UNIVERSITY OF THE NATIONS, KONA, INC.
2020 MASTER PLAN UPDATE

FINAL ENVIRONMENTAL IMPACT STATEMENT
Volume II: Appendices

APPLICANT:

University of the Nations, Kona, Inc.
75-5851 Kuakini Highway
Kailua-Kona, HI 96740

PREPARED BY:

G70
111 S. King Street, Suite 170
Honolulu, Hawaiʻi 96813

JUNE 2025

UNIVERSITY OF THE NATIONS, KONA, INC. 2020 MASTER PLAN UPDATE

Kailua-Kona, Island of Hawai‘i, Hawai‘i
TMK (3) 7-5-010:085 and (3) 7-5-017:006

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This environmental document was prepared pursuant to Hawai‘i Revised Statutes, Chapter 343, Environmental Impact Statement Law and Hawai‘i Administration Rules, Chapter 11-200.1, Environmental Impact Statement Rules.

JUNE 2025

Appendix A

Findings of Fact, Conclusions of Law, and Decision and Order for a State Land Use District Boundary Amendment Docket No. A02-737, August 2003

BEFORE THE LAND USE COMMISSION

OF THE STATE OF HAWAII

In the Matter of the Petition of U of N BENCORP To Amend the Agricultural Land Use District to the Urban Land Use District for approximately 62 acres, Tax Map Key Nos.: (3) 7-5-10:85 and 7-5-17:06 situate at Waiaha 1st, North Kona, Island, County and State of Hawaii.	)))))))))))	DOCKET NO. A02-737 FINDINGS OF FACT, CONCLUSIONS OF LAW, AND DECISION AND ORDER FOR A STATE LAND USE DISTRICT BOUNDARY AMENDMENT; EXHIBIT A

This is to certify that this is a true and correct copy of the document on file in the office of the State Land Use Commission, Honolulu, Hawaii.

AUG 8 2003 by Anthony J. H. Ching
Date Executive Officer

FINDINGS OF FACT, CONCLUSIONS OF LAW, AND DECISION AND ORDER
<u>FOR A STATE LAND USE DISTRICT BOUNDARY AMENDMENT</u>

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OF THE STATE OF HAWAII

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FINDINGS OF FACT, CONCLUSIONS OF LAW, AND DECISION AND ORDER
FOR A STATE LAND USE DISTRICT BOUNDARY AMENDMENT

U of N Bencorp, a Hawaii non-profit corporation ("Petitioner" or “Bencorp”) submitted a State Land Use Boundary Amendment Application on November 21, 2003 (“Petition”), and an Amended State Land use Boundary Amendment Application on December 5, 2003 (“Amended Petition”), pursuant to Sections 205-3.1(c) and 205-4, Hawaii Revised Statutes (“HRS”), and Chapter 15-15, Hawaii Administrative Rules (“HAR”), to amend the State Land Use District boundary by reclassifying approximately 62 acres of land situate at Waiaha 1st, Kailua-Kona, District of North Kona, County and State of Hawaii, and designated by Tax Map Key Nos.:(3) 7-5-10:85 and 7-5-17:06 (“Property” or “Petition Area”), from the Agricultural Land Use District to the Urban Land Use District to allow for the development of the Hualalai Village condominiums, a multi-function Cultural Center, and a five-acre Educational Facility (“Project”).

The Land Use Commission (“Commission”), having considered the entire record on this matter, hereby makes the following Findings of Fact, Conclusions of Law and Decision and Order.

FINDINGS OF FACT

PROCEDURAL MATTERS

1. On November 21, 2002, Petitioner filed the Petition proposing the development of the Project.

2. On December 5, 2002, Commission staff transmitted its comments upon review of the Petition, which deemed the Petition incomplete.

3. On December 5, 2002, Petitioner filed the Amended Petition.

4. On December 6, 2002, the Commission received a facsimile transmission from Petitioner of a letter of intent to intervene from Mr. Lunakanawai Hauanio.

5. On December 20, 2002, Petitioner provided comments and clarification pursuant to the Commission staff's review of the Amended Petition.

6. On December 30, 2002, Commission staff deemed the Amended Petition as a proper filing pursuant to Section15-15-50, HAR.

7. On January 5, 2003, the Notice of Hearing was published in the Star Bulletin, and West Hawaii Today. The deadline for timely petition to intervene was January 21, 2003.

8. On January 21, 2003, Petitioner filed its witness list and exhibit list identifying Exhibits 1 to 14.

9. On January 21, 2003, the County of Hawaii Planning Department ("County") filed its witness list and its Statement of Position in Support of the Petition, and the State of Hawaii Office of Planning ("OP") filed its Statement of Position in Support of the Project.

10. On February 20, 2003, OP filed its witness list and exhibit list, and Exhibits 1 and 2.

11. On February 21, 2003, the Commission conducted a field trip to the Petition Area.

12. On February 21, 2003, a prehearing conference was held in Kona. Petitioner filed Exhibit 5, the archaeological inventory survey and Exhibit 15, addendum to its Final Traffic Impact Analysis Report.

13. On February 26, 2003, the County filed its exhibit list and Exhibits 1 to 3; OP filed its first amended witness list.

14. On February 27, 2003, Petitioner filed its second amended witness list and second amended exhibit list, and Exhibits 15 to 25.

15. On March 5 and 6, 2003, the Commission conducted a hearing on the Amended Petition in Kona.

16. On March 5, 2003, the Commission received public witness testimony from Mary Kamahele Boyd, Lunakanawai Hauanio, and Mikahala Roy. The Commission did not receive Mr. Hauanio's written petition to intervene pursuant to Section 15-15-52, HAR, and his verbal request for intervention pursuant to Land Use Commission Rule 15-15-34, HAR, was denied by the Commission on March 5, 2003.

17. On May 16, 2003, Petitioner filed its fourth amended witness list and third and fourth amended exhibit lists, and Exhibits 26 to 35.

18. On May 19, 2003, the County filed its first amended witness list and first amended exhibit list, and Exhibits 4 and 5.

19. On May 22, 2003, the Commission continued the hearings for the subject docket in Kona.

20. On May 22, 2003, the Commission received public witness testimony from Richard T. Bell, Kathryn Ward-Smith, Curtis Tyler, Dr. William H. Wilson, and Holo Hoopai.

21. On May 22, 2003, Petitioner filed its Exhibit 36.

22. On May 22, 2003, OP filed its second amended witness list and second amended exhibit list, and Exhibit 4.

23. On May 23, 2003, Petitioner filed its Exhibits 37 and 38.

24. On May 23, 2003, OP filed its Exhibit 5.

25. On June 9, 2003, the County filed its second amended witness list and Exhibits 6 and 7.

DESCRIPTION OF THE PROPERTY

26. The Property is located on the west coast of the Island of Hawaii, approximately one mile southeast of the town center of Kailua-Kona, on the lower western slopes of Mount Hualalai at an elevation ranging from approximately 100 to 325 feet.

27. The Property is bordered by Kuakini Highway on the west, Queen Ka`ahumanu (Queen K) Highway and Hualalai Road on the east, the University of the Nations-Kona ("University") campus on the north and the Kona Hillcrest subdivision on the south.

