be sold, neither any landing places.
>
> As a general thing you will charge the natives but 50 cents pr. acre, not exceeding 50 acres to any one individual.
>
> Whenever about to survey land adjoining that of private individuals, notice must be given them or their agents to be present and point out their boundaries… [Interior Department Letter Book 3:210-211]

Between 1855 and 1864, at least six applications were made for land in the *ahupuaʻa* of ʻOʻoma, and four of them were patented. The applications were made by:

Grant	Applicant	Land	Acreage	Book and Year
1590	Kauhini	Hamanamana, Kalaoa and Ooma 1	1,816	8:1855 (canceled)
1599	J. Hall	Ooma 2	101.33	8:1855 (canceled)
1600	Kaakau	Ooma 2	58.5	8:1855
2027	Kameheu	Ooma 2	101.33	11:1856 (same area as Grant 1599)
2031	Koanui	Ooma 1	24.5	11:1856
2972	Kaakau & Kama	Kalaoa 5 & Ooma 1	515	14:1864

["Index of all Grants Issued…Previous to March 31, 1886;" 1887]

The grants to Ka'akau and Kameheu in 'O'oma 2nd were patented by 1859, as recorded in the following letter:

April 8, 1859
S. Spencer, Interior Department Clerk;
to Lot Kamehameha, Minister of the Interior;
Lands in Puaa and Ooma 2 in Kona, Hawaii which were sold by the Government Agent:

Royal Patent 1600, Kaakau 58 50/100 acres in Ooma	$29.25
Royal Patent 2027, Kameheu, 101 33/100 acres in Ooma	$38.00

[HSA – Interior Department, Lands]

In the years following issuance of the first Royal Patents in 'O'oma and vicinity, native tenants and others continued to express interest in the lands of 'O'oma and neighboring *ahupua'a*. Applications were made to either lease or purchase portions of the remaining government lands. In 1865, Government Surveyor and Land Agent, S.C. Wiltse, wrote to the Minister of the Interior, describing the condition and status of the lands remaining to the government.

September 5, 1865
S.C. Wiltse, Government Surveyor and Land Agent;
to F.W. Hutchinson, Minister of the Interior.
Kona Hawaii. Government Lands in this District not Sold;
also those Sold and Not Patented:

…"Kalaoa 5th"
Not in the Mahele book but believed to be Gov't. land. This land above the Govt. Road has been sold and Patented. Below the road I have surveyed 515 acres which was sold by Sheldon to "Kaakau" & "Kama" who payed him $165.00. As no valuation was made of this land per acre by Sheldon I afterwards valued it myself as follows, 300 Ac. at 50 cts. per acre, 215 at 25 cts. per Ac. The balance due according to this valuation including Patent was $42.75 which was payed to me in March 1864 and forwarded by me to your office. The survey of this land is in your office. If the payments made are satisfactory, these men would be very glad to get their Patent.

This is a piece of 3rd rate land, used only as goat pasture, no improvements on it. Makai of this survey is about 400 Ac. remaining to the Govt., but of very little value.

"Ooma 1st & 2nd"
The best part of these lands have been sold, there remains to the Govt. the forest part, 2 or 300 Ac., and the makai part some 1500 Ac., about 500 of which is 3rd rate land, the balance rocks.

> "Kohanaiki"
> The forest part of this land is all that remains to the Gov't., this is extensive, extending to the mauka side of the forest. It may contain 1500 to 2000 Ac.
>
> The makai part of this land containing 220 Ac. has been sold both by Sheldon and myself. In April 1863 I was surveying in Kona when "Nahuina" (who lives on the adjoining land of "Kaloko") applied to me to survey the makai part of the Gov't. land Kohanaiki which he wished to purchase. I inquired whether he had applied to Sheldon for this lands (Sheldon was then in Honolulu) he told me that he had not, but would do so immediately, if it was necessary he would go to Honolulu for that purpose. I told him that I was then writing to Sheldon and I would make the application for him which I did, but never got an answer. I wrote several times to him about that time, for information about Gov't. lands, but he declined to answer my letters.
>
> On the 30th of May following, I surveyed said piece of land for "Nahuina." When I was making this survey "Kapena" (who bought this land from Sheldon) was present, and afterwards went to Honolulu and payed Sheldon for this land.
>
> "Nahuina" had the money then to pay for this land, and I told him to keep it until he knew who he was paying it to. I was perfectly satisfied then that Sheldon's transaction as Gov't. land Agt. was not honest. Mr. Sheldon had then been away from Kona nearly three months, he had previous to this resigned his office as Judge and taken up his residence permanently in Honolulu. Afterwards when requested by Mr. S. Spencer to act as land Agt. for Kona, "Nahuina" payed me for this land at 25 cents per Acre. Its only value is for a place for a residence on the beach.
>
> I have been thus particular in giving you the history of this affair, so that you might be able to decide which of the parties were intitled to said land… [HSA – Interior Department, Lands]

Historical records document that the primary use of the *kula* – lowlands in the Kekaha region, was for goat ranching, with limited cattle ranching. Throughout the 1800s, most of the cattle ranching occurred on the *mauka* slopes nearer the old upper government road.

Summary of Land Tenure Described in Grant Records

Grant No.'s 1600 (for Kaakau) and 2031 (for Koanui) are situated on the *mauka* side of the Alanui Aupuni (the Upper Government Road, near present-day Māmalahoa Highway) in ʻOʻoma 2nd and 1st.

Grant No. 1599 (surveyed for Kauhini), was situated across the *kula* lands from Oʻoma 1st in the south, to Hāmanamana, in the north. Communications from the 1880s, indicate that the parcel was never patented, though Kauhini had lived in ʻOʻoma 1st, through the time of his death (before 1888). J.S. Emerson's Register Map No. 1449, identifies a Triangulation Station in ʻOʻoma 1st as "Kauhini." At almost the same time that Kauhini's grant was surveyed, other grants in Kalaoa and ʻOʻoma covering a portion of the area described under Kauhini's grant were patented to Kakau and Kama (Royal Patent Grant No. 2972). In 1888, this confusing situation was brought to the government's attention in a letter from more than 70 native residents of ʻOʻoma and the larger Kekaha region, when the Minister of the Interior was developing homestead lots for applicants (see communications below).

Grant No. 2027 (for Kameheu), situated in ʻOʻoma 2nd, extends from the *makai* edge of the Upper Government Road, to a short distance below the historic Homestead Road between Kaloko and Kalaoa, at about 900 feet above sea level (see Register Map No. 1449).

ʻOʻoma grantee Kaakau (Grant No. 1600), also held an interest in Grant No. 2972 in the land of Kalaoa 5th and ʻOʻoma 1st, which he shared with his relative, Kama. Historic survey records (in Register Maps and Survey

Field Books) do identify "Kama's house" near the Wawaloli pond (Register Map No. 1449) in ʻOʻoma 2nd. The same house is later identified as "Keoki Mao's House" (Register Map No. 1280).

In 1888, government surveyor J.S. Emerson identified Kama as a resident in ʻOʻoma, near the *mauka* government road (see communication below). This Kama is identified in oral history interviews as being an elder of the Kamaka line, from whom the often-mentioned Palakiko Kamaka and others descend. A temporary beach shelter—in the vicinity of "Kama's House" marked near the shore of ʻOʻoma 2nd on Register Maps 1449 and 1280—remained in use by family members at least until the outbreak of World War II (see interviews with Peter Kaikuaana Park, Geo. Kinoulu Kahananui, and Valentine K. Ako).

While no formal awards or grants of land appear to have been made for the near shore *kula* or beach lands, it is logical to assume that families living in the uplands of the ʻOʻoma and Kalaoa-Kohanaiki *ahupuaʻa*, made regular visits to the near shore lands. The practice of continued travel between upland residences and near-shore shelters, is also described by *kūpuna* Peter K. Park, and Elizabeth Lee, who was born and raised in the *mauka* section of ʻOʻoma, and by other *kupuna* from neighboring lands.

No records indicating that the above Royal Patent Grantees had applied for coastal parcels as a part of their original claims were found while conducting the present research. A further review of the *Māhele* records was also made to determine if any of the grant applicants had been *Māhele* claimants (as is sometimes the case). Their names did not appear in the Register or Testimony volumes for the area.

Ka ʻĀina Kaha–(A Native's Perspective)

In 1875, J.P Puuokupa, a native resident of Kalaoa wrote a letter to the editor of the Hawaiian newspaper, *Ku Okoa*, responding to a letter which had been previously published in the paper (written by a visitor to Kona). The first account apparently described the Kekaha region as a hard land that presented many difficulties to the residents. It was also reported that a drought on Hawaiʻi had significantly impacted crop production, and that a "famine" was occurring. Puuokupa, responded to the account and described the situation as he knew it, from living upon the land. His letter is important as it provides us with an explanation as to why people of the region—including ʻOʻoma—lived mostly in the uplands, for it was there that the rich soils enabled residents to cultivate the land and sustain themselves.

> *Mai Kailua a hiki i Kiholo*–(From Kailua to Kiholo)
> …The people who live in the area around Kailua are not bothered by the famine. They all have food. There are sweet potatoes and taro. These are the foods of these lands. There are at this time, breadfruit bearing fruit at Honokohau on the side of Kailua, and at Kaloko, Kohanaiki, Ooma and the Kalaoas where lives J.P. [the author]. All of these lands are cultivated. There is land on which coffee is cultivated, where taro and sweet potatoes are cultivated, and land livestock is raised. All of us living from Kailua to Kalaoa are not in a famine, there is nothing we lack for the well being of our bodies.
>
> Mokuola[6] is seen clearly upon the ocean, like the featherless back of the *ʻukeke* (shore bird). So it is in the uplands where one may wander gathering what is needed, as far as Kiholo which opens like the mouth of a long house into the wind. It is there that the bow of the boats may safely land upon the shore. The livelihood of the people there is fishing and the raising of livestock. The people in the uplands of Napuu are farmers, and as is the custom of those people of the backlands, they all eat in the morning and then go to work. So it is with all of the native people of these lands, they are a people that are well off.
>
> …As was said earlier, coffee is the plant of value on these lands, and so, is the raising of livestock. From the payments for those products, the people are well off, and they have built wooden houses. If you come here you shall see that it is true. Fish are also something which benefits the people. The people who make the *pai ai* on Maui bring it to Kona and trade it.

[6] *Moku-ola* — literally: Island of life — is a poetic reference to a small island in Hilo Bay which was known as a place of sanctuary, healing, and life. By poetic inference, the Kekaha region was described as a place of life and well-being.

> Some people also trade their *poi* for the coffee of the natives here… (J.P. Puuokupa, in *Ku Okoa* November 27, 1875; translated by Kepā Maly)

The Government Homesteading Program in Kekaha

Following the *Māhele* and Grant programs of the middle 1800s, it was found that many native tenants still remained on lands for which they had no title. In 1884, the Hawaiian Kingdom initiated a program to create Homestead lots on Government lands—a primary goal being to get more Hawaiian tenants in possession of fee-simple property (Homestead Act of 1884). The Homestead Act allowed applicants to apply for lots of up to 20 acres in size, and required that they own no other land.

On Hawai‘i, several lands in the Kekaha region of North Kona, were selected and a surveying program was authorized to subdivide the lands. Initially, those lands extended from Kohanaiki to Kūki‘o. Because it was the intent of the Homestead Act to provide residents with land upon which they could cultivate crops or graze animals, most of the lots were situated near the *mauka* road (near the present-day Māmalahoa Highway) that ran between Kailua and ‘Akāhipu‘u.

Early in the process, native residents of Kekaha soon began writing letters to the Minister of the Interior, observing that 20 acre parcels were insufficient “to live on in every respect.” They noted that because of the rocky nature of the land, goats were the only animals that they could raise, and thus, try to make their living (cf. State Archives–Land File, December 26, 1888, and Land Matters Document No. 255; and communications below).

During the first years of the Homestead Program, all of the remaining government lands in the Kekaha region, from Kohanaiki to Kūki‘o 2nd, had been leased to King David Kalākaua for grazing purposes. The following lease was issued, with the notation that should portions of the land be desired for Homesteading purposes, the King would relinquish his lease:

> *August 2nd 1886*
> *General Lease 364*
> *Between His Majesty Kalakaua;*
> *and Walter M. Gibson, Minister of the Interior*
> [Lease of unencumbered government lands between Kealakehe to Kukio 2nd]:
>
> …Oma [Ooma] No. 1 & 2 – yearly rent Ten dollars…
> Each and every of the above mentioned lands are let subject to the express condition that at any time during the term of this lease, the Minister of the Interior may at his discretion peaceably enter upon, take possession, and dispose of such piece or pieces of land included in the lands hereby demised, as may be required for the purposes of carrying out the terms and intent of the Homestead Laws now in force, or that may be hereafter be enacted during the term of this lease… [State Land Division Lease Files]

By 1889, the demand for homestead lots in ‘O‘oma and other Kekaha lands was so great that King Kalākaua gave up his interest in the lands:

> *January 22, 1889*
> *J.W. Robertson, Acting Chamberlain;*
> *to J.A. Hassinger, Chief Clerk, Interior Department*
> [Regarding termination of Lease No. 364 for lands from Kukio to Kohanaiki]:
>
> …I have the honor to acknowledge the receipt of your communication, of the 17th, instant, informing me that you are directed, by His Excellency the Minister of the Interior, to say, that he desires to take possession of the lands, described in Government Lease No. 364, for Homestead purposes, and requests the surrender of the lease.
>
> His Majesty the King, is willing, for the purpose of assisting in carrying out the Homestead

Act, to accede to the terms of the lease, so far as to give up only such portions of the lands, as are suitable to be apportioned off for Homestead purposes.

It has come to the knowledge of His Majesty, that several of the applicants for portions of the above lands, are already in possession of lands elsewhere, and living in comfortable homes. They are not poor people, nor are they entitled to the privilege of obtaining lands under the Homestead Act, but are desirous of obtaining more of such property, for the purpose of selling or leasing to the Chinese, which class is beginning to outnumber the natives in nearly every district…

His Majesty is desirous of retaining the balance of lands, that may be left after the apportionment has been completed; and also desires to lease remnants of other Government lands in that section of the Island…

Reply attached – Dated January 22, 1889:
The lands of Kohanaiki and Kalaoa and Makaula have been divided up into Homestead lots, and taken up.

Lands marked * are in Emerson's List of lands to be sold. Emerson's List attached.

His Majesty has paid rent to Aug. 22, 1889. Another rent is due in adv. from this date…

* Kukio 2	* Maniniowali
* Mahaiula	* Kaulana
* Awalua	Puukala
+ Makaula	+ Kalaoa 1, 2, 3, 4 & 5
* Ooma 1 & 2	+ Kohanaiki

Lease cancelled by order – Minister of Int. August 2, 1889 [HSA – Interior Department, Lands]

One of the significant issues that arose with the development of homesteads in the Kekaha region, involved the lands of ʻOʻoma, Kalaoa and Hāmanamana, which had been surveyed for Kauhini in 1855, under Grant No. 1590. The grant was apparently never patented, and questions regarding the government's authority to divide portions of the ʻOʻoma-Kalaoa-Hāmanamana lands into Homestead lots were raised. Adding to the confusion, in 1888, John A. Maguire was also making his move from Kohala to Kona, and in the process of establishing his Huehue Ranch. One of the lands he reportedly purchased was covered under the unperfected Grant No. 1590. Thus, homestead applicants and program managers met with a wide range of challenges during the program's history.

Homestead Communications

There are a number of letters between native residents (applicants for Homestead lands) and government agents, documenting the development of the homesteading program and residency in Kekaha. Tracts of land in Kohanaiki, ʻOʻoma, Kalaoa and neighboring *ahupuaʻa* were let out to native residents, and eventually to non-native residents as well. Those lands which were not sold to native tenants were sold or leased to ranching interests—most of which came under John A. Maguire of Huehue Ranch.

One requirement of the Homestead Program was that lots which were to be sold as homesteads to the applicants, needed to be surveyed. J.S. Emerson, one of the most knowledgeable and best-informed surveyors to work in Kona, began surveying the Kekaha region homestead lots in 1888. Emerson's letters to Surveyor General, W. D. Alexander, provide valuable historical documentation about the community and land. Writing from ʻOʻoma in April 1888, Emerson spoke highly of the Hawaiian families living on the land; he also described land conditions and weather at the time. In the letter, we find that questions regarding the status of several lands in Kona had arisen, and that John A. Maguire was planning to "settle" in Kona (see communications in Part 4 of this section of the study). Emerson's letters along with those below from the native

tenants of the land, provide first hand accounts of the land development of the communities in Kekaha. The following communications are among those found in the collection of the Hawai‘i State Archives (HSA).

May 1888
J.W.H. Isaac Kihe, Jr., et al.; to L.A. Thurston, Minister of the Interior
[Petition with 71 signatures, regarding discrepancy in land grant to Kauhini in Kalaoa and Ooma; and desires that said land be divided into Homestead Lots for applicants]:

…We, the undersigned, subjects residing within the boundaries of Kekaha, from Kohanaiki to Makalawena, and Whereas, the land said to belong to Kauhini is within the boundaries above set forth; Whereas, some doubt and hesitancy has come into our minds concerning the things relating to said land of Kauhini, and that it is proper that a very careful investigation be made, because, we have never known said Kauhini to have lands in the Kalaoas and Ooma 1, and because of such doubt, the Government sold some pieces in said land of 687 acres to Kama, Kaakau and Hueu, and they have been living with all the rights for 20 years and over, on pieces that were acquired by them. Therefore, we leave this request before your Excellency, the honorable one, with the grounds of this request:

First: The said land of Kauhini is not a land that is clear in every way, so that it can be shown truthfully and clearly that it belongs to Kauhini and his heirs – said kuleana.

Second: The land said to belong to Kauhini was only surveyed, but the money was not paid, that is the price for the land, only the payment for the survey was paid. We are ready with witnesses to prove this ground, as well as other grounds.

Third: Because of Kama and Kaakau and Hueu’s knowing that Kauhini had no true interest in the land, therefore, they bought from the Government some acres of in the piece which Kauhini had surveyed, and the Government readily agreed to sell to them. This is real proof that said land was not conveyed to Kauhini, and the second is that Kauhini was living right there and he made no protest against the sale by the Government of those 687 acres to Kama (k), Kaakau (k) and Hueu (k), up to the time of his death, and only now has the question been raised through the plat of the survey, and thereby basing the claim that Kauhini had some land.

…We ask your honor that this matter be traced in the Government Departments, so as to find out the truth, there is much trouble and uncertainty about this land.
And our inquiry to be based upon these great questions. Does the land belong to Kauhini? Or to the Government?… [HSA – Interior Department, Lands]

May 16, 1888
Interior Department Clerk; to J.W.H. Isaac Kihe, Jr.:
…I have been directed by the Honorable Minister of the Interior, to say, that your request asking that Kauhini’s interest in the lands of Kalaoa & Ooma 1 be investigated, and to let you know the you are wanted to send, or to bring here to Honolulu, 2 or 3 good witnesses, and all the papers found by you or them, concerning this land of Kauhini… [HSA Interior Department Lands]

May 16, 1888
J.F. Brown, Government Surveyor; to L.A. Thurston, Minister of the Interior
[Regarding disposition of Grant No. 1590, to Kauhini for Lands in Hamanamana, Kalaoa, and Ooma; Figure 6]:

…With reference to the letter of inquiry of numerous natives in N. Kona, Hawaii, I beg to report:

That as regards the land belonging to Kauhini, I find that Grant 1590 on record and signed in due form, assigned to Kauhini something over 1800 acres shown in sketch by yellow tinted boundary line. At the bottom of the page however and in different handwriting is the following remark “Memo – this to be cancelled” S.S. (Stephen Spencer)?

Later the grants shown in sketch by blue lines were issued to the parties indicated in the sketch, and this fact together with the memo attached to the Grant, and the statements and beliefs of the natives leads me to think that the Grant to Kauhini was actually cancelled, but of this I have not yet obtained further proof than I have here given… [HSA – Interior Department, Lands]

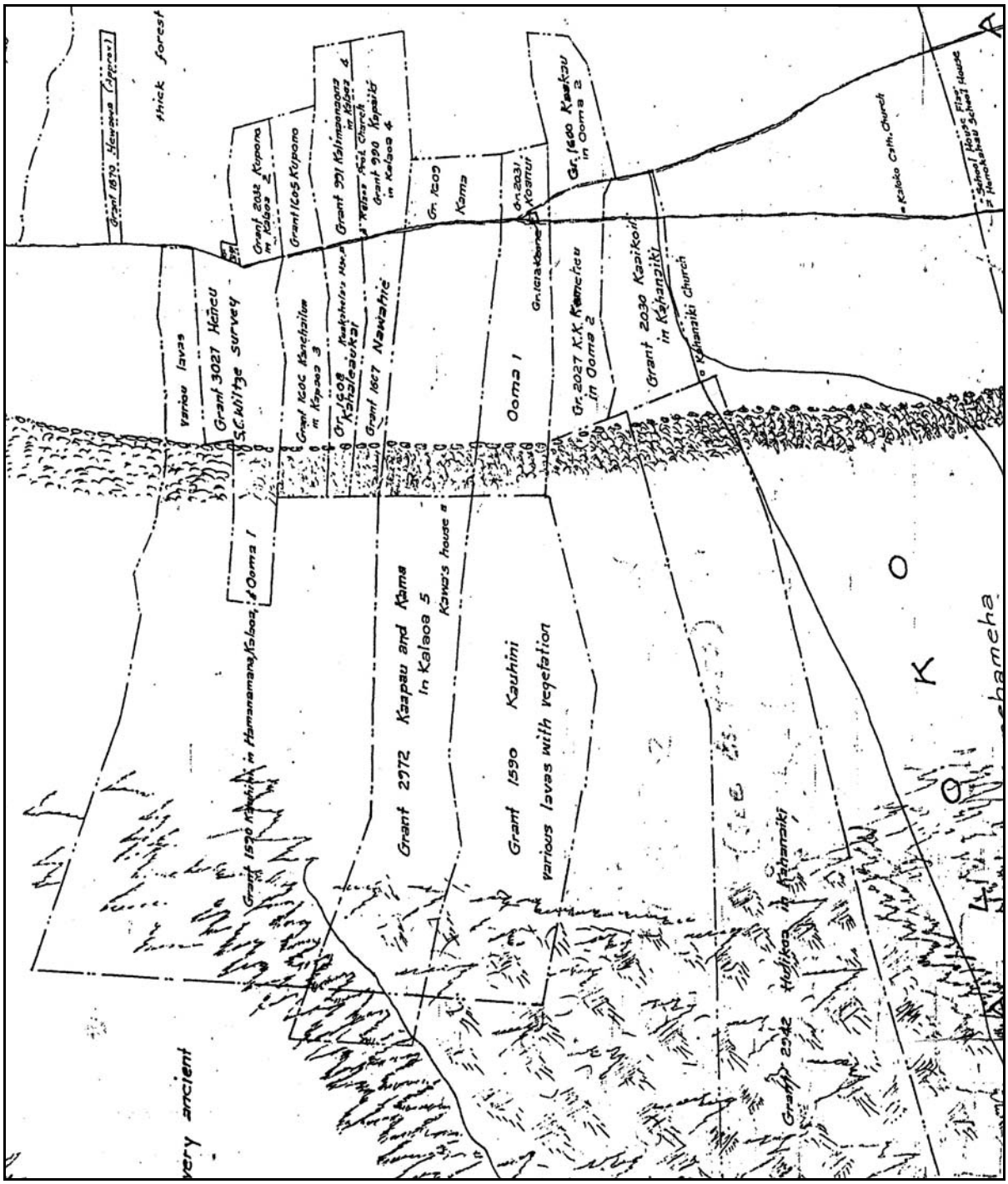

Figure 6. Portion of 1882 Register Map No. 1280 showing original boundaries of Grant No. 1590, to Kauhini.

May 1888 - J.W.H.I. Kihe, Jr.; to L.A. Thurston, Minister of the Interior:
…Oh honorable one, I am ready with the right witnesses to come when I receive the order, and if you agree, oh honorable one, to help with the fares for us on the vessel, and for our support while staying there and coming back.

Proofs are ample to prove that the land belongs to the Government, when I arrive with the witnesses, according to what you wish to be done… [HSA – Interior Department, Lands]

[Applying to purchase remnant lands from Makaula to Ooma 2nd, as a native Hui; and that land not be sold to outsiders.]

…We the undersigned, kamaaina (old residents) who reside from "Makaula" to "Ooma 2," joining "Kohanaiki," hereby petition and we also file this petition with you, and for you to consider and conferring with the Minister of the Interior, whether to consent or refuse the petition which we humbly file, and at the same time setting forth the nature of the land and the boundaries desired.

We ask that all be sold to us as a Hui, that the remnants of all the Government lands from "Hamanamana" to "Ooma 2 (two)," that is from the Government remnant of "Hamanamana, Kalaoa 1, 2, 3, 4, 5, Ooma 1 & 2" running until it meets the sea. Being the remnants remaining from the "Homesteads" lately, and remaining after the sale of the lands formerly sold by the Government, these are the remnants which we wish to buy as a "HUI." If you consent, and also the "Minister of the Interior," for these reasons:

1. The "remnants of Government lands" aforesaid, join our land kuleanas and were lately surveyed, and for that reason we believe it proper that they be sold to us.

2. The "kuleanas" that were surveyed for us are not sufficient to live on in every respect, they are too small, and are not in accordance with the law, that is one hundred acres, (Laws 1888).

3. Because of our belonging to, and being old residents of said places, is why we ask that consent be granted us for the sale to us and not to any one from other places, or we may be put to trouble in the future.

With these reasons, we leave this with you, and for you to approve, and we also adhere to our first offer per acre, and the explanations in regards to said offer.

FIRST: The price per acre to be 10 cents per acre.

SECOND: The nature of the land is rocky and lava stones in all from one and to the other, and there is only one kind of animal which can roam thereon, and it is goats, and that is the only thing to make anything out of, and to benefit us if we acquire it.

THIRD: If this land is acquired by others, they will probably cause us trouble, because the kuleanas which we have got are very small and not enough, not 20 acres of the land were acquired by us; very few of the lots reach 20 acres or more.

And because of these reasons and the explanations herein, we leave before your Excellency for the granting of the consent or not… [HSA – Interior Department, Lands]

ca. February 1889
Petition of J.W.H. Isaac Kihe, Jr. and 21 others;
to L.A. Thurston, Minister of the Interior
[Transmitting first payment for Homestead Land from Makaula to Kohanaiki]:

…We, the ones whose names are below, persons who but for the pieces of "Homestead" lands from Makaula to Kohanaiki, present to you documents of proof and money as first payment of ten ($10.00) dollars in the hands of J. Kaelemakule, the Agent appointed for the "Homestead" lands in North Kona, Hawaii.

We ask that the Agreements be sent up, with the Government for five years to J. Kaelemakule, the Agent here, in number the same as there are names below…

1. J.W.H. Isaac Kihe, Jr.	9. P. Nahulanui	17. Keawehawaii
2. S. Mahauluae	10. Kaukaliinea	18. D. Kaninau
3. D.P. Manuia	11. Kamahiai (w)	19. Mokuaikai
4. S.M. Kaawa	12. C.K. Kapa	20. Nuuanau
5. H.P. Ku	13. P.K. Kanuha	21. S. Kaimuloa
6. W.N. Kailiino	14. J. Haau	22. J. Kaloa
7. Z. Kawainui	15. G. Mao	
8. Kikane	16. J. Pule	

[HSA – Interior Department Document No. 227]

February 18, 1889
J. Kaelemakule, Land Agent; to L.A. Thurston, Minister of the Interior:
I am sending the correct report of the applicants for homestead lands here in North Kona, and their respective names, and the amount they have paid for their initial deposits in order that the agreements will be made correctly…

Pule $10.	Keoki Mao $10.	Mahuluae $10.	Haau $10.
Nuuanu $10.	Manuia $10.	Kaukaliinea $10.	Kamahiai (w) $10.
Kaawa $10.	Kaninau $10.	J. Kaelemakule $10.	Kawainui $10.
Mokuaikai $10.	Keawehawaii $10.	Nahulanui $10.	Kaloa $10.
Haiha $10.	Kapa $10.	Kaumuloa $10.	Isaac Kihe $10.
Kailiino $10.	Kanuha $10.	Ku $10.	Kikane $10.

[HSA – Interior Department, Lands]

October 7, 1889
J. Kaelemakule, Land Agent; to L.A. Thurston, Minister of the Interior:
…The applications of Kahinu and Lilinoe which were sent down during the month of August, please have the lots changed, because the map of Ooma has arrived with new numbers, as follows: Kahinu, Lot 51; Lilinoe, Lot 49, in Ooma 1st … [HSA – Interior Department, Lands]

October 10, 1889
J.W.H. Isaac Kihe, Secretary; to L.A. Thurston, Minister of the Interior:
…I leave some more names who make applications for homestead lands here in North Kona… The places wanted by those named are:

Pika Kaninau at Ooma 1
Kahinu at Ooma 2
Keaweiwi at Ooma 2… [HSA – Interior Department, Lands]

October 28, 1889
J. Kaelemakule, Land Agent; to L.A. Thurston, Minister of the Interior:
…The eight lots in Ooma have all been taken, none are left… These lots have been very quickly taken by the bidders, before the issuance of the notice from the Minister… Bear in mind the agreements for Kahinu and Lilinoe… [HSA – Interior Department, Lands]

December 31, 1890
J.W.H.I. Kihe, Jr.; to C.N. Spencer, Minister of the Interior:
We, the undersigned, who are without homes, and are destitute and have no place to live on, and whereas, the government has permitted all the people who have no lands, and that they receive homesteads, and for that reason, your humble servants make application that our

application may be speedily granted which we now place before Your Excellency, that the Government land which was divided and surveyed by Joseph S. Emerson, be immediately sub-divided , the same being portions of Kalaoa 5 and Ooma, on the mauka side of Kama (k), Koanui (k), to the junction with Ooma of Kaakau (k), containing an area of one hundred and fifteen acres (115), and it is those acres which your applicants are applying for before Your Excellency, and where as your applicants are native Hawaiians by birth, residing at Kalaoa, North Kona, Island of Hawaii. And the minds of your servants hope and desire to have a place to live on in the future, and to have a home for all time, and Your Excellency, your servants humbly place their petition with the hope that you will grant this application...

M.E. Kuluwaimaka (k)
H. Hanawahine (k)
D.W. Kanui (k)
Mr. Kahumoku (k)
[HSA – Interior Department, Lands]

July 30, 1890
Petition of Kaihemakawalu and 63 native residents of Kekaha;
to C.N. Spencer, Minister of the Interior
[Requesting that lands available for Homesteading be sub-divided and granted to applicants]:

…We, the undersigned, old-timers living from Kealakehe to Kapalaoa, who are subject to taxes, and who have the right to vote in the District of Kona, Hawaii, and ones who are really without lands, and who wish to place this application before Your Excellency, that all of these Government lands here in North Kona, be given to the native Hawaiians who are destitute and poor, being the lots which were sub-divided by the Government which are lying idle and for which no Agreements have been given out, and also the lots which were granted Agreements and issued in the time when Lorrin A. Thurston was Minister of the Interior, and also the lots which still remain undivided. All of these Government lands are what we are now again asking that the dividing and sub-dividing be continued in these remnants of Government lands, until all of the poor and needy ones are provided for.

Your Excellency, we ask that no consent whatever be given to permitting lands to be acquired by the rich through sale at auction, or by lease, and if there is to be any lease, then to be leased to the poor ones, if they are supplied with homes.

Your Excellency, we ask that you immediately send copies of all agreements of the Government lands which were cut up and sub-divided, which are remaining and have no documents for those lots. And we also ask that a surveyor be sent now to again survey and sub-divide the remaining Government lands, being the Government lands of Kaulana, Mahaiula, Kukio 1 & 2, mauka of the Government Road, and Kalaoa 5 & Ooma 1, mauka of the Government Road, joining Kama's and Koanui's.

And now, Your Excellency, we also ask that all of the pieces of Government land lying idle outside of these lands which have been sub-divided, and lands which are to be sub-divided, applied for above, to be allowed to be leased to use for five cents per acre, because, they are rocky and pahoehoe lands only left, and the number of acres being about three thousand and over, thereby giving the Government some income from these which have been lying idle and without any value… [HSA – Interior Department, Lands]

June 22, 1893
J. Kaelemakule, Land Agent; to J.A. King, Minister of the Interior:
…I am forwarding you with this, the copy of the agreement of Wm. Harbottle, and some applications as herein below set forth (Figure 7):

107, Kalua (w), for Lot # 59, Map 6, Ooma;
108, G.M. Paiwa, for Lot # 56, Map 6, Ooma;
109, Namakaokalani, for Lot # 58, Map 6, Ooma;
110, Pika Kaninau, for Lot # 57, Map 6, Ooma.

Lot # 57 above set forth, was formerly agreed with D. Kealoha Hoopii, but this applicant left altogether and lived a long time in Kohala, and has done nothing towards the land, and has never signed the agreement to this day. As two years have gone by, I thought it would be better to give the lands to the new applicant… [HSA – Interior Department, Lands]

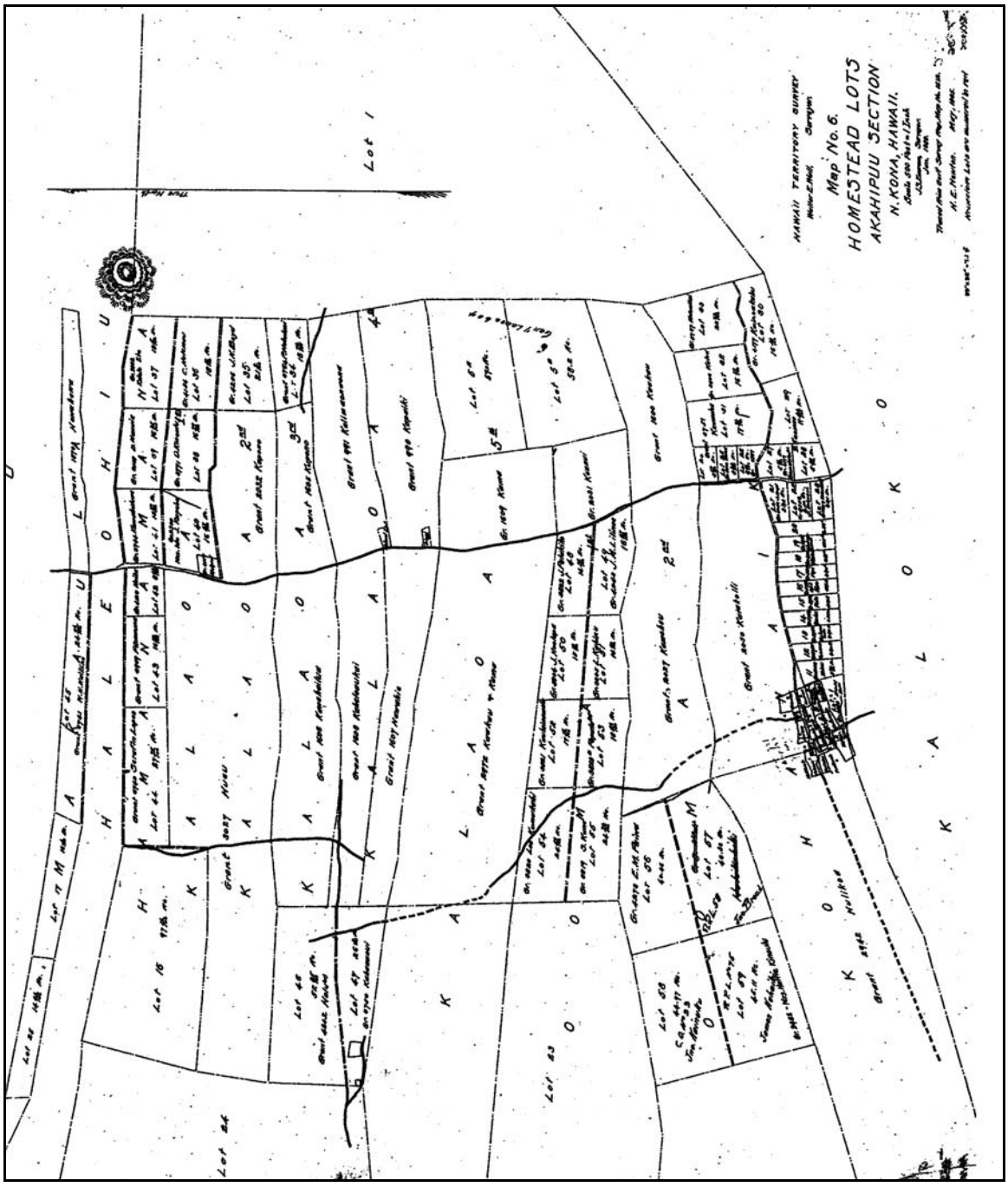

Figure 7. 1902 homestead map No. 6 showing Ooma-Kalaoa Homestead Lots (State Survey Division).

August 31, 1898
Statement of Leases of Public Lands
Under Control of the Commissioner of Public Lands…
…Ooma (mauka) 1160 acres – Coffee, wood lands & grazing
Lease No. 432 – Annual rent $60. – Expires August 1st, 1906…
Reservation in lease by which the Gov't. may take up portions suited to settlement. [HSA – F.O. & Ex, 1898 – Public Lands]

In May 1902, the Territorial Survey Office issued Register Map No. 2123, depicting a portion of the Kalaoa-Ooma Homesteads. ʻOʻoma 1st had been divided into 25 lots extending from near the shore (excluding the shore line) to the upper limits of the ahupuaʻa; also excluding the early Royal Patent Grant parcels previously sold to native tenants.

Applicants for land in ʻOʻoma 1st (from *maka*i to *mauka*) included:

- Kanealii – Right of Purchase Lease # 30; Lot 4-B (cancelled);

Kanealii's parcel was just mauka of the shore line exclusion.

- Wm. Keanaaina – Right of Purchase Lease #33; Lot 13

(Patented by Grant No. 5472);
The makai end of Wm. Nuuanu Keanaaina's Grant 5472, is situated at approximately 325 feet above sea level.

- J. Maiola – Right of Purchase Lease # 28; Lot 14 (cancelled);

J. Maiola's parcel was situated about 525 feet above sea level.

- K. Kama Jr. – Right of Purchase Lease #27; Lot 15

(Patented by Grant No. 5046).
The makai end of K. Kama's Grant No. 5046, is situated at approximately 725 feet above sea level.

Territorial Survey Map No. 6 (Homestead Lots, Akahipuu Section), surveyed by J.S. Emerson in 1889, depicts the eight original homestead lots sold to applicants. The lots are in the area extending from 1,022 feet above sea level to the old Māmalahoa Highway. The lots contained approximately 15 to 25 acres each, and were (*makai* to *mauka*) sold to:

- S. Kane – Grant No. 3819, Lot 55;
- Loe Kumukahi – Grant No. 3820, Lot 54;
- Papala (w) – Grant No. 3820 B, Lot 53;
- Kaulainamoku – Grant No. 3821, Lot 52
- L. Kahinu – Grant No. 3805, Lot 51
- J. Hoolapa – Grant No. 3804, Lot 50
- J.M. Lilinoe – Grant No. 4343, Lot 49
- J. Palakiko – Grant No. 3822, Lot 48

Except for the Homestead parcels and the two lots patented to Keanaaina and Kama (totaling ten parcels of the available 25 parcels), no other land in ʻOʻoma 1st was sold during this time. The land was retained by the government and portions leased out for grazing (see General Lease No.'s 590 and 604).

ʻOʻoma 2nd was also divided into homestead parcels, but only six lots were made in the subdivision (see Figure 7 and Figure 8). Between 700 and 1,100 feet elevation, and comprising the bulk of the current study area, four Homestead lots were subdivided, containing 40.50 to 45 acres each. Applicants for the lots (*makai* to *mauka*) were:

James Kuhaiki – Right of Purchase Lease # 75, Lot 59
(Patented to Mrs. Hattie Kinoulu; current Parcel 09:007);

Jno. Kainuku – C.O. No. 33, Lot 58 (not granted by 1902; current Parcel 09:008);

Holokahiki – C.O. No. 11, Lot 57
(cancelled; R.P.L. # 59 to Jno. Broad; current Parcel 07:038); and

E.M. Paiwa – Grant No. 4273, Lot 56 (current Parcel 07:039).

Land use on these parcels associated with the Homestead Grants began in the early twentieth century and consisted of both livestock grazing and small-scale agriculture (primarily sweet potato cultivation).

The two *makai* lots consisted of approximately 1,333 acres—the first lot from above the shore to the 1847 *Alanui Aupuni*, containing approximately 302 acres, and the other lot running *mauka* from the same *Alanui Aupuni*, to about the 800 foot elevation (containing approximately 1,031 acres). In 1899, John A. Maguire, founder of Huehue Ranch applied for a Patent Grant on both of the *makai* lots, but he only secured Grant No. 4536, for the lower parcel of 302 acres, in ʻOʻoma 2nd. Maguire's Huehue Ranch did hold General Lease No.'s 1001 and 590 for grazing purposes on the remaining government lands—both below and above the *mauka* highway—in ʻOʻoma 2nd. The notes of survey from Maguire's Grant No. 4536 describes the near shore parcel in ʻOʻoma 2nd. Of particular interest, it also references one of the prominent cultural-historical features on the boundary between ʻOʻoma 2nd and Kohanaiki, an "old ʻKahua hale' on white sand…" The "kahua hale" being an old house site. The notes of survey read (see Figure 8):

Grant No. 4536
To J.A. Maguire
Purchase Price $351.00
A Portion of Ooma 2nd, N. Kona, Hawaii Applied for by J.C. Lenhart, June 8, 1899.
Beginning at Puhili Gov't. trig. St. on the boundary between Kohanaiki and Ooma marked by a drill hole in stone 9 feet South of the South corner of an old "Kahua hale" on white sand at a point from which
Akahipuu Gov't. trig. Sta. is N 55º 27' 39" E true 32634.7 feet
Keahole Gov't. Trig. Sta. is N 21º 52' 36" W true 9310.5 ft.
Keahuolu Gov't Trig. Sta. is S 22º 24' 36" E true 20,141.8 ft., and running —
1. S. 79º 26' W. true 298.0 feet along Gr. 3086 Kapena, to a large [mark] on solid pahoehoe by the sea at Puhili Point, thence continuing the same line to the sea shore and along the sea shore to a point whose direct bearing and distance is:
2. N. 4º 54' W. true 4192.0 feet;
3. Due east true 2920.0 feet along Ooma 1st;
4. S. 31º 30' E. true 3920.0 feet along reservation for Gov't. Road 30 feet wide;
5. S 790º 45' W. true 4387.0 feet along Grant 3086 Kapena, to initial point and including an area of 302 acres.

J.S. Emerson, Surveyor
Oct. 10, 1901.

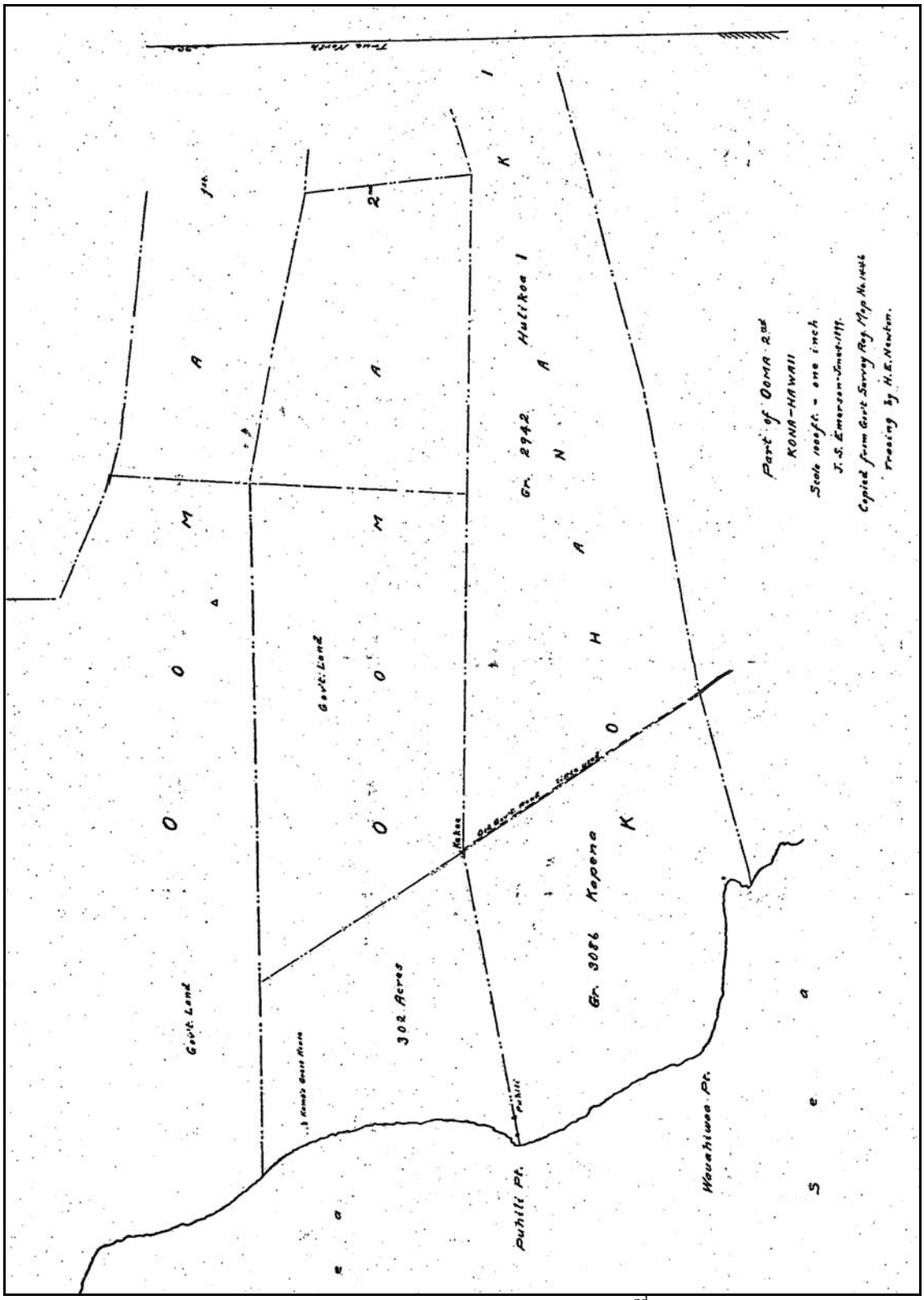

Figure 8. 1899 Grant Map No. 4536 showing *makai* portion of ‘O‘oma 2nd to John A. Maguire.

Field Surveys of J.S. Emerson (1882-1889)

Among the most interesting historic Government records of the study area—in the later nineteenth century—are the communications and field notebooks of Kingdom Surveyor, Joseph S. Emerson. Born on O‘ahu, J.S. Emerson (like his brother, Nathaniel Emerson, a compiler of Hawaiian history) had the ability to converse in Hawaiian, and he was greatly interested in Hawaiian beliefs, traditions, and customs. As a result of this interest, his letters and field notebooks record more than coordinates for developing maps. While in the field, Emerson also sought out knowledgeable native residents of the lands he surveyed, as guides. Thus, while he was in the field he also recorded their traditions of place names, residences, trails, and various features of the cultural and natural landscape (including the extent of the forest and areas impacted by grazing). Among the lands that Emerson worked in was the greater Kekaha region of North Kona, including the lands of ‘O‘oma and vicinity.

One of the unique facets of the Emerson field notebooks is that his assistant J. Perryman, was also a sketch artist. While in the field, Perryman prepared detailed sketches that help to bring the landscape of the period to life. In a letter to W.D. Alexander, Surveyor General, Emerson described his methods and wrote that he took readings off of:

> …every visible hill, cape, bay, or point of interest in the district, recording its local name, and the name of the *Ahupuaa* in which it is situated. Every item of local historical, mythological or geological interest has been carefully sought & noted. Perryman has embellished the pages of the field book with twenty four neatly executed views & sketches from the various trig stations we have occupied… [Emerson to Alexander, May 21, 1882; HSA – DAGS 6, Box 1]

Discussing the field books, Emerson also wrote to Alexander, reporting “I must compliment my comrade, Perryman, for his very artistic sketches in the field book of the grand mountain scenery…” (HSA – HGS DAGS 6, Box 1; Apr. 5, 1882). Later he noted, “Perryman is just laying himself out in the matter of topography. His sketches deserve the highest praise…” (ibid. May 5, 1882). Field book sketches and the Register Maps that resulted from the fieldwork provide a glimpse of the country side of more than 100 years ago.

Field Notebooks and Correspondence from the Kekaha Region

The following documentation is excerpted from the field notebooks and field communications of J. S. Emerson. Emerson undertook his original surveys of lands in the Kekaha region in 1882-1883 (producing Register Maps No. 1278 and 1280). Subsequently, in 1888-1889, Emerson returned to Kekaha to survey out the lots to be developed into Homesteads for native residents of ‘O‘oma and vicinity (see above, The Government Homesteading Program in Kekaha). Through Emerson’s letters and notes taken while surveying, we learn about the people who lived on the land—some of them identified in preceding parts of the study—and about places on the landscape. The numbered sites and place names cited from the field books coincide with sketches prepared by Perryman, which are shown as figures in the current study.

> *J.S. Emerson Field Notebook Vol. 111 Reg. No. 253*
> *West Hawaii Primary Triangulation, Kona District*
> *Akahipuu; May 27, 1882*
> (Figures 9 and 10)
>
> *Site # and Comment:*
> …6 – Koanui’s frame house. E.G. In Honokohau – nui.
> 7 – Aimakapaa Cape. Extremity. In Honokohau-nui.
> 11 – Beniamina’s house (frame). N.G. In Aiopio. In Honokohau-nui.
> 12 – Beniamina’s house No. 2. E.G. In Honokohau-nui.
> 18 – Lae o Palaha. Between Kaloko and Honokohau-nui.
> 19 – Awanuka Bay (Haven of rest) Retreat during storms in this dist.
> 20 – Kealiihelepo’s (frame house). N.G. In Kaloko.

21 – Lae Maneo. From the "Maneo" fish in Kaloko.

22 – Kohanaiki Bay. By sea wall of fish pond.

23 – Kaloko-nui fish pond. Tang. S. end by Nuuanu's grass house.

24 – Wall between fish pond of Kaloko nui and iki.

25 – Kaloko iki fish pond. Tang. N. extremity.

Kaloko nui was originally a bay, shut off from the sea by a wall by Kamehameha 1st order.

26 – Kawaimaka's frame house. In Kohanaiki.

27 – Lae o Wawahiwaa. Rock cape. In Kohanaiki.

28 – Keoki Mao's grass house. In Ooma.

29 – Pahoehoe hill. Between Ooma and Kalaoa 5.

30 – Lae o Keahole. Extremity. In Kalaoa 5.

31 – Lae o Kukaenui. Resting place for boats.

32 – Makolea Bay.

33 – Lae o Unualoha.

34 – Pohaku Pelekane.

35 – Lae o Kahekaiao. Kahe-ka-iao – place of the "iao" which abound there. [Notebook 253:33,35]

…Keahole Bay.

Lae o Kalihi in Kalaoa 5.

Wawaloli Bay in Kalaoa 5.

Lae o Kekaaiki.

Limu Koko in Ooma 1.

Lae o Puhili in Kohanaiki.

Lae o Kealakehe in Kealakehe.

Hueu's frame house in Kalaoa 4, makai side of Gov't. Road.

Kuakahela's frame house in Kalaoa 5.

Protestant Church Steeple in Kalaoa 5.

Kama's frame house, N. gable in Ooma 1.

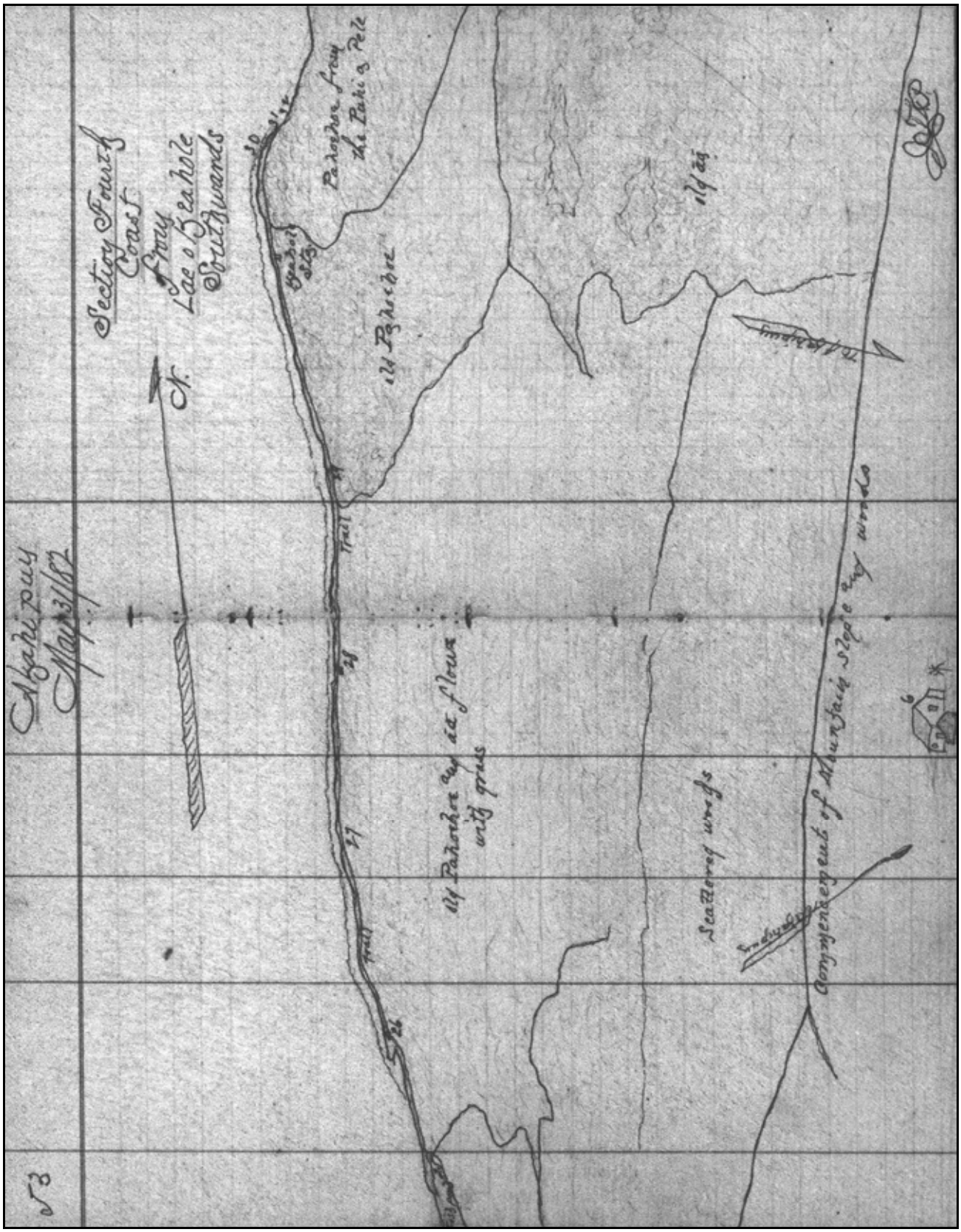

Figure 9. J. S. Emerson, field notebook map, Book 253:53 (State Survey Division).

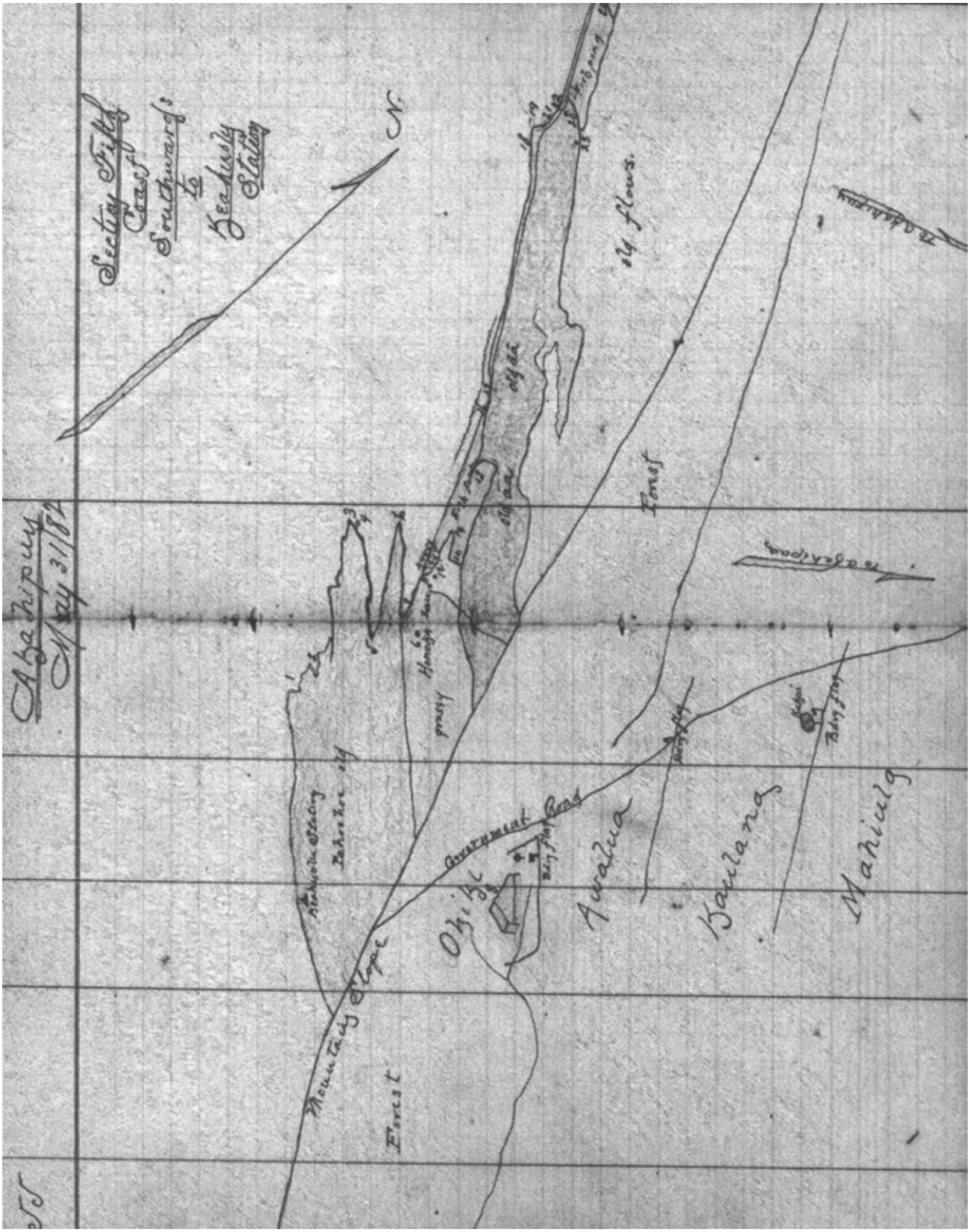

Figure 10. J. S. Emerson, field notebook map, Book 253:55 (State Survey Division).

While taking sightings from Keāhole, Perryman prepared additional sketches of the landscape. One sketch on page 69 of the field book (Figure 11) depicts the view up the slope of Hualālai. Dated June 4, 1882, the sketch is of importance as it also depicts Kalaoa Village and church; the upper Government road; Kohanaiki Village; and two trails to the coast, one trail to Honokōhau, and the other near the Kaloko-Kohanaiki boundary. Use of these trails continued through the 1950s.

The other sketch on page 73 of the field book (dated June 8, 1882) depicts the coastline south from Keāhole, to an area beyond Keauhou (Figure 12). Of interest, we see only the near-shore "Trail" in the foreground, with no trail on the *kula* lands. Then a short distance south, a house is depicted on the shore, in the ʻOʻoma vicinity (identified as the house of Kama or Keoki Mao on Emerson's Register Maps). And a little further beyond (south) the house, two trails are indicated—presumably the *Alanui Aupuni* on the *kula* lands to ʻOʻoma, and the near shore trail, seen coming in from Honokōhau.

While surveying the uplands on Hualālai in August 1882, Perryman drew a sketch of the Keāhole-Honokōhauiki coastal lands. This sketch (Figure 13) from field Book No. 254 shows the reverse view of Figure 12. Noting again, that the only trail given at that time, was the near shore trail, running out of Honokōhau-Kaloko, Kohanaiki, ʻOʻoma and on to Keāhole.

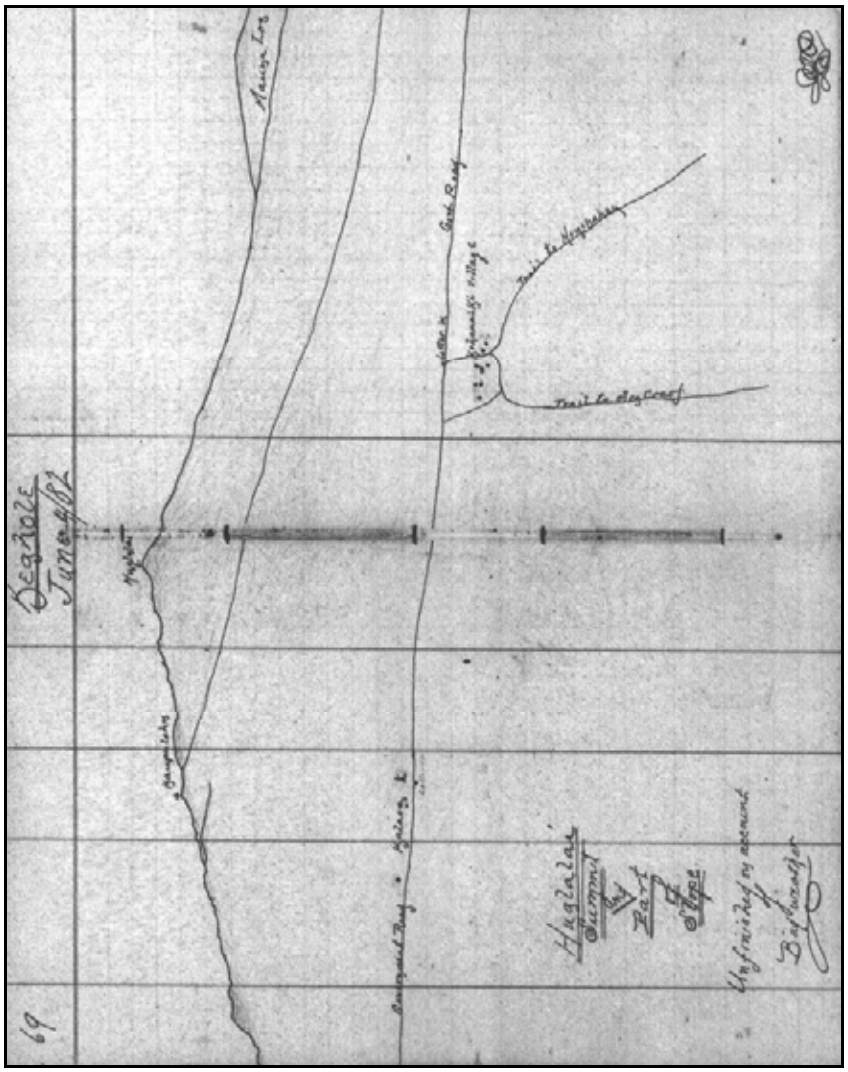

Figure 11. J. S. Emerson, field notebook map, Book 253:69 (State Survey Division).

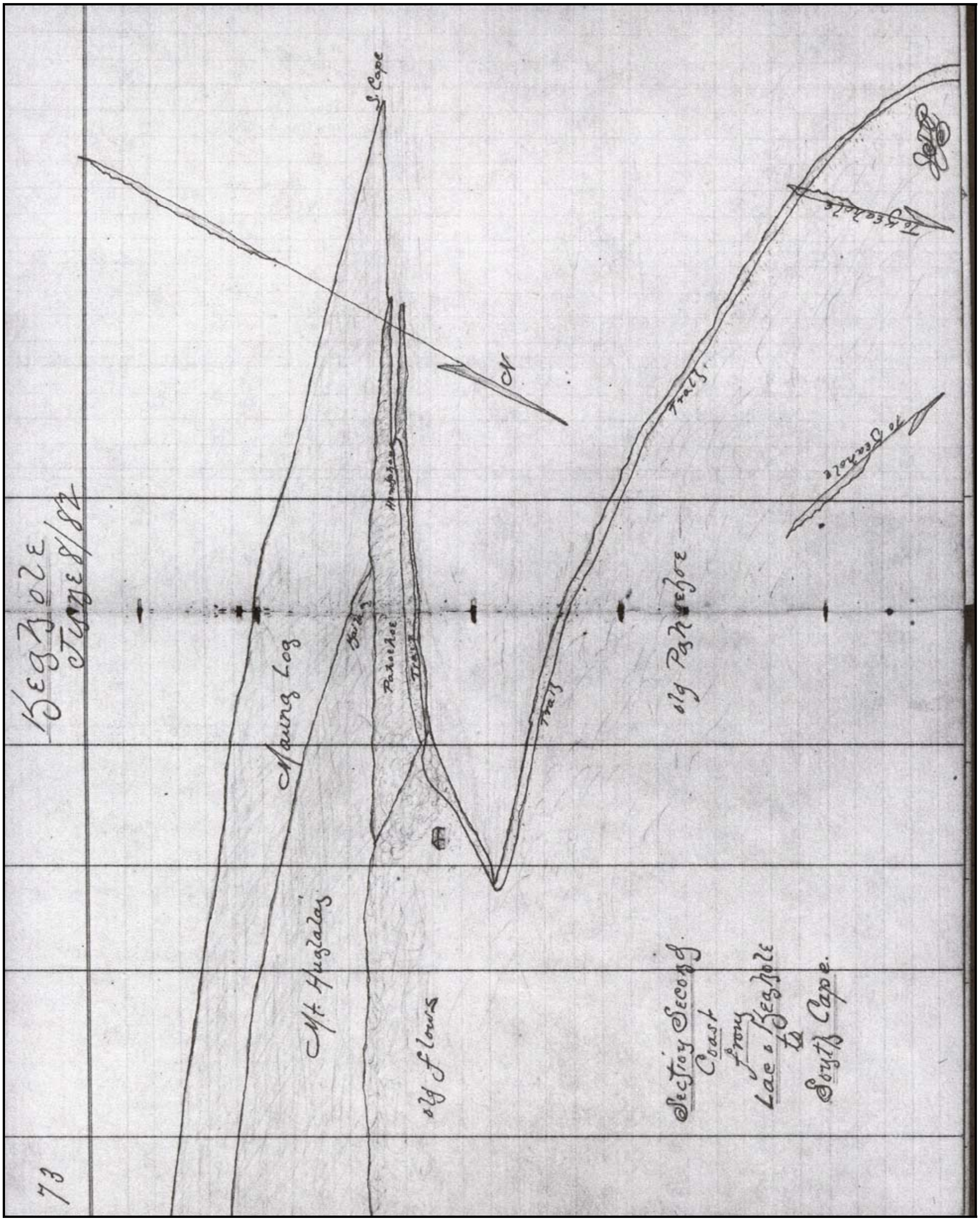

Figure 12. J. S. Emerson, field notebook map, Book 253:73 (State Survey Division).

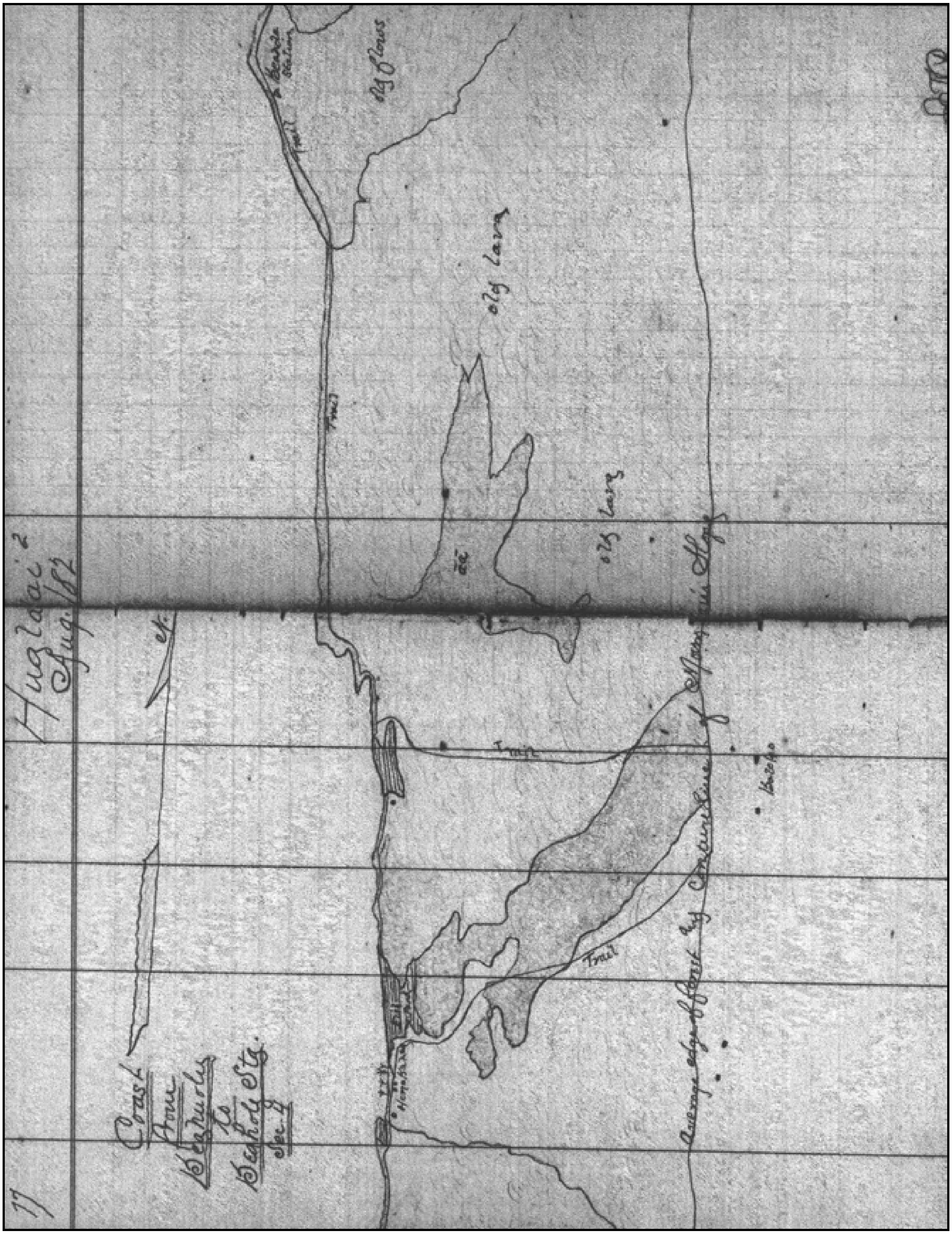

Figure 13. J. S. Emerson, field notebook map, Book 254:77 (State Survey Division).

While surveying the ‘O‘oma and vicinity homestead lots in 1888-1889, Emerson camped near Kama’s house in ‘O‘oma 1st. The following communications were sent by Emerson to W.D. Alexander, and tell us more about the people of the land, their beliefs, and commentary on then current events in the Kingdom. Of interest, we also find that J.W.H. Isaac Kihe, whose writing of traditions, and as a representative of the native families in the land application process—which have been cited extensively in this study—is also mentioned in Emerson’s narratives.

(Underlining, italics and brackets are inserted to draw attention to certain passages.)

> *April 8, 1888*
> …Our tent is pitched in Ooma on the *mauka* Govt. road at a convenient distance from Kama’s fine cistern which supplies us with the water we need. The pasturage is excellent and fire wood abundant. As I write 4:45 P.M. the thermometer is 71º, barometer 28.78. The entire sky is overcast with black storm clouds over the mountains. The rainy season comes late to Kona this year and has apparently just begun. We have had about three soaking rains with a good deal of cloud & drizzle. We are now having a gentle rain which gladdens the residents with water for their cisterns… We have set a large number of survey signals and identified many important corners of Gov’t. lands etc. from Puhiapele on the boundary of Kaupulehu to the boundary line of Kaloko. The natives welcome us and do a great deal to help the work along. Tomorrow I expect to go to Kuili station with a transit and make a few observations & reset the old signal... The Kamaainas tell me that Awakee belongs to the Gov’t. though I see it put down as LCA 10474 Namauu no Kekuanaoa.
>
> They also tell me that the heirs of Kanaina estate still receive rent for the Ahupuaa of Kaulana, though I have recorded as follows in my book, Kaulana ½ Gov’t. per civil Code 379, ½ J. Malo per Mahele Bk. Title not perfected; all Gov’t. Please examine into the facts about Kaulana and instruct me as to what I shall do about it. Kealoha Hopulaau rents it and if it is Gov’t. land the Gov’t. should receive the rent or sell it off as homesteads. It is a desirable piece of land, a part of it at least… [HSA – HGS DAGS 6, Box 2]
>
> *April 17, 1888*
> ...The work is being pushed rapidly and steadily forward. The natives render me most valuable assistance and find all the important corners for me as fast as I can locate them. It is hard getting around on account of the rocks & stones, to say nothing of trees etc., but there is a great deal of really fine land belonging to the Government, admirably adapted to coffee etc. The more I see of it the better it appears.
>
> As to Kaulana, if I hear nothing to the contrary from you, I will leave it all as Gov’t. land.
>
> Mr. McGuire [sic] of Kohala, the representative for that district, proposes to settle in Kona. He has bought Grant 1590, Kauhine, in Ooma, Kalaoa etc. and wants the Gov’t. to make good to him the amount taken from him by Grants 2972, Kaakau & Kama, and 3027, Hueu, which occupy portions of the same land granted to Kauhine. If his title is good, would it not be just to leave Kaakau & Kama as well as Hueu in possession of their lots where they have lived for over 20 years, and give McGuire an area in adjoining lands equal to that taken from him by these two grants.
>
> It is said that Chas. Achi has written to the natives that Grant 1590, Kauhine, has been cancelled. Will you learn the true state of the case and be so kind as to inform me… [HSA – HGS DAGS 6, box 2 Jan.-Apr. 1888]

In his field book notes, on May 1st, 1888, Emerson noted that he had placed the “Pulehu” station on the “ground by ahu, about 4 feet makai of Kama’s goat pen, on the iwi aina between Kalaoa 5 and Ooma 1…” (J.S. Emerson Field Book 291:83).

In the same field book on May 19th, 1888, while surveying the area near the boundary of ʻOʻoma 1st and 2nd, at the 325 foot elevation, Emerson cited off of a station named "Kahokukahi." The point is "on the entrance of the cave, Kahokukahi… The above is the vertical entrance of a famous *ana kaua*, which extends for a long distance to the E. and to the W…" (J.S. Emerson Field Book 291:137). An "ana kaua" would be a place, where during times of war, people could hide and fortify themselves. Emerson's description indicates that the cave runs some distance *mauka* and *makai* of "Kahokukahi."

On May 23, 1888, Emerson surveyed Pūhili, the boundary between Kohanaiki and ʻOʻoma 2nd. He observed, "Large [mark] on solid pahoehoe, on bound. bet. Kohanaiki & Ooma, by the sea, near the end of a cape… Station mark, drill hole in stone, 9 ft. S. of the S. corner of an old "kahua hale" on white sand…" (J.S. Emerson Field Book 291:151).