28. The Property is generally gently sloped, with steeper slopes (approaching 25 percent) on the upper mauka side just below Hualalai Road.

29. The Property comprises approximately 62 acres, and two tax map parcels: TMKs (3) 7-5-10:85 and 7-5-17:6**.**

Soils and Geology

30. The Property comprises two soil groups. The Soil Conservation Service's *Soil Survey of the Island of Hawaii, State of Hawaii*, locates a narrow band of Honuaulu extremely stony silty clay loam ("HVD") along the mauka border of the property. The Honuaulu series consists of well-drained silty clay loams that formed in volcanic ash. The HVD soil subtype is generally found with stones covering 3-15% of the area and with slopes of 12-20%.

Its typical use is for growing of coffee or macadamia nuts (at higher elevations than the Property), or pasturage.

31. The vast majority of the Property is Punalu`u extremely rocky peat ("rPYD") with slopes of 6-20%. The Punalu`u Series consists of well-drained, thin organic soils over pahoehoe lava bedrock. Soils of this type are used for pasturage. The peat is rapidly permeable; the underlying lava is very slowly permeable, with runoff slow and erosion hazard slight.

32. The ground surface is very broken with heaps of sharp broken lava rock appearing more like a`a than the smooth pahoehoe. These fragments have been piled, apparently by hand, to facilitate cattle grazing. The potential for agricultural productivity is low.

<u>Agricultural/ALISH/Land Study Bureau Classification</u>

33. The agricultural potential for the Property is generally poor because of the shallow, rocky soil type. None of the Property is classified as within "agricultural lands of importance to the State of Hawaii" (ALISH). The ALISH classification system contains four categories: prime, unique, other important agricultural lands, and unrated. The Property is classified as unrated. The nearest rated ALISH parcel is roughly three-quarters of a mile south.

34. The Land Study Bureau map classification for the Property is "E", or very poorly suited for agricultural productivity.

<u>Climate</u>

35. The climate of the Island of Hawaii is characterized by remarkable differences in rainfall over short distances, mild temperatures, persistent northeasterly trade winds, and distinct climatic regimes in locales sheltered from the prevailing winds. The Property is on the leeward side of the Big Island, at a low elevation, and thus receives relatively little precipitation.

36. Yearly rainfall at the nearest weather station (Holualoa Beach) averages around 28 inches, and is spread relatively evenly throughout the year. At this station August, the month of greatest average precipitation, averages 3.33 inches and December, the month with

least rainfall, 1.6 inches. The property is on the 750-mm isohyet, equal to approximately 29.5 inches per year.

37. Temperatures are similarly fairly constant, with the daily highs averaging between 80 and 85 degrees (with the highest temperatures from August to October), and the lowest temperatures ranging from 64 to 70 degrees Fahrenheit, with the coolest temperatures in January and February.

38. The local daily solar heating and nightly cooling results in ocean breezes flowing up the slopes in the daytime and cooling mountain breezes blowing toward the ocean in the evening. The site plan orients the condominium units so as to catch these breezes and utilize passive cooling techniques.

PROPOSAL FOR RECLASSIFICATION

39. The Project comprises three separate developments: Hualalai Village, the Cultural Center, and the Educational Facility. Hualalai Village, a 400-unit condominium complex to be developed in four stages, with Phase I (103 units) already zoned and currently under construction, and therefore is not a part of the Petition and Petition Area. Phases II, III and IV of the Hualalai Village project comprise the remaining 297 units which are included in the Petition. The Cultural Center will comprise of a designed landscaped park that focuses upon the historical relationship of the native Hawaiian culture with Christianity and the establishment of Hawaii's multicultural mix.

40. The Educational Facility, which will be a part of the adjacent University, utilizes approximately 5.0 acres of the 62 acre site, with the Hualalai Village and Cultural Center utilizing the balance of the site almost equally.

The Hualalai Village

41. Hualalai Village, a 400-unit condominium complex, will be developed in four stages, with Phase I (103 units) previously zoned and currently under construction, and is not a part of the Petition.

42. The remaining three phases of the Hualalai Village development consist of approximately 297 high-quality condominium units in approximately 21 two- and three-story structures distributed over approximately 31 acres. There will be a recreation center with exercise facilities and a pool for residents and guests. The structures will be of steel and stucco construction to avoid deterioration due to time, weather and insects, will have no party walls, non-creak floors, and a variety of available interior layouts and appointments. The buildings will be oriented to take advantage both of makai views to the ocean and Kailua Bay and mauka-makai breezes, which shift in direction morning and evening. The condominiums range in size from one to four bedrooms and in price from $167,500 to $502,500.

43. The philosophy of the development is to "build to the land," avoiding major cuts and fills, design to facilitate pedestrian access, and build to a lower density (RM-4) than the site would allow, to provide a better quality of life for residents over the long term. The landscaping and design through the development will encourage residents to leave their cars at home and walk to and from Kailua Village, as well as to the adjacent University campus.

44. Development will proceed in phases and sub-phases, with each phase significantly pre-sold before construction begins. In early May, 2002 ground was broken on phase 1A with 75 percent of the planned units pre-sold.

45. Two different market segments will be served by the project: University of the Nations-Kona affiliates, including donors and friends, faculty and staff, and some students; and the general public. These sectors will likely be financially segmented, with friends and donors of the University and the target general public being relatively more able to purchase, and faculty, staff and students relatively less able to purchase. Mechanisms will be sought to aid less affluent University affiliates to own in Hualalai Village. Efforts will be made to make a number of these units available for use or purchase by University staff. It is anticipated that

condominiums in Hualalai Village will be purchased in significant part by friends and affiliates of the adjacent University, a Christian college.

46. Mechanisms will also be sought to enable Hualalai Village to accommodate the housing needs of some of the University student body. This may be accomplished through the purchase by donors and friends of some number of units, which could then be managed as a limited pool of rental housing for students.

47. Within the normal market segment, market data and research indicated strong demand for the project, especially for mid-priced condominiums in the $125,000-225,000 range, occupied by owners with few or no children and an annual median family income of $56,000-$82,000. It is anticipated that the special relationship between Hualalai Village and supporters of the University of the Nations-Kona will provide a substantial source of support for sales of the condominiums.

48. Hualalai Village will benefit Kailua-Kona by helping satisfy the demand for high-quality condominium residences and by helping to meet the needs of friends and staff of the University for nearby housing.

49. The landscape plan for the remaining phases of Hualalai Villages will maintain the style and pattern followed in Phase I. Similar plant species will be utilized to provide a continuity of visual pattern and texture. The selection of plant material will have a stronger emphasis on native species: endemic, indigenous and Polynesian introduced, either coastal species or species that are found in the dry mesic forest of the original Hawaiian landscape.

The Cultural Center

50. The Cultural Center, a first-class visitor destination, is intended to present the authentic story of the native Hawaiian culture and its historical relationship with the introduction of Christianity, its impact upon the monarchy and the people of Hawaii and the region of Kona, with references to traditional cultures from Pacific regions that have combined to produce Hawaii's unique multicultural mosaic. The present plan is that these stories will be told through on-going daytime performances in outdoor performance area(s) and enclosed

performance auditorium; and other features include an outdoor water feature; an educational living museum complex, a restaurant and shops. These presentations will last approximately 20 minutes and the entire Cultural Center can be experienced in approximately two and one-half hours. A water feature will provide water-based activities and a sense of place in Hawaii.

51. The Cultural Center will provide education and entertainment related to different elements of native Hawaiian culture and history both outdoors and in an indoor main performance auditorium, all in a beautifully landscaped park setting. It is anticipated that the facilities of the Cultural Center, including the auditorium, will also be made available for community use, such as concerts.

52. The Cultural Center will benefit Kailua-Kona by providing a needed venue and visitor attraction in the Kona region, that respects, educates, and tells the story of Hawaii's cultures, thus building respect for, and awareness of cultural diversity as well as similarity across cultures. The Cultural Center will appeal to families and across generations.

53. The Cultural Center will enhance the exposure of University students to native Hawaiian and Pacific cultures. Net revenues generated by both the Village project and the Cultural Center project will stay in Hawaii, as they flow through Bencorp to benefit the University of the Nations-Kona.

54. The preliminary site plan devotes approximately 26.5 acres to the Cultural Center including parking that can accommodate 15 tour buses and up to 840 cars.

55. Economically, the Cultural Center will enhance the Kailua-Kona community as a significant new visitor attraction. The Cultural Center will add measurably to the region's economic stability and economic growth by bringing a constant flow of income to the region. Because any net profit will pass through Bencorp directly to University of the Nations-Kona, this income will stay in the region (as opposed to leaving to support a mainland home office or operations elsewhere), circulate through the local economy in goods and services purchased, and have a substantial local multiplier effect. By helping to facilitate the continued growth of the University, this income will fuel the arrival of a growing student population from the U.S. mainland and elsewhere that will continue to contribute to the local and regional

economy at a concomitantly growing rate. The construction of the Cultural Center will result in local employment and the purchase of local and regional goods and services.

56. The ongoing operations of the Cultural Center will provide a continuing demand for local goods and services, and a supply of new and steady jobs, the income from which will also circulate through the region on a continuing basis. In the absence of any comparable attraction currently existing in the Kona region or on the Big Island, the Cultural Center will add a wholly new dimension to the attractiveness and economy of the region while not competing with any similar existing enterprise.

57. Based upon the feasibility assumption prepared by Steven Au and Roy Tokujo, 500 to 1100 visitors per day are projected to experience the Cultural Center. Cruise line passengers will be shuttled via buses from the pier to the Cultural Center and will represent approximately 75% of the daily visitor count to the Cultural Center. In addition, 50 tour patrons will arrive by van transport, and 50 kamaaina and 200 independent travelers will arrive by private automobiles.

58. Socially, the primary programmatic goals of the Cultural Center are to introduce and educate visitors and local families to the authentic story of the native Hawaiian culture and its historical relationship with the introduction of Christianity, its impact upon the monarchy, the people of Hawaii and the region of Kona. Inherent in this authentic telling is how Christianity changed the Hawaiian culture, which promotes respect for differences among cultures and the value of community. The Cultural Center will do this through a set of experiences that are fun, intellectually and creatively stimulating, and appealing to families and across generations, all in the context of a beautifully landscaped park that takes full advantage of the setting and view planes.

59. It is anticipated that facilities will also be open to the community, and provide a new and high quality performance venue for Kailua-Kona. The main performance area is situated on site as far as possible from any existing or planned residential areas and will be completely enclosed to ameliorate noise concerns Community activities and concerts may be held in this main performance space and community groups could also make use of the space,

which will contribute to the community well being and integrate the Cultural Center into Kailua-Kona's community life.

60. Educationally, the Cultural Center will offer local residents and particularly local schoolchildren the opportunity to deepen their understanding of their own culture by seeing it in its traditional form and by experiencing the range of traditional cultures that produced Hawaii's present cultural amalgam. Student educational events will be scheduled on "non-ship arrival" days and during the normal hours of opening.

61. The landscape plan for the Cultural Center will focus on education. Remnants of the previous agricultural features that can be preserved will be preserved. Plantings related to Hawaiian agriculture will be planted, and will model the dry mesic forest of olden times. This will be a focus within the Cultural Center project area including the passive park and open space areas.

62. A two to three acre passive park will be developed between the Hualalai Village and the Cultural Center. The park is sited adjacent to the existing Hillcrest Community Park, creating expanded and improved recreational facilities. Walking paths and recreational landscaping will be provided. Native species and Polynesian introductions suited to the area will be emphasized in the park landscaping

Educational Facility

63. The approximately 5.0-acre Educational Facility will be an extension of the University and will be developed as part of their programming and construction schedule. The exact site plan and configuration has not yet been determined. This site is an exchange area for land previously transferred from the University to Hualalai Village to facilitate the development schedule.

DEVELOPMENT TIMETABLE

64. The Hualalai Village residential development is slated to run over a period of five years and will be completed during the Year 2007. Commencement of the Cultural

Center is targeted to begin during the Year 2007 and the Educational Facility is being planned for commencement in 2005/2006.

PETITIONER'S FINANCIAL CAPABILITIES TO UNDERTAKE THE PROPOSED DEVELOPMENT

65. Petitioner was established in 1988 as a non-profit tax exempt 501(c)(2) benefit corporation for the purpose of providing financial and material support to the University, a Hawaii 501(c) (3) non-profit corporation

66. The special purpose niche financing secured by Petitioner requires that the entire Petition Area be reclassified in order to maintain the required minimum 70% debt to equity ratio required by the lenders.

67. Petitioner and the parent organization for the Cultural Center would provide necessary financial statements to assist in the procurement of financing. Initial capital monies can be raised by donations, private investors, and/or conventional financing.

68. Primarily through niche and conventional financing, and contributions from University affiliates, including donors and friends, faculty and staff, and some students, approximately $20.5 million has been received for the development of Hualalai Village.

STATE AND COUNTY PLANS AND PROGRAMS

69. The State Land Use Commission currently classifies the Property in the Agricultural district.

70. The Property is surrounded on three sides by lands in the Urban District classification. Abutting the Property on the north, the University is in the Urban District classification and zoned RM-4. Bordering the project area to the south is the Kona Hillcrest subdivision, classified in the Urban District and zoned RS-7.5; there is also a narrow parcel owned by Petitioner that is in the Urban District and split-zoned RD-3.75 and R-7.5. Across Kuakini Highway lies a 6.8-acre parcel classified Urban and zoned RM-2; adjacent to that is a 7.8-acre parcel still classified in the Agricultural District and zoned AG-5. To the east across Queen Ka`ahumanu Highway lie parcels zoned commercial and RD-3.75; nearby, the planned Pualani Subdivision is classified in Urban District and zoned RS 7.5.