Returning to his "old camp Ooma," in August 1888, Emerson submitted the following letter to Alexander:

> *August 25th, 1888*
> …I have to report that the very intricate and irregular remainder of Gov't. land situated in Kealakehe is cut up into homesteads, ready for the committee to estimate its values. The job has been made unusually long & tedious by the absurd arrangement of the old kuleanas scattered around at random. I have also run out the boundaries of Papaakoko, ready for fencing. Thursday P.M. I made my way through a heavy rain to this place and set up tent in the storm. It rained a good deal every day since and is raining now. In spite of the weather the work of cutting up Ooma 1st goes bravely on. I have a huge umbrella to camp under while it rains. I propose to finish up Ooma 1st & return to Honolulu by the next trip of the *Hall*.
>
> Kailua beach is the great rendezvous for men & asses from all parts of the country when the steamer arrives from Honolulu. It has in consequence become the natural place to tell and hear gossip & news. Here, the sand-lot orator, mounted on a packing box, can address the largest crowd. T.N. Simeona, who stole the church money, keeps the pound and takes care of the court house wanting to make a speech, repaired to the beach last Wednesday morning and is reported to have made a windy harangue to the effect that the King was hewa and that the Ministers were pono! Up to that time he had always been the contemptible too of the King's party and was loud in his denunciation of the Government. I explain this change in his talk by his wish to retain his Gov't. billets & his desire to avoid arrest as a rebel.
>
> A native man told me the other day (Wednesday) that the Cabinet was hewa in two things viz.
>
> 1st They taxed chickens, banana trees and many other things that had not been heretofore taxed.
>
> 2nd They arrested and sent to Molokai many who were not lepers. For these reasons many justified Wilcox for trying to out the ministers.
>
> There is a sturdy old native living at Kaloko named Kealiihelepo, whom I greatly respect. Said he to me "When King Kalakaua returned from his foreign trip he made a speech at Kailua and said that 'in foreign lands the foreign God was losing his power. His former worshippers were deserting him. That the old Hawaiian Gods were still mana and them he would worship.'" But said Kealiihelepo "The King was mistaken. Our old Gods were once mighty, but the coming of the foreigner with his Gods has robbed them of their strength. Therefore the King has made the mistake to oppose the God who is now in power, and Jehovah is opposing him. Hence the King's pilikia."
>
> You are entirely justified in calling Kona "that heathen district." [HSA – HGS DAGS 6, box 2 Jan.-Apr. 1888]

On October 14th 1888, Emerson wrote to Alexander, briefing him on conversations he was having with J.W.H. Isaac Kihe, his "encyclopedia," "the son of a famous sorcerer." Later, Emerson used many of the notes taken during his conversations with Kihe, to develop his paper on Hawaiian religion (Emerson 1892). J.W.H. Isaac Kihe, was the son of Kihe, who was the son of Kuapahoa, of Kaloko (notes of J.S. Emerson, September 25, 1915; in collection of the Hawaiian Historical Society). While at ʻOʻoma, Kihe described the various nature forms taken by the deceased, and their role in the spiritual practices. On October 14th Kihe named for him some of the gods called upon by those who practiced the Kahuna Kuni sorcery.

> *Ooma*
> *October 14, 1888*
> *J.S. Emerson; to W.D. Alexander:*
> …I have just been having a chat with a son of a famous sorcerer, with the following for a summary of what he said.
>
> There are four gods worshipped by murders and sorcerers viz:
>
> (1). Kui-a-Lua, the god of the Lua, Mokomoko, Haihai and other forms of violence.
>
> (2). Uli, the god of the Anaana, Kuni, Hoopiopio and Lawe Maunu.
>
> (3). Kalaipahoa, god of the Hoounauna, Hookomokomo and Hooleilei.
>
> (4). Hiiaka-i-ka-poli-o-Pele, the goddess of the Poi uhane, Apo leo, Pahiuhiu and Hoonoho uhane… [J.S. Emerson, in collection of the Hawaiian Historical Society]

Trails and Roads of Kekaha (Governmental Communications)

Alahele (trails and byways) and *alaloa* (regional thoroughfares) are an integral part of the cultural landscape of Hawaiʻi. The *alahele* provided access for local and regional travel, subsistence activities, cultural and religious purposes, and for communication between extended families and communities. Trails were, and still remain important features of the cultural landscape.

Traditional and historical accounts (cited in this study) describe at least two traditional trails that were of regional importance which pass through the lands of ʻOʻoma. One trail is the *alaloa*—parts of which were modified in the 1840s and later, into what is now called the *Alanui Aupuni* (Government Road) or Māmalahoa Trail or King's Highway—that crosses the *makai* (near shore) lands, linking royal centers, coastal communities, and resources together. The other major thoroughfare of this region is "*Kealaehu*" (The path of Ehu), which passes through the uplands, generally a little above the *mauka* Government Road or old Māmalahoa Highway, out to the ʻAkāhipuʻu vicinity, and then cuts down to Kīholo in Puʻu Waʻawaʻa. From Kīholo, the *makai alaloa* and Kealaehu join together as the *Alanui Aupuni*, and into Kohala, passing through Kawaihae and beyond. The *mauka* route provided travelers with a zone for cooler traveling, and access to inland communities and resources. It also allowed for more direct travel between the extremities of North and South Kona (cf. Malo 1951; Iʻi 1959; Kamakau 1961; Ellis 1963; and *Māhele* and Boundary Commission Testimonies).

In addition to the *alahele* and *alaloa*, running laterally with the shore, there are another set of trails that run from the shore to the uplands. By nature of traditional land use and residency practices, every *ahupuaʻa* also included one or more *mauka-makai* trail. In native terminology, these trails were generally known as—*ala piʻi uka* or *ala piʻi mauna* (trails that ascend to the uplands or mountain). Some of these trails are described in native accounts and oral history interviews cited in this study.

Along the trails of the Kekaha region of which ʻOʻoma is a part, are found a wide variety of cultural resources, including, but not limited to residences (both permanent and temporary), enclosures and exclosures, wall alignments, agricultural complexes, resting places, resource collection sites, ceremonial features, *ilina* (burial sites), petroglyphs, subsidiary trails, and other sites of significance to the families who once lived in the vicinity of the trails. The trails themselves also exhibit a variety of construction methods, generally determined

by the environmental zone and natural topography of the land. "Ancient" trail construction methods included the making of worn paths on *pāhoehoe* or *ʻaʻā* lava surfaces, curbstone and coral-cobble lined trails, or cobble stepping stone pavements, and trails across sandy shores and dry rocky soils.

Following the early nineteenth century, western contact brought about changes in the methods of travel (horses and other hoofed animals were introduced). By the mid-nineteenth century, wheeled carts were also being used on some of the trails. In the Kona region portions of both near shore and upland *ala hele-ala loa* were realigned (straightened out), widened, and smoothed over, while other sections were simply abandoned for newer more direct routes. In establishing modified trail—and early road-systems—portions of the routes were moved far enough inland so as to make a straight route, thus, taking travel away from the shoreline.

It was not until 1847, that detailed communications regarding road construction on Hawaiʻi began to be written and preserved. It was also at that time that the ancient trail system began to be modified and the alignments became a part of a system of "roads" called the "*Alanui Aupuni*" or Government Roads. Work on the roads was funded in part by government appropriations, and through the labor or financial contributions of area residents and prisoners working off penalties (see communications below). Where the *Alanui Aupuni* crosses the lands of ʻOʻoma, the alignment includes several construction methods, such as being lined with curbstones; elevated; and with stone filled "bridges" in areas that level out the contour of the roadway.

The following letters provide readers with a historical overview of the *Alanui Aupuni*, and travel through ʻOʻoma and the Kekaha region. Of particular interest to the lands of ʻOʻoma, are those communications addressing the lower Government Road which passes through the proposed development area.

(Underlining, italics, and square brackets have been added.)

> *June 26, 1847*
> *George L. Kapeau to Keoni Ana*
> I have received your instructions, that I should explain to you about the *alaloa* (roadways), *alahaka* (bridges), lighthouses, markets, and animal pounds. I have not yet done all of these things. I have thought about where the *alanui heleloa* (highways) should be made, from Kailua to Kaawaloa and <u>from Kailua to Ooma, where our King was cared for [7]</u>, and then afterwards around the island. It will be a thing of great value, for the roads to be completed. Please instruct me which is the proper thing for me to do about the *alaloa*, *alahaka*, and the laying out of the *alaloa*… [HSA – Interior Department Misc., Box 142; Kepā Maly, translator)
>
> *August 13, 1847*
> *Governor of Hawaii, George L. Kapeau; to*
> *Premier and Minister of Interior, Keoni Ana*
> *Aloha oe e ka mea Hanohano –*
> I have a few questions which I wish to ask you. Will the police officers be required to pay, when they do not attend the Tuesday (*Poalua*) labor days? How about parents who have several children? What about school teachers and school agents? Are they not required to work like all other people when there is Government work on the roads and highways?
>
> I believe that school agents, school teachers and parents who have several children, should only go and work on the weeks of the public, and not on the *konohiki* days…
>
> …<u>The roads from Kailua and down the pali of Kealakekua, and from Kailua to Honokohau, Kaloko, Ooma, at the places that were told our King, and from thence to Kaelehuluhulu [at Kaulana in Kekaha], are now being surveyed</u>. When I find a suitable day, I will go to

[7] For the first five years of his life (until ca. 1818), Kauikeaouli was raised at ʻOʻoma, by Ka-iki-o-ʻewa and Keawe-a-mahi *mā* (see Kamakau 1960; and this study).

Napoopoo immediately, to confer with the old timers of that place, in order to decide upon the proper place to build the highway from Napoopoo to Honaunau, and Kauhako, and thence continue on to meet the road from Kau. The road is close to the shore of Kapalilua…

The width of the highways around Hawaii, is only one fathom, but, where it is suitable to widen where there is plenty of dirt, two fathoms and over would be all right… If the roads are put into proper condition, there are a lot of places for the strangers to visit when they come here. The Kilauea volcano, and the mountains of Maunaloa, Maunakea, Hualalai.

There is only one trouble to prevent the building of a highway all around, it is the steep gulches at Waipio and Pololu, but this place can be left to the very last… [HSA – Roads, Hawaii]

March 29, 1848
Governor Kapeau; to Minister of the Interior, Keoni Ana:
[Acknowledging receipt of communication and answering questions regarding construction methods used in building the roads.]

…I do not know just what amount of work has been done, but, I can only let you know what has come under my notice.

The highway has been laid from Kailua to Kaloko, and running to the North West, about four miles long, but it is not completely finished with dirt. The place laid with dirt and in good condition is only 310 fathoms.

The highway from Kealakekua to Honaunau has been laid, but is not all finished, and are only small sections… [HSA – Roads, Hawaii]

July 9, 1873
R.A. Lyman; to
E.O. Hall, Minister of the Interior.
Notifies Minister that *the road from Kiholo to Kailua needs repairing.* [HSA – Interior Department – Land Files]

August 14, 1873
R.A. Lyman; to
E.O. Hall, Minister of the Interior:
I have just reached here [Kawaihae] from Kona. I have seen most of the roads in N. Kona, and they are being improved near where the people live. If there is any money to be expended on the roads in N. Kona, I would say that the place where it is most needed is from Kiholo to Makalawena, or the Notch on Hualalai.

This is the main road around the island and is in very bad condition. Hardly anyone lives there, and there are several miles of road across the lava there, that can only be worked by hiring men to do it. There is also a road across a strip of Aa a mile & a half or 2 in length in the south end of S. Kohala next to the boundary of N. Kona, that needs working, and then the road from here [Kawaihae] to Kona will be quite passable… [HSA – Roads, Hawaii]

November 4, 1880
J.W. Smith, Road Supervisor, North Kona; to
A.P. Carter, Minister of the Interior:
…Heretofore I have been paying one dollar per day, but few natives will work for that, they want $1.50 per day. Thus far I have refused to pay more than $1.00 and have been getting men for that sum.

The most urgent repairs are needed on the main road from Kaupulehu to Kiholo, and north of Kiholo to the Kohala boundary, a distance of about 20 miles… [HSA – Roads, Hawaii]

Kailua Nov. 19th, 1880
Geo. McDougall; to
A.P. Carter, Minister of the Interior —
…I noticed among the appropriation passed by the last Legislature, an item of $5000 for Roads in North Kona Hawaii — as I am very much interested about roads in this neighbourhood, I take the liberty to express my opinions what is wanted to put the roads in good repair and give the most satisfaction to all concerned.

The Road from Kailua going north for about eight miles to where it joins the upper Road, has never been made, it is only a mule track winding through the lava. It could cost to make it a good cart road, fully two thousand dollars. And from Kailua to where it joins the South Kona road, about 12 miles was made by Gov. Adams, and is in pretty much the same state as he left it, only a little worse of the ware of 20 years or more, it could cost to make it in good repair about 15 hundred dollars. Then we could have 20 miles of good road… [HSA – Interior Department Letters]

March 21st, 1885
C.N. Arnold, Road Superintendent-in-Chief, Hawaii; to
Charles Gulick, Minister of Interior:
…In accordance with your instructions I beg to hand you the following list of names as being those I would select for Supervisors in the different Road Districts under my charge:

… Judge J.K. Hoapili, North Kona District…

Hoping these parties may meet with your approval… [HSA – Roads, Hawaii]

March 1886
Petition to Charles Gulick, Minister of the Interior:
[Signed by 53 residents of North Kona, asking that the appropriated funds be expended for the Kailua-Kohanaiki Road]:

We the people whose names are below, subjects of the King, residing in North Kona, Island of Hawaii:

The funds have been appropriated by the Legislature for the opening of the road from Kailua to Kohanaiki, therefore, we humbly request that the road be made there. The length of this road being thought of is about five miles more or less. The road that is there at the present time is not fit for either man nor beast.

Your people have confidence that as so explained, you will kindly grant our request, and end this trouble in our District…

[those signing included names of individuals known to have ties to the ʻOʻoma vicinity]: …J. Kamaka, Kuakahela, Kahulanui, & Palakiko… [HSA – Roads Hawaii; Maly, translator]

March 9th, 1887
C.N. Arnold, Road Superintendent-in-Chief, Hawaii; to
Chas. Gulick, Minister of the Interior:

[Arnold provides documentation of the early native trail from Kailua to the upper Kohanaiki region, and its' ongoing use at the time. He also notes that McDougall (resident at Honokōhau) and others are presently in the business of dairy ranching]:

…The enclosed petition [cited above] has just come to hand from North Kona. The petitioners are mistaken when they say that any special appropriation has been made for this road as there has never been a Government road in this part of the District. There is however an old native trail which has always been used as a short cut, from the lower part of the district between Keahou [sic] and Kailua, by persons who were traveling to Kawaihae and Waimea. The opening of a good road here would be a great convenience to the traveling public and also a great accommodation to a great many people who live on, or nearly on the line of it. I may mention among the number, Messrs. McDougall and Clark who are engaged in dairy ranching near the head of the proposed line. I may also mention that I, with Mr. Smith, made a preliminary survey of it, at the request of His Majesty the King, who is also interested in the opening of this road, as itopens up all of His Kailua lands for settlement. I regard the road as necessary for the above reasons.

From the preliminary survey made, I estimate that a wagon road 12 feet wide will cost from Kailua to the *mauka* Govt. road at Kohanaiki $6000. The length of the road is 5 ¾ miles. The elevation of highest point (*mauka* Road) is 1600 feet above tide at Kailua. Mr. Smith Supt. of Public Works has all the notes of the survey, and can give you full information in regard to this matter… [HSA – Roads, Hawaii]

July 14th, 1887
C.N. Arnold, Road Superintendent-in-Chief, Hawaii; to
L.A. Thurston, Minister of the Interior:
…In obedience to your request I beg to hand you the following list of the District Supervisors under my jurisdiction:

…North Kona – Hon. J.K. Nahale; Native… [HSA – Roads Hawaii]

March 8, 1888
J. Kaelemkule; Supervisor, North Kona Road Board; to
L.A. Thurston, Minister of the Interior.
[Ka'elemakule provides Thurston with an overview of work on the roads of North Kona, and describes the Government roads (*Ala nui Aupuni* or *Ala loa*) which pass through the Kekaha region]:

The road that runs from Kailua to Kohanaiki, on the north of Kailua, perhaps 6 miles. It is covered with aa stone, and is perhaps one of the worst roads here. The Road Board of North Kona has appropriated $200 for work in the worst areas, and that work has been undertaken and the road improved. The work continues at this time. This is one of the important roads of this district, and it is one of the first roads that should be worked on.

The government road or ala loa from upland Kainaliu (that is the boundary between this district of South Kona) [Kealaehu], runs straight down to Kiholo and reaches the boundary of the district adjoining South Kohala, its length is 20 and 30 miles. With a troubled heart I explain to your Excellency that from the place called Kapalaoa next to South Kohala until Kiholo – this is a very bad section of about 8 miles; This place is always damaged by the animals of the people who travel along this road. The pahoehoe to the north of Kiholo called Ke A. hou, is a place that it is justified to work quickly without waiting. Schedule A, attached, will tell you what is proposed to care for these bad places…

Schedule A: [Appropriations needed]

The road from Kailua to Kohanaiki, and then joining with the inland Government Road – $500.

The upland Road from Kainaliu to the boundary adjoining S. Kohala – $1,500.00. [HSA – Roads Hawaii; Kepā Maly, translator]

September 30, 1889
Thos. Aiu, Secretary, North Kona Road Board (for J. Kaelemakule); to
L.A. Thurston, Minister of the Interior.
[Provides Thurston with an overview of work on the roads of North Kona, and identifies individuals who are responsible for road maintenance (cantoniers) in various portions of the district; several of the individuals named were also old residents and applicants for Homestead lots. Of interest, Kaelemakule's report indicates that maintenance of the Alanui Aupuni which crossed into the kula lands of ʻOʻoma, had not been assigned to anyone. (see report of Dec. 22, 1890)]:

1. In that section of the road which proceeds from Kailua near the shore to Kohanaiki, Mano is the cantonier.
2. That section of the road from Kukuiooohiwai to Keahuolono, Paiwa is the cantonier…
3. That section of road from Kailua to the shore of Honokohau, Keaweiwi is the cantonier …
4. That section of road from Kukuioohiwai to Lanihau along the upland road, Isaac Kihe is the caretaker…

The work done along these sections is the cutting of brush – guava, lantana and such – which trouble the road, and the removal of bothersome stones… [HSA – Roads Hawaii; Kepā Maly, translator]

December 22, 1890
J. Kaelemkule; Supervisor, North Kona Road Board; to
C.N. Spencer, Minister of the Interior
[Reports on the cantoniers assigned to road work in various sections of North Kona. As in 1889, apparently no one was assigned to the lower Alanui Aupuni through the ʻOʻoma kula lands. Though Kaelemakule did include the road section on the land, extending through Kalaoa, on his attached diagram]:

…I forward to you the list of names of the cantoniers who have been hired to work on the roads of this district, totaling 15 sections; showing the alignment of the road and the length of each of the sections. The monthly pay is $4.00 per month, at one day of work each week. The board wanted to increase it totwo days a week, but if that was done, there would not have been enough money as our road tax is only $700.00 for this district… You will receive here the diagram of the roads of North Kona. [HSA – Roads Hawaii; Kepā Maly, translator] (Figure 14)

Twentieth Century Travel in ʻOʻoma and Neighboring lands of Kekaha

Kamaʻāina who have participated in oral history interviews, describe on-going travel between the uplands and coastal lands of ʻOʻoma and other *ahupuaʻa* in Kekaha. The primary method of travel between 1900 and 1947, was by foot or on horse or donkey, and those who traveled the land, were generally residents of the ʻOʻoma, Kalaoa, Kohanaiki Homesteads and other lands in the immediate vicinity. After World War II, retired military vehicles became available to the public, after that time, the *Alanui Aupuni* (Figure 15) and some of the smaller trails along the shore were modified for vehicular traffic.

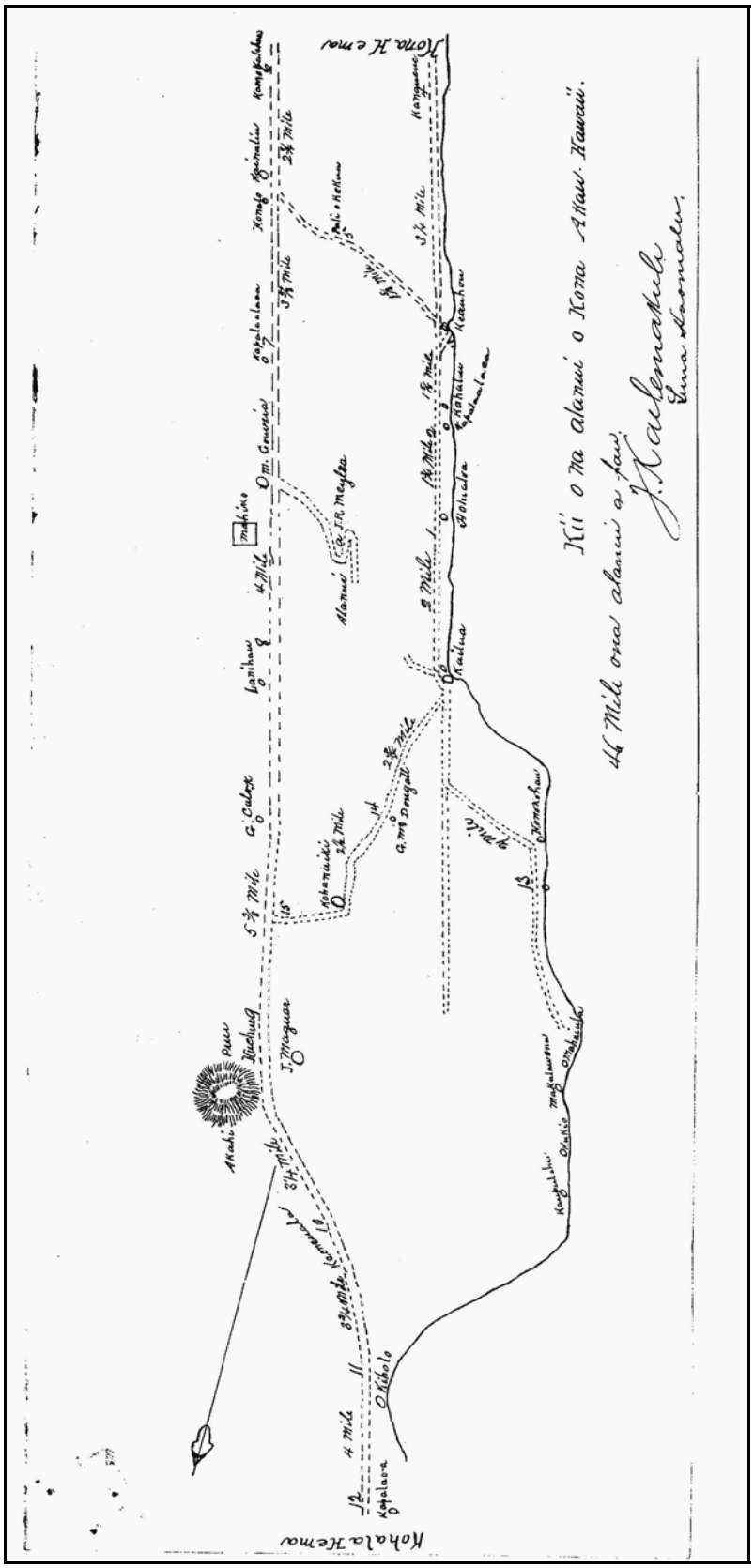

Figure 14. *Kii o na alanui o Kona Akau* (diagram of the roads of North Kona); J. Kaelemakule Sr., Road Supervisor (HSA – Roads, Hawaii; December 22, 1890).

Figure 15. Portion of the *Alanui Aupuni* crossing the *kula kai* lands of ʻOʻoma 2nd; view to Kohanaiki.

The primary routes of travel through the 1960s, descended from upland Kohanaiki and Kaloko, or came out of Kailua. In the 1950s, Huʻehuʻe Ranch bulldozed a jeep road to the shore at Kaloko. The ranch, and some individuals who went to the shore either as a part of their ranch duties, or for leisure fishing along the coast, used this jeep road. The *Alanui Aupuni* was modified from Kailua, to at least as far as Honokōhau and Kaloko, and remained in use through the 1970s. It was not until the Queen Kaʻahumanu Highway was opened (ca. 1973) that travel across the *kula kai* (shoreward plains) of ʻOʻoma was once again made possible for the general public.

ORAL HISTORY INTERVIEWS

Information is presented from six oral history interviews that had been previously conducted by Kepā Maly. One of these interviews was conducted in 1996 and the others between 2000 and 2003. The present author conducted three additional interviews, two in 2005 and one in 2006. Transcripts of the recorded interview are available upon request and are archived with Rechtman Consulting, LLC.

Interview Method

The oral-historical information was collected using a standard interview format that included the following process. Personal and demographic information about each interviewee was obtained, as well as the details about how she or he came to know the lands of ʻOʻoma and the larger Kekaha region. Information was obtained from the interviewee concerning the time and/or place of specific events they recalled The formal interviews were recorded, transcribed, and returned to the interviewees for review, correction, and release-approval. Copies of the final interview transcripts, along with the historical background and summary information were provided to each of the interviewees or their families. The informal interviews were conducted both in person on the land and over the telephone.

All of the interviewees had genealogical ties to early residents of lands within or adjoining the study area. Each is recognized within the community as being someone possessing specific knowledge of lore or historical wisdom pertaining to the lands, families, practices, and land use and subsistence activities in the region, and the older the informant, the greater the likelihood that the individual had personal communications or first-hand experiences with even older, now deceased Hawaiians and area residents.

Readers are asked to keep in mind that while this component of the study records a depth of cultural and historical knowledge of ʻOʻoma and the Kekaha region, by nature, the documentation is incomplete. In the process of conducting oral history interviews, it is impossible to record all the knowledge or information that the interviewees possess. Thus, the records provide only glimpses into the stories being told, and of the lives of the interview participants. Every effort has been made to accurately relay the recollections, thoughts and recommendations of the people who so openly shared their personal histories.

Interview Participants

All of the individuals that participated in the oral history interviews cited in this sudy are directly descended from traditional residents of ʻOʻoma and adjoining lands, and many of the personal recollections date back to the 1920s. The interviewees also benefited from the words of their own elders and extended family members, whose personal recollections dated back to the middle 1800s. Following is a summary of the interviewees.

Valentine K. Ako is of Hawaiian ancestry and was born at Hōlualoa in 1926. He currently resides on Kauaʻi. Interviewed in 1996, *kupuna* Ako visited families and fished at ʻOʻoma and neighboring lands of Kekaha (ca. 1930s-1940s). He is well known for his knowledge of Hawaiian fishing customs and fisheries, and is a member of several cultural committees.

George Kinoulu Kahananui Sr. is of Hawaiian ancestry and was born at Hōlualoa in 1925. Raised from infancy at ʻOʻoma 2nd, he continues to reside on old family land in ʻOʻoma. Uncle Kino regularly traveled the uplands and coastal lands of ʻOʻoma and Kekaha, learned of traditions and practices; and later managed the lands under Huʻehuʻe Ranch. He continues to fish on the coastal lands of ʻOʻoma and Kohanaiki. As a child he farmed the family lands that make up a portion of the current project area, a portion of which he retained ownership of until recently. Uncle Kino is well respected and known for his knowledge of the land, and is a valued resource on a number of cultural committees.

Elizabeth Maluihi Ako Lee is of Hawaiian ancestry and is the sister of Uncle Kino. Auntie Elizabeth was born in 1929 and was raised by her *hanai* family, Kahananui, in upland ʻOʻoma. As a child she walked the upland trails and cultivated sweet potatoes on her family land in ʻOʻoma 2nd Ahupuaʻa, which are now part of the current project area. She is a well-respected *lauhala* weaver and retains valuable cultural knowledge.

Samuel Keanaaina is of Hawaiian ancestry and was born at Kolaoa in 1926, where he remains resident. Descendant of families with generational ties to various lands of the Kekaha region, including ʻOʻoma. *Kupuna* Keanaaina regularly traveled the uplands and coastal lands of ʻOʻoma and Kekaha. He learned of traditions and practices of the families of the land, and was a fisherman in his youth.

Malaea Agnes Keanaaina-Tolentino (with daughter Cynthia Torres) is of Hawaiian ancestry and was born at Kolaoa in 1928. She currently resides in Kealakehe and is the Sister of Samuel Keanaaina, who shared in similar experiences as her brother. She was raised by her grandparents in Honokōhau Nui and as a youth she regularly traveled between the uplands and coastal lands of Honokōhau-Kaloko, Kalaoa-ʻOʻoma and Kohanaiki. Kupuna Malaea has served on several cultural committees and is known for her knowledge of the land.

Ruby Keanaaina McDonald was born at Kalihi on Oʻahu in 1942 and moved to Kona when she was about six years old. *Kūpuna* Keanaaina and Malaea are her uncle and auntie. Ruby grew up with her aunties and uncles in Kona (*mauka* Kalaoa and Hōlualoa) and spent a lot of time with her *kūpuna* listening to their stories and later documenting the family geneology. As a child her experiences on the land in ʻOʻoma included stopovers at the family's *kula* house (Kamaka homestead) on the way to the shore to gather and process *lauhala*. She currently works as the Office of Hawaiian Affairs liason for west Hawaiʻi.

Peter Keka is of Hawaiian ancestry and was born at Waikiʻi in 1940. His family resided for years in the Kalaoa-Kohanaiki-Honokōhau vicinity, and he currently resides in Kohanaiki. Peter traveled the Kekaha region and fished at ʻOʻoma and neighboring lands. He has been employed by the National Park Service and was responsible for the restoration of the Kaloko-Honokōhau fishponds and other cultural sites in the park

Peter Keikuaʻana Park is of Hawaiian ancestry and was born at ʻOʻoma in 1918. He currently resides in Kalaoa 5th. Born and raised in the upland section of ʻOʻoma 2nd he regularly traveled with his grandparents (adoptive parents) to the coastal lands of ʻOʻoma. *Kupuna* Park describes life on the lands and identifies elder families of ʻOʻoma and neighboring lands. He also shares important documentation pertaining to traditions associated with fishing and cultivation of the land. Kupuna Park's elders were noted *lauhala* weavers, a craft that was passed on to him and his sisters, and was an activity that sustained their family. They collected *lauhala* from ʻOhikapua on the *kula* lands of Kalaoa 5th. Kupuna Park is a noted weaver and resource for several cultural programs.

Summary of Oral-Historical Information

Elder *kamaʻāina* of the Kekaha region, tell much the same story as that described in the communications from the period of homestead development, and in the accounts given by J. Puuokupa in 1875 and J.W.H. Isaac Kihe in 1924. By the late 1800s, only a few permanent residence remained along the ʻOʻoma (and Kekaha) coastline. Primary residences were in the uplands, in the vicinity of the old Māmalahoa Highway. In that region, people were able to cultivate a wide range of crops—both native staples and new introductions—with which to sustain themselves, and in some case even as cash crops.

By the middle to late 1800s, the *kula* lands, from around the 900-foot elevation to shore, were primarily used for goat, cattle, and donkey pasturage. The families of the uplands regularly traveled to the coast via trails. This was usually done to go fishing, or to round up cattle, goats, or donkeys. During periods of extreme dry weather, when water resources dried up, the families relied on the brackish water ponds in the near-shore lands. In ʻOʻoma, near Wawaloli, the area marked on J.S. Emerson's Register Maps 1280 (see Figure 7), as Kama's or Keoki Mao's house, families still took shelter, and drank the water from the spring, through the 1940s. Such was the case at various locations of the coast, between Kohanaiki, ʻOʻoma, Kalaoa, Hoʻonā, Kaulana, and lands further north to Kapalaoa.

Near the coastline several sites were described and, during field visits, pointed out by *kūpuna* Peter Kaikuaana Park and George Kinoulu Kahananui. These are also described by other elder *kamaʻāina*. The features included old goat and cattle corrals, old *kahua hale* (house sites), shelters, springs, burial sites, and fishery resources. Except for the old *mauka/makai* trail, the *Alanui Aupuni* (*makai* Government Road – "King's Trail"), and walls, few other features were known by the interviewees on the lower *kula* lands (the area of the current proposed development). This is not surprising as the interviewees observed, when they were young, they were instructed not to wander around, and *mahaʻoi* (poke their noses) into caves and such. Their primary interest while traveling *makai* was to get to the fishing ground, and in reverse, to get back home. In the region of the lower homestead lots (the area of the current project) and above, interviewees have described the occurrence of caves, walls, and various features, including burials. Occasionally, when working the range, rounding up cattle, *huakaʻi pō* or night marchers have been heard, or even seen. The explanation being that the people of old, who once lived on the land, were traveling the trails in one direction or the other to attend to some ceremony or to venture out on fishing journeys, or other such activities. Both Auntie Elizabeth Maluihi Ako Lee and George Kinoulu Kahananui described their family's agricultural practices within portion of the current project area, and their father's use of the *mauka/makai* trails to access the shore for fishing.

When asked about proposed development on the ʻOʻoma lands and in other locations of Kekaha, the interviewees all speak with hesitancy. It is difficult for them to see the landscape that they have known all their lives, and for which traditions were handed down, change. None of the interviewees shared any specific knowledge about traditional cultural resources and associated practices within the boundaries of the current project area. All interviewees believe that *ilina* (burial sites) should be preserved in place; likewise, should any *heiau*, or other important sites be located, they should be protected. Whenever possible all sites, such as house sites, petroglyphs, walls, and other features should be protected.

IDENTIFICATION AND MITIGATION OF POTENTIAL CULTURAL IMPACTS

The OEQC guidelines identify several possible types of cultural practices and beliefs that are subject to assessment. These include subsistence, commercial, residential, agricultural, access-related, recreational, and religious and spiritual customs. The guidelines also identify the types of potential cultural resources, associated with cultural practices and beliefs that are subject to assessment. Essentially these are nature features of the landscape and historic sites, including traditional cultural properties. In the Hawai‘i Revised Statutes–Chapter 6E a definition of traditional cultural property is provided.

> "Traditional cultural property" means any historic property associated with the traditional practices and beliefs of an ethnic community or members of that community for more than fifty years. These traditions shall be founded in an ethnic community's history and contribute to maintaining the ethnic community's cultural identity. Traditional associations are those demonstrating a continuity of practice or belief until present or those documented in historical source materials, or both.

The origin of the concept of traditional cultural property is found in National Register Bulletin 38 published by the U.S. Department of Interior-National Park Service. "Traditional" as it is used, implies a time depth of at least 50 years, and a generalized mode of transmission of information from one generation to the next, either orally or by act. "Cultural" refers to the beliefs, practices, lifeways, and social institutions of a given community. The use of the term "Property" defines this category of resource as an identifiable place. Traditional cultural properties are not intangible, they must have some kind of boundary; and are subject to the same kind of evaluation as any other historic resource, with one very important exception. By definition, the significance of traditional cultural properties should be determined by the community that values them.

It is however with the definition of "Property" wherein there lies an inherent contradiction, and corresponding difficulty in the process of identification and evaluation of potential Hawaiian traditional cultural properties, because it is precisely the concept of boundaries that runs counter to the traditional Hawaiian belief system. The sacredness of a particular landscape feature is often times cosmologically tied to the rest of the landscape as well as to other features on it. To limit a property to a specifically defined area may actually partition it from what makes it significant in the first place. However offensive the concept of boundaries may be, it is nonetheless the regulatory benchmark for defining and assessing traditional cultural properties. As the OEQC guidelines do not contain criteria for assessing the significance for traditional cultural properties, this study will adopt the state criteria for evaluating the significance of historic properties, of which traditional cultural properties are a subset. To be significant the potential historic property or traditional cultural property must possess integrity of location, design, setting, materials, workmanship, feeling, and association and meet one or more of the following criteria:

A Be associated with events that have made an important contribution to the broad patterns of our history;

B Be associated with the lives of persons important in our past;

C Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value;

D Have yielded, or is likely to yield, information important for research on prehistory or history;

E Have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with 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.

While it is the practice of the DLNR-SHPD to consider most historic properties significant under Criterion D at a minimum, it is clear that traditional cultural properties by definition would also be significant under

Criterion E. A further analytical framework for addressing the preservation and protection of customary and traditional native practices specific to Hawaiian communities resulted from the *Ka Paʻakai O Kaʻāina* v Land Use Commission court case. The court decision established a three-part process relative to evaluating such potential impacts: first, to identify whether any valued cultural, historical, or natural resources are present; and identify the extent to which any traditional and customary native Hawaiian rights are exercised; second, to identify the extent to which those resources and rights will be affected or impaired; and third, specify any mitigative actions to be taken to reasonably protect native Hawaiian rights if they are found to exist.

As a result of the numerous archaeological studies conducted within the current project area, fifty-two historic properties (Table 2) are recognized by DLNR-SHPD to retain the potential to be impacted by the proposed development activities. These impacts could be direct, as the result of development activities; or indirect, resulting from increased access and site visitation traffic. The DLNR-SHPD approved treatment for fouteen of these sites is preservation and thirty-eight will be mitigated through data recovery.

Table 2. Historic properties that might be impacted by the proposed development activities.

SIHP No.	*Function*	*Temporal Association*	*Significance*	*Recommended Treatment*
16103	Burial	Precontact	D, E	Preservation
16105	Burial	Precontact	D, E	Preservation
16126	Boundary	Historic	A, D	Preservation
16127	Habitation/Agricultural	Precontact	D	Data recovery
16128	Burial	Precontact	D, E	Preservation
16131	Habitation	Precontact	D	Data recovery
24413	Burial	Precontact	D, E	Preservation
24417	Habitation	Precontact	D	Data recovery
24418	Agriculture/clearing	Precontact	D	Data recovery
24420	Habitation	Precontact/Historic	D	Data recovery
24424	Water collection	Precontact	D, E	Preservation
24762	Habitation	Precontact	D	Data recovery
24764	Habitation	Precontact	D	Data recovery
24768	Burial/Habitation	Precontact	D, E	Preservation
24773	Habitation	Precontact	D	Data Recovery
24774	Boundary	Historic	A, D	Preservation
24776	Agriculture	Precontact	D	Data recovery
25035	Habitation	Precontact	D	Data recovery
25036	Habitation	Precontact	D	Data recovery
25037	Habitation	Precontact	D	Data recovery
25038	Habitation	Precontact	D	Data recovery
25039	Habitation	Precontact	D	Data recovery
25040	Habitation	Precontact	D	Data recovery
25041	Habitation	Precontact	D	Data recovery
25042	Habitation	Precontact	D	Data recovery
25043	Habitation	Precontact	D	Data recovery
25044	Habitation	Precontact	D	Data recovery
25045	Habitation	Precontact	D	Data recovery
25046	Habitation	Precontact	D	Data recovery
25047	Habitation	Precontact	D	Data recovery
25048	Habitation	Precontact	D	Data recovery
25049	Habitation	Precontact	D	Data recovery
25050	Habitation	Precontact	D	Data recovery
25051	Habitation	Precontact	D	Data recovery
25052	Habitation	Precontact	D	Data recovery
25053	Habitation	Precontact	D	Data recovery
25054	Habitation	Precontact	D	Data recovery
25055	Habitation	Precontact	D	Data recovery

continued on next page

Table 2. Cont.

SIHP No.	*Function*	*Temporal Association*	*Significance*	*Recommended Treatment*
25056	Habitation	Precontact	D	Data recovery
25057	Habitation	Precontact	D	Data recovery
25058	Habitation	Precontact	D	Data recovery
25059	Habitation	Precontact	D	Data recovery
25060	Habitation	Precontact	C, D	Preservation
25061	Habitation	Precontact	D	Data recovery
25062	Habitation	Precontact	D	Data recovery
25063	Habitation	Precontact	D	Data recovery
25065	Habitation	Precontact	D	Data recovery
25067	Habitation	Precontact	D, E	Preservation
25069	Burial	Precontact	D, E	Preservation
25070	Burial	Precontact	D, E	Preservation
25071	Burial	Precontact	D, E	Preservation
25072	Burial	Precontact	D, E	Preservation

For the nine sites containing burials, which are significant under both criterion D and E, all will be preserved pursuant to a burial treatment plan prepared in consultation with recognized descedants and the Hawai‘i Island Burial Council. The five other preservation sites, all significant under multiple criteria (A and D, Cand D, E and D), will be treated in accordance with a preservation plan submitted to and approved by DLNR-SHPD prior to final subdivision approval. Development activities will not commence until the site protection measures and stewardship aspects of these preservation plans are implemented. One of these sites is the former homestead road, and this site will be integrated into the development plans and preserved as a pedestrian walkway within open space and connected to a community park.

To mitigate the potential impacts to the thirty-eight archaeological sites approved for data recovery, an archaeological data recovery plan will be submitted to and approved by DLNR-SHPD prior to the commencement of any ground-altering development activies within the project area.

There were no ongoing cultural practices identified relative to the land within the proposed development area. However, based on past native Hawaiian traditional practices, the lava tube site with extensive water collection features (SIHP Site 24424) should be considered a traditional cultural property. This site will be preservation and protected from both direct and indirect impacts as detailed in a preservation plan, prepared in consultation with descendants of the area, and submitted to and approved by DLNR-SHPD.

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Appendix M

TRAFFIC STUDY
FOR THE
KULA NEI RESIDENTIAL DEVELOPMENT

NORTH KONA, ISLAND OF HAWAII, HAWAII

MAY 2007

PREPARED FOR

TSG O'OMA, L.P.

PREPARED BY

FEHR & PEERS
KAKU ASSOCIATES

TRAFFIC STUDY
FOR THE
KULA NEI RESIDENTIAL DEVELOPMENT
NORTH KONA, ISLAND OF HAWAII, HAWAII

May 2007

Prepared for:

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I. INTRODUCTION

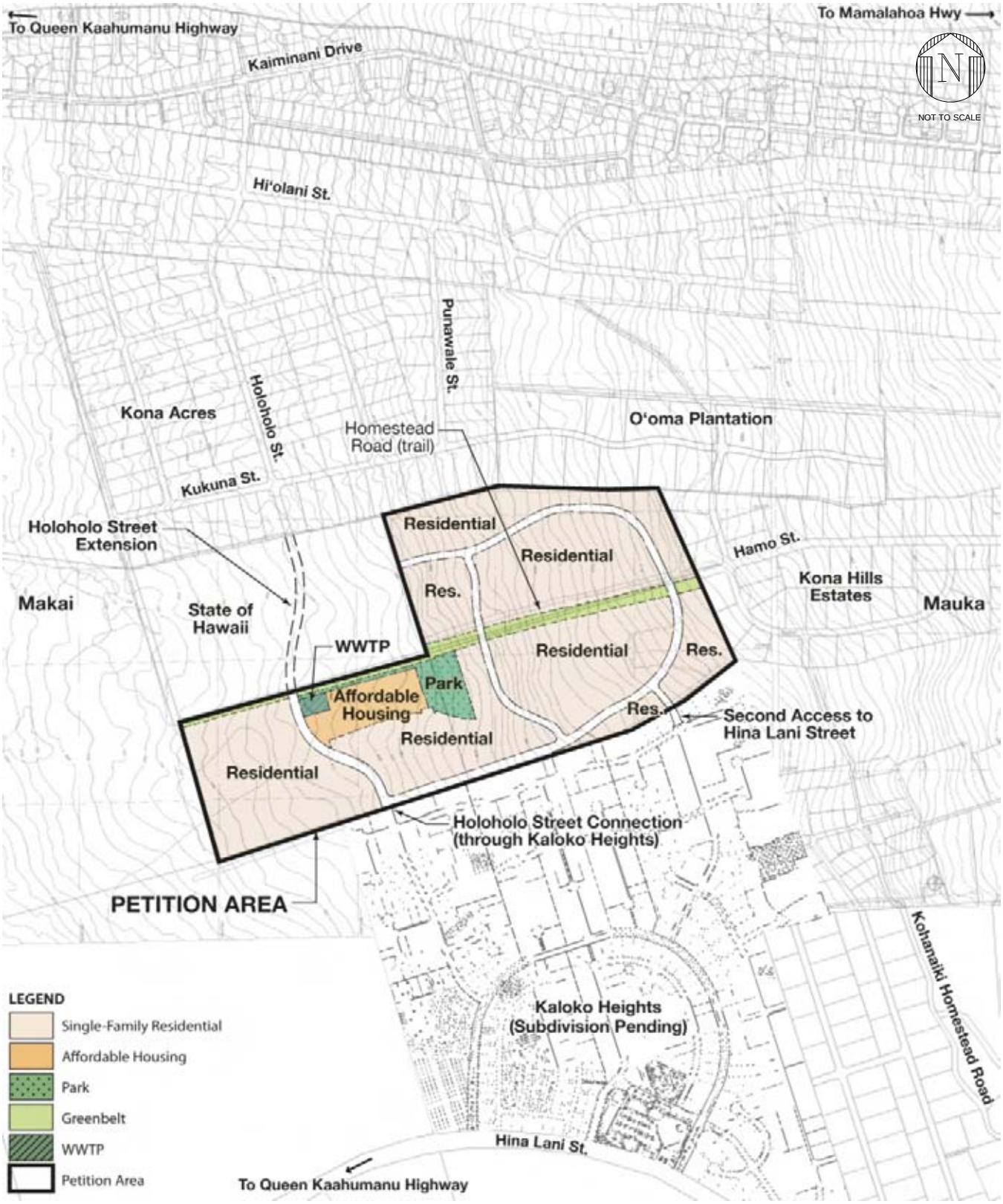
This report documents the results of a traffic study conducted by Fehr & Peers/Kaku Associates to evaluate the potential traffic impacts associated with the proposed residential development located in the Kalaoa area of North Kona on the island of Hawaii (project). It includes a description of the assumptions and methods used to conduct the study as well as a discussion of the results.

PROJECT DESCRIPTION

The proposed Kula Nei project involves the construction of 270 dwelling units of single-family residential and 2.5 acres of open space with a completion year of 2017. The site plan for the proposed project is provided in Figure 1. The currently undeveloped project site is located in the Kalaoa area of North Kona on the island of Hawaii, just north of the approved Kaloko Heights/Stanford Carr development project (formerly known as the Y.O. Partners development project). The site is mauka of Queen Kaahumanu Highway (SR 19), makai of Mamalahoa Highway (also known as SR 190 and the Hawaii Belt Road) and the gated community Kona Hills Estates, north of Hina Lani Street, and south of Kaiminani Drive. As shown in Figure 1, primary access will be provided by the planned Kealakaa Street/Holoholo Street extension across Hina Lani Street through Kaloko Heights/Stanford Carr Development. Secondary access roads will be linked by a second access route to Hina Lani Street through the Kaloko Heights/Stanford Carr development and by the planned Kealakaa Street/Holoholo Street extension across vacant state land to Kaiminani Drive.

STUDY SCOPE

The study analyzes the potential project-related traffic impacts on the roadway system in the vicinity of the proposed project. While the projected completion year of the proposed project is 2017, for planning purposes, the study evaluates projected 2020 conditions. The impact



Source: Belt Collins Hawaii

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FIGURE 1
SITE PLAN

analysis examines projected future conditions, both with and without the proposed project. The following traffic scenarios are analyzed in the study:

- Existing Conditions (2006) - The analysis of existing traffic conditions provides a basis for the remainder of the study. The existing conditions analysis includes an assessment of streets, traffic volumes, and operating conditions.

- Cumulative Base (No Project) Conditions (2020) - The objective of this scenario is to project future traffic growth and operating conditions resulting from regional growth and related projects in the vicinity of the project site, without consideration of traffic generated by the proposed project.

- Cumulative plus Project Conditions (2020) - The objective of this scenario is to project potential impacts of the proposed project on future traffic operating conditions with project traffic added to the cumulative base traffic forecasts in 2020.

The study analyzed the potential project-related traffic impacts during the typical weekday a.m. and p.m. peak hour traffic conditions at six intersections in the vicinity of the proposed project. The analyzed intersections are illustrated in Figure 2 and are as follows:

1. Kaiminani Drive and Queen Kaahumanu Highway (SR 19) (signalized)
2. Kaiminani Drive and Holoholo Street (stop-controlled)
3. Kaiminani Drive and Mamalahoa Highway (SR 190) (stop-controlled)
4. Hina Lani Street and Mamalahoa Highway (SR 190) (signalized)
5. Hina Lani Street and Kealakaa Street/Holoholo Street (future intersection)
6. Hina Lani Street and Queen Kaahumanu Highway (SR 19) (signalized)

The effect of the proposed on daily traffic volumes was also measured on the following four street segments, which are also shown in Figure 2:

1. Kaiminani Drive mauka of Queen Kaahumanu Highway (SR 19)
2. Hina Lani Street mauka of Queen Kaahumanu Highway (SR 19)
3. Mamalahoa Highway north of Kaalele Street (SR 190)
4. Mamalahoa Highway south of Hina Lani Street (SR 190)

New baseline traffic counts were collected at these locations (except for study intersection #5, which is a future intersection) in September 2006.

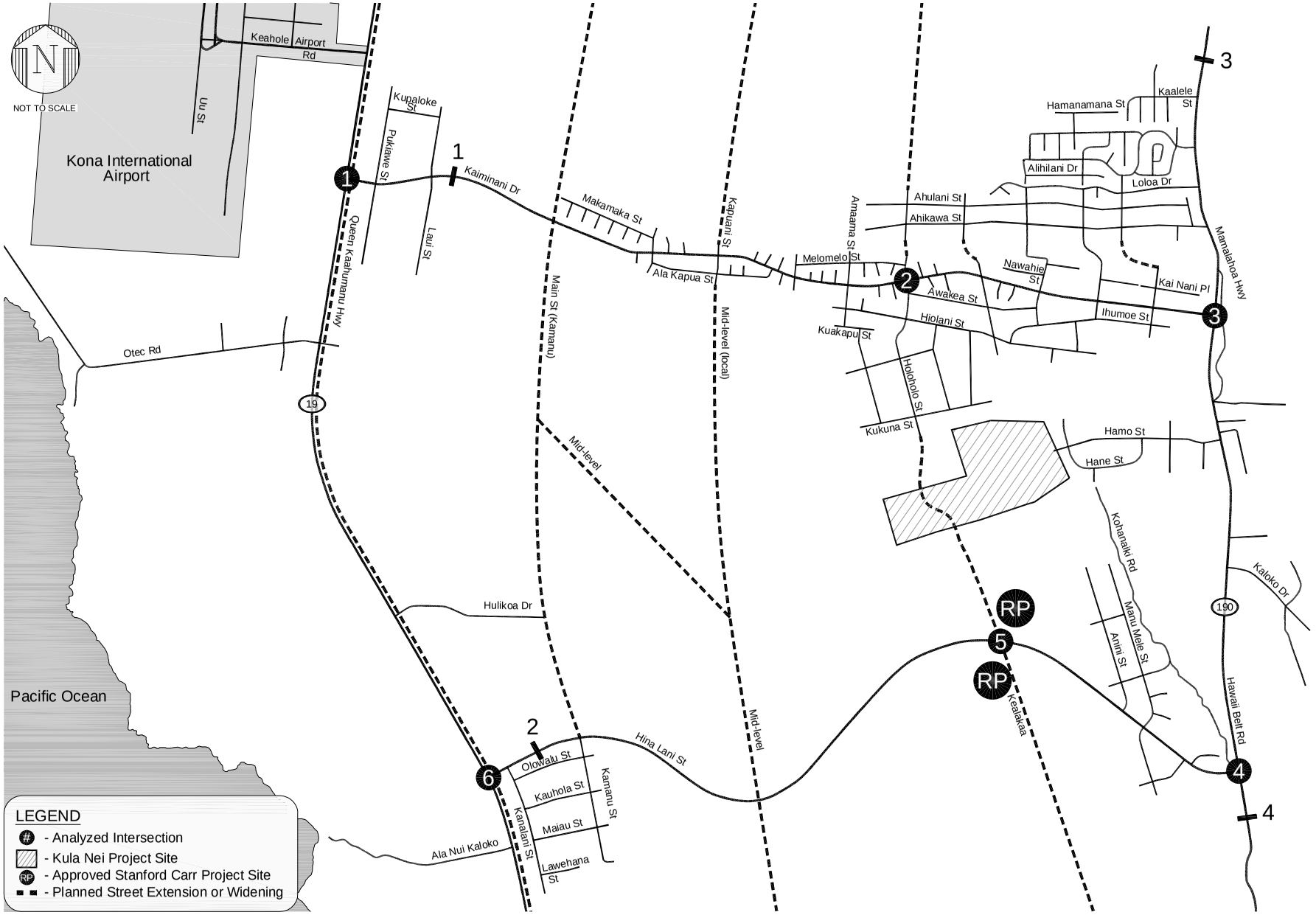

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FIGURE 2
STUDY AREA AND ANALYZED LOCATIONS

ORGANIZATION OF REPORT

This report is divided into seven chapters, including this introduction. Chapter II describes the existing circulation system, traffic volumes, and operating conditions in the study area and presents planned transportation improvements provided. The methodologies used to forecast future cumulative and project traffic volumes and the resultant forecasts are described in Chapter III. Chapter IV presents an assessment of potential traffic impacts and identifies the need for cumulative and project-specific traffic mitigation measures. Estimates of the project's fair share contribution to the identified mitigation measures are also presented in Chapter IV. Chapters V and VI provide a discussion of alternative future scenarios and their transportation impacts related to the proposed project. Finally, the conclusions of the study are summarized in Chapter VII.

II. EXISTING CONDITIONS

A comprehensive data collection effort was undertaken to identify existing transportation conditions in the vicinity of the proposed project. The assessment of existing conditions relevant to this study includes an inventory of the street and highway system, traffic volumes on these facilities, and operating conditions at key intersections and street segments.

EXISTING ROADWAY SYSTEM

The study area, as shown in Figure 2, is generally bounded by Kaiminani Drive on the north, Queen Kaahumanu Highway (SR 19) on the west, Hina Lani Street on the south, and Mamalahoa Highway (SR 190) on the east. The street system in the study area is illustrated in Figure 2. Primary regional access to the area is provided by Queen Kaahumanu Highway, which runs north-south approximately two miles makai of the project site and Mamalahoa Highway (SR 190), which runs north-south approximately one mile mauka of the project site. Kaiminani Drive and Hina Lani Street, running east-west, provide access to these highways from the project site. Holoholo Street and the proposed Kealakaa Street/Holoholo Street extension will serve the project site by providing direct access to Kaiminani Drive and Hina Lani Street. Direct access to Mamalahoa Highway through Hamo Street is not possible because Kona Hills Estates is a gated community. Diagrams of the existing intersection lane configurations at the five existing study intersections are provided in Appendix A.

EXISTING TRAFFIC VOLUMES AND OPERATING CONDITIONS

The following sections present the existing peak hour traffic volumes at the study intersections, daily street segment traffic volumes, a description of the methodology used to analyze operating conditions, and the resulting level of service (LOS) at each location under existing conditions.

Existing Peak Hour Traffic Volumes

New weekday peak period intersection turning movement counts were collected between 6:00 and 9:00 a.m. and between 3:00 and 6:00 p.m. at the five existing study intersections on Tuesday, September 12 and Wednesday, September 13, 2006. Existing weekday peak hour volumes at these intersections are illustrated in Figure 3 and the traffic count data sheets are provided in Appendix B.

Existing Daily Street Segment Traffic Volumes

24-hour machine counts were conducted at the following four street segments for analysis of impacts of the proposed project on September 13, 2006. The existing daily traffic volume data are available in Appendix B. The four street segments are:

- Kaiminani Drive mauka of Queen Kaahumanu Highway (SR 19)
- Hina Lani Street mauka of Queen Kaahumanu Highway (SR 19)
- Mamalahoa Highway north of Kaalele Street (SR 190)
- Mamalahoa Highway south of Hina Lani Street (SR 190)

Level of Service Methodology

LOS is a qualitative measure used to describe the condition of traffic flow ranging from excellent conditions at LOS A to overload conditions at LOS F. Level of service definitions for signalized and unsignalized intersections are provided in Tables 1 and 2. LOS D is typically considered to be the minimum desirable level of service in urban areas.

LOS analyses were conducted at each of the study intersections to determine existing and future operating conditions using the operations methodology for signalized intersections and the two-way stop-controlled methodology for unsignalized intersections from *2000 Highway Capacity Manual* (2000 HCM) (Transportation Research Board, 2000).

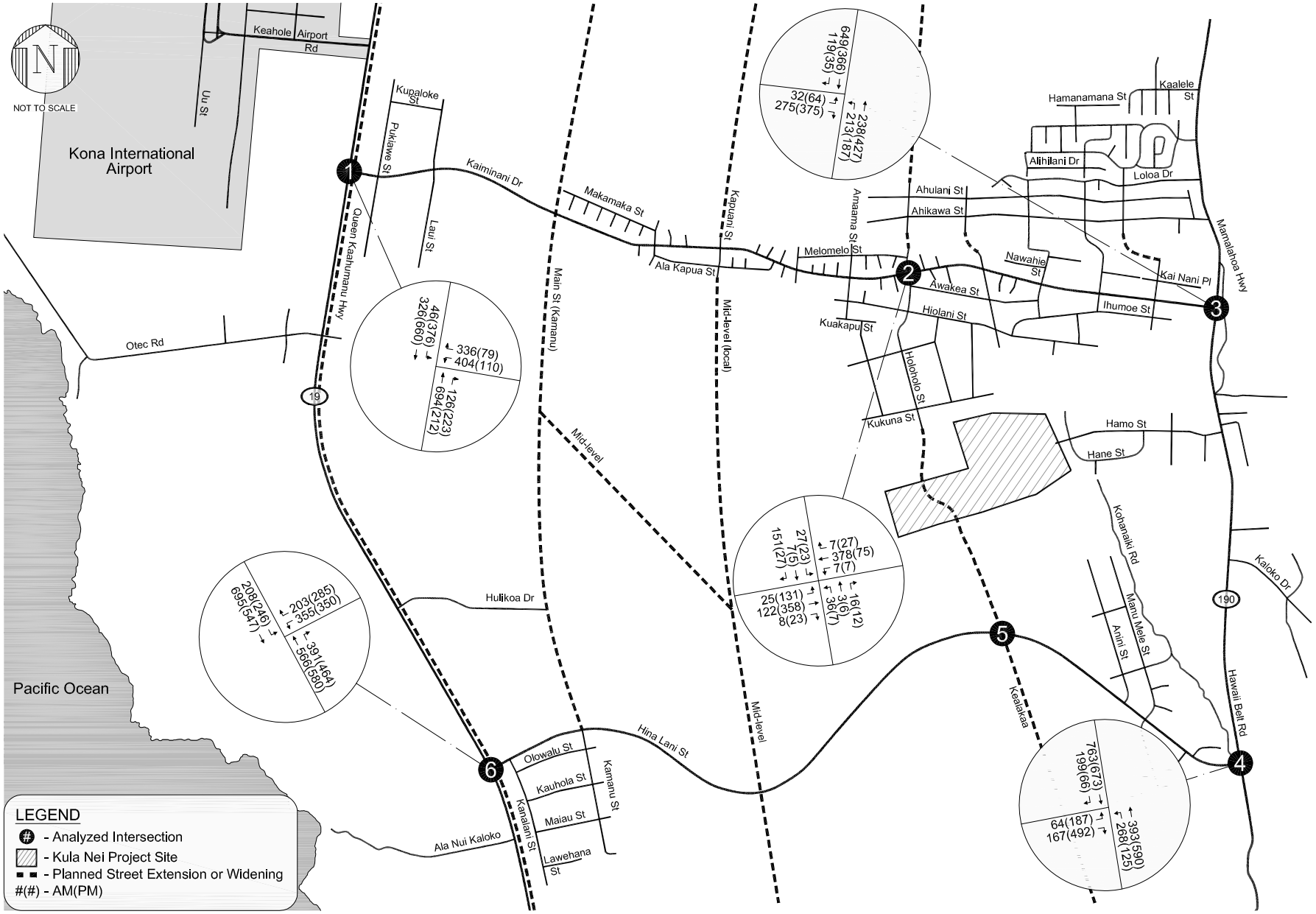

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FIGURE 3
EXISTING PEAK HOUR TRAFFIC VOLUMES

TABLE 1
LEVEL OF SERVICE DEFINITIONS FOR SIGNALIZED INTERSECTIONS

Level of Service	Volume/Capacity	Average Stopped Delay per Vehicle (seconds)*
A	0.000 - 0.600	≤10
B	>0.600 - 0.700	>10 and ≤20
C	>0.700 - 0.800	>20 and ≤35
D	>0.800 - 0.900	>35 and ≤55
E	>0.900 - 1.000	>55 and ≤80
F	> 1.000	>80

Source: Highway Capacity Manual (Transportation Research Board, 2000).

TABLE 2
LEVEL OF SERVICE DEFINITIONS FOR UNSIGNALIZED INTERSECTIONS

Level of Service	Average Total Delay (seconds/vehicle)
A	$\leq$ 10.0
B	> 10.0 and $\leq$ 15.0
C	> 15.0 and $\leq$ 25.0
D	> 25.0 and $\leq$ 35.0
E	> 35.0 and $\leq$ 50.0
F	> 50.0

Source: Highway Capacity Manual (Transportation Research Board, 2000).

Existing Peak Hour Intersection Levels of Service

The existing weekday a.m. and p.m. peak hour turning movements depicted in Figure 3 were used in conjunction with the LOS methodologies described above to determine existing operating conditions at each study intersection. Detailed LOS calculation worksheets are included in Appendix C.

Table 3 summarizes the results of the analysis conducted at the five existing locations to assess the existing operating conditions at these intersections, including the average control delay and corresponding LOS for the five existing study intersections during the a.m. and p.m. peak hours. Calculated volume-to-capacity (V/C) ratios are also shown in Table 3. As indicated in Table 3, one of the five existing study intersections is currently operating at LOS F during both the a.m. and p.m. peak hours:

- Mamalahoa Highway and Kaiminani Drive

The remaining four existing study intersections are operating at LOS D or better during the a.m. and p.m. peak hours.

TABLE 3
YEAR 2006 EXISTING CONDITIONS
PEAK HOUR LEVELS OF SERVICE

Intersections	Peak Hour	V/C	Del/Veh*	LOS
1. Queen Kaahumanu Hwy (SR 19) & Kaiminani Dr	A.M. P.M.	0.872 0.552	30 16	C B
2. Holoholo St & Kaiminani Dr [a]	A.M. P.M.	NC NC	18 15	C B
3. Mamalahoa Hwy (SR 190) & Kaiminani Dr [a]	A.M. P.M.	NC NC	** **	F F
4. Mamalahoa Hwy (SR 190) & Hina Lani St	A.M. P.M.	0.854 0.952	24 38	C D
5. Kealaka St/Holoholo St & Hina Lani St [b]	A.M. P.M.	NA NA	NA NA	NA NA
6. Queen Kaahumanu Hwy (SR 19) & Hina Lani St	A.M. P.M.	0.858 0.890	30 34	C C

Note:

* Delay indicates average stopped delay per vehicle in seconds for signalized intersections. The worst case vehicular delay is reported for stop-controlled intersections.

** Indicates oversaturated conditions. Delay cannot be calculated.

NA = Not Applicable

NC = Not Calculated

[a] Intersection is controlled by stop signs on the minor approaches.

[b] Future intersection.

III. FUTURE TRAFFIC PROJECTIONS

In order to evaluate the potential impact of traffic generated by the proposed project on the surrounding street system, it was necessary to develop estimates of future traffic conditions in the area both with and without the project. Future traffic conditions without the proposed project reflect traffic increases due to general regional growth and development as well as traffic increases generated by other specific developments in the vicinity of the project site. These conditions are referred to as the cumulative base condition (i.e., no project conditions). The sum of the cumulative base and project generated traffic represents the cumulative plus project conditions. Development of these future 2020 traffic scenarios conditions is described in this chapter.

CUMULATIVE BASE TRAFFIC PROJECTIONS

The cumulative base traffic projections include two elements. The first element is growth in the existing background traffic volumes reflecting the effects of overall regional growth and development in and around the study area, referred to as ambient growth. The second is the traffic generated by specific cumulative projects located in or near the study area.

Areawide Traffic Growth

Traffic projections were estimated for this study on the basis of actual traffic growth on Queen Kaahumanu Highway (SR 19) and Mamalahoa Highway (SR 190) between 1998 and 2004, which shows that peak hour traffic volumes have increased at a rate of approximately 5% per year during the period. Accordingly, the 2006 existing traffic count data were increased by a total of 70% (5% per year x 14 years) through 2020, as shown in Table 4.

TABLE 4
ESTIMATED TRAFFIC GROWTH
KULA NEI RESIDENTIAL PROJECT

	A.M. Peak Hour			P.M. Peak Hour		
	In	Out	Total	In	Out	Total
Existing (2006)						
Total Northbound and Southbound Volume in Study Area (SR19 and SR 190)	2,758	3,280	6,038	3,196	2,844	6,040
Future (2020)						
Kula Nei Project*	51	152	203	172	101	273
Stanford Carr Property**	278	777	1,055	941	599	1,540
Ambient Growth	1,602	1,367	2,969	1,124	1,291	2,415
Total Increased Northbound and Southbound Volume in Study Area (All Roads)	1,931	2,296	4,227	2,237	1,991	4,228

Note:
The study area is defined in Chapter I.
2020 Future Trip Generation is based on 70% areawide growth rate discussed in Chapter II.
* See Table 6 for details
** See Table 5 for details

Traffic Generation of Cumulative Development Projects

Information regarding potential future projects that are either under construction, planned, or proposed for development within or near the study area was obtained from several sources. There is one related project identified in the immediate study area, the Stanford Carr project just south of the proposed Kula Nei project. This approved project will construct 1,093 single-family residences, 340 multi-family dwelling units and 5.5 acres of commercial development on the north and south sides of Hina Lani Street (*Land Use Petition* [Docket No. A81-525], Y-O Limited Partnership, January 1983). As summarized in Table 5, it is estimated to generate approximately 1,055 trips during the morning peak hour (278 inbound, 777 outbound) and approximately 1,540 trips during the evening peak hour (941 inbound, 599 outbound).

The geographic distribution of traffic generated by developments such as this depends on several factors. These factors include the type and density of the proposed land uses, the geographic distribution of the population from which employees and/or patrons may be drawn, the geographic distribution of activity centers (employment, commercial, and other) to which residents of proposed residential projects may be drawn, and its location in relation to the surrounding street system.

The resulting cumulative base traffic volumes, representing future conditions without the project for year 2020, are presented in Figure 4. These future projections take into account the estimated overall growth in the surrounding area without the addition of traffic generated by the proposed Kula Nei project.

Baseline Street System Improvements

Several key roadway improvements in or near the study area are planned for completion by 2020. These improvements, whether the result of local capital improvement programs or being made in connection with planned or approved projects, would result in dramatically improved mobility options for residents and visitors and in capacity changes at various locations throughout the study area. Relevant information from *Keahole to Honaunau Regional Circulation Plan* (Planning Department, County of Hawaii, August 2006) is presented in Figure 5 and in Appendix D. It shows that the following roadway system improvements are planned:

TABLE 5
TRIP GENERATION ESTIMATES FOR RELATED PROJECTS

Index	Project Location	Project Description	ITE	SIZE	A.M. Peak Hour			P.M. Peak Hour		
					In	Out	Total	In	Out	Total
1	Stanford Carr*	SINGLE FAMILY RESIDENTIAL	210	1,093 DU	205	615	820	696	408	1,104
2	Stanford Carr*	MULTIPLE FAMILY RESIDENTIAL	220	340 DU	35	138	173	137	74	211
3	Stanford Carr*	COMMERCIAL	820	60 KSF**	38	24	62	108	117	225
				Total	**278**	**777**	**1,055**	**941**	**599**	**1,540**

Sources:

* Total trip generation was estimated using *Trip Generation, 7th Edition* (ITE, 2003) based on the Land Use Petition submitted by Y-O Limited Partnership in 1983.

** Assume 5.5 acres of commercial development will be developed at a 0.25 Floor Area Ratio.

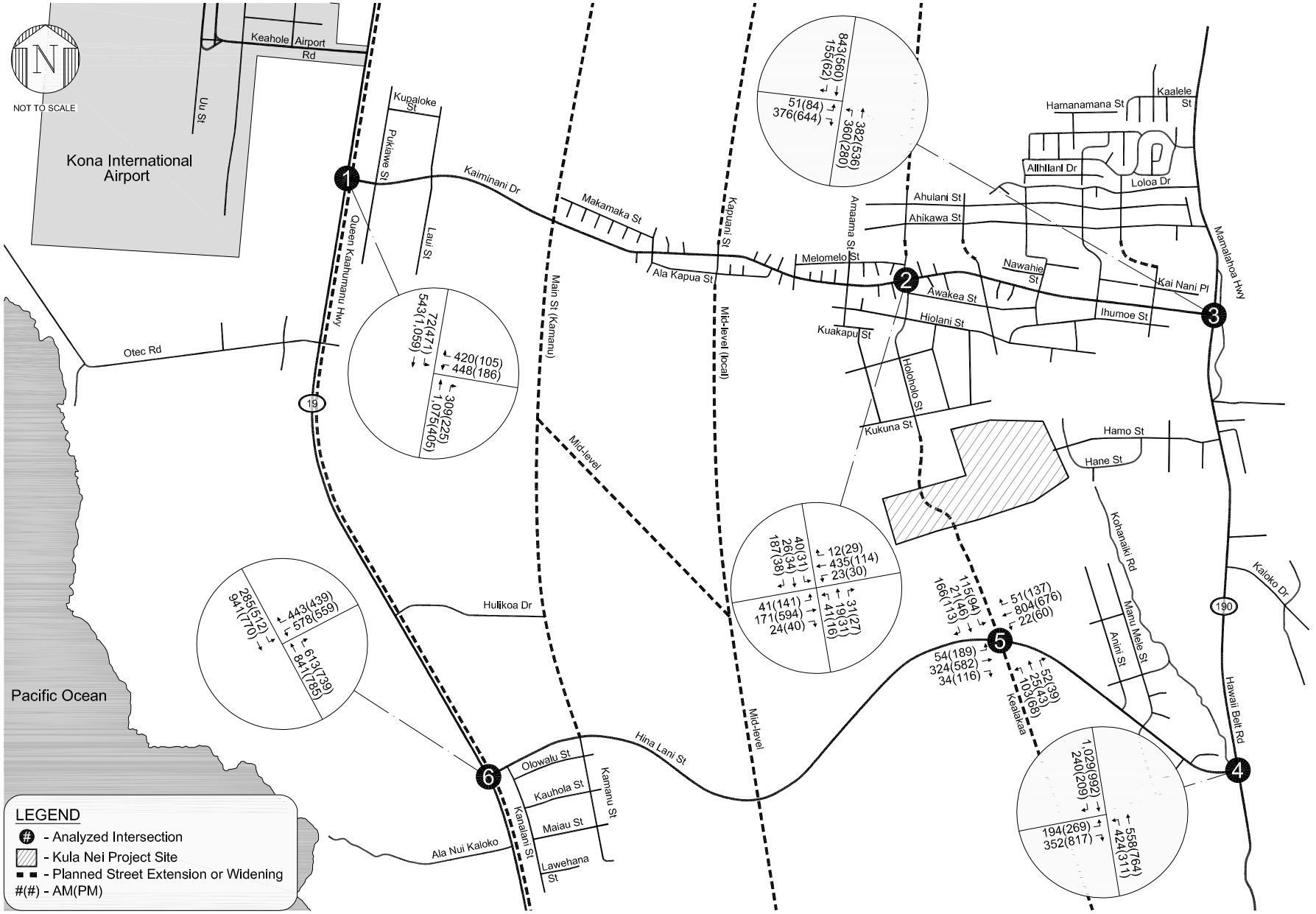

FIGURE 4
CUMULATIVE BASE PEAK HOUR TRAFFIC VOLUMES

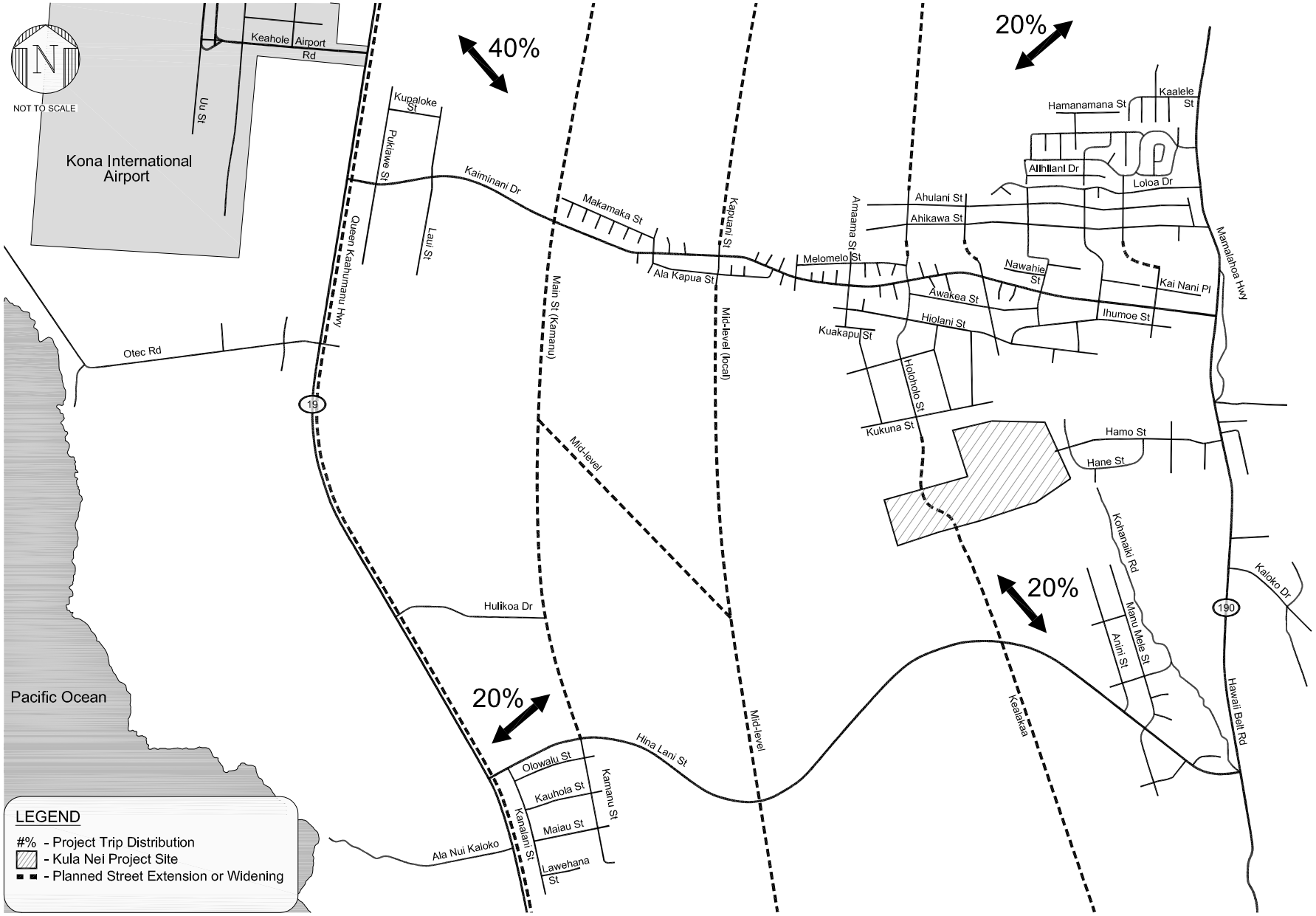

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FIGURE 5
PROJECT TRIP DISTRIBUTION

- Queen Kaahumanu Highway – The main arterial highway through Kailua-Kona is currently being widened from two to four lanes (two in each direction) with a median from Kona International Airport to Henry Street in Kailua.

- Main Street (Kamanu Street) – Kamanu Street will be extended to connect with Kealakehe Parkway and north to the proposed University Drive.

- Mid-Level Road – This project will extend Henry Street from Palani Road to the Ane Keohokalole Highway and north to the proposed University Drive Extension.

- University Drive – The proposed street planned north of Kaiminani Drive would carry mauka-makai traffic between Queen Kaahumanu Highway and Mamalahoa Highway by connecting with the existing Makalei Drive.

- University Drive Extension – This project will extend the proposed Mid-Level (Local) Road to connect with Mamalahoa Highway north of the existing intersection of Makalei Drive and Mamalahoa Highway.

- Kealakaa Street/Holoholo Street Extension – The proposed street would connect to the proposed Kealakehe Parkway, Hina Lani Street, and Holoholo Street.

- Kalaoa Connector Roads – In order to connect two major subdivisions, Kona Palisades and Coastview, four internal connector roads would be established: Nana Street-Holoholo Street, Ahiahi Street-Kauhale Street, Holu Street-Keokeo Street, and Iliili Street-Kiekie Street.

- Intersection of Mamalahoa Highway and Kaiminani Drive – A new right turn lane on Kaiminani Drive to Mamalahoa Highway will be installed with estimated completion in June 2007.

- Intersection of Kealakaa Street/Holoholo Street and Hina Lani Street – A new intersection will be established when the project and the developments adjacent to the project open.

Cumulative Base Traffic Volumes

Forecasts of cumulative base traffic volumes were developed by adding the total projected traffic growth to the background existing volumes and distributing it over the future street network. Estimated traffic shifts for the 2020 horizon year were developed based on field observations and current and future land use patterns. It was estimated that approximately 9% of the vehicles traveling through Queen Kaahumanu Highway and Mamalahoa Highway would divert to the planned new roads described above that will be parallel to these highways. The resulting traffic volumes at the analyzed intersections, as illustrated in Figure 4, represent the 2020 projected cumulative base conditions, i.e., future conditions without the project.

PROJECT TRAFFIC PROJECTIONS

Development of future traffic projections for the proposed project involved a three-step process. This process included the estimation of project trip generation, trip distribution, and trip assignment.

Project Trip Generation

Trip generation rates found in *Trip Generation, 7th Edition* (Institute of Transportation Engineers, 2003) were used to estimate number of trips to and from the proposed Kula Nei project. The trip generation rates used in this study and the estimated new trips generated by the proposed project are summarized in Table 6.