71. The County of Hawaii General Plan, in its Land Use Pattern Allocation Guide (LUPAG) Maps, designates the Property as Medium Density Urban. This designation includes “village and neighborhood commercial and residential and related functions (3-story commercial; residential -- up to 35 units per acre).”

72. The Property is not within the Special Management Area established by the County of Hawaii pursuant to Chapter 205A, Hawaii Revised Statutes.

73. The Property is currently zoned A-1a. The Petitioner will be concurrently seeking a change of zone to RM-4, or possibly Residential – Commercial Mixed Use or Village Commercial to facilitate development of the Project.

74. The Kona Regional Plan was adopted by the Planning Commission of the County of Hawaii as Resolution No. 184 in April 1984, and designates the Property as Medium Density Urban RES 6 (6 units per acre). The Project is consistent with this designation.

75. The Office of State Planning developed the West Hawaii Regional Plan (“Plan”) in November 1989. The Plan identifies the Property as falling within the Keahole-Keauhou Resort Destination Node. The Project is consistent with the policies of clustering resort development within designated resort destination nodes, developing employment opportunities within those nodes, and encouraging the County to use its zoning powers to support the development of those nodes.

76. The Kailua-Kona Master Plan was adopted in 1994 to help advise the Hawaii County Planning Director and guide urban design in the Kailua Village area, which includes the project area. The Kailua-Kona Master Plan lists the Property as low-density residential in its entirety. The Project is consistent with the objectives of the Kailua-Kona Master Plan.

77. The Project is located within the boundaries of the Kailua Village Special District. The plans for Hualalai Village, Phase I, were reviewed and approved by the Kailua Village Design Commission.

78. The Keahole to Kailua Development Plan (K to K Plan) was adopted by resolution by the Hawaii County Council in April 1991. The K to K Plan serves as an implementing tool for the County General Plan and as a flexible guide for the future growth and development of an area of approximately 17,000 acres in the North Kona District extending from the Kau ahupuaa to the north, Mamalahoa Highway to the east, Palani Road and Kailua Village to the south, and the shoreline to the west. The existing roadway system has sufficient capacity to accommodate the growth in ambient traffic and the traffic that would be generated by the Cultural Center and the Hualalai Village. The critical turning movements at the unsignalized intersections on Kuakini Highway and Queen Ka`ahumanu Highway Extension are forecast to operate at acceptable levels of service with all three proposed projects in place with no mitigating measures required.

NEED FOR PROPOSED DEVELOPMENT

Hualalai Village

79. A feasibility study was performed to determine the strength of market demand for the proposed condominium project. The research examined historical data, interviews with local real estate agents, unit qualitative analysis, and internal needs assessments. Two market segments were considered: (a) affiliates of the University, including donors, friends, faculty, staff, and students; and (b) the general public and faith-based audiences. The study found a strong demand for the project.

80. *Demand from University affiliates*: Bencorp was formed in 1988 as a 501(c)(2) non-profit benefit corporation serving the development of the University. The University is a mission-based educational institution, founded in Kona in the late 1970's and is now actively involved in equipping men and women in more than 100 nations through field-driven course work within its seven colleges and focused centers.

81. Over the last two decades, through both the educational and physical development of the campus, tens of thousands of lives have been impacted, and have in turn identified with and invested in the mission and vision of the University. These include parents who have sent their children, thousands of volunteers who have labored in the building and staffing of the facilities, and a growing constituency of donors. There has been a significant and

growing demand among friends, alumni, donors, staff and volunteers for housing opportunities near the Kona campus. These requests are not solely investment oriented, but also represent the intention and commitment of part or full-time engagement with the University, and thus there is an ongoing demand for appropriate housing that addresses the needs of these affiliates while fulfilling the primary mission of serving the University. Moreover, the University is projected to continue to grow, thus continuing the related growth in demand for residences and accommodations convenient to the campus.

82. The marketing strategy relies initially on contacts developed over the years between the University and its affiliates; widens to include a circle of faith-based organizations and contacts; and reaches the general public through traditional marketing methods. The goal is to have each sub-phase of construction substantially pre-sold before ground is broken for that sub-phase. The first phase of construction, Phase 1A, broke ground in May 2002, and comprised 103 units. The first sub-phase was approximately 75% pre-sold, indicating the existence of a tremendous demand for the housing being offered by Hualalai Village.

83. The Hualalai Village market study indicated: a strong demand for mid-priced condominium units, ranging in price from $125,000 to $225,000; a strong market for owner-occupied housing. Projected demand for mid-priced housing will remain strong for at least 3-5 years, starting in 2000. Values will rise on average 3% per year over this time.

84. The typical condominium buyer will have a median family income of $56,000-$82,000 per year; be between 56-65 years of age; be in or nearing retirement; and have few or no children at home. There was a demand of 331 through 506 new condominium units annually in North Kona from 2000-2005.

85. *Relationship of the Hualalai Village project to the local housing market*: The project area is within the Holualoa Census Designated Place ("CDP") of the Island of Hawaii, just south of the Kailua CDP. A comparison of the median family incomes of the Big Island as a whole, and the typical condominium purchaser shows that at the low end, the Hualalai Village condominiums could be purchased by families with median incomes of 108-120% of the median incomes for the Holualoa neighborhood, Kailua Village, and Hawaii County as a whole,

respectively (if price were the only consideration). While these condominiums may not be within the easy financial reach of families below the median income level, at the low end of the price range and based on price alone these condominiums may be within the reach of a larger-than-expected portion of area families (over half the families in Holualoa, and over 40% of families in Kailua and the Big Island as a whole). The low homeowner vacancy rate of 1.1% in Holualoa and 1.5% in Kailua suggests a demand for more owner-occupied housing.

86. There appeared to be a healthy rental market with a substantial number of rental units available in the area, especially in Kailua. In 2000, nearly 48% of the occupied housing units in Kailua were rentals, and the rental vacancy rate was 11.9%, exceeding the 4.9% in Holualoa, where 38% of the occupied units were rentals, and still substantially higher than the Big Island as a whole, where 35% of the occupied housing was rented and the vacancy rate was 7.6%. One effect of the availability of rental housing is an increased ability of lower income families to find affordable rental housing. In Kailua, 71% of specified renter-occupied units rented in the range of $300-$1000 per month.

87. Efforts will be made to help University affiliates unable to purchase in Hualalai Village to take advantage of the availability of condominiums as rental housing, through the formation of a pool of dedicated units purchased and donated for that purpose or perhaps through the aggregation of units only seasonally occupied. Other creative ideas will also be considered that are in keeping with the preservation of the integrity of the high quality and careful design of the development as a whole, which will serve the area, the University and the residents well for the long term.

88. In general, the Hualalai Village development will offer high-quality condominiums that are moderately priced and planned to reinforce the Kona way of life by avoiding over-density, building to the land, and encouraging pedestrian dominance. The project will help satisfy the demand for condominiums in the Kona area, owner occupied housing, and the special need for housing serving the friends, donors, and University affiliates.

Cultural Center

89. The Kona coast has relatively few visitor destinations besides its traditional beaches, newer deluxe hotels, and world-class billfishing. The Cultural Center will

provide a new destination that reinforces respect for traditional culture and cultural diversity as it attracts visitors to the Kona region. Because the Cultural Center will provide an experience appropriate for all age groups, individuals and families, it can be expected to have a broad appeal to visitors from both sides of the Pacific, and add to Kona's growing appeal as a visitor destination.

90. The Kona region has experienced strong growth over the last decade, and is in need of a venue for concerts and other performances beyond the facilities that now exist. Petitioner is committed to strong interaction with and support for community activities, and believe the Cultural Center can help meet the demand for new arts and performance facilities.

91. The Project will provide both short-term employment in the areas of development, construction, financing, architectural, engineering, insurance, accounting, legal and other related employment relative to the development, and long-term employment in operation of the Cultural Center. Both full- and part-time job opportunities created would include, but not be limited to: administration and staff support, accounting, finance, customer services, security and safety, property management, personnel, production and promotion, clerical, entertainment, eateries, gift shops, landscape maintenance, janitorial services, marketing and advertising. The Cultural Center includes certain restaurants(s), gift stores, food eateries, entertainment, luaus, catering and ticket sales for admission to the Cultural Center, with revenues estimated to range from $13 million - $20 million per annum increasing the County's tax incremental benefit.

92. The University hosts international students from 30 – 50 nations at any one time. This institution makes a significant contribution to cultural diversity as well as training in cross-cultural relationships. Hualalai Village will be closely linked to the University and may provide much needed additional housing opportunities for the staff. Staff and students associated with the University community also make a substantial contribution to the Kona economy. The Project will enhance further growth of the University, and consequently, add opportunities for residents to improve their quality of life through further educational opportunities. Moreover, the development and operational success of the Project's Cultural Center will enhance Kona's position as a tourist attraction.

93. Petitioner has represented and committed to the Commission that in order to enhance the programs proposed at the Cultural Center, Petitioner has committed to fund a gift of scholarships covering the costs of tuition and books for full-time students ("Scholarships") of the Hawaiian language under the following terms and conditions:

a. Starting in the Fall 2003 semester of the College of Hawaiian Language at the University of Hawaii - Hilo ("College of Hawaiian Language"), Petitioner shall select and fund Scholarships for two (2) full-time students selected by Petitioner enrolled in the College of Hawaiian Language at the University of Hawaii – Hilo ("UH-H") through the graduation of each student to obtain a fourth year teaching certificate in the Hawaiian language. Following graduation, the Petitioner shall pay the salary for the two graduates to teach the Hawaiian language at a non-profit educational program specializing in Hawaiian language and cultural instruction, which salary payment shall terminate at the earlier of the commencement of the Cultural Center operations, or January 1, 2008.

b. Upon the opening for operations of the Cultural Center, and for a maximum of five (5) years from the opening of the Cultural Center, the Petitioner shall establish and administer a Hawaiian language scholarship fund by setting aside 1% of each admission ticket sold for the Cultural Center. The proceeds of the Hawaiian language scholarship fund shall fund the costs of scholarships for students of all ages attending Hawaiian language programs, ranging in scope from an immersion school, to a non-profit educational program specializing in Hawaiian language and cultural instruction, to the College of Hawaiian Language. If, for whatever reason, the Cultural Center is not open for operations by January 1, 2008, the Petitioner has committed to return to the Commission for further discussions on this issue.

SOCIO-ECONOMIC IMPACTS

Population

94. In 1980, there were 13,748 people living in the North Kona region, the area including Kailua-Kona. By 2000 the population had more than doubled, to 28,543. The increase over the last 10 years, from 1990-2000, was 28.1%. The population of the Kailua CDP increased just 8% from 1990-2000, to 9,870; but the Holualoa CDP, the one closest to the

Property, increased by 59.3% over that time, to 6,107. Together this local population equals 15,977.

95. In 2000, Hawaii County per-capita income was $18,791; in Kailua-Kona it was $20,353; while in Holualoa it was $25,222, 22% higher than Kailua and 39% higher than Hawaii County. The above statistical picture is of a Kailua-Kona a bit better off than the island as a whole but generally similar in socioeconomic profile except for a higher proportion of workers in the resort sector that grew up with the area over the last 10-20 years; with fewer professionals but more workers in the "arts, entertainment, recreation, accommodation and food services." Holualoa appears more upscale and newer than Kona. Overall, the census data bears out the impression that Kailua is the hub of North Kona around which an influx of newer in-migration is gathering.

96. Assuming an average household size of 2.5, at full build-out Hualalai Village's 400 units would have potentially 1,000 occupants. If half of those were new to the Big Island, 500 new residents would be added. This represents an increase of less than two percent in the population of North Kona and an increase of around three percent in the population of Kailua-Kona and Holualoa combined. However this occupant number may be decreased due to the high incidence of second home buyers in Kona.

Housing

97. A decadal increase in housing units generally mirrored the increase in population between 1990 and 2000. As of 2000, there were 13,330 housing units in the North Kona district, up 68% from 1990. Kailua had 4,322 units, up 20% from 1990; Holualoa had 3,330, up 63% from 1990. The distribution of housing stock between owner-occupied and rental housing was profoundly divergent from the island-wide average.

98. In Hawaii County, 65% of housing units were owner-occupied, and 35% of the housing units were rentals; the rental vacancy rate was 8%. Holualoa had generally similar numbers. But in Kailua, owner-occupied and rental housing was nearly evenly divided, and according to the 2000 US Census the rental vacancy rate was a healthy (for renters) 12%. This suggests that renters currently have access to a significant number of choices, and further

suggests that rents currently are not subject to the upward pressures generated by a tight rental market.

99. The addition of 400 new units will raise the number of North Kona housing units by 3%, from 13,330 to 13,730. It will increase the total number in Kailua and Holualoa by 5%, from 7,652 to 8,052.

100. The operations of the Cultural Center are expected to offer approximately 400 - 500 jobs. It is expected that volunteers and students from the University will fill some of the positions at the Cultural Center, with the remainder of the positions being filled from the local community. While some employees and performers at the Cultural Center will come from other areas, the Cultural Center is not anticipated to create enough of an employment opportunity to independently attract migrants to Kona.

101. The construction of Hualalai Village and the Cultural Center will provide temporary employment for current area residents. The rental vacancy rate of 12% should ensure that any construction workers attracted to Kailua-Kona could find housing for the duration of their employment, or longer.

102. Condition J under Ordinance No. 02-101, requires Petitioner to comply with the applicable affordable housing requirements pursuant to Chapter 11, Hawaii County Code which may include but not limited to the following options:

- provision of in-lieu fees;
- provision of off-site housing units;
- provision of developable lands;
- provision of infrastructure/services; and
- other means approved by the County housing agency.

Petitioner has committed to the Commission to comply with the Hawaii County affordable housing requirements.