As shown in Table 6, the project is estimated to generate about 2,584 daily trips, including approximately 203 trips during the morning peak hour (51 inbound and 152 outbound) and approximately 273 trips during the evening peak hour (172 inbound and 101 outbound).

Project Trip Distribution and Trip Assignment

Factors considered in the development of the project trip distribution include a review of historic traffic volume data in the area, observations of existing traffic patterns and discussions with residents, the geographic distribution of employment and commercial activity in the vicinity, and the proposed street extension program described in *Keahole to Honaunau Regional Circulation Plan*. Based on these factors, the following trip distribution pattern was estimated for the project-generated traffic and is illustrated in Figure 5:

- Northwest 40%
- Northeast 20%
- Southwest 20%
- Southeast 20%

TABLE 6
PROJECT TRIP GENERATION ESTIMATES
KULA NEI RESIDENTIAL PROJECT

Trip Generation Rates and Estimates							
Land Use	**Daily**	**A.M. Peak Hour**			**P.M. Peak Hour**		
		% In	**% Out**	**Rate**	**% In**	**% Out**	**Rate**
Rates							
Single Family Residential - Trips per Dwelling Unit	9.57	25%	75%	0.75	63%	37%	1.01
Estimated Trips 270 DU	2,584	51	152	203	172	101	273

Source: Trip Generation, 7th Edition (Institute of Transportation Engineers, 2003), Land Use Code 210.

The project trip assignment took into account the roadway network planned to be in place by 2020, when the project would be fully built out, including the fact that the planned YO/Stanford Carr project will construct two new streets connecting to Hina Lani Street. Figure 6 illustrates the assignment of new project-related traffic at each study intersection.

CUMULATIVE PLUS PROJECT TRAFFIC PROJECTIONS

The project-generated traffic volumes were added to the cumulative base traffic projections to develop the cumulative plus project traffic forecasts for 2020. Figure 7 illustrates the projected cumulative plus project a.m. and p.m. peak hour traffic volumes at each of the six study intersections.

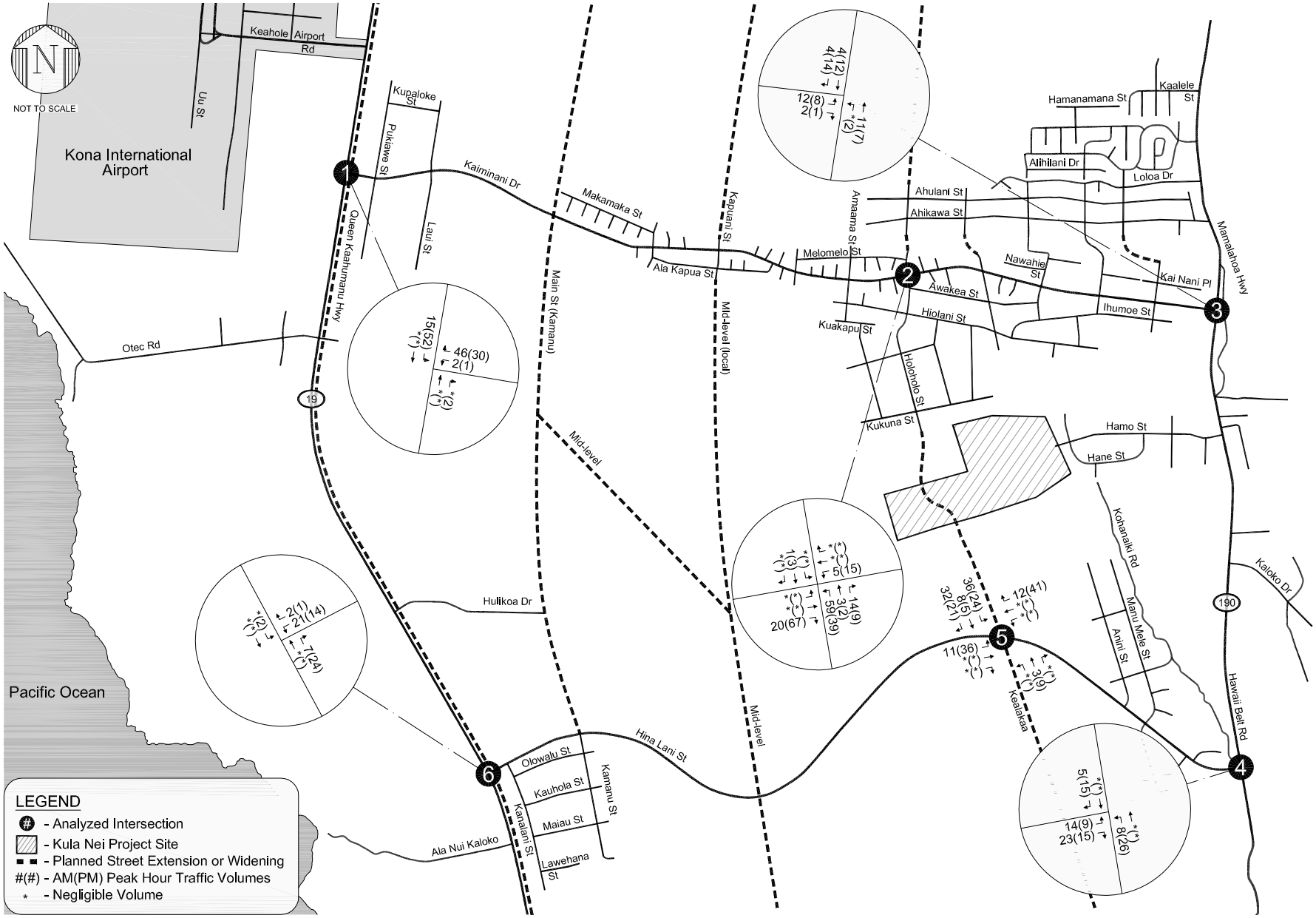

FIGURE 6
PROJECT ONLY PEAK HOUR TRAFFIC VOLUMES

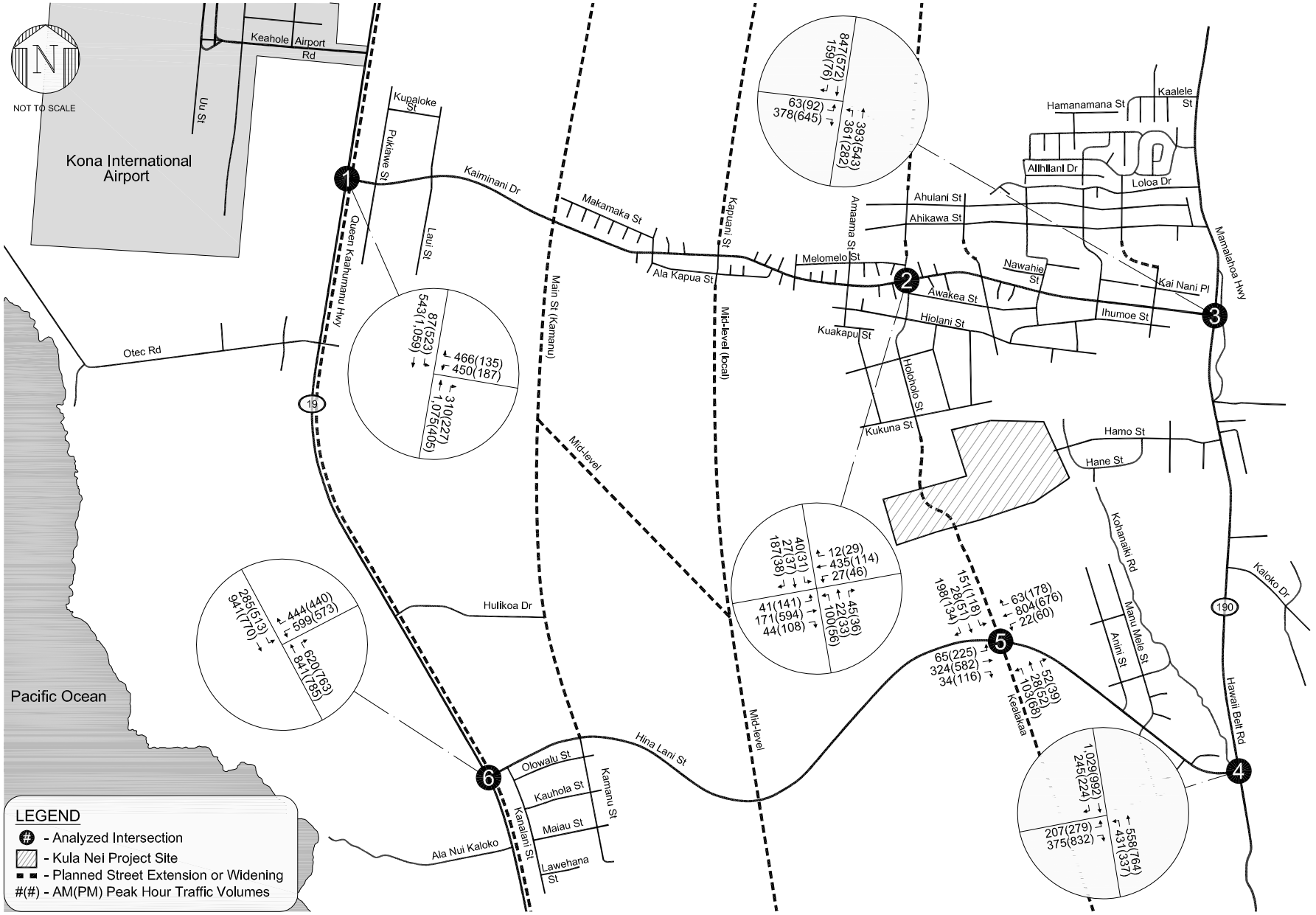

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FIGURE 7
CUMULATIVE PLUS PROJECT PEAK HOUR TRAFFIC VOLUMES

IV. TRAFFIC IMPACT ANALYSIS

This chapter presents an analysis of the potential impacts of the traffic generated by the proposed project on the roadway system. The analysis compares the projected levels of service at each study intersection under cumulative conditions for 2020 both with and without the proposed project to determine its potential impact.

INTERSECTION SIGNIFICANT IMPACT CRITERIA

The levels of service range from excellent conditions at LOS A to overloaded conditions at LOS F. LOS D is typically considered to be the minimum desirable level of service in urban areas.

CUMULATIVE BASE TRAFFIC CONDITIONS

This section presents an analysis of potential future traffic conditions under projected year 2020 conditions. The cumulative base traffic volumes projected in Chapter III were analyzed using the methodologies described in Chapter II to forecast cumulative base peak hour LOS at the study locations.

The first columns in Table 7 summarize the results of this analysis. The following intersections are expected to operate at LOS E or F during one or both peak hours in 2020:

- Holoholo Street and Kaiminani Drive
- Mamalahoa Highway and Kaiminani Drive
- Mamalahoa Highway and Hina Lani Street
- Kealakaa Street/Holoholo Street and Hina Lani Street
- Queen Kaahumanu Highway and Hina Lani Street

TABLE 7
INTERSECTION LEVEL OF SERVICE ANALYSIS SUMMARY
KULA NEI RESIDENTIAL PROJECT
FUTURE CONDITIONS (2020)

Intersections	Peak Hour	CUMULATIVE BASE (2020)			CUMULATIVE PLUS PROJECT (2020)			LOS D OR BETTER	CUMULATIVE PLUS PROJECT WITH MITIGATION (2020)			LOS D OR BETTER
		V/C	Del/Veh*	LOS	V/C	Del/Veh*	LOS		V/C	Del/Veh*	LOS	
1. Queen Kaahumanu Hwy (SR 19) & Kaiminani Dr	A.M. P.M.	0.842 0.690	28 20	C B	0.855 0.730	29 21	C C	YES YES	No mitigation necessary			YES YES
2. Holoholo St & Kaiminani Dr [a]	A.M. P.M.	NC NC	28 40	D E	NC NC	** **	F F	NO NO	0.545 0.772	19 17	B B	YES YES
3. Mamalahoa Hwy (SR 190) & Kaiminani Dr [a]	A.M. P.M.	NC NC	** **	F F	NC NC	** **	F F	NO NO	0.890 1.120	28 33	C C	YES YES
4. Mamalahoa Hwy (SR 190) & Hina Lani St	A.M. P.M.	1.346 1.564	** **	F F	1.412 1.660	** **	F F	NO NO	0.937 1.343	32 73	C E	YES NO
5. Kealakaa St/Holoholo St & Hina Lani St [a]	A.M. P.M.	NC NC	** **	F F	NC NC	** **	F F	NO NO	0.959 1.106	39 40	D D	YES YES
6. Queen Kaahumanu Hwy (SR 19) & Hina Lani St	A.M. P.M.	1.183 1.496	68 **	E F	1.204 1.525	72 **	E F	NO NO	0.945 1.046	33 54	C D	YES YES

Note:
* Delay indicates average stopped delay per vehicle in seconds for signalized intersections. The worst case vehicular delay is reported for stop-controlled intersections.
** Indicates oversaturated conditions. Delay cannot be calculated.
NC = Not Calculated
[a] Intersection is controlled by stop signs on the minor approaches.

The remaining study intersection, Queen Kaahumanu Highway/Kaiminani Drive, is expected to continue operating at a desirable level of service (LOS D or better) during both peak hours.

CUMULATIVE PLUS PROJECT TRAFFIC CONDITIONS

The cumulative plus project peak hour traffic volumes illustrated in Figure 7 were analyzed to determine 2020 operating conditions with the addition of project related traffic. The results of the cumulative plus project analysis are presented in Table 7. The proposed project would contribute to cumulative impacts (LOS E of F conditions) during one or both peak hours at five study intersections:

- Holoholo Street and Kaiminani Drive
- Mamalahoa Highway and Kaiminani Drive
- Mamalahoa Highway and Hina Lani Street
- Kealakaa Street/Holoholo Street and Hina Lani Street
- Queen Kaahumanu Highway and Hina Lani Street

The impact at the intersection of Holoholo Street and Kaiminani Drive would be both cumulative and project-specific, as the addition of project-generated traffic would cause it to decline below LOS D in the a.m. peak hour.

PROPOSED MITIGATION MEASURES AND PROJECT CONTRIBUTION

The mitigation program for the project developed measures to increase the capacity and/or efficiency of the roadway system at the locations where the addition of project related traffic would contribute to projected poor operating conditions. The primary emphasis was to identify physical and/or operational improvements that could be implemented within the existing or planned roadway rights-of-way. The suggested intersection improvement measures are illustrated in Appendix A. Table 7 summarizes the projected LOS in 2020 at the impacted locations with the recommended mitigations measures in place.

The project-related component of future traffic growth at the impacted intersections was calculated based on the proportion of project peak hour traffic relative to the total new peak hour 2020 traffic volumes. Fair-share calculations were made for both the a.m. and p.m. peak hours, and the maximum project contribution was identified to be between approximately 3% and 9%, as shown in Table 8. Because the cumulative impact at Holoholo Street and Kaiminani Drive is also identified as a project-specific impact (*i.e.*, the addition of project-generated traffic would cause it to decline below LOS D in the a.m. peak hour), the project's fair-share contribution to the mitigation measure there is identified as 100%.

The recommended mitigations measures to address the identified traffic impacts, both project-related and cumulative, are described below. Each of the identified project-related impacts would be fully mitigated (*i.e.*, the recommended improvements would result in better v/c ratios and levels of service than are projected under cumulative base conditions). The cumulative impact at Mamalahoa Highway and Hina Lani Street in the p.m. peak hour (LOS E), however, cannot be fully mitigated.

- Holoholo Street and Kaiminani Drive – The intersection of Holoholo Street/Kaiminani Drive could be mitigated to LOS D or better by installing a traffic signal with the existing lane configuration. Signal warrant analysis was conducted based on the Peak Hour Warrant presented in *Manual on Uniform Traffic Control Devices* (MUTCD) (National Committee on Uniform Traffic Control Devices, 2003) and is included in Appendix E. It indicates that a traffic signal installation at the intersection of Holoholo Street/Kaiminani Drive would be warranted under future plus project conditions. With the installation of the traffic signal, the intersection of Holoholo Street/Kaiminani Drive would operate at LOS B. While the project-related portion of the total forecast traffic growth at this intersection is approximately 28% (in the a.m. peak hour), the project's fair-share contribution to the cost of this improvement is identified as 100% because the impact there is both project-specific (in the a.m. peak hour) and cumulative (in the p.m. peak hour).

- Mamalahoa Highway and Kaiminani Drive – The intersection of Mamalahoa Highway/Kaiminani Drive could be mitigated to LOS D or better by installing a traffic signal. As shown in Appendix E, the signal warrant analysis indicates that a traffic signal at the intersection of Mamalahoa Highway/Kaiminani Drive would be warranted under both existing and future plus project conditions. With the installation of the traffic signal, the intersection of Mamalahoa Highway/Kaiminani Drive would operate at LOS C. The project's fair-share contribution to the cost of this mitigation measure is identified as 5.8%.

- Mamalahoa Highway and Hina Lani Street – A mitigation measure was developed that contemplates widening the southbound departure of Mamalahoa Highway to accommodate two travel lanes between this intersection and the existing two-lane segment of Mamalahoa Highway/Hawaii Belt Road (SR 190) approaching Mamalahoa

TABLE 8

2020 PROJECT FAIR SHARE INTERSECTION TRAFFIC CONTRIBUTION

Int #	Intersection	A.M. Peak Hour					P.M. Peak Hour					Maximum Contribution
		Existing Traffic	2020 with Project Traffic	Project Traffic	Total New Traffic	Project % of New Traffic	Existing Traffic	2020 with Project Traffic	Project Traffic	Total New Traffic	Project % of New Traffic	
2	Holoholo St & Kaiminani Dr	787	1,152	102	365	27.8%	701	1,262	137	561	24.3%	100%*
3	Mamalahoa Hwy & Kaiminani Dr	1,526	2,200	32	674	4.8%	1,454	2,210	44	756	5.8%	5.8%
4	Mamalahoa Hwy & Hina Lani St	1,854	2,845	49	991	4.9%	2,133	3,427	66	1,294	5.1%	5.1%
5	Holoholo St & Hina Lani St	727	1,872	102	1,145	8.9%	601	2,300	137	1,699	8.0%	8.9%
6	Queen Kaahumanu Hwy & Hina Lani St	2,418	3,731	30	1,313	2.3%	2,472	3,845	41	1,373	3.0%	3.0%

* The cumulative impact at this location is also identified as a project specific impact in the a.m. peak hour.

Highway (SR 180), a distance of approximately 550 feet. The southbound approach would then provide one through lane and one shared through/right-turn lane. If this mitigation measure were determined to be feasible, the intersection of Mamalahoa Highway/Hina Lani Street would operate at LOS C during the a.m. peak hour and at LOS E during the p.m. peak hour. Due to physical constraints on the mauka side of Mamalahoa Highway, additional mitigation measures at this location, such as adding a second northbound lane, do not appear feasible. The project's fair-share contribution to the cost of this mitigation measure is identified as 5.1%.

- Kealakaa Street/Holoholo Street and Hina Lani Street – The intersection of Kealakaa Street/Holoholo Street and Hina Lani Street does not currently exist, so one lane on each approach with stop signs on the minor (north-south direction) approaches was assumed as a default future intersection configuration. With this configuration, the intersection of Kealakaa Street/Holoholo Street and Hina Lani Street is predicted to operate at LOS F during both peak hours. In order to accommodate the projected increase in traffic at this intersection, a traffic signal should be installed and the east and westbound approaches should be constructed with separate left-turn lanes, resulting in one left-turn lane and one shared through/right-turn lane. As shown in Appendix E, the signal warrant analysis indicates that a traffic signal installation at this intersection would be warranted under future plus project conditions. With these improvements, the intersection is projected to operate at LOS D during both peak hours. The project's fair-share contribution to the cost of this mitigation measure is identified as 8.9%.

- Queen Kaahumanu Highway and Hina Lani Street – The intersection of Queen Kaahumanu Highway and Hina Lani Street could be mitigated to acceptable conditions by implementing an overlapping protected northbound right-turn phase and prohibiting U-turns on the westbound approach. With this improvement, the intersection of Queen Kaahumanu/Hina Lani Street would operate at LOS D or better under cumulative plus project conditions. The project's fair-share contribution to the cost of this mitigation measure is identified as 3.0%.

STREET SEGMENT IMPACT ANALYSIS

As described in Chapter II, 24-hour machine counts were conducted at the four analyzed street segments in September 2006. The daily traffic volumes on the four study street segments under existing conditions are shown in Table 9.

Estimates of future peak hour traffic volumes for the four street segments under the cumulative base conditions (without project) were developed by adjusting the existing peak hour traffic volumes to reflect the ambient growth and related development projects on the street system in the study area. The future peak hour traffic volumes without the proposed project are shown in Table 9. Future peak hour traffic volumes for the four street segments under cumulative plus project conditions are also shown in Table 9.

TABLE 9
STREET SEGMENT IMPACT ANALYSIS

Segment	Location	Peak Hour	Dir.	EXISTING (2006)			CUMULATIVE BASE (2020)			CUMULATIVE PLUS PROJECT (2020)		
				Volumes	V/C	LOS	Volumes	V/C	LOS	Volumes	V/C	LOS
1. Kaiminani Drive	mauka of Queen Kaahumanu Highway	A.M.	EB	170	0.10	A	198	0.12	A	214	0.13	A
			WB	765	0.45	A	824	0.48	A	872	0.51	A
		P.M.	EB	627	0.37	A	694	0.41	A	748	0.44	A
			WB	158	0.09	A	215	0.13	A	246	0.14	A
2. Hina Lani Street	mauka of Queen Kaahumanu Highway	A.M.	EB	217	0.13	A	478	0.28	A	486	0.29	A
			WB	402	0.24	A	849	0.50	A	872	0.51	A
		P.M.	EB	380	0.22	A	983	0.58	A	1,009	0.59	A
			WB	320	0.19	A	652	0.38	A	667	0.39	A
3. Mamalahoa Highway	north of Kaalele Street	A.M.	NB	201	0.12	A	357	0.21	A	380	0.22	A
			SB	301	0.18	A	484	0.28	A	492	0.29	A
		P.M.	NB	267	0.16	A	374	0.22	A	389	0.23	A
			SB	284	0.17	A	493	0.29	A	519	0.31	A
4. Mamalahoa Highway	south of Hina Lani Street	A.M.	NB	706	0.42	A	982	0.58	A	990	0.58	A
			SB	1,021	0.60	A	1,481	0.87	D	1,504	0.88	D
			SB	*With Mitigation (Second Southbound Lane)*						1,504	0.47	A
		P.M.	NB	672	0.40	A	1,075	0.63	B	1,101	0.65	B
			SB	2,041	1.20	F	2,773	1.63	F	2,788	1.64	F
			SB	*With Mitigation (Second Southbound Lane)*						2,788	0.87	D

Note: Roadway Capacity of 1,700 passenger car per lane is based on *Highway Capacity Manual* (Transportation Research Board, 2000).

Table 9 summarizes the street segment impact analysis using the methodology defined in the *2000 HCM*. As shown in Table 9, the southbound segment of Mamalahoa Highway located south of Hina Lani Street already experiences heavy traffic (LOS F), particularly during the p.m. peak hour, a condition that is projected to worsen in the future. The other analyzed street segments can adequately accommodate the projected increase in volumes during the peak hours.

The segment of Mamalahoa Highway south of Hina Lani Street can be mitigated to LOS D by widening the roadway to accommodate two southbound travel lanes. This potential mitigation measure, described in the preceding section of this report, was also identified to mitigate projected poor LOS at the intersection of Mamalahoa Highway and Hina Lani Street.

V. ALTERNATIVES ANALYSIS I

Three alternative future scenarios were developed and fully evaluated, each of which assumes the full buildout of the proposed Kula Nei residential project as described previously:

- Alternative Future Scenario I: This alternative assumes that the planned Stanford Carr project would not be built by the study horizon year (2020) and that Kealakaa Street/Holoholo Street would not be extended southward from the proposed project site to Hina Lani Street. Thus, traffic would only have access to the Kula Nei site to and from the north.

- Alternative Future Scenario II: This alternative assumes that the planned Stanford Carr project would be built by the study horizon year (2020) and that Kealakaa Street/Holoholo Street would be extended southward from the proposed project site to Hina Lani Street (the future intersection 5). However, it assumes that Holoholo Street/Kealakaa Street would not be extended northward from the proposed project. Thus, traffic would only have access to the Kula Nei site through the planned Stanford Carr project to and from the south.

- HDOT Alternative Future Scenario: This alternative was evaluated at the request of the Hawaii Department of Transportation (HDOT) and assumes that, of the planned expansion of the roadway network in the project vicinity (including Main Street (Kamanu), Mid-Level (Local), University Drive, and Kealakaa Street), only Holoholo Street/Kealakaa Street would be constructed through the planned Stanford Carr project site. This roadway would provide access between the Kula Nei project site and Hina Lani Street. This alternative is considered improbable and unlikely to occur.

The analyses of Alternative Future Scenarios I and II are discussed in this chapter and Chapter VI. The level of service worksheets for Alternative Future Future Scenarios I and II are included in Appendix G and Appendix H, respectively. The analysis of the HDOT Alternative Future Scenario is presented and discussed in Appendix I.

ALTERNATIVE FUTURE SCENARIO I TRAFFIC PROJECTIONS

Alternative Future Scenario I assumes that the planned Stanford Carr development, located just south of the proposed Kula Nei project, would not be completed by the project buildout year of 2020. Consequently, the Kealakaa Street/Holoholo Street extension between the proposed

project and Hina Lani Street would not be constructed. Direct access to the project would be provided only northward to Kaiminani Drive. The previously discussed estimates of areawide traffic growth were assumed in this scenario, with the exception of traffic generated by the planned Stanford Carr project. The other assumptions made to estimate alternative future traffic projections, including the project trip generation, trip distribution and street system improvements, were the same as those described in Chapter III.

Forecasts of Alternative Future Scenario I traffic volumes were developed for the following six intersections:

1. Kaiminani Drive and Queen Kaahumanu Highway (SR 19) (signalized)
2. Kaiminani Drive and Holoholo Street (stop-controlled)
3. Kaiminani Drive and Mamalahoa Highway (SR 190) (stop-controlled)
4. Hina Lani Street and Mamalahoa Highway (SR 190) (signalized)
5. (Study Intersection 5, Kealakaa Street/Holoholo Street and Hina Lani Street, would not exist in this scenario.)
6. Hina Lani Street and Queen Kaahumanu Highway (SR 19) (signalized)

The projected peak hour traffic volumes for Alternative Future Scenario I are illustrated in Figures 8, 9 and 10 for the cumulative base, project-related traffic, and cumulative plus project projections, respectively.

ALTERNATIVE FUTURE SCENARIO I TRAFFIC CONDITIONS

The first columns in Table 10 summarize the results of cumulative base traffic conditions for Alternative Future Scenario I. Three of five analyzed intersections are projected to operate at LOS E or F during one or both peak hours in 2020 under Alternative Future Scenario I conditions.

The cumulative plus project peak hour traffic volumes were analyzed to determine Alternative Future Scenario I operating conditions in 2020 with the addition of project-generated traffic. The results of the cumulative plus project analysis are also presented in Table 10. The proposed

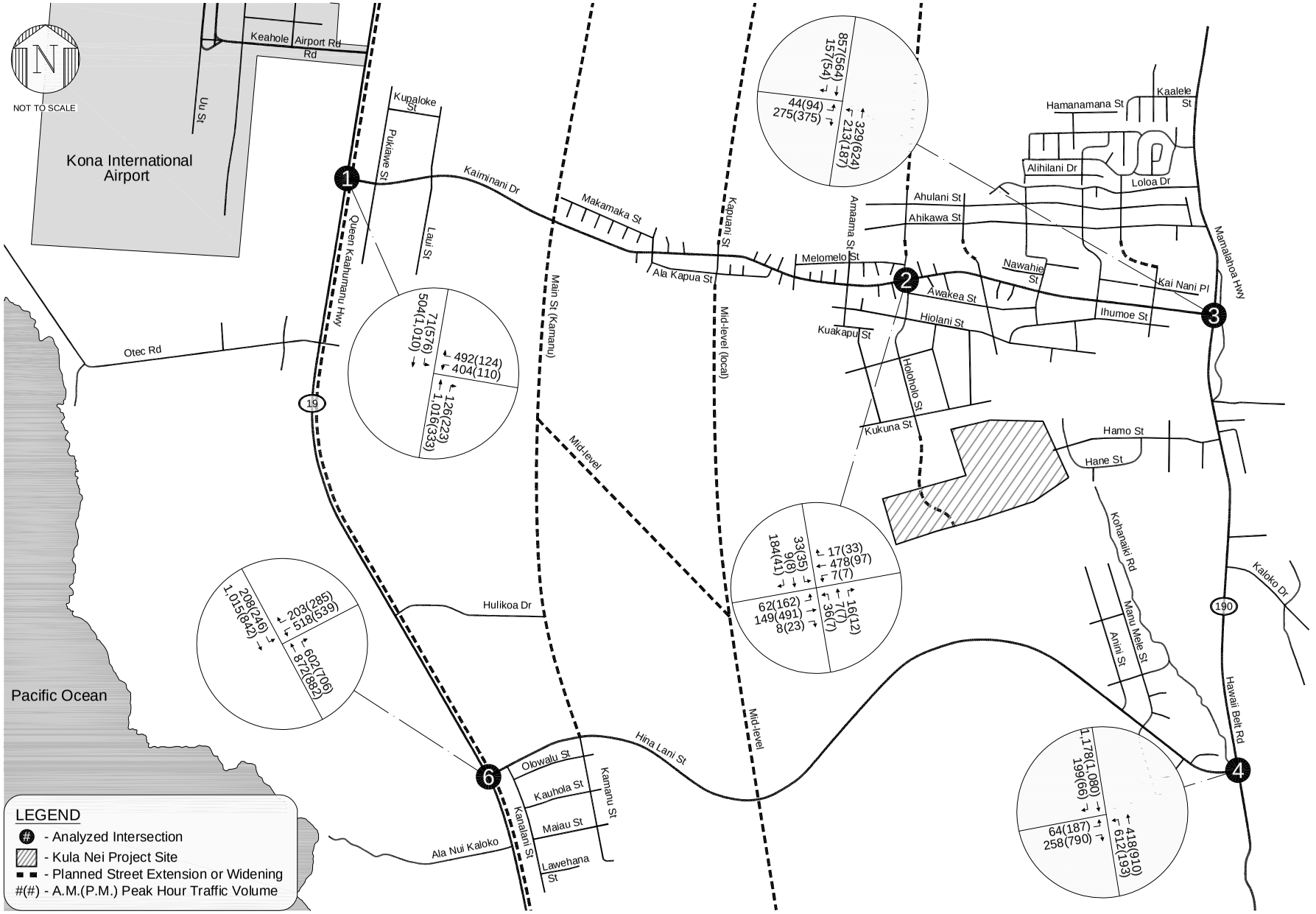

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FIGURE 8
CUMULATIVE BASE PEAK HOUR TRAFFIC VOLUMES
ALTERNATIVE FUTURE SCENARIO I

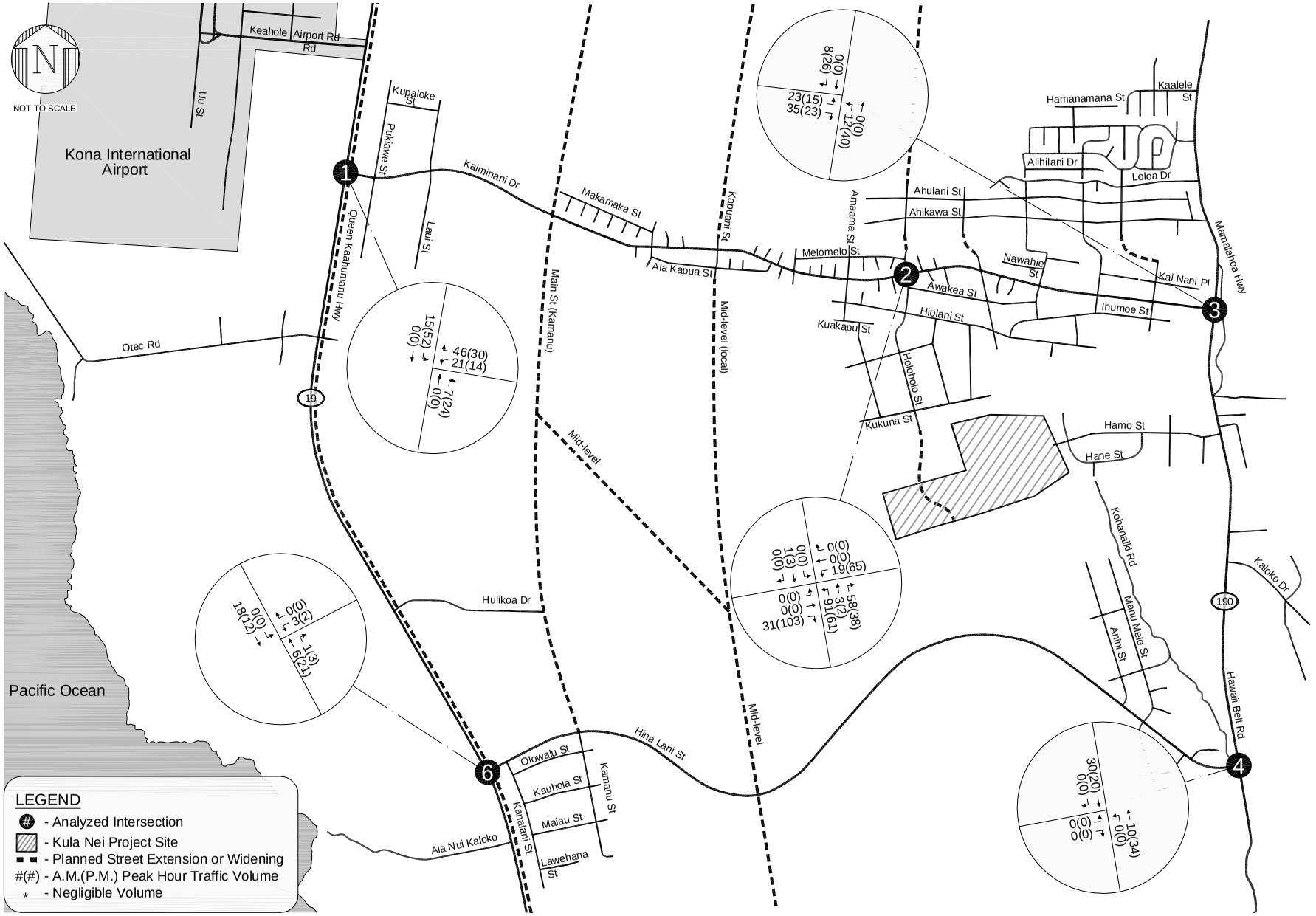

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FIGURE 9
PROJECT ONLY PEAK HOUR TRAFFIC VOLUMES
ALTERNATIVE FUTURE SCENARIO I

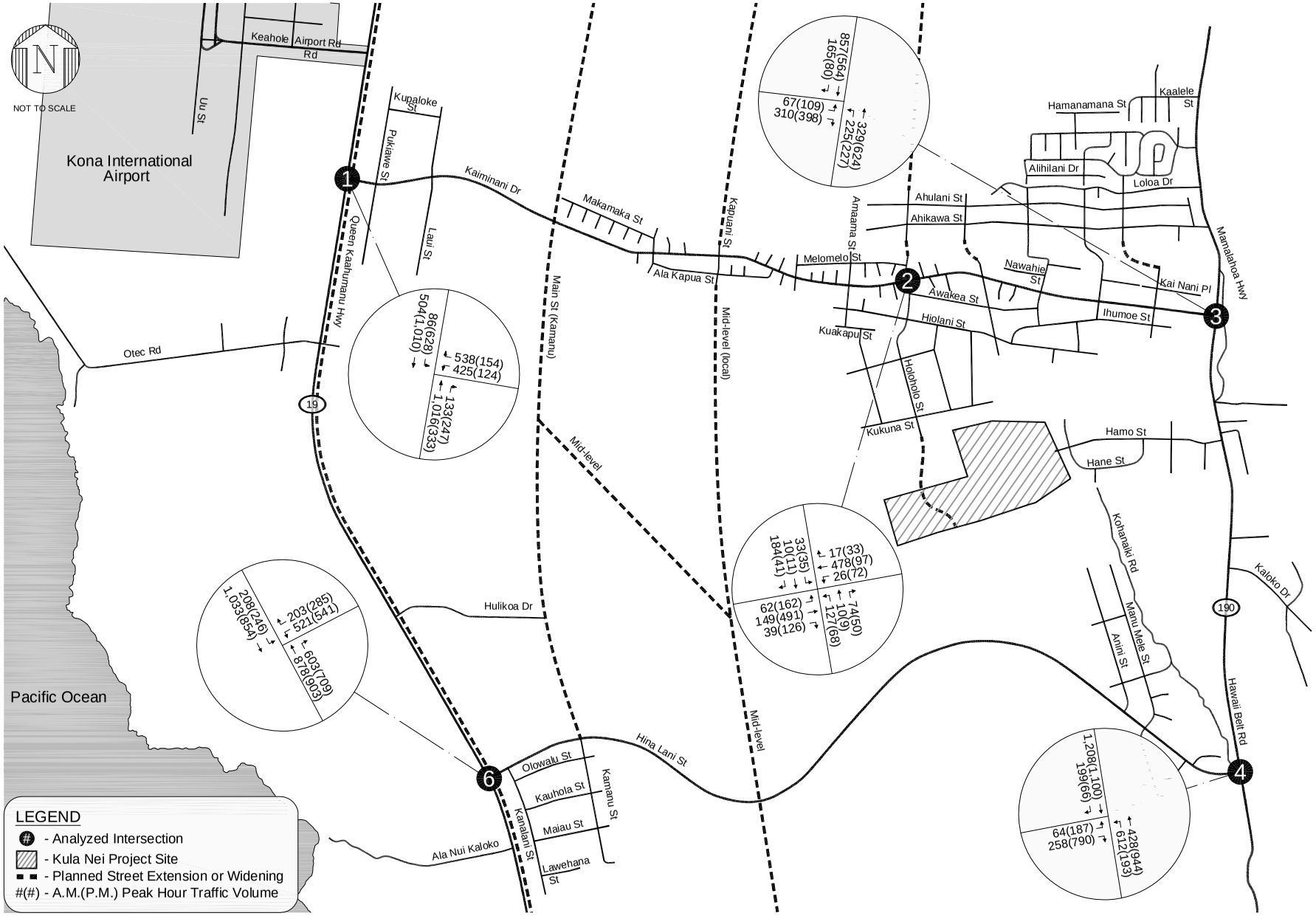

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FIGURE 10
CUMULATIVE PLUS PROJECT PEAK HOUR TRAFFIC VOLUMES
ALTERNATIVE FUTURE SCENARIO I

TABLE 10
INTERSECTION LEVEL OF SERVICE ANALYSIS SUMMARY
ALTERNATIVE FUTURE SCENARIO I (2020)

Intersections	Peak Hour	CUMULATIVE BASE (2020)			CUMULATIVE PLUS PROJECT (2020)			LOS D OR BETTER	CUMULATIVE PLUS PROJECT WITH MITIGATION (2020)			LOS D OR BETTER
		V/C	Del/Veh*	LOS	V/C	Del/Veh*	LOS		V/C	Del/Veh*	LOS	
1. Queen Kaahumanu Hwy (SR 19) & Kaiminani Dr	A.M. P.M.	0.818 0.696	27 17	C B	0.866 0.779	30 20	C B	YES YES	No mitigation necessary			YES YES
2. Holoholo St & Kaiminani Dr [a]	A.M. P.M.	NC NC	29 21	D C	NC NC	** **	F F	NO NO	0.612 0.745	20 16	B B	YES YES
3. Mamalahoa Hwy (SR 190) & Kaiminani Dr [a]	A.M. P.M.	NC NC	** **	F F	NC NC	** **	F F	NO NO	0.841 0.710	21 18	C B	YES YES
4. Mamalahoa Hwy (SR 190) & Hina Lani St	A.M. P.M.	1.404 1.474	** **	F F	1.456 1.487	** **	F F	NO NO	1.023 1.289	50 **	D F	YES NO
6. Queen Kaahumanu Hwy (SR 19) & Hina Lani St	A.M. P.M.	1.087 1.198	48 68	D E	1.091 1.202	49 69	D E	YES NO	0.846 0.897	25 28	C C	YES YES

Note:
* Delay indicates average stopped delay per vehicle in seconds for signalized intersections. The worst case vehicular delay is reported for stop-controlled intersections.
** Indicates oversaturated conditions. Delay cannot be calculated.
NC = Not Calculated
[a] Intersection is controlled by stop signs on the minor approaches.

project would contribute to cumulative impacts (LOS E or F conditions) during one or both peak hours at four analyzed intersections. The impact at the intersection of Holoholo Street and Kaiminani Drive would be both cumulative and project-specific, as the addition of project-generated traffic would cause it to decline below LOS D in both the a.m. and the p.m. peak hours.

PROPOSED MITIGATION MEASURES AND PROJECT CONTRIBUTION FOR ALTERNATIVE FUTURE SCENARIO I

The proposed mitigation measures described in Chapter IV and illustrated in Appendix A were assessed for Alternative Future Scenario I and the results are presented in Table 10. All of the study intersections would operate at LOS D or better with mitigation, except for the intersection of Mamalahoa Highway and Hina Lani Street, which would operate at LOS F in the p.m. peak hour. As discussed previously, due to physical constraints at that intersection, it does not appear feasible to provide further mitigation (such as adding a second northbound lane).

For Alternative Future Scenario I, the project-related component of future traffic growth at the impacted intersections was calculated based on the proportion of project peak hour traffic relative to the total new peak hour 2020 traffic volumes. Fair-share calculations were made for both the a.m. and p.m. peak hours, and the maximum project contribution was identified to be between approximately 4% and 19%, as shown in Table 11. Because the cumulative impact at Holoholo Street and Kaiminani Drive is also identified as a project-specific impact (*i.e.*, the addition of project-generated traffic would cause it to decline below LOS D in both analyzed peak hours), the project's fair-share contribution to the mitigation measure there is identified as 100%.

STREET SEGMENT IMPACT ANALYSIS FOR ALTERNATIVE FUTURE SCENARIO I

Peak hour traffic volumes for Alternative Future Scenario I for the four street segments are shown in Table 12. While three of four street segments are expected to operate at desirable levels of service during both peak hours, the southbound segment of Mamalahoa Highway south of Hina Lani Street is projected to operate at LOS E and F during a.m. and p.m. peak hours, respectively.

TABLE 11

PROJECT FAIR SHARE INTERSECTION TRAFFIC CONTRIBUTION

ALTERNATIVE FUTURE SCENARIO I (2020)

Int #	Intersection	A.M. Peak Hour					P.M. Peak Hour					Maximum Contribution
		Existing Traffic	2020 with Project Traffic	Project Traffic	Total New Traffic	Project % of New Traffic	Existing Traffic	2020 with Project Traffic	Project Traffic	Total New Traffic	Project % of New Traffic	
2	Holoholo St & Kaiminani Dr	787	1,209	203	422	48.1%	701	1,195	272	494	55.1%	100%*
3	Mamalahoa Hwy & Kaiminani Dr	1,526	1,953	78	427	18.3%	1,454	2,002	104	548	19.0%	19.0%
4	Mamalahoa Hwy & Hina Lani St	1,854	2,769	40	915	4.4%	2,133	3,280	54	1,147	4.7%	4.7%
6	Queen Kaahumanu Hwy & Hina Lani St	2,418	3,446	28	1,028	2.7%	2,472	3,538	38	1,066	3.6%	3.6%

* The cumulative impact at this location is also identified as a project specific impact in both a.m. and p.m. peak hours.

TABLE 12
STREET SEGMENT IMPACT ANALYSIS
ALTERNATIVE FUTURE SCENARIO I (2020)

Segment	Location	Peak Hour	Dir.	EXISTING (2006)			CUMULATIVE BASE (2020)			CUMULATIVE PLUS PROJECT (2020)		
				Volumes	V/C	LOS	Volumes	V/C	LOS	Volumes	V/C	LOS
1. Kaiminani Drive	mauka of Queen Kaahumanu Highway	A.M.	EB	170	0.10	A	197	0.12	A	219	0.13	A
			WB	765	0.45	A	896	0.53	A	963	0.57	A
		P.M.	EB	627	0.37	A	799	0.47	A	875	0.51	A
			WB	158	0.09	A	234	0.14	A	278	0.16	A
2. Hina Lani Street	mauka of Queen Kaahumanu Highway	A.M.	EB	217	0.13	A	369	0.22	A	370	0.22	A
			WB	402	0.24	A	511	0.30	A	514	0.30	A
		P.M.	EB	380	0.22	A	646	0.38	A	646	0.38	A
			WB	320	0.19	A	432	0.25	A	434	0.26	A
3. Mamalahoa Highway	north of Kaalele Street	A.M.	NB	201	0.12	A	278	0.16	A	301	0.18	A
			SB	301	0.18	A	397	0.23	A	405	0.24	A
		P.M.	NB	267	0.16	A	390	0.23	A	405	0.24	A
			SB	284	0.17	A	438	0.26	A	464	0.27	A
4. Mamalahoa Highway	south of Hina Lani Street	A.M.	NB	706	0.42	A	1,030	0.61	B	1,040	0.61	B
			SB	1,021	0.60	A	1,557	0.92	E	1,586	0.93	E
			SB	*With Mitigation (Second Southbound Lane)*						1,586	0.50	A
		P.M.	NB	672	0.40	A	1,103	0.65	B	1,137	0.67	B
			SB	2,041	1.20	F	2,766	1.63	F	2,785	1.64	F
			SB	*With Mitigation (Second Southbound Lane)*						2,785	0.87	D

Note: Roadway Capacity of 1,700 passenger car per lane is based on *Highway Capacity Manual* (Transportation Research Board, 2000).

The segment of Mamalahoa Highway south of Hina Lani Street can be mitigated to LOS B and D during the a.m. and p.m. peak hours, respectively, by widening the roadway as described in Chapter IV to accommodate two southbound travel lanes.

VI. ALTERNATIVES ANALYSIS II

The analysis of Alternative Future Scenario II is presented in this chapter.

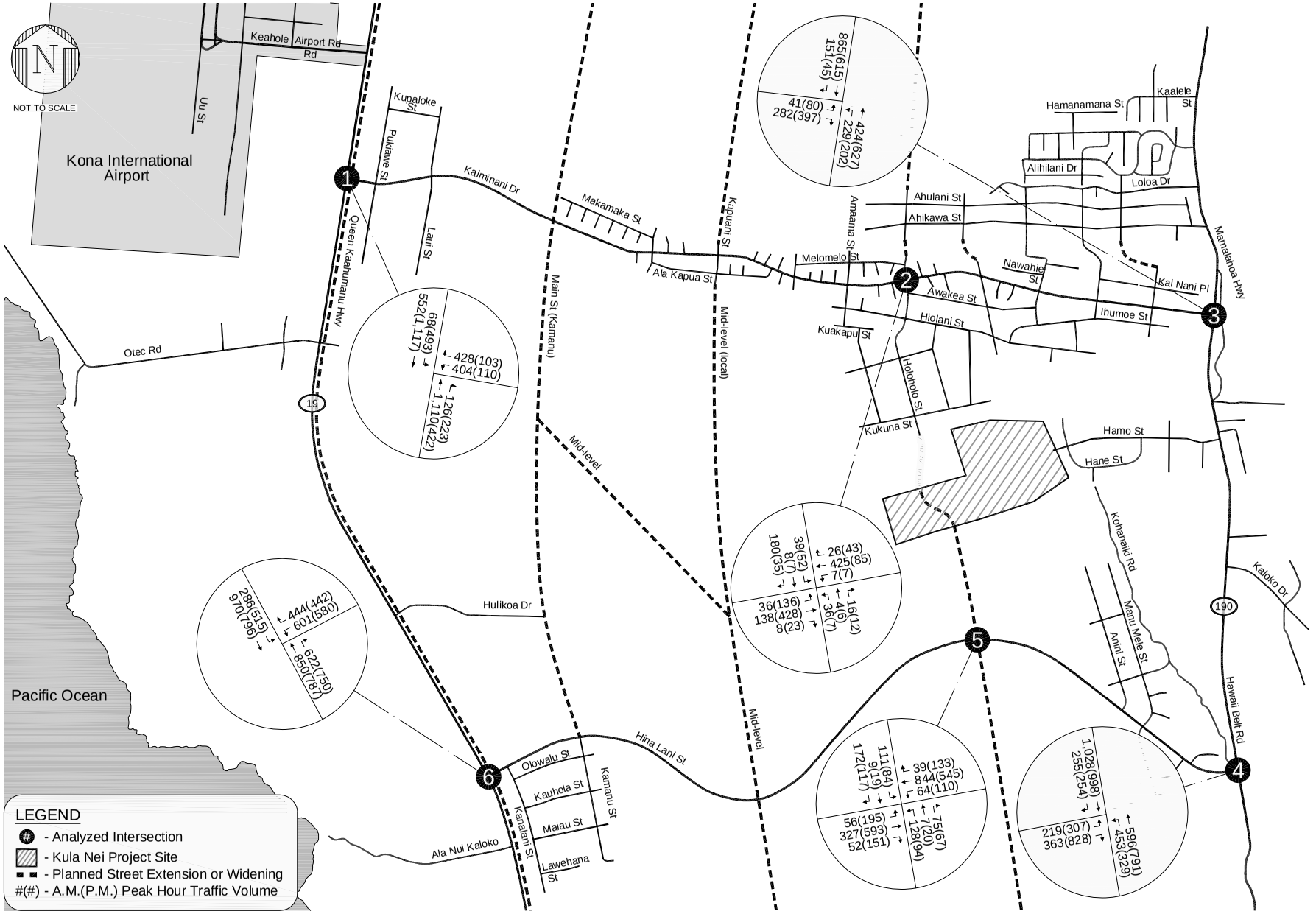
ALTERNATIVE FUTURE SCENARIO II TRAFFIC PROJECTIONS

Alternative Future Scenario II assumes that the planned Stanford Carr development, located just south of the proposed Kula Nei project, would be completed by the project buildout year of 2020 and that the Kealakaa Street/Holoholo Street extension between the Kula Nei project site and Hina Lani Street would be constructed. This scenario assumes, however, that the segment of Holoholo Street immediately north of the project site would not be present. Thus, no direct connection would be available in the project vicinity between Hina Lani Street and Kaiminani Drive and all access from the project site to the surrounding street system would be to and from the south using Hina Lani Street. The assumptions made to estimate areawide traffic growth, alternative future traffic projections, including the project trip generation, trip distribution and street system improvements, were similar to those described in Chapter III. The projected peak hour traffic volumes at the six study intersections for Alternative Future Scenario II are illustrated in Figures 11, 12 and 13 for the cumulative base, project-only traffic, and cumulative plus project conditions, respectively.

ALTERNATIVE FUTURE SCENARIO II TRAFFIC CONDITIONS

The first columns in Table 13 summarize the results of cumulative base traffic conditions for the alternative future. Four of six analyzed intersections are projected to operate at LOS E or F during one or both peak hours in 2020 under this scenario.

The cumulative plus project peak hour traffic volumes were analyzed to determine the projected operating conditions in 2020 with the addition of project-generated traffic. The results of this



FEHR & PEERS
KAKU ASSOCIATES

FIGURE 11
CUMULATIVE BASE PEAK HOUR TRAFFIC VOLUMES
ALTERNATIVE FUTURE SCENARIO II

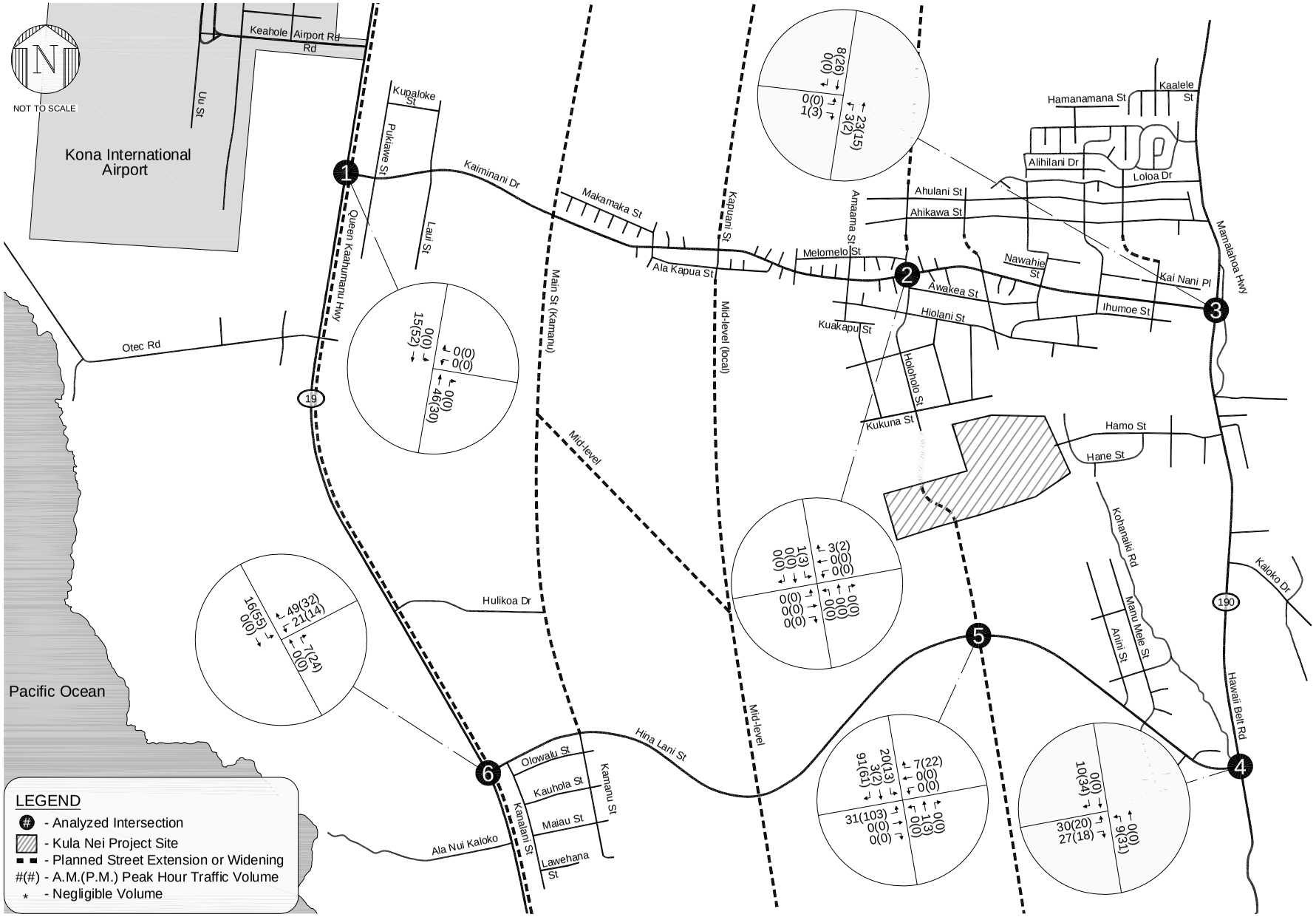


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FIGURE 12
PROJECT ONLY PEAK HOUR TRAFFIC VOLUMES
ALTERNATIVE FUTURE SCENARIO II

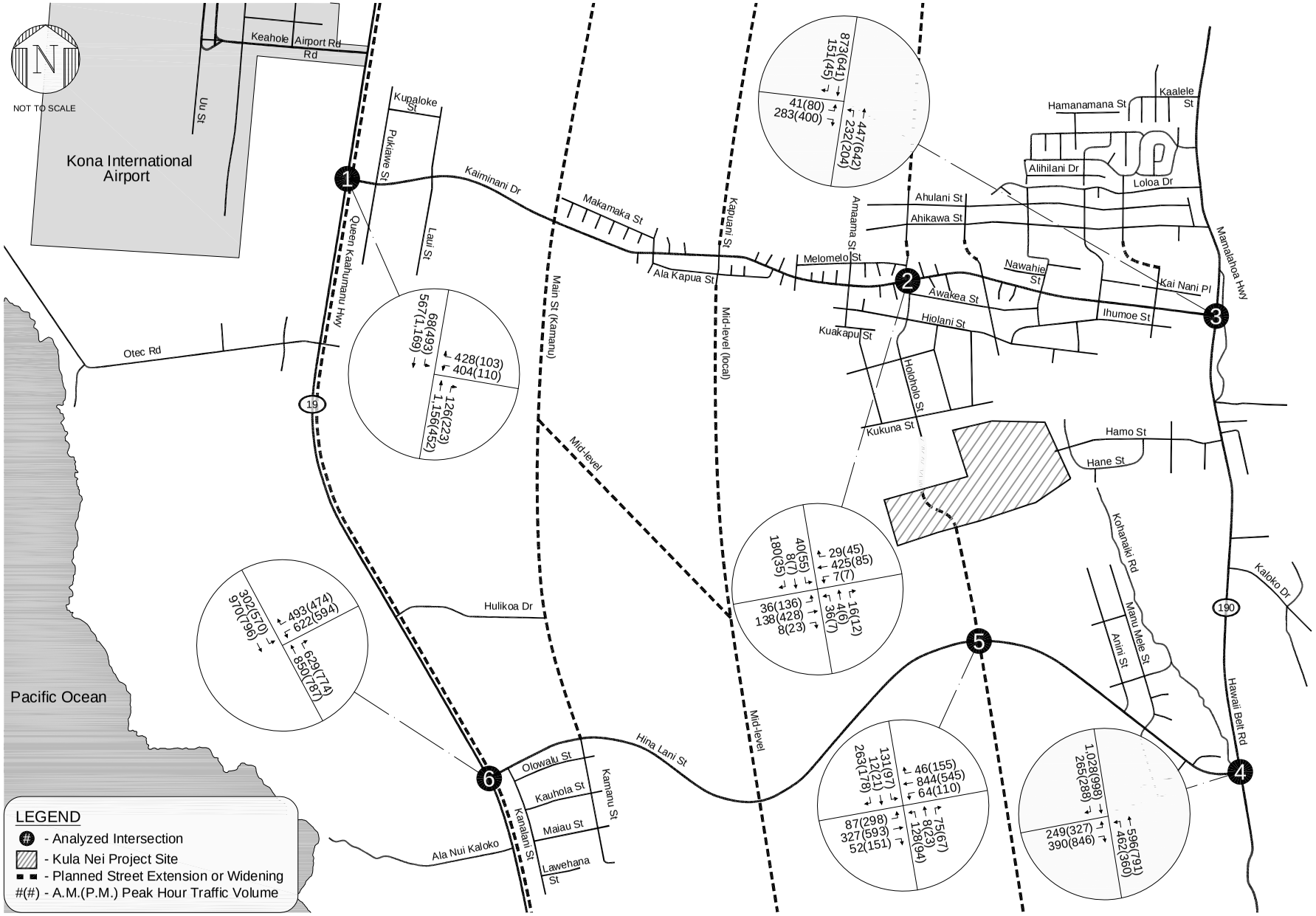


FIGURE 13
CUMULATIVE PLUS PROJECT PEAK HOUR TRAFFIC VOLUMES
ALTERNATIVE FUTURE SCENARIO II

TABLE 13
INTERSECTION LEVEL OF SERVICE ANALYSIS SUMMARY
ALTERNATIVE FUTURE SCENARIO II (2020)

Intersections	Peak Hour	CUMULATIVE BASE (2020)			CUMULATIVE PLUS PROJECT (2020)			LOS D OR BETTER	CUMULATIVE PLUS PROJECT WITH MITIGATION (2020)			LOS D OR BETTER
		V/C	Del/Veh*	LOS	V/C	Del/Veh*	LOS		V/C	Del/Veh*	LOS	
1. Queen Kaahumanu Hwy (SR 19) & Kaiminani Dr	A.M. P.M.	0.864 0.676	22 13	C B	0.882 0.676	23 13	C B	YES YES	No mitigation necessary			YES YES
2. Holoholo St & Kaiminani Dr [a]	A.M. P.M.	NC NC	22 21	C C	NC NC	22 21	C C	YES YES	No mitigation necessary			YES YES
3. Mamalahoa Hwy (SR 190) & Kaiminani Dr [a]	A.M. P.M.	NC NC	** **	F F	NC NC	** **	F F	NO NO	0.998 0.913	50 39	D D	YES YES
4. Mamalahoa Hwy (SR 190) & Hina Lani St	A.M. P.M.	1.611 1.789	** **	F F	1.706 1.925	** **	F F	NO NO	0.988 1.120	42 80	D F	YES NO
5. Kealakaa St/Holoholo St & Hina Lani St [a]	A.M. P.M.	NC NC	** **	F F	NC NC	** **	F F	NO NO	0.961 1.044	49 36	D D	YES YES
6. Queen Kaahumanu Hwy (SR 19) & Hina Lani St	A.M. P.M.	1.181 1.454	74 **	E F	1.209 1.656	** **	F F	NO NO	0.904 0.964	24 29	C C	YES YES

Note:
* Delay indicates average stopped delay per vehicle in seconds for signalized intersections. The worst case vehicular delay is reported for stop-controlled intersections.
** Indicates oversaturated conditions. Delay cannot be calculated.
NC = Not Calculated
[a] Intersection is controlled by stop signs on the minor approaches.

analysis are presented in Table 13. The proposed project would contribute to cumulative impacts (LOS E or F conditions) during one or both peak hours at four analyzed intersections.

PROPOSED MITIGATION MEASURES AND PROJECT CONTRIBUTION FOR ALTERNATIVE FUTURE SCENARIO II

The proposed mitigation measures described in Chapter IV and illustrated in Appendix A were assessed for Alternative Future Scenario II. The improvements that were identified for three study intersections (Kaiminani Drive & Mamalahoa Highway, Hina Lani Street & Mamalahoa Highway, and Hina Lani Street & Kealakaa Street/Holoholo Street) were found to effectively mitigate the identified project and cumulative impacts under this scenario and the results are presented in Table 13. The improvements necessary to achieve LOS D or better at the intersection of Queen Kaahumanu Highway and Hina Lani Street under this scenario are described below.

- The improvements necessary to achieve LOS D or better at the intersection of Queen Kaahumanu Highway and Hina Lani Street under this scenario are described below.
- Queen Kaahumanu Highway and Hina Lani Street – Implement an overlapping protected northbound right-turn phase and prohibit U-turns on the westbound approach, and widen the southbound approach to provide a second left-turn lane as well as the corresponding departure lanes.

With mitigation, all of the study intersections would operate at LOS D or better, except for the intersection of Mamalahoa Highway and Hina Lani Street in the p.m. peak hour, which would operate at LOS F. As discussed previously, due to physical constraints at that intersection, it does not appear feasible to provide further mitigation (such as adding a second northbound lane).

For Alternative Future Scenario II, the project-related component of future traffic growth at the impacted intersections was calculated based on the proportion of project peak hour traffic relative to the total new peak hour 2020 traffic volumes. Fair-share calculations were made for both the a.m. and p.m. peak hours, and the maximum project contribution was estimated to be between 8% and 12%, as shown in Table 14.

TABLE 14

PROJECT FAIR SHARE INTERSECTION TRAFFIC CONTRIBUTION
ALTERNATIVE FUTURE SCENARIO II (2020)

Int #	Intersection	A.M. Peak Hour					P.M. Peak Hour					Maximum Contribution
		Existing Traffic	2020 with Project Traffic	Project Traffic	Total New Traffic	Project % of New Traffic	Existing Traffic	2020 with Project Traffic	Project Traffic	Total New Traffic	Project % of New Traffic	
3	Mamalahoa Hwy & Kaiminani Dr	1,526	2,027	35	501	7.0%	1,454	2,012	46	558	8.2%	8.2%
4	Mamalahoa Hwy & Hina Lani St	1,854	2,990	76	1,136	6.7%	2,133	3,610	103	1,477	7.0%	7.0%
5	Holoholo St & Hina Lani St	727	2,037	153	1,310	11.7%	601	2,332	204	1,731	11.8%	11.8%
6	Queen Kaahumanu Hwy & Hina Lani St	2,418	3,866	93	1,448	6.4%	2,472	3,995	125	1,523	8.2%	8.2%

STREET SEGMENT IMPACT ANALYSIS FOR ALTERNATIVE FUTURE SCENARIO II

Peak hour traffic volumes for Alternative Future Scenario II for the four street segments are shown in Table 15. While three of the four street segments are expected to operate at desirable levels of service during both peak hours, the southbound segment of Mamalahoa Highway south of Hina Lani Street is projected to operate at LOS F during the p.m. peak hour.

The segment of Mamalahoa Highway south of Hina Lani Street can be mitigated to LOS D in the p.m. peak hour by widening the roadway as described in Chapter IV to accommodate two southbound travel lanes.

TABLE 15
STREET SEGMENT IMPACT ANALYSIS
ALTERNATIVE FUTURE SCENARIO II (2020)

Segment	Location	Peak Hour	Dir.	EXISTING (2006)			CUMULATIVE BASE (2020)			CUMULATIVE PLUS PROJECT (2020)		
				Volumes	V/C	LOS	Volumes	V/C	LOS	Volumes	V/C	LOS
1. Kaiminani Drive	mauka of Queen Kaahumanu Highway	A.M.	EB	170	0.10	A	194	0.11	A	194	0.11	A
			WB	765	0.45	A	832	0.49	A	832	0.49	A
		P.M.	EB	627	0.37	A	716	0.42	A	716	0.42	A
			WB	158	0.09	A	213	0.13	A	213	0.13	A
2. Hina Lani Street	mauka of Queen Kaahumanu Highway	A.M.	EB	217	0.13	A	482	0.28	A	505	0.30	A
			WB	402	0.24	A	858	0.50	A	928	0.55	A
		P.M.	EB	380	0.22	A	1,035	0.61	B	1,114	0.66	B
			WB	320	0.19	A	660	0.39	A	706	0.42	A
3. Mamalahoa Highway	north of Kaalele Street	A.M.	NB	201	0.12	A	376	0.22	A	399	0.23	A
			SB	301	0.18	A	426	0.25	A	434	0.26	A
		P.M.	NB	267	0.16	A	426	0.25	A	441	0.26	A
			SB	284	0.17	A	509	0.30	A	535	0.31	A
4. Mamalahoa Highway	south of Hina Lani Street	A.M.	NB	706	0.42	A	1,049	0.62	B	1,058	0.62	B
			SB	1,021	0.60	A	1,482	0.87	D	1,509	0.89	D
			SB	*With Mitigation (Second Southbound Lane)*						1,509	0.47	A
		P.M.	NB	672	0.40	A	1,120	0.66	B	1,151	0.68	B
			SB	2,041	1.20	F	2,702	1.59	F	2,720	1.60	F
			SB	*With Mitigation (Second Southbound Lane)*						2,720	0.85	D

Note: Roadway Capacity of 1,700 passenger car per lane is based on *Highway Capacity Manual* (Transportation Research Board, 2000).

VII. SUMMARY AND CONCLUSIONS

This study was undertaken to analyze potential traffic impacts of the proposed Kula Nei residential development located in the Kalaoa area of North Kona on the island of Hawaii. The following summarizes the key findings of the study:

- The proposed Kula Nei project would construct 270 new residential dwelling units and 2.5 acres of open space with a completion year of 2017.

- Peak hour capacity analyses were conducted for six (five existing and one proposed) intersections on the street system in the vicinity of the project site. Four of five existing intersections currently operate at LOS D or better during the weekday peak hours.

- Street segment analysis was conducted for four street segments: Kaiminani Drive mauka of Queen Kaahumanu Highway, Hina Lani Street mauka of Queen Kaahumanu Highway, Mamalahoa Highway north of Kaalele Street, and Mamalahoa Highway south of Hina Lani Street.

- The project is expected to generate approximately 2,584 weekday daily trips, including 203 trips (51 inbound, 152 outbound) during the weekday morning peak hour, and 273 trips (172 inbound, 101 outbound) during the weekday afternoon peak hour.

- Analysis of projected year 2020 cumulative base conditions, representing future conditions without the proposed project, indicates that four of the six analyzed intersections would operate at LOS F during both peak hours and one of the six would operate at LOS D in the a.m. peak hour and LOS E in the p.m. peak hour.

- Analysis of projected year 2020 cumulative base plus project conditions indicates that five of the six analyzed intersections would operate at LOS F during both peak hours. Thus, the project would result in one project-specific traffic impact in the vicinity and would also contribute to four cumulative traffic impacts.

- Mitigation strategies for future (2020) conditions with the project to address identified deficiencies at the five study intersections with projected poor levels of service (LOS E or F) were developed. Each of the identified project-related impacts would be fully mitigated (i.e., the recommended improvements would result in better V/C ratios and levels of service than are projected under cumulative base conditions). The cumulative impact at one study intersection (Mamalahoa Highway and Hina Lani Street in the p.m. peak hour), however, cannot be fully mitigated.

- Project fair-share contributions to the recommended cumulative mitigation measures were identified on the basis of the maximum proportion of project-related traffic in each of the analyzed peak hours, relative to the total projected traffic growth at each location. The identified contributions range from approximately 3% to 9%, except at the intersection of Holoholo Street and Kaiminani Drive, where a project-specific impact was identified and the project's fair-share contribution would be 100%.

- Future increases in peak hour traffic volumes were evaluated for four street segments. Street segment analysis of projected year 2020 cumulative base plus project conditions indicates that three of four street segments would adequately accommodate the projected increase in volumes during the peak hours. A mitigation measure was developed to improve traffic flow where necessary (southbound Mamalahoa Highway south of Hina Lani Street).

- Alternative Future Scenario I assumed that the planned Stanford Carr project would not be built by the study horizon year. Thus, all of the planned improvements to the street system in the project vicinity were assumed to be in place, with the exception of Kealakaa Street/Holoholo Street extension between the project and Hina Lani Street. The number and location of cumulative and project-specific traffic impacts in this scenario was found to be similar to the assessment of the anticipated future scenario, except that no impact would occur at the intersection of Hina Lani Street and Kealakaa Street/Holoholo Street, as it would not exist. Implementation of the proposed mitigation measures would fully mitigate the project-related impacts and would result in LOS D or better at all but one study intersection. The cumulative impact at Mamalahoa Highway and Hina Lani Street (in the p.m. peak hour only), however, cannot be fully mitigated.

- Alternative Future Scenario II assumed that the planned extension of Holoholo Street immediately north of the project site would not be constructed, though the remainder of the planned roadway network extension and background traffic growth was assumed. In this scenario, direct access to the project would be available only southward to Hina Lani Street. Four of six study intersections and one street segment would be impacted in this scenario. Implementation of the proposed mitigation measures would fully mitigate the project-related impacts and would result in LOS D or better at all but one study intersection. The cumulative impact at Mamalahoa Highway and Hina Lani Street (in the p.m. peak hour only), however, cannot be fully mitigated.

- A third alternative future scenario was evaluated at the request of HDOT, which assumed that the full expansion of the regional street system planned by County of Hawaii would not be implemented by the study horizon year (2020) but that the planned Stanford Carr project would be completed. The number and location of cumulative and project-specific traffic impacts in this scenario was found to be similar to the assessment of the anticipated future scenario. Additional mitigation measures were developed to achieve LOS D or better at all but one study intersection (Mamalahoa Highway and Hina Lani Street in the p.m. peak hour only).

REFERENCES

2000 Highway Capacity Manual, Transportation Research Board, 2000.

Keahole to Honaunau Regional Circulation Plan Planning Department, County of Hawaii, August 2006.

Land Use Petition (Docket No. A81-525), Y-O Limited Partnership, January 1983.

Manual on Uniform Traffic Control Devices, National Committee on Uniform Traffic Control Devices, 2003.

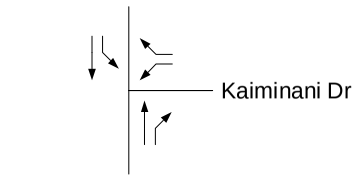
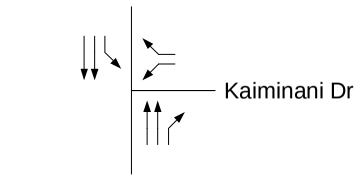
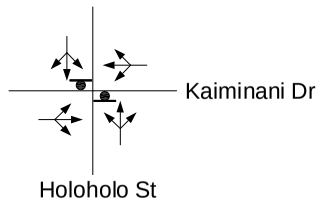
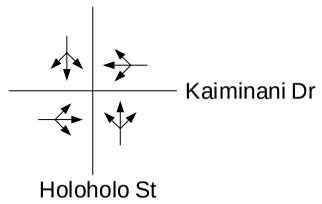
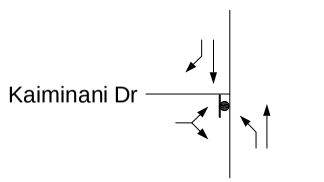
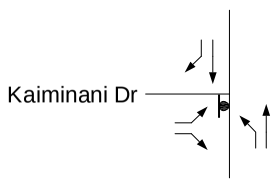
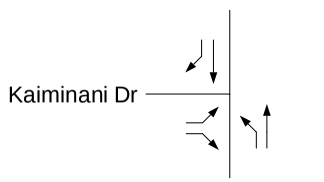
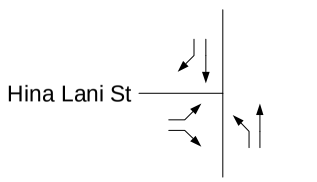
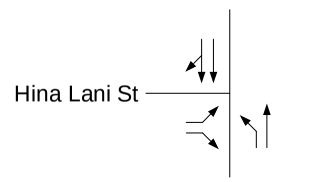
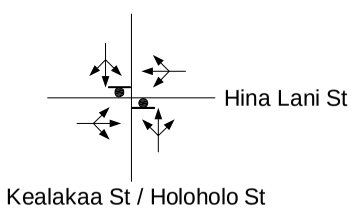
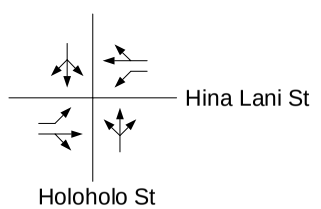
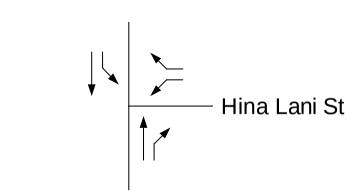
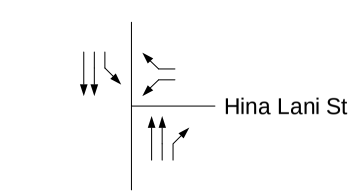
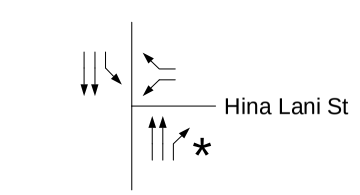
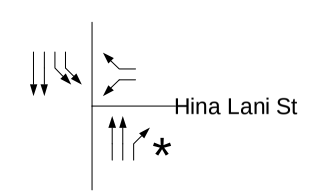
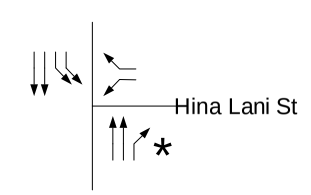
Trip Generation, 7th Edition, Institute of Transportation Engineers, 2003.