<u>Economy</u>

103. Portions of the Project will provide both short-term employment in the areas of development, construction, financing, architectural, engineering, insurance, accounting, legal and other related employment relative to the development and long-term employment in operation of the Cultural Center. Both full- and part-time job opportunities created would include, but not be limited to: administration and staff support, accounting, finance, customer services, security and safety, property management, personnel, production and promotion, clerical, entertainment, eateries, gift shops, landscape maintenance, janitorial services, marketing and advertising. The Cultural Center includes certain restaurants(s), gift stores, food eateries, entertainment, luaus, catering and ticket sales for admission to the Cultural Center, which brings estimated revenues to range from $13 million - $20 million per annum increasing the County's incremental tax benefit.

104. The University hosts international students from 30 – 50 nations at any one time. This institution makes a significant contribution to cultural diversity as well as training in cross-cultural relationships. Hualalai Village will be closely linked to theUniversity and may provide much needed additional housing opportunities for the staff. Staff and students associated with the University community also make a substantial contribution to the Kona economy. This project will enhance further growth of the University, and consequently, add opportunities for residents to improve their quality of life through further educational opportunities. Moreover, the development and operational success of the Cultural Center will enhance and further highlight Kona's postion as a tourist attraction.

IMPACTS UPON THE RESOURCES OF THE AREA

Flora and Fauna

105. A flora and fauna study and biological survey of the Petition Area was completed in July 2002. The purpose of the survey was to identify any State or federally listed threatened or endangered plant species growing on or near the Petition Area, and to summarize the populations of native and introduced plant species. All portions of the Petition Area were surveyed, and all of the naturalized and most of the prominent landscaped plants were noted. During the course of the plant survey, all bird species present on the project site were identified by sight or sound. No mammals were sighted, although it is likely that a number of aliens including mongooses, rats and cats inhabit the property.

106. The general landscape of the Kailua-Kona area has been radically changed by centuries of settlements, over a century of grazing and particularly by the development of hotels, condominiums, resort homes and associated infrastructure and commercial activity since 1960. The vegetation has also been fundamentally altered by alien species invasion to the point that in many locations native species are few to none. The alien species invasion of kiawe (*Prosopis pallida*) and koa haole (*Leucaena leucocephala*), long ago became dominant in the coastal dry forest. As is typical of the region, the Property has been managed for grazing and thus the vegetation is non-natural and almost completely alien. The Petition Area is basically kiawe parkland with an understory of guinea grass (*Panicum maximum*). Other trees, including opiuma (*Pithecellobium dulce*) are present infrequently in the canopy. The understory contains a number of other species, and is in some areas dominated by *Desmanthus virgatus*. Variations in grazing and lava type appeared to have left some areas (particularly the mauka and southern ends) denser with vegetation than others.

107. No threatened or endangered plant or animal species are present or would be expected to be present on the Property. In terms of conservation value, no botanical or zoological resources requiring special protection are present.

Surface Water, Flooding and Drainage

108. There are no known drainage ways on the Property. The nearest major drainage way is the Waiaha drainage way located about 600 feet from the edge of the Property on the opposite side of the Hillcrest subdivision. The low rainfall, site drainage plan and any drainage mitigation measures to be implemented pursuant to requirements of the County Department of Public Works will minimize the impacts associated with storm water runoff. The Federal Emergency Management Agency's Flood Rate Insurance Maps indicate that the Property is within Zone X, which represents areas determined to be outside the 500-year floodplain.

109. A Drainage Report for Hualalai Village was prepared to analyze off-site drainage flows that are tributary to the Property and to propose mitigation for the impacts of these flows. The study quantified flows through three culverts below the Queen Kaahumanu Highway that could potentially impact the Property. Of the three culverts, only one culvert, an 84" culvert near the southeast corner of the Petition Area actually impacts the Petition Area.

Flow from this culvert will be directed to a retention basin with drywells designed to infiltrate the 100-year storm flow. Discharge from the other two culverts will not impact the Property. There are catch basins along the Hualalai Road/Queen Kaahumanu intersection that contribute a small amount of off-site flow. This flow will be disposed of through drywells.

110. The County of Hawaii, Department of Public Works expressed concern regarding possible diversion of flows to off-site properties due to the curb, gutter and sidewalk that is currently being constructed along Hualalai Road as part of the Hualalai Village Phase I project. Petitioner demonstrated to the Department's satisfaction that off-site drainage is not being diverted to other than historic drainage patterns through the University property at TMK: (3) 7-5-10:03. By letter dated March 4, 2003, the Department of Public Works, accepted the Drainage Report for Hualalai Village dated September, 2002 as satisfying Condition G of Ordinance No. 02-01.

<u>Historical/Cultural Resources</u>

111. A Cultural Impact Assessment was conducted in December, 2002 to assess the potential impacts upon any identifiable cultural properties, features, resources, practices or beliefs of native Hawaiians or any other ethnic groups that are associated with the Property or specific to the Wai'aha ahupua'a.

112. The Property is located within the Kula zone, and thus was probably not heavily settled in comparison to the shoreline and mauka regions. The historic clearing of much of the Property for cattle grazing and ranching further impacted the Property.

113. The Petitioner and its consultants have uncovered substantial evidence, as determined by Petitioner's cultural assessment, of valued cultural, historical or natural resources within the Property, but have not found any traditional and customary native Hawaiian rights being currently exercised within the Property. As such, it is unlikely that any valued resources, including traditional and customary native Hawaiian rights, will be affected or impaired by the proposed action. Additional archaeological survey and mitigation work will be undertaken on the Property.

114. If in the future, any valued cultural, historical, natural resources and/or traditional and customary native Hawaiian rights are discovered in the Property, Petitioner will report this matter to the State of Hawaii, Department of Land and Natural Resources, Historic Preservation Division ("DLNR-SHPD") for review and assessment.

115. As a cultural landscape, the ahupua`a of Wai`aha offers a kaleidoscope of historical and cultural features and properties. Historical documentation indicates that as early as the 15th century, the mokuoloko of Kona was a recognized residential and political center whose population was sustained by a variety of agricultural activities and an abundant coastal resources base. Evidence of these traditional land use patterns are documented in remnant cultural properties and features of na heiau ho'oulu 'ai, na ku'ula, springs, enclosures, and terraces of the once extensive Kona field system.

116. During the late 1800s, the upper slopes of Wai'aha served as a summer residence for Emma Naea Rooke and Alexander Kalanikualiholihokekapu 'Iolani.

117. Wai'aha, meaning "gathering water," has one major tributary system whose headwaters are situated in the upper slopes of Hualalai, near 'Umiahu and Kumukou. However, intermittent flow rates of the system historically influenced the development of dryland agriculture.

118. Sources suggest that by the late 1890s, much of the land within the Wai'aha ahupua'a was utilized by the Kona Sugar Company to support the sugarcane industry. Following the closure of the plantation in 1926, Manuel Gomes as part of an immense cattle and ranching operation purchased much of the land within Wai'aha, including a large portion of the Petition Area.

119. The Petitioner has proposed to establish and fund a committee to monitor development. The two-member Wai'aha Development Monitoring Committee is proposed by Petitioner to be comprised of Petitioner's representative, Mary Kamahele Boyd and lineal descendant Josephine Nahale Kamoku. The Wai'aha Development Monitoring Committee will be established to monitor the development of the Hualalai Village, the Cultural Center, and the

educational component. The Petitioner proposed that the two-member group shall be called the "Kahu Wai'aha Committee" ("KWC").

120. The Petitioner, through the Cultural Center will cooperate with the College of Hawaiian Language to establish programs that would be mutually beneficial to identify and preserve identifiable cultural features, resources, practices or beliefs of native Hawaiians or any other ethnic groups associated with the Property. .

Archaeological Resources

121. Permanent settlement began in the Kailua-Kona area in approximately A.D. 1000-1200. Several large and densely populated centers were situated at several locations along the shoreline between Kailua and Honaunau, and included dwellings for rulers, chiefs and people, places of refuge, and other structures. Also present are large and small heiau, sporting areas, and burial clusters. Fishing and farming were the major economic activities. The zone of habitation was segmented makai to mauka, a land division known as an ahupuaa, and included: a) the shoreline inland to approximately 600 feet; b) the Kula, which extended approximately to 500 feet in elevation where some food growing occurred and where permanent habitations are more sparsely distributed; and c) several other zones demarcated primarily by elevation. The Property lies within the Kula zone.

122. Two levels of archaeological/historical reconnaissance have been performed for a portion of the Petition Area. Previously, an eastern portion of the Property was inspected and given clearance by the DLNR-SHPD. In April 2002, an initial field assessment survey was done for the remainder of the Petition Area to determine if any features of archaeological, cultural or historic importance were observable and to make a preliminary assessment of possible historic-preservation treatments appropriate or required by such features. The assessment survey identified 28 possible sites comprising approximately 53 features, including walls, terraces, mounds, modified outcrops, stone concentrations, platforms, enclosures, and a lava blister cave. The functional types included boundary, temporary and permanent habitation, possible grave, possible ceremonial, clearing, ranching, and indeterminate. During this survey, as many as 30-35 component structural features at eleven different sites were tentatively identified as possible burial features. This tentative functional identification was

based primarily on physical similarities to structural features previously identified on other survey projects and confirmed through excavation to contain human skeletal remains.

123. Subsequently, a follow-up investigation was conducted in the survey area of the April 2002 assessment to sample a reasonable number of the possible burial features to determine the following: (a) the presence or absence of burials in the sample of features tested; (b) if present, the number of additional burials likely to be represented by the remaining features that were not tested; (c) the historic preservation implications of any such burials for the feasibility of any proposed development; and (d) the general scope of the work and level of effort for any subsequent archaeological-historical preservation work that might be appropriate and/or required. The ultimate objective of any such subsequent work would be to comply with all applicable historic preservation requirements of the Hawaii State Historic Preservation Division (SHPD) and the Hawaii County Planning Department. The April 2002 survey and the follow-up sampling were performed by PHRI, Inc.

124. No human skeletal remains were recovered within or beneath the eleven sampled possible burial features at eleven different sites. Possible explanations of rock mound features include prehistoric, historic, or modern agricultural clearing mounds; areas of prehistoric sweet potato cultivation, or temporary prehistoric habitation platforms. Other significant archaeological features were noted during the initial survey and recommended for follow-up investigation and appropriate treatment, possibly including preservation in place in some cases. The results of the fieldwork in the April 2002 survey area do not preclude the existence of human skeletal remains elsewhere on the Property.

125. During the follow-up investigation, cultural remains, including a coral abrader (surface) and several pieces of cowrie shell (subsurface) were noted at Site 2235-7. An adze fragment (surface) and several pieces of unidentified shell (subsurface) were noted at Site 2235-4.

126. An Archaeological Inventory Survey was conducted by Rechtman Consulting in February, 2003 for the April 2002 survey area. Twenty-six sites were defined including the previous recorded Kuakini Wall. The sites include Historic Period walls and enclosures, Precontact temporary and permanent habitation sites, Precontact burial sites, trail

segments, an agricultural complex containing 297 features, one ceremonial enclosure and platform, and a papamu. There are four breaches in the Kuakini Wall. No lava tube entrances were found.

127. Subsurface testing was conducted at 22 separate features within 10 sites, including habitation, agricultural, and suspected burial features. The presence of human remains was confirmed at three suspected burial sites. DLNR-SHPD Burial Program was notified of the discovery of the human remains.

128. All 26 sites were assessed for their significance based on criteria established and promoted by DLNR-SHPD and draft Section 13-284-6, HAR (1998) with treatment recommendations for the 26 sites. Five sites were recommended for preservation: Site 6302 (ranching/boundary-Great Wall of Kuakini); Site 23681 (ceremonial-agricultural heiau); and Sites 23683, 23684 and 23685 (burials). The Petitioner has also voluntarily committed to preserve, with interpretative development, the papamu or rough square game board identified as Site 23682.

129. DLNR-SHPD, by letter dated May 7, 2003, concurred with the site significance evaluations as addressed in the Archaeological Inventory Survey, and recommended the five sites for preservation and 10 sites for data recovery.

130. Two mauka-makai trail segments located on the Property were not recommended for preservation by DLNR-SHPD.

<u>Scenic and Visual Resources</u>

131. The Property is located on the lower western slopes of Mount Hualalai, one of five shield volcanoes whose lava flows created the island of Hawaii. The Property is bordered by Kuakini Highway on the west, Hualalai Road and Queen Ka`ahumanu Highway to the east, the University of the Nations-Kona campus to the north and the Kona Hillcrest subdivision on the south. The Property is gently sloping, rising in elevation from approximately 100 feet at Kuakini Highway to 325 feet at its highest point, with the steepest slopes on the upper mauka side just below Hualalai Road. Slopes average 5-10% but increase to as much as 25% just below Hualalai Road. The slightly steeper slopes on the mauka end afford the opportunity to

provide sweeping ocean views from Hualalai Village. Some condominium units may have a view of Kailua Bay. The site plan preserves these views.

ENVIRONMENTAL QUALITY

Hazards – Tsunami, Earthquake and Lava Flows

132. Tsunami: The Federal Emergency Management Agency Flood Insurance Rate Map shows no areas of potential tsunami inundation on the Property.

133. Lava Flows: Hazard zones from lava flows are based chiefly on the location and frequency of both historic and prehistoric eruptions. The hazard zones also take into account the larger topographic area. The island of Hawaii is divided into nine hazard zones according to the level and degree of potential hazards related to lava flows. An area designated as Zone 1 is considered to be an area of greatest potential hazard. These designated zones are determined primarily from the location and frequency of past eruptions.

134. The Kailua-Kona area is within Zone 4, indicating a moderate hazard. Zone 4 includes all of Hualalai, where the frequency of eruptions is lower than on Kilauea and Mauna Loa. Flows typically cover large areas. The dormant Hualalai last erupted in 1801 (Stearns and McDonald, 1946). Since 1800, five percent of the Hualalai area has been covered by lava. In the last 750 years, 15% has been covered.