APPENDIX A

INTERSECTION LANE CONFIGURATIONS

INTERSECTION LANE CONFIGURATIONS

NOT TO SCALE

	EXISTING CONDITIONS	FUTURE CONDITIONS	FUTURE CONDITIONS PROPOSED PROJECT WITH MITIGATION	FUTURE CONDITIONS PROPOSED PROJECT WITH MITIGATION ALTERNATIVE SCENARIO **I**	FUTURE CONDITIONS PROPOSED PROJECT WITH MITIGATION ALTERNATIVE SCENARIO **II**	FUTURE CONDITIONS PROPOSED PROJECT WITH MITIGATION ALTERNATIVE SCENARIO **III**
1. Queen Kaahumanu Hwy & Kaiminani Dr			No Mitigation Needed	No Mitigation Needed	No Mitigation Needed	No Mitigation Needed
2. Holoholo St & Kaiminani Dr		Same as Existing Conditions		Same as Future Conditions Prposed Project with Mitigation	No Mitigation Needed	Same as Future Conditions Prposed Project with Mitigation
3. Mamalahoa Hwy & Kaiminani Dr				Same as Future Conditions Prposed Project with Mitigation	Same as Future Conditions Prposed Project with Mitigation	Same as Future Conditions Prposed Project with Mitigation
4. Mamalahoa Hwy & Hina Lani St		Same as Existing Conditions		Same as Future Conditions Prposed Project with Mitigation	Same as Future Conditions Prposed Project with Mitigation	Same as Future Conditions Prposed Project with Mitigation
5. Kealakaa St / Holoholo St & Hina Lani St	Intersection Does Not Exist			Intersection Does Not Exist	Same as Future Conditions Prposed Project with Mitigation	Same as Future Conditions Prposed Project with Mitigation
6. Queen Kaahumanu Hwy & Hina Lani St				Same as Future Conditions Prposed Project with Mitigation		

LEGEND

- Stop Controlled
- * Add protected overlapping Northbound Right Turn phase

FEHR & PEERS
KAKU ASSOCIATES

APPENDIX B

INTERSECTION AND DAILY TRAFFIC COUNTS

WILTEC Phone: (626) 564-1944 Fax: (626) 564-0969

24-HOUR ADT COUNT SUMMARY

CLIENT: KAKU ASSOCIATES
PROJECT: HAWAII
LOCATION: KAIMINANI DRIVE EAST OF LAUI STREET
DATE: WEDNESDAY SEPTEMBER 13, 2006

DIRECTION:	EB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	8	5	8	3	24
1:00	3	1	1	0	5
2:00	0	1	5	2	8
3:00	4	0	0	1	5
4:00	2	2	6	3	13
5:00	3	9	9	6	27
6:00	10	14	16	20	60
7:00	31	33	35	23	122
8:00	31	53	36	50	170
9:00	38	41	29	44	152
10:00	46	32	54	43	175
11:00	40	48	56	46	190
12:00	38	51	60	69	218
13:00	60	49	70	64	243
14:00	75	97	73	90	335
15:00	98	100	140	166	504
16:00	178	143	114	151	586
17:00	112	128	147	96	483
18:00	90	86	88	72	336
19:00	72	71	52	48	243
20:00	48	62	45	50	205
21:00	41	42	35	41	159
22:00	24	38	27	16	105
23:00	17	20	17	14	68
				TOTAL	4436

AM PEAK HOUR	1100-1200
VOLUME	190
PM PEAK HOUR	1530-1630
VOLUME	627

DIRECTION:	WB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	0	0	2	0	2
1:00	0	1	1	0	2
2:00	3	1	1	1	6
3:00	2	4	3	5	14
4:00	7	14	24	28	73
5:00	42	54	73	89	258
6:00	110	160	191	194	655
7:00	174	193	204	138	709
8:00	108	114	105	84	411
9:00	62	58	68	66	254
10:00	68	72	70	54	264
11:00	40	54	58	54	206
12:00	52	44	50	65	211
13:00	50	46	44	46	186
14:00	62	43	50	37	192
15:00	32	38	50	36	156
16:00	31	30	40	27	128
17:00	39	42	38	39	158
18:00	39	39	42	26	146
19:00	30	29	19	25	103
20:00	27	13	16	6	62
21:00	15	8	12	10	45
22:00	6	5	5	5	21
23:00	4	4	8	2	18
				TOTAL	4280

AM PEAK HOUR	0645-0745
VOLUME	765
PM PEAK HOUR	1200-1300
VOLUME	211

TOTAL BI-DIRECTIONAL VOLUME	8716

WILTEC Phone: (626) 564-1944 Fax: (626) 564-0969

24-HOUR ADT COUNT SUMMARY

CLIENT: KAKU ASSOCIATES
PROJECT: HAWAII
LOCATION: HINA LINI STREET BETWEEN KANALANI STREET AND KAMANU STREET
DATE: WEDNESDAY SEPTEMBER 13, 2006

DIRECTION:		EB			
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	2	5	4	1	12
1:00	2	1	4	0	7
2:00	1	0	0	1	2
3:00	1	2	4	4	11
4:00	2	1	1	3	7
5:00	0	6	7	11	24
6:00	15	11	20	24	70
7:00	28	32	58	66	184
8:00	41	52	50	52	195
9:00	52	56	48	46	202
10:00	51	58	62	48	219
11:00	72	60	50	50	232
12:00	61	54	58	104	277
13:00	58	84	60	58	260
14:00	80	62	80	78	300
15:00	76	82	78	97	333
16:00	109	90	84	77	360
17:00	68	68	75	48	259
18:00	46	56	42	46	190
19:00	44	22	25	15	106
20:00	20	22	14	16	72
21:00	21	13	14	12	60
22:00	14	6	6	9	35
23:00	6	6	5	7	24
				TOTAL	3441

AM PEAK HOUR	1030-1130
VOLUME	242
PM PEAK HOUR	1545-1645
VOLUME	380

DIRECTION:		WB			
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	1	1	2	1	5
1:00	1	0	0	2	3
2:00	0	0	1	3	4
3:00	0	0	5	8	13
4:00	9	3	11	12	35
5:00	12	13	38	46	109
6:00	48	77	91	90	306
7:00	78	75	92	94	339
8:00	98	118	72	58	346
9:00	66	46	46	70	228
10:00	48	66	70	82	266
11:00	83	97	105	94	379
12:00	110	101	120	94	425
13:00	86	110	90	98	384
14:00	92	97	90	76	355
15:00	88	80	72	80	320
16:00	84	69	84	81	318
17:00	63	62	52	58	235
18:00	44	46	42	32	164
19:00	35	23	24	24	106
20:00	12	22	8	12	54
21:00	11	9	7	5	32
22:00	6	4	4	4	18
23:00	0	3	3	3	9
				TOTAL	4453

AM PEAK HOUR	0730-0830
VOLUME	402
PM PEAK HOUR	1200-1300
VOLUME	425

TOTAL BI-DIRECTIONAL VOLUME	7894

WILTEC Phone: (626) 564-1944 Fax: (626) 564-0969

24-HOUR ADT COUNT SUMMARY

CLIENT: KAKU ASSOCIATES
PROJECT: HAWAII
LOCATION: MAMALAHOA HIGHWAY NORTH OF KAALELE STREET
DATE: WEDNESDAY SEPTEMBER 13, 2006

DIRECTION:	NB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	2	8	1	5	16
1:00	2	0	2	4	8
2:00	4	3	0	0	7
3:00	1	3	3	6	13
4:00	4	4	10	10	28
5:00	16	13	9	20	58
6:00	27	40	44	41	152
7:00	43	49	36	38	166
8:00	48	58	47	48	201
9:00	46	44	52	42	184
10:00	44	38	48	39	169
11:00	44	34	36	40	154
12:00	42	40	39	40	161
13:00	46	36	42	46	170
14:00	37	69	60	52	218
15:00	50	46	74	52	222
16:00	54	62	55	62	233
17:00	74	76	54	47	251
18:00	44	36	38	45	163
19:00	35	21	22	22	100
20:00	23	27	21	14	85
21:00	26	4	18	8	56
22:00	13	9	5	4	31
23:00	5	7	3	5	20
				TOTAL	2866

AM PEAK HOUR	0800-0900
VOLUME	201
PM PEAK HOUR	1630-1730
VOLUME	267

DIRECTION:	SB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	1	2	4	6	13
1:00	3	2	2	1	8
2:00	2	1	2	0	5
3:00	0	1	3	4	8
4:00	4	6	2	6	18
5:00	11	15	13	30	69
6:00	38	62	55	97	252
7:00	64	70	70	56	260
8:00	50	47	52	56	205
9:00	44	48	50	40	182
10:00	42	39	50	50	181
11:00	31	62	34	46	173
12:00	43	27	38	42	150
13:00	52	50	34	52	188
14:00	39	60	51	40	190
15:00	54	58	50	77	239
16:00	66	64	77	48	255
17:00	54	56	49	42	201
18:00	53	46	50	35	184
19:00	27	24	20	21	92
20:00	22	13	26	16	77
21:00	8	9	9	8	34
22:00	3	18	13	4	38
23:00	7	7	3	1	18
				TOTAL	3040

AM PEAK HOUR	0645-0745
VOLUME	301
PM PEAK HOUR	1545-1645
VOLUME	284

TOTAL BI-DIRECTIONAL VOLUME	5906

WILTEC Phone: (626) 564-1944 Fax: (626) 564-0969

24-HOUR ADT COUNT SUMMARY

CLIENT: KAKU ASSOCIATES
PROJECT: HAWAII
LOCATION: MAMALAHOA HIGHWAY SOUTH OF HINA LANI STREET
DATE: WEDNESDAY SEPTEMBER 13, 2006

DIRECTION:	NB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	12	15	6	9	42
1:00	6	10	6	8	30
2:00	6	8	4	2	20
3:00	5	6	4	16	31
4:00	8	12	16	26	62
5:00	28	36	38	68	170
6:00	90	129	154	160	533
7:00	148	164	141	160	613
8:00	216	189	100	122	627
9:00	124	108	94	94	420
10:00	121	110	88	106	425
11:00	80	117	117	117	431
12:00	97	116	96	112	421
13:00	110	158	133	138	539
14:00	130	137	142	141	550
15:00	118	148	138	172	576
16:00	144	150	186	166	646
17:00	154	166	172	128	620
18:00	122	152	119	126	519
19:00	97	106	83	83	369
20:00	81	68	78	61	288
21:00	81	81	65	60	287
22:00	48	44	35	17	144
23:00	25	26	14	16	81
				TOTAL	8444

AM PEAK HOUR	0730-0830
VOLUME	706
PM PEAK HOUR	1630-1730
VOLUME	672

DIRECTION:	SB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	10	8	6	10	34
1:00	2	6	7	4	19
2:00	2	2	5	2	11
3:00	3	2	1	7	13
4:00	6	6	16	11	39
5:00	16	28	32	62	138
6:00	74	106	142	201	523
7:00	251	262	270	238	1021
8:00	172	129	158	142	601
9:00	128	122	118	120	488
10:00	110	114	123	116	463
11:00	96	108	112	121	437
12:00	130	126	127	182	565
13:00	156	129	146	147	578
14:00	144	166	140	128	578
15:00	185	178	249	269	881
16:00	268	310	260	250	1088
17:00	1221	209	177	153	1760
18:00	161	122	131	102	516
19:00	87	81	60	57	285
20:00	63	57	56	46	222
21:00	43	33	40	22	138
22:00	22	32	19	17	90
23:00	22	15	12	5	54
				TOTAL	10542

AM PEAK HOUR	0700-0800
VOLUME	1021
PM PEAK HOUR	1615-1715
VOLUME	2041

TOTAL BI-DIRECTIONAL VOLUME	18986

WILTEC

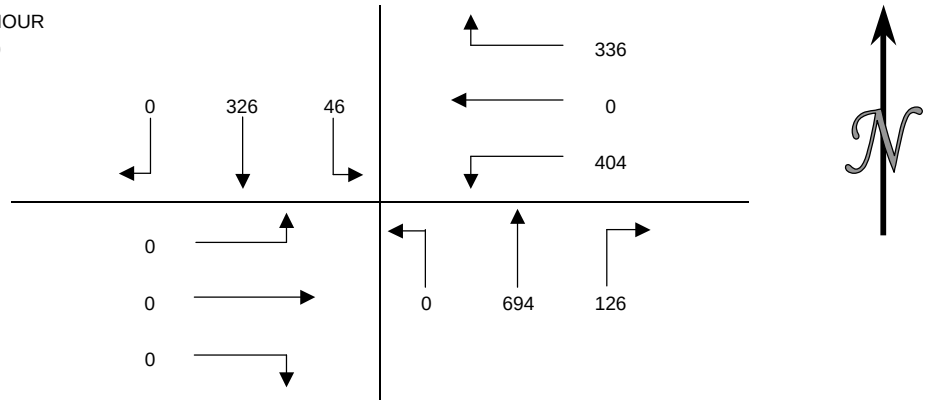
Phone: (925) 706-9911 Fax: (925) 706-9914

INTERSECTION TURNING MOVEMENT COUNT SUMMARY

CLIENT: KAKU ASSOCIATES
PROJECT: KONA, BIG ISLAND OF HAWAII
DATE: TUESDAY SEPTEMBER 12, 2006
PERIOD: 6:00 AM TO 9:00 AM
INTERSECTION: N/S QUEEN HAAHUMANU HIGHWAY (SR-19)
E/W KAIMINANI DRIVE

15 MIN COUNTS													
	1	2	3	4	5	6	7	8	9	10	11	12	
PERIOD	SBRT	SBTH	SBLT	WBRT	WBTH	WBLT	NBRT	NBTH	NBLT	EBRT	EBTH	EBLT	TOTAL
600-615	0	40	12	80	0	40	31	147	0	0	0	0	350
615-630	0	59	16	95	0	60	37	176	0	0	0	0	443
630-645	0	64	9	100	0	81	39	203	0	0	0	0	496
645-700	0	66	7	86	0	93	26	178	0	0	0	0	456
700-715	0	85	21	77	0	109	34	177	0	0	0	0	503
715-730	0	111	9	73	0	121	27	136	0	0	0	0	477
730-745	0	109	12	60	0	129	29	124	0	0	0	0	463
745-800	0	116	10	32	0	118	27	105	0	0	0	0	408
80-815	0	108	11	44	0	82	35	86	0	0	0	0	366
815-830	0	131	17	27	0	72	25	87	0	0	0	0	359
830-845	0	110	10	31	0	47	18	85	0	0	0	0	301
845-900	0	130	17	26	0	63	23	62	0	0	0	0	321
HOUR TOTALS													
	1	2	3	4	5	6	7	8	9	10	11	12	
TIME	SBRT	SBTH	SBLT	WBRT	WBTH	WBLT	NBRT	NBTH	NBLT	EBRT	EBTH	EBLT	TOTAL
600-700	0	229	44	361	0	274	133	704	0	0	0	0	1745
615-715	0	274	53	358	0	343	136	734	0	0	0	0	1898
630-730	0	326	46	336	0	404	126	694	0	0	0	0	1932
645-745	0	371	49	296	0	452	116	615	0	0	0	0	1899
700-800	0	421	52	242	0	477	117	542	0	0	0	0	1851
715-815	0	444	42	209	0	450	118	451	0	0	0	0	1714
730-830	0	464	50	163	0	401	116	402	0	0	0	0	1596
745-845	0	465	48	134	0	319	105	363	0	0	0	0	1434
800-900	0	479	55	128	0	264	101	320	0	0	0	0	1347

A.M. PEAK HOUR
630-730



WILTEC

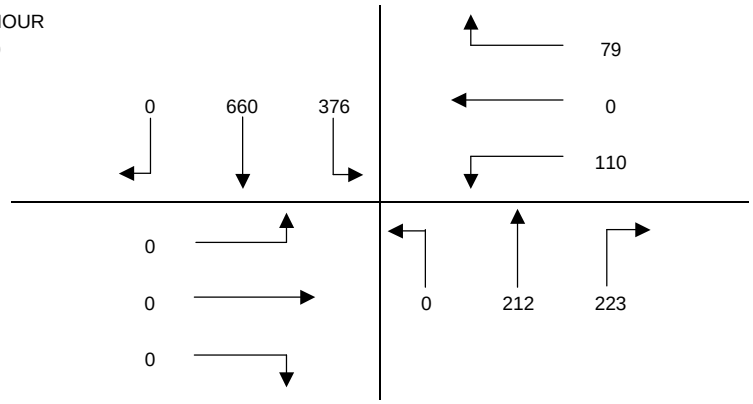
Phone: (925) 706-9911 Fax: (925) 706-9914

INTERSECTION TURNING MOVEMENT COUNT SUMMARY

CLIENT: KAKU ASSOCIATES
PROJECT: KONA, BIG ISLAND OF HAWAII
DATE: TUESDAY SEPTEMBER 12, 2006
PERIOD: 3:00 PM TO 6:00 PM
INTERSECTION: N/S QUEEN HAAHUMANU HIGHWAY (SR-19)
E/W KAIMINANI DRIVE

15 MIN COUNTS													
	1	2	3	4	5	6	7	8	9	10	11	12	
PERIOD	SBRT	SBTH	SBLT	WBRT	WBTH	WBLT	NBRT	NBTH	NBLT	EBRT	EBTH	EBLT	TOTAL
'300-315	0	178	49	22	0	27	58	59	0	0	0	0	393
315-330	0	168	60	14	0	25	65	41	0	0	0	0	373
330-345	0	187	99	26	0	33	52	57	0	0	0	0	454
345-400	0	152	86	13	0	17	53	44	0	0	0	0	365
400-415	0	176	104	21	0	31	65	63	0	0	0	0	460
415-430	0	145	87	19	0	29	53	48	0	0	0	0	381
430-445	0	122	53	24	0	28	43	54	0	0	0	0	324
445-500	0	137	66	20	0	26	66	68	0	0	0	0	383
500-515	0	102	37	14	0	18	47	41	0	0	0	0	259
515-530	0	125	66	16	0	33	51	56	0	0	0	0	347
530-545	0	141	54	8	0	30	28	37	0	0	0	0	298
545-600	0	116	41	18	0	39	40	35	0	0	0	0	289
HOUR TOTALS													
	1	2	3	4	5	6	7	8	9	10	11	12	
TIME	SBRT	SBTH	SBLT	WBRT	WBTH	WBLT	NBRT	NBTH	NBLT	EBRT	EBTH	EBLT	TOTAL
'300-400	0	685	294	75	0	102	228	201	0	0	0	0	1585
315-415	0	683	349	74	0	106	235	205	0	0	0	0	1652
330-430	0	660	376	79	0	110	223	212	0	0	0	0	1660
345-445	0	595	330	77	0	105	214	209	0	0	0	0	1530
400-500	0	580	310	84	0	114	227	233	0	0	0	0	1548
415-515	0	506	243	77	0	101	209	211	0	0	0	0	1347
430-530	0	486	222	74	0	105	207	219	0	0	0	0	1313
445-545	0	505	223	58	0	107	192	202	0	0	0	0	1287
500-600	0	484	198	56	0	120	166	169	0	0	0	0	1193

A.M. PEAK HOUR
330-430



KAIMINANI DRIVE

QUEEN HAAHUMANU HIGHWAY (SR-19)

WILTEC

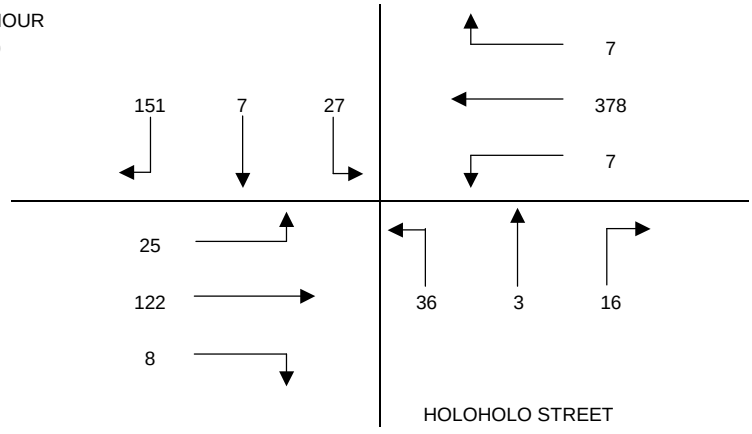
Phone: (925) 706-9911 Fax: (925) 706-9914

INTERSECTION TURNING MOVEMENT COUNT SUMMARY

CLIENT: KAKU ASSOCIATES
PROJECT: KONA, BIG ISLAND OF HAWAII
DATE: TUESDAY SEPTEMBER 12, 2006
PERIOD: 6:00 AM TO 9:00 AM
INTERSECTION: N/S HOLOHOLO STREET
E/W KAIMINANI DRIVE

15 MIN COUNTS													
PERIOD	1 SBRT	2 SBTH	3 SBLT	4 WBRT	5 WBTH	6 WBLT	7 NBRT	8 NBTH	9 NBLT	10 EBRT	11 EBTH	12 EBLT	TOTAL
600-615	22	1	4	0	62	1	2	1	5	0	10	4	112
615-630	30	2	3	1	79	0	1	0	6	4	14	3	143
630-645	38	3	3	2	106	0	2	0	8	1	18	4	185
645-700	33	1	4	1	89	3	4	1	6	3	22	10	177
700-715	32	1	12	3	86	4	4	1	7	2	48	6	206
715-730	48	2	8	1	97	0	6	1	15	2	34	5	219
730-745	30	0	3	1	72	1	3	0	8	1	23	5	147
745-800	25	1	3	7	71	2	1	2	6	5	19	2	144
80-815	22	1	5	5	53	4	4	0	7	3	19	12	135
815-830	23	0	5	4	44	1	0	0	4	0	20	10	111
830-845	19	0	5	3	38	2	1	0	9	4	10	4	95
845-900	19	0	1	1	24	0	1	0	4	0	17	5	72
HOUR TOTALS													
TIME	1 SBRT	2 SBTH	3 SBLT	4 WBRT	5 WBTH	6 WBLT	7 NBRT	8 NBTH	9 NBLT	10 EBRT	11 EBTH	12 EBLT	TOTAL
600-700	123	7	14	4	336	4	9	2	25	8	64	21	617
615-715	133	7	22	7	360	7	11	2	27	10	102	23	711
630-730	151	7	27	7	378	7	16	3	36	8	122	25	787
645-745	143	4	27	6	344	8	17	3	36	8	127	26	749
700-800	135	4	26	12	326	7	14	4	36	10	124	18	716
715-815	125	4	19	14	293	7	14	3	36	11	95	24	645
730-830	100	2	16	17	240	8	8	2	25	9	81	29	537
745-845	89	2	18	19	206	9	6	2	26	12	68	28	485
800-900	83	1	16	13	159	7	6	0	24	7	66	31	413

A.M. PEAK HOUR
630-730



WILTEC

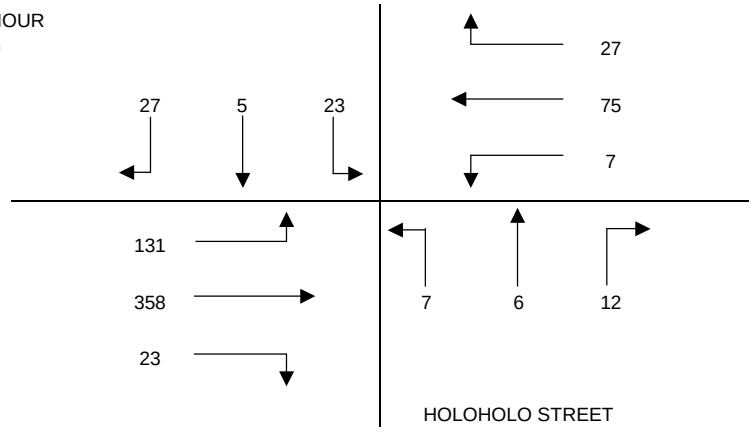
Phone: (925) 706-9911 Fax: (925) 706-9914

INTERSECTION TURNING MOVEMENT COUNT SUMMARY

CLIENT: KAKU ASSOCIATES
PROJECT: KONA, BIG ISLAND OF HAWAII
DATE: TUESDAY SEPTEMBER 12, 2006
PERIOD: 3:00 PM TO 6:00 PM
INTERSECTION: N/S HOLOHOLO STREET
E/W KAIMINANI DRIVE

15 MIN COUNTS													
	1	2	3	4	5	6	7	8	9	10	11	12	
PERIOD	SBRT	SBTH	SBLT	WBRT	WBTH	WBLT	NBRT	NBTH	NBLT	EBRT	EBTH	EBLT	TOTAL
'300-315	8	1	3	4	26	2	3	0	4	10	42	14	117
315-330	4	0	1	3	17	0	1	1	3	7	79	27	143
330-345	6	2	12	8	25	5	5	2	2	5	82	35	189
345-400	7	2	2	2	15	1	2	2	2	7	104	36	182
400-415	7	0	2	7	17	1	3	1	1	6	92	29	166
415-430	7	1	7	10	18	0	2	1	2	5	80	31	164
430-445	6	0	6	7	27	1	2	1	1	10	64	26	151
445-500	5	0	5	3	16	0	3	2	7	8	55	35	139
500-515	9	0	7	3	18	3	0	1	0	6	44	26	117
515-530	8	2	6	4	26	1	0	3	2	13	58	37	160
530-545	8	0	3	4	14	1	1	1	1	4	67	36	140
545-600	6	1	2	3	14	1	4	0	5	10	46	20	112
HOUR TOTALS													
	1	2	3	4	5	6	7	8	9	10	11	12	
TIME	SBRT	SBTH	SBLT	WBRT	WBTH	WBLT	NBRT	NBTH	NBLT	EBRT	EBTH	EBLT	TOTAL
'300-400	25	5	18	17	83	8	11	5	11	29	307	112	631
315-415	24	4	17	20	74	7	11	6	8	25	357	127	680
330-430	27	5	23	27	75	7	12	6	7	23	358	131	701
345-445	27	3	17	26	77	3	9	5	6	28	340	122	663
400-500	25	1	20	27	78	2	10	5	11	29	291	121	620
415-515	27	1	25	23	79	4	7	5	10	29	243	118	571
430-530	28	2	24	17	87	5	5	7	10	37	221	124	567
445-545	30	2	21	14	74	5	4	7	10	31	224	134	556
500-600	31	3	18	14	72	6	5	5	8	33	215	119	529

A.M. PEAK HOUR
330-430



WILTEC

Phone: (925) 706-9911 Fax: (925) 706-9914

INTERSECTION TURNING MOVEMENT COUNT SUMMARY

CLIENT: KAKU ASSOCIATES
PROJECT: KONA, BIG ISLAND OF HAWAII
DATE: TUESDAY SEPTEMBER 12, 2006
PERIOD: 6:00 AM TO 9:00 AM
INTERSECTION: N/S MAMALAHOA HIGHWAY (SR-190)
E/W KAIMINANI DRIVE

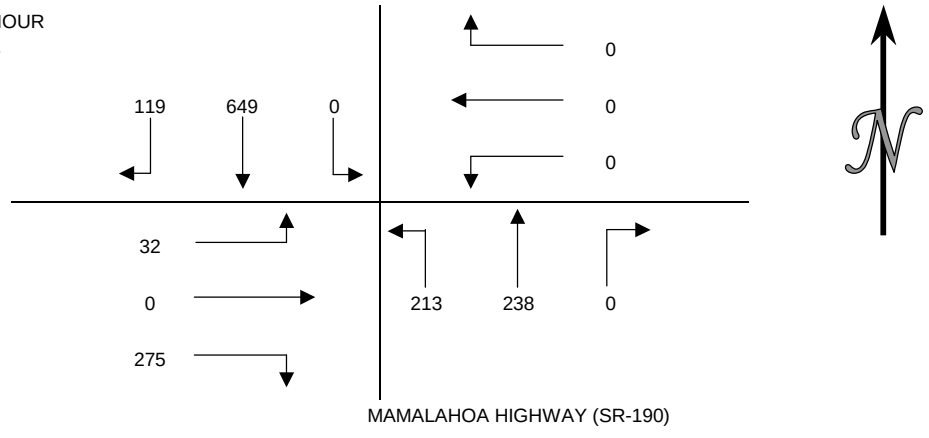
15 MIN COUNTS

PERIOD	1 SBRT	2 SBTH	3 SBLT	4 WBRT	5 WBTH	6 WBLT	7 NBRT	8 NBTH	9 NBLT	10 EBRT	11 EBTH	12 EBLT	TOTAL
600-615	16	97	0	0	0	0	0	31	35	29	0	3	211
615-630	21	119	0	0	0	0	0	48	49	41	0	2	280
630-645	24	134	0	0	0	0	0	39	55	36	0	7	295
645-700	23	163	0	0	0	0	0	51	73	63	0	7	380
700-715	27	170	0	0	0	0	0	46	57	79	0	11	390
715-730	42	168	0	0	0	0	0	78	37	91	0	8	424
730-745	27	148	0	0	0	0	0	63	46	42	0	6	332
745-800	24	108	0	0	0	0	0	63	52	45	0	6	298
80-815	12	91	0	0	0	0	0	61	47	22	0	10	243
815-830	19	82	0	0	0	0	0	94	33	32	0	13	273
830-845	18	103	0	0	0	0	0	57	30	36	0	9	253
845-900	8	96	0	0	0	0	0	64	24	32	0	9	233

HOUR TOTALS

TIME	1 SBRT	2 SBTH	3 SBLT	4 WBRT	5 WBTH	6 WBLT	7 NBRT	8 NBTH	9 NBLT	10 EBRT	11 EBTH	12 EBLT	TOTAL
600-700	84	513	0	0	0	0	0	169	212	169	0	19	1166
615-715	95	586	0	0	0	0	0	184	234	219	0	27	1345
630-730	116	635	0	0	0	0	0	214	222	269	0	33	1489
645-745	119	649	0	0	0	0	0	238	213	275	0	32	1526
700-800	120	594	0	0	0	0	0	250	192	257	0	31	1444
715-815	105	515	0	0	0	0	0	265	182	200	0	30	1297
730-830	82	429	0	0	0	0	0	281	178	141	0	35	1146
745-845	73	384	0	0	0	0	0	275	162	135	0	38	1067
800-900	57	372	0	0	0	0	0	276	134	122	0	41	1002

A.M. PEAK HOUR
645-745



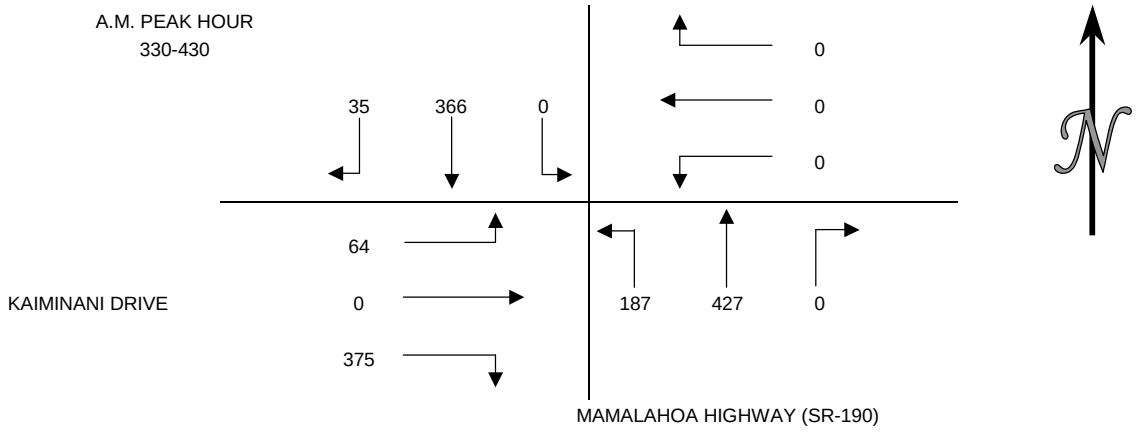
WILTEC

Phone: (925) 706-9911 Fax: (925) 706-9914

INTERSECTION TURNING MOVEMENT COUNT SUMMARY

CLIENT: KAKU ASSOCIATES
PROJECT: KONA, BIG ISLAND OF HAWAII
DATE: TUESDAY SEPTEMBER 12, 2006
PERIOD: 3:00 PM TO 6:00 PM
INTERSECTION: N/S MAMALAHOA HIGHWAY (SR-190)
E/W KAIMINANI DRIVE

15 MIN COUNTS													
	1	2	3	4	5	6	7	8	9	10	11	12	
PERIOD	SBRT	SBTH	SBLT	WBRT	WBTH	WBLT	NBRT	NBTH	NBLT	EBRT	EBTH	EBLT	TOTAL
'300-315	8	82	0	0	0	0	0	70	29	47	0	14	250
315-330	10	107	0	0	0	0	0	86	35	65	0	9	312
330-345	4	94	0	0	0	0	0	118	47	93	0	20	376
345-400	4	80	0	0	0	0	0	97	39	106	0	14	340
400-415	11	88	0	0	0	0	0	97	54	98	0	20	368
415-430	16	104	0	0	0	0	0	115	47	78	0	10	370
430-445	13	99	0	0	0	0	0	114	33	79	0	15	353
445-500	9	80	0	0	0	0	0	126	50	65	0	16	346
500-515	17	90	0	0	0	0	0	113	39	47	0	12	318
515-530	9	102	0	0	0	0	0	135	42	59	0	9	356
530-545	9	84	0	0	0	0	0	117	37	55	0	19	321
545-600	9	80	0	0	0	0	0	93	39	44	0	15	280
HOUR TOTALS													
	1	2	3	4	5	6	7	8	9	10	11	12	
TIME	SBRT	SBTH	SBLT	WBRT	WBTH	WBLT	NBRT	NBTH	NBLT	EBRT	EBTH	EBLT	TOTAL
'300-400	26	363	0	0	0	0	0	371	150	311	0	57	1278
315-415	29	369	0	0	0	0	0	398	175	362	0	63	1396
330-430	35	366	0	0	0	0	0	427	187	375	0	64	1454
345-445	44	371	0	0	0	0	0	423	173	361	0	59	1431
400-500	49	371	0	0	0	0	0	452	184	320	0	61	1437
415-515	55	373	0	0	0	0	0	468	169	269	0	53	1387
430-530	48	371	0	0	0	0	0	488	164	250	0	52	1373
445-545	44	356	0	0	0	0	0	491	168	226	0	56	1341
500-600	44	356	0	0	0	0	0	458	157	205	0	55	1275



WILTEC

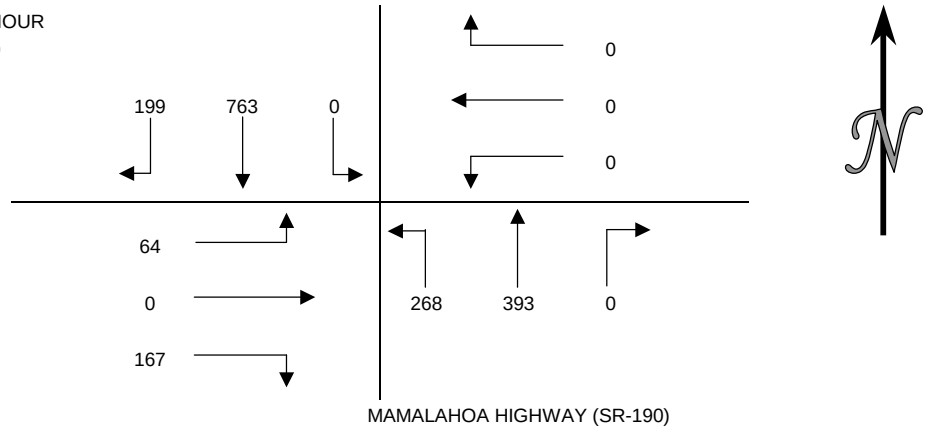
Phone: (925) 706-9911 Fax: (925) 706-9914

INTERSECTION TURNING MOVEMENT COUNT SUMMARY

CLIENT: KAKU ASSOCIATES
PROJECT: KONA, BIG ISLAND OF HAWAII
DATE: WEDNESDAY SEPTEMBER 13, 2006
PERIOD: 6:00 AM TO 9:00 AM
INTERSECTION: N/S MAMALAHOA HIGHWAY (SR-190)
E/W HINA LANI STREET

15 MIN COUNTS													
	1	2	3	4	5	6	7	8	9	10	11	12	
PERIOD	SBRT	SBTH	SBLT	WBRT	WBTH	WBLT	NBRT	NBTH	NBLT	EBRT	EBTH	EBLT	TOTAL
600-615	42	80	0	0	0	0	0	48	38	11	0	8	227
615-630	51	110	0	0	0	0	0	79	46	17	0	14	317
630-645	45	147	0	0	0	0	0	86	67	23	0	12	380
645-700	35	179	0	0	0	0	0	70	74	40	0	15	413
700-715	55	207	0	0	0	0	0	91	54	34	0	17	458
715-730	39	184	0	0	0	0	0	103	75	39	0	12	452
730-745	40	200	0	0	0	0	0	94	54	52	0	16	456
745-800	65	172	0	0	0	0	0	105	85	42	0	19	488
80-815	37	146	0	0	0	0	0	112	61	36	0	16	408
815-830	21	122	0	0	0	0	0	80	75	34	0	10	342
830-845	22	117	0	0	0	0	0	58	22	18	0	24	261
845-900	32	101	0	0	0	0	0	94	44	19	0	15	305
HOUR TOTALS													
	1	2	3	4	5	6	7	8	9	10	11	12	
TIME	SBRT	SBTH	SBLT	WBRT	WBTH	WBLT	NBRT	NBTH	NBLT	EBRT	EBTH	EBLT	TOTAL
600-700	173	516	0	0	0	0	0	283	225	91	0	49	1337
615-715	186	643	0	0	0	0	0	326	241	114	0	58	1568
630-730	174	717	0	0	0	0	0	350	270	136	0	56	1703
645-745	169	770	0	0	0	0	0	358	257	165	0	60	1779
700-800	199	763	0	0	0	0	0	393	268	167	0	64	1854
715-815	181	702	0	0	0	0	0	414	275	169	0	63	1804
730-830	163	640	0	0	0	0	0	391	275	164	0	61	1694
745-845	145	557	0	0	0	0	0	355	243	130	0	69	1499
800-900	112	486	0	0	0	0	0	344	202	107	0	65	1316

A.M. PEAK HOUR
700-800



HINA LANI STREET

MAMALAHOA HIGHWAY (SR-190)

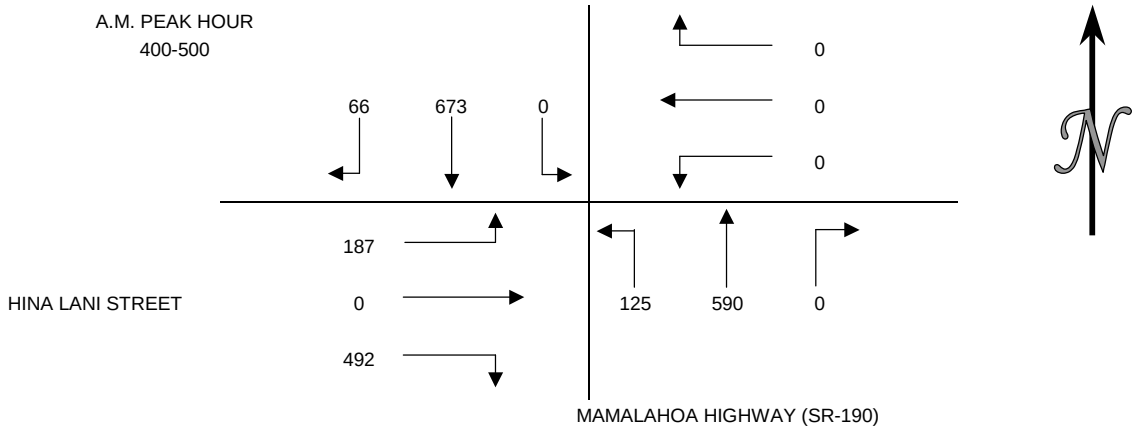
WILTEC

Phone: (925) 706-9911 Fax: (925) 706-9914

INTERSECTION TURNING MOVEMENT COUNT SUMMARY

CLIENT: KAKU ASSOCIATES
PROJECT: KONA, BIG ISLAND OF HAWAII
DATE: TUESDAY SEPTEMBER 12, 2006
PERIOD: 3:00 PM TO 6:00 PM
INTERSECTION: N/S MAMALAHOA HIGHWAY (SR-190)
E/W HINA LANI STREET

15 MIN COUNTS													
	1	2	3	4	5	6	7	8	9	10	11	12	
PERIOD	SBRT	SBTH	SBLT	WBRT	WBTH	WBLT	NBRT	NBTH	NBLT	EBRT	EBTH	EBLT	TOTAL
'300-315	20	126	0	0	0	0	0	103	24	69	0	47	389
315-330	21	127	0	0	0	0	0	132	32	78	0	35	425
330-345	21	158	0	0	0	0	0	122	19	94	0	39	453
345-400	10	181	0	0	0	0	0	146	28	105	0	44	514
400-415	13	164	0	0	0	0	0	119	23	115	0	60	494
415-430	10	150	0	0	0	0	0	135	27	132	0	39	493
430-445	18	172	0	0	0	0	0	171	30	122	0	38	551
445-500	25	187	0	0	0	0	0	165	45	123	0	50	595
500-515	13	159	0	0	0	0	0	142	32	92	0	43	481
515-530	19	157	0	0	0	0	0	141	35	89	0	25	466
530-545	14	136	0	0	0	0	0	146	28	52	0	42	418
545-600	25	129	0	0	0	0	0	134	19	40	0	57	404
HOUR TOTALS													
	1	2	3	4	5	6	7	8	9	10	11	12	
TIME	SBRT	SBTH	SBLT	WBRT	WBTH	WBLT	NBRT	NBTH	NBLT	EBRT	EBTH	EBLT	TOTAL
'300-400	72	592	0	0	0	0	0	503	103	346	0	165	1781
315-415	65	630	0	0	0	0	0	519	102	392	0	178	1886
330-430	54	653	0	0	0	0	0	522	97	446	0	182	1954
345-445	51	667	0	0	0	0	0	571	108	474	0	181	2052
400-500	66	673	0	0	0	0	0	590	125	492	0	187	2133
415-515	66	668	0	0	0	0	0	613	134	469	0	170	2120
430-530	75	675	0	0	0	0	0	619	142	426	0	156	2093
445-545	71	639	0	0	0	0	0	594	140	356	0	160	1960
500-600	71	581	0	0	0	0	0	563	114	273	0	167	1769



WILTEC

Phone: (925) 706-9911 Fax: (925) 706-9914

INTERSECTION TURNING MOVEMENT COUNT SUMMARY

CLIENT: KAKU ASSOCIATES
PROJECT: KONA, BIG ISLAND OF HAWAII
DATE: WEDNESDAY SEPTEMBER 13, 2006
PERIOD: 6:00 AM TO 9:00 AM
INTERSECTION: N/S QUEEN KAAHUMANU HIGHWAY (SR-19)
E/W HINA LANI STREET

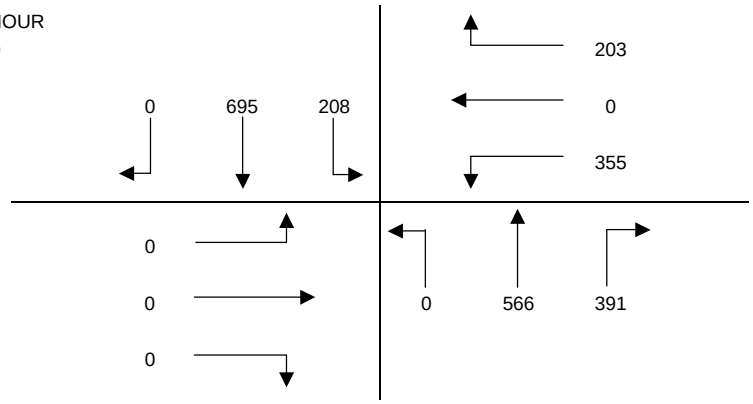
15 MIN COUNTS

PERIOD	1 SBRT	2 SBTH	3 SBLT	4 WBRT	5 WBTH	6 WBLT	7 NBRT	8 NBTH	9 NBLT	10 EBRT	11 EBTH	12 EBLT	TOTAL
600-615	0	72	14	44	0	50	31	141	0	0	0	0	352
615-630	0	70	29	54	0	43	49	176	0	0	0	0	421
630-645	0	94	30	59	0	47	54	165	0	0	0	0	449
645-700	0	113	32	80	0	51	60	153	0	0	0	0	489
700-715	0	131	38	75	0	55	85	148	0	0	0	0	532
715-730	0	161	51	39	0	31	67	128	0	0	0	0	477
730-745	0	180	59	59	0	82	98	151	0	0	0	0	629
745-800	0	169	56	55	0	83	112	132	0	0	0	0	607
80-815	0	165	51	39	0	96	88	149	0	0	0	0	588
815-830	0	181	42	50	0	94	93	134	0	0	0	0	594
830-845	0	152	39	53	0	84	78	109	0	0	0	0	515
845-900	0	181	55	70	0	79	92	115	0	0	0	0	592

HOUR TOTALS

TIME	1 SBRT	2 SBTH	3 SBLT	4 WBRT	5 WBTH	6 WBLT	7 NBRT	8 NBTH	9 NBLT	10 EBRT	11 EBTH	12 EBLT	TOTAL
600-700	0	349	105	237	0	191	194	635	0	0	0	0	1711
615-715	0	408	129	268	0	196	248	642	0	0	0	0	1891
630-730	0	499	151	253	0	184	266	594	0	0	0	0	1947
645-745	0	585	180	253	0	219	310	580	0	0	0	0	2127
700-800	0	641	204	228	0	251	362	559	0	0	0	0	2245
715-815	0	675	217	192	0	292	365	560	0	0	0	0	2301
730-830	0	695	208	203	0	355	391	566	0	0	0	0	2418
745-845	0	667	188	197	0	357	371	524	0	0	0	0	2304
800-900	0	679	187	212	0	353	351	507	0	0	0	0	2289

A.M. PEAK HOUR
730-830



WILTEC

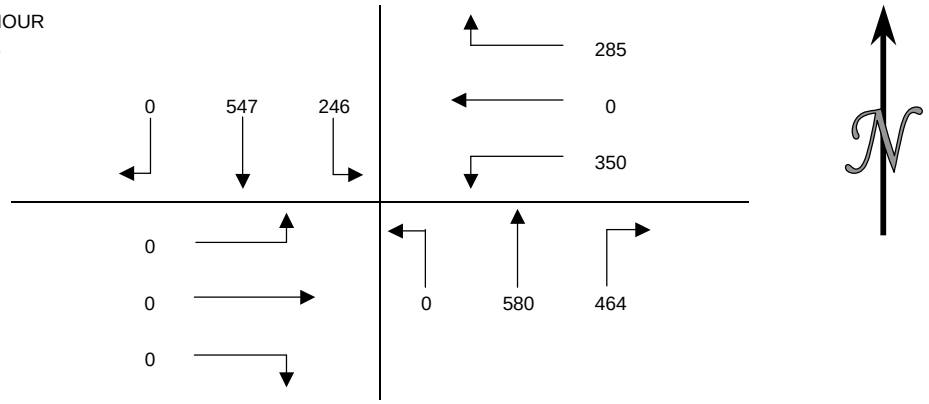
Phone: (925) 706-9911 Fax: (925) 706-9914

INTERSECTION TURNING MOVEMENT COUNT SUMMARY

CLIENT: KAKU ASSOCIATES
PROJECT: KONA, BIG ISLAND OF HAWAII
DATE: TUESDAY SEPTEMBER 12, 2006
PERIOD: 3:00 PM TO 6:00 PM
INTERSECTION: N/S QUEEN KAAHUMANU HIGHWAY (SR-19)
E/W HINA LANI STREET

15 MIN COUNTS													
	1	2	3	4	5	6	7	8	9	10	11	12	
PERIOD	SBRT	SBTH	SBLT	WBRT	WBTH	WBLT	NBRT	NBTH	NBLT	EBRT	EBTH	EBLT	TOTAL
'300-315	0	124	49	38	0	60	112	96	0	0	0	0	479
315-330	0	125	67	43	0	100	104	93	0	0	0	0	532
330-345	0	136	79	49	0	85	122	99	0	0	0	0	570
345-400	0	133	85	76	0	84	120	104	0	0	0	0	602
400-415	0	139	84	52	0	69	122	112	0	0	0	0	578
415-430	0	159	76	68	0	84	101	129	0	0	0	0	617
430-445	0	135	65	70	0	79	110	141	0	0	0	0	600
445-500	0	126	60	78	0	90	130	166	0	0	0	0	650
500-515	0	127	45	69	0	97	123	144	0	0	0	0	605
515-530	0	111	56	60	0	86	108	132	0	0	0	0	553
530-545	0	105	33	30	0	71	89	119	0	0	0	0	447
545-600	0	87	24	24	0	52	78	95	0	0	0	0	360
HOUR TOTALS													
	1	2	3	4	5	6	7	8	9	10	11	12	
TIME	SBRT	SBTH	SBLT	WBRT	WBTH	WBLT	NBRT	NBTH	NBLT	EBRT	EBTH	EBLT	TOTAL
'300-400	0	518	280	206	0	329	458	392	0	0	0	0	2183
315-415	0	533	315	220	0	338	468	408	0	0	0	0	2282
330-430	0	567	324	245	0	322	465	444	0	0	0	0	2367
345-445	0	566	310	266	0	316	453	486	0	0	0	0	2397
400-500	0	559	285	268	0	322	463	548	0	0	0	0	2445
415-515	0	547	246	285	0	350	464	580	0	0	0	0	2472
430-530	0	499	226	277	0	352	471	583	0	0	0	0	2408
445-545	0	469	194	237	0	344	450	561	0	0	0	0	2255
500-600	0	430	158	183	0	306	398	490	0	0	0	0	1965

A.M. PEAK HOUR
415-515



APPENDIX C

INTERSECTION LEVEL OF SERVICE WORKSHEETS

EXISTING CONDITIONS

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.872
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	29.9
Optimal Cycle:	93	Level Of Service:	C

Street Name:	Queen Kaahumanu Highway (SR-19)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	1	0 1	1 0	1	0 0	0 0	0	0 0	1 0	0	0 1
Volume Module:												
Base Vol:	0	694	126	46	326	0	0	0	0	404	0	336
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	694	126	46	326	0	0	0	0	404	0	336
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	731	133	48	343	0	0	0	0	425	0	354
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	731	133	48	343	0	0	0	0	425	0	354
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	731	133	48	343	0	0	0	0	425	0	354
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	1.00	0.85	0.95	1.00	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	1700	1445	1615	1700	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.43	0.09	0.03	0.20	0.00	0.00	0.00	0.00	0.33	0.00	0.24
Crit Moves:		****		****						****		
Green/Cycle:	0.00	0.49	0.49	0.53	0.53	0.00	0.00	0.00	0.00	0.37	0.00	0.37
Volume/Cap:	0.00	0.87	0.19	0.32	0.38	0.00	0.00	0.00	0.00	0.87	0.00	0.66
Uniform Del:	0.0	22.6	14.2	18.0	14.0	0.0	0.0	0.0	0.0	29.1	0.0	26.0
IncremntDel:	0.0	9.9	0.1	1.3	0.3	0.0	0.0	0.0	0.0	15.7	0.0	2.9
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	32.5	14.3	19.3	14.3	0.0	0.0	0.0	0.0	44.9	0.0	29.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	32.5	14.3	19.3	14.3	0.0	0.0	0.0	0.0	44.9	0.0	29.0
LOS by Move:	A	C	B	B	B	A	A	A	A	D	A	C
HCM2kAvgQ:	0	23	2	1	6	0	0	0	0	15	0	10

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Average Delay (sec/veh): 4.9 Worst Case Level Of Service: C[17.6]

Street Name:	Holoholo Street						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	36	3	16	27	7	151	25	122	8	7	378	7
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	36	3	16	27	7	151	25	122	8	7	378	7
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	38	3	17	28	7	159	26	128	8	7	398	7
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	38	3	17	28	7	159	26	128	8	7	398	7
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	685	605	133	612	606	402	405	xxxx	xxxxx	137	xxxx	xxxxx
Potent Cap.:	365	414	922	408	414	653	1164	xxxx	xxxxx	1460	xxxx	xxxxx
Move Cap.:	267	403	922	390	403	653	1164	xxxx	xxxxx	1460	xxxx	xxxxx
Volume/Cap:	0.14	0.01	0.02	0.07	0.02	0.24	0.02	xxxx	xxxx	0.01	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.1	xxxx	xxxxx	0.0	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	8.2	xxxx	xxxxx	7.5	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	A	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	344	xxxxx	xxxx	582	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	0.6	xxxxx	xxxxx	1.5	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	17.6	xxxxx	xxxxx	14.3	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	C	*	*	B	*	*	*	*	*	*	*
ApproachDel:	17.6			14.3			xxxxxx			xxxxxx		
ApproachLOS:	C			B			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #3 Mamalahoa/Kaiminani

Average Delay (sec/veh): 13.9 Worst Case Level Of Service: F[61.4]

Street Name:	Mamalahoa Highway (SR-190)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0 1	0 0		0 0 1	0 1		0 0 1!	0 0		0 0	0 0 0	
Volume Module:												
Base Vol:	213	238	0	0	649	119	32	0	275	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	213	238	0	0	649	119	32	0	275	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	224	251	0	0	683	125	34	0	289	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	224	251	0	0	683	125	34	0	289	0	0	0
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2	xxxxx	xxxx	xxxxx
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3	xxxxx	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	808	xxxx	xxxxx	xxxx	xxxx	xxxxx	1382	xxxx	683	xxxx	xxxx	xxxxx
Potent Cap.:	826	xxxx	xxxxx	xxxx	xxxx	xxxxx	160	xxxx	453	xxxx	xxxx	xxxxx
Move Cap.:	826	xxxx	xxxxx	xxxx	xxxx	xxxxx	127	xxxx	453	xxxx	xxxx	xxxxx
Volume/Cap:	0.27	xxxx	xxxx	xxxx	xxxx	xxxx	0.27	xxxx	0.64	xxxx	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	1.1	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
Control Del:	11.0	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
LOS by Move:	B	*	*	*	*	*	*	*	*	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	357	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	9.1	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	61.4	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	*	*	F	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			61.4			xxxxxx		
ApproachLOS:	*			*			F			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalahoa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.854
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	23.9
Optimal Cycle:	86	Level Of Service:	C

Street Name:	Mamalahoa Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0	0 1	0	1	0 0	0 1	0	0 0	0 0 0
Volume Module:												
Base Vol:	268	393	0	0	763	199	64	0	167	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	268	393	0	0	763	199	64	0	167	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	282	414	0	0	803	209	67	0	176	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	282	414	0	0	803	209	67	0	176	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	282	414	0	0	803	209	67	0	176	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.95	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	1615	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.17	0.24	0.00	0.00	0.47	0.14	0.04	0.00	0.12	0.00	0.00	0.00
Crit Moves:	****				****				****			
Green/Cycle:	0.76	0.76	0.00	0.00	0.55	0.55	0.14	0.00	0.14	0.00	0.00	0.00
Volume/Cap:	0.63	0.32	0.00	0.00	0.85	0.26	0.29	0.00	0.85	0.00	0.00	0.00
Uniform Del:	19.1	3.9	0.0	0.0	18.9	11.7	38.4	0.0	41.9	0.0	0.0	0.0
IncremntDel:	2.9	0.1	0.0	0.0	7.7	0.2	0.7	0.0	27.6	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	22.0	4.0	0.0	0.0	26.6	11.9	39.1	0.0	69.5	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	22.0	4.0	0.0	0.0	26.6	11.9	39.1	0.0	69.5	0.0	0.0	0.0
LOS by Move:	C	A	A	A	C	B	D	A	E	A	A	A
HCM2kAvgQ:	5	4	0	0	24	3	2	0	8	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.858
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	30.0
Optimal Cycle:	88	Level Of Service:	C

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	1	0 1	1	0 1	0 0	0 0	0	0 0	1	0 0	0 1
Volume Module:												
Base Vol:	0	566	391	208	695	0	0	0	0	355	0	203
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	566	391	208	695	0	0	0	0	355	0	203
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	596	412	219	732	0	0	0	0	374	0	214
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	596	412	219	732	0	0	0	0	374	0	214
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	596	412	219	732	0	0	0	0	374	0	214
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	1.00	0.85	0.95	1.00	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	1700	1445	1615	1700	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.35	0.28	0.14	0.43	0.00	0.00	0.00	0.00	0.29	0.00	0.15
Crit Moves:		****		****						****		
Green/Cycle:	0.00	0.41	0.41	0.57	0.57	0.00	0.00	0.00	0.00	0.33	0.00	0.33
Volume/Cap:	0.00	0.86	0.70	0.64	0.76	0.00	0.00	0.00	0.00	0.86	0.00	0.44
Uniform Del:	0.0	26.9	24.4	17.7	16.5	0.0	0.0	0.0	0.0	31.1	0.0	26.1
IncremntDel:	0.0	10.4	3.7	4.1	3.6	0.0	0.0	0.0	0.0	15.5	0.0	0.7
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	37.3	28.1	21.8	20.0	0.0	0.0	0.0	0.0	46.6	0.0	26.7
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	37.3	28.1	21.8	20.0	0.0	0.0	0.0	0.0	46.6	0.0	26.7
LOS by Move:	A	D	C	C	C	A	A	A	A	D	A	C
HCM2kAvgQ:	0	20	12	6	18	0	0	0	0	14	0	5

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.552
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	16.3
Optimal Cycle:	40	Level Of Service:	B

Street Name:	Queen Kaahumanu Highway (SR-19)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	1	0 1	1 0	1	0 0	0 0	0	0 0	1 0	0	0 1
Volume Module:												
Base Vol:	0	212	223	376	660	0	0	0	0	110	0	79
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	212	223	376	660	0	0	0	0	110	0	79
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	223	235	396	695	0	0	0	0	116	0	83
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	223	235	396	695	0	0	0	0	116	0	83
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	223	235	396	695	0	0	0	0	116	0	83
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	1.00	0.85	0.95	1.00	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	1700	1445	1615	1700	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.13	0.16	0.25	0.41	0.00	0.00	0.00	0.00	0.09	0.00	0.06
Crit Moves:					****					****		
Green/Cycle:	0.00	0.29	0.29	0.74	0.74	0.00	0.00	0.00	0.00	0.16	0.00	0.16
Volume/Cap:	0.00	0.45	0.55	0.43	0.55	0.00	0.00	0.00	0.00	0.55	0.00	0.36
Uniform Del:	0.0	28.6	29.7	5.3	5.7	0.0	0.0	0.0	0.0	38.6	0.0	37.4
IncremntDel:	0.0	0.6	1.6	0.3	0.5	0.0	0.0	0.0	0.0	3.1	0.0	0.9
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	29.3	31.3	5.6	6.3	0.0	0.0	0.0	0.0	41.8	0.0	38.3
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	29.3	31.3	5.6	6.3	0.0	0.0	0.0	0.0	41.8	0.0	38.3
LOS by Move:	A	C	C	A	A	A	A	A	A	D	A	D
HCM2kAvgQ:	0	6	7	5	10	0	0	0	0	4	0	3

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Average Delay (sec/veh): 3.2 Worst Case Level Of Service: B[14.9]

Street Name:	Holoholo Street						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	7	6	12	23	5	27	131	358	23	7	75	27
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	7	6	12	23	5	27	131	358	23	7	75	27
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	7	6	13	24	5	28	138	377	24	7	79	28
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	7	6	13	24	5	28	138	377	24	7	79	28
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	789	787	389	782	785	93	107	xxxx	xxxxx	401	xxxx	xxxxx
Potent Cap.:	311	326	664	314	327	969	1496	xxxx	xxxxx	1169	xxxx	xxxxx
Move Cap.:	273	292	664	279	293	969	1496	xxxx	xxxxx	1169	xxxx	xxxxx
Volume/Cap:	0.03	0.02	0.02	0.09	0.02	0.03	0.09	xxxx	xxxx	0.01	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.3	xxxx	xxxxx	0.0	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	7.7	xxxx	xxxxx	8.1	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	A	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	389	xxxxx	xxxx	431	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	0.2	xxxxx	xxxxx	0.5	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	14.9	xxxxx	xxxxx	14.6	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	B	*	*	B	*	*	*	*	*	*	*
ApproachDel:	14.9			14.6			xxxxxx			xxxxxx		
ApproachLOS:	B			B			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #3 Mamalahoa/Kaiminani

Average Delay (sec/veh): 21.4 Worst Case Level Of Service: F[67.1]

Street Name:	Mamalahoa Highway (SR-190)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0 1	0 0		0 0 1	0 1		0 0 1!	0 0		0 0	0 0 0	
Volume Module:												
Base Vol:	187	427	0	0	366	35	64	0	375	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	187	427	0	0	366	35	64	0	375	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	197	449	0	0	385	37	67	0	395	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	197	449	0	0	385	37	67	0	395	0	0	0
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2	xxxxx	xxxx	xxxxx
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3	xxxxx	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	422	xxxx	xxxxx	xxxx	xxxx	xxxxx	1228	xxxx	385	xxxx	xxxx	xxxxx
Potent Cap.:	1148	xxxx	xxxxx	xxxx	xxxx	xxxxx	198	xxxx	667	xxxx	xxxx	xxxxx
Move Cap.:	1148	xxxx	xxxxx	xxxx	xxxx	xxxxx	172	xxxx	667	xxxx	xxxx	xxxxx
Volume/Cap:	0.17	xxxx	xxxx	xxxx	xxxx	xxxx	0.39	xxxx	0.59	xxxx	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	0.6	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
Control Del:	8.8	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
LOS by Move:	A	*	*	*	*	*	*	*	*	*	*	*
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	470	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	12.7	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	67.1	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	*	*	F	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			67.1			xxxxxx		
ApproachLOS:	*			*			F			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalahoa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.952
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	38.3
Optimal Cycle:	139	Level Of Service:	D

Street Name:	Mamalahoa Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0	0 1	0 1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	125	590	0	0	673	66	187	0	492	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	125	590	0	0	673	66	187	0	492	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	132	621	0	0	708	69	197	0	518	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	132	621	0	0	708	69	197	0	518	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	132	621	0	0	708	69	197	0	518	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.95	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	1615	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.08	0.37	0.00	0.00	0.42	0.05	0.12	0.00	0.36	0.00	0.00	0.00
Crit Moves:	****				****				****			
Green/Cycle:	0.52	0.52	0.00	0.00	0.44	0.44	0.38	0.00	0.38	0.00	0.00	0.00
Volume/Cap:	0.64	0.70	0.00	0.00	0.95	0.11	0.32	0.00	0.95	0.00	0.00	0.00
Uniform Del:	20.1	17.9	0.0	0.0	27.1	16.6	22.1	0.0	30.3	0.0	0.0	0.0
IncremntDel:	6.5	2.5	0.0	0.0	21.9	0.1	0.3	0.0	26.9	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	26.6	20.4	0.0	0.0	49.0	16.7	22.4	0.0	57.2	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	26.6	20.4	0.0	0.0	49.0	16.7	22.4	0.0	57.2	0.0	0.0	0.0
LOS by Move:	C	C	A	A	D	B	C	A	E	A	A	A
HCM2kAvgQ:	4	15	0	0	26	1	4	0	21	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.890
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	34.2
Optimal Cycle:	101	Level Of Service:	C

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	1	0 1	1	0 1	0 0	0 0	0	0 0	1	0 0	0 1
Volume Module:												
Base Vol:	0	580	464	246	547	0	0	0	0	350	0	285
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	580	464	246	547	0	0	0	0	350	0	285
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	611	488	259	576	0	0	0	0	368	0	300
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	611	488	259	576	0	0	0	0	368	0	300
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	611	488	259	576	0	0	0	0	368	0	300
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	1.00	0.85	0.95	1.00	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	1700	1445	1615	1700	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.36	0.34	0.16	0.34	0.00	0.00	0.00	0.00	0.28	0.00	0.21
Crit Moves:		****		****						****		
Green/Cycle:	0.00	0.40	0.40	0.58	0.58	0.00	0.00	0.00	0.00	0.32	0.00	0.32
Volume/Cap:	0.00	0.89	0.84	0.72	0.58	0.00	0.00	0.00	0.00	0.89	0.00	0.66
Uniform Del:	0.0	27.8	26.9	23.8	13.1	0.0	0.0	0.0	0.0	32.5	0.0	29.5
IncremntDel:	0.0	13.7	10.4	6.7	0.9	0.0	0.0	0.0	0.0	20.6	0.0	3.4
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	41.5	37.2	30.5	14.0	0.0	0.0	0.0	0.0	53.1	0.0	32.9
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	41.5	37.2	30.5	14.0	0.0	0.0	0.0	0.0	53.1	0.0	32.9
LOS by Move:	A	D	D	C	B	A	A	A	A	D	A	C
HCM2kAvgQ:	0	21	16	7	11	0	0	0	0	14	0	9

Note: Queue reported is the number of cars per lane.

CUMULATIVE BASE CONDITIONS

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Average Delay (sec/veh): 8.5 Worst Case Level Of Service: D[27.9]

Street Name:	Holoholo St						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	41	19	31	40	26	187	41	171	24	23	435	12
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	41	19	31	40	26	187	41	171	24	23	435	12
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	43	20	33	42	27	197	43	180	25	24	458	13
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	43	20	33	42	27	197	43	180	25	24	458	13
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	904	798	193	818	804	464	471	xxxx	xxxxx	205	xxxx	xxxxx
Potent Cap.:	260	321	854	297	319	602	1102	xxxx	xxxxx	1378	xxxx	xxxxx
Move Cap.:	156	303	854	260	300	602	1102	xxxx	xxxxx	1378	xxxx	xxxxx
Volume/Cap:	0.28	0.07	0.04	0.16	0.09	0.33	0.04	xxxx	xxxx	0.02	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.1	xxxx	xxxxx	0.1	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	8.4	xxxx	xxxxx	7.7	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	A	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	251	xxxxx	xxxx	459	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	1.7	xxxxx	xxxxx	3.6	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	27.9	xxxxx	xxxxx	23.1	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	D	*	*	C	*	*	*	*	*	*	*
ApproachDel:	27.9			23.1			xxxxxx			xxxxxx		
ApproachLOS:	D			C			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #3 Mamalahoa/Kaiminani

Average Delay (sec/veh): 37.7 Worst Case Level Of Service: F[176.8]

Street Name:	Mamalahoa Hwy								Kaiminani Dr							
Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Uncontrolled				Uncontrolled				Stop Sign				Stop Sign			
Rights:	Include				Include				Include				Include			
Lanes:	1	0	1	0 0	0	0	1	0 1	1	0	0	0 1	0	0	0	0 0
Volume Module:																
Base Vol:	360	382	0	0	843	155			51	0	376		0	0	0	
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00			1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	360	382	0	0	843	155			51	0	376		0	0	0	
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00			1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95			0.95	0.95	0.95		0.95	0.95	0.95	
PHF Volume:	379	402	0	0	887	163			54	0	396		0	0	0	
Reduct Vol:	0	0	0	0	0	0			0	0	0		0	0	0	
Final Vol.:	379	402	0	0	887	163			54	0	396		0	0	0	
Critical Gap Module:																
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx			6.4	xxxx	6.2	xxxxx	xxxx	xxxxx		
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx			3.5	xxxx	3.3	xxxxx	xxxx	xxxxx		
Capacity Module:																
Cnflict Vol:	1051	xxxx	xxxxx	xxxx	xxxx	xxxxx			2047	xxxx	887	xxxx	xxxx	xxxxx		
Potent Cap.:	670	xxxx	xxxxx	xxxx	xxxx	xxxxx			62	xxxx	346	xxxx	xxxx	xxxxx		
Move Cap.:	670	xxxx	xxxxx	xxxx	xxxx	xxxxx			34	xxxx	346	xxxx	xxxx	xxxxx		
Volume/Cap:	0.57	xxxx	xxxx	xxxx	xxxx	xxxx			1.56	xxxx	1.14	xxxx	xxxx	xxxx		
Level Of Service Module:																
2Way95thQ:	3.6	xxxx	xxxxx	xxxx	xxxx	xxxxx			5.9	xxxx	15.7	xxxx	xxxx	xxxxx		
Control Del:	17.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx			536.2	xxxx	128.1	xxxxx	xxxx	xxxxx		
LOS by Move:	C	*	*	*	*	*			F	*	F	*	*	*		
Movement:	LT -	LTR -	RT	LT -	LTR -	RT			LT -	LTR -	RT	LT -	LTR -	RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx			xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx		
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx		
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx		
Shared LOS:	*	*	*	*	*	*			*	*	*	*	*	*		
ApproachDel:	xxxxxx			xxxxxx					176.8			xxxxxx				
ApproachLOS:	*			*					F			*				

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalahoa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.346
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	104.3
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Mamalahoa Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0 0	1 0	1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	424	558	0	0	1029	240	194	0	352	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	424	558	0	0	1029	240	194	0	352	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	446	587	0	0	1083	253	204	0	371	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	446	587	0	0	1083	253	204	0	371	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	446	587	0	0	1083	253	204	0	371	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.27	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	467	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.95	0.35	0.00	0.00	0.64	0.17	0.13	0.00	0.26	0.00	0.00	0.00
Crit Moves:	****								****			
Green/Cycle:	0.70	0.70	0.00	0.00	0.49	0.49	0.20	0.00	0.20	0.00	0.00	0.00
Volume/Cap:	1.09	0.49	0.00	0.00	1.30	0.36	0.64	0.00	1.30	0.00	0.00	0.00
Uniform Del:	5.9	6.8	0.0	0.0	25.5	15.8	36.9	0.0	40.1	0.0	0.0	0.0
IncremntDel:	69.2	0.3	0.0	0.0	144	0.3	4.4	0.0	158.3	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	75.1	7.1	0.0	0.0	169	16.1	41.3	0.0	198.4	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	75.1	7.1	0.0	0.0	169	16.1	41.3	0.0	198.4	0.0	0.0	0.0
LOS by Move:	E	A	A	A	F	B	D	A	F	A	A	A
HCM2kAvgQ:	22	8	0	0	65	5	7	0	24	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #5 Kealakaa/Hina Lani

Average Delay (sec/veh): 202.1 Worst Case Level Of Service: F[985.1]

Street Name:	Kealakaa Street						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	103	25	52	115	21	166	54	324	34	22	804	51
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	103	25	52	115	21	166	54	324	34	22	804	51
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	108	26	55	121	22	175	57	341	36	23	846	54
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	108	26	55	121	22	175	57	341	36	23	846	54
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1491	1419	359	1433	1410	873	900	xxxx	xxxxx	377	xxxx	xxxxx
Potent Cap.:	103	138	690	113	140	352	763	xxxx	xxxxx	1193	xxxx	xxxxx
Move Cap.:	42	125	690	81	126	352	763	xxxx	xxxxx	1193	xxxx	xxxxx
Volume/Cap:	2.60	0.21	0.08	1.49	0.17	0.50	0.07	xxxx	xxxx	0.02	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.2	xxxx	xxxxx	0.1	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	10.1	xxxx	xxxxx	8.1	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	B	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	66	xxxxx	xxxx	147	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	19.2	xxxxx	xxxxx	26.0	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	985	xxxxx	xxxxx	596	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	F	*	*	F	*	*	*	*	*	*	*
ApproachDel:	985.1			595.7			xxxxxx			xxxxxx		
ApproachLOS:	F			F			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.183
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	67.6
Optimal Cycle:	180	Level Of Service:	E

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0 2	0 1		1 0 2	0 0		0 0 0	0 0		1 0	0 0 1	
Volume Module:												
Base Vol:	0	841	613	285	941	0	0	0	0	578	0	443
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	841	613	285	941	0	0	0	0	578	0	443
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	885	645	300	991	0	0	0	0	608	0	466
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	885	645	300	991	0	0	0	0	608	0	466
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	885	645	300	991	0	0	0	0	608	0	466
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.44	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	743	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.27	0.45	0.40	0.31	0.00	0.00	0.00	0.00	0.47	0.00	0.32
Crit Moves:			****	****						****		
Green/Cycle:	0.00	0.37	0.37	0.52	0.52	0.00	0.00	0.00	0.00	0.38	0.00	0.38
Volume/Cap:	0.00	0.75	1.22	0.92	0.59	0.00	0.00	0.00	0.00	1.22	0.00	0.85
Uniform Del:	0.0	27.7	31.7	25.3	16.7	0.0	0.0	0.0	0.0	30.9	0.0	28.2
IncremntDel:	0.0	2.7	115.1	31.1	0.6	0.0	0.0	0.0	0.0	115.9	0.0	11.6
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	30.4	146.8	56.4	17.3	0.0	0.0	0.0	0.0	146.9	0.0	39.8
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	30.4	146.8	56.4	17.3	0.0	0.0	0.0	0.0	146.9	0.0	39.8
LOS by Move:	A	C	F	E	B	A	A	A	A	F	A	D
HCM2kAvgQ:	0	14	37	12	11	0	0	0	0	35	0	16

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.690
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	19.6
Optimal Cycle:	53	Level Of Service:	B

Street Name:	Queen Kaahumanu Highway (SR-19)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2 0	1	1 0	2 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	405	225	471	1059	0	0	0	0	186	0	105
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	405	225	471	1059	0	0	0	0	186	0	105
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	426	237	496	1115	0	0	0	0	196	0	111
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	426	237	496	1115	0	0	0	0	196	0	111
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	426	237	496	1115	0	0	0	0	196	0	111
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.95	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1615	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.13	0.16	0.31	0.35	0.00	0.00	0.00	0.00	0.15	0.00	0.08
Crit Moves:			****	****						****		
Green/Cycle:	0.00	0.24	0.24	0.68	0.68	0.00	0.00	0.00	0.00	0.22	0.00	0.22
Volume/Cap:	0.00	0.56	0.69	0.60	0.51	0.00	0.00	0.00	0.00	0.69	0.00	0.35
Uniform Del:	0.0	33.5	34.8	9.4	7.7	0.0	0.0	0.0	0.0	36.0	0.0	33.2
IncremntDel:	0.0	0.9	5.9	1.2	0.2	0.0	0.0	0.0	0.0	7.0	0.0	0.7
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	34.4	40.6	10.6	7.9	0.0	0.0	0.0	0.0	43.1	0.0	33.9
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	34.4	40.6	10.6	7.9	0.0	0.0	0.0	0.0	43.1	0.0	33.9
LOS by Move:	A	C	D	B	A	A	A	A	A	D	A	C
HCM2kAvgQ:	0	7	8	9	9	0	0	0	0	7	0	3

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Average Delay (sec/veh): 7.1 Worst Case Level Of Service: E[39.9]

Street Name:	Holoholo St						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	16	31	27	31	34	38	141	594	40	30	114	29
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	16	31	27	31	34	38	141	594	40	30	114	29
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	17	33	28	33	36	40	148	625	42	32	120	31
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	17	33	28	33	36	40	148	625	42	32	120	31
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1179	1157	646	1172	1163	135	151	xxxx	xxxxx	667	xxxx	xxxxx
Potent Cap.:	169	198	475	171	196	919	1443	xxxx	xxxxx	932	xxxx	xxxxx
Move Cap.:	121	170	475	122	168	919	1443	xxxx	xxxxx	932	xxxx	xxxxx
Volume/Cap:	0.14	0.19	0.06	0.27	0.21	0.04	0.10	xxxx	xxxx	0.03	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.3	xxxx	xxxxx	0.1	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	7.8	xxxx	xxxxx	9.0	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	A	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	199	xxxxx	xxxx	207	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	1.7	xxxxx	xxxxx	2.7	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	34.3	xxxxx	xxxxx	39.9	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	D	*	*	E	*	*	*	*	*	*	*
ApproachDel:		34.3			39.9			xxxxxx			xxxxxx	
ApproachLOS:		D			E			*			*	

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #3 Mamalahoa/Kaiminani

Average Delay (sec/veh): 66.3 Worst Case Level Of Service: F[193.2]

Street Name:	Mamalahoa Hwy						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0	1 0	0	0 0	1 0	1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	280	536	0	0	560	62	84	0	644	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	280	536	0	0	560	62	84	0	644	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	295	564	0	0	589	65	88	0	678	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	295	564	0	0	589	65	88	0	678	0	0	0
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2	xxxxx	xxxx	xxxxx
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3	xxxxx	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	655	xxxx	xxxxx	xxxx	xxxx	xxxxx	1743	xxxx	589	xxxx	xxxx	xxxxx
Potent Cap.:	942	xxxx	xxxxx	xxxx	xxxx	xxxxx	96	xxxx	512	xxxx	xxxx	xxxxx
Move Cap.:	942	xxxx	xxxxx	xxxx	xxxx	xxxxx	73	xxxx	512	xxxx	xxxx	xxxxx
Volume/Cap:	0.31	xxxx	xxxx	xxxx	xxxx	xxxx	1.21	xxxx	1.32	xxxx	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	1.3	xxxx	xxxxx	xxxx	xxxx	xxxxx	6.8	xxxx	29.4	xxxx	xxxx	xxxxx
Control Del:	10.6	xxxx	xxxxx	xxxxx	xxxx	xxxxx	272.9	xxxx	182.8	xxxxx	xxxx	xxxxx
LOS by Move:	B	*	*	*	*	*	F	*	F	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			193.2			xxxxxx		
ApproachLOS:	*			*			F			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalahoa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.564
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	181.5
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Mamalahoa Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0	0 1	0	1	0 0	1	0	0 0	0
Volume Module:												
Base Vol:	311	764	0	0	992	209	269	0	817	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	311	764	0	0	992	209	269	0	817	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	327	804	0	0	1044	220	283	0	860	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	327	804	0	0	1044	220	283	0	860	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	327	804	0	0	1044	220	283	0	860	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.24	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	403	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.81	0.47	0.00	0.00	0.61	0.15	0.18	0.00	0.60	0.00	0.00	0.00
Crit Moves:	****								****			
Green/Cycle:	0.52	0.52	0.00	0.00	0.39	0.39	0.38	0.00	0.38	0.00	0.00	0.00
Volume/Cap:	1.18	0.91	0.00	0.00	1.57	0.39	0.46	0.00	1.57	0.00	0.00	0.00
Uniform Del:	13.9	21.8	0.0	0.0	30.4	21.8	23.4	0.0	31.0	0.0	0.0	0.0
IncremntDel:	113.1	13.1	0.0	0.0	263	0.4	0.6	0.0	264.8	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	127.0	34.9	0.0	0.0	294	22.3	23.9	0.0	295.8	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	127.0	34.9	0.0	0.0	294	22.3	23.9	0.0	295.8	0.0	0.0	0.0
LOS by Move:	F	C	A	A	F	C	C	A	F	A	A	A
HCM2kAvgQ:	19	26	0	0	79	5	7	0	65	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #5 Kealakaa/Hina Lani

Average Delay (sec/veh): OVERFLOW Worst Case Level Of Service: F[xxxxx]

Street Name:	Kealakaa Street						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	68	43	39	94	46	113	189	582	116	60	676	137
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	68	43	39	94	46	113	189	582	116	60	676	137
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	72	45	41	99	48	119	199	613	122	63	712	144
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	72	45	41	99	48	119	199	613	122	63	712	144
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	2065	2054	674	2025	2043	784	856	xxxx	xxxxx	735	xxxx	xxxxx
Potent Cap.:	41	56	458	43	57	397	793	xxxx	xxxxx	880	xxxx	xxxxx
Move Cap.:	0	37	458	0	38	397	793	xxxx	xxxxx	880	xxxx	xxxxx
Volume/Cap:	xxxx	1.21	0.09	xxxx	1.28	0.30	0.25	xxxx	xxxx	0.07	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	1.0	xxxx	xxxxx	0.2	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	11.1	xxxx	xxxxx	9.4	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	B	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	0	xxxxx	xxxx	0	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			xxxxxx		
ApproachLOS:	F			F			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.842
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	27.7
Optimal Cycle:	83	Level Of Service:	C

Street Name:	Queen Kaahumanu Highway (SR-19)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2 0	1	1 0	2 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	1075	309	72	543	0	0	0	0	448	0	420
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	1075	309	72	543	0	0	0	0	448	0	420
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	1132	325	76	572	0	0	0	0	472	0	442
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	1132	325	76	572	0	0	0	0	472	0	442
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	1132	325	76	572	0	0	0	0	472	0	442
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.95	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1615	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.35	0.23	0.05	0.18	0.00	0.00	0.00	0.00	0.36	0.00	0.31
Crit Moves:		****		****						****		
Green/Cycle:	0.00	0.42	0.42	0.47	0.47	0.00	0.00	0.00	0.00	0.43	0.00	0.43
Volume/Cap:	0.00	0.84	0.54	0.48	0.38	0.00	0.00	0.00	0.00	0.84	0.00	0.71
Uniform Del:	0.0	26.3	22.0	19.5	17.0	0.0	0.0	0.0	0.0	25.6	0.0	23.5
IncremntDel:	0.0	5.0	1.0	2.3	0.2	0.0	0.0	0.0	0.0	11.1	0.0	4.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	31.2	23.0	21.8	17.1	0.0	0.0	0.0	0.0	36.7	0.0	27.5
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	31.2	23.0	21.8	17.1	0.0	0.0	0.0	0.0	36.7	0.0	27.5
LOS by Move:	A	C	C	C	B	A	A	A	A	D	A	C
HCM2kAvgQ:	0	19	8	2	6	0	0	0	0	16	0	12

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.496
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	122.3
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0 2	0 1		1 0 2	0 0		0 0 0	0 0		1 0	0 0 1	
Volume Module:												
Base Vol:	0	785	739	512	770	0	0	0	0	559	0	439
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	785	739	512	770	0	0	0	0	559	0	439
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	826	778	539	811	0	0	0	0	588	0	462
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	826	778	539	811	0	0	0	0	588	0	462
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	826	778	539	811	0	0	0	0	588	0	462
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.35	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	601	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.26	0.54	0.90	0.25	0.00	0.00	0.00	0.00	0.45	0.00	0.32
Crit Moves:				****						****		
Green/Cycle:	0.00	0.37	0.37	0.59	0.59	0.00	0.00	0.00	0.00	0.31	0.00	0.31
Volume/Cap:	0.00	0.70	1.47	1.17	0.42	0.00	0.00	0.00	0.00	1.47	0.00	1.04
Uniform Del:	0.0	27.0	31.7	26.3	11.0	0.0	0.0	0.0	0.0	34.7	0.0	34.7
IncremntDel:	0.0	1.9	221.2	97.1	0.2	0.0	0.0	0.0	0.0	224.3	0.0	54.6
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	28.8	252.9	123.4	11.2	0.0	0.0	0.0	0.0	259.0	0.0	89.3
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	28.8	252.9	123.4	11.2	0.0	0.0	0.0	0.0	259.0	0.0	89.3
LOS by Move:	A	C	F	F	B	A	A	A	A	F	A	F
HCM2kAvgQ:	0	12	56	29	7	0	0	0	0	43	0	22

Note: Queue reported is the number of cars per lane.

CUMULATIVE PLUS PROJECT CONDITIONS

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.855
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	29.3
Optimal Cycle:	87	Level Of Service:	C

Street Name:	Queen Kaahumanu Highway (SR-19)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2 0	1	1 0	2 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	1075	310	87	543	0	0	0	0	450	0	466
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	1075	310	87	543	0	0	0	0	450	0	466
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	1132	326	92	572	0	0	0	0	474	0	491
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	1132	326	92	572	0	0	0	0	474	0	491
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	1132	326	92	572	0	0	0	0	474	0	491
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.95	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1615	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.35	0.23	0.06	0.18	0.00	0.00	0.00	0.00	0.36	0.00	0.34
Crit Moves:		****		****						****		
Green/Cycle:	0.00	0.41	0.41	0.48	0.48	0.00	0.00	0.00	0.00	0.42	0.00	0.42
Volume/Cap:	0.00	0.85	0.55	0.52	0.37	0.00	0.00	0.00	0.00	0.85	0.00	0.80
Uniform Del:	0.0	26.8	22.5	19.6	16.7	0.0	0.0	0.0	0.0	26.0	0.0	25.1
IncremntDel:	0.0	5.7	1.1	2.9	0.2	0.0	0.0	0.0	0.0	12.4	0.0	7.4
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	32.5	23.6	22.5	16.8	0.0	0.0	0.0	0.0	38.4	0.0	32.6
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	32.5	23.6	22.5	16.8	0.0	0.0	0.0	0.0	38.4	0.0	32.6
LOS by Move:	A	C	C	C	B	A	A	A	A	D	A	C
HCM2kAvgQ:	0	19	8	3	6	0	0	0	0	16	0	15

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Average Delay (sec/veh): 16.6 Worst Case Level Of Service: F[73.9]

Street Name:	Holoholo St						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	100	22	45	40	27	187	41	171	44	27	435	12
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	100	22	45	40	27	187	41	171	44	27	435	12
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	105	23	47	42	28	197	43	180	46	28	458	13
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	105	23	47	42	28	197	43	180	46	28	458	13
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	923	817	203	846	834	464	471	xxxx	xxxxx	226	xxxx	xxxxx
Potent Cap.:	252	313	843	285	306	602	1102	xxxx	xxxxx	1354	xxxx	xxxxx
Move Cap.:	150	294	843	241	288	602	1102	xxxx	xxxxx	1354	xxxx	xxxxx
Volume/Cap:	0.70	0.08	0.06	0.17	0.10	0.33	0.04	xxxx	xxxx	0.02	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.1	xxxx	xxxxx	0.1	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	8.4	xxxx	xxxxx	7.7	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	A	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	210	xxxxx	xxxx	445	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	6.3	xxxxx	xxxxx	3.8	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	73.9	xxxxx	xxxxx	24.5	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	F	*	*	C	*	*	*	*	*	*	*
ApproachDel:	73.9			24.5			xxxxxx			xxxxxx		
ApproachLOS:	F			C			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #3 Mamalahoa/Kaiminani

Average Delay (sec/veh): 46.3 Worst Case Level Of Service: F[217.1]

Street Name:	Mamalahoa Hwy						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0 1	0	0	0 0 1	0	1	1 0 0	0	1	0 0 0	0	0
Volume Module:												
Base Vol:	361	393	0	0	847	159	63	0	378	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	361	393	0	0	847	159	63	0	378	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	380	414	0	0	892	167	66	0	398	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	380	414	0	0	892	167	66	0	398	0	0	0
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2	xxxxx	xxxx	xxxxx
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3	xxxxx	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1059	xxxx	xxxxx	xxxx	xxxx	xxxxx	2065	xxxx	892	xxxx	xxxx	xxxxx
Potent Cap.:	665	xxxx	xxxxx	xxxx	xxxx	xxxxx	61	xxxx	344	xxxx	xxxx	xxxxx
Move Cap.:	665	xxxx	xxxxx	xxxx	xxxx	xxxxx	33	xxxx	344	xxxx	xxxx	xxxxx
Volume/Cap:	0.57	xxxx	xxxx	xxxx	xxxx	xxxx	2.00	xxxx	1.16	xxxx	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	3.6	xxxx	xxxxx	xxxx	xxxx	xxxxx	7.5	xxxx	16.1	xxxx	xxxx	xxxxx
Control Del:	17.4	xxxx	xxxxx	xxxxx	xxxx	xxxxx	723.3	xxxx	132.7	xxxxx	xxxx	xxxxx
LOS by Move:	C	*	*	*	*	*	F	*	F	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			217.1			xxxxxx		
ApproachLOS:	*			*			F			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalahoa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.412
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	110.7
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Mamalahoa Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0 0	1 0	1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	431	558	0	0	1029	245	207	0	375	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	431	558	0	0	1029	245	207	0	375	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	454	587	0	0	1083	258	218	0	395	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	454	587	0	0	1083	258	218	0	395	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	454	587	0	0	1083	258	218	0	395	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.27	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	455	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	1.00	0.35	0.00	0.00	0.64	0.18	0.13	0.00	0.27	0.00	0.00	0.00
Crit Moves:	****								****			
Green/Cycle:	0.69	0.69	0.00	0.00	0.48	0.48	0.21	0.00	0.21	0.00	0.00	0.00
Volume/Cap:	1.10	0.50	0.00	0.00	1.32	0.37	0.65	0.00	1.32	0.00	0.00	0.00
Uniform Del:	6.3	7.2	0.0	0.0	25.9	16.4	36.4	0.0	39.7	0.0	0.0	0.0
IncremntDel:	75.8	0.3	0.0	0.0	154	0.3	4.6	0.0	167.1	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	82.1	7.5	0.0	0.0	180	16.7	41.0	0.0	206.8	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	82.1	7.5	0.0	0.0	180	16.7	41.0	0.0	206.8	0.0	0.0	0.0
LOS by Move:	F	A	A	A	F	B	D	A	F	A	A	A
HCM2kAvgQ:	23	9	0	0	67	5	7	0	26	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #5 Kealakaa/Hina Lani

Average Delay (sec/veh): 353.1 Worst Case Level Of Service: F[1589.6]

Street Name:	Kealakaa Street						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	103	28	52	151	28	198	65	324	34	22	804	63
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	103	28	52	151	28	198	65	324	34	22	804	63
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	108	29	55	159	29	208	68	341	36	23	846	66
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	108	29	55	159	29	208	68	341	36	23	846	66
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1541	1455	359	1464	1439	879	913	xxxx	xxxxx	377	xxxx	xxxxx
Potent Cap.:	95	131	690	108	134	349	755	xxxx	xxxxx	1193	xxxx	xxxxx
Move Cap.:	28	117	690	73	119	349	755	xxxx	xxxxx	1193	xxxx	xxxxx
Volume/Cap:	3.81	0.25	0.08	2.17	0.25	0.60	0.09	xxxx	xxxx	0.02	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.3	xxxx	xxxxx	0.1	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	10.2	xxxx	xxxxx	8.1	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	B	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	47	xxxxx	xxxx	132	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	21.6	xxxxx	xxxxx	37.2	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	1590	xxxxx	xxxxx	979	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	F	*	*	F	*	*	*	*	*	*	*
ApproachDel:	1589.6			979.3			xxxxxx			xxxxxx		
ApproachLOS:	F			F			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.204
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	71.9
Optimal Cycle:	180	Level Of Service:	E

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0 2	0 1		1 0 2	0 0		0 0 0	0 0		1 0	0 0	1
Volume Module:												
Base Vol:	0	841	620	285	941	0	0	0	0	599	0	444
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	841	620	285	941	0	0	0	0	599	0	444
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	885	653	300	991	0	0	0	0	631	0	467
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	885	653	300	991	0	0	0	0	631	0	467
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	885	653	300	991	0	0	0	0	631	0	467
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.41	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	699	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.27	0.45	0.43	0.31	0.00	0.00	0.00	0.00	0.48	0.00	0.32
Crit Moves:			****	****						****		
Green/Cycle:	0.00	0.36	0.36	0.51	0.51	0.00	0.00	0.00	0.00	0.39	0.00	0.39
Volume/Cap:	0.00	0.75	1.24	0.94	0.60	0.00	0.00	0.00	0.00	1.24	0.00	0.83
Uniform Del:	0.0	27.9	31.8	26.0	17.2	0.0	0.0	0.0	0.0	30.6	0.0	27.7
IncremntDel:	0.0	2.8	125.2	36.1	0.6	0.0	0.0	0.0	0.0	125.7	0.0	10.4
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	30.8	157.1	62.1	17.8	0.0	0.0	0.0	0.0	156.3	0.0	38.1
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	30.8	157.1	62.1	17.8	0.0	0.0	0.0	0.0	156.3	0.0	38.1
LOS by Move:	A	C	F	E	B	A	A	A	A	F	A	D
HCM2kAvgQ:	0	14	38	13	12	0	0	0	0	37	0	16

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.730
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	20.7
Optimal Cycle:	58	Level Of Service:	C

Street Name:	Queen Kaahumanu Highway (SR-19)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2 0	1	1 0	2 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	405	227	523	1059	0	0	0	0	187	0	135
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	405	227	523	1059	0	0	0	0	187	0	135
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	426	239	551	1115	0	0	0	0	197	0	142
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	426	239	551	1115	0	0	0	0	197	0	142
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	426	239	551	1115	0	0	0	0	197	0	142
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.95	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1615	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.13	0.17	0.34	0.35	0.00	0.00	0.00	0.00	0.15	0.00	0.10
Crit Moves:			****	****						****		
Green/Cycle:	0.00	0.23	0.23	0.69	0.69	0.00	0.00	0.00	0.00	0.21	0.00	0.21
Volume/Cap:	0.00	0.58	0.73	0.64	0.50	0.00	0.00	0.00	0.00	0.73	0.00	0.48
Uniform Del:	0.0	34.5	35.8	10.8	7.2	0.0	0.0	0.0	0.0	37.1	0.0	34.9
IncremntDel:	0.0	1.2	8.1	1.7	0.2	0.0	0.0	0.0	0.0	9.7	0.0	1.2
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	35.7	43.9	12.5	7.3	0.0	0.0	0.0	0.0	46.8	0.0	36.1
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	35.7	43.9	12.5	7.3	0.0	0.0	0.0	0.0	46.8	0.0	36.1
LOS by Move:	A	D	D	B	A	A	A	A	A	D	A	D
HCM2kAvgQ:	0	7	8	10	9	0	0	0	0	7	0	4

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Average Delay (sec/veh): 16.9 Worst Case Level Of Service: F[110.0]

Street Name:	Holoholo St						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	56	33	36	31	37	38	141	594	108	46	114	29
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	56	33	36	31	37	38	141	594	108	46	114	29
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	59	35	38	33	39	40	148	625	114	48	120	31
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	59	35	38	33	39	40	148	625	114	48	120	31
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1251	1226	682	1247	1268	135	151	xxxx	xxxxx	739	xxxx	xxxxx
Potent Cap.:	151	180	453	152	170	919	1443	xxxx	xxxxx	877	xxxx	xxxxx
Move Cap.:	100	151	453	101	142	919	1443	xxxx	xxxxx	877	xxxx	xxxxx
Volume/Cap:	0.59	0.23	0.08	0.32	0.27	0.04	0.10	xxxx	xxxx	0.06	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.3	xxxx	xxxxx	0.2	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	7.8	xxxx	xxxxx	9.3	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	A	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	146	xxxxx	xxxx	174	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	6.2	xxxxx	xxxxx	3.7	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	110	xxxxx	xxxxx	56.7	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	F	*	*	F	*	*	*	*	*	*	*
ApproachDel:	110.0			56.7			xxxxxx			xxxxxx		
ApproachLOS:	F			F			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #3 Mamalahoa/Kaiminani

Average Delay (sec/veh): 72.1 Worst Case Level Of Service: F[212.0]

Street Name:	Mamalahoa Hwy						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0 1	0	0	0 0 1	0	1	1 0 0	0	1	0 0 0	0	0
Volume Module:												
Base Vol:	282	543	0	0	572	76	92	0	645	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	282	543	0	0	572	76	92	0	645	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	297	572	0	0	602	80	97	0	679	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	297	572	0	0	602	80	97	0	679	0	0	0
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2	xxxxx	xxxx	xxxxx
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3	xxxxx	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	682	xxxx	xxxxx	xxxx	xxxx	xxxxx	1767	xxxx	602	xxxx	xxxx	xxxxx
Potent Cap.:	920	xxxx	xxxxx	xxxx	xxxx	xxxxx	93	xxxx	503	xxxx	xxxx	xxxxx
Move Cap.:	920	xxxx	xxxxx	xxxx	xxxx	xxxxx	70	xxxx	503	xxxx	xxxx	xxxxx
Volume/Cap:	0.32	xxxx	xxxx	xxxx	xxxx	xxxx	1.39	xxxx	1.35	xxxx	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	1.4	xxxx	xxxxx	xxxx	xxxx	xxxxx	8.0	xxxx	30.3	xxxx	xxxx	xxxxx
Control Del:	10.8	xxxx	xxxxx	xxxxx	xxxx	xxxxx	343.5	xxxx	193.2	xxxxx	xxxx	xxxxx
LOS by Move:	B	*	*	*	*	*	F	*	F	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			212.0			xxxxxx		
ApproachLOS:	*			*			F			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalahoa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.660
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	189.4
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Mamalahoa Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0 0	1 0	1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	337	764	0	0	992	224	279	0	832	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	337	764	0	0	992	224	279	0	832	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	355	804	0	0	1044	236	294	0	876	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	355	804	0	0	1044	236	294	0	876	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	355	804	0	0	1044	236	294	0	876	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.23	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	399	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.89	0.47	0.00	0.00	0.61	0.16	0.18	0.00	0.61	0.00	0.00	0.00
Crit Moves:	****								****			
Green/Cycle:	0.52	0.52	0.00	0.00	0.38	0.38	0.38	0.00	0.38	0.00	0.00	0.00
Volume/Cap:	1.22	0.91	0.00	0.00	1.60	0.43	0.48	0.00	1.60	0.00	0.00	0.00
Uniform Del:	14.0	21.8	0.0	0.0	30.8	22.7	23.6	0.0	31.1	0.0	0.0	0.0
IncremntDel:	127.8	13.0	0.0	0.0	277	0.5	0.6	0.0	278.5	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	141.8	34.7	0.0	0.0	308	23.2	24.2	0.0	309.5	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	141.8	34.7	0.0	0.0	308	23.2	24.2	0.0	309.5	0.0	0.0	0.0
LOS by Move:	F	C	A	A	F	C	C	A	F	A	A	A
HCM2kAvgQ:	22	26	0	0	80	6	7	0	68	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #5 Kealakaa/Hina Lani

Average Delay (sec/veh): OVERFLOW Worst Case Level Of Service: F[xxxxx]

Street Name:	Kealakaa Street						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	68	52	39	118	51	134	225	582	116	60	676	178
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	68	52	39	118	51	134	225	582	116	60	676	178
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	72	55	41	124	54	141	237	613	122	63	712	187
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	72	55	41	124	54	141	237	613	122	63	712	187
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	2176	2173	674	2127	2140	805	899	xxxx	xxxxx	735	xxxx	xxxxx
Potent Cap.:	34	47	458	37	50	385	764	xxxx	xxxxx	880	xxxx	xxxxx
Move Cap.:	0	28	458	0	29	385	764	xxxx	xxxxx	880	xxxx	xxxxx
Volume/Cap:	xxxx	1.95	0.09	xxxx	1.82	0.37	0.31	xxxx	xxxx	0.07	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	1.3	xxxx	xxxxx	0.2	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	11.8	xxxx	xxxxx	9.4	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	B	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	0	xxxxx	xxxx	0	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			xxxxxx		
ApproachLOS:	F			F			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.525
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	129.1
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2 0	1	1 0	2 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	785	763	513	770	0	0	0	0	573	0	440
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	785	763	513	770	0	0	0	0	573	0	440
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	826	803	540	811	0	0	0	0	603	0	463
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	826	803	540	811	0	0	0	0	603	0	463
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	826	803	540	811	0	0	0	0	603	0	463
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.35	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	593	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.26	0.56	0.91	0.25	0.00	0.00	0.00	0.00	0.46	0.00	0.32
Crit Moves:				****						****		
Green/Cycle:	0.00	0.37	0.37	0.59	0.59	0.00	0.00	0.00	0.00	0.31	0.00	0.31
Volume/Cap:	0.00	0.69	1.50	1.18	0.42	0.00	0.00	0.00	0.00	1.50	0.00	1.04
Uniform Del:	0.0	26.7	31.5	26.1	11.1	0.0	0.0	0.0	0.0	34.6	0.0	34.6
IncremntDel:	0.0	1.8	235.4	102.7	0.2	0.0	0.0	0.0	0.0	238.5	0.0	54.4
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	28.4	266.9	128.7	11.2	0.0	0.0	0.0	0.0	273.1	0.0	89.1
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	28.4	266.9	128.7	11.2	0.0	0.0	0.0	0.0	273.1	0.0	89.1
LOS by Move:	A	C	F	F	B	A	A	A	A	F	A	F
HCM2kAvgQ:	0	12	59	30	7	0	0	0	0	45	0	22

Note: Queue reported is the number of cars per lane.

CUMULATIVE PLUS PROJECT CONDITIONS WITH MITIGATION

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.545
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	18.9
Optimal Cycle:	39	Level Of Service:	B

Street Name:	Holoholo St						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	1! 0	0	0 0	1! 0	0	0 0	1! 0	0	0 0	1! 0	0
Volume Module:												
Base Vol:	100	22	45	40	27	187	41	171	44	27	435	12
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	100	22	45	40	27	187	41	171	44	27	435	12
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	105	23	47	42	28	197	43	180	46	28	458	13
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	105	23	47	42	28	197	43	180	46	28	458	13
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	105	23	47	42	28	197	43	180	46	28	458	13
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.61	0.61	0.61	0.84	0.84	0.84	0.86	0.86	0.86	0.97	0.97	0.97
Lanes:	0.60	0.13	0.27	0.16	0.11	0.73	0.16	0.67	0.17	0.06	0.92	0.02
Final Sat.:	617	136	278	224	151	1049	234	975	251	94	1512	42
Capacity Analysis Module:												
Vol/Sat:	0.17	0.17	0.17	0.19	0.19	0.19	0.18	0.18	0.18	0.30	0.30	0.30
Crit Moves:					****						****	
Green/Cycle:	0.34	0.34	0.34	0.34	0.34	0.34	0.56	0.56	0.56	0.56	0.56	0.56
Volume/Cap:	0.50	0.50	0.50	0.55	0.55	0.55	0.33	0.33	0.33	0.55	0.55	0.55
Uniform Del:	25.9	25.9	25.9	26.5	26.5	26.5	12.1	12.1	12.1	14.2	14.2	14.2
IncremntDel:	1.1	1.1	1.1	1.3	1.3	1.3	0.2	0.2	0.2	0.7	0.7	0.7
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	27.0	27.0	27.0	27.7	27.7	27.7	12.3	12.3	12.3	14.8	14.8	14.8
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	27.0	27.0	27.0	27.7	27.7	27.7	12.3	12.3	12.3	14.8	14.8	14.8
LOS by Move:	C	C	C	C	C	C	B	B	B	B	B	B
HCM2kAvgQ:	5	5	5	7	7	7	5	5	5	10	10	10

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #3 Mamalahoa/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.890
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	28.4
Optimal Cycle:	100	Level Of Service:	C

Street Name:	Mamalahoa Hwy						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0 0	1 0	1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	361	393	0	0	847	159	63	0	378	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	361	393	0	0	847	159	63	0	378	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	380	414	0	0	892	167	66	0	398	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	380	414	0	0	892	167	66	0	398	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	380	414	0	0	892	167	66	0	398	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.95	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	1615	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.24	0.24	0.00	0.00	0.52	0.12	0.04	0.00	0.28	0.00	0.00	0.00
Crit Moves:	****				****		****					
Green/Cycle:	0.85	0.85	0.00	0.00	0.59	0.59	0.05	0.00	0.31	0.00	0.00	0.00
Volume/Cap:	0.71	0.28	0.00	0.00	0.89	0.20	0.89	0.00	0.89	0.00	0.00	0.00
Uniform Del:	23.7	1.4	0.0	0.0	17.7	9.5	47.4	0.0	32.8	0.0	0.0	0.0
IncremntDel:	4.6	0.1	0.0	0.0	10.0	0.1	67.8	0.0	18.8	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	28.3	1.5	0.0	0.0	27.7	9.6	115.3	0.0	51.6	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	28.3	1.5	0.0	0.0	27.7	9.6	115.3	0.0	51.6	0.0	0.0	0.0
LOS by Move:	C	A	A	A	C	A	F	A	D	A	A	A
HCM2kAvgQ:	6	3	0	0	27	2	4	0	15	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalahoa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.937
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	32.4
Optimal Cycle:	128	Level Of Service:	C

Street Name:	Mamalahoa Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0	0 1	1 0	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	431	558	0	0	1029	245	207	0	375	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	431	558	0	0	1029	245	207	0	375	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	454	587	0	0	1083	258	218	0	395	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	454	587	0	0	1083	258	218	0	395	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	454	587	0	0	1083	258	218	0	395	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.95	1.00	1.00	1.00	0.92	0.92	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.62	0.38	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	1615	1700	0	0	2533	603	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.28	0.35	0.00	0.00	0.43	0.43	0.13	0.00	0.27	0.00	0.00	0.00
Crit Moves:	****				****		****					
Green/Cycle:	0.76	0.76	0.00	0.00	0.46	0.46	0.14	0.00	0.44	0.00	0.00	0.00
Volume/Cap:	0.82	0.46	0.00	0.00	0.94	0.94	0.94	0.00	0.62	0.00	0.00	0.00
Uniform Del:	25.8	4.5	0.0	0.0	25.8	25.8	42.4	0.0	21.3	0.0	0.0	0.0
IncremntDel:	9.6	0.3	0.0	0.0	11.9	11.9	41.9	0.0	1.8	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	35.4	4.8	0.0	0.0	37.7	37.7	84.2	0.0	23.1	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	35.4	4.8	0.0	0.0	37.7	37.7	84.2	0.0	23.1	0.0	0.0	0.0
LOS by Move:	D	A	A	A	D	D	F	A	C	A	A	A
HCM2kAvgQ:	12	7	0	0	26	26	10	0	10	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #5 Kealakaa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.959
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	39.0
Optimal Cycle:	146	Level Of Service:	D

Street Name:	Kealakaa Street						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	1! 0	0	0 0	1! 0	0	1 0	0 1	0	1 0	0 1	0
Volume Module:												
Base Vol:	103	28	52	151	28	198	65	324	34	22	804	63
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	103	28	52	151	28	198	65	324	34	22	804	63
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	108	29	55	159	29	208	68	341	36	23	846	66
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	108	29	55	159	29	208	68	341	36	23	846	66
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	108	29	55	159	29	208	68	341	36	23	846	66
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.58	0.58	0.58	0.73	0.73	0.73	0.10	0.99	0.99	0.48	0.99	0.99
Lanes:	0.57	0.15	0.28	0.40	0.07	0.53	1.00	0.91	0.09	1.00	0.93	0.07
Final Sat.:	558	152	282	497	92	651	165	1517	159	807	1559	122
Capacity Analysis Module:												
Vol/Sat:	0.19	0.19	0.19	0.32	0.32	0.32	0.41	0.22	0.22	0.03	0.54	0.54
Crit Moves:				****							****	
Green/Cycle:	0.33	0.33	0.33	0.33	0.33	0.33	0.57	0.57	0.57	0.57	0.57	0.57
Volume/Cap:	0.58	0.58	0.58	0.96	0.96	0.96	0.73	0.40	0.40	0.05	0.96	0.96
Uniform Del:	27.5	27.5	27.5	32.6	32.6	32.6	16.1	12.1	12.1	9.7	20.6	20.6
IncremntDel:	2.6	2.6	2.6	33.6	33.6	33.6	25.6	0.3	0.3	0.0	19.8	19.8
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	30.2	30.2	30.2	66.2	66.2	66.2	41.7	12.4	12.4	9.7	40.4	40.4
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	30.2	30.2	30.2	66.2	66.2	66.2	41.7	12.4	12.4	9.7	40.4	40.4
LOS by Move:	C	C	C	E	E	E	D	B	B	A	D	D
HCM2kAvgQ:	6	6	6	17	17	17	3	7	7	0	33	33

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.945
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	32.8
Optimal Cycle:	134	Level Of Service:	C

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Split Phase			Split Phase		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2	0 1	1 0	2	0 0	0 0	0	0 0	1 0	0	0 1
Volume Module:												
Base Vol:	0	841	620	285	941	0	0	0	0	599	0	444
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	841	620	285	941	0	0	0	0	599	0	444
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	885	653	300	991	0	0	0	0	631	0	467
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	885	653	300	991	0	0	0	0	631	0	467
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	885	653	300	991	0	0	0	0	631	0	467
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.95	0.95	1.00	1.00	1.00	1.00	0.95	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1615	3230	0	0	0	0	1615	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.27	0.45	0.19	0.31	0.00	0.00	0.00	0.00	0.39	0.00	0.32
Crit Moves:		****		****						****		
Green/Cycle:	0.00	0.29	0.70	0.49	0.49	0.00	0.00	0.00	0.00	0.41	0.00	0.41
Volume/Cap:	0.00	0.94	0.64	0.78	0.63	0.00	0.00	0.00	0.00	0.94	0.00	0.78
Uniform Del:	0.0	34.7	8.0	24.0	19.0	0.0	0.0	0.0	0.0	28.2	0.0	25.4
IncremntDel:	0.0	17.5	1.4	9.7	0.8	0.0	0.0	0.0	0.0	22.2	0.0	6.7
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	52.3	9.4	33.6	19.8	0.0	0.0	0.0	0.0	50.4	0.0	32.1
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	52.3	9.4	33.6	19.8	0.0	0.0	0.0	0.0	50.4	0.0	32.1
LOS by Move:	A	D	A	C	B	A	A	A	A	D	A	C
HCM2kAvgQ:	0	19	12	10	12	0	0	0	0	24	0	14

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.772
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	17.1
Optimal Cycle:	66	Level Of Service:	B

Street Name:	Holoholo St						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	1! 0	0	0 0	1! 0	0	0 0	1! 0	0	0 0	1! 0	0
Volume Module:												
Base Vol:	56	33	36	31	37	38	141	594	108	46	114	29
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	56	33	36	31	37	38	141	594	108	46	114	29
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	59	35	38	33	39	40	148	625	114	48	120	31
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	59	35	38	33	39	40	148	625	114	48	120	31
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	59	35	38	33	39	40	148	625	114	48	120	31
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.73	0.73	0.73	0.82	0.82	0.82	0.89	0.89	0.89	0.73	0.73	0.73
Lanes:	0.45	0.26	0.29	0.29	0.35	0.36	0.17	0.70	0.13	0.24	0.61	0.15
Final Sat.:	556	327	357	408	486	500	252	1062	193	301	746	190
Capacity Analysis Module:												
Vol/Sat:	0.11	0.11	0.11	0.08	0.08	0.08	0.59	0.59	0.59	0.16	0.16	0.16
Crit Moves:		****						****				
Green/Cycle:	0.14	0.14	0.14	0.14	0.14	0.14	0.76	0.76	0.76	0.76	0.76	0.76
Volume/Cap:	0.77	0.77	0.77	0.58	0.58	0.58	0.77	0.77	0.77	0.21	0.21	0.21
Uniform Del:	41.6	41.6	41.6	40.4	40.4	40.4	6.9	6.9	6.9	3.4	3.4	3.4
IncremntDel:	19.3	19.3	19.3	4.5	4.5	4.5	3.3	3.3	3.3	0.1	0.1	0.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	60.9	60.9	60.9	44.9	44.9	44.9	10.1	10.1	10.1	3.5	3.5	3.5
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	60.9	60.9	60.9	44.9	44.9	44.9	10.1	10.1	10.1	3.5	3.5	3.5
LOS by Move:	E	E	E	D	D	D	B	B	B	A	A	A
HCM2kAvgQ:	6	6	6	4	4	4	17	17	17	2	2	2

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #3 Mamalahoa/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.120
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	32.6
Optimal Cycle:	114	Level Of Service:	C

Street Name:	Mamalahoa Hwy						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0 0	1 0	1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	282	543	0	0	572	76	92	0	645	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	282	543	0	0	572	76	92	0	645	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	297	572	0	0	602	80	97	0	679	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	297	572	0	0	602	80	97	0	679	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	297	572	0	0	602	80	97	0	679	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.95	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	1615	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.18	0.34	0.00	0.00	0.35	0.06	0.06	0.00	0.47	0.00	0.00	0.00
Crit Moves:	****				****				****			
Green/Cycle:	0.59	0.59	0.00	0.00	0.39	0.39	0.31	0.00	0.51	0.00	0.00	0.00
Volume/Cap:	0.76	0.57	0.00	0.00	0.92	0.14	0.19	0.00	0.92	0.00	0.00	0.00
Uniform Del:	25.3	12.8	0.0	0.0	29.1	19.9	25.1	0.0	22.4	0.0	0.0	0.0
IncremntDel:	8.2	0.8	0.0	0.0	17.6	0.1	0.2	0.0	16.0	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	33.5	13.6	0.0	0.0	46.7	20.0	25.3	0.0	38.4	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	33.5	13.6	0.0	0.0	46.7	20.0	25.3	0.0	38.4	0.0	0.0	0.0
LOS by Move:	C	B	A	A	D	C	C	A	D	A	A	A
HCM2kAvgQ:	9	11	0	0	22	2	2	0	23	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalahoa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.343
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	72.6
Optimal Cycle:	180	Level Of Service:	E

Street Name:	Mamalahoa Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0	0 1	1 0	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	337	764	0	0	992	224	279	0	832	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	337	764	0	0	992	224	279	0	832	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	355	804	0	0	1044	236	294	0	876	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	355	804	0	0	1044	236	294	0	876	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	355	804	0	0	1044	236	294	0	876	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.51	1.00	1.00	1.00	0.92	0.92	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.63	0.37	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	872	1700	0	0	2561	578	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.41	0.47	0.00	0.00	0.41	0.41	0.18	0.00	0.61	0.00	0.00	0.00
Crit Moves:	****				****				****			
Green/Cycle:	0.56	0.56	0.00	0.00	0.36	0.36	0.34	0.00	0.54	0.00	0.00	0.00
Volume/Cap:	0.93	0.85	0.00	0.00	1.13	1.13	0.53	0.00	1.13	0.00	0.00	0.00
Uniform Del:	29.1	18.6	0.0	0.0	31.9	31.9	26.4	0.0	23.1	0.0	0.0	0.0
IncremntDel:	28.2	7.3	0.0	0.0	68.6	68.6	1.0	0.0	73.0	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	57.3	26.0	0.0	0.0	100	100.5	27.4	0.0	96.1	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	57.3	26.0	0.0	0.0	100	100.5	27.4	0.0	96.1	0.0	0.0	0.0
LOS by Move:	E	C	A	A	F	F	C	A	F	A	A	A
HCM2kAvgQ:	14	23	0	0	34	34	8	0	43	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #5 Kealakaa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.106
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	39.7
Optimal Cycle:	180	Level Of Service:	D

Street Name:	Kealakaa Street						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	1! 0	0	0 0	1! 0	0	1 0	0 1	0	1 0	0 1	0
Volume Module:												
Base Vol:	68	52	39	118	51	134	225	582	116	60	676	178
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	68	52	39	118	51	134	225	582	116	60	676	178
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	72	55	41	124	54	141	237	613	122	63	712	187
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	72	55	41	124	54	141	237	613	122	63	712	187
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	72	55	41	124	54	141	237	613	122	63	712	187
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.65	0.65	0.65	0.73	0.73	0.73	0.19	0.98	0.98	0.28	0.97	0.97
Lanes:	0.43	0.33	0.24	0.39	0.17	0.44	1.00	0.83	0.17	1.00	0.79	0.21
Final Sat.:	475	363	272	482	208	547	321	1382	275	471	1304	343
Capacity Analysis Module:												
Vol/Sat:	0.15	0.15	0.15	0.26	0.26	0.26	0.74	0.44	0.44	0.13	0.55	0.55
Crit Moves:					****			****				
Green/Cycle:	0.23	0.23	0.23	0.23	0.23	0.23	0.67	0.67	0.67	0.67	0.67	0.67
Volume/Cap:	0.65	0.65	0.65	1.11	1.11	1.11	1.11	0.66	0.66	0.20	0.82	0.82
Uniform Del:	34.6	34.6	34.6	38.3	38.3	38.3	16.7	10.0	10.0	6.4	12.2	12.2
IncremntDel:	5.6	5.6	5.6	84.3	84.3	84.3	92.6	1.5	1.5	0.3	4.9	4.9
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	40.2	40.2	40.2	122.7	123	122.7	109.3	11.5	11.5	6.7	17.2	17.2
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	40.2	40.2	40.2	122.7	123	122.7	109.3	11.5	11.5	6.7	17.2	17.2
LOS by Move:	D	D	D	F	F	F	F	B	B	A	B	B
HCM2kAvgQ:	6	6	6	17	17	17	14	14	14	1	22	22

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.046
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	53.8
Optimal Cycle:	180	Level Of Service:	D

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Split Phase			Split Phase		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2	0 1	1 0	2	0 0	0 0	0	0 0	1 0	0	0 1
Volume Module:												
Base Vol:	0	785	763	513	770	0	0	0	0	573	0	440
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	785	763	513	770	0	0	0	0	573	0	440
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	826	803	540	811	0	0	0	0	603	0	463
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	826	803	540	811	0	0	0	0	603	0	463
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	826	803	540	811	0	0	0	0	603	0	463
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.73	0.95	1.00	1.00	1.00	1.00	0.95	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1234	3230	0	0	0	0	1615	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.26	0.56	0.44	0.25	0.00	0.00	0.00	0.00	0.37	0.00	0.32
Crit Moves:		****		****						****		
Green/Cycle:	0.00	0.24	0.59	0.55	0.55	0.00	0.00	0.00	0.00	0.35	0.00	0.35
Volume/Cap:	0.00	1.07	0.95	0.94	0.46	0.00	0.00	0.00	0.00	1.07	0.00	0.92
Uniform Del:	0.0	38.1	19.1	15.1	13.4	0.0	0.0	0.0	0.0	32.6	0.0	31.2
IncremntDel:	0.0	53.0	19.0	24.4	0.2	0.0	0.0	0.0	0.0	58.3	0.0	22.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	91.1	38.1	39.5	13.6	0.0	0.0	0.0	0.0	90.8	0.0	53.2
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	91.1	38.1	39.5	13.6	0.0	0.0	0.0	0.0	90.8	0.0	53.2
LOS by Move:	A	F	D	D	B	A	A	A	A	F	A	D
HCM2kAvgQ:	0	21	28	20	8	0	0	0	0	28	0	18

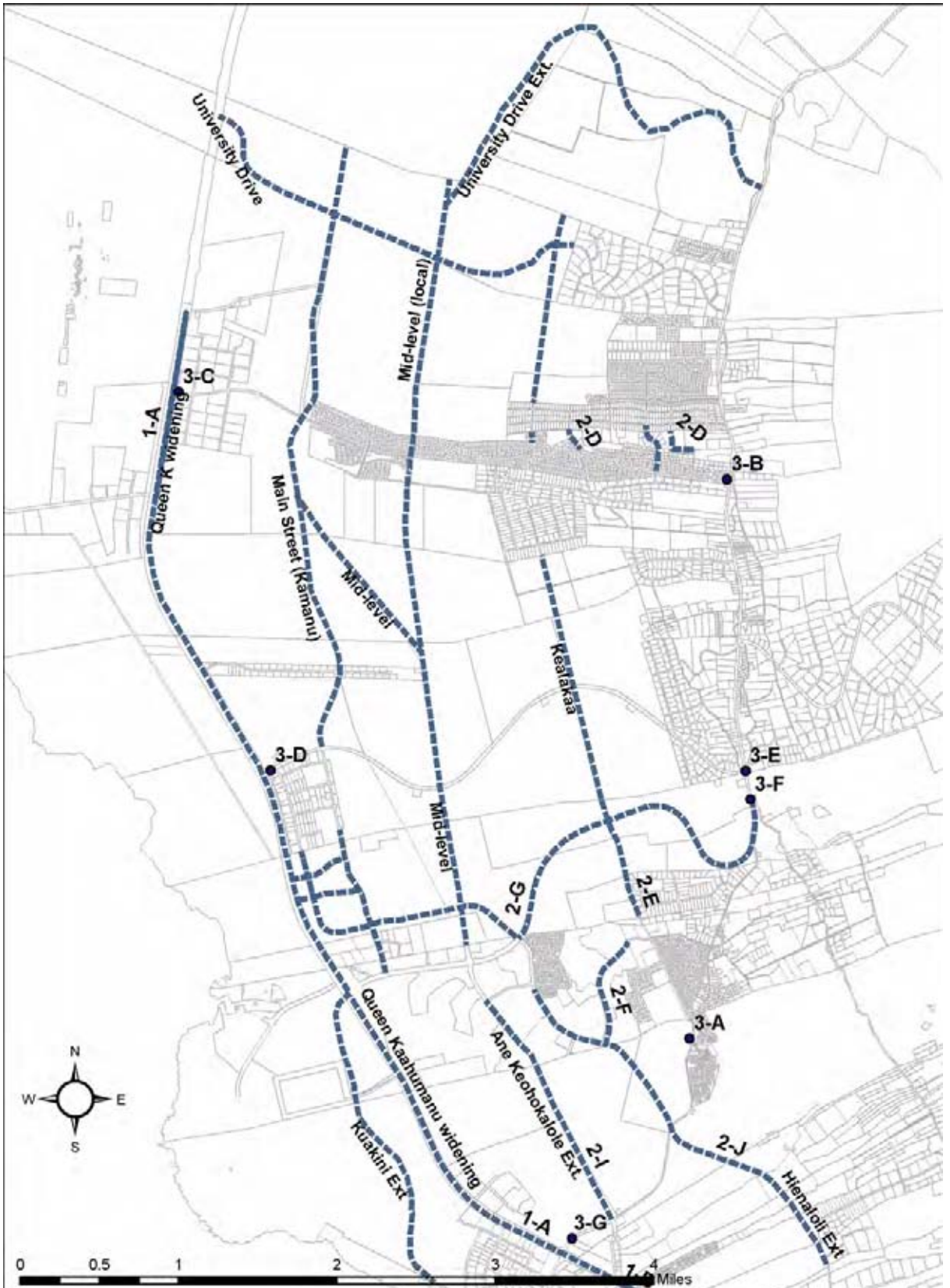
Note: Queue reported is the number of cars per lane.

APPENDIX D

EXCERPTS FROM THE *KEAHOLE TO HONAUNAU REGIONAL CIRCULATION PLAN COUNTY ACTION PLAN*

(County Of Hawaii Planning Department, August 14, 2006)

FIGURE 4. Projects Map-- North of Palani Road



- Funding/Status: private

1-A Kuakini Highway improvements. The purpose of this improvement is to widen this road from 2 to 4 lanes to improve the traffic flow in downtown Kailua-Kona, as well as add sidewalks and bicycle lanes. The project will be done in two phases: Phase I (Palani to Hualalai) and Phase II (Hualalai to Alii Parkway). Eventually, there will be a Phase III widening from Alii Parkway to the Hawaii Belt Road.

- Lead Responsible: Department of Public Works
- Funding/Status
  - •Phase I :

    Planning/Design: Completed.

    Construction: STIP 2004-06 80% federal-aid ($10.4M) and 20% County CIP ($2.6M). Construction underway with estimated completion in October 2006.
  - •Phase II:

    Planning: STIP 2004-06 ($0.33M total, $0.24M Federal, $0.306M County). Underway.

    Design: STIP 2004-06 $0.5M County

    Construction: Estimated $5M, not programmed

4.1.2 Strategy #2: Improve connectivity with a road network that spreads the traffic rather than funneling all the traffic to the major arterials.

2-A Lako Street Extension. The extension of Lako Street would provide a mauka-makai connection from Kuakini Highway to Alii Highway to Alii Drive. Lako Street will serve as the northern terminus of the Alii Highway Southern Phase.

- Lead Responsible: County Department of Public Works
- Funding/Status
  - •Planning: EA completed, but stuck in litigation
  - •Design/ROW: CIP appropriated, but cannot start until litigation resolved
  - •Construction: CIP appropriated

2-B Lako Street Mauka Connection. Mauka of Kuakini Highway, a private developer is constructing a connection of Lako Street to complete a continuous route from Kuakini to Hualalai.

- Lead Responsible: Private developer
- Funding/Status
  - •Planning/Design/ROW: Completed; privately funded
  - •Construction: Privately funded. Estimated completion is September 2006.

2-C Laaloa Avenue Extension. The extension of Laaloa Avenue would provide another mauka-makai connection from Kuakini Highway to Alii Highway to Alii Drive. Besides improving overall traffic circulation, these mauka-makai connectors provide alternative evacuation routes from coastal areas. A private developer is funding the preliminary engineering and EA in satisfaction of rezoning and SMA permit conditions.

- Lead Responsible: County Department of Public Works
- Funding/Status

•Planning: Private developer

•Design/ROW/Construction: County CIP appropriated ($3.6 million), with County commitment for additional funding as needed to complete construction

2-D Kalaoa Connector Roads. Between two major subdivisions in Kalaoa (Kona Palisades and Coastview), internal roads extend to the subdivision boundaries in anticipation of connection, but have never been connected, thereby forcing traffic onto Mamalahoa Highway. Through a combination of private development and County action, four connections will be established to Kaiminani Drive: Nana-Holoholo, Ahiahi-Kauhale, Holu-Keokeo, and Iliili-Kiekie.

- Lead Responsible: County Department of Public Works
- Funding/Status

  •Planning/ROW: Condemnation is necessary for Ahiahi-Kauhale, Holu-Keokeo, and Iliili-Kiekie. Appraisals and title reports have been completed. Awaiting resolution of condemnation issues. Fair share contribution funds are being used to fund this phase.

  •Design/ROW/Construction: Nana/Holoholo has been completed by a private developer, dedicated to the County, and opened. Appropriated $0.5 million CIP funds to design and construct Ahiahi-Kauhale. Holu-Keokeo is an existing road that meets County standards. A private developer will construct Iliili-Kiekie.

2-E Kealakaa Street Extension. The extension of Kealakaa Street would connect to Kealakehe Parkway (as extended, see 2-G below), Hina Lani Street, and Holoholo Street thereby providing an essential link to the Kealakehe elementary, middle, and high school without having to use the main highways (Mamalahoa, Palani, and Queen Kaahumanu).

- Lead Responsible: Planning Department (planning phase)
- Funding/Status

  •Planning: The Planning Department has been holding meetings with the affected landowners to determine available information, potential alternative alignments, and issues. The Planning Department will procure a consultant for project coordination and environmental studies. CIP funds have been appropriated ($1.5 million).

  •Design/ROW: Funding sources to be determined upon negotiations with affected landowners.

  •Construction: Funding sources to be determined upon negotiations with affected landowners.

2-F Keanalehu/Manawalea Street Extension. The connection of Manawalea to Keanalehu would provide another link between the Kealakehe elementary, middle and high schools for the residents of Laiopua and Kealakehe (in the vicinity of the elementary and middle schools). These roads are nearly "construction-ready" since the EIS has been completed, and the design is almost complete. The County will advance the funds and DHHL will reimburse the County its proportionate share.

- Lead Responsible: County Department of Public Works (with Department of Hawaiian Home Lands)
- Funding/Status

  •Planning: Completed.

•Design/ROW/Construction: Design is 80% complete, with estimated bid date of February 2007. DHHL will convey (by license) the rights-of-way to the County. The County will use appropriated CIP funds to complete design ($0.5 million).

•Construction: The County has appropriated $7.6M.

2-G Kealakehe Parkway Extension (to Kealakaa). Kealakehe Parkway, a State road, currently dead-ends just mauka of Kealakehe High School. The connection of the parkway to the extended Kealakaa Street would complete a vital link to enable traffic to flow from Hina Lani to Queen Kaahumanu.

- Lead Responsible: DOT
- Funding/Status

  •Planning: The EIS has been completed.

  •Design/ROW: 2006-08 STIP HS-20, Design ($0.5 million), Right-of-Way ($1 million)

  •Construction: Not programmed.

2-H Kamanu Street Extension. Kamanu Street currently dead-ends in Kaloko Industrial Park just mauka of Costco. This project will extend Kamanu to connect with Kealakehe Parkway. As a north-south road parallel to Queen Kaahumanu Highway, Kamanu Street will partially relieve Queen Kaahumanu of some traffic for that segment.

- Lead Responsible: County Department of Public Works
- Funding/Status

  •Planning: EIS complete (by private landowner)

  •Design/ROW: Currently underway by private developer as fulfillment of rezoning condition

  •Construction: County will advance funds with proportionate reimbursement by landowner. Appropriated CIP funds available ($3 million), with County commitment to supplement as necessary.

2-I Ane Keohokalole Extension (aka Henry Street Extension or Mid-Level Road). This project will extend Henry Street from Palani Road to the existing terminus of Ane Keohokalole makai of Kealakehe High School. The 2006 State legislature appropriated $6 million for this project. Once constructed, this road will enable someone to drive from Kailua Village to the Kaloko Industrial Park via Henry Street and the Kamanu Street Extension, without having to drive on Queen Kaahumanu Highway.

- Lead Responsible: Planning Department (planning phase), Department of Public Works (design and construction)
- Funding/Status

  •Planning/Design/ROW: $6M State CIP funds appropriated.

  •Construction: Not programmed.

2-J Hienaloli Street Extension. This project will extend Hienaloli Street to connect with Palani Road. At the intersection with Palani, the motorist will have a choice to turn onto Palani or to continue straight through onto the extended Keanalehu Street. Keanalehu Street will eventually connect with the planned Mid-Level Road. The ultimate plan is to enable residents in the area mauka of Kuakini and south of Palani to access Palani Road, Kealakehe High School, Kaloko Industrial Park, and eventually the West Hawaii University campus and the airport without having to load onto Kuakini or Queen Kaahumanu.

- Lead Responsible: Planning Department (planning phase)
- Funding/Status

  •Planning: CIP funds appropriated (($1.7 million) for preliminary engineering and environmental studies.

  •Design/ROW: Not programmed.

  •Construction: Not programmed.

2-K Nani Kailua Extension. The existing makai terminus of Nani Kailua Drive is Hualalai Road. There are two segments to extend this road to Alii Drive: Hualalai to Kuakini, (mauka segment), and Hualalai to Alii Drive (makai segment). The proposed extension would connect Nani Kailua to Alii Drive to provide another mauka-makai route closer to Kailua Village. The initial priority is to construct the makai segment.

- Lead Responsible: Planning Department (planning phase); DPW (makai segment design and construction phases)
- Funding/Status

  •Planning/ROW/Design: CIP-appropriated funds ($1.5 million) (makai segment)

  •Construction: Construction funding to be determined among County and private parties.

2-L Puapuanui Street. This road is entirely privately funded and will provide a more direct mauka-makai connector (compared to Hualalai) from the mauka segments of Hualalai Road to Queen Kaahumanu through the Pualani Estates subdivision. A traffic signal at that intersection will enable crossing Queen Kaahumanu through a proposed commercial area to connect with Kuakini.

- Lead Responsible: Private
- Funding/Status

  •Planning/Design/Construction: Private. Mauka segment from Queen Kaahumanu to Hualalai nearly complete.

4.1.3 Strategy #3: Use existing roadways more efficiently by improving traffic flow and turning movements.

3-A Palani Street Safety Improvments. This project will realign Kealakaa to intersect Palani Road at Palihiolo Street to create a new and safer signalized intersection.

- Lead Responsible: County Department of Public Works
- Funding/Status

  •Planning/Design/Construction: CIP funds ($1 million) with federal matching ($4 million); EA and design nearly complete. Estimated construction start is March 2007.

3-B Kaiminani right turn lane to Mamalahoa Highway. The right turn lane improvements will increase the capacity of that intersection.

- Lead Responsible: County Department of Public Works
- Funding/Status

  •Planning/Design/Construction: Design and construction inhouse by DPW staff. Awaiting utility relocation by HELCO and Oceanic to complete construction, with estimated completion in June 2007.

3-C Kaiminani right turn lane to Queen Kaahumanu Highway

- Lead Responsible: County Department of Public Works
- Funding/Status

  •Planning/Design/Construction: Design completed inhouse by DPW staff. CIP funds of $0.4 million appropriated for construction.

3-D Hina Lani right turn lane to Queen Kaahumanu Highway. This improvement will increase the capacity of this intersection.

- Lead Responsible: County Department of Public Works
- Funding/Status

  •Planning/Design/Construction: Design and construction completed inhouse by DPW staff.

3-E Traffic signal at Hina Lani/Mamalahoa. This traffic signal will improve the safety of left turns at this intersection.

- Lead Responsible: County Department of Public Works
- Funding/Status

  •Planning/Design/Construction: Design completed inhouse by DPW staff. CIP funds of $0.3 million appropriated for construction. Construction completed in June 2006.

3-F Palani Junction left turn pocket to Mamalahoa Highway. This project will provide capacity improvements by allowing makai-bound traffic to flow more efficiently through this intersection.

- Lead Responsible: County Department of Public Works
- Funding/Status

  •Planning/Design/Construction: Design completed inhouse by DPW staff. CIP funds of $1 million appropriated for construction. Estimated completion by November 2006.

3-G Palani left turn pocket to Kamakaeha. This project will provide capacity improvements to mauka-bound traffic on Palani Road.

- Lead Responsible: County Department of Public Works
- Funding/Status

  •Planning/Design/Construction: Design completed inhouse by DPW staff. CIP funds of $1 million appropriated for construction. Estimated construction start by January 2007 and estimated completion by January 2008.

3-H Mamalahoa Highway, Honalo to Captain Cook. The County will consult and work closely with the community to develop workable solutions. Suggested improvements to date include left turn pockets, peak-period onstreet parking restrictions, designated bus stop pull-outs, County parking lot, coordination of traffic signal timing, park & ride facility, and roundabouts.

- Lead Responsible: County Department of Public Works
- Funding/Status

  •Planning/Design/Construction: CIP funds of $12 million appropriated for design, right-of-way acquisition, and construction.

APPENDIX E

SIGNAL WARRANT ANALYSIS

TRAFFIC SIGNAL WARRANTS
EIGHT-HOUR VEHICULAR VOLUME (MUTCD Warrant 1)

Major Street: MAMALAHOA HIGHWAY
Minor Street: KAIMINANI DRIVE
Scenario: EXISTING WEEKDAY - A.M. PEAK HOUR (2006)
Urban/Rural: r (U=urban, R=rural or high speed [c])

MINIMUM VEHICULAR VOLUME (MUTCD Condition A)

Number of Lanes on Each Approach	
Major Street:	2
Minor Street:	1
Vehicles Per Hour (8th Highest Hour)	
Major Street (Approach 1):	461
Major Street (Approach 2):	271
Major Street Left Turn (see note [d]):	0
Minor Street (Higher Volume App.):	184
MINIMUM VEHICULAR VOLUME SATISFIED?	**YES**

Minimum Requirements

Number of Lanes for Moving Traffic on Each Approach		Vehicles Per Hour (eighth highest hour) on Major Street (Total of Both Approaches)			Vehicles Per Hour (eighth highest hour) on Higher-Volume Minor Street Approach (1 Direction Only)		
Major Street	Minor Street	100% [a]	80% [b]	70% [c]	100% [a]	80% [b]	70% [c]
1	1	500	400	350	150	120	105
>=2	1	600	480	420	150	120	105
>=2	>=2	600	480	420	200	160	140
1	>=2	500	400	350	200	160	140
Minimum Required		#N/A	#N/A	420	#N/A	#N/A	105
Test Amount		#N/A	#N/A	732	#N/A	#N/A	184

INTERRUPTION OF CONTINUOUS TRAFFIC (MUTCD Condition B)

Number of Lanes on Each Approach	
Major Street:	2
Minor Street:	1
Vehicles Per Hour (8th Highest Hour)	
Major Street (Approach 1):	461
Major Street (Approach 2):	271
Major Street Left Turn (see note [d]):	0
Minor Street (Higher Volume App.):	184
INTERRUPT. OF CONT. TRAFFIC SATISFIED?	**YES**

Minimum Requirements

Number of Lanes for Moving Traffic on Each Approach		Vehicles Per Hour (eighth highest hour) on Major Street (Total of Both Approaches)			Vehicles Per Hour (eighth highest hour) on Higher-Volume Minor Street Approach (1 Direction Only)		
Major Street	Minor Street	100% [a]	80% [b]	70% [c]	100% [a]	80% [b]	70% [c]
1	1	750	600	525	75	60	53
>=2	1	900	720	630	75	60	53
>=2	>=2	900	720	630	100	80	70
1	>=2	750	600	525	100	80	70
Minimum Required		#N/A	#N/A	630	#N/A	#N/A	53
Test Amount		#N/A	#N/A	732	#N/A	#N/A	184

80% COMBINATION

No one warrant satisfied but following warrants fulfilled 80% or more:

Condition A 80% Fulfilled?	YES
Condition B 80% Fulfilled?	YES
80% COMBINATION SATISFIED?	**YES**

Minimum Requirements:
Conditions A and B Both 80% Fulfilled

Notes:

a. Basic minimum hourly volume (eighth highest hour).
b. Used for combination of Conditions A and B.
c. May be used when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000.
d. Heavier left-turn movement from the major street may be included with minor street volume if a separate signal phase is proposed for left-turn movements.

Adopted from: U.S. Department of Transportation, Federal Highway Administration, *Manual on Uniform Traffic Control Devices, Millennium Edition* , 2001.

TRAFFIC SIGNAL WARRANTS
FOUR HOUR VEHICULAR VOLUME (MUTCD Warrant 2)
PEAK HOUR VEHICULAR VOLUME (MUTCD Warrant 3)

Major Street: MAMALAHOA HIGHWAY
Minor Street: KAIMINANI DRIVE
Scenario: EXISTING WEEKDAY - A.M. PEAK HOUR (2006)
Urban/Rural: r (U=urban, R=rural [a])

FOUR HOUR VOLUME (MUTCD Warrant 2)

Number of Lanes on Each Approach			
Major Street:	2		
Minor Street:	1		
Vehicles Per Hour (4th Highest Hour)			
Major Street (Approach 1):	653	Major Street Left Turn (see note [b]):	0
Major Street (Approach 2):	383	Minor Street (Higher Volume App.):	261
Major Street Total (Both Approaches):	1,036	Minor Street Total:	261
Minimum Volume on Major Street to Satisfy Warrant (see note [c]):	280	Minimum Volume on Minor Street to Satisfy Warrant (see note [c]):	60

FOUR HOUR VOLUME WARRANT SATISFIED? **YES**

PEAK HOUR VOLUME (MUTCD Warrant 3)

Number of Lanes on Each Approach			
Major Street:	2		
Minor Street:	1		
Vehicles Per Hour (Peak Hour)			
Major Street (Approach 1):	768	Major Street Left Turn (see note [b]):	0
Major Street (Approach 2):	451	Minor Street (Higher Volume App.):	307
Major Street Total (Both Approaches):	1,219	Minor Street Total:	307
Minimum Volume on Major Street to Satisfy Warrant (see note [d]):	350	Minimum Volume on Minor Street to Satisfy Warrant (see note [d]):	75

PEAK HOUR VOLUME WARRANT SATISFIED? **YES**

Notes:

a. May be used when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000.
b. Heavier left-turn movement from the major street may be included with minor street volume if a separate signal phase is proposed for left-turn movements.
c. From: USDOT, FHWA, "Manual on Uniform Traffic Control Devices," 2001, Figure 4C-2.
d. From: USDOT, FHWA, "Manual on Uniform Traffic Control Devices," 2001, Figure 4C-4.

Adopted from: U.S. Department of Transportation, Federal Highway Administration, "Manual on Uniform Traffic Control Devices, Millennium Edition," 2001.

TRAFFIC SIGNAL WARRANTS
EIGHT-HOUR VEHICULAR VOLUME (MUTCD Warrant 1)

Major Street: MAMALAHOA HIGHWAY
Minor Street: KAIMINANI DRIVE
Scenario: FUTURE WEEKDAY - A.M. PEAK HOUR (2020)
Urban/Rural: r (U=urban, R=rural or high speed [c])

MINIMUM VEHICULAR VOLUME (MUTCD Condition A)

Number of Lanes on Each Approach	
Major Street:	2
Minor Street:	2
Vehicles Per Hour (8th Highest Hour)	
Major Street (Approach 1):	604
Major Street (Approach 2):	452
Major Street Left Turn (see note [d]):	0
Minor Street (Higher Volume App.):	265
MINIMUM VEHICULAR VOLUME SATISFIED?	**YES**

Minimum Requirements

Number of Lanes for Moving Traffic on Each Approach		Vehicles Per Hour (eighth highest hour) on Major Street (Total of Both Approaches)			Vehicles Per Hour (eighth highest hour) on Higher-Volume Minor Street Approach (1 Direction Only)		
Major Street	Minor Street	100% [a]	80% [b]	70% [c]	100% [a]	80% [b]	70% [c]
1	1	500	400	350	150	120	105
>=2	1	600	480	420	150	120	105
>=2	>=2	600	480	420	200	160	140
1	>=2	500	400	350	200	160	140
Minimum Required		#N/A	#N/A	420	#N/A	#N/A	140
Test Amount		#N/A	#N/A	1,056	#N/A	#N/A	265

INTERRUPTION OF CONTINUOUS TRAFFIC (MUTCD Condition B)

Number of Lanes on Each Approach	
Major Street:	2
Minor Street:	2
Vehicles Per Hour (8th Highest Hour)	
Major Street (Approach 1):	604
Major Street (Approach 2):	452
Major Street Left Turn (see note [d]):	0
Minor Street (Higher Volume App.):	265
INTERRUPT. OF CONT. TRAFFIC SATISFIED?	**YES**

Minimum Requirements

Number of Lanes for Moving Traffic on Each Approach		Vehicles Per Hour (eighth highest hour) on Major Street (Total of Both Approaches)			Vehicles Per Hour (eighth highest hour) on Higher-Volume Minor Street Approach (1 Direction Only)		
Major Street	Minor Street	100% [a]	80% [b]	70% [c]	100% [a]	80% [b]	70% [c]
1	1	750	600	525	75	60	53
>=2	1	900	720	630	75	60	53
>=2	>=2	900	720	630	100	80	70
1	>=2	750	600	525	100	80	70
Minimum Required		#N/A	#N/A	630	#N/A	#N/A	70
Test Amount		#N/A	#N/A	1,056	#N/A	#N/A	265

80% COMBINATION

No one warrant satisfied but following warrants fulfilled 80% or more:

Condition A 80% Fulfilled?	YES
Condition B 80% Fulfilled?	YES
80% COMBINATION SATISFIED?	**YES**

Minimum Requirements:
Conditions A and B Both 80% Fulfilled

Notes:

a. Basic minimum hourly volume (eighth highest hour).
b. Used for combination of Conditions A and B.
c. May be used when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000.
d. Heavier left-turn movement from the major street may be included with minor street volume if a separate signal phase is proposed for left-turn movements.

Adopted from: U.S. Department of Transportation, Federal Highway Administration, *Manual on Uniform Traffic Control Devices, Millennium Edition* , 2001.

TRAFFIC SIGNAL WARRANTS
FOUR HOUR VEHICULAR VOLUME (MUTCD Warrant 2)
PEAK HOUR VEHICULAR VOLUME (MUTCD Warrant 3)

Major Street: MAMALAHOA HIGHWAY
Minor Street: KAIMINANI DRIVE
Scenario: FUTURE WEEKDAY - A.M. PEAK HOUR (2020)
Urban/Rural: r (U=urban, R=rural [a])

FOUR HOUR VOLUME (MUTCD Warrant 2)

Number of Lanes on Each Approach			
Major Street:	2		
Minor Street:	2		
Vehicles Per Hour (4th Highest Hour)			
Major Street (Approach 1):	855	Major Street Left Turn (see note [b]):	0
Major Street (Approach 2):	641	Minor Street (Higher Volume App.):	375
Major Street Total (Both Approaches):	1,496	Minor Street Total:	375
Minimum Volume on Major Street to Satisfy Warrant (see note [c]):	330	Minimum Volume on Minor Street to Satisfy Warrant (see note [c]):	80

FOUR HOUR VOLUME WARRANT SATISFIED? **YES**

PEAK HOUR VOLUME (MUTCD Warrant 3)

Number of Lanes on Each Approach			
Major Street:	2		
Minor Street:	2		
Vehicles Per Hour (Peak Hour)			
Major Street (Approach 1):	1,006	Major Street Left Turn (see note [b]):	0
Major Street (Approach 2):	754	Minor Street (Higher Volume App.):	441
Major Street Total (Both Approaches):	1,760	Minor Street Total:	441
Minimum Volume on Major Street to Satisfy Warrant (see note [d]):	420	Minimum Volume on Minor Street to Satisfy Warrant (see note [d]):	100

PEAK HOUR VOLUME WARRANT SATISFIED? **YES**

Notes:

a. May be used when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000.
b. Heavier left-turn movement from the major street may be included with minor street volume if a separate signal phase is proposed for left-turn movements.
c. From: USDOT, FHWA, "Manual on Uniform Traffic Control Devices," 2001, Figure 4C-2.
d. From: USDOT, FHWA, "Manual on Uniform Traffic Control Devices," 2001, Figure 4C-4.

Adopted from: U.S. Department of Transportation, Federal Highway Administration, "Manual on Uniform Traffic Control Devices, Millennium Edition," 2001.

TRAFFIC SIGNAL WARRANTS
EIGHT-HOUR VEHICULAR VOLUME (MUTCD Warrant 1)

Major Street: KAIMINANI DRIVE
Minor Street: HOLOHOLO STREET
Scenario: FUTURE WEEKDAY - P.M. PEAK HOUR (2020)
Urban/Rural: r (U=urban, R=rural or high speed [c])

MINIMUM VEHICULAR VOLUME (MUTCD Condition A)

Number of Lanes on Each Approach	
Major Street:	1
Minor Street:	1
Vehicles Per Hour (8th Highest Hour)	
Major Street (Approach 1):	506
Major Street (Approach 2):	113
Major Street Left Turn (see note [d]):	0
Minor Street (Higher Volume App.):	75
MINIMUM VEHICULAR VOLUME SATISFIED?	**NO**

Minimum Requirements

Number of Lanes for Moving Traffic on Each Approach		Vehicles Per Hour (eighth highest hour) on Major Street (Total of Both Approaches)			Vehicles Per Hour (eighth highest hour) on Higher-Volume Minor Street Approach (1 Direction Only)		
Major Street	Minor Street	100% [a]	80% [b]	70% [c]	100% [a]	80% [b]	70% [c]
1	1	500	400	350	150	120	105
>=2	1	600	480	420	150	120	105
>=2	>=2	600	480	420	200	160	140
1	>=2	500	400	350	200	160	140
Minimum Required		#N/A	#N/A	350	#N/A	#N/A	105
Test Amount		#N/A	#N/A	619	#N/A	#N/A	75

INTERRUPTION OF CONTINUOUS TRAFFIC (MUTCD Condition B)

Number of Lanes on Each Approach	
Major Street:	1
Minor Street:	1
Vehicles Per Hour (8th Highest Hour)	
Major Street (Approach 1):	506
Major Street (Approach 2):	113
Major Street Left Turn (see note [d]):	0
Minor Street (Higher Volume App.):	75
INTERRUPT. OF CONT. TRAFFIC SATISFIED?	**YES**

Minimum Requirements

Number of Lanes for Moving Traffic on Each Approach		Vehicles Per Hour (eighth highest hour) on Major Street (Total of Both Approaches)			Vehicles Per Hour (eighth highest hour) on Higher-Volume Minor Street Approach (1 Direction Only)		
Major Street	Minor Street	100% [a]	80% [b]	70% [c]	100% [a]	80% [b]	70% [c]
1	1	750	600	525	75	60	53
>=2	1	900	720	630	75	60	53
>=2	>=2	900	720	630	100	80	70
1	>=2	750	600	525	100	80	70
Minimum Required		#N/A	#N/A	525	#N/A	#N/A	53
Test Amount		#N/A	#N/A	619	#N/A	#N/A	75

80% COMBINATION

No one warrant satisfied but following warrants fulfilled 80% or more:

Condition A 80% Fulfilled?	NO
Condition B 80% Fulfilled?	YES
80% COMBINATION SATISFIED?	**NO**

Minimum Requirements:
Conditions A and B Both 80% Fulfilled

Notes:

a. Basic minimum hourly volume (eighth highest hour).
b. Used for combination of Conditions A and B.
c. May be used when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000.
d. Heavier left-turn movement from the major street may be included with minor street volume if a separate signal phase is proposed for left-turn movements.

Adopted from: U.S. Department of Transportation, Federal Highway Administration, *Manual on Uniform Traffic Control Devices, Millennium Edition* , 2001.

TRAFFIC SIGNAL WARRANTS
FOUR HOUR VEHICULAR VOLUME (MUTCD Warrant 2)
PEAK HOUR VEHICULAR VOLUME (MUTCD Warrant 3)

Major Street: KAIMINANI DRIVE
Minor Street: HOLOHOLO STREET
Scenario: FUTURE WEEKDAY - P.M. PEAK HOUR (2020)
Urban/Rural: r (U=urban, R=rural [a])

FOUR HOUR VOLUME (MUTCD Warrant 2)

Number of Lanes on Each Approach			
Major Street:	1		
Minor Street:	1		
Vehicles Per Hour (4th Highest Hour)			
Major Street (Approach 1):	717	Major Street Left Turn (see note [b]):	0
Major Street (Approach 2):	161	Minor Street (Higher Volume App.):	106
Major Street Total (Both Approaches):	878	Minor Street Total:	106
Minimum Volume on Major Street to Satisfy Warrant (see note [c]):	270	Minimum Volume on Minor Street to Satisfy Warrant (see note [c]):	60

FOUR HOUR VOLUME WARRANT SATISFIED? **YES**

PEAK HOUR VOLUME (MUTCD Warrant 3)

Number of Lanes on Each Approach			
Major Street:	1		
Minor Street:	1		
Vehicles Per Hour (Peak Hour)			
Major Street (Approach 1):	843	Major Street Left Turn (see note [b]):	0
Major Street (Approach 2):	189	Minor Street (Higher Volume App.):	125
Major Street Total (Both Approaches):	1,032	Minor Street Total:	125
Minimum Volume on Major Street to Satisfy Warrant (see note [d]):	310	Minimum Volume on Minor Street to Satisfy Warrant (see note [d]):	75

PEAK HOUR VOLUME WARRANT SATISFIED? **YES**

Notes:

a. May be used when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000.
b. Heavier left-turn movement from the major street may be included with minor street volume if a separate signal phase is proposed for left-turn movements.
c. From: USDOT, FHWA, "Manual on Uniform Traffic Control Devices," 2001, Figure 4C-2.
d. From: USDOT, FHWA, "Manual on Uniform Traffic Control Devices," 2001, Figure 4C-4.

Adopted from: U.S. Department of Transportation, Federal Highway Administration, "Manual on Uniform Traffic Control Devices, Millennium Edition," 2001.

TRAFFIC SIGNAL WARRANTS
EIGHT-HOUR VEHICULAR VOLUME (MUTCD Warrant 1)

Major Street: HINA LANI STREET
Minor Street: KEALAKAA STREET/HOLOHOLO STREET
Scenario: FUTURE WEEKDAY - P.M. PEAK HOUR (2020)
Urban/Rural: r (U=urban, R=rural or high speed [c])

MINIMUM VEHICULAR VOLUME (MUTCD Condition A)

Number of Lanes on Each Approach	
Major Street:	2
Minor Street:	2
Vehicles Per Hour (8th Highest Hour)	
Major Street (Approach 1):	554
Major Street (Approach 2):	548
Major Street Left Turn (see note [d]):	0
Minor Street (Higher Volume App.):	182
MINIMUM VEHICULAR VOLUME SATISFIED?	**YES**

Minimum Requirements

Number of Lanes for Moving Traffic on Each Approach		Vehicles Per Hour (eighth highest hour) on Major Street (Total of Both Approaches)			Vehicles Per Hour (eighth highest hour) on Higher-Volume Minor Street Approach (1 Direction Only)		
Major Street	Minor Street	100% [a]	80% [b]	70% [c]	100% [a]	80% [b]	70% [c]
1	1	500	400	350	150	120	105
>=2	1	600	480	420	150	120	105
>=2	>=2	600	480	420	200	160	140
1	>=2	500	400	350	200	160	140
Minimum Required		#N/A	#N/A	420	#N/A	#N/A	140
Test Amount		#N/A	#N/A	1,102	#N/A	#N/A	182

INTERRUPTION OF CONTINUOUS TRAFFIC (MUTCD Condition B)

Number of Lanes on Each Approach	
Major Street:	2
Minor Street:	2
Vehicles Per Hour (8th Highest Hour)	
Major Street (Approach 1):	554
Major Street (Approach 2):	548
Major Street Left Turn (see note [d]):	0
Minor Street (Higher Volume App.):	182
INTERRUPT. OF CONT. TRAFFIC SATISFIED?	**YES**

Minimum Requirements

Number of Lanes for Moving Traffic on Each Approach		Vehicles Per Hour (eighth highest hour) on Major Street (Total of Both Approaches)			Vehicles Per Hour (eighth highest hour) on Higher-Volume Minor Street Approach (1 Direction Only)		
Major Street	Minor Street	100% [a]	80% [b]	70% [c]	100% [a]	80% [b]	70% [c]
1	1	750	600	525	75	60	53
>=2	1	900	720	630	75	60	53
>=2	>=2	900	720	630	100	80	70
1	>=2	750	600	525	100	80	70
Minimum Required		#N/A	#N/A	630	#N/A	#N/A	70
Test Amount		#N/A	#N/A	1,102	#N/A	#N/A	182

80% COMBINATION

No one warrant satisfied but following warrants fulfilled 80% or more:

Condition A 80% Fulfilled?	YES
Condition B 80% Fulfilled?	YES
80% COMBINATION SATISFIED?	**YES**

Minimum Requirements:
Conditions A and B Both 80% Fulfilled

Notes:

a. Basic minimum hourly volume (eighth highest hour).
b. Used for combination of Conditions A and B.
c. May be used when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000.
d. Heavier left-turn movement from the major street may be included with minor street volume if a separate signal phase is proposed for left-turn movements.

Adopted from: U.S. Department of Transportation, Federal Highway Administration, *Manual on Uniform Traffic Control Devices, Millennium Edition* , 2001.

TRAFFIC SIGNAL WARRANTS
FOUR HOUR VEHICULAR VOLUME (MUTCD Warrant 2)
PEAK HOUR VEHICULAR VOLUME (MUTCD Warrant 3)

Major Street: HINA LANI STREET
Minor Street: KEALAKAA STREET/HOLOHOLO STREET
Scenario: FUTURE WEEKDAY - P.M. PEAK HOUR (2020)
Urban/Rural: r (U=urban, R=rural [a])

FOUR HOUR VOLUME (MUTCD Warrant 2)

Number of Lanes on Each Approach			
Major Street:	2		
Minor Street:	2		
Vehicles Per Hour (4th Highest Hour)			
Major Street (Approach 1):	785	Major Street Left Turn (see note [b]):	0
Major Street (Approach 2):	777	Minor Street (Higher Volume App.):	258
Major Street Total (Both Approaches):	1,562	Minor Street Total:	258
Minimum Volume on Major Street to Satisfy Warrant (see note [c]):	330	Minimum Volume on Minor Street to Satisfy Warrant (see note [c]):	80

FOUR HOUR VOLUME WARRANT SATISFIED? **YES**

PEAK HOUR VOLUME (MUTCD Warrant 3)

Number of Lanes on Each Approach			
Major Street:	2		
Minor Street:	2		
Vehicles Per Hour (Peak Hour)			
Major Street (Approach 1):	923	Major Street Left Turn (see note [b]):	0
Major Street (Approach 2):	914	Minor Street (Higher Volume App.):	303
Major Street Total (Both Approaches):	1,837	Minor Street Total:	303
Minimum Volume on Major Street to Satisfy Warrant (see note [d]):	420	Minimum Volume on Minor Street to Satisfy Warrant (see note [d]):	100

PEAK HOUR VOLUME WARRANT SATISFIED? **YES**

Notes:

a. May be used when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000.
b. Heavier left-turn movement from the major street may be included with minor street volume if a separate signal phase is proposed for left-turn movements.
c. From: USDOT, FHWA, "Manual on Uniform Traffic Control Devices," 2001, Figure 4C-2.
d. From: USDOT, FHWA, "Manual on Uniform Traffic Control Devices," 2001, Figure 4C-4.

Adopted from: U.S. Department of Transportation, Federal Highway Administration, "Manual on Uniform Traffic Control Devices, Millennium Edition," 2001.

APPENDIX F

HDOT ALTERNATIVE FUTURE SCENARIO

APPENDIX F

HDOT ALTERNATIVE FUTURE SCENARIO

The traffic impact analysis of the alternative future scenario requested by HDOT is discussed in this appendix. It is assumed that the expansion of the regional street system planned by County of Hawaii would not be implemented by the study horizon year (2020) but that the planned Stanford Carr project would be completed. Thus, Holoholo Street/Kealakaa Street would be constructed between the Kula Nei project site and Hina Lani Street. This scenario assumes that the following improvements would be completed by Year 2020:

- Queen Kaahumanu Highway – It is currently being widened from two to four lanes (two in each direction).
- Intersection of Mamalahoa Highway and Kaiminani Drive – A new right-turn lane on Kaiminani Drive to Mamalahoa Highway would be installed by June 2007.
- Kealakaa Street/Holoholo Street Extension – The proposed street would be extended from the project site to Hina Lani Street.
- Stanford Carr Development – The planned project, as described in Chapter III, would be constructed immediately south of the proposed Kula Nei project and will be considered part of the future traffic conditions (cumulative base conditions).

The other assumptions made to estimate future traffic conditions, including the project trip generation, trip distribution and areawide traffic growth, were the same as those described in Chapter 3.

Traffic forecasts were developed for the following six intersections:

1. Kaiminani Drive and Queen Kaahumanu Highway (SR 19) (signalized)
2. Kaiminani Drive and Holoholo Street (stop-controlled)
3. Kaiminani Drive and Mamalahoa Highway (SR 190) (stop-controlled)
4. Hina Lani Street and Mamalahoa Highway (SR 190) (signalized)
5. Hina Lani Street and Kealakaa Street/Holoholo Street (future intersection)
6. Hina Lani Street and Queen Kaahumanu Highway (SR 19) (signalized)

The resulting peak hour traffic volumes are illustrated in Figures F-1, F-2 and F-3 for the cumulative base, project-related traffic, and cumulative plus project projections, respectively.

Table F-1 summarizes the projected LOS in 2020 at each analyzed location without and with the recommended mitigations measures described below:

- Holoholo Street and Kaiminani Drive – Installation of a traffic signal.
- Mamalahoa Highway and Kaiminani Drive – Installation of a traffic signal.
- Mamalahoa Highway and Hina Lani Street – Widen the southbound departure from the intersection to provide an additional southbound through lane, resulting in one through/right and one through lane.
- Kealakaa Street/Holoholo Street and Hina Lani Street – Install a traffic signal and add separate left-turn lanes on the eastbound and westbound approaches.
- Queen Kaahumanu Highway and Hina Lani Street – Implement an overlapping protected northbound right-turn phase and prohibit U-turns on the westbound approach, and add a second southbound left-turn lane as well as the corresponding departure lanes.

Implementation of these measures would fully mitigate the identified project-related impacts (i.e., the recommended improvements would result in better v/c ratios and levels of service than are projected under cumulative base conditions). The cumulative impact at Mamalahoa Highway and Hina Lani Street in the p.m. peak hour (LOS F), however, cannot be fully mitigated.

Peak hour traffic volumes for the HDOT Alternative Future Scenario for the four street segments are shown in Table F-2. While three of four street segments are expected to operate at desirable levels of service during both peak hours, the southbound segment of Mamalahoa Highway south of Hina Lani Street is projected to operate at LOS E and F during a.m. and p.m. peak hours, respectively. The segment of Mamalahoa Highway south of Hina Lani Street can be mitigated to LOS D or better by widening the roadway, as described in Chapter IV, to accommodate two southbound travel lanes.

For the HDOT Alternative Future Scenario, the project-related component of future traffic growth at the impacted intersections was calculated based on the proportion of project peak hour traffic relative to the total new peak hour 2020 traffic volumes. Fair-share calculations were made for both the a.m. and p.m. peak hours, and the maximum project contribution was identified to be

between approximately 3% and 6%, as shown in Table F-3. Because the cumulative impact at Holoholo Street and Kaiminani Drive is also identified as a project-specific impact, the project's fair-share contribution to the mitigation measure identified there is identified as 100%.

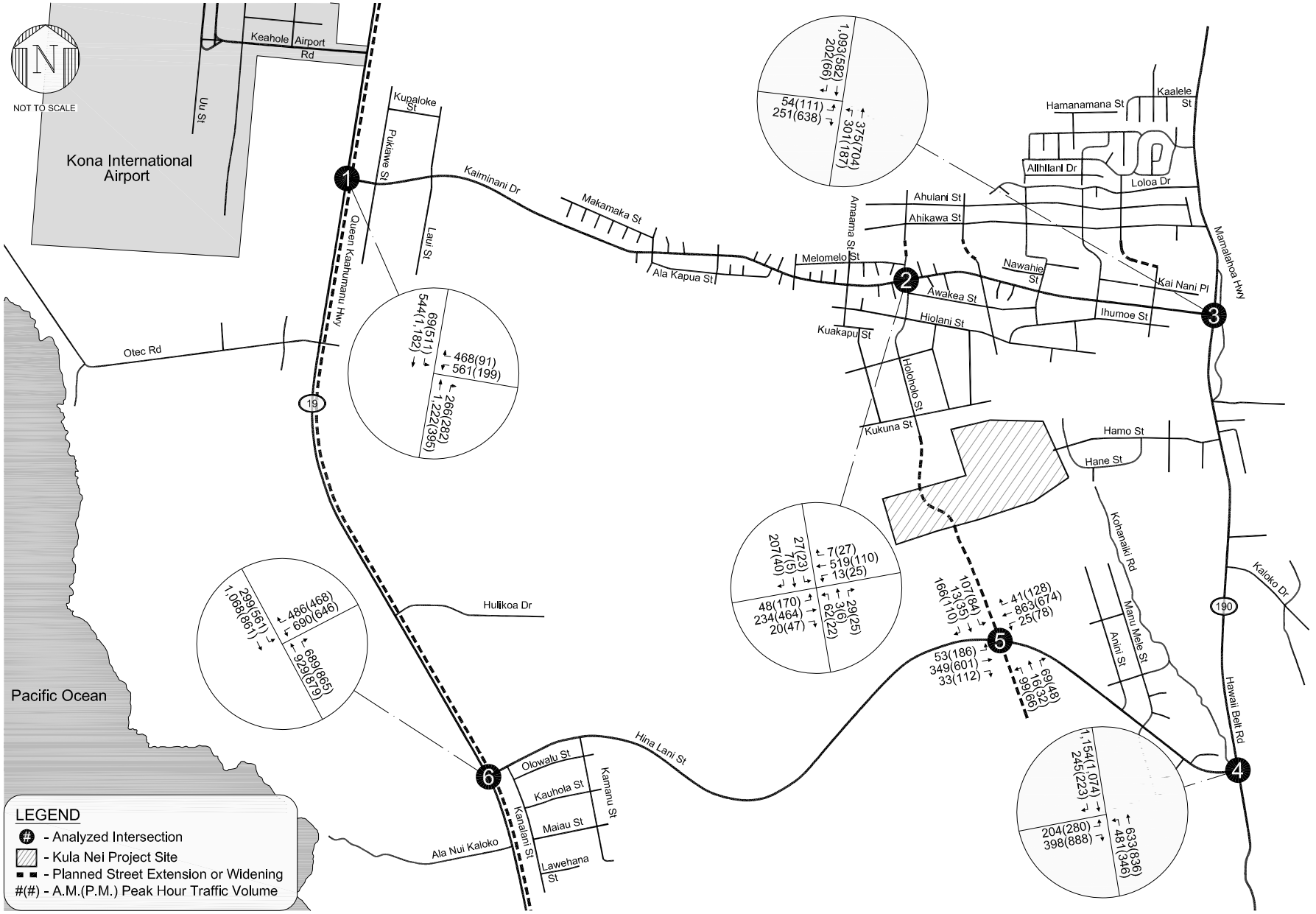
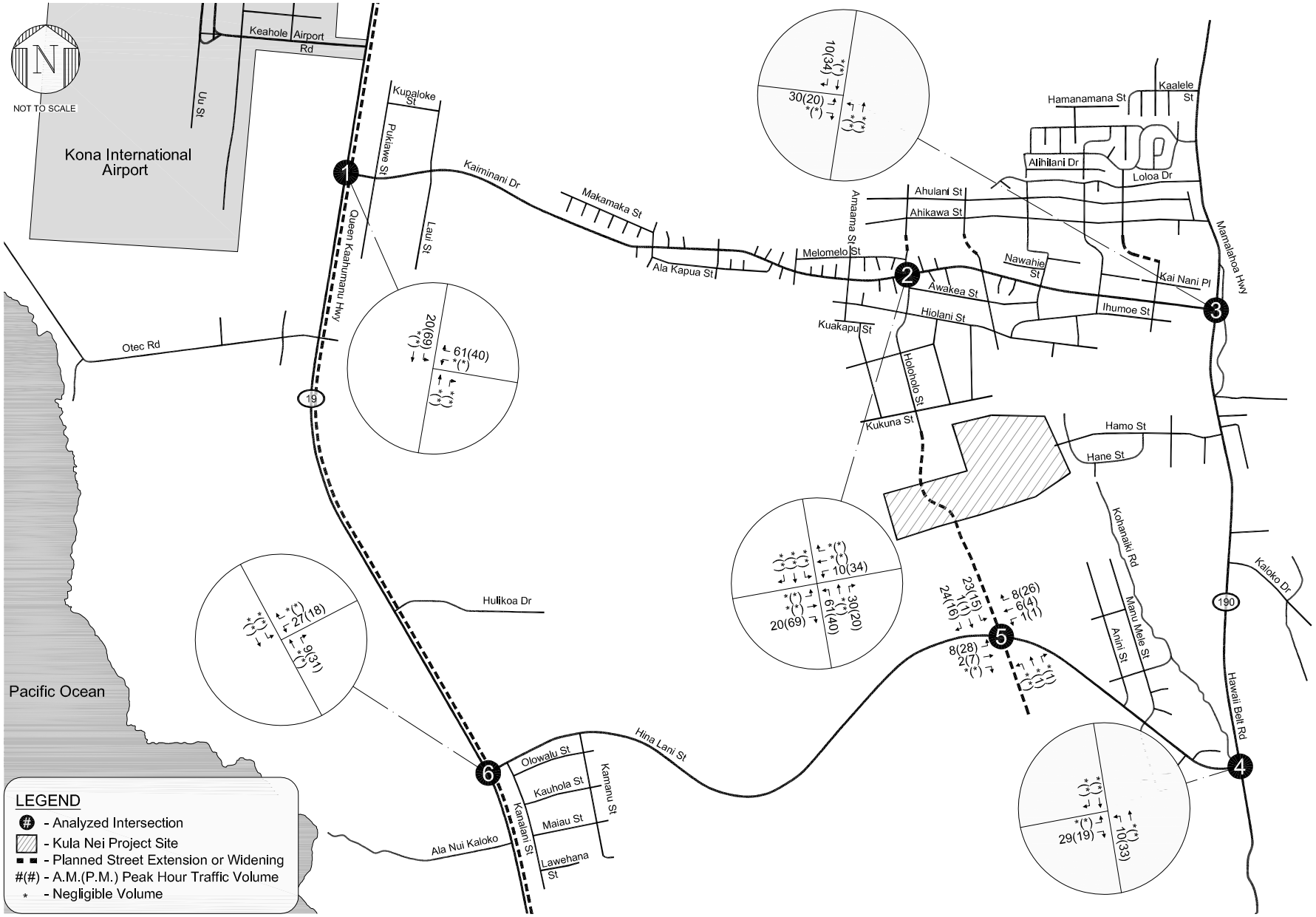


FIGURE F-1
CUMULATIVE BASE PEAK HOUR TRAFFIC VOLUMES
HDOT ALTERNATIVE FUTURE SCENARIO



FEHR & PEERS
KAKU ASSOCIATES

FIGURE F-2
PROJECT ONLY PEAK HOUR TRAFFIC VOLUMES
HDOT ALTERNATIVE FUTURE SCENARIO

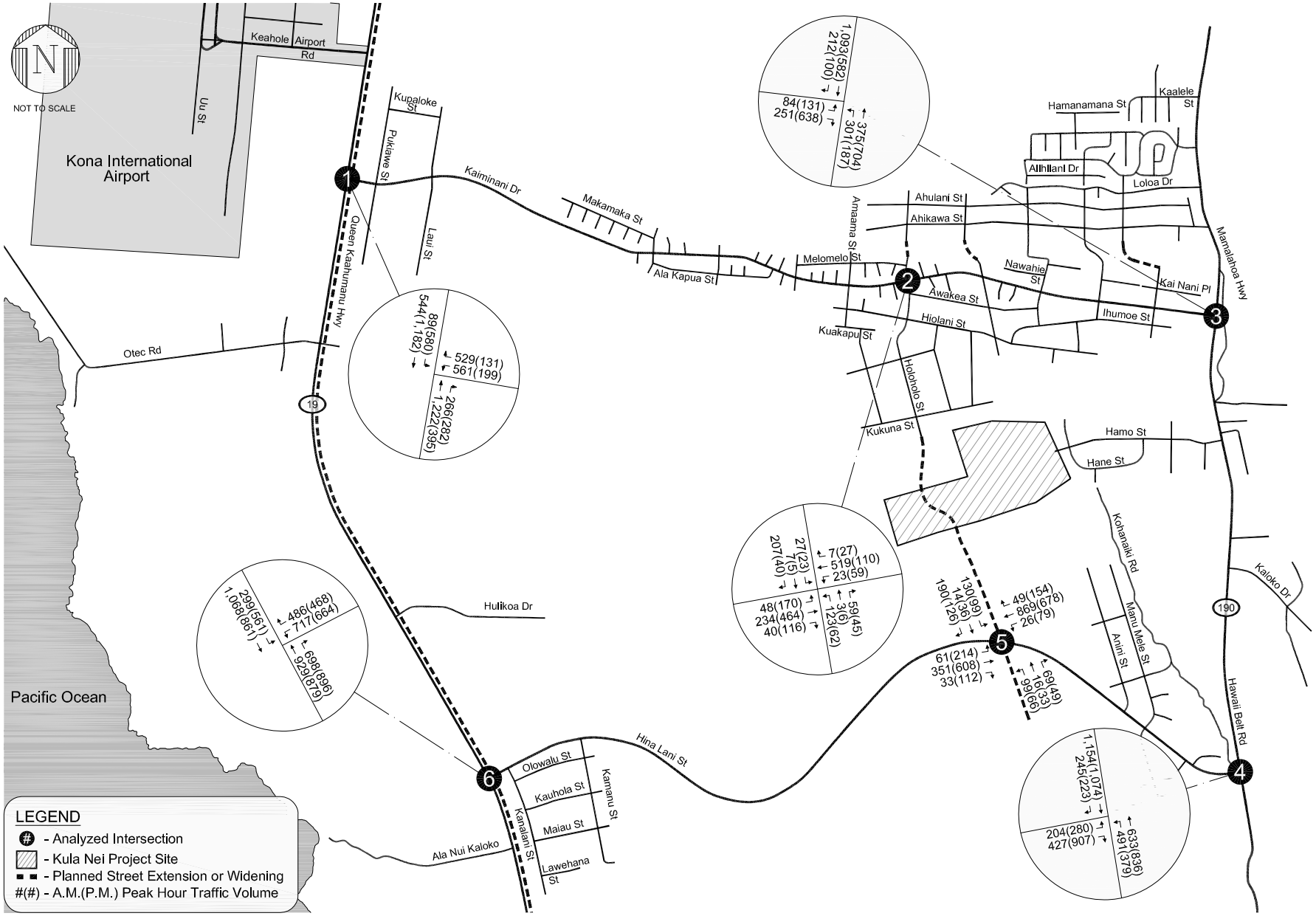


FIGURE F-3
CUMULATIVE PLUS PROJECT PEAK HOUR TRAFFIC VOLUMES
HDOT ALTERNATIVE FUTURE SCENARIO

APPENDIX F-1
INTERSECTION LEVEL OF SERVICE ANALYSIS SUMMARY
HDOT ALTERNATIVE FUTURE SCENARIO (2020)

Intersections	Peak Hour	CUMULATIVE BASE (2020)			CUMULATIVE PLUS PROJECT (2020)			LOS D OR BETTER	CUMULATIVE PLUS PROJECT WITH MITIGATION (2020)			LOS D OR BETTER
		V/C	Del/Veh*	LOS	V/C	Del/Veh*	LOS		V/C	Del/Veh*	LOS	
1. Queen Kaahumanu Hwy (SR 19) & Kaiminani Dr	A.M. P.M.	0.994 0.776	42 20	D B	1.008 0.826	45 22	D C	YES YES	No mitigation necessary			YES YES
2. Holoholo St & Kaiminani Dr [a]	A.M. P.M.	NC NC	** 23	F C	NC NC	** **	F F	NO NO	0.619 0.711	20 14	B B	YES YES
3. Mamalahoa Hwy (SR 190) & Kaiminani Dr [a]	A.M. P.M.	NC NC	** **	F F	NC NC	** **	F F	NO NO	1.024 0.917	42 35	D C	YES YES
4. Mamalahoa Hwy (SR 190) & Hina Lani St	A.M. P.M.	1.840 1.826	** **	F F	1.920 1.952	** **	F F	NO NO	1.015 1.168	44 **	D F	YES NO
5. Kealakaa St/Holoholo St & Hina Lani St [a]	A.M. P.M.	NC NC	** **	F F	NC NC	** **	F F	NO NO	0.954 0.962	36 28	D C	YES YES
6. Queen Kaahumanu Hwy (SR 19) & Hina Lani St	A.M. P.M.	1.331 2.155	** **	F F	1.359 2.173	** **	F F	NO NO	0.967 1.007	34 39	C D	YES YES

Note:
* Delay indicates average stopped delay per vehicle in seconds for signalized intersections. The worst case vehicular delay is reported for stop-controlled intersections.
** Indicates oversaturated conditions. Delay cannot be calculated.
NC = Not Calculated
[a] Intersection is controlled by stop signs on the minor approaches.

APPENDIX F-2
STREET SEGMENT IMPACT ANALYSIS - HDOT ALTERNATIVE FUTURE SCENARIO (2020)

Segment	Location	Peak Hour	Dir.	EXISTING (2006)			CUMULATIVE BASE (2020)			CUMULATIVE PLUS PROJECT (2020)		
				Volumes	V/C	LOS	Volumes	V/C	LOS	Volumes	V/C	LOS
1. Kaiminani Drive	mauka of Queen Kaahumanu Highway	A.M.	EB	170	0.10	A	195	0.11	A	215	0.13	A
			WB	765	0.45	A	872	0.51	A	933	0.55	A
		P.M.	EB	627	0.37	A	734	0.43	A	803	0.47	A
			WB	158	0.09	A	201	0.12	A	241	0.14	A
2. Hina Lani Street	mauka of Queen Kaahumanu Highway	A.M.	EB	217	0.13	A	478	0.28	A	487	0.29	A
			WB	402	0.24	A	938	0.55	A	965	0.57	A
		P.M.	EB	380	0.22	A	1,123	0.66	B	1,154	0.68	B
			WB	320	0.19	A	710	0.42	A	728	0.43	A
3. Mamalahoa Highway	north of Kaalele Street	A.M.	NB	201	0.12	A	341	0.20	A	371	0.22	A
			SB	301	0.18	A	525	0.31	A	535	0.31	A
		P.M.	NB	267	0.16	A	471	0.28	A	491	0.29	A
			SB	284	0.17	A	488	0.29	A	522	0.31	A
4. Mamalahoa Highway	south of Hina Lani Street	A.M.	NB	706	0.42	A	1,114	0.66	B	1,124	0.66	B
			SB	1,021	0.60	A	1,643	0.97	E	1,672	0.98	E
			SB	*With Mitigation (Second Southbound Lane)*						1,672	0.52	A
		P.M.	NB	672	0.40	A	1,182	0.70	B	1,215	0.71	B
			SB	2,041	1.20	F	2,838	1.67	F	2,857	1.68	F
			SB	*With Mitigation (Second Southbound Lane)*						2,857	0.89	D

Note: Roadway Capacity of 1,700 passenger car per lane is based on *Highway Capacity Manual* (Transportation Research Board, 2000).

APPENDIX F-3

2020 PROJECT FAIR SHARE INTERSECTION TRAFFIC CONTRIBUTION - HDOT ALTERNATIVE FUTURE CONDITIONS

Int #	Intersection	A.M. Peak Hour					P.M. Peak Hour					Maximum Contribution
		Existing Traffic	2020 with Project Traffic	Project Traffic	Total New Traffic	Project % of New Traffic	Existing Traffic	2020 with Project Traffic	Project Traffic	Total New Traffic	Project % of New Traffic	
2	Holoholo St & Kaiminani Dr	787	1,297	121	510	23.7%	701	1,127	163	426	38.3%	100%*
3	Mamalahoa Hwy & Kaiminani Dr	1,526	2,316	40	790	5.1%	1,454	2,342	54	888	6.1%	6.1%
4	Mamalahoa Hwy & Hina Lani St	1,854	3,154	39	1,300	3.0%	2,133	3,699	52	1,566	3.3%	3.3%
5	Holoholo St & Hina Lani St	727	1,907	73	1,180	6.2%	601	2,254	100	1,653	6.0%	6.2%
6	Queen Kaahumanu Hwy & Hina Lani St	2,418	4,197	36	1,779	2.0%	2,472	4,329	49	1,857	2.6%	2.6%

* The cumulative impact at this location is also identified as a project specific impact in the p.m. peak hour.

APPENDIX G

ALTERNATIVE FUTURE SCENARIO I LEVEL OF SERVICE WORKSHEETS

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.818
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	27.4
Optimal Cycle:	76	Level Of Service:	C

Street Name:	Queen Kaahumanu Highway (SR-19)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2 0	1	1 0	2 0	0	0 0	0 0	0 0	1 0	0 0	1
Volume Module:												
Base Vol:	0	1016	126	71	504	0	0	0	0	404	0	492
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	1016	126	71	504	0	0	0	0	404	0	492
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	1069	133	75	531	0	0	0	0	425	0	518
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	1069	133	75	531	0	0	0	0	425	0	518
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	1069	133	75	531	0	0	0	0	425	0	518
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.95	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1615	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.33	0.09	0.05	0.16	0.00	0.00	0.00	0.00	0.33	0.00	0.36
Crit Moves:		****		****								****
Green/Cycle:	0.00	0.41	0.41	0.46	0.46	0.00	0.00	0.00	0.00	0.44	0.00	0.44
Volume/Cap:	0.00	0.82	0.23	0.47	0.36	0.00	0.00	0.00	0.00	0.74	0.00	0.82
Uniform Del:	0.0	26.5	19.5	19.5	17.3	0.0	0.0	0.0	0.0	23.4	0.0	24.6
IncremntDel:	0.0	4.2	0.2	2.2	0.1	0.0	0.0	0.0	0.0	5.2	0.0	8.2
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	30.6	19.7	21.7	17.5	0.0	0.0	0.0	0.0	28.6	0.0	32.8
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	30.6	19.7	21.7	17.5	0.0	0.0	0.0	0.0	28.6	0.0	32.8
LOS by Move:	A	C	B	C	B	A	A	A	A	C	A	C
HCM2kAvgQ:	0	18	3	2	6	0	0	0	0	12	0	16

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Average Delay (sec/veh): 6.8 Worst Case Level Of Service: D[28.6]

Street Name:	Holoholo St						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	36	7	16	33	9	184	62	149	8	7	478	17
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	36	7	16	33	9	184	62	149	8	7	478	17
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	38	7	17	35	9	194	65	157	8	7	503	18
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	38	7	17	35	9	194	65	157	8	7	503	18
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	920	827	161	831	823	512	521	xxxx	xxxxx	165	xxxx	xxxxx
Potent Cap.:	254	309	889	291	311	566	1056	xxxx	xxxxx	1425	xxxx	xxxxx
Move Cap.:	154	288	889	266	289	566	1056	xxxx	xxxxx	1425	xxxx	xxxxx
Volume/Cap:	0.25	0.03	0.02	0.13	0.03	0.34	0.06	xxxx	xxxx	0.01	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.2	xxxx	xxxxx	0.0	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	8.6	xxxx	xxxxx	7.5	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	A	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	214	xxxxx	xxxx	470	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	1.2	xxxxx	xxxxx	2.8	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	28.6	xxxxx	xxxxx	20.2	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	D	*	*	C	*	*	*	*	*	*	*
ApproachDel:	28.6			20.2			xxxxxx			xxxxxx		
ApproachLOS:	D			C			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #3 Mamalahoa/Kaiminani

Average Delay (sec/veh): 12.1 Worst Case Level Of Service: F[62.1]

Street Name:	Mamalahoa Hwy						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0 1	0	0	0 0 1	0	1	1 0 0	0	1	0 0 0	0	0
Volume Module:												
Base Vol:	213	329	0	0	857	157	44	0	275	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	213	329	0	0	857	157	44	0	275	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	224	346	0	0	902	165	46	0	289	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	224	346	0	0	902	165	46	0	289	0	0	0
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2	xxxxx	xxxx	xxxxx
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3	xxxxx	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1067	xxxx	xxxxx	xxxx	xxxx	xxxxx	1697	xxxx	902	xxxx	xxxx	xxxxx
Potent Cap.:	661	xxxx	xxxxx	xxxx	xxxx	xxxxx	103	xxxx	339	xxxx	xxxx	xxxxx
Move Cap.:	661	xxxx	xxxxx	xxxx	xxxx	xxxxx	76	xxxx	339	xxxx	xxxx	xxxxx
Volume/Cap:	0.34	xxxx	xxxx	xxxx	xxxx	xxxx	0.61	xxxx	0.85	xxxx	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	1.5	xxxx	xxxxx	xxxx	xxxx	xxxxx	2.7	xxxx	7.8	xxxx	xxxx	xxxxx
Control Del:	13.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	109.0	xxxx	54.5	xxxxx	xxxx	xxxxx
LOS by Move:	B	*	*	*	*	*	F	*	F	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			62.1			xxxxxx		
ApproachLOS:	*			*			F			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.087
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	48.1
Optimal Cycle:	180	Level Of Service:	D

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0 2	0 1		1 0 2	0 0		0 0 0	0 0		1 0	0 0 1	
Volume Module:												
Base Vol:	0	872	602	208	1015	0	0	0	0	518	0	203
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	872	602	208	1015	0	0	0	0	518	0	203
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	918	634	219	1068	0	0	0	0	545	0	214
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	918	634	219	1068	0	0	0	0	545	0	214
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	918	634	219	1068	0	0	0	0	545	0	214
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.62	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1050	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.28	0.44	0.21	0.33	0.00	0.00	0.00	0.00	0.42	0.00	0.15
Crit Moves:			****	****						****		
Green/Cycle:	0.00	0.40	0.40	0.52	0.52	0.00	0.00	0.00	0.00	0.38	0.00	0.38
Volume/Cap:	0.00	0.71	1.10	0.75	0.63	0.00	0.00	0.00	0.00	1.10	0.00	0.39
Uniform Del:	0.0	25.3	30.1	17.4	17.1	0.0	0.0	0.0	0.0	31.1	0.0	22.6
IncremntDel:	0.0	1.9	68.3	10.2	0.8	0.0	0.0	0.0	0.0	71.0	0.0	0.5
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	27.2	98.4	27.6	17.9	0.0	0.0	0.0	0.0	102.0	0.0	23.1
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	27.2	98.4	27.6	17.9	0.0	0.0	0.0	0.0	102.0	0.0	23.1
LOS by Move:	A	C	F	C	B	A	A	A	A	F	A	C
HCM2kAvgQ:	0	14	31	7	13	0	0	0	0	27	0	5

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalahoa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.404
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	110.9
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Mamalahoa Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0	0 1	0	1 0	0	1	0 0	0	0 0	0	0
Volume Module:												
Base Vol:	418	612	0	0	1178	199	64	0	258	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	418	612	0	0	1178	199	64	0	258	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	440	644	0	0	1240	209	67	0	272	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	440	644	0	0	1240	209	67	0	272	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	440	644	0	0	1240	209	67	0	272	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.24	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	409	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	1.08	0.38	0.00	0.00	0.73	0.14	0.04	0.00	0.19	0.00	0.00	0.00
Crit Moves:	****								****			
Green/Cycle:	0.76	0.76	0.00	0.00	0.55	0.55	0.14	0.00	0.14	0.00	0.00	0.00
Volume/Cap:	1.10	0.50	0.00	0.00	1.32	0.26	0.29	0.00	1.32	0.00	0.00	0.00
Uniform Del:	3.9	4.7	0.0	0.0	22.4	11.7	38.4	0.0	42.9	0.0	0.0	0.0
IncremntDel:	74.0	0.3	0.0	0.0	152	0.2	0.7	0.0	174.7	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	77.9	5.0	0.0	0.0	175	11.9	39.1	0.0	217.6	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	77.9	5.0	0.0	0.0	175	11.9	39.1	0.0	217.6	0.0	0.0	0.0
LOS by Move:	E	A	A	A	F	B	D	A	F	A	A	A
HCM2kAvgQ:	22	8	0	0	76	3	2	0	19	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.696
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	17.2
Optimal Cycle:	54	Level Of Service:	B

Street Name:	Queen Kaahumanu Highway (SR-19)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2 0	1	1 0	2 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	333	223	576	1010	0	0	0	0	110	0	124
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	333	223	576	1010	0	0	0	0	110	0	124
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	351	235	606	1063	0	0	0	0	116	0	131
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	351	235	606	1063	0	0	0	0	116	0	131
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	351	235	606	1063	0	0	0	0	116	0	131
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.95	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1615	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.11	0.16	0.38	0.33	0.00	0.00	0.00	0.00	0.09	0.00	0.09
Crit Moves:			****	****						****		
Green/Cycle:	0.00	0.23	0.23	0.77	0.77	0.00	0.00	0.00	0.00	0.13	0.00	0.13
Volume/Cap:	0.00	0.46	0.70	0.60	0.43	0.00	0.00	0.00	0.00	0.70	0.00	0.71
Uniform Del:	0.0	33.0	35.1	5.7	3.8	0.0	0.0	0.0	0.0	41.8	0.0	41.9
IncremntDel:	0.0	0.5	6.2	1.0	0.1	0.0	0.0	0.0	0.0	12.1	0.0	12.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	33.4	41.3	6.8	4.0	0.0	0.0	0.0	0.0	53.9	0.0	54.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	33.4	41.3	6.8	4.0	0.0	0.0	0.0	0.0	53.9	0.0	54.0
LOS by Move:	A	C	D	A	A	A	A	A	A	D	A	D
HCM2kAvgQ:	0	5	8	9	6	0	0	0	0	5	0	5

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Average Delay (sec/veh): 3.9 Worst Case Level Of Service: C[21.1]

Street Name:	Holoholo St						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	7	7	12	35	8	41	162	491	23	7	97	33
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	7	7	12	35	8	41	162	491	23	7	97	33
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	7	7	13	37	8	43	171	517	24	7	102	35
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	7	7	13	37	8	43	171	517	24	7	102	35
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1030	1022	529	1014	1016	119	137	xxxx	xxxxx	541	xxxx	xxxxx
Potent Cap.:	214	238	554	219	240	938	1460	xxxx	xxxxx	1038	xxxx	xxxxx
Move Cap.:	177	206	554	187	207	938	1460	xxxx	xxxxx	1038	xxxx	xxxxx
Volume/Cap:	0.04	0.04	0.02	0.20	0.04	0.05	0.12	xxxx	xxxx	0.01	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.4	xxxx	xxxxx	0.0	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	7.8	xxxx	xxxxx	8.5	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	A	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	273	xxxxx	xxxx	311	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	0.3	xxxxx	xxxxx	1.1	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	19.6	xxxxx	xxxxx	21.1	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	C	*	*	C	*	*	*	*	*	*	*
ApproachDel:	19.6			21.1			xxxxxx			xxxxxx		
ApproachLOS:	C			C			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #3 Mamalahoa/Kaiminani

Average Delay (sec/veh): 17.0 Worst Case Level Of Service: F[65.0]

Street Name:	Mamalahoa Hwy						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0	1 0	0	0 0	1 0	1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	187	624	0	0	564	54	94	0	375	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	187	624	0	0	564	54	94	0	375	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	197	657	0	0	594	57	99	0	395	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	197	657	0	0	594	57	99	0	395	0	0	0
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2	xxxxx	xxxx	xxxxx
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3	xxxxx	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	651	xxxx	xxxxx	xxxx	xxxx	xxxxx	1644	xxxx	594	xxxx	xxxx	xxxxx
Potent Cap.:	945	xxxx	xxxxx	xxxx	xxxx	xxxxx	111	xxxx	509	xxxx	xxxx	xxxxx
Move Cap.:	945	xxxx	xxxxx	xxxx	xxxx	xxxxx	93	xxxx	509	xxxx	xxxx	xxxxx
Volume/Cap:	0.21	xxxx	xxxx	xxxx	xxxx	xxxx	1.06	xxxx	0.78	xxxx	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	0.8	xxxx	xxxxx	xxxx	xxxx	xxxxx	6.5	xxxx	7.0	xxxx	xxxx	xxxxx
Control Del:	9.8	xxxx	xxxxx	xxxxx	xxxx	xxxxx	194.7	xxxx	32.4	xxxxx	xxxx	xxxxx
LOS by Move:	A	*	*	*	*	*	F	*	D	*	*	*
Movement:	LT	LTR	RT	LT	LTR	RT	LT	LTR	RT	LT	LTR	RT
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			65.0			xxxxxx		
ApproachLOS:	*			*			F			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalahoa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.474
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	186.1
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Mamalahoa Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0 0	1 0	1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	193	910	0	0	1080	66	187	0	790	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	193	910	0	0	1080	66	187	0	790	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	203	958	0	0	1137	69	197	0	832	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	203	958	0	0	1137	69	197	0	832	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	203	958	0	0	1137	69	197	0	832	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.22	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	381	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.53	0.56	0.00	0.00	0.67	0.05	0.12	0.00	0.58	0.00	0.00	0.00
Crit Moves:	****				****				****			
Green/Cycle:	0.52	0.52	0.00	0.00	0.44	0.44	0.38	0.00	0.38	0.00	0.00	0.00
Volume/Cap:	1.01	1.08	0.00	0.00	1.52	0.11	0.32	0.00	1.52	0.00	0.00	0.00
Uniform Del:	13.1	23.9	0.0	0.0	28.0	16.5	22.0	0.0	31.1	0.0	0.0	0.0
IncremntDel:	65.6	54.0	0.0	0.0	242	0.1	0.3	0.0	244.2	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	78.7	77.9	0.0	0.0	270	16.6	22.3	0.0	275.3	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	78.7	77.9	0.0	0.0	270	16.6	22.3	0.0	275.3	0.0	0.0	0.0
LOS by Move:	E	E	A	A	F	B	C	A	F	A	A	A
HCM2kAvgQ:	11	43	0	0	83	1	4	0	61	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.198
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	68.0
Optimal Cycle:	180	Level Of Service:	E

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0 2	0 1		1 0 2	0 0		0 0 0	0 0		1 0	0 0 1	
Volume Module:												
Base Vol:	0	882	706	246	842	0	0	0	0	539	0	285
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	882	706	246	842	0	0	0	0	539	0	285
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	928	743	259	886	0	0	0	0	567	0	300
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	928	743	259	886	0	0	0	0	567	0	300
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	928	743	259	886	0	0	0	0	567	0	300
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.47	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	800	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.29	0.51	0.32	0.27	0.00	0.00	0.00	0.00	0.43	0.00	0.21
Crit Moves:			****	****						****		
Green/Cycle:	0.00	0.42	0.42	0.55	0.55	0.00	0.00	0.00	0.00	0.35	0.00	0.35
Volume/Cap:	0.00	0.69	1.23	0.82	0.50	0.00	0.00	0.00	0.00	1.23	0.00	0.59
Uniform Del:	0.0	23.8	29.1	17.4	14.1	0.0	0.0	0.0	0.0	32.4	0.0	26.5
IncremntDel:	0.0	1.5	118.3	15.6	0.2	0.0	0.0	0.0	0.0	122.1	0.0	1.8
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	25.3	147.4	33.1	14.3	0.0	0.0	0.0	0.0	154.4	0.0	28.3
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	25.3	147.4	33.1	14.3	0.0	0.0	0.0	0.0	154.4	0.0	28.3
LOS by Move:	A	C	F	C	B	A	A	A	A	F	A	C
HCM2kAvgQ:	0	13	42	9	9	0	0	0	0	33	0	8

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.866
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	30.1
Optimal Cycle:	91	Level Of Service:	C

Street Name:	Queen Kaahumanu Highway (SR-19)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2 0	1	1 0	2 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	1016	133	86	504	0	0	0	0	425	0	538
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	1016	133	86	504	0	0	0	0	425	0	538
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	1069	140	91	531	0	0	0	0	447	0	566
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	1069	140	91	531	0	0	0	0	447	0	566
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	1069	140	91	531	0	0	0	0	447	0	566
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.95	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1615	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.33	0.10	0.06	0.16	0.00	0.00	0.00	0.00	0.34	0.00	0.39
Crit Moves:		****		****								****
Green/Cycle:	0.00	0.38	0.38	0.45	0.45	0.00	0.00	0.00	0.00	0.45	0.00	0.45
Volume/Cap:	0.00	0.87	0.25	0.52	0.37	0.00	0.00	0.00	0.00	0.76	0.00	0.87
Uniform Del:	0.0	28.5	21.1	20.7	18.3	0.0	0.0	0.0	0.0	22.8	0.0	24.6
IncremntDel:	0.0	6.6	0.2	2.9	0.2	0.0	0.0	0.0	0.0	5.5	0.0	11.7
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	35.1	21.4	23.7	18.4	0.0	0.0	0.0	0.0	28.3	0.0	36.3
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	35.1	21.4	23.7	18.4	0.0	0.0	0.0	0.0	28.3	0.0	36.3
LOS by Move:	A	D	C	C	B	A	A	A	A	C	A	D
HCM2kAvgQ:	0	19	3	3	6	0	0	0	0	13	0	19

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Average Delay (sec/veh): 29.3 Worst Case Level Of Service: F[139.8]

Street Name:	Holoholo St						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	127	10	74	33	10	184	62	149	39	26	478	17
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	127	10	74	33	10	184	62	149	39	26	478	17
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	134	11	78	35	11	194	65	157	41	27	503	18
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	134	11	78	35	11	194	65	157	41	27	503	18
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	977	884	177	919	895	512	521	xxxx	xxxxx	198	xxxx	xxxxx
Potent Cap.:	232	287	871	254	282	566	1056	xxxx	xxxxx	1387	xxxx	xxxxx
Move Cap.:	139	263	871	210	259	566	1056	xxxx	xxxxx	1387	xxxx	xxxxx
Volume/Cap:	0.96	0.04	0.09	0.17	0.04	0.34	0.06	xxxx	xxxx	0.02	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.2	xxxx	xxxxx	0.1	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	8.6	xxxx	xxxxx	7.6	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	A	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	203	xxxxx	xxxx	436	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	10.4	xxxxx	xxxxx	3.2	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	140	xxxxx	xxxxx	22.8	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	F	*	*	C	*	*	*	*	*	*	*
ApproachDel:	139.8			22.8			xxxxxx			xxxxxx		
ApproachLOS:	F			C			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #3 Mamalahoa/Kaiminani

Average Delay (sec/veh): 20.5 Worst Case Level Of Service: F[98.1]

Street Name:	Mamalahoa Hwy						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0 1 0 0			0 0 1 0 1			1 0 0 0 1			0 0 0 0 0		
Volume Module:												
Base Vol:	225	329	0	0	857	165	67	0	310	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	225	329	0	0	857	165	67	0	310	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	237	346	0	0	902	174	71	0	326	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	237	346	0	0	902	174	71	0	326	0	0	0
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2	xxxxx	xxxx	xxxxx
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3	xxxxx	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1076	xxxx	xxxxx	xxxx	xxxx	xxxxx	1722	xxxx	902	xxxx	xxxx	xxxxx
Potent Cap.:	656	xxxx	xxxxx	xxxx	xxxx	xxxxx	99	xxxx	339	xxxx	xxxx	xxxxx
Move Cap.:	656	xxxx	xxxxx	xxxx	xxxx	xxxxx	71	xxxx	339	xxxx	xxxx	xxxxx
Volume/Cap:	0.36	xxxx	xxxx	xxxx	xxxx	xxxx	0.99	xxxx	0.96	xxxx	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	1.6	xxxx	xxxxx	xxxx	xxxx	xxxxx	5.1	xxxx	10.3	xxxx	xxxx	xxxxx
Control Del:	13.6	xxxx	xxxxx	xxxxx	xxxx	xxxxx	202.6	xxxx	75.5	xxxxx	xxxx	xxxxx
LOS by Move:	B	*	*	*	*	*	F	*	F	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			98.1			xxxxxx		
ApproachLOS:	*			*			F			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalahoa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.456
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	116.5
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Mamalahoa Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0	0 1	0	1	0 0	1	0	0 0	0
Volume Module:												
Base Vol:	418	622	0	0	1208	199	64	0	258	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	418	622	0	0	1208	199	64	0	258	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	440	655	0	0	1272	209	67	0	272	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	440	655	0	0	1272	209	67	0	272	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	440	655	0	0	1272	209	67	0	272	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.23	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	392	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	1.12	0.39	0.00	0.00	0.75	0.14	0.04	0.00	0.19	0.00	0.00	0.00
Crit Moves:	****								****			
Green/Cycle:	0.76	0.76	0.00	0.00	0.56	0.56	0.14	0.00	0.14	0.00	0.00	0.00
Volume/Cap:	1.11	0.51	0.00	0.00	1.34	0.26	0.30	0.00	1.34	0.00	0.00	0.00
Uniform Del:	3.8	4.7	0.0	0.0	22.1	11.5	38.6	0.0	43.0	0.0	0.0	0.0
IncremntDel:	79.1	0.3	0.0	0.0	161	0.2	0.7	0.0	183.5	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	82.9	5.0	0.0	0.0	183	11.6	39.3	0.0	226.5	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	82.9	5.0	0.0	0.0	183	11.6	39.3	0.0	226.5	0.0	0.0	0.0
LOS by Move:	F	A	A	A	F	B	D	A	F	A	A	A
HCM2kAvgQ:	23	8	0	0	79	3	2	0	19	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.091
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	48.6
Optimal Cycle:	180	Level Of Service:	D

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2 0	1	1 0	2 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	878	603	208	1033	0	0	0	0	521	0	203
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	878	603	208	1033	0	0	0	0	521	0	203
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	924	635	219	1087	0	0	0	0	548	0	214
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	924	635	219	1087	0	0	0	0	548	0	214
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	924	635	219	1087	0	0	0	0	548	0	214
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.61	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1030	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.29	0.44	0.21	0.34	0.00	0.00	0.00	0.00	0.42	0.00	0.15
Crit Moves:			****	****						****		
Green/Cycle:	0.00	0.40	0.40	0.52	0.52	0.00	0.00	0.00	0.00	0.38	0.00	0.38
Volume/Cap:	0.00	0.72	1.10	0.76	0.65	0.00	0.00	0.00	0.00	1.10	0.00	0.39
Uniform Del:	0.0	25.4	30.1	17.6	17.3	0.0	0.0	0.0	0.0	31.0	0.0	22.6
IncremntDel:	0.0	2.0	69.6	10.8	0.9	0.0	0.0	0.0	0.0	72.2	0.0	0.5
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	27.4	99.7	28.3	18.2	0.0	0.0	0.0	0.0	103.2	0.0	23.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	27.4	99.7	28.3	18.2	0.0	0.0	0.0	0.0	103.2	0.0	23.0
LOS by Move:	A	C	F	C	B	A	A	A	A	F	A	C
HCM2kAvgQ:	0	14	31	7	13	0	0	0	0	27	0	5

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.779
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	19.6
Optimal Cycle:	67	Level Of Service:	B

Street Name:	Queen Kaahumanu Highway (SR-19)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2 0	1	1 0	2 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	333	247	628	1010	0	0	0	0	124	0	154
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	333	247	628	1010	0	0	0	0	124	0	154
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	351	260	661	1063	0	0	0	0	131	0	162
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	351	260	661	1063	0	0	0	0	131	0	162
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	351	260	661	1063	0	0	0	0	131	0	162
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.95	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1615	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.11	0.18	0.41	0.33	0.00	0.00	0.00	0.00	0.10	0.00	0.11
Crit Moves:			****	****								****
Green/Cycle:	0.00	0.23	0.23	0.76	0.76	0.00	0.00	0.00	0.00	0.14	0.00	0.14
Volume/Cap:	0.00	0.47	0.78	0.68	0.44	0.00	0.00	0.00	0.00	0.69	0.00	0.78
Uniform Del:	0.0	33.2	36.1	7.7	4.4	0.0	0.0	0.0	0.0	40.7	0.0	41.3
IncremntDel:	0.0	0.5	11.2	1.9	0.1	0.0	0.0	0.0	0.0	10.7	0.0	17.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	33.6	47.2	9.6	4.6	0.0	0.0	0.0	0.0	51.4	0.0	58.3
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	33.6	47.2	9.6	4.6	0.0	0.0	0.0	0.0	51.4	0.0	58.3
LOS by Move:	A	C	D	A	A	A	A	A	A	D	A	E
HCM2kAvgQ:	0	5	9	11	6	0	0	0	0	5	0	7

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Average Delay (sec/veh): 12.0 Worst Case Level Of Service: F[72.7]

Street Name:	Holoholo St						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	68	9	50	35	11	41	162	491	126	72	97	33
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	68	9	50	35	11	41	162	491	126	72	97	33
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	72	9	53	37	12	43	171	517	133	76	102	35
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	72	9	53	37	12	43	171	517	133	76	102	35
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1223	1213	583	1226	1262	119	137	xxxx	xxxxx	649	xxxx	xxxxx
Potent Cap.:	158	183	516	157	172	938	1460	xxxx	xxxxx	946	xxxx	xxxxx
Move Cap.:	119	146	516	113	137	938	1460	xxxx	xxxxx	946	xxxx	xxxxx
Volume/Cap:	0.60	0.06	0.10	0.33	0.08	0.05	0.12	xxxx	xxxx	0.08	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.4	xxxx	xxxxx	0.3	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	7.8	xxxx	xxxxx	9.1	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	A	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	174	xxxxx	xxxx	201	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	5.0	xxxxx	xxxxx	2.2	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	72.7	xxxxx	xxxxx	37.1	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	F	*	*	E	*	*	*	*	*	*	*
ApproachDel:	72.7			37.1			xxxxxx			xxxxxx		
ApproachLOS:	F			E			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #3 Mamalahoa/Kaiminani

Average Delay (sec/veh): 27.9 Worst Case Level Of Service: F[105.6]

Street Name:	Mamalahoa Hwy						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0 1	0 0		0 0 1	0 1		1 0 0	0 1		0 0 0	0 0	
Volume Module:												
Base Vol:	227	624	0	0	564	80	109	0	398	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	227	624	0	0	564	80	109	0	398	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	239	657	0	0	594	84	115	0	419	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	239	657	0	0	594	84	115	0	419	0	0	0
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2	xxxxx	xxxx	xxxxx
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3	xxxxx	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	678	xxxx	xxxxx	xxxx	xxxx	xxxxx	1728	xxxx	594	xxxx	xxxx	xxxxx
Potent Cap.:	924	xxxx	xxxxx	xxxx	xxxx	xxxxx	98	xxxx	509	xxxx	xxxx	xxxxx
Move Cap.:	924	xxxx	xxxxx	xxxx	xxxx	xxxxx	79	xxxx	509	xxxx	xxxx	xxxxx
Volume/Cap:	0.26	xxxx	xxxx	xxxx	xxxx	xxxx	1.46	xxxx	0.82	xxxx	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	1.0	xxxx	xxxxx	xxxx	xxxx	xxxxx	9.2	xxxx	8.1	xxxx	xxxx	xxxxx
Control Del:	10.3	xxxx	xxxxx	xxxxx	xxxx	xxxxx	355.4	xxxx	37.1	xxxxx	xxxx	xxxxx
LOS by Move:	B	*	*	*	*	*	F	*	E	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			105.6			xxxxxx		
ApproachLOS:	*			*			F			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalahoa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.487
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	192.5
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Mamalahoa Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0 0	1 0	1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	193	944	0	0	1100	66	187	0	790	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	193	944	0	0	1100	66	187	0	790	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	203	994	0	0	1158	69	197	0	832	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	203	994	0	0	1158	69	197	0	832	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	203	994	0	0	1158	69	197	0	832	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.22	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	373	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.54	0.58	0.00	0.00	0.68	0.05	0.12	0.00	0.58	0.00	0.00	0.00
Crit Moves:	****				****				****			
Green/Cycle:	0.53	0.53	0.00	0.00	0.44	0.44	0.37	0.00	0.37	0.00	0.00	0.00
Volume/Cap:	1.01	1.11	0.00	0.00	1.54	0.11	0.33	0.00	1.54	0.00	0.00	0.00
Uniform Del:	12.9	23.7	0.0	0.0	27.8	16.3	22.3	0.0	31.3	0.0	0.0	0.0
IncremntDel:	67.4	66.0	0.0	0.0	248	0.1	0.3	0.0	250.4	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	80.2	89.7	0.0	0.0	276	16.3	22.6	0.0	281.6	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	80.2	89.7	0.0	0.0	276	16.3	22.6	0.0	281.6	0.0	0.0	0.0
LOS by Move:	F	F	A	A	F	B	C	A	F	A	A	A
HCM2kAvgQ:	11	47	0	0	85	1	4	0	62	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.202
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	68.7
Optimal Cycle:	180	Level Of Service:	E

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0 2	0 1		1 0 2	0 0		0 0 0	0 0		1 0	0 0 1	
Volume Module:												
Base Vol:	0	903	709	246	854	0	0	0	0	541	0	285
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	903	709	246	854	0	0	0	0	541	0	285
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	951	746	259	899	0	0	0	0	569	0	300
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	951	746	259	899	0	0	0	0	569	0	300
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	951	746	259	899	0	0	0	0	569	0	300
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.45	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	768	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.29	0.52	0.34	0.28	0.00	0.00	0.00	0.00	0.44	0.00	0.21
Crit Moves:			****	****						****		
Green/Cycle:	0.00	0.42	0.42	0.55	0.55	0.00	0.00	0.00	0.00	0.35	0.00	0.35
Volume/Cap:	0.00	0.70	1.24	0.84	0.51	0.00	0.00	0.00	0.00	1.24	0.00	0.59
Uniform Del:	0.0	24.0	29.1	19.0	14.2	0.0	0.0	0.0	0.0	32.4	0.0	26.5
IncremntDel:	0.0	1.7	120.0	17.9	0.2	0.0	0.0	0.0	0.0	123.8	0.0	1.8
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	25.7	149.1	36.8	14.4	0.0	0.0	0.0	0.0	156.2	0.0	28.3
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	25.7	149.1	36.8	14.4	0.0	0.0	0.0	0.0	156.2	0.0	28.3
LOS by Move:	A	C	F	D	B	A	A	A	A	F	A	C
HCM2kAvgQ:	0	14	43	9	9	0	0	0	0	33	0	8

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.612
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	20.0
Optimal Cycle:	44	Level Of Service:	B

Street Name:	Holoholo St						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0	0	1! 0	0	0	1! 0	0	0	1! 0	0	0	1! 0
Volume Module:												
Base Vol:	127	10	74	33	10	184	62	149	39	26	478	17
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	127	10	74	33	10	184	62	149	39	26	478	17
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	134	11	78	35	11	194	65	157	41	27	503	18
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	134	11	78	35	11	194	65	157	41	27	503	18
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	134	11	78	35	11	194	65	157	41	27	503	18
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.60	0.60	0.60	0.83	0.83	0.83	0.78	0.78	0.78	0.97	0.97	0.97
Lanes:	0.60	0.05	0.35	0.15	0.04	0.81	0.25	0.60	0.15	0.05	0.92	0.03
Final Sat.:	611	48	356	205	62	1144	331	795	208	82	1516	54
Capacity Analysis Module:												
Vol/Sat:	0.22	0.22	0.22	0.17	0.17	0.17	0.20	0.20	0.20	0.33	0.33	0.33
Crit Moves:		****									****	
Green/Cycle:	0.36	0.36	0.36	0.36	0.36	0.36	0.54	0.54	0.54	0.54	0.54	0.54
Volume/Cap:	0.61	0.61	0.61	0.47	0.47	0.47	0.36	0.36	0.36	0.61	0.61	0.61
Uniform Del:	26.4	26.4	26.4	24.8	24.8	24.8	13.0	13.0	13.0	15.7	15.7	15.7
IncremntDel:	3.1	3.1	3.1	0.7	0.7	0.7	0.3	0.3	0.3	1.3	1.3	1.3
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	29.5	29.5	29.5	25.6	25.6	25.6	13.3	13.3	13.3	16.9	16.9	16.9
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	29.5	29.5	29.5	25.6	25.6	25.6	13.3	13.3	13.3	16.9	16.9	16.9
LOS by Move:	C	C	C	C	C	C	B	B	B	B	B	B
HCM2kAvgQ:	7	7	7	6	6	6	5	5	5	12	12	12

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #3 Mamalahoa/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.841
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	21.4
Optimal Cycle:	82	Level Of Service:	C

Street Name:	Mamalahoa Hwy						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0	0 1	0	1	0	0 1	0	0 0	0 0 0
Volume Module:												
Base Vol:	225	329	0	0	857	165	67	0	310	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	225	329	0	0	857	165	67	0	310	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	237	346	0	0	902	174	71	0	326	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	237	346	0	0	902	174	71	0	326	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	237	346	0	0	902	174	71	0	326	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.95	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	1615	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.15	0.20	0.00	0.00	0.53	0.12	0.04	0.00	0.23	0.00	0.00	0.00
Crit Moves:	****				****				****			
Green/Cycle:	0.81	0.81	0.00	0.00	0.63	0.63	0.09	0.00	0.27	0.00	0.00	0.00
Volume/Cap:	0.55	0.25	0.00	0.00	0.84	0.19	0.46	0.00	0.84	0.00	0.00	0.00
Uniform Del:	14.5	2.4	0.0	0.0	14.5	7.7	42.9	0.0	34.5	0.0	0.0	0.0
IncremntDel:	1.6	0.1	0.0	0.0	6.1	0.1	2.2	0.0	15.0	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	16.1	2.5	0.0	0.0	20.5	7.8	45.1	0.0	49.6	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	16.1	2.5	0.0	0.0	20.5	7.8	45.1	0.0	49.6	0.0	0.0	0.0
LOS by Move:	B	A	A	A	C	A	D	A	D	A	A	A
HCM2kAvgQ:	3	3	0	0	24	2	3	0	12	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalahoa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.023
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	49.5
Optimal Cycle:	180	Level Of Service:	D

Street Name:	Mamalahoa Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0	0 1	1 0	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	418	622	0	0	1208	199	64	0	258	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	418	622	0	0	1208	199	64	0	258	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	440	655	0	0	1272	209	67	0	272	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	440	655	0	0	1272	209	67	0	272	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	440	655	0	0	1272	209	67	0	272	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.73	1.00	1.00	1.00	0.93	0.93	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.72	0.28	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	1240	1700	0	0	2715	447	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.35	0.39	0.00	0.00	0.47	0.47	0.04	0.00	0.19	0.00	0.00	0.00
Crit Moves:	****				****				****			
Green/Cycle:	0.72	0.72	0.00	0.00	0.45	0.45	0.18	0.00	0.18	0.00	0.00	0.00
Volume/Cap:	0.89	0.54	0.00	0.00	1.03	1.03	0.23	0.00	1.03	0.00	0.00	0.00
Uniform Del:	28.5	6.5	0.0	0.0	27.3	27.3	34.9	0.0	40.9	0.0	0.0	0.0
IncremntDel:	17.8	0.5	0.0	0.0	32.4	32.4	0.4	0.0	64.0	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	46.3	6.9	0.0	0.0	59.7	59.7	35.3	0.0	104.9	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	46.3	6.9	0.0	0.0	59.7	59.7	35.3	0.0	104.9	0.0	0.0	0.0
LOS by Move:	D	A	A	A	E	E	D	A	F	A	A	A
HCM2kAvgQ:	14	9	0	0	33	33	2	0	14	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.846
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	25.1
Optimal Cycle:	84	Level Of Service:	C

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Split Phase			Split Phase		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2	0 1	1 0	2	0 0	0 0	0	0 0	1 0	0	0 1
Volume Module:												
Base Vol:	0	878	603	208	1033	0	0	0	0	521	0	203
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	878	603	208	1033	0	0	0	0	521	0	203
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	924	635	219	1087	0	0	0	0	548	0	214
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	924	635	219	1087	0	0	0	0	548	0	214
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	924	635	219	1087	0	0	0	0	548	0	214
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.95	0.95	1.00	1.00	1.00	1.00	0.95	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1615	3230	0	0	0	0	1615	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.29	0.44	0.14	0.34	0.00	0.00	0.00	0.00	0.34	0.00	0.15
Crit Moves:		****		****						****		
Green/Cycle:	0.00	0.34	0.74	0.50	0.50	0.00	0.00	0.00	0.00	0.40	0.00	0.40
Volume/Cap:	0.00	0.85	0.59	0.67	0.68	0.00	0.00	0.00	0.00	0.85	0.00	0.37
Uniform Del:	0.0	30.7	6.0	20.4	19.0	0.0	0.0	0.0	0.0	27.1	0.0	21.0
IncremntDel:	0.0	6.2	0.9	5.3	1.2	0.0	0.0	0.0	0.0	10.0	0.0	0.4
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	36.9	6.9	25.7	20.1	0.0	0.0	0.0	0.0	37.2	0.0	21.4
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	36.9	6.9	25.7	20.1	0.0	0.0	0.0	0.0	37.2	0.0	21.4
LOS by Move:	A	D	A	C	C	A	A	A	A	D	A	C
HCM2kAvgQ:	0	17	10	6	14	0	0	0	0	18	0	5

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.745
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	15.9
Optimal Cycle:	61	Level Of Service:	B

Street Name:	Holoholo St						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0	0 1!	0	0	0 1!	0	0	0 1!	0	0	0 1!	0
Volume Module:												
Base Vol:	68	9	50	35	11	41	162	491	126	72	97	33
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	68	9	50	35	11	41	162	491	126	72	97	33
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	72	9	53	37	12	43	171	517	133	76	102	35
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	72	9	53	37	12	43	171	517	133	76	102	35
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	72	9	53	37	12	43	171	517	133	76	102	35
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.74	0.74	0.74	0.77	0.77	0.77	0.85	0.85	0.85	0.63	0.63	0.63
Lanes:	0.54	0.07	0.39	0.40	0.13	0.47	0.21	0.63	0.16	0.36	0.48	0.16
Final Sat.:	672	89	494	528	166	619	302	916	235	384	517	176
Capacity Analysis Module:												
Vol/Sat:	0.11	0.11	0.11	0.07	0.07	0.07	0.56	0.56	0.56	0.20	0.20	0.20
Crit Moves:		****						****				
Green/Cycle:	0.14	0.14	0.14	0.14	0.14	0.14	0.76	0.76	0.76	0.76	0.76	0.76
Volume/Cap:	0.75	0.75	0.75	0.49	0.49	0.49	0.75	0.75	0.75	0.26	0.26	0.26
Uniform Del:	41.1	41.1	41.1	39.5	39.5	39.5	6.8	6.8	6.8	3.7	3.7	3.7
IncremntDel:	15.6	15.6	15.6	2.0	2.0	2.0	2.8	2.8	2.8	0.2	0.2	0.2
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	56.7	56.7	56.7	41.5	41.5	41.5	9.6	9.6	9.6	3.8	3.8	3.8
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	56.7	56.7	56.7	41.5	41.5	41.5	9.6	9.6	9.6	3.8	3.8	3.8
LOS by Move:	E	E	E	D	D	D	A	A	A	A	A	A
HCM2kAvgQ:	6	6	6	3	3	3	15	15	15	2	2	2

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #3 Mamalahoa/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.710
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	18.2
Optimal Cycle:	55	Level Of Service:	B

Street Name:	Mamalahoa Hwy						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0 0	1 0	1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	227	624	0	0	564	80	109	0	398	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	227	624	0	0	564	80	109	0	398	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	239	657	0	0	594	84	115	0	419	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	239	657	0	0	594	84	115	0	419	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	239	657	0	0	594	84	115	0	419	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.95	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	1615	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.15	0.39	0.00	0.00	0.35	0.06	0.07	0.00	0.29	0.00	0.00	0.00
Crit Moves:	****				****				****			
Green/Cycle:	0.70	0.70	0.00	0.00	0.49	0.49	0.20	0.00	0.41	0.00	0.00	0.00
Volume/Cap:	0.46	0.55	0.00	0.00	0.71	0.12	0.36	0.00	0.71	0.00	0.00	0.00
Uniform Del:	9.9	7.3	0.0	0.0	19.8	13.7	34.5	0.0	24.7	0.0	0.0	0.0
IncremntDel:	0.7	0.6	0.0	0.0	2.9	0.1	0.7	0.0	4.0	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	10.6	7.9	0.0	0.0	22.7	13.8	35.1	0.0	28.7	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	10.6	7.9	0.0	0.0	22.7	13.8	35.1	0.0	28.7	0.0	0.0	0.0
LOS by Move:	B	A	A	A	C	B	D	A	C	A	A	A
HCM2kAvgQ:	4	10	0	0	15	1	3	0	12	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalahoa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.289
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	128.0
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Mamalahoa Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0	0	1 1 0	1 0	0	0 1	0	0	0 0 0
Volume Module:												
Base Vol:	193	944	0	0	1100	66	187	0	790	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	193	944	0	0	1100	66	187	0	790	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	203	994	0	0	1158	69	197	0	832	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	203	994	0	0	1158	69	197	0	832	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	203	994	0	0	1158	69	197	0	832	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.53	1.00	1.00	1.00	0.94	0.94	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.89	0.11	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	908	1700	0	0	3020	181	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.22	0.58	0.00	0.00	0.38	0.38	0.12	0.00	0.58	0.00	0.00	0.00
Crit Moves:		****							****			
Green/Cycle:	0.45	0.45	0.00	0.00	0.34	0.34	0.45	0.00	0.45	0.00	0.00	0.00
Volume/Cap:	0.82	1.29	0.00	0.00	1.12	1.12	0.27	0.00	1.29	0.00	0.00	0.00
Uniform Del:	22.4	27.3	0.0	0.0	32.9	32.9	17.4	0.0	27.7	0.0	0.0	0.0
IncremntDel:	18.5	140	0.0	0.0	67.6	67.6	0.2	0.0	141.4	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	40.9	167	0.0	0.0	101	100.5	17.7	0.0	169.1	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	40.9	167	0.0	0.0	101	100.5	17.7	0.0	169.1	0.0	0.0	0.0
LOS by Move:	D	F	A	A	F	F	B	A	F	A	A	A
HCM2kAvgQ:	8	59	0	0	32	32	4	0	50	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.897
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	27.8
Optimal Cycle:	104	Level Of Service:	C

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Split Phase			Split Phase		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2	0 1	1 0	2	0 0	0 0	0	0 0	1 0	0	0 1
Volume Module:												
Base Vol:	0	903	709	246	854	0	0	0	0	541	0	285
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	903	709	246	854	0	0	0	0	541	0	285
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	951	746	259	899	0	0	0	0	569	0	300
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	951	746	259	899	0	0	0	0	569	0	300
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	951	746	259	899	0	0	0	0	569	0	300
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.95	0.95	1.00	1.00	1.00	1.00	0.95	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1615	3230	0	0	0	0	1615	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.29	0.52	0.16	0.28	0.00	0.00	0.00	0.00	0.35	0.00	0.21
Crit Moves:		****		****						****		
Green/Cycle:	0.00	0.33	0.72	0.51	0.51	0.00	0.00	0.00	0.00	0.39	0.00	0.39
Volume/Cap:	0.00	0.90	0.72	0.73	0.55	0.00	0.00	0.00	0.00	0.90	0.00	0.53
Uniform Del:	0.0	32.0	8.0	22.8	16.8	0.0	0.0	0.0	0.0	28.4	0.0	23.2
IncremntDel:	0.0	10.1	2.4	7.3	0.4	0.0	0.0	0.0	0.0	15.5	0.0	0.9
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	42.1	10.4	30.1	17.2	0.0	0.0	0.0	0.0	43.9	0.0	24.2
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	42.1	10.4	30.1	17.2	0.0	0.0	0.0	0.0	43.9	0.0	24.2
LOS by Move:	A	D	B	C	B	A	A	A	A	D	A	C
HCM2kAvgQ:	0	18	14	8	10	0	0	0	0	20	0	7

Note: Queue reported is the number of cars per lane.

APPENDIX H

ALTERNATIVE FUTURE SCENARIO II LEVEL OF SERVICE WORKSHEETS

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Haahumanu/Kaiminani

Cycle (sec):	65	Critical Vol./Cap.(X):	0.864
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	22.4
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Street Name:	Queen Haahumanu Highway (SR-19)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2 0	1	1 0	2 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	1110	126	68	552	0	0	0	0	404	0	428
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	1110	126	68	552	0	0	0	0	404	0	428
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	1168	133	72	581	0	0	0	0	425	0	451
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	1168	133	72	581	0	0	0	0	425	0	451
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	1168	133	72	581	0	0	0	0	425	0	451
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.95	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1615	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.36	0.09	0.04	0.18	0.00	0.00	0.00	0.00	0.33	0.00	0.31
Crit Moves:		****		****						****		
Green/Cycle:	0.00	0.42	0.42	0.47	0.47	0.00	0.00	0.00	0.00	0.38	0.00	0.38
Volume/Cap:	0.00	0.86	0.22	0.38	0.38	0.00	0.00	0.00	0.00	0.86	0.00	0.83
Uniform Del:	0.0	17.2	12.1	12.8	11.1	0.0	0.0	0.0	0.0	18.7	0.0	18.4
IncremntDel:	0.0	6.0	0.2	1.3	0.2	0.0	0.0	0.0	0.0	14.7	0.0	10.2
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	23.3	12.3	14.1	11.3	0.0	0.0	0.0	0.0	33.4	0.0	28.6
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	23.3	12.3	14.1	11.3	0.0	0.0	0.0	0.0	33.4	0.0	28.6
LOS by Move:	A	C	B	B	B	A	A	A	A	C	A	C
HCM2kAvgQ:	0	15	2	1	4	0	0	0	0	11	0	11

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Average Delay (sec/veh): 6.1 Worst Case Level Of Service: C[22.3]

Street Name:	Holoholo Street						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	36	4	16	39	8	180	36	138	8	7	425	26
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	36	4	16	39	8	180	36	138	8	7	425	26
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	38	4	17	41	8	189	38	145	8	7	447	27
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	38	4	17	41	8	189	38	145	8	7	447	27
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	800	715	149	712	705	461	475	xxxx	xxxxx	154	xxxx	xxxxx
Potent Cap.:	306	359	902	350	363	605	1098	xxxx	xxxxx	1439	xxxx	xxxxx
Move Cap.:	200	344	902	330	349	605	1098	xxxx	xxxxx	1439	xxxx	xxxxx
Volume/Cap:	0.19	0.01	0.02	0.12	0.02	0.31	0.03	xxxx	xxxx	0.01	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.1	xxxx	xxxxx	0.0	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	8.4	xxxx	xxxxx	7.5	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	A	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	267	xxxxx	xxxx	517	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	0.8	xxxxx	xxxxx	2.4	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	22.3	xxxxx	xxxxx	17.8	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	C	*	*	C	*	*	*	*	*	*	*
ApproachDel:	22.3			17.8			xxxxxx			xxxxxx		
ApproachLOS:	C			C			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #3 Mamalaho/Kaiminani

Average Delay (sec/veh): 13.3 Worst Case Level Of Service: F[72.2]

Street Name:	Mamalaho Highway (SR-190)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0 1	0	0	0	0 1	0 1	1 0	0	1	0	0 0	0 0
Volume Module:												
Base Vol:	229	424	0	0	865	151	41	0	282	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	229	424	0	0	865	151	41	0	282	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	241	446	0	0	911	159	43	0	297	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	241	446	0	0	911	159	43	0	297	0	0	0
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2	xxxxx	xxxx	xxxxx
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3	xxxxx	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1069	xxxx	xxxxx	xxxx	xxxx	xxxxx	1839	xxxx	911	xxxx	xxxx	xxxxx
Potent Cap.:	659	xxxx	xxxxx	xxxx	xxxx	xxxxx	84	xxxx	335	xxxx	xxxx	xxxxx
Move Cap.:	659	xxxx	xxxxx	xxxx	xxxx	xxxxx	60	xxxx	335	xxxx	xxxx	xxxxx
Volume/Cap:	0.37	xxxx	xxxx	xxxx	xxxx	xxxx	0.72	xxxx	0.89	xxxx	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	1.7	xxxx	xxxxx	xxxx	xxxx	xxxxx	3.1	xxxx	8.4	xxxx	xxxx	xxxxx
Control Del:	13.6	xxxx	xxxxx	xxxxx	xxxx	xxxxx	154.3	xxxx	60.2	xxxxx	xxxx	xxxxx
LOS by Move:	B	*	*	*	*	*	F	*	F	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			72.2			xxxxxx		
ApproachLOS:	*			*			F			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalaho/Hina Lani

Cycle (sec):	125	Critical Vol./Cap.(X):	1.611
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	109.6
Optimal Cycle:	OPTIMIZED	Level Of Service:	F

Street Name:	Mamalaho Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0	0 1	0	1	0 0	1	0	0 0	0
Volume Module:												
Base Vol:	453	596	0	0	1028	255	219	0	363	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	453	596	0	0	1028	255	219	0	363	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	477	627	0	0	1082	268	231	0	382	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	477	627	0	0	1082	268	231	0	382	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	477	627	0	0	1082	268	231	0	382	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.23	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	392	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	1.22	0.37	0.00	0.00	0.64	0.19	0.14	0.00	0.26	0.00	0.00	0.00
Crit Moves:	****								****			
Green/Cycle:	0.72	0.72	0.00	0.00	0.49	0.49	0.20	0.00	0.20	0.00	0.00	0.00
Volume/Cap:	1.13	0.51	0.00	0.00	1.30	0.38	0.70	0.00	1.30	0.00	0.00	0.00
Uniform Del:	6.8	8.0	0.0	0.0	31.9	20.0	46.3	0.0	49.8	0.0	0.0	0.0
IncremntDel:	85.1	0.4	0.0	0.0	144	0.3	6.7	0.0	157.8	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	91.9	8.3	0.0	0.0	176	20.3	52.9	0.0	207.6	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	91.9	8.3	0.0	0.0	176	20.3	52.9	0.0	207.6	0.0	0.0	0.0
LOS by Move:	F	A	A	A	F	C	D	A	F	A	A	A
HCM2kAvgQ:	29	11	0	0	73	6	9	0	28	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #5 Holoholo/Hina Lani

Average Delay (sec/veh): 191.1 Worst Case Level Of Service: F[1053.9]

Street Name:	Holoholo Street						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	105	7	66	111	9	172	56	327	35	22	844	39
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	105	7	66	111	9	172	56	327	35	22	844	39
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	111	7	69	117	9	181	59	344	37	23	888	41
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	111	7	69	117	9	181	59	344	37	23	888	41
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1531	1456	363	1474	1454	909	929	xxxx	xxxxx	381	xxxx	xxxxx
Potent Cap.:	97	131	687	106	131	336	744	xxxx	xxxxx	1188	xxxx	xxxxx
Move Cap.:	39	118	687	84	118	336	744	xxxx	xxxxx	1188	xxxx	xxxxx
Volume/Cap:	2.86	0.06	0.10	1.40	0.08	0.54	0.08	xxxx	xxxx	0.02	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.3	xxxx	xxxxx	0.1	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	10.3	xxxx	xxxxx	8.1	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	B	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	62	xxxxx	xxxx	152	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	19.3	xxxxx	xxxxx	24.1	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	1054	xxxxx	xxxxx	529	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	F	*	*	F	*	*	*	*	*	*	*
ApproachDel:	1053.9			528.6			xxxxxx			xxxxxx		
ApproachLOS:	F			F			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	130	Critical Vol./Cap.(X):	1.181
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	74.0
Optimal Cycle:	OPTIMIZED	Level Of Service:	E

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2 0	1	1 0	2 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	850	622	286	970	0	0	0	0	601	0	444
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	850	622	286	970	0	0	0	0	601	0	444
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	895	655	301	1021	0	0	0	0	633	0	467
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	895	655	301	1021	0	0	0	0	633	0	467
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	895	655	301	1021	0	0	0	0	633	0	467
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.44	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	751	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.28	0.45	0.40	0.32	0.00	0.00	0.00	0.00	0.48	0.00	0.32
Crit Moves:			****	****						****		
Green/Cycle:	0.00	0.37	0.37	0.53	0.53	0.00	0.00	0.00	0.00	0.40	0.00	0.40
Volume/Cap:	0.00	0.74	1.22	0.92	0.60	0.00	0.00	0.00	0.00	1.22	0.00	0.81
Uniform Del:	0.0	35.4	40.8	32.4	21.4	0.0	0.0	0.0	0.0	39.2	0.0	34.9
IncremntDel:	0.0	2.6	113.8	29.5	0.6	0.0	0.0	0.0	0.0	114.3	0.0	8.7
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	38.0	154.6	62.0	22.0	0.0	0.0	0.0	0.0	153.4	0.0	43.5
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	38.0	154.6	62.0	22.0	0.0	0.0	0.0	0.0	153.4	0.0	43.5
LOS by Move:	A	D	F	E	C	A	A	A	A	F	A	D
HCM2kAvgQ:	0	17	43	15	15	0	0	0	0	41	0	18

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Haahumanu/Kaiminani

Cycle (sec):	65	Critical Vol./Cap.(X):	0.676
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	12.7
Optimal Cycle: OPTIMIZED		Level Of Service:	B

Street Name:	Queen Haahumanu Highway (SR-19)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2	0 1	1 0	2	0 0	0 0	0	0 0 0	1 0	0	0 1
Volume Module:												
Base Vol:	0	422	223	493	1117	0	0	0	0	110	0	103
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	422	223	493	1117	0	0	0	0	110	0	103
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	444	235	519	1176	0	0	0	0	116	0	108
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	444	235	519	1176	0	0	0	0	116	0	108
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	444	235	519	1176	0	0	0	0	116	0	108
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.95	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1615	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.14	0.16	0.32	0.36	0.00	0.00	0.00	0.00	0.09	0.00	0.08
Crit Moves:			****	****						****		
Green/Cycle:	0.00	0.24	0.24	0.72	0.72	0.00	0.00	0.00	0.00	0.13	0.00	0.13
Volume/Cap:	0.00	0.57	0.68	0.59	0.51	0.00	0.00	0.00	0.00	0.68	0.00	0.57
Uniform Del:	0.0	21.8	22.4	5.9	4.1	0.0	0.0	0.0	0.0	26.9	0.0	26.5
IncremntDel:	0.0	1.0	5.3	1.1	0.2	0.0	0.0	0.0	0.0	10.3	0.0	4.2
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	22.8	27.7	7.0	4.3	0.0	0.0	0.0	0.0	37.2	0.0	30.7
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	22.8	27.7	7.0	4.3	0.0	0.0	0.0	0.0	37.2	0.0	30.7
LOS by Move:	A	C	C	A	A	A	A	A	A	D	A	C
HCM2kAvgQ:	0	5	6	6	6	0	0	0	0	4	0	3

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Average Delay (sec/veh): 4.1 Worst Case Level Of Service: C[20.6]

Street Name:	Holoholo Street						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0	1! 0	0	0 0	1! 0	0	0 0	1! 0	0	0 0	1! 0	0
Volume Module:												
Base Vol:	7	6	12	52	7	35	136	428	23	7	85	43
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	7	6	12	52	7	35	136	428	23	7	85	43
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	7	6	13	55	7	37	143	451	24	7	89	45
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	7	6	13	55	7	37	143	451	24	7	89	45
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	898	898	463	885	888	112	135	xxxx	xxxxx	475	xxxx	xxxxx
Potent Cap.:	262	281	603	268	285	946	1462	xxxx	xxxxx	1098	xxxx	xxxxx
Move Cap.:	225	249	603	235	253	946	1462	xxxx	xxxxx	1098	xxxx	xxxxx
Volume/Cap:	0.03	0.03	0.02	0.23	0.03	0.04	0.10	xxxx	xxxx	0.01	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.3	xxxx	xxxxx	0.0	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	7.7	xxxx	xxxxx	8.3	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	A	*	*	A	*	*
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT
Shared Cap.:	xxxx	333	xxxxx	xxxx	329	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	0.3	xxxxx	xxxxx	1.2	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	16.7	xxxxx	xxxxx	20.6	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	C	*	*	C	*	*	*	*	*	*	*
ApproachDel:		16.7			20.6			xxxxxx			xxxxxx	
ApproachLOS:		C			C			*			*	

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #3 Mamalaho/Kaiminani

Average Delay (sec/veh): 18.9 Worst Case Level Of Service: F[73.8]

Street Name:	Mamalaho Highway (SR-190)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0 1	0 0		0 0 1	0 1		1 0 0	0 1		0 0	0 0 0	
Volume Module:												
Base Vol:	202	627	0	0	615	45	80	0	397	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	202	627	0	0	615	45	80	0	397	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	213	660	0	0	647	47	84	0	418	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	213	660	0	0	647	47	84	0	418	0	0	0
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2	xxxxx	xxxx	xxxxx
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3	xxxxx	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	695	xxxx	xxxxx	xxxx	xxxx	xxxxx	1733	xxxx	647	xxxx	xxxx	xxxxx
Potent Cap.:	910	xxxx	xxxxx	xxxx	xxxx	xxxxx	98	xxxx	474	xxxx	xxxx	xxxxx
Move Cap.:	910	xxxx	xxxxx	xxxx	xxxx	xxxxx	80	xxxx	474	xxxx	xxxx	xxxxx
Volume/Cap:	0.23	xxxx	xxxx	xxxx	xxxx	xxxx	1.05	xxxx	0.88	xxxx	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	0.9	xxxx	xxxxx	xxxx	xxxx	xxxxx	5.9	xxxx	9.5	xxxx	xxxx	xxxxx
Control Del:	10.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	207.5	xxxx	46.9	xxxxx	xxxx	xxxxx
LOS by Move:	B	*	*	*	*	*	F	*	E	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			73.8			xxxxxx		
ApproachLOS:	*			*			F			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalaho/Hina Lani

Cycle (sec):	125	Critical Vol./Cap.(X):	1.789
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	183.8
Optimal Cycle:	OPTIMIZED	Level Of Service:	F

Street Name:	Mamalaho Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0 0	1 0	1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	329	791	0	0	998	254	307	0	828	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	329	791	0	0	998	254	307	0	828	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	346	833	0	0	1051	267	323	0	872	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	346	833	0	0	1051	267	323	0	872	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	346	833	0	0	1051	267	323	0	872	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.20	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	332	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	1.04	0.49	0.00	0.00	0.62	0.19	0.20	0.00	0.60	0.00	0.00	0.00
Crit Moves:	****								****			
Green/Cycle:	0.53	0.53	0.00	0.00	0.40	0.40	0.39	0.00	0.39	0.00	0.00	0.00
Volume/Cap:	1.25	0.92	0.00	0.00	1.56	0.47	0.52	0.00	1.56	0.00	0.00	0.00
Uniform Del:	16.4	26.7	0.0	0.0	37.7	28.0	29.4	0.0	38.3	0.0	0.0	0.0
IncremntDel:	140.2	14.0	0.0	0.0	259	0.6	0.8	0.0	260.9	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	156.6	40.7	0.0	0.0	297	28.6	30.2	0.0	299.2	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	156.6	40.7	0.0	0.0	297	28.6	30.2	0.0	299.2	0.0	0.0	0.0
LOS by Move:	F	D	A	A	F	C	C	A	F	A	A	A
HCM2kAvgQ:	24	33	0	0	86	8	10	0	72	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #5 Holoholo/Hina Lani

Average Delay (sec/veh): 346.8 Worst Case Level Of Service: F[2032.2]

Street Name:	Holoholo Street						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	70	20	44	84	19	117	195	593	118	75	545	133
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	70	20	44	84	19	117	195	593	118	75	545	133
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	74	21	46	88	20	123	205	624	124	79	574	140
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	74	21	46	88	20	123	205	624	124	79	574	140
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1970	1968	686	1932	1961	644	714	xxxx	xxxxx	748	xxxx	xxxxx
Potent Cap.:	47	63	451	50	64	477	896	xxxx	xxxxx	869	xxxx	xxxxx
Move Cap.:	17	43	451	21	43	477	896	xxxx	xxxxx	869	xxxx	xxxxx
Volume/Cap:	4.31	0.49	0.10	4.17	0.46	0.26	0.23	xxxx	xxxx	0.09	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.9	xxxx	xxxxx	0.3	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	10.2	xxxx	xxxxx	9.6	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	B	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	29	xxxxx	xxxx	47	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	17.1	xxxxx	xxxxx	26.3	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	2032	xxxxx	xxxxx	1923	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	F	*	*	F	*	*	*	*	*	*	*
ApproachDel:	2032.2			1923.5			xxxxxx			xxxxxx		
ApproachLOS:	F			F			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	130	Critical Vol./Cap.(X):	1.454
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	126.6
Optimal Cycle:	OPTIMIZED	Level Of Service:	F

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2 0	1	1 0	2 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	787	750	515	796	0	0	0	0	580	0	442
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	787	750	515	796	0	0	0	0	580	0	442
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	828	789	542	838	0	0	0	0	611	0	465
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	828	789	542	838	0	0	0	0	611	0	465
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	828	789	542	838	0	0	0	0	611	0	465
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.36	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	620	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.26	0.55	0.87	0.26	0.00	0.00	0.00	0.00	0.47	0.00	0.32
Crit Moves:				****						****		
Green/Cycle:	0.00	0.37	0.37	0.60	0.60	0.00	0.00	0.00	0.00	0.32	0.00	0.32
Volume/Cap:	0.00	0.69	1.46	1.15	0.43	0.00	0.00	0.00	0.00	1.46	0.00	1.01
Uniform Del:	0.0	34.3	40.7	33.7	13.8	0.0	0.0	0.0	0.0	44.2	0.0	44.2
IncremntDel:	0.0	1.7	217.7	90.8	0.2	0.0	0.0	0.0	0.0	220.5	0.0	43.8
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	35.9	258.4	124.5	13.9	0.0	0.0	0.0	0.0	264.7	0.0	88.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	35.9	258.4	124.5	13.9	0.0	0.0	0.0	0.0	264.7	0.0	88.0
LOS by Move:	A	D	F	F	B	A	A	A	A	F	A	F
HCM2kAvgQ:	0	15	63	33	9	0	0	0	0	49	0	25

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Haahumanu/Kaiminani

Cycle (sec):	65	Critical Vol./Cap.(X):	0.882
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	23.4
Optimal Cycle: OPTIMIZED		Level Of Service:	C

Street Name:	Queen Haahumanu Highway (SR-19)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0 2	0 1		1 0 2	0 0		0 0 0	0 0		1 0	0 0 1	
Volume Module:												
Base Vol:	0	1156	126	68	567	0	0	0	0	404	0	428
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	1156	126	68	567	0	0	0	0	404	0	428
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	1217	133	72	597	0	0	0	0	425	0	451
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	1217	133	72	597	0	0	0	0	425	0	451
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	1217	133	72	597	0	0	0	0	425	0	451
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.95	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1615	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.38	0.09	0.04	0.18	0.00	0.00	0.00	0.00	0.33	0.00	0.31
Crit Moves:		****		****						****		
Green/Cycle:	0.00	0.43	0.43	0.48	0.48	0.00	0.00	0.00	0.00	0.37	0.00	0.37
Volume/Cap:	0.00	0.88	0.21	0.39	0.39	0.00	0.00	0.00	0.00	0.88	0.00	0.85
Uniform Del:	0.0	17.1	11.7	12.8	10.9	0.0	0.0	0.0	0.0	19.2	0.0	18.8
IncremntDel:	0.0	7.0	0.2	1.3	0.2	0.0	0.0	0.0	0.0	17.1	0.0	11.9
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	24.1	11.9	14.1	11.1	0.0	0.0	0.0	0.0	36.3	0.0	30.7
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	24.1	11.9	14.1	11.1	0.0	0.0	0.0	0.0	36.3	0.0	30.7
LOS by Move:	A	C	B	B	B	A	A	A	A	D	A	C
HCM2kAvgQ:	0	16	2	1	4	0	0	0	0	12	0	11

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Average Delay (sec/veh): 6.1 Worst Case Level Of Service: C[22.3]

Street Name:	Holoholo Street						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0	1! 0	0	0 0	1! 0	0	0 0	1! 0	0	0 0	1! 0	0
Volume Module:												
Base Vol:	36	4	16	40	8	180	36	138	8	7	425	29
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	36	4	16	40	8	180	36	138	8	7	425	29
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	38	4	17	42	8	189	38	145	8	7	447	31
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	38	4	17	42	8	189	38	145	8	7	447	31
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	802	718	149	713	707	463	478	xxxx	xxxxx	154	xxxx	xxxxx
Potent Cap.:	305	357	902	349	363	603	1095	xxxx	xxxxx	1439	xxxx	xxxxx
Move Cap.:	199	343	902	329	348	603	1095	xxxx	xxxxx	1439	xxxx	xxxxx
Volume/Cap:	0.19	0.01	0.02	0.13	0.02	0.31	0.03	xxxx	xxxx	0.01	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.1	xxxx	xxxxx	0.0	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	8.4	xxxx	xxxxx	7.5	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	A	*	*	A	*	*
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT
Shared Cap.:	xxxx	266	xxxxx	xxxx	515	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	0.8	xxxxx	xxxxx	2.4	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	22.3	xxxxx	xxxxx	17.9	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	C	*	*	C	*	*	*	*	*	*	*
ApproachDel:		22.3			17.9			xxxxxx			xxxxxx	
ApproachLOS:		C			C			*			*	

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #3 Mamalaho/Kaiminani

Average Delay (sec/veh): 13.9 Worst Case Level Of Service: F[77.0]

Street Name:	Mamalaho Highway (SR-190)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0 1	0	0	0 0 1	0	1	1 0 0	0	1	0 0 0	0	0
Volume Module:												
Base Vol:	232	447	0	0	873	151	41	0	283	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	232	447	0	0	873	151	41	0	283	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	244	471	0	0	919	159	43	0	298	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	244	471	0	0	919	159	43	0	298	0	0	0
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2	xxxxx	xxxx	xxxxx
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3	xxxxx	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1078	xxxx	xxxxx	xxxx	xxxx	xxxxx	1878	xxxx	919	xxxx	xxxx	xxxxx
Potent Cap.:	655	xxxx	xxxxx	xxxx	xxxx	xxxxx	79	xxxx	332	xxxx	xxxx	xxxxx
Move Cap.:	655	xxxx	xxxxx	xxxx	xxxx	xxxxx	56	xxxx	332	xxxx	xxxx	xxxxx
Volume/Cap:	0.37	xxxx	xxxx	xxxx	xxxx	xxxx	0.77	xxxx	0.90	xxxx	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	1.7	xxxx	xxxxx	xxxx	xxxx	xxxxx	3.3	xxxx	8.7	xxxx	xxxx	xxxxx
Control Del:	13.7	xxxx	xxxxx	xxxxx	xxxx	xxxxx	173.5	xxxx	63.1	xxxxx	xxxx	xxxxx
LOS by Move:	B	*	*	*	*	*	F	*	F	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			77.0			xxxxxx		
ApproachLOS:	*			*			F			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalaho/Hina Lani

Cycle (sec):	125	Critical Vol./Cap.(X):	1.706
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	117.2
Optimal Cycle:	OPTIMIZED	Level Of Service:	F

Street Name:	Mamalaho Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0 0	1 0	1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	462	596	0	0	1028	265	249	0	390	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	462	596	0	0	1028	265	249	0	390	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	486	627	0	0	1082	279	262	0	411	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	486	627	0	0	1082	279	262	0	411	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	486	627	0	0	1082	279	262	0	411	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.22	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	378	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	1.28	0.37	0.00	0.00	0.64	0.19	0.16	0.00	0.28	0.00	0.00	0.00
Crit Moves:	****								****			
Green/Cycle:	0.71	0.71	0.00	0.00	0.48	0.48	0.21	0.00	0.21	0.00	0.00	0.00
Volume/Cap:	1.16	0.52	0.00	0.00	1.33	0.40	0.76	0.00	1.33	0.00	0.00	0.00
Uniform Del:	7.3	8.6	0.0	0.0	32.5	21.0	46.1	0.0	49.1	0.0	0.0	0.0
IncremntDel:	94.0	0.4	0.0	0.0	156	0.4	9.4	0.0	168.3	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	101.3	9.0	0.0	0.0	189	21.4	55.5	0.0	217.4	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	101.3	9.0	0.0	0.0	189	21.4	55.5	0.0	217.4	0.0	0.0	0.0
LOS by Move:	F	A	A	A	F	C	E	A	F	A	A	A
HCM2kAvgQ:	30	11	0	0	75	7	11	0	30	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #5 Holoholo/Hina Lani

Average Delay (sec/veh): 610.4 Worst Case Level Of Service: F[4540.1]

Street Name:	Holoholo Street						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0	1! 0	0	0 0	1! 0	0	0 0	1! 0	0	0 0	1! 0	0
Volume Module:												
Base Vol:	105	8	66	131	12	263	87	327	35	22	844	46
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	105	8	66	131	12	263	87	327	35	22	844	46
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	111	8	69	138	13	277	92	344	37	23	888	48
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	111	8	69	138	13	277	92	344	37	23	888	48
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1649	1529	363	1544	1523	913	937	xxxx	xxxxx	381	xxxx	xxxxx
Potent Cap.:	80	118	687	95	119	334	739	xxxx	xxxxx	1188	xxxx	xxxxx
Move Cap.:	11	101	687	71	102	334	739	xxxx	xxxxx	1188	xxxx	xxxxx
Volume/Cap:	10.00	0.08	0.10	1.95	0.12	0.83	0.12	xxxx	xxxx	0.02	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.4	xxxx	xxxxx	0.1	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	10.6	xxxx	xxxxx	8.1	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	B	*	*	A	*	*
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT
Shared Cap.:	xxxx	18	xxxxx	xxxx	147	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	24.2	xxxxx	xxxxx	39.1	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	4540	xxxxx	xxxxx	921	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	F	*	*	F	*	*	*	*	*	*	*
ApproachDel:	4540.1			921.3			xxxxxx			xxxxxx		
ApproachLOS:	F			F			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	130	Critical Vol./Cap.(X):	1.209
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	81.3
Optimal Cycle:	OPTIMIZED	Level Of Service:	F

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2 0	1	1 0	2 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	850	629	302	970	0	0	0	0	622	0	493
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	850	629	302	970	0	0	0	0	622	0	493
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	895	662	318	1021	0	0	0	0	655	0	519
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	895	662	318	1021	0	0	0	0	655	0	519
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	895	662	318	1021	0	0	0	0	655	0	519
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.40	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	683	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.28	0.46	0.47	0.32	0.00	0.00	0.00	0.00	0.50	0.00	0.36
Crit Moves:			****	****						****		
Green/Cycle:	0.00	0.37	0.37	0.52	0.52	0.00	0.00	0.00	0.00	0.40	0.00	0.40
Volume/Cap:	0.00	0.76	1.25	0.96	0.60	0.00	0.00	0.00	0.00	1.25	0.00	0.90
Uniform Del:	0.0	36.1	41.2	34.9	21.6	0.0	0.0	0.0	0.0	39.0	0.0	36.5
IncremntDel:	0.0	2.9	128.4	39.7	0.6	0.0	0.0	0.0	0.0	128.6	0.0	16.8
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	39.0	169.6	74.6	22.2	0.0	0.0	0.0	0.0	167.6	0.0	53.3
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	39.0	169.6	74.6	22.2	0.0	0.0	0.0	0.0	167.6	0.0	53.3
LOS by Move:	A	D	F	E	C	A	A	A	A	F	A	D
HCM2kAvgQ:	0	18	45	17	15	0	0	0	0	44	0	23

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Haahumanu/Kaiminani

Cycle (sec):	65	Critical Vol./Cap.(X):	0.676
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	12.9
Optimal Cycle: OPTIMIZED		Level Of Service:	B

Street Name:	Queen Haahumanu Highway (SR-19)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2	0 1	1 0	2	0 0	0 0	0	0 0	1 0	0	0 1
Volume Module:												
Base Vol:	0	452	223	493	1169	0	0	0	0	110	0	103
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	452	223	493	1169	0	0	0	0	110	0	103
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	476	235	519	1231	0	0	0	0	116	0	108
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	476	235	519	1231	0	0	0	0	116	0	108
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	476	235	519	1231	0	0	0	0	116	0	108
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.95	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1615	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.15	0.16	0.32	0.38	0.00	0.00	0.00	0.00	0.09	0.00	0.08
Crit Moves:			****	****						****		
Green/Cycle:	0.00	0.24	0.24	0.72	0.72	0.00	0.00	0.00	0.00	0.13	0.00	0.13
Volume/Cap:	0.00	0.61	0.68	0.60	0.53	0.00	0.00	0.00	0.00	0.68	0.00	0.57
Uniform Del:	0.0	22.0	22.4	6.1	4.3	0.0	0.0	0.0	0.0	26.9	0.0	26.5
IncremntDel:	0.0	1.5	5.3	1.1	0.2	0.0	0.0	0.0	0.0	10.3	0.0	4.2
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	23.5	27.7	7.2	4.5	0.0	0.0	0.0	0.0	37.2	0.0	30.7
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	23.5	27.7	7.2	4.5	0.0	0.0	0.0	0.0	37.2	0.0	30.7
LOS by Move:	A	C	C	A	A	A	A	A	A	D	A	C
HCM2kAvgQ:	0	6	6	6	7	0	0	0	0	4	0	3

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Average Delay (sec/veh): 4.2 Worst Case Level Of Service: C[21.1]

Street Name:	Holoholo Street						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	7	6	12	55	7	35	136	428	23	7	85	45
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	7	6	12	55	7	35	136	428	23	7	85	45
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	7	6	13	58	7	37	143	451	24	7	89	47
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	7	6	13	58	7	37	143	451	24	7	89	47
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	899	901	463	886	889	113	137	xxxx	xxxxx	475	xxxx	xxxxx
Potent Cap.:	262	280	603	267	285	945	1460	xxxx	xxxxx	1098	xxxx	xxxxx
Move Cap.:	225	249	603	235	253	945	1460	xxxx	xxxxx	1098	xxxx	xxxxx
Volume/Cap:	0.03	0.03	0.02	0.25	0.03	0.04	0.10	xxxx	xxxx	0.01	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.3	xxxx	xxxxx	0.0	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	7.7	xxxx	xxxxx	8.3	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	A	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	333	xxxxx	xxxx	324	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	0.3	xxxxx	xxxxx	1.3	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	16.7	xxxxx	xxxxx	21.1	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	C	*	*	C	*	*	*	*	*	*	*
ApproachDel:	16.7			21.1			xxxxxx			xxxxxx		
ApproachLOS:	C			C			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #3 Mamalaho/Kaiminani

Average Delay (sec/veh): 21.6 Worst Case Level Of Service: F[86.1]

Street Name:	Mamalaho Highway (SR-190)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0 1 0 0			0 0 1 0 1			1 0 0 0 1			0 0 0 0 0		
Volume Module:												
Base Vol:	204	642	0	0	641	45	80	0	400	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	204	642	0	0	641	45	80	0	400	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	215	676	0	0	675	47	84	0	421	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	215	676	0	0	675	47	84	0	421	0	0	0
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2	xxxxx	xxxx	xxxxx
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3	xxxxx	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	722	xxxx	xxxxx	xxxx	xxxx	xxxxx	1780	xxxx	675	xxxx	xxxx	xxxxx
Potent Cap.:	889	xxxx	xxxxx	xxxx	xxxx	xxxxx	91	xxxx	458	xxxx	xxxx	xxxxx
Move Cap.:	889	xxxx	xxxxx	xxxx	xxxx	xxxxx	74	xxxx	458	xxxx	xxxx	xxxxx
Volume/Cap:	0.24	xxxx	xxxx	xxxx	xxxx	xxxx	1.13	xxxx	0.92	xxxx	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	0.9	xxxx	xxxxx	xxxx	xxxx	xxxxx	6.3	xxxx	10.5	xxxx	xxxx	xxxxx
Control Del:	10.3	xxxx	xxxxx	xxxxx	xxxx	xxxxx	243.1	xxxx	54.7	xxxxx	xxxx	xxxxx
LOS by Move:	B	*	*	*	*	*	F	*	F	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			86.1			xxxxxx		
ApproachLOS:	*			*			F			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalaho/Hina Lani

Cycle (sec):	125	Critical Vol./Cap.(X):	1.925
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	192.1
Optimal Cycle:	OPTIMIZED	Level Of Service:	F

Street Name:	Mamalaho Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0 0	1 0	1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	360	791	0	0	998	288	327	0	846	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	360	791	0	0	998	288	327	0	846	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	379	833	0	0	1051	303	344	0	891	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	379	833	0	0	1051	303	344	0	891	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	379	833	0	0	1051	303	344	0	891	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.19	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	328	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	1.15	0.49	0.00	0.00	0.62	0.21	0.21	0.00	0.62	0.00	0.00	0.00
Crit Moves:	****								****			
Green/Cycle:	0.53	0.53	0.00	0.00	0.39	0.39	0.39	0.00	0.39	0.00	0.00	0.00
Volume/Cap:	1.30	0.92	0.00	0.00	1.60	0.54	0.55	0.00	1.60	0.00	0.00	0.00
Uniform Del:	16.6	26.6	0.0	0.0	38.3	29.7	29.9	0.0	38.4	0.0	0.0	0.0
IncremntDel:	157.4	13.9	0.0	0.0	276	1.1	1.1	0.0	276.8	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	174.0	40.5	0.0	0.0	314	30.8	31.0	0.0	315.2	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	174.0	40.5	0.0	0.0	314	30.8	31.0	0.0	315.2	0.0	0.0	0.0
LOS by Move:	F	D	A	A	F	C	C	A	F	A	A	A
HCM2kAvgQ:	27	33	0	0	88	9	11	0	75	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #5 Holoholo/Hina Lani

Average Delay (sec/veh): OVERFLOW Worst Case Level Of Service: F[xxxxx]

Street Name:	Holoholo Street						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	70	23	44	97	21	178	298	593	118	75	545	155
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	70	23	44	97	21	178	298	593	118	75	545	155
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	74	24	46	102	22	187	314	624	124	79	574	163
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	74	24	46	102	22	187	314	624	124	79	574	163
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	2232	2208	686	2162	2189	655	737	xxxx	xxxxx	748	xxxx	xxxxx
Potent Cap.:	31	45	451	35	46	469	878	xxxx	xxxxx	869	xxxx	xxxxx
Move Cap.:	2	23	451	0	24	469	878	xxxx	xxxxx	869	xxxx	xxxxx
Volume/Cap:	32.66	1.05	0.10	xxxx	0.93	0.40	0.36	xxxx	xxxx	0.09	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	1.6	xxxx	xxxxx	0.3	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	11.4	xxxx	xxxxx	9.6	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	B	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	4	xxxxx	xxxx	0	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	20.2	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	F	*	*	*	*	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			xxxxxx		
ApproachLOS:	F			F			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	130	Critical Vol./Cap.(X):	1.656
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	146.4
Optimal Cycle:	OPTIMIZED	Level Of Service:	F

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2 0	1	1 0	2 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	787	774	570	796	0	0	0	0	594	0	474
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	787	774	570	796	0	0	0	0	594	0	474
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	828	815	600	838	0	0	0	0	625	0	499
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	828	815	600	838	0	0	0	0	625	0	499
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	828	815	600	838	0	0	0	0	625	0	499
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.34	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	571	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.26	0.56	1.05	0.26	0.00	0.00	0.00	0.00	0.48	0.00	0.35
Crit Moves:				****						****		
Green/Cycle:	0.00	0.37	0.37	0.61	0.61	0.00	0.00	0.00	0.00	0.31	0.00	0.31
Volume/Cap:	0.00	0.70	1.53	1.23	0.42	0.00	0.00	0.00	0.00	1.53	0.00	1.11
Uniform Del:	0.0	34.9	41.1	34.2	13.3	0.0	0.0	0.0	0.0	44.7	0.0	44.7
IncremntDel:	0.0	1.8	248.5	121.6	0.1	0.0	0.0	0.0	0.0	251.2	0.0	74.2
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	36.7	289.6	155.8	13.4	0.0	0.0	0.0	0.0	295.9	0.0	118.9
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	36.7	289.6	155.8	13.4	0.0	0.0	0.0	0.0	295.9	0.0	118.9
LOS by Move:	A	D	F	F	B	A	A	A	A	F	A	F
HCM2kAvgQ:	0	15	67	40	9	0	0	0	0	52	0	29

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #3 Mamalaho/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.998
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	49.5
Optimal Cycle:	180	Level Of Service:	D

Street Name:	Mamalaho Highway (SR-190)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Protected			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0 0	1 0	1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	232	447	0	0	873	151	41	0	283	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	232	447	0	0	873	151	41	0	283	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	244	471	0	0	919	159	43	0	298	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	244	471	0	0	919	159	43	0	298	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	244	471	0	0	919	159	43	0	298	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.95	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	1615	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.15	0.28	0.00	0.00	0.54	0.11	0.03	0.00	0.21	0.00	0.00	0.00
Crit Moves:	****				****				****			
Green/Cycle:	0.15	0.69	0.00	0.00	0.54	0.54	0.21	0.00	0.21	0.00	0.00	0.00
Volume/Cap:	1.00	0.40	0.00	0.00	1.00	0.20	0.13	0.00	1.00	0.00	0.00	0.00
Uniform Del:	42.4	6.5	0.0	0.0	22.8	11.8	32.3	0.0	39.6	0.0	0.0	0.0
IncremntDel:	56.8	0.2	0.0	0.0	29.1	0.1	0.2	0.0	51.4	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	99.2	6.7	0.0	0.0	51.9	11.9	32.5	0.0	91.1	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	99.2	6.7	0.0	0.0	51.9	11.9	32.5	0.0	91.1	0.0	0.0	0.0
LOS by Move:	F	A	A	A	D	B	C	A	F	A	A	A
HCM2kAvgQ:	12	6	0	0	36	3	1	0	14	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalaho/Hina Lani

Cycle (sec):	110	Critical Vol./Cap.(X):	0.988
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	41.7
Optimal Cycle:	180	Level Of Service:	D

Street Name:	Mamalaho Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0 0	1 1	0	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	462	596	0	0	1028	265	249	0	390	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	462	596	0	0	1028	265	249	0	390	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	486	627	0	0	1082	279	262	0	411	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	486	627	0	0	1082	279	262	0	411	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	486	627	0	0	1082	279	262	0	411	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.95	1.00	1.00	1.00	0.92	0.92	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.59	0.41	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	1615	1700	0	0	2488	641	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.30	0.37	0.00	0.00	0.43	0.43	0.16	0.00	0.28	0.00	0.00	0.00
Crit Moves:	****				****		****					
Green/Cycle:	0.74	0.74	0.00	0.00	0.44	0.44	0.16	0.00	0.47	0.00	0.00	0.00
Volume/Cap:	0.88	0.50	0.00	0.00	0.99	0.99	0.99	0.00	0.61	0.00	0.00	0.00
Uniform Del:	30.0	5.7	0.0	0.0	30.5	30.5	45.9	0.0	21.7	0.0	0.0	0.0
IncremntDel:	14.8	0.3	0.0	0.0	21.3	21.3	51.8	0.0	1.6	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	44.8	6.0	0.0	0.0	51.9	51.9	97.7	0.0	23.2	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	44.8	6.0	0.0	0.0	51.9	51.9	97.7	0.0	23.2	0.0	0.0	0.0
LOS by Move:	D	A	A	A	D	D	F	A	C	A	A	A
HCM2kAvgQ:	16	9	0	0	31	31	14	0	11	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #5 Holoholo/Hina Lani

Cycle (sec):	85	Critical Vol./Cap.(X):	1.096
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	49.7
Optimal Cycle: OPTIMIZED		Level Of Service:	D

Street Name:	Holoholo Street						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	1! 0	0	0 0	1! 0	0	1 0	0 1	0	1 0	0 1	0
Volume Module:												
Base Vol:	105	8	66	131	12	263	87	327	35	22	844	46
Growth Adj:	1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00	
Initial Bse:	105	8	66	131	12	263	87	327	35	22	844	46
User Adj:	1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00	
PHF Adj:	0.95 0.95	0.95		0.95 0.95	0.95		0.95 0.95	0.95		0.95 0.95	0.95	
PHF Volume:	111	8	69	138	13	277	92	344	37	23	888	48
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	111	8	69	138	13	277	92	344	37	23	888	48
PCE Adj:	1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00	
MLF Adj:	1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00	
Final Vol.:	111	8	69	138	13	277	92	344	37	23	888	48
Saturation Flow Module:												
Sat/Lane:	1700 1700	1700		1700 1700	1700		1700 1700	1700		1700 1700	1700	
Adjustment:	0.53 0.53	0.53		0.75 0.75	0.75		0.09 0.99	0.99		0.48 0.99	0.99	
Lanes:	0.59 0.04	0.37		0.32 0.03	0.65		1.00 0.90	0.10		1.00 0.95	0.05	
Final Sat.:	530	40	333	414	38	830	145	1513	162	807	1599	87
Capacity Analysis Module:												
Vol/Sat:	0.21 0.21	0.21		0.33 0.33	0.33		0.63 0.23	0.23		0.03 0.56	0.56	
Crit Moves:				****			****					
Green/Cycle:	0.30 0.30	0.30		0.30 0.30	0.30		0.58 0.58	0.58		0.58 0.58	0.58	
Volume/Cap:	0.69 0.69	0.69		1.10 1.10	1.10		1.08 0.39	0.39		0.05 0.96	0.96	
Uniform Del:	26.0 26.0	26.0		29.6 29.6	29.6		17.9 9.8	9.8		7.8 17.0	17.0	
IncremntDel:	7.1 7.1	7.1		74.0 74.0	74.0		121.6 0.3	0.3		0.0 19.9	19.9	
InitQueuDel:	0.0 0.0	0.0		0.0 0.0	0.0		0.0 0.0	0.0		0.0 0.0	0.0	
Delay Adj:	1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00	
Delay/Veh:	33.1 33.1	33.1		103.6 104	103.6		139.5 10.1	10.1		7.8 36.9	36.9	
User DelAdj:	1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00	
AdjDel/Veh:	33.1 33.1	33.1		103.6 104	103.6		139.5 10.1	10.1		7.8 36.9	36.9	
LOS by Move:	C	C	C	F	F	F	F	B	B	A	D	D
HCM2kAvgQ:	6	6	6	20	20	20	6	6	6	0	30	30

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	130	Critical Vol./Cap.(X):	0.953
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	41.1
Optimal Cycle:	166	Level Of Service:	D

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Split Phase			Split Phase		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0 2	0	1	1 0 2	0	0	0 0 0	0	0	1 0 0	0	1
Volume Module:												
Base Vol:	0	850	629	302	970	0	0	0	0	622	0	493
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	850	629	302	970	0	0	0	0	622	0	493
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	895	662	318	1021	0	0	0	0	655	0	519
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	895	662	318	1021	0	0	0	0	655	0	519
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	895	662	318	1021	0	0	0	0	655	0	519
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.95	0.95	1.00	1.00	1.00	1.00	0.95	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1615	3230	0	0	0	0	1615	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.28	0.46	0.20	0.32	0.00	0.00	0.00	0.00	0.41	0.00	0.36
Crit Moves:		****		****						****		
Green/Cycle:	0.00	0.29	0.72	0.50	0.50	0.00	0.00	0.00	0.00	0.43	0.00	0.43
Volume/Cap:	0.00	0.95	0.64	0.82	0.64	0.00	0.00	0.00	0.00	0.95	0.00	0.84
Uniform Del:	0.0	45.2	9.6	36.0	24.0	0.0	0.0	0.0	0.0	36.1	0.0	33.5
IncremntDel:	0.0	18.9	1.4	13.4	0.8	0.0	0.0	0.0	0.0	23.2	0.0	10.3
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	64.1	11.0	49.4	24.9	0.0	0.0	0.0	0.0	59.3	0.0	43.8
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	64.1	11.0	49.4	24.9	0.0	0.0	0.0	0.0	59.3	0.0	43.8
LOS by Move:	A	E	B	D	C	A	A	A	A	E	A	D
HCM2kAvgQ:	0	23	14	13	16	0	0	0	0	30	0	21

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #3 Mamalaho/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.913
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	38.9
Optimal Cycle:	112	Level Of Service:	D

Street Name:	Mamalaho Highway (SR-190)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Protected			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0 0	1 0	1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	204	642	0	0	641	45	80	0	400	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	204	642	0	0	641	45	80	0	400	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	215	676	0	0	675	47	84	0	421	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	215	676	0	0	675	47	84	0	421	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	215	676	0	0	675	47	84	0	421	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.95	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	1615	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.13	0.40	0.00	0.00	0.40	0.03	0.05	0.00	0.29	0.00	0.00	0.00
Crit Moves:	****				****				****			
Green/Cycle:	0.15	0.58	0.00	0.00	0.43	0.43	0.32	0.00	0.32	0.00	0.00	0.00
Volume/Cap:	0.91	0.68	0.00	0.00	0.91	0.08	0.16	0.00	0.91	0.00	0.00	0.00
Uniform Del:	42.1	14.6	0.0	0.0	26.5	16.5	24.4	0.0	32.7	0.0	0.0	0.0
IncremntDel:	35.9	2.0	0.0	0.0	15.6	0.1	0.1	0.0	22.3	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	78.0	16.6	0.0	0.0	42.1	16.6	24.6	0.0	55.0	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	78.0	16.6	0.0	0.0	42.1	16.6	24.6	0.0	55.0	0.0	0.0	0.0
LOS by Move:	E	B	A	A	D	B	C	A	E	A	A	A
HCM2kAvgQ:	10	15	0	0	24	1	2	0	16	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalaho/Hina Lani

Cycle (sec):	110	Critical Vol./Cap.(X):	1.120
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	80.3
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Mamalaho Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0 0	1 1	0	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	360	791	0	0	998	288	327	0	846	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	360	791	0	0	998	288	327	0	846	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	379	833	0	0	1051	303	344	0	891	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	379	833	0	0	1051	303	344	0	891	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	379	833	0	0	1051	303	344	0	891	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.44	1.00	1.00	1.00	0.92	0.92	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.55	0.45	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	740	1700	0	0	2421	699	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.51	0.49	0.00	0.00	0.43	0.43	0.21	0.00	0.62	0.00	0.00	0.00
Crit Moves:	****				****				****			
Green/Cycle:	0.58	0.58	0.00	0.00	0.38	0.38	0.33	0.00	0.53	0.00	0.00	0.00
Volume/Cap:	0.97	0.85	0.00	0.00	1.16	1.16	0.65	0.00	1.16	0.00	0.00	0.00
Uniform Del:	12.8	19.1	0.0	0.0	34.3	34.3	31.3	0.0	25.7	0.0	0.0	0.0
IncremntDel:	38.1	6.9	0.0	0.0	79.8	79.8	2.7	0.0	84.2	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	50.8	26.0	0.0	0.0	114	114.2	34.1	0.0	109.9	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	50.8	26.0	0.0	0.0	114	114.2	34.1	0.0	109.9	0.0	0.0	0.0
LOS by Move:	D	C	A	A	F	F	C	A	F	A	A	A
HCM2kAvgQ:	17	25	0	0	39	39	11	0	48	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #5 Holoholo/Hina Lani

Cycle (sec):	85	Critical Vol./Cap.(X):	1.037
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	32.4
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Street Name:	Holoholo Street						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	1! 0	0	0 0	1! 0	0	1 0	0 1	0	1 0	0 1	0
Volume Module:												
Base Vol:	70	23	44	97	21	178	298	593	118	75	545	155
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	70	23	44	97	21	178	298	593	118	75	545	155
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	74	24	46	102	22	187	314	624	124	79	574	163
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	74	24	46	102	22	187	314	624	124	79	574	163
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	74	24	46	102	22	187	314	624	124	79	574	163
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.59	0.59	0.59	0.77	0.77	0.77	0.27	0.98	0.98	0.27	0.97	0.97
Lanes:	0.51	0.17	0.32	0.33	0.07	0.60	1.00	0.83	0.17	1.00	0.78	0.22
Final Sat.:	511	168	321	427	93	784	464	1382	275	452	1280	364
Capacity Analysis Module:												
Vol/Sat:	0.14	0.14	0.14	0.24	0.24	0.24	0.68	0.45	0.45	0.17	0.45	0.45
Crit Moves:					****		****					
Green/Cycle:	0.23	0.23	0.23	0.23	0.23	0.23	0.65	0.65	0.65	0.65	0.65	0.65
Volume/Cap:	0.63	0.63	0.63	1.04	1.04	1.04	1.04	0.69	0.69	0.27	0.69	0.69
Uniform Del:	29.4	29.4	29.4	32.7	32.7	32.7	14.8	9.4	9.4	6.2	9.3	9.3
IncremntDel:	5.3	5.3	5.3	61.8	61.8	61.8	61.6	2.0	2.0	0.5	1.9	1.9
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	34.7	34.7	34.7	94.5	94.5	94.5	76.4	11.3	11.3	6.7	11.2	11.2
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	34.7	34.7	34.7	94.5	94.5	94.5	76.4	11.3	11.3	6.7	11.2	11.2
LOS by Move:	C	C	C	F	F	F	E	B	B	A	B	B
HCM2kAvgQ:	5	5	5	14	14	14	14	13	13	1	13	13

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	130	Critical Vol./Cap.(X):	1.063
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	68.4
Optimal Cycle:	180	Level Of Service:	E

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Split Phase			Split Phase		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0 2	0	1	1 0 2	0	0	0 0 0	0	0	1 0 0	0	1
Volume Module:												
Base Vol:	0	787	774	570	796	0	0	0	0	594	0	474
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	787	774	570	796	0	0	0	0	594	0	474
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	828	815	600	838	0	0	0	0	625	0	499
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	828	815	600	838	0	0	0	0	625	0	499
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	828	815	600	838	0	0	0	0	625	0	499
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.61	0.95	1.00	1.00	1.00	1.00	0.95	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1034	3230	0	0	0	0	1615	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.26	0.56	0.58	0.26	0.00	0.00	0.00	0.00	0.39	0.00	0.35
Crit Moves:		****		****						****		
Green/Cycle:	0.00	0.23	0.59	0.57	0.57	0.00	0.00	0.00	0.00	0.35	0.00	0.35
Volume/Cap:	0.00	1.10	0.96	1.00	0.45	0.00	0.00	0.00	0.00	1.10	0.00	0.98
Uniform Del:	0.0	49.8	25.6	19.0	16.2	0.0	0.0	0.0	0.0	42.1	0.0	41.7
IncremntDel:	0.0	63.5	22.4	37.7	0.2	0.0	0.0	0.0	0.0	67.9	0.0	34.8
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	113	48.0	56.7	16.3	0.0	0.0	0.0	0.0	110.1	0.0	76.5
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	113	48.0	56.7	16.3	0.0	0.0	0.0	0.0	110.1	0.0	76.5
LOS by Move:	A	F	D	E	B	A	A	A	A	F	A	E
HCM2kAvgQ:	0	26	36	30	10	0	0	0	0	36	0	25

Note: Queue reported is the number of cars per lane.

APPENDIX I

HDOT ALTERNATIVE FUTURE SCENARIO LEVEL OF SERVICE WORKSHEETS

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.994
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	42.0
Optimal Cycle:	180	Level Of Service:	D

Street Name:	Queen Kaahumanu Highway (SR-19)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2 0	1	1 0	2 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	1222	266	69	544	0	0	0	0	561	0	468
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	1222	266	69	544	0	0	0	0	561	0	468
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	1286	280	73	573	0	0	0	0	591	0	493
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	1286	280	73	573	0	0	0	0	591	0	493
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	1286	280	73	573	0	0	0	0	591	0	493
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.95	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1615	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.40	0.19	0.04	0.18	0.00	0.00	0.00	0.00	0.45	0.00	0.34
Crit Moves:		****		****						****		
Green/Cycle:	0.00	0.40	0.40	0.45	0.45	0.00	0.00	0.00	0.00	0.45	0.00	0.45
Volume/Cap:	0.00	0.99	0.48	0.52	0.40	0.00	0.00	0.00	0.00	0.99	0.00	0.75
Uniform Del:	0.0	29.9	22.3	22.9	18.7	0.0	0.0	0.0	0.0	27.2	0.0	22.6
IncremntDel:	0.0	23.6	0.6	3.3	0.2	0.0	0.0	0.0	0.0	35.4	0.0	4.8
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	53.5	22.9	26.1	18.9	0.0	0.0	0.0	0.0	62.6	0.0	27.4
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	53.5	22.9	26.1	18.9	0.0	0.0	0.0	0.0	62.6	0.0	27.4
LOS by Move:	A	D	C	C	B	A	A	A	A	E	A	C
HCM2kAvgQ:	0	28	7	2	6	0	0	0	0	25	0	14

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Average Delay (sec/veh): 9.8 Worst Case Level Of Service: F[58.3]

Street Name:	Holoholo St						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	62	3	29	27	7	207	48	234	20	13	519	7
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	62	3	29	27	7	207	48	234	20	13	519	7
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	65	3	31	28	7	218	51	246	21	14	546	7
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	65	3	31	28	7	218	51	246	21	14	546	7
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1048	939	257	952	946	550	554	xxxx	xxxxx	267	xxxx	xxxxx
Potent Cap.:	208	266	787	241	264	539	1027	xxxx	xxxxx	1308	xxxx	xxxxx
Move Cap.:	115	250	787	219	248	539	1027	xxxx	xxxxx	1308	xxxx	xxxxx
Volume/Cap:	0.57	0.01	0.04	0.13	0.03	0.40	0.05	xxxx	xxxx	0.01	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.2	xxxx	xxxxx	0.0	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	8.7	xxxx	xxxxx	7.8	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	A	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	160	xxxxx	xxxx	450	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	3.4	xxxxx	xxxxx	3.4	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	58.3	xxxxx	xxxxx	22.9	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	F	*	*	C	*	*	*	*	*	*	*
ApproachDel:	58.3			22.9			xxxxxx			xxxxxx		
ApproachLOS:	F			C			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #3 Mamalahoa/Kaiminani

Average Delay (sec/veh): 37.6 Worst Case Level Of Service: F[257.7]

Street Name:	Mamalahoa Hwy						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0	1 0	0	0 0	1 0	1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	301	375	0	0	1093	202	54	0	251	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	301	375	0	0	1093	202	54	0	251	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	317	395	0	0	1151	213	57	0	264	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	317	395	0	0	1151	213	57	0	264	0	0	0
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2	xxxxx	xxxx	xxxxx
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3	xxxxx	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1363	xxxx	xxxxx	xxxx	xxxx	xxxxx	2179	xxxx	1151	xxxx	xxxx	xxxxx
Potent Cap.:	511	xxxx	xxxxx	xxxx	xxxx	xxxxx	51	xxxx	243	xxxx	xxxx	xxxxx
Move Cap.:	511	xxxx	xxxxx	xxxx	xxxx	xxxxx	26	xxxx	243	xxxx	xxxx	xxxxx
Volume/Cap:	0.62	xxxx	xxxx	xxxx	xxxx	xxxx	2.19	xxxx	1.09	xxxx	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	4.2	xxxx	xxxxx	xxxx	xxxx	xxxxx	6.9	xxxx	11.3	xxxx	xxxx	xxxxx
Control Del:	22.9	xxxx	xxxxx	xxxxx	xxxx	xxxxx	868.8	xxxx	126.2	xxxxx	xxxx	xxxxx
LOS by Move:	C	*	*	*	*	*	F	*	F	*	*	*
Movement:	LT	LTR	RT	LT	LTR	RT	LT	LTR	RT	LT	LTR	RT
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			257.7			xxxxxx		
ApproachLOS:	*			*			F			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalahoa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.840
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	148.7
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Mamalahoa Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0 0	1 0	1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	481	633	0	0	1154	245	204	0	398	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	481	633	0	0	1154	245	204	0	398	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	506	666	0	0	1215	258	215	0	419	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	506	666	0	0	1215	258	215	0	419	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	506	666	0	0	1215	258	215	0	419	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.22	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	371	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	1.37	0.39	0.00	0.00	0.71	0.18	0.13	0.00	0.29	0.00	0.00	0.00
Crit Moves:	****								****			
Green/Cycle:	0.70	0.70	0.00	0.00	0.49	0.49	0.20	0.00	0.20	0.00	0.00	0.00
Volume/Cap:	1.22	0.56	0.00	0.00	1.46	0.37	0.67	0.00	1.46	0.00	0.00	0.00
Uniform Del:	6.0	7.3	0.0	0.0	25.6	16.0	37.1	0.0	40.1	0.0	0.0	0.0
IncremntDel:	120.6	0.6	0.0	0.0	216	0.3	5.5	0.0	227.2	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	126.5	7.9	0.0	0.0	241	16.3	42.6	0.0	267.3	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	126.5	7.9	0.0	0.0	241	16.3	42.6	0.0	267.3	0.0	0.0	0.0
LOS by Move:	F	A	A	A	F	B	D	A	F	A	A	A
HCM2kAvgQ:	30	10	0	0	85	5	7	0	31	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #5 Kealakaa/Hina Lani

Average Delay (sec/veh): 214.3 Worst Case Level Of Service: F[1145.5]

Street Name:	Kealakaa Street						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	99	16	69	107	13	166	53	349	33	25	863	41
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	99	16	69	107	13	166	53	349	33	25	863	41
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	104	17	73	113	14	175	56	367	35	26	908	43
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	104	17	73	113	14	175	56	367	35	26	908	43
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1573	1501	385	1524	1496	930	952	xxxx	xxxxx	402	xxxx	xxxxx
Potent Cap.:	90	123	667	98	124	327	730	xxxx	xxxxx	1168	xxxx	xxxxx
Move Cap.:	35	111	667	71	112	327	730	xxxx	xxxxx	1168	xxxx	xxxxx
Volume/Cap:	2.96	0.15	0.11	1.58	0.12	0.53	0.08	xxxx	xxxx	0.02	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.2	xxxx	xxxxx	0.1	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	10.3	xxxx	xxxxx	8.2	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	B	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	60	xxxxx	xxxx	134	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	20.3	xxxxx	xxxxx	25.3	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	1146	xxxxx	xxxxx	635	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	F	*	*	F	*	*	*	*	*	*	*
ApproachDel:	1145.5			634.6			xxxxxx			xxxxxx		
ApproachLOS:	F			F			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.331
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	97.8
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2 0	1	1 0	2 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	929	689	299	1068	0	0	0	0	690	0	486
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	929	689	299	1068	0	0	0	0	690	0	486
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	978	725	315	1124	0	0	0	0	726	0	512
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	978	725	315	1124	0	0	0	0	726	0	512
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	978	725	315	1124	0	0	0	0	726	0	512
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.30	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	516	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.30	0.50	0.61	0.35	0.00	0.00	0.00	0.00	0.56	0.00	0.35
Crit Moves:			****	****						****		
Green/Cycle:	0.00	0.36	0.36	0.50	0.50	0.00	0.00	0.00	0.00	0.40	0.00	0.40
Volume/Cap:	0.00	0.84	1.39	1.07	0.70	0.00	0.00	0.00	0.00	1.39	0.00	0.89
Uniform Del:	0.0	29.3	32.0	28.6	19.1	0.0	0.0	0.0	0.0	30.0	0.0	27.9
IncremntDel:	0.0	5.6	187.7	72.2	1.3	0.0	0.0	0.0	0.0	187.7	0.0	15.4
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	34.9	219.7	100.9	20.5	0.0	0.0	0.0	0.0	217.7	0.0	43.3
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	34.9	219.7	100.9	20.5	0.0	0.0	0.0	0.0	217.7	0.0	43.3
LOS by Move:	A	C	F	F	C	A	A	A	A	F	A	D
HCM2kAvgQ:	0	17	49	16	15	0	0	0	0	49	0	18

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.776
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	19.8
Optimal Cycle:	66	Level Of Service:	B

Street Name:	Queen Kaahumanu Highway (SR-19)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2 0	1	1 0	2 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	395	282	511	1182	0	0	0	0	199	0	91
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	395	282	511	1182	0	0	0	0	199	0	91
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	416	297	538	1244	0	0	0	0	209	0	96
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	416	297	538	1244	0	0	0	0	209	0	96
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	416	297	538	1244	0	0	0	0	209	0	96
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.95	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1615	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.13	0.21	0.33	0.39	0.00	0.00	0.00	0.00	0.16	0.00	0.07
Crit Moves:			****	****						****		
Green/Cycle:	0.00	0.26	0.26	0.69	0.69	0.00	0.00	0.00	0.00	0.21	0.00	0.21
Volume/Cap:	0.00	0.49	0.78	0.65	0.56	0.00	0.00	0.00	0.00	0.78	0.00	0.32
Uniform Del:	0.0	31.0	34.0	8.6	7.6	0.0	0.0	0.0	0.0	37.5	0.0	33.7
IncremntDel:	0.0	0.4	9.6	1.8	0.3	0.0	0.0	0.0	0.0	13.2	0.0	0.6
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	31.5	43.7	10.4	7.9	0.0	0.0	0.0	0.0	50.7	0.0	34.4
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	31.5	43.7	10.4	7.9	0.0	0.0	0.0	0.0	50.7	0.0	34.4
LOS by Move:	A	C	D	B	A	A	A	A	A	D	A	C
HCM2kAvgQ:	0	6	10	10	10	0	0	0	0	8	0	3

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Average Delay (sec/veh): 4.3 Worst Case Level Of Service: C[23.4]

Street Name:	Holoholo St						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	22	6	25	23	5	40	170	464	47	25	110	27
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	22	6	25	23	5	40	170	464	47	25	110	27
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	23	6	26	24	5	42	179	488	49	26	116	28
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	23	6	26	24	5	42	179	488	49	26	116	28
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1077	1068	513	1070	1078	130	144	xxxx	xxxxx	538	xxxx	xxxxx
Potent Cap.:	198	224	565	201	220	925	1451	xxxx	xxxxx	1041	xxxx	xxxxx
Move Cap.:	163	188	565	164	185	925	1451	xxxx	xxxxx	1041	xxxx	xxxxx
Volume/Cap:	0.14	0.03	0.05	0.15	0.03	0.05	0.12	xxxx	xxxx	0.03	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.4	xxxx	xxxxx	0.1	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	7.8	xxxx	xxxxx	8.5	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	A	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	251	xxxxx	xxxx	323	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	0.8	xxxxx	xxxxx	0.8	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	23.4	xxxxx	xxxxx	19.3	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	C	*	*	C	*	*	*	*	*	*	*
ApproachDel:	23.4			19.3			xxxxxx			xxxxxx		
ApproachLOS:	C			C			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #3 Mamalahoa/Kaiminani

Average Delay (sec/veh): 72.5 Worst Case Level Of Service: F[218.9]

Street Name:	Mamalahoa Hwy								Kaiminani Dr							
Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Uncontrolled				Uncontrolled				Stop Sign				Stop Sign			
Rights:	Include				Include				Include				Include			
Lanes:	1	0	1	0 0	0	0	1	0 1	1	0	0	0 1	0	0	0	0 0
Volume Module:																
Base Vol:	187	704		0 0	582			66	111		0	638		0	0	0
Growth Adj:	1.00	1.00		1.00 1.00	1.00			1.00	1.00		1.00	1.00		1.00	1.00	1.00
Initial Bse:	187	704		0 0	582			66	111		0	638		0	0	0
User Adj:	1.00	1.00		1.00 1.00	1.00			1.00	1.00		1.00	1.00		1.00	1.00	1.00
PHF Adj:	0.95	0.95		0.95 0.95	0.95			0.95	0.95		0.95	0.95		0.95	0.95	0.95
PHF Volume:	197	741		0 0	613			69	117		0	672		0	0	0
Reduct Vol:	0	0		0 0	0			0	0		0	0		0	0	0
Final Vol.:	197	741		0 0	613			69	117		0	672		0	0	0
Critical Gap Module:																
Critical Gp:	4.1	xxxx	xxxxx	xxxxx xxxx	xxxxx				6.4	xxxx		6.2	xxxxx	xxxx	xxxxx	
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx xxxx	xxxxx				3.5	xxxx		3.3	xxxxx	xxxx	xxxxx	
Capacity Module:																
Cnflict Vol:	682	xxxx	xxxxx	xxxx xxxx	xxxxx				1747	xxxx		613	xxxx	xxxx	xxxxx	
Potent Cap.:	920	xxxx	xxxxx	xxxx xxxx	xxxxx				96	xxxx		496	xxxx	xxxx	xxxxx	
Move Cap.:	920	xxxx	xxxxx	xxxx xxxx	xxxxx				80	xxxx		496	xxxx	xxxx	xxxxx	
Volume/Cap:	0.21	xxxx	xxxx	xxxx xxxx	xxxx				1.46	xxxx		1.35	xxxx	xxxx	xxxx	
Level Of Service Module:																
2Way95thQ:	0.8	xxxx	xxxxx	xxxx xxxx	xxxxx				9.3	xxxx		30.2	xxxx	xxxx	xxxxx	
Control Del:	10.0	xxxx	xxxxx	xxxxx xxxx	xxxxx				354.8	xxxx		195.2	xxxxx	xxxx	xxxxx	
LOS by Move:	A	*		*	*		*		F	*		F	*	*	*	
Movement:	LT -	LTR -	RT	LT -	LTR -	RT			LT -	LTR -	RT		LT -	LTR -	RT	
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx			xxxx	xxxx	xxxxx		xxxx	xxxx	xxxxx	
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx		xxxxx	xxxx	xxxxx	
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx		xxxxx	xxxx	xxxxx	
Shared LOS:	*	*		*	*		*		*	*		*	*	*	*	
ApproachDel:	xxxxxx			xxxxxx					218.9				xxxxxx			
ApproachLOS:	*			*					F				*			

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalahoa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.826
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	223.2
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Mamalahoa Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0 0	1 0	1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	346	836	0	0	1074	223	280	0	888	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	346	836	0	0	1074	223	280	0	888	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	364	880	0	0	1131	235	295	0	935	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	364	880	0	0	1131	235	295	0	935	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	364	880	0	0	1131	235	295	0	935	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.21	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	365	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	1.00	0.52	0.00	0.00	0.67	0.16	0.18	0.00	0.65	0.00	0.00	0.00
Crit Moves:	****								****			
Green/Cycle:	0.52	0.52	0.00	0.00	0.39	0.39	0.38	0.00	0.38	0.00	0.00	0.00
Volume/Cap:	1.30	0.99	0.00	0.00	1.71	0.42	0.48	0.00	1.71	0.00	0.00	0.00
Uniform Del:	13.9	23.8	0.0	0.0	30.5	22.3	23.6	0.0	31.1	0.0	0.0	0.0
IncremntDel:	156.6	28.4	0.0	0.0	325	0.5	0.6	0.0	326.5	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	170.5	52.2	0.0	0.0	356	22.8	24.2	0.0	357.5	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	170.5	52.2	0.0	0.0	356	22.8	24.2	0.0	357.5	0.0	0.0	0.0
LOS by Move:	F	D	A	A	F	C	C	A	F	A	A	A
HCM2kAvgQ:	24	34	0	0	92	5	7	0	77	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #5 Kealakaa/Hina Lani

Average Delay (sec/veh): OVERFLOW Worst Case Level Of Service: F[xxxxx]

Street Name:	Kealakaa Street						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	66	32	48	84	35	110	186	601	112	78	674	128
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	66	32	48	84	35	110	186	601	112	78	674	128
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	69	34	51	88	37	116	196	633	118	82	709	135
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	69	34	51	88	37	116	196	633	118	82	709	135
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	2101	2092	692	2066	2083	777	844	xxxx	xxxxx	751	xxxx	xxxxx
Potent Cap.:	38	53	448	41	54	400	801	xxxx	xxxxx	868	xxxx	xxxxx
Move Cap.:	0	35	448	3	35	400	801	xxxx	xxxxx	868	xxxx	xxxxx
Volume/Cap:	xxxx	0.97	0.11	27.37	1.05	0.29	0.24	xxxx	xxxx	0.09	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	1.0	xxxx	xxxxx	0.3	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	10.9	xxxx	xxxxx	9.6	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	B	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	0	xxxxx	xxxx	8	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	31.9	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	F	*	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			xxxxxx		
ApproachLOS:	F			F			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	2.155
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	172.5
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0 2	0 1		1 0 2	0 0		0 0 0	0 0		1 0	0 0 1	
Volume Module:												
Base Vol:	0	879	865	561	861	0	0	0	0	646	0	468
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	879	865	561	861	0	0	0	0	646	0	468
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	925	911	591	906	0	0	0	0	680	0	493
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	925	911	591	906	0	0	0	0	680	0	493
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	925	911	591	906	0	0	0	0	680	0	493
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.24	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	416	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.29	0.63	1.42	0.28	0.00	0.00	0.00	0.00	0.52	0.00	0.34
Crit Moves:				****						****		
Green/Cycle:	0.00	0.37	0.37	0.59	0.59	0.00	0.00	0.00	0.00	0.31	0.00	0.31
Volume/Cap:	0.00	0.77	1.68	1.39	0.47	0.00	0.00	0.00	0.00	1.68	0.00	1.10
Uniform Del:	0.0	27.5	31.3	28.8	11.6	0.0	0.0	0.0	0.0	34.6	0.0	34.6
IncremntDel:	0.0	3.0	316.0	188.9	0.2	0.0	0.0	0.0	0.0	318.6	0.0	73.9
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	30.4	347.2	217.7	11.8	0.0	0.0	0.0	0.0	353.1	0.0	108.5
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	30.4	347.2	217.7	11.8	0.0	0.0	0.0	0.0	353.1	0.0	108.5
LOS by Move:	A	C	F	F	B	A	A	A	A	F	A	F
HCM2kAvgQ:	0	15	74	40	8	0	0	0	0	56	0	25

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.008
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	45.4
Optimal Cycle:	180	Level Of Service:	D

Street Name: Queen Kaahumanu Highway (SR-19) Kaiminani Drive

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2 0	1	1 0	2 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	1222	266	89	544	0	0	0	0	561	0	529
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	1222	266	89	544	0	0	0	0	561	0	529
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	1286	280	94	573	0	0	0	0	591	0	557
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	1286	280	94	573	0	0	0	0	591	0	557
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	1286	280	94	573	0	0	0	0	591	0	557
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.88	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1504	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.40	0.19	0.06	0.18	0.00	0.00	0.00	0.00	0.45	0.00	0.39
Crit Moves:		****		****						****		
Green/Cycle:	0.00	0.39	0.39	0.45	0.45	0.00	0.00	0.00	0.00	0.45	0.00	0.45
Volume/Cap:	0.00	1.01	0.49	0.58	0.39	0.00	0.00	0.00	0.00	1.01	0.00	0.86
Uniform Del:	0.0	30.3	22.7	22.9	18.2	0.0	0.0	0.0	0.0	27.6	0.0	24.8
IncremntDel:	0.0	27.4	0.7	5.3	0.2	0.0	0.0	0.0	0.0	39.4	0.0	11.3
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	57.6	23.4	28.2	18.4	0.0	0.0	0.0	0.0	67.0	0.0	36.1
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	57.6	23.4	28.2	18.4	0.0	0.0	0.0	0.0	67.0	0.0	36.1
LOS by Move:	A	E	C	C	B	A	A	A	A	E	A	D
HCM2kAvgQ:	0	28	7	3	6	0	0	0	0	25	0	18

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Average Delay (sec/veh): 37.2 Worst Case Level Of Service: F[225.7]

Street Name:	Holoholo St						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	123	3	59	27	7	207	48	234	40	23	519	7
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	123	3	59	27	7	207	48	234	40	23	519	7
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	129	3	62	28	7	218	51	246	42	24	546	7
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	129	3	62	28	7	218	51	246	42	24	546	7
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1079	971	267	999	988	550	554	xxxx	xxxxx	288	xxxx	xxxxx
Potent Cap.:	198	255	776	224	249	539	1027	xxxx	xxxxx	1285	xxxx	xxxxx
Move Cap.:	109	237	776	193	232	539	1027	xxxx	xxxxx	1285	xxxx	xxxxx
Volume/Cap:	1.19	0.01	0.08	0.15	0.03	0.40	0.05	xxxx	xxxx	0.02	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.2	xxxx	xxxxx	0.1	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	8.7	xxxx	xxxxx	7.9	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	A	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	152	xxxxx	xxxx	435	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	11.6	xxxxx	xxxxx	3.6	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	226	xxxxx	xxxxx	24.2	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	F	*	*	C	*	*	*	*	*	*	*
ApproachDel:	225.7			24.2			xxxxxx			xxxxxx		
ApproachLOS:	F			C			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #3 Mamalahoa/Kaiminani

Average Delay (sec/veh): 68.0 Worst Case Level Of Service: F[449.5]

Street Name:	Mamalahoa Hwy						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0 1	0	0	0 0 1	0	1	1 0 0	0	1	0 0 0	0	0
Volume Module:												
Base Vol:	301	375	0	0	1093	212	84	0	251	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	301	375	0	0	1093	212	84	0	251	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	317	395	0	0	1151	223	88	0	264	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	317	395	0	0	1151	223	88	0	264	0	0	0
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2	xxxxx	xxxx	xxxxx
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3	xxxxx	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1374	xxxx	xxxxx	xxxx	xxxx	xxxxx	2179	xxxx	1151	xxxx	xxxx	xxxxx
Potent Cap.:	506	xxxx	xxxxx	xxxx	xxxx	xxxxx	51	xxxx	243	xxxx	xxxx	xxxxx
Move Cap.:	506	xxxx	xxxxx	xxxx	xxxx	xxxxx	26	xxxx	243	xxxx	xxxx	xxxxx
Volume/Cap:	0.63	xxxx	xxxx	xxxx	xxxx	xxxx	3.44	xxxx	1.09	xxxx	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	4.3	xxxx	xxxxx	xxxx	xxxx	xxxxx	10.9	xxxx	11.3	xxxx	xxxx	xxxxx
Control Del:	23.3	xxxx	xxxxx	xxxxx	xxxx	xxxxx	1416	xxxx	126.2	xxxxx	xxxx	xxxxx
LOS by Move:	C	*	*	*	*	*	F	*	F	*	*	*
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			449.5			xxxxxx		
ApproachLOS:	*			*			F			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalahoa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.920
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	158.2
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Mamalahoa Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0 0	1 0	1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	491	633	0	0	1154	245	204	0	427	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	491	633	0	0	1154	245	204	0	427	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	517	666	0	0	1215	258	215	0	449	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	517	666	0	0	1215	258	215	0	449	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	517	666	0	0	1215	258	215	0	449	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.21	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	365	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	1.42	0.39	0.00	0.00	0.71	0.18	0.13	0.00	0.31	0.00	0.00	0.00
Crit Moves:	****								****			
Green/Cycle:	0.69	0.69	0.00	0.00	0.48	0.48	0.21	0.00	0.21	0.00	0.00	0.00
Volume/Cap:	1.25	0.57	0.00	0.00	1.50	0.37	0.64	0.00	1.50	0.00	0.00	0.00
Uniform Del:	6.4	7.8	0.0	0.0	26.1	16.6	36.2	0.0	39.6	0.0	0.0	0.0
IncremntDel:	130.9	0.7	0.0	0.0	229	0.3	4.1	0.0	239.6	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	137.3	8.5	0.0	0.0	255	16.9	40.3	0.0	279.2	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	137.3	8.5	0.0	0.0	255	16.9	40.3	0.0	279.2	0.0	0.0	0.0
LOS by Move:	F	A	A	A	F	B	D	A	F	A	A	A
HCM2kAvgQ:	31	11	0	0	87	5	7	0	34	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #5 Kealakaa/Hina Lani

Average Delay (sec/veh): 317.7 Worst Case Level Of Service: F[1657.7]

Street Name:	Kealakaa Street						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	99	16	69	130	14	190	61	351	33	26	869	49
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	99	16	69	130	14	190	61	351	33	26	869	49
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	104	17	73	137	15	200	64	369	35	27	915	52
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	104	17	73	137	15	200	64	369	35	27	915	52
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1618	1536	387	1555	1528	941	966	xxxx	xxxxx	404	xxxx	xxxxx
Potent Cap.:	84	117	666	93	119	322	721	xxxx	xxxxx	1165	xxxx	xxxxx
Move Cap.:	26	104	666	66	105	322	721	xxxx	xxxxx	1165	xxxx	xxxxx
Volume/Cap:	4.01	0.16	0.11	2.07	0.14	0.62	0.09	xxxx	xxxx	0.02	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.3	xxxx	xxxxx	0.1	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	10.5	xxxx	xxxxx	8.2	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	B	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	45	xxxxx	xxxx	124	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	21.9	xxxxx	xxxxx	32.5	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	1658	xxxxx	xxxxx	898	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	F	*	*	F	*	*	*	*	*	*	*
ApproachDel:	1657.7			898.2			xxxxxx			xxxxxx		
ApproachLOS:	F			F			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.359
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	103.9
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2 0	1	1 0	2 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	929	698	299	1068	0	0	0	0	717	0	486
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	929	698	299	1068	0	0	0	0	717	0	486
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	978	735	315	1124	0	0	0	0	755	0	512
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	978	735	315	1124	0	0	0	0	755	0	512
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	978	735	315	1124	0	0	0	0	755	0	512
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.29	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	501	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.30	0.51	0.63	0.35	0.00	0.00	0.00	0.00	0.58	0.00	0.35
Crit Moves:			****	****						****		
Green/Cycle:	0.00	0.36	0.36	0.49	0.49	0.00	0.00	0.00	0.00	0.41	0.00	0.41
Volume/Cap:	0.00	0.85	1.42	1.09	0.70	0.00	0.00	0.00	0.00	1.42	0.00	0.87
Uniform Del:	0.0	29.6	32.1	28.5	19.6	0.0	0.0	0.0	0.0	29.7	0.0	27.3
IncremntDel:	0.0	6.0	201.4	78.6	1.4	0.0	0.0	0.0	0.0	201.1	0.0	13.5
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	35.6	233.6	107.1	21.1	0.0	0.0	0.0	0.0	230.9	0.0	40.9
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	35.6	233.6	107.1	21.1	0.0	0.0	0.0	0.0	230.9	0.0	40.9
LOS by Move:	A	D	F	F	C	A	A	A	A	F	A	D
HCM2kAvgQ:	0	17	51	17	15	0	0	0	0	52	0	18

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.826
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	21.7
Optimal Cycle:	78	Level Of Service:	C

Street Name:	Queen Kaahumanu Highway (SR-19)						Kaiminani Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	2 0	1	1 0	2 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	395	282	580	1182	0	0	0	0	199	0	131
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	395	282	580	1182	0	0	0	0	199	0	131
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	416	297	611	1244	0	0	0	0	209	0	138
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	416	297	611	1244	0	0	0	0	209	0	138
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	416	297	611	1244	0	0	0	0	209	0	138
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.95	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	1615	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.13	0.21	0.38	0.39	0.00	0.00	0.00	0.00	0.16	0.00	0.10
Crit Moves:			****	****						****		
Green/Cycle:	0.00	0.25	0.25	0.71	0.71	0.00	0.00	0.00	0.00	0.19	0.00	0.19
Volume/Cap:	0.00	0.52	0.83	0.71	0.55	0.00	0.00	0.00	0.00	0.83	0.00	0.49
Uniform Del:	0.0	32.4	35.5	10.8	7.0	0.0	0.0	0.0	0.0	38.7	0.0	35.9
IncremntDel:	0.0	0.6	14.5	2.7	0.3	0.0	0.0	0.0	0.0	19.5	0.0	1.4
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	33.0	50.0	13.5	7.3	0.0	0.0	0.0	0.0	58.2	0.0	37.3
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	33.0	50.0	13.5	7.3	0.0	0.0	0.0	0.0	58.2	0.0	37.3
LOS by Move:	A	C	D	B	A	A	A	A	A	E	A	D
HCM2kAvgQ:	0	6	11	12	10	0	0	0	0	9	0	4

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Average Delay (sec/veh): 8.2 Worst Case Level Of Service: F[50.6]

Street Name:	Holoholo St						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	62	6	45	23	5	40	170	464	116	59	110	27
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	62	6	45	23	5	40	170	464	116	59	110	27
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	65	6	47	24	5	42	179	488	122	62	116	28
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	65	6	47	24	5	42	179	488	122	62	116	28
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1185	1176	549	1188	1223	130	144	xxxx	xxxxx	611	xxxx	xxxxx
Potent Cap.:	167	193	539	166	181	925	1451	xxxx	xxxxx	978	xxxx	xxxxx
Move Cap.:	132	156	539	125	146	925	1451	xxxx	xxxxx	978	xxxx	xxxxx
Volume/Cap:	0.49	0.04	0.09	0.19	0.04	0.05	0.12	xxxx	xxxx	0.06	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.4	xxxx	xxxxx	0.2	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	7.8	xxxx	xxxxx	8.9	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	A	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	191	xxxxx	xxxx	261	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	3.5	xxxxx	xxxxx	1.1	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	50.6	xxxxx	xxxxx	24.0	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	F	*	*	C	*	*	*	*	*	*	*
ApproachDel:		50.6			24.0			xxxxxx			xxxxxx	
ApproachLOS:		F			C			*			*	

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #3 Mamalahoa/Kaiminani

Average Delay (sec/veh): 80.1 Worst Case Level Of Service: F[241.4]

Street Name:	Mamalahoa Hwy						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0	1 0	0	0 0	1 0	1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	187	704	0	0	582	100	131	0	638	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	187	704	0	0	582	100	131	0	638	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	197	741	0	0	613	105	138	0	672	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	197	741	0	0	613	105	138	0	672	0	0	0
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2	xxxxx	xxxx	xxxxx
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3	xxxxx	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	718	xxxx	xxxxx	xxxx	xxxx	xxxxx	1747	xxxx	613	xxxx	xxxx	xxxxx
Potent Cap.:	892	xxxx	xxxxx	xxxx	xxxx	xxxxx	96	xxxx	496	xxxx	xxxx	xxxxx
Move Cap.:	892	xxxx	xxxxx	xxxx	xxxx	xxxxx	79	xxxx	496	xxxx	xxxx	xxxxx
Volume/Cap:	0.22	xxxx	xxxx	xxxx	xxxx	xxxx	1.74	xxxx	1.35	xxxx	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	0.8	xxxx	xxxxx	xxxx	xxxx	xxxxx	11.7	xxxx	30.2	xxxx	xxxx	xxxxx
Control Del:	10.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	466.3	xxxx	195.2	xxxxx	xxxx	xxxxx
LOS by Move:	B	*	*	*	*	*	F	*	F	*	*	*
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			241.4			xxxxxx		
ApproachLOS:	*			*			F			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalahoa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.952
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	235.0
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Mamalahoa Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0 0	1 0	1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	379	836	0	0	1074	223	280	0	907	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	379	836	0	0	1074	223	280	0	907	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	399	880	0	0	1131	235	295	0	955	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	399	880	0	0	1131	235	295	0	955	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	399	880	0	0	1131	235	295	0	955	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.21	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	364	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	1.10	0.52	0.00	0.00	0.67	0.16	0.18	0.00	0.66	0.00	0.00	0.00
Crit Moves:	****								****			
Green/Cycle:	0.52	0.52	0.00	0.00	0.38	0.38	0.38	0.00	0.38	0.00	0.00	0.00
Volume/Cap:	1.35	0.99	0.00	0.00	1.75	0.43	0.48	0.00	1.75	0.00	0.00	0.00
Uniform Del:	14.0	23.7	0.0	0.0	31.0	22.9	23.7	0.0	31.1	0.0	0.0	0.0
IncremntDel:	176.7	28.1	0.0	0.0	343	0.5	0.6	0.0	343.9	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	190.7	51.8	0.0	0.0	374	23.4	24.3	0.0	375.0	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	190.7	51.8	0.0	0.0	374	23.4	24.3	0.0	375.0	0.0	0.0	0.0
LOS by Move:	F	D	A	A	F	C	C	A	F	A	A	A
HCM2kAvgQ:	27	34	0	0	94	6	7	0	80	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #5 Kealakaa/Hina Lani

Average Delay (sec/veh): OVERFLOW Worst Case Level Of Service: F[xxxxx]

Street Name:	Kealakaa Street						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0	1! 0	0	0 0	1! 0	0	0 0	1! 0	0	0 0	1! 0	0
Volume Module:												
Base Vol:	66	33	49	99	36	126	214	608	112	79	678	154
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	66	33	49	99	36	126	214	608	112	79	678	154
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	69	35	52	104	38	133	225	640	118	83	714	162
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	69	35	52	104	38	133	225	640	118	83	714	162
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	2196	2192	699	2154	2169	795	876	xxxx	xxxxx	758	xxxx	xxxxx
Potent Cap.:	33	46	443	35	47	391	779	xxxx	xxxxx	862	xxxx	xxxxx
Move Cap.:	0	28	443	0	29	391	779	xxxx	xxxxx	862	xxxx	xxxxx
Volume/Cap:	xxxx	1.26	0.12	xxxx	1.33	0.34	0.29	xxxx	xxxx	0.10	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	1.2	xxxx	xxxxx	0.3	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	11.5	xxxx	xxxxx	9.6	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	B	*	*	A	*	*
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT
Shared Cap.:	xxxx	0	xxxxx	xxxx	0	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			xxxxxx		
ApproachLOS:	F			F			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	2.173
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	181.7
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Prot+Permit			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0 2	0 1		1 0 2	0 0		0 0 0	0 0		1 0	0 0 1	
Volume Module:												
Base Vol:	0	879	896	561	861	0	0	0	0	664	0	468
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	879	896	561	861	0	0	0	0	664	0	468
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	925	943	591	906	0	0	0	0	699	0	493
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	925	943	591	906	0	0	0	0	699	0	493
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	925	943	591	906	0	0	0	0	699	0	493
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.24	0.95	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	2.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	415	3230	0	0	0	0	1307	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.29	0.65	1.42	0.28	0.00	0.00	0.00	0.00	0.53	0.00	0.34
Crit Moves:				****						****		
Green/Cycle:	0.00	0.38	0.38	0.59	0.59	0.00	0.00	0.00	0.00	0.31	0.00	0.31
Volume/Cap:	0.00	0.76	1.73	1.41	0.48	0.00	0.00	0.00	0.00	1.73	0.00	1.10
Uniform Del:	0.0	27.1	31.1	28.5	11.7	0.0	0.0	0.0	0.0	34.5	0.0	34.5
IncremntDel:	0.0	2.8	334.2	196.7	0.2	0.0	0.0	0.0	0.0	336.7	0.0	72.6
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	29.9	365.2	225.2	11.9	0.0	0.0	0.0	0.0	371.3	0.0	107.1
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	29.9	365.2	225.2	11.9	0.0	0.0	0.0	0.0	371.3	0.0	107.1
LOS by Move:	A	C	F	F	B	A	A	A	A	F	A	F
HCM2kAvgQ:	0	15	78	41	8	0	0	0	0	58	0	25

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.619
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	19.6
Optimal Cycle:	45	Level Of Service:	B

Street Name:	Holoholo St						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	1! 0	0	0 0	1! 0	0	0 0	1! 0	0	0 0	1! 0	0
Volume Module:												
Base Vol:	123	3	59	27	7	207	48	234	40	23	519	7
Growth Adj:	1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00	
Initial Bse:	123	3	59	27	7	207	48	234	40	23	519	7
User Adj:	1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00	
PHF Adj:	0.95 0.95	0.95		0.95 0.95	0.95		0.95 0.95	0.95		0.95 0.95	0.95	
PHF Volume:	129	3	62	28	7	218	51	246	42	24	546	7
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	129	3	62	28	7	218	51	246	42	24	546	7
PCE Adj:	1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00	
MLF Adj:	1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00	
Final Vol.:	129	3	62	28	7	218	51	246	42	24	546	7
Saturation Flow Module:												
Sat/Lane:	1700 1700	1700		1700 1700	1700		1700 1700	1700		1700 1700	1700	
Adjustment:	0.55 0.55	0.55		0.84 0.84	0.84		0.85 0.85	0.85		0.98 0.98	0.98	
Lanes:	0.66 0.02	0.32		0.11 0.03	0.86		0.15 0.73	0.12		0.04 0.95	0.01	
Final Sat.:	619	15	297	160	42	1230	216	1054	180	70	1569	21
Capacity Analysis Module:												
Vol/Sat:	0.21 0.21	0.21		0.18 0.18	0.18		0.23 0.23	0.23		0.35 0.35	0.35	
Crit Moves:	****									****		
Green/Cycle:	0.34 0.34	0.34		0.34 0.34	0.34		0.56 0.56	0.56		0.56 0.56	0.56	
Volume/Cap:	0.62 0.62	0.62		0.52 0.52	0.52		0.42 0.42	0.42		0.62 0.62	0.62	
Uniform Del:	27.7 27.7	27.7		26.6 26.6	26.6		12.5 12.5	12.5		14.7 14.7	14.7	
IncremntDel:	3.8 3.8	3.8		1.1 1.1	1.1		0.3 0.3	0.3		1.3 1.3	1.3	
InitQueuDel:	0.0 0.0	0.0		0.0 0.0	0.0		0.0 0.0	0.0		0.0 0.0	0.0	
Delay Adj:	1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00	
Delay/Veh:	31.5 31.5	31.5		27.7 27.7	27.7		12.9 12.9	12.9		16.0 16.0	16.0	
User DelAdj:	1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00	
AdjDel/Veh:	31.5 31.5	31.5		27.7 27.7	27.7		12.9 12.9	12.9		16.0 16.0	16.0	
LOS by Move:	C	C	C	C	C	C	B	B	B	B	B	B
HCM2kAvgQ:	6	6	6	7	7	7	6	6	6	12	12	12

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #3 Mamalahoa/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.024
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	42.3
Optimal Cycle:	180	Level Of Service:	D

Street Name:	Mamalahoa Hwy						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0 0	1 0	1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	301	375	0	0	1093	212	84	0	251	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	301	375	0	0	1093	212	84	0	251	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	317	395	0	0	1151	223	88	0	264	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	317	395	0	0	1151	223	88	0	264	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	317	395	0	0	1151	223	88	0	264	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.66	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	1125	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.28	0.23	0.00	0.00	0.68	0.15	0.05	0.00	0.18	0.00	0.00	0.00
Crit Moves:	****				****		****					
Green/Cycle:	0.85	0.85	0.00	0.00	0.66	0.66	0.05	0.00	0.24	0.00	0.00	0.00
Volume/Cap:	0.84	0.27	0.00	0.00	1.03	0.24	1.03	0.00	0.75	0.00	0.00	0.00
Uniform Del:	33.3	1.5	0.0	0.0	17.2	7.0	47.3	0.0	35.0	0.0	0.0	0.0
IncremntDel:	15.9	0.1	0.0	0.0	35.1	0.1	105.8	0.0	8.8	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	49.2	1.6	0.0	0.0	52.3	7.1	153.2	0.0	43.8	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	49.2	1.6	0.0	0.0	52.3	7.1	153.2	0.0	43.8	0.0	0.0	0.0
LOS by Move:	D	A	A	A	D	A	F	A	D	A	A	A
HCM2kAvgQ:	8	3	0	0	46	3	6	0	9	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalahoa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.015
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	43.9
Optimal Cycle:	180	Level Of Service:	D

Street Name:	Mamalahoa Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0	0 1	1 0	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	491	633	0	0	1154	245	204	0	427	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	491	633	0	0	1154	245	204	0	427	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	517	666	0	0	1215	258	215	0	449	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	517	666	0	0	1215	258	215	0	449	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	517	666	0	0	1215	258	215	0	449	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.78	1.00	1.00	1.00	0.93	0.93	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.65	0.35	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	1318	1700	0	0	2595	551	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.39	0.39	0.00	0.00	0.47	0.47	0.13	0.00	0.31	0.00	0.00	0.00
Crit Moves:	****				****		****					
Green/Cycle:	0.77	0.77	0.00	0.00	0.46	0.46	0.13	0.00	0.44	0.00	0.00	0.00
Volume/Cap:	0.90	0.51	0.00	0.00	1.02	1.02	1.02	0.00	0.70	0.00	0.00	0.00
Uniform Del:	27.3	4.3	0.0	0.0	27.1	27.1	43.5	0.0	22.5	0.0	0.0	0.0
IncremntDel:	17.5	0.3	0.0	0.0	29.8	29.8	68.3	0.0	3.5	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	44.8	4.7	0.0	0.0	57.0	57.0	111.9	0.0	26.1	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	44.8	4.7	0.0	0.0	57.0	57.0	111.9	0.0	26.1	0.0	0.0	0.0
LOS by Move:	D	A	A	A	E	E	F	A	C	A	A	A
HCM2kAvgQ:	16	8	0	0	33	33	11	0	12	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #5 Kealakaa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.954
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	36.4
Optimal Cycle:	141	Level Of Service:	D

Street Name:	Kealakaa Street						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	1! 0	0	0 0	1! 0	0	1 0	0 1	0	1 0	0 1	0
Volume Module:												
Base Vol:	99	16	69	130	14	190	61	351	33	26	869	49
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	99	16	69	130	14	190	61	351	33	26	869	49
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	104	17	73	137	15	200	64	369	35	27	915	52
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	104	17	73	137	15	200	64	369	35	27	915	52
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	104	17	73	137	15	200	64	369	35	27	915	52
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.59	0.59	0.59	0.72	0.72	0.72	0.10	0.99	0.99	0.47	0.99	0.99
Lanes:	0.54	0.09	0.37	0.39	0.04	0.57	1.00	0.91	0.09	1.00	0.95	0.05
Final Sat.:	536	87	373	479	52	701	167	1534	144	794	1596	90
Capacity Analysis Module:												
Vol/Sat:	0.19	0.19	0.19	0.29	0.29	0.29	0.39	0.24	0.24	0.03	0.57	0.57
Crit Moves:					****						****	
Green/Cycle:	0.30	0.30	0.30	0.30	0.30	0.30	0.60	0.60	0.60	0.60	0.60	0.60
Volume/Cap:	0.65	0.65	0.65	0.95	0.95	0.95	0.64	0.40	0.40	0.06	0.95	0.95
Uniform Del:	30.5	30.5	30.5	34.4	34.4	34.4	13.0	10.5	10.5	8.3	18.7	18.7
IncremntDel:	5.0	5.0	5.0	34.9	34.9	34.9	13.3	0.3	0.3	0.1	18.1	18.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	35.5	35.5	35.5	69.2	69.2	69.2	26.2	10.8	10.8	8.3	36.8	36.8
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	35.5	35.5	35.5	69.2	69.2	69.2	26.2	10.8	10.8	8.3	36.8	36.8
LOS by Move:	D	D	D	E	E	E	C	B	B	A	D	D
HCM2kAvgQ:	6	6	6	15	15	15	3	7	7	0	34	34

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.967
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	33.8
Optimal Cycle:	154	Level Of Service:	C

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Prot+Permit			Split Phase			Split Phase		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0 2	0 1		2 0 2	0 0		0 0 0	0 0		1 0 0	0 1	
Volume Module:												
Base Vol:	0	929	698	299	1068	0	0	0	0	717	0	486
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	929	698	299	1068	0	0	0	0	717	0	486
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	978	735	315	1124	0	0	0	0	755	0	512
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	978	735	315	1124	0	0	0	0	755	0	512
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	978	735	315	1124	0	0	0	0	755	0	512
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.92	0.95	1.00	1.00	1.00	1.00	0.95	1.00	0.85
Lanes:	0.00	2.00	1.00	2.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	3133	3230	0	0	0	0	1615	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.30	0.51	0.10	0.35	0.00	0.00	0.00	0.00	0.47	0.00	0.35
Crit Moves:		****		****						****		
Green/Cycle:	0.00	0.31	0.80	0.42	0.42	0.00	0.00	0.00	0.00	0.48	0.00	0.48
Volume/Cap:	0.00	0.97	0.64	0.37	0.83	0.00	0.00	0.00	0.00	0.97	0.00	0.73
Uniform Del:	0.0	33.8	4.2	22.8	26.1	0.0	0.0	0.0	0.0	25.1	0.0	20.7
IncremntDel:	0.0	20.7	1.2	0.3	4.7	0.0	0.0	0.0	0.0	24.3	0.0	4.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	54.6	5.4	23.1	30.8	0.0	0.0	0.0	0.0	49.4	0.0	24.7
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	54.6	5.4	23.1	30.8	0.0	0.0	0.0	0.0	49.4	0.0	24.7
LOS by Move:	A	D	A	C	C	A	A	A	A	D	A	C
HCM2kAvgQ:	0	21	10	4	19	0	0	0	0	29	0	14

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #2 Holoholo/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.711
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	13.9
Optimal Cycle:	55	Level Of Service:	B

Street Name:	Holoholo St						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	1!	0	0 0	1!	0	0 0	1!	0	0 0	1!	0
Volume Module:												
Base Vol:	62	6	45	23	5	40	170	464	116	59	110	27
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	62	6	45	23	5	40	170	464	116	59	110	27
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	65	6	47	24	5	42	179	488	122	62	116	28
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	65	6	47	24	5	42	179	488	122	62	116	28
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	65	6	47	24	5	42	179	488	122	62	116	28
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.77	0.77	0.77	0.81	0.81	0.81	0.85	0.85	0.85	0.69	0.69	0.69
Lanes:	0.55	0.05	0.40	0.34	0.07	0.59	0.23	0.62	0.15	0.30	0.56	0.14
Final Sat.:	716	69	519	464	101	808	326	891	223	355	662	162
Capacity Analysis Module:												
Vol/Sat:	0.09	0.09	0.09	0.05	0.05	0.05	0.55	0.55	0.55	0.17	0.17	0.17
Crit Moves:	****						****					
Green/Cycle:	0.13	0.13	0.13	0.13	0.13	0.13	0.77	0.77	0.77	0.77	0.77	0.77
Volume/Cap:	0.71	0.71	0.71	0.41	0.41	0.41	0.71	0.71	0.71	0.23	0.23	0.23
Uniform Del:	41.8	41.8	41.8	40.1	40.1	40.1	5.8	5.8	5.8	3.2	3.2	3.2
IncremntDel:	13.3	13.3	13.3	1.5	1.5	1.5	2.2	2.2	2.2	0.1	0.1	0.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	55.1	55.1	55.1	41.6	41.6	41.6	7.9	7.9	7.9	3.3	3.3	3.3
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	55.1	55.1	55.1	41.6	41.6	41.6	7.9	7.9	7.9	3.3	3.3	3.3
LOS by Move:	E	E	E	D	D	D	A	A	A	A	A	A
HCM2kAvgQ:	5	5	5	2	2	2	13	13	13	2	2	2

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #3 Mamalahoa/Kaiminani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.917
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	34.5
Optimal Cycle:	114	Level Of Service:	C

Street Name:	Mamalahoa Hwy						Kaiminani Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0 0	1 0	1	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	187	704	0	0	582	100	131	0	638	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	187	704	0	0	582	100	131	0	638	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	197	741	0	0	613	105	138	0	672	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	197	741	0	0	613	105	138	0	672	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	197	741	0	0	613	105	138	0	672	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.95	1.00	1.00	1.00	1.00	0.85	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	1615	1700	0	0	1700	1445	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.12	0.44	0.00	0.00	0.36	0.07	0.09	0.00	0.46	0.00	0.00	0.00
Crit Moves:	****				****				****			
Green/Cycle:	0.53	0.53	0.00	0.00	0.39	0.39	0.37	0.00	0.51	0.00	0.00	0.00
Volume/Cap:	0.70	0.83	0.00	0.00	0.92	0.19	0.23	0.00	0.92	0.00	0.00	0.00
Uniform Del:	21.7	19.9	0.0	0.0	28.8	19.9	21.4	0.0	22.7	0.0	0.0	0.0
IncremntDel:	7.4	6.5	0.0	0.0	17.5	0.2	0.2	0.0	16.3	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	29.1	26.4	0.0	0.0	46.3	20.0	21.6	0.0	39.1	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	29.1	26.4	0.0	0.0	46.3	20.0	21.6	0.0	39.1	0.0	0.0	0.0
LOS by Move:	C	C	A	A	D	C	C	A	D	A	A	A
HCM2kAvgQ:	6	21	0	0	22	2	3	0	23	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Mamalahoa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.168
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	96.6
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Mamalahoa Highway (SR-190)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0	0 1	1 0	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	379	836	0	0	1074	223	280	0	907	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	379	836	0	0	1074	223	280	0	907	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	399	880	0	0	1131	235	295	0	955	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	399	880	0	0	1131	235	295	0	955	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	399	880	0	0	1131	235	295	0	955	0	0	0
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.41	1.00	1.00	1.00	0.93	0.93	0.95	1.00	0.85	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	1.66	0.34	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	693	1700	0	0	2605	541	1615	0	1445	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.58	0.52	0.00	0.00	0.43	0.43	0.18	0.00	0.66	0.00	0.00	0.00
Crit Moves:	****				****				****			
Green/Cycle:	0.56	0.56	0.00	0.00	0.36	0.36	0.34	0.00	0.54	0.00	0.00	0.00
Volume/Cap:	1.01	0.92	0.00	0.00	1.22	1.22	0.54	0.00	1.22	0.00	0.00	0.00
Uniform Del:	12.8	20.1	0.0	0.0	32.2	32.2	26.6	0.0	22.8	0.0	0.0	0.0
IncremntDel:	47.1	14.3	0.0	0.0	106	105.6	1.1	0.0	108.9	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	59.9	34.4	0.0	0.0	138	137.8	27.7	0.0	131.7	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	59.9	34.4	0.0	0.0	138	137.8	27.7	0.0	131.7	0.0	0.0	0.0
LOS by Move:	E	C	A	A	F	F	C	A	F	A	A	A
HCM2kAvgQ:	18	29	0	0	40	40	8	0	52	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #5 Kealakaa/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	0.962
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	27.5
Optimal Cycle:	149	Level Of Service:	C

Street Name:	Kealakaa Street						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	1! 0	0	0 0	1! 0	0	1 0	0 1	0	1 0	0 1	0
Volume Module:												
Base Vol:	66	33	49	99	36	126	214	608	112	79	678	154
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	66	33	49	99	36	126	214	608	112	79	678	154
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	69	35	52	104	38	133	225	640	118	83	714	162
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	69	35	52	104	38	133	225	640	118	83	714	162
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	69	35	52	104	38	133	225	640	118	83	714	162
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	0.65	0.65	0.65	0.74	0.74	0.74	0.21	0.98	0.98	0.27	0.97	0.97
Lanes:	0.45	0.22	0.33	0.38	0.14	0.48	1.00	0.84	0.16	1.00	0.81	0.19
Final Sat.:	496	248	368	475	173	605	349	1403	258	454	1347	306
Capacity Analysis Module:												
Vol/Sat:	0.14	0.14	0.14	0.22	0.22	0.22	0.65	0.46	0.46	0.18	0.53	0.53
Crit Moves:					****		****					
Green/Cycle:	0.23	0.23	0.23	0.23	0.23	0.23	0.67	0.67	0.67	0.67	0.67	0.67
Volume/Cap:	0.61	0.61	0.61	0.96	0.96	0.96	0.96	0.68	0.68	0.27	0.79	0.79
Uniform Del:	34.7	34.7	34.7	38.2	38.2	38.2	15.2	9.9	9.9	6.6	11.4	11.4
IncremntDel:	4.4	4.4	4.4	42.8	42.8	42.8	48.0	1.7	1.7	0.5	3.9	3.9
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	39.1	39.1	39.1	80.9	80.9	80.9	63.2	11.6	11.6	7.1	15.3	15.3
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	39.1	39.1	39.1	80.9	80.9	80.9	63.2	11.6	11.6	7.1	15.3	15.3
LOS by Move:	D	D	D	F	F	F	E	B	B	A	B	B
HCM2kAvgQ:	5	5	5	13	13	13	11	15	15	1	20	20

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu/Hina Lani

Cycle (sec):	100	Critical Vol./Cap.(X):	1.007
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	38.9
Optimal Cycle:	180	Level Of Service:	D

Street Name:	Queen Kaahumanu Highway (SR-19)						Hina Lani Street					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Prot+Permit			Split Phase			Split Phase		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0 2	0 1		2 0 2	0 0		0 0 0	0 0		1 0	0 0 1	
Volume Module:												
Base Vol:	0	879	896	561	861	0	0	0	0	664	0	468
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	879	896	561	861	0	0	0	0	664	0	468
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	925	943	591	906	0	0	0	0	699	0	493
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	925	943	591	906	0	0	0	0	699	0	493
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	925	943	591	906	0	0	0	0	699	0	493
Saturation Flow Module:												
Sat/Lane:	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
Adjustment:	1.00	0.95	0.85	0.92	0.95	1.00	1.00	1.00	1.00	0.95	1.00	0.85
Lanes:	0.00	2.00	1.00	2.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	3230	1445	3114	3230	0	0	0	0	1615	0	1445
Capacity Analysis Module:												
Vol/Sat:	0.00	0.29	0.65	0.19	0.28	0.00	0.00	0.00	0.00	0.43	0.00	0.34
Crit Moves:		****		****						****		
Green/Cycle:	0.00	0.28	0.71	0.47	0.47	0.00	0.00	0.00	0.00	0.43	0.00	0.43
Volume/Cap:	0.00	1.01	0.92	0.53	0.60	0.00	0.00	0.00	0.00	1.01	0.00	0.79
Uniform Del:	0.0	35.8	11.8	20.8	19.5	0.0	0.0	0.0	0.0	28.5	0.0	24.7
IncremntDel:	0.0	31.8	12.3	0.5	0.6	0.0	0.0	0.0	0.0	36.3	0.0	7.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	67.6	24.2	21.4	20.1	0.0	0.0	0.0	0.0	64.9	0.0	31.7
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	67.6	24.2	21.4	20.1	0.0	0.0	0.0	0.0	64.9	0.0	31.7
LOS by Move:	A	E	C	C	C	A	A	A	A	E	A	C
HCM2kAvgQ:	0	22	28	7	11	0	0	0	0	29	0	15

Note: Queue reported is the number of cars per lane.

Appendix N

AIR QUALITY STUDY

FOR THE PROPOSED

KULA NEI PROJECT

NORTH KONA, HAWAII

Prepared for:

Belt Collins Hawaii Ltd.

May 2007

B.D. NEAL & ASSOCIATES

Applied Meteorology • Air Quality • Computer Science

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1.0 SUMMARY

The Shopoff Group is proposing to develop the Kula Nei Residential Development near Kalaoa in the North Kona District on the island of Hawaii. The proposed project will include 270 residential market and affordable units and associated amenities and facilities. Development of the project is expected to be completed and fully occupied by 2017. This study examines the potential short- and long-term air quality impacts that could occur as a result of construction and use of the proposed facilities and suggests mitigative measures to reduce any potential air quality impacts where possible and appropriate.

Both federal and state standards have been established to maintain ambient air quality. At the present time, seven parameters are regulated including: particulate matter, sulfur dioxide, hydrogen sulfide, nitrogen dioxide, carbon monoxide, ozone and lead. Hawaii air quality standards are comparable to the national standards except those for nitrogen dioxide and carbon monoxide which are more stringent than the national standards.

Regional and local climate together with the amount and type of human activity generally dictate the air quality of a given location. The climate of the project area is very much affected by its near coastal situation and by nearby mountains. Winds are predominantly light and variable, although kona storms generate occasional strong winds from the south or southwest during winter. Temperatures in the project area are generally very consistent and moderate with average daily temperatures ranging from about 65°F to 85°F. The extreme minimum temperature recorded at the nearby Old Kona Airport is 47°F, while the extreme maximum temperature is

93°F. Average annual rainfall in the area amounts to about 25 inches with each month typically contributing about 2 inches.

Except for periodic impacts from volcanic emissions (vog) and possibly occasional localized impacts from traffic congestion, the present air quality of the project area is believed to be relatively good. The limited air quality data that are available for the area from the Department of Health indicate that (despite the vog) concentrations are well within state and national air quality standards.

If the proposed project is given the necessary approvals to proceed, it may be inevitable that some short- and/or long-term impacts on air quality will occur either directly or indirectly as a consequence of project construction and use. Short-term impacts from fugitive dust will likely occur during the project construction phase. To a lesser extent, exhaust emissions from stationary and mobile construction equipment, from the disruption of traffic, and from workers' vehicles may also affect air quality during the period of construction. State air pollution control regulations require that there be no visible fugitive dust emissions at the property line. Hence, an effective dust control plan must be implemented to ensure compliance with state regulations. Fugitive dust emissions can be controlled to a large extent by watering of active work areas, using wind screens, keeping adjacent paved roads clean, and by covering of open-bodied trucks. Other dust control measures could include limiting the area that can be disturbed at any given time and/or mulching or chemically stabilizing inactive areas that have been worked. Paving and landscaping of project areas early in the construction schedule will also reduce dust emissions. Monitoring dust at the project boundary during the period of construction could be considered as

a means to evaluate the effectiveness of the project dust control program. Exhaust emissions can be mitigated by moving construction equipment and workers to and from the project site during off-peak traffic hours.

After construction, motor vehicles coming to and from the proposed development will result in a long-term increase in air pollution emissions in the project area. To assess the impact of emissions from these vehicles, a computerized air quality modeling study was undertaken to estimate current ambient concentrations of carbon monoxide at several roadway intersections in the project vicinity and to predict future levels both with and without the proposed project. During worst-case conditions, model results indicated that present 1-hour and 8-hour carbon monoxide concentrations are within both the state and the national ambient air quality standards. In the year 2020 without the project, carbon monoxide concentrations were generally predicted to remain about the same or decrease in the project area even though larger volumes of traffic are expected. This is the result of older, more-polluting vehicles being retired over time. With the project in the year 2020 and with the traffic mitigation measures recommended in the project traffic study, carbon monoxide concentrations were estimated to either remain about the same or decrease compared to the without-project case. Worst-case concentrations should remain within both national and state standards through the year 2020. Implementing mitigation measures for traffic-related air quality impacts is probably unnecessary and unwarranted.

Depending on the demand levels, long-term impacts on air quality are also possible due to indirect emissions associated with a development's electrical power and solid waste disposal requirements. Quantitative estimates of these potential impacts were

not made, but based on the estimated demand levels and emission rates involved, any significant impacts are unlikely. Nevertheless, incorporating energy conservation design features and promoting conservation and recycling programs within the proposed development could serve to further reduce any associated impacts and conserve the island's resources.

2.0 INTRODUCTION

The Shopoff Group is proposing to develop the Kula Nei Residential Development on approximately 130 acres of undeveloped lands near Kalaoa in the North Kona District on the island of Hawaii (see Figure 1 for project location). The project site is mauka of Queen Kaahumanu Highway, makai of Mamalahoa Highway and the Kona Hills Estates subdivision, north of Hina Lani Street, and south of Kaiminani Drive. The proposed development includes 270 residential market and affordable units and 2.5 acres of open space. Full development and occupancy of the development is planned by 2017.

The purpose of this study is to describe existing air quality in the project area and to assess the potential short- and long-term direct and indirect air quality impacts that could result from construction and use of the proposed facilities as planned. Measures to mitigate project impacts are suggested where possible and appropriate.

3.0 AMBIENT AIR QUALITY STANDARDS

Ambient concentrations of air pollution are regulated by both national and state ambient air quality standards (AAQS). National AAQS are specified in Section 40, Part 50 of the Code of

Federal Regulations (CFR), while State of Hawaii AAQS are defined in Chapter 11-59 of the Hawaii Administrative Rules. Table 1 summarizes both the national and the state AAQS that are specified in the cited documents. As indicated in the table, national and state AAQS have been established for particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead. The state has also set a standard for hydrogen sulfide. National AAQS are stated in terms of both primary and secondary standards for most of the regulated air pollutants. National primary standards are designed to protect the public health with an "adequate margin of safety". National secondary standards, on the other hand, define levels of air quality necessary to protect the public welfare from "any known or anticipated adverse effects of a pollutant". Secondary public welfare impacts may include such effects as decreased visibility, diminished comfort levels, or other potential injury to the natural or man-made environment, e.g., soiling of materials, damage to vegetation or other economic damage. In contrast to the national AAQS, Hawaii State AAQS are given in terms of a single standard that is designed "to protect public health and welfare and to prevent the significant deterioration of air quality".

Each of the regulated air pollutants has the potential to create or exacerbate some form of adverse health effect or to produce environmental degradation when present in sufficiently high concentration for prolonged periods of time. The AAQS specify a maximum allowable concentration for a given air pollutant for one or more averaging times to prevent harmful effects. Averaging times vary from one hour to one year depending on the pollutant and type of exposure necessary to cause adverse effects. In the case of the short-term (i.e., 1- to 24-hour) AAQS, both national and state standards allow a specified number of exceedances each year.

The Hawaii AAQS are in some cases considerably more stringent than the comparable national AAQS. In particular, the Hawaii 1-hour AAQS for carbon monoxide is four times more stringent than the comparable national limit. The U.S. Environmental Protection Agency (EPA) is currently working on a plan to phase out the national 1-hour ozone standard in favor of the new (and more stringent) 8-hour standard.

The Hawaii AAQS for sulfur dioxide were relaxed in 1986 to make the state standards essentially the same as the national limits. In 1993, the state also revised its particulate standards to follow those set by the federal government. During 1997, the federal government again revised its standards for particulate, but the new standards were challenged in federal court. A Supreme Court ruling was issued during February 2001, and as a result, the new standards for particulate were implemented during 2005. To date, the Hawaii Department of Health has not updated the state particulate standards. In September 2001, the state vacated the state 1-hour standard for ozone and an 8-hour standard was adopted.

4.0 REGIONAL AND LOCAL CLIMATOLOGY

Regional and local climatology significantly affect the air quality of a given location. Wind, temperature, atmospheric turbulence, mixing height and rainfall all influence air quality. Although the climate of Hawaii is relatively moderate throughout most of the state, significant differences in these parameters may occur from one location to another. Most differences in regional and local climates within the state are caused by the mountainous topography.

The site of the proposed project is located near the midpoint of the western coast of the island of Hawaii. The topography of Hawaii Island is dominated by the great volcanic masses of Mauna Loa (13,653 feet), Mauna Kea (13,796 feet), and of Hualalai, the Kohala Mountains and Kilauea. The island consists entirely of the slopes of these mountains and of the broad saddles between them. Mauna Loa and Kilauea, located on the southern half of the island, are still active volcanoes.

Hawaii lies well within the belt of northeasterly trade winds generated by the semi-permanent Pacific high pressure cell to the north and east. Nearly the entire western coast of the island of Hawaii, however, is sheltered from the trade winds by high mountains, except when unusually strong trade winds sweep through the saddle between the Kohala Mountains and Mauna Kea and reach some areas to the lee. Due to wind shadow effects caused by the terrain, winds in the project area are predominantly light and variable. Local winds such as land/sea breezes and/or upslope/downslope winds dominate the wind pattern for the area. During the daytime, winds typically move onshore because of seabreeze and/or upslope effects. At night, winds generally are land breezes and/or drainage winds that move downslope and out to sea. During winter, occasional strong winds from the south or southwest occur in association with the passage of winter storm systems.

Air pollution emissions from motor vehicles, the formation of photochemical smog and smoke plume rise all depend in part on air temperature. Colder temperatures tend to result in higher emissions of contaminants from automobiles but lower concentrations of photochemical smog and ground-level concentrations of air pollution from elevated plumes. In Hawaii, the

annual and daily variation of temperature depends to a large degree on elevation above sea level, distance inland and exposure to the trade winds. Average temperatures at locations near sea level generally are warmer than those at higher elevations. Areas exposed to the trade winds tend to have the least temperature variation, while inland and leeward areas often have the most. The project site's leeward location results in a larger temperature profile compared to windward locations at the same elevation. At the Old Kona Airport, located a few miles south of the project site, average daily minimum and maximum temperatures are 67°F and 83°F, respectively [1]. The extreme minimum temperature on record at this location is 47°F, and the extreme maximum is 93°F. Temperatures at the project site are similar but probably slightly cooler due to the higher elevation.

Small scale, random motions in the atmosphere (turbulence) cause air pollutants to be dispersed as a function of distance or time from the point of emission. Turbulence is caused by both mechanical and thermal forces in the atmosphere. It is often measured and described in terms of Pasquill-Gifford stability class. Stability class 1 is the most turbulent and class 6 is the least. Thus, air pollution dissipates the best during stability class 1 conditions and the worst when stability class 6 prevails. In the Kona area, stability classes 5 or 6 typically occur during the nighttime or early morning hours when temperature inversions form due to radiational cooling or to drainage flow from the mountainous interior of the island. Stability classes 1 through 4 occur during the daytime, depending mainly on the amount of cloud cover and incoming solar radiation and the onset and extent of the sea breeze.

Mixing height is defined as the height above the surface through which relatively vigorous vertical mixing occurs. Low mixing heights can result in high ground-level air pollution concentrations because contaminants emitted from or near the surface can become trapped within the mixing layer. In Hawaii, minimum mixing heights tend to be high because of mechanical mixing caused by the trade winds and because of the temperature moderating effect of the surrounding ocean. Low mixing heights may sometimes occur, however, at inland locations and even at times along coastal areas early in the morning following a clear, cool, windless night. Coastal areas also may experience low mixing levels during sea breeze conditions when cooler ocean air rushes in over warmer land. Mixing heights in Hawaii typically are above 3000 feet (1000 meters).

Rainfall can have a beneficial affect on the air quality of an area in that it helps to suppress fugitive dust emissions, and it also may "washout" gaseous contaminants that are water soluble. Rainfall in Hawaii is highly variable depending on elevation and on location with respect to the trade wind. The climate of the project area is wetter than might be expected for a leeward location. This is due to the persistent onshore and upslope movement of marine air caused by both eddie and seabreeze or mountain slope effects. Some of the rainfall occurs during summer afternoons and evenings as a result of this onshore and upslope movement of moisture-laden marine air, and some occurs in conjunction with winter storms. At the Old Kona Airport, average annual rainfall amounts to about 25 inches with each month registering about 2 inches [1]. Rainfall at the project site is probably slightly higher due to the higher elevation.

5.0 PRESENT AIR QUALITY

Present air quality in the project area is mostly affected by air pollutants from vehicular, industrial, natural and/or agricultural sources. Table 2 presents an air pollutant emission summary for the island of Hawaii for calendar year 1993. The emission rates shown in the table pertain to manmade emissions only, i.e., emissions from natural sources are not included. As suggested in the table, much of the manmade particulate emissions on Hawaii originate from area sources, such as the mineral products industry and agriculture. Manmade sulfur oxides are emitted almost exclusively by point sources, such as power plants and other fuel-burning industries. Nitrogen oxides emissions emanate predominantly from area sources (mostly motor vehicle traffic), although industrial point sources contribute a significant share. The majority of carbon monoxide emissions occur from area sources (motor vehicle traffic), while hydrocarbons are emitted mainly from point sources.

It should be noted that Hawaii Island is unique from the other islands in the state in terms of the natural volcanic air pollution emissions that occur. Volcanic emissions periodically plague the project area. This is especially so since the latest eruption phase of the Kilauea Volcano began in 1983. Air pollution emissions from the Hawaiian volcanoes consist primarily of sulfur dioxide. After entering the atmosphere, these sulfur dioxide emissions are carried away by the wind and either washed out as acid rain or gradually transformed into particulate sulfates or acid aerosols. Although emissions from Kilauea are vented on the other side of a mountain barrier more than 50 miles east of the project site, the prevailing wind patterns eventually carry some of the emissions into the Kona area. These emissions can be seen in the form of the volcanic haze (vog) which persistently hangs over the area.

The major industrial source of air pollution in the project vicinity is Hawaii Electric Light Company's Keahole Power Plant, which is located about 4 miles to the northwest. Air pollution emissions from Keahole Power Plant consist mostly of sulfur dioxide and oxides of nitrogen.

The project site is situated between Queen Kaahumanu Highway and Mamalahoa Highway. Both of these are regional arterial roadways that often carry substantial volumes of traffic. Upslope/downslope winds will tend to carry emissions from motor vehicles traversing these roadways toward the project area at times.

The State Department of Health operates a network of air quality monitoring stations at various locations around the state. Unfortunately, very limited data are available for Hawaii Island, and even less data are available for the Kona area specifically. During the most recent 5-year period for which data have been reported (2000-2004), the Department of Health operated an air quality monitoring site in the Kealakekua area for measuring sulfur dioxide. Particulate was also monitored at this site, but monitoring for this parameter was discontinued during 2000. As indicated in Table 3, measurements of sulfur dioxide concentrations at this location during the 2000-2004 monitoring period were consistently low with annual average concentrations of 6 to 10 $\mu g/m^3$, which represents about 10 percent of the state and national standard. The highest annual second-highest 3-hour and 24-hour concentrations (which are most relevant to the standards) for these five years were 58 and 22 $\mu g/m^3$, respectively; these are about 6 percent or less of the applicable

standards. No exceedances of the state/national 3-hour and 24-hour AAQS for sulfur dioxide were recorded. The annual average particulate concentration for 2000 was 18 $\mu g/m^3$, which equates to about 36 percent of the state/national standard. The second-highest 24-hour concentration of particulate matter, 23 $\mu g/m^3$, is about 15 percent of the state/national standard, and there were no violations of the state/national AAQS during the 2000 monitoring period. Monitoring of particulate matter was discontinued at this site during June 2000.

At this time, there are no reported measurements of lead, ozone, nitrogen dioxide or carbon monoxide in the project vicinity. These are primarily motor vehicle related air pollutants. Lead, ozone and nitrogen dioxide typically are regional scale problems. Concentrations of lead and nitrogen dioxide generally have not been found to exceed AAQS elsewhere in the state. Ozone concentrations, on the other hand, have been found to exceed the state standard at times at Sand Island on Oahu. Carbon monoxide air pollution typically is a microscale problem caused by congested motor vehicular traffic. In traffic congested areas such as urban Honolulu, carbon monoxide concentrations have been found to occasionally exceed the state AAQS. Present concentrations of carbon monoxide in the project area are estimated later in this study based on computer modeling of motor vehicle emissions.

6.0 SHORT-TERM IMPACTS OF PROJECT

Short-term direct and indirect impacts on air quality could potentially occur due to project construction. For a project of this nature, there are two potential types of air pollution emissions that could directly result in short-term air quality

impacts during project construction: (1) fugitive dust from vehicle movement and soil excavation; and (2) exhaust emissions from on-site construction equipment. Indirectly, there also could be short-term impacts from slow-moving construction equipment traveling to and from the project site, from a temporary increase in local traffic caused by commuting construction workers, and from the disruption of normal traffic flow caused by lane closures of adjacent roadways.

Fugitive dust emissions may arise from the grading and dirt-moving activities associated with site clearing and preparation work. The emission rate for fugitive dust emissions from construction activities is difficult to estimate accurately. This is because of its elusive nature of emission and because the potential for its generation varies greatly depending upon the type of soil at the construction site, the amount and type of dirt-disturbing activity taking place, the moisture content of exposed soil in work areas, and the wind speed. The EPA [2] has provided a rough estimate for uncontrolled fugitive dust emissions from construction activity of 1.2 tons per acre per month under conditions of "medium" activity, moderate soil silt content (30%), and precipitation/evaporation (P/E) index of 50. Uncontrolled fugitive dust emissions at the project site would likely be somewhere near that level, depending on the amount of rainfall that occurs. In any case, State of Hawaii Air Pollution Control Regulations [3] prohibit visible emissions of fugitive dust from construction activities at the property line. Thus, an effective dust control plan for the project construction phase is essential.

Adequate fugitive dust control can usually be accomplished by the establishment of a frequent watering program to keep bare-dirt surfaces in construction areas from becoming significant sources of dust. In dust-prone or dust-sensitive areas, other control

measures such as limiting the area that can be disturbed at any given time, applying chemical soil stabilizers, mulching and/or using wind screens may be necessary. Control regulations further stipulate that open-bodied trucks be covered at all times when in motion if they are transporting materials that could be blown away. Haul trucks tracking dirt onto paved streets from unpaved areas is often a significant source of dust in construction areas. Some means to alleviate this problem, such as road cleaning or tire washing, may be appropriate. Paving of parking areas and/or establishment of landscaping as early in the construction schedule as possible can also lower the potential for fugitive dust emissions. Monitoring dust at the project property line could be considered to quantify and document the effectiveness of dust control measures.

On-site mobile and stationary construction equipment also will emit air pollutants from engine exhausts. The largest of this equipment is usually diesel-powered. Nitrogen oxides emissions from diesel engines can be relatively high compared to gasoline-powered equipment, but the standard for nitrogen dioxide is set on an annual basis and is not likely to be violated by short-term construction equipment emissions. Carbon monoxide emissions from diesel engines, on the other hand, are low and should be relatively insignificant compared to vehicular emissions on nearby roadways.

Project construction activities will also likely obstruct the normal flow of traffic at times to such an extent that overall vehicular emissions in the project area will temporarily increase. The only means to alleviate this problem will be to attempt to keep roadways open during peak traffic hours and to move heavy construction equipment and workers to and from construction areas during periods of low traffic volume. Thus,

most potential short-term air quality impacts from project construction can be mitigated.

7.0 LONG-TERM IMPACTS OF PROJECT

7.1 Roadway Traffic

After construction is completed, use of the proposed facilities will result in increased motor vehicle traffic in the project area, potentially causing long-term impacts on ambient air quality. Motor vehicles with gasoline-powered engines are significant sources of carbon monoxide. They also emit nitrogen oxides and other contaminates.

Federal air pollution control regulations require that new motor vehicles be equipped with emission control devices that reduce emissions significantly compared to a few years ago. In 1990, the President signed into law the Clean Air Act Amendments. This legislation requires further emission reductions, which have been phased in since 1994. More recently, additional restrictions were signed into law during the Clinton administration, which will begin to take effect during the next decade. The added restrictions on emissions from new motor vehicles will lower average emissions each year as more and more older vehicles leave the state's roadways. It is estimated that carbon monoxide emissions, for example, will go down by an average of about 30 to 40 percent per vehicle during the next 10 years due to the replacement of older vehicles with newer models.

To evaluate the potential long-term indirect ambient air quality impact of increased roadway traffic associated with a project such as this, computerized emission and atmospheric dispersion models

can be used to estimate ambient carbon monoxide concentrations along roadways leading to and from the project. Carbon monoxide is selected for modeling because it is both the most stable and the most abundant of the pollutants generated by motor vehicles. Furthermore, carbon monoxide air pollution is generally considered to be a microscale problem that can be addressed locally to some extent, whereas nitrogen oxides air pollution most often is a regional issue that cannot be addressed by a single new development.

For this project, three scenarios were selected for the carbon monoxide modeling study: (1) year 2006 with present conditions, (2) year 2020 without the project, and (3) year 2020 with the project. To begin the modeling study of the three scenarios, critical receptor areas in the vicinity of the project were identified for analysis. Generally speaking, roadway intersections are the primary concern because of traffic congestion and because of the increase in vehicular emissions associated with traffic queuing. For this study, the same key intersections identified in the traffic study were also selected for air quality analysis. These included the following intersections:

- Queen Kaahumanu Highway at Kaiminani Drive
- Holoholo Street at Kaiminani Drive
- Mamalahoa Highway at Kaiminani Drive
- Mamalahoa Highway at Hina Lani Street
- Kealakaa Street at Hina Lani Street
- Queen Kaahumanu Highway at Hina Lani Street

The traffic impact report for the project [4] describes the projected future traffic conditions and laneage configurations of these intersections in detail. In performing the air quality

impact analysis, it was assumed that all recommended traffic mitigation measures would be implemented.

The main objective of the modeling study was to estimate maximum 1-hour average carbon monoxide concentrations for each of the three scenarios studied. To evaluate the significance of the estimated concentrations, a comparison of the predicted values for each scenario can be made. Comparison of the estimated values to the national and state AAQS was also used to provide another measure of significance.

Maximum carbon monoxide concentrations typically coincide with peak traffic periods. The traffic impact assessment report evaluated morning and afternoon peak traffic periods. These same periods were evaluated in the air quality impact assessment.

The EPA computer model MOBILE6 [5] was used to calculate vehicular carbon monoxide emissions for each year studied. One of the key inputs to MOBILE6 is vehicle mix. Unless very detailed information is available, national average values are typically assumed, which is what was used for the present study. Based on national average vehicle mix figures, the present vehicle mix in the project area was estimated to be 40.9% light-duty gasoline-powered automobiles, 46.2% light-duty gasoline-powered trucks and vans, 3.6% heavy-duty gasoline-powered vehicles, 0.2% light-duty diesel-powered vehicles, 8.5% heavy-duty diesel-powered trucks and buses, and 0.6% motorcycles. For the future scenarios studied, the vehicle mix was estimated to change slightly with fewer light-duty gasoline-powered automobiles and more light-duty gasoline-powered trucks and vans.

Ambient temperatures of 59 and 68 degrees F were used for morning and afternoon peak-hour emission computations, respectively. These are conservative assumptions since morning/afternoon ambient temperatures will generally be warmer than this, and emission estimates given by MOBILE6 generally have an inverse relationship to the ambient temperature.

After computing vehicular carbon monoxide emissions through the use of MOBILE6, these data were then input to an atmospheric dispersion model. EPA air quality modeling guidelines [6] currently recommend that the computer model CAL3QHC [7] be used to assess carbon monoxide concentrations at roadway intersections, or in areas where its use has previously been established, CALINE4 [8] may be used. Until a few years ago, CALINE4 was used extensively in Hawaii to assess air quality impacts at roadway intersections. In December 1997, the California Department of Transportation recommended that the intersection mode of CALINE4 no longer be used because it was thought the model has become outdated. Studies have shown that CALINE4 may tend to over-predict maximum concentrations in some situations. Therefore, CAL3QHC was used for the subject analysis.

CAL3QHC was developed for the U.S. EPA to simulate vehicular movement, vehicle queuing and atmospheric dispersion of vehicular emissions near roadway intersections. It is designed to predict 1-hour average pollutant concentrations near roadway intersections based on input traffic and emission data, roadway/receptor geometry and meteorological conditions.

Although CAL3QHC is intended primarily for use in assessing atmospheric dispersion near signalized roadway intersections, it

can also be used to evaluate unsignalized intersections. This is accomplished by manually estimating queue lengths and then applying the same techniques used by the model for signalized intersections. Currently, some of the study intersections are unsignalized. In the future, in accordance with the traffic report, some of the study intersections were assumed to remain unsignalized.

Input peak-hour traffic data were obtained from the traffic study cited previously. This included vehicle approach volumes, saturation capacity estimates, intersection laneage and signal timings (where applicable). All emission factors that were input to CAL3QHC for free-flow traffic on roadways were obtained from MOBILE6 based on assumed free-flow vehicle speeds corresponding to the posted speed limits (25 to 45 mph depending on location).

Model roadways were set up to reflect roadway geometry, physical dimensions and operating characteristics. Concentrations predicted by air quality models generally are not considered valid within the roadway-mixing zone. The roadway-mixing zone is usually taken to include 3 meters on either side of the traveled portion of the roadway and the turbulent area within 10 meters of a cross street. Model receptor sites were thus located at the edges of the mixing zones near all intersections that were studied for all three scenarios. This implies that pedestrian sidewalks either already exist or are assumed to exist in the future. All receptor heights were placed at 1.8 meters above ground to simulate levels within the normal human breathing zone.

Input meteorological conditions for this study were defined to provide "worst-case" results. One of the key meteorological inputs is atmospheric stability category. For these analyses, atmospheric stability category 6 was assumed for the morning cases, while atmospheric stability category 4 was assumed for the afternoon cases. These are the most conservative stability categories that are generally used for estimating worst-case pollutant dispersion within suburban areas for these periods. A surface roughness length of 100 cm and a mixing height of 1000 meters were used in all cases. Worst-case wind conditions were defined as a wind speed of 1 meter per second with a wind direction resulting in the highest predicted concentration. Concentration estimates were calculated at wind directions of every 5 degrees.

Existing background concentrations of carbon monoxide in the project vicinity are believed to be at low levels. Thus, background contributions of carbon monoxide from sources or roadways not directly considered in the analysis were accounted for by adding a background concentration of 0.5 ppm to all predicted concentrations for 2006. Although increased traffic is expected to occur within the project area during the next several years with or without the project, background carbon monoxide concentrations may not change significantly since individual emissions from motor vehicles are forecast to decrease with time. Hence, a background value of 0.5 ppm was assumed to persist for the future scenarios studied.

Predicted Worst-Case 1-Hour Concentrations

Table 4 summarizes the final results of the modeling study in the form of the estimated worst-case 1-hour morning and afternoon ambient carbon monoxide concentrations. These results can be

compared directly to the state and the national AAQS. Estimated worst-case carbon monoxide concentrations are presented in the table for three scenarios: year 2006 with existing traffic, year 2020 without the project and year 2020 with the project. The locations of these estimated worst-case 1-hour concentrations all occurred at or very near the indicated intersections.

As indicated in the table, the highest estimated 1-hour concentration within the project vicinity for the present (2006) case was 5.8 mg/m^3. This was projected to occur during the morning peak traffic hour near the intersection of Queen Kaahumanu Highway and Hina Lani Street. Concentrations at other locations and times studied were 5.1 mg/m^3 or lower. All predicted worst-case 1-hour concentrations for the 2006 scenario were within both the national AAQS of 40 mg/m^3 and the state standard of 10 mg/m^3.

In the year 2020 without the proposed project, the highest worst-case 1-hour concentration was predicted to continue to occur during the morning at the intersection of Queen Kaahumanu Highway and Hina Lani Street. A value of 5.6 mg/m^3 was predicted to occur at this location and time. Peak-hour worst-case values at the other locations and times studied for the 2020 without project scenario ranged between 1.7 and 5.3 mg/m^3. Compared to the existing case, concentrations remained about the same despite the higher traffic volumes, slightly increasing or decreasing at different locations. All projected worst-case concentrations for this scenario remained within the state and national standards.

In the year 2020 with the proposed project and with the recommended traffic mitigation measures, the predicted highest worst-case 1-hour concentration continued to occur during the

morning at the intersection of Queen Kaahumanu Highway and Hina Lani Street with a value of 5.0 mg/m^3, which is about 12 percent lower compared to the without project case. Other concentrations for this scenario ranged between 1.8 and 4.4 mg/m^3. With the project and with the recommended traffic mitigation measures, concentrations would remain about the same or decrease compared to the without project scenario, and concentrations would remain within the state and federal standards.

Predicted Worst-Case 8-Hour Concentrations

Worst-case 8-hour carbon monoxide concentrations were estimated by multiplying the worst-case 1-hour values by a persistence factor of 0.5. This accounts for two factors: (1) traffic volumes averaged over eight hours are lower than peak 1-hour values, and (2) meteorological conditions are more variable (and hence more favorable for dispersion) over an 8-hour period than they are for a single hour. Based on monitoring data, 1-hour to 8-hour persistence factors for most locations generally vary from 0.4 to 0.8 with 0.6 being the most typical. One study based on modeling [9] concluded that 1-hour to 8-hour persistence factors could typically be expected to range from 0.4 to 0.5. EPA guidelines [10] recommend using a value of 0.7 unless a locally derived persistence factor is available. Recent monitoring data for locations on Oahu reported by the Department of Health [11] suggest that this factor may range between about 0.2 and 0.6 depending on location and traffic variability. Considering the location of the project and the traffic pattern for the area, a 1-hour to 8-hour persistence factor of 0.5 will likely yield reasonable estimates of worst-case 8-hour concentrations.

The resulting estimated worst-case 8-hour concentrations are indicated in Table 5. For the 2006 scenario, the estimated

worst-case 8-hour carbon monoxide concentrations for the five locations studied ranged from 1.4 mg/m^3 at Holoholo Street and Kaiminani Drive to 2.9 mg/m^3 at Queen Kaahumanu Highway and Hina Lani Street. The estimated worst-case concentrations were within both the state standard of 5 mg/m^3 and the national limit of 10 mg/m^3.

For the year 2020 without project scenario, worst-case concentrations ranged between 1.2 and 2.8 mg/m^3, with the highest concentration at the Queen Kaahumanu Highway and Hina Lani Street intersection. Concentrations at all locations studied decreased slightly or remained about the same compared to the existing case except at the intersection of Mamalahoa Highway and Hina Lani Street where a slight increase was indicated. All predicted concentrations were within the standards.

For the 2020 with project scenario (assuming traffic mitigation measures), worst-case concentrations remained about the same or decreased compared to the without project case. Concentrations ranged from 1.2 mg/m^3 at Holoholo Street and Kaiminani Drive to 2.5 mg/m^3 at Queen Kaahumanu Highway and Hina Lani Street. All predicted 8-hour concentrations for this scenario were well within both the national and the state AAQS.

Conservativeness of Estimates

The results of this study reflect several assumptions that were made concerning both traffic movement and worst-case meteorological conditions. One such assumption concerning worst-case meteorological conditions is that a wind speed of 1 meter per second with a steady direction for 1 hour will occur. A steady wind of 1 meter per second blowing from a single direction

for an hour is extremely unlikely and may occur only once a year or less. With wind speeds of 2 meters per second, for example, computed carbon monoxide concentrations would be only about half the values given above. The 8-hour estimates are also conservative in that it is unlikely that anyone would occupy the assumed receptor sites (within 3 m of the roadways) for a period of 8 hours.

7.2 Electrical Demand

The proposed project also will cause indirect air pollution emissions from power generating facilities as a consequence of electrical power usage. The annual electrical demand of the project when fully developed is expected to reach approximately 8 million kilowatt-hours [12]. Electrical power for the project will most probably be provided mainly by oil-fired generating facilities, but some of the project power may also be derived from geothermal energy, wind power or other sources. In order to meet the electrical power needs of the proposed project, power generating facilities will likely be required to burn more fuel and hence more air pollution will be emitted at these facilities. Given in Table 6 are estimates of the indirect air pollution emissions that would result from the project electrical demand assuming all power is provided by burning more fuel oil at local power plants. These values can be compared to the island-wide emission estimates for 1993 given in Table 2. The estimated indirect emissions from project electrical demand amount to less than 1 percent of the present air pollution emissions occurring on Hawaii Island even if all power is assumed to be derived from oil.

7.3 Solid Waste Disposal

Solid waste generated by the proposed development when fully completed and occupied is not expected to exceed about 846 tons per year [12]. This assumes that approximately 294 tons per year can be diverted into recycling. Currently, all solid waste on the island is buried at solid waste landfills. Thus, assuming this continues to be the method for solid waste disposal, the only associated air pollution emissions that will occur will be from trucking the waste to the landfill and burying it. These emissions should be relatively minor.

8.0 CONCLUSIONS AND RECOMMENDATIONS

The major potential short-term air quality impact of the project will occur from the emission of fugitive dust during construction. Uncontrolled fugitive dust emissions from construction activities are estimated to amount to about 1.2 tons per acre per month, depending on rainfall. To control dust, active work areas and any temporary unpaved work roads should be watered at least twice daily on days without rainfall. Use of wind screens and/or limiting the area that is disturbed at any given time will also help to contain fugitive dust emissions. Wind erosion of inactive areas of the site that have been disturbed could be controlled by mulching or by the use of chemical soil stabilizers. Dirt-hauling trucks should be covered when traveling on roadways to prevent windage. A routine road cleaning and/or tire washing program will also help to reduce fugitive dust emissions that may occur as a result of trucks tracking dirt onto paved roadways in the project area. Paving of parking areas and establishment of landscaping early in the construction schedule will also help to control dust. Monitoring dust at the project boundary during the period of

construction could be considered as a means to evaluate the effectiveness of the project dust control program and to adjust the program if necessary.

During construction phases, emissions from engine exhausts (primarily consisting of carbon monoxide and nitrogen oxides) will also occur both from on-site construction equipment and from vehicles used by construction workers and from trucks traveling to and from the project. Increased vehicular emissions due to disruption of traffic by construction equipment and/or commuting construction workers can be alleviated by moving equipment and personnel to the site during off-peak traffic hours.

After construction of the proposed project is completed and it is fully occupied, carbon monoxide concentrations in the project area due to motor vehicle emissions will likely remain about the same or decrease if the recommended traffic mitigation measures are implemented. Worst-case concentrations should remain within both the state and the national ambient air quality standards. Implementing any air quality mitigation measures for long-term traffic-related impacts is probably unnecessary and unwarranted.

Any long-term impacts on air quality due to indirect emissions from supplying the project with electricity and from the disposal of solid waste materials generated by the project will likely be small based on the relatively small magnitudes of these emissions. Nevertheless, indirect emissions from project electrical demand could likely be reduced somewhat by incorporating energy-saving features into project design requirements. This might include the use of solar water heaters; designing building space so that window positions maximize indoor light without unduly increasing indoor heat; using landscaping where feasible to provide afternoon

shade to cut down on the use of air conditioning; installation of insulation and double-glazed doors to reduce the effects of the sun and heat; providing movable, controlled openings for ventilation at opportune times; and possibly installing automated room occupancy sensors.

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12. Personal communication via email, Walter Billingsley, Belt Collins Hawaii, to Barry D. Neal, B.D. Neal & Associates, February 23, 2007, Electrical and Solid Waste Estimates for Kula Nei.

Figure 1 - Project Location

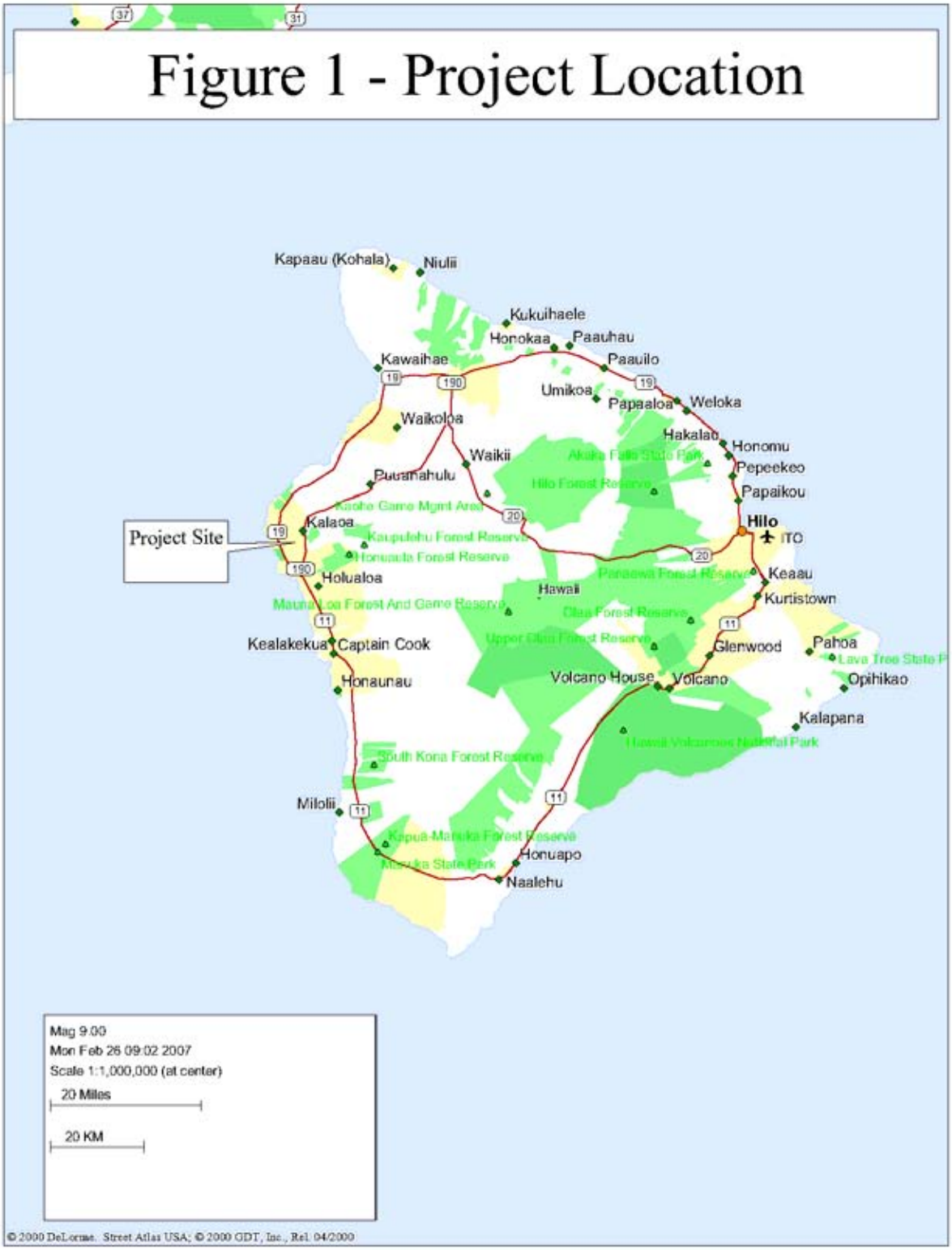


Table 1

SUMMARY OF STATE OF HAWAII AND NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Units	Averaging Time	Maximum Allowable Concentration		
			National Primary	**National Secondary**	**State of Hawaii**
Particulate Matter (<10 microns)	$\mu g/m^3$	Annual 24 Hours	50[a] 150[b]	50[a] 150[b]	50 150[c]
Particulate Matter (<2.5 microns)	$\mu g/m^3$	Annual 24 Hours	15[a] 65[d]	15[a] 65[d]	- -
Sulfur Dioxide	$\mu g/m^3$	Annual 24 Hours 3 Hours	80 365[c] -	- - 1300[c]	80 365[c] 1300[c]
Nitrogen Dioxide	$\mu g/m^3$	Annual	100	100	70
Carbon Monoxide	mg/m^3	8 Hours 1 Hour	10[c] 40[c]	- -	5[c] 10[c]
Ozone	$\mu g/m^3$	8 Hours 1 Hour	157[e] 235[f]	157[e] 235[f]	157[e] -
Lead	$\mu g/m^3$	Calendar Quarter	1.5	1.5	1.5
Hydrogen Sulfide	$\mu g/m^3$	1 Hour	-	-	35[c]

[a] Three-year average of annual arithmetic mean.

[b] 99th percentile value averaged over three years.

[c] Not to be exceeded more than once per year.

[d] 98th percentile value averaged over three years.

[e] Three-year average of fourth-highest daily 8-hour maximum.

[f] Standard is attained when the expected number of exceedances is less than or equal to 1.

Table 2

AIR POLLUTION EMISSIONS INVENTORY FOR ISLAND OF HAWAII, 1993

Air Pollutant	Point Sources (tons/year)	Area Sources (tons/year)	Total (tons/year)
Particulate	30,311	9,157	39,468
Sulfur Oxides	9,345	nil	9,345
Nitrogen Oxides	4,054	8,858	12,912
Carbon Monoxide	3,357	23,934	27,291
Hydrocarbons	1,477	203	1,680

Source: Final Report, “Review, Revise and Update of the Hawaii Emissions Inventory Systems for the State of Hawaii”, prepared for Hawaii Department of Health by J.L. Shoemaker & Associates, Inc., 1996

Table 3

ANNUAL SUMMARIES OF AIR QUALITY MEASUREMENTS FOR MONITORING STATIONS NEAREST KULA NEI PROJECT

Parameter / Location	2000	2001	2002	2003	2004
Sulfur Dioxide / Kealakekua, Kona					
3-Hour Averaging Period:					
No. of Samples	2897	2869	2877	2886	2513
Highest Concentration ($\mu g/m^3$)	50	38	50	91	55
2nd Highest Concentration ($\mu g/m^3$)	49	37	37	58	54
No. of State AAQS Exceedances	0	0	0	0	0
24-Hour Averaging Period:					
No. of Samples	365	360	362	364	317
Highest Concentration ($\mu g/m^3$)	25	22	19	39	21
2nd Highest Concentration ($\mu g/m^3$)	16	20	18	22	19
No. of State AAQS Exceedances	0	0	0	0	0
Annual Average Concentration ($\mu g/m^3$)	6	8	8	10	8
Particulate (PM-10) / Kealakekua, Kona					
24-Hour Averaging Period:					
No. of Samples	17	-	-	-	-
Highest Concentration ($\mu g/m^3$)	23	-	-	-	-
2nd Highest Concentration ($\mu g/m^3$)	23	-	-	-	-
No. of State AAQS Exceedances	0	-	-	-	-
Annual Average Concentration ($\mu g/m^3$)	18	-	-	-	-

Source: State of Hawaii Department of Health, “Annual Summaries, Hawaii Air Quality Data, 2000 - 2004”

Table 4

ESTIMATED WORST-CASE 1-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR KULA NEI PROJECT (milligrams per cubic meter)

Roadway Intersection	Year/Scenario					
	2006/Present		2020/Without Project		2020/With Project[a]	
	AM	PM	AM	PM	AM	PM
Queen Kaahumanu Hwy at Kaimiani Drive	5.1	3.6	4.0	2.8	4.1	2.8
Holoholo Street at Kaiminani Drive	2.8	1.4	2.3	1.7	2.4	1.8
Mamalahoa Highway at Kaiminani Drive	5.1	3.1	5.3	3.3	4.3	2.5
Mamalahoa Highway at Hina Lani Street	4.6	3.2	5.0	2.9	4.4	3.1
Kealakaa Street at Hina Lani Street	-	-	3.4	2.4	3.3	2.2
Queen Kaahumanu Hwy at Hina Lani Street	5.8	3.9	5.6	3.6	5.0	3.6

Hawaii State AAQS: 10
National AAQS: 40

[a]Includes mitigation measures given in project traffic report.

Table 5

ESTIMATED WORST-CASE 8-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR KULA NEI PROJECT (milligrams per cubic meter)

Roadway Intersection	Year/Scenario		
	2006/Present	2020/Without Project	2020/With Project[a]
Queen Kaahumanu Hwy at Kaimiani Drive	2.6	2.0	2.0
Holoholo Street at Kaiminani Drive	1.4	1.2	1.2
Mamalahoa Highway at Kaiminani Drive	2.6	2.6	2.2
Mamalahoa Highway at Hina Lani Street	2.3	2.5	2.2
Kealakaa Street at Hina Lani Street	-	1.7	1.6
Queen Kaahumanu Hwy at Hina Lani Street	2.9	2.8	2.5

Hawaii State AAQS: 5
National AAQS: 10

[a]Includes mitigation measures given in project traffic report.

Table 6

ESTIMATED INDIRECT AIR POLLUTION EMISSIONS FROM KULA NEI PROJECT ELECTRICAL DEMAND[a]

Air Pollutant	Emission Rate (tons/year)
Particulate	2
Sulfur Dioxide	21
Carbon Monoxide	2
Volatile Organics	<1
Nitrogen Oxides	9

[a]Based on U.S. EPA emission factors for utility boilers [2]. Assumes demand of 8 million kw-hrs per year of electrical power use. Estimated emission rates assume low-sulfur oil used to generate power.

Appendix O

waimea water services inc.

May 2007

Review of Potential Well Development

(TMK (3) 7-3-6:por36-New lot B) also known as "DWS lot"

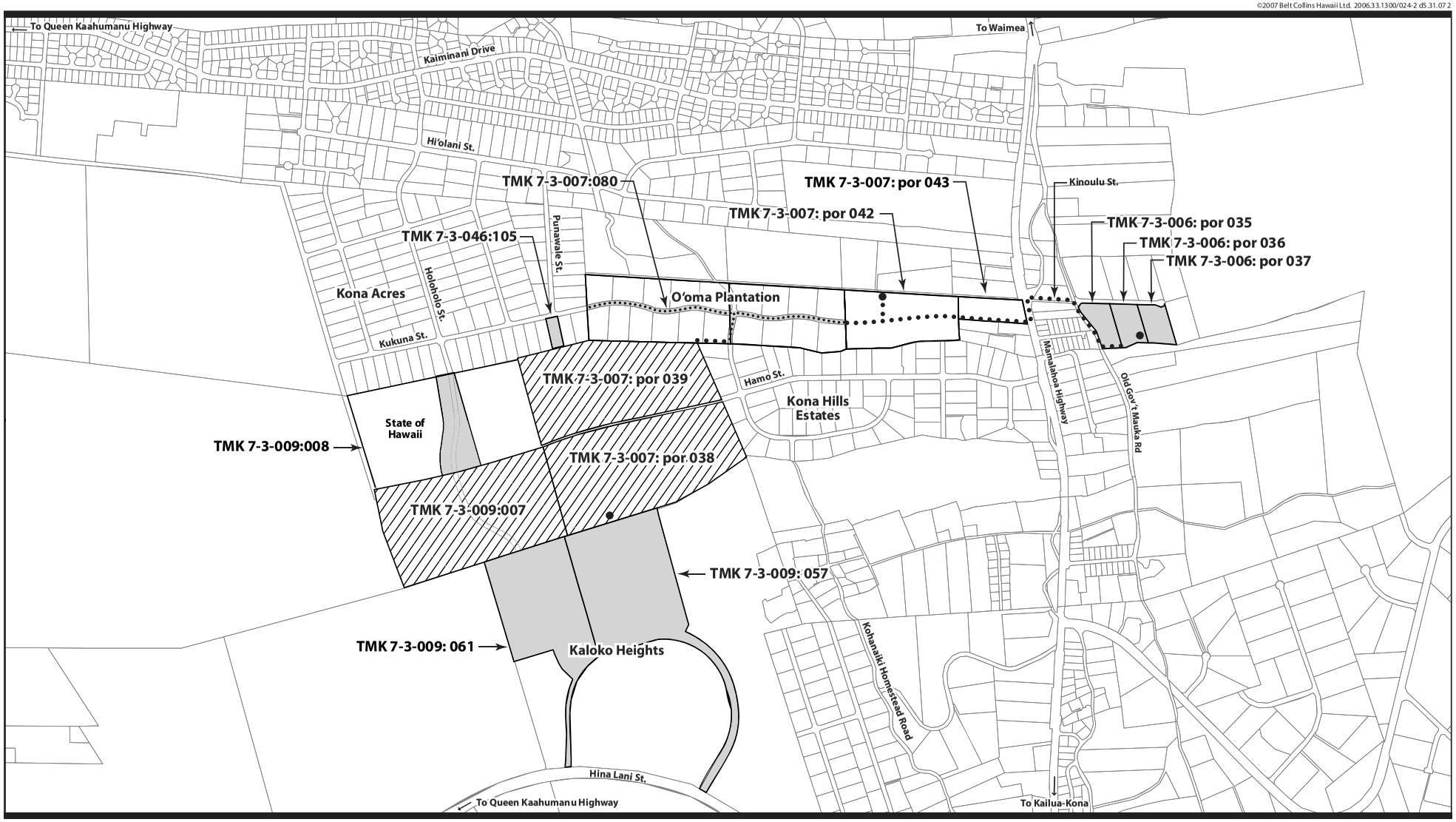
For the Kula Nei Project

Background

Recent studies by WWS (Groundwater Resources of North Hualalai-March 2003) and Glenn Bauer (A study of the Ground-Water Conditions in North and South Kona and South Kohala Districts, Island of Hawaii, 1991-2002, September 2003) represent the most up to date information on the water resources of North Kona. Earlier work, prepared by the USGS (Water-resources Investigation Report 99-4070, 1999) was reviewed, as well as a file search of the Commission on Water Resource Management (CWRM) well records.

The purpose of this review was to estimate the quantity of groundwater resource available for development within or near the subject parcel and to recommend well locations for the long-term development.

The file search documented only one potable well built within a ½ mile distance from TMK (3) 7-3-6: por 36 and 3 fresh water wells total within a 2 mile distance along the Mamalahoa Highway from the parcel (see attached map). Numerous wells have been permitted or proposed, however, there are no plans actually made to construct any of the other wells. Robert Lee received a permit in 1993 for a well below the west boundary of DWS lot which was not built, the permit was renewed in 2005 (well # 4258-04) and has lapsed as of January 2007 . Other proposed well permits have since lapsed as have a number of the previously proposed wells. The County DWS is also proposing a well on TMK (3) 7-3-6: por 36 (DWS lot) to be incorporated as part of a well field.



NORTH

0 500 1000

SCALE IN FEET

LEGEND

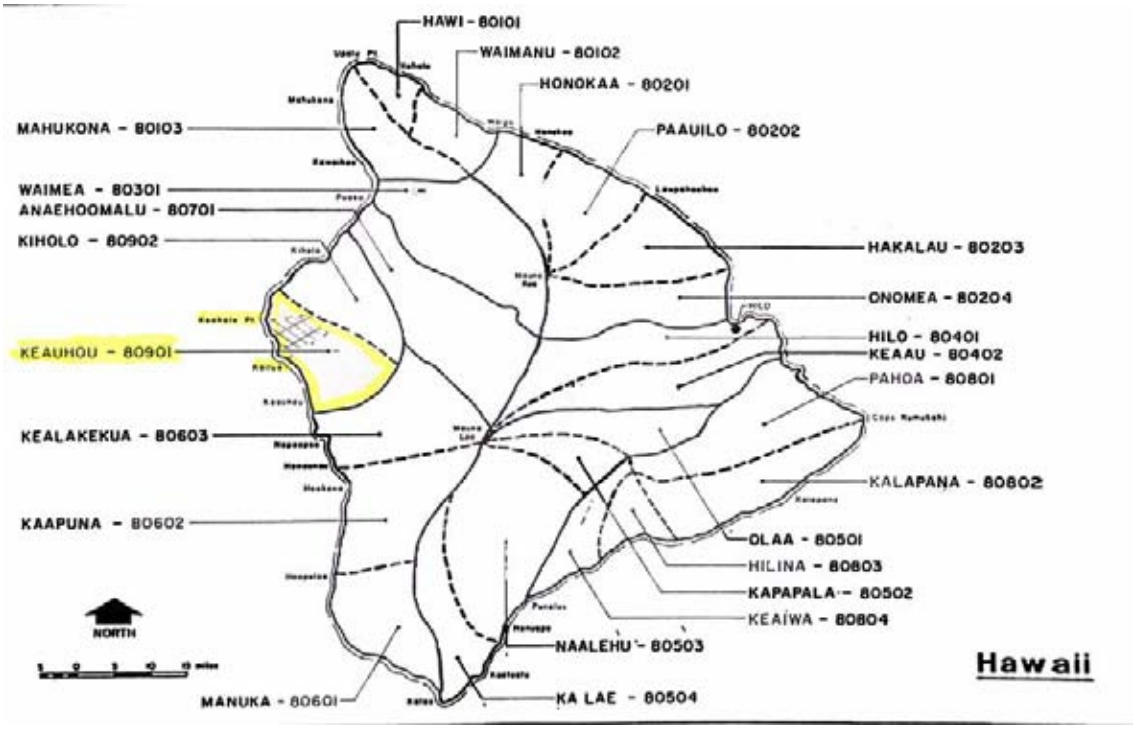
- Primary Project Area
- Accessory Area
- Existing Water Line
- Proposed Water Line
- Proposed Reservoir

PRIMARY PROJECT AREA AND ACCESSORY AREA

Kula Nei
North Kona, Hawaii
Environmental Impact Statement
Prepared for The Shopoff Group

Water Resources

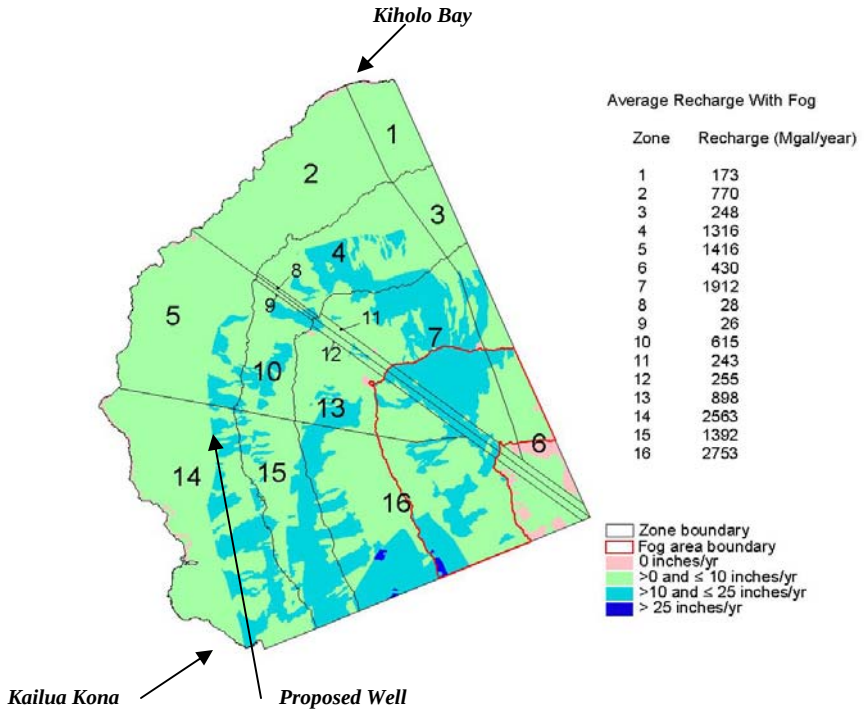
The CWRM estimates the sustainable yield of the Keauhou Aquifer unit at 38 mgd. According to Bauer (personal communication-3/2004), he has estimated the total pumpage through 2003 at 10 mgd for potable use and 3 mgd for various brackish uses.



HYDROLOGIC UNITS – ISLAND OF HAWAII

WWS estimated the recharge to the groundwater of North Hualalai in its report of March 2003. The map below summarizes the total estimate recharge from rainfall and fog drip. The units of interest are 14 (basal lens), 15 and 16 (high-level) where the basal lens consists primarily of brackish water (recharge = 7.0 mgd) and the high-level units (recharge = 11.5 mgd).

In addition to the natural recharge in the basal lens, at least 2.0 mgd treated sewage effluent is imported from south of Kailua Village, most of which is disposed of in a shallow pit at near the Kealakehe landfill. Most of the household wastewater is discharged into cesspools in the vicinity of Mamalahoa Highway.



If it is assumed that the sustainable yield is 60% of the recharge, the estimated developable resources of the units 14 and 15-16 would be about 4.2 mgd (brackish) and 6.9 mgd (fresh). These seem to be reasonable estimates for planning purposes. The present pumpage of the fresh (high-level) water is from three active wells used by the DWS and totals about 3 mgd.

There has been no accurate determination of the geologic structure(s) causing the high- level groundwater occurrence; however, indirect evidence indicates that it is most likely a result of major faulting on the western slopes of Hualalai. These faults are known to exist, based on the side view ultrasound studies of the 1980's and early 1990's and the detection of major off shore avalanches

The CWRM sustainable yield estimates were created before the discovery of the high-level groundwater in the Kona Districts. As of this date the most likely cause for the occurrence of the high-level aquifers is associated with the evidence of both major faulting systems and thick dense trachyte or hawaiite lava flows or both in association.

In the North Kona Water Master Plan Report R-104 of DLNR, 1995, it is estimated that the long term recharge to the high-level aquifer for the area north of the Queen Liliuokalani Trust Land at Mamalahoa Highway is 13.4 mgd. This is an area approximately equal to the above study area 16 above and is significantly higher than the 7.4 mgd (2753 mgy) in the WWS study.

Water Development

Based upon the present knowledge of the water resources, it is reasonable to develop a well source with a capacity of 1 mgd (700 to 1000 gpm). The well would be located at an elevation 1785' or lower. It is anticipated that the well will be constructed within the high level portion of the Keauhou Aquifer unit. As noted in the system map, the well would feed directly to a new 1.0 mg tank (OF = 1815') The previous well (4258-04) permit has lapsed and a new well permit is required however the project will be undertaken under a joint agreement with the Hawaii Department of Water Supply, in which two wells will be drilled with one being considered as the normal operating unit

The Kula Nei project water needs will be supplied via an interconnection with the DWS system along Mamalahoa Highway and transmitted makai to Ooma Plantation and on to Kula Nei..

Depending on the DWS requirements, a second well will be drilled within the zone. However, this second well should be used for stand by service or operational rotation only. There are a number of wells proposed for the region as indicated in Report R-101..

The compartments containing the high-level groundwater in both the Hualalai (42-58-03) and Honokohau (42-58-03) DWS wells are dewatering when pumped on a sustained basis in excess of 1000 gpm. The Kalaoa (43-58-01) well has proven to be artesian in nature and may be developing water from within the transition between the high-level and basal lens aquifers. The fact that the water level rose when the latter well was deepened from –43 to –142' (G. Bauer, CWRM, September, 2003) is a clear indication of aquifer confinement.

The proposed well(s) are expected to strike the high-level water at about elevation 100 +/-. The high-level aquifer compartments are all very fresh (Chlorides of 12 milligrams/liter) and the quality is not likely to vary significantly. The major impact of new well development will be for the long term water levels to be lowered under prolonged pumping. Surrounding wells will influence the water level thus the total development of the high-level aquifers needs monitoring to prevent over pumping.

The proposals for source development as shown in Report R 101 appear to be excessive for the known hydrology. If and when the demand on the resource reaches 90% of the sustainable yield estimate, the CWRM has had a policy of placing the unit under CWRM management thus restricting further source development. Regardless, such an event is in the distant future and planning has commenced such that, if continued, it will provide adequate water for North Kona.

Storm Runoff

Traditionally and beneficially, the management practice has been to divert storm runoff into dry wells. The local hydrology of the Kula Nei lands have never experienced significant runoff and the recharging from storm is essential in sustaining the basal brackish lens beneath the Kula Nei project.