135. "Historic eruptions" include those for which there are written records, beginning in the early 1800's, and those that are known from the oral traditions of the Hawaiian people. Our knowledge of prehistoric eruptions is based on geologic mapping and dating of the old flows of each volcano. In the last 3000 years, Hualalai has erupted near its summit, along the northwest and south-southeast rift zones, and from vents on the north flank of the volcano. Twenty-five percent of the volcano is covered by flows less than 1000 years old. Hualalai last erupted in 1800-1801 from several vents on the northwest rift zone. Large flows spilled down both sides of the ridge formed by the rift zone and quickly reached the ocean. One of these flows lies south of Kiholo Bay, and part of the Kona Village resort is built upon it. Another flow underlies the northern end of the Keahole (Kona) Airport. Other major eruptions occurred about

300 and 700 years ago. A large flow from the 700-year old eruption forms the north side of Keauhou Bay, south of Kailua-Kona.

136. Earthquakes: The entire island of Hawaii is susceptible to earthquakes originating in fault zones under and adjacent to the island. Two fault zones have been identified within the Kona region: the Kealakekua and the Kaloko faults, both located in South Kona and well away from the Property. According to previously established procedures, the United States Geological Survey conducted a probabilistic seismic-hazards assessment in 1997. From this assessment, seismic zones were re-assigned for each county. The classification system is based on a scale of 0 to 4, increasing in level of risk due to seismic occurrence and danger. Due to the island's active volcanic activity, the entire county of Hawaii lies in a seismic zone designated as Zone 4, the highest designation.

137. Under the Uniform Building Code seismic provisions, a Zone 4 area could experience severe seismic activity between .30 and .40 of the earth's gravitational acceleration (g-forces) causing major damage to poorly designed or built structures. The potential of damage caused by strong earthquakes is a prevalent concern for the entire County of Hawaii. As such, the Project will be in compliance with the Uniform Building Code and County of Hawaii structural design standards, including earthquake design provisions.

Coastal Waters

138. As described above, rainfall in the area is generally quite low and evenly distributed throughout the year. Site design will minimize runoff and provide for its collection, including runoff from newly hard-topped areas, and for its dispersal through percolation from drywells. Adequate provision has been made for the 100-year flood event. No surface water is expected to reach the coast directly, or flow into drainage ways north or south of the Property and so reach the coast. The management of surface water and drainage control measures during construction and subsequent operation will meet County of Hawaii and State Department of Health standards. The Property's location approximately one-quarter mile inland from the coast is sufficient to further reduce the possibility of any such impacts, and no impacts on coastal waters are anticipated.

Air Quality and Noise

139. The Project is expected to create short-term disturbances to the present air quality and noise levels for the area due to construction. The Petitioner will implement standard dust and noise attenuation measures during the construction period to minimize the negative short-term effects on these conditions.

140. Potential subsequent impacts to local air quality are expected to be minimal, and limited to emissions from an increased number of motor vehicles operated by residents and guests of Hualalai Village and visitors to the Cultural Center. By providing adequate parking so that a visitor may quickly find an available parking place, and by landscape design that encourages walking, noise and air quality impacts will be minimized. Buses waiting to load or unload passengers may be asked to wait without their engines running.

141. Cultural Center Programs: The programmatic aspect of the Cultural Center is planned to focus upon the historical relationship of the native Hawaiian culture with Christianity and establishment of Hawaii's multicultural mix. However, in concept the Cultural Center will have an enclosed mainstage area, one or more outdoor performance areas, some outdoor activities around a central water feature, and some displays, all of which may generate sound impacts. The greatest potential noise generators are likely to be performances of traditional music and dance. Any nighttime activities which may be scheduled would be held indoors. Residents of Hualalai Village, the Kona Hillcrest subdivision, and resident students at the University of the Nations-Kona potentially may be affected by heightened sound levels from the Cultural Center.

142. Sound intensity levels from the Cultural Center performances will be mitigated through placement of the activity and event areas within the site away from residences, through the timing and duration of the events, and through the use of the enclosed mainstage area at night when noise has the greatest potential for impacts to surrounding properties. The Petitioner's sensitivity to this issue will be reflected in the design and development of the Cultural Center.

143. The enclosed mainstage area has been located on the extreme north edge of the Cultural Center site, as far from all of these potentially affected areas as possible. The completely enclosed main stage area will ensure that escaping noise will be minimal.

Water Quality

144. There are currently 297 water units available for the portion of the Hualalai Village within the Petition Area. The Department of Water Supply (DWS) is in the process of developing a well at Waiaha and up to 1,000 units of water from that source will become available within the next 12 to 18 months. Off-site infrastructure improvements are required to transmit the water from the well to the Petition Area. Discussions with DWS regarding the development of the necessary transmission lines and tanks are ongoing. Once an agreement is reached regarding the off-site infrastructure improvements, water commitments can be secured for the Cultural Center and the Educational Facility.

145. The only intrusion into the groundwater table is expected to be the possible drilling of a well to supply brackish water for the central water feature. This is not expected to have a significant impact because the water will be recirculating and evaporation losses are not expected to be significant. The low rainfall, site drainage plan and any drainage mitigation measures to be implemented pursuant to requirements of the County Department of Public Works and State Department of Health will minimize the potential for adverse water quality impacts.

146. Two 500,000 gallon water tanks are located on the Property and will be replaced by a 1.0 million gallon tank located further south on the Property.

Recreational Resources

147. The Cultural Center will provide a new recreational resource for the Kona region and for residents of and visitors to the Big Island. It will provide family-oriented activities related to different elements of native Hawaiian culture and history for all age groups. Activities may include performances in outdoor areas and the enclosed mainstage; outdoor activities around the central water feature; displays and exhibits; the education center; and the restaurant or other food outlets. As discussed earlier, it is anticipated that the main stage and perhaps other Cultural Center facilities will be available for community events. Many of the activities provided for by the Cultural Center are unavailable currently on the Big Island.

148. Hualalai Village has made appropriate provision for recreation within the development. There will be an exercise room in the recreation center, a swimming pool for

residents and guests, and a landscape design that encourages walking and biking instead of driving.

ADEQUACY OF PUBLIC SERVICES AND FACILITIES

Transportation/Roads/Traffic

149. Based upon the findings of the final report on the Keahole to Honaunau regional circulation plan, the County of Hawaii is in the process of developing an action plan to prioritize local transportation projects .

150. To address traffic congestion in the Kona Region, the County of Hawaii and/or the State of Hawaii have committed to roadway improvement projects which have been funded through the construction phase. These include the widening of Queen Kaahumanu from Kealakehe to Henry Street, traffic safety improvements without widening at Palani Road, Kuakini Highway widening, pedestrian improvement project along Alii Drive, and the southern phase of the Kahului-Keauhou Parkway from Kamehameha III Road up to Lako Street.

151. Additional planned projects include roadway improvements to the Queen Kaahumanu Highway from Henry Street to Kamehameha III Road; the northern phase of Kahului-Keauhou Parkway; completion of mauka/makai roads along Lako Street and Laaloa Avenue; and alternatives to the intersection of Palani and Queen Kaahumanu, such as the Kealakehe Parkway connection to the Henry Street extension. Funding for these projects is still being determined.

152. Projects with committed funding in the vicinity of the Property include the widening of Kuakini Highway and pedestrian improvements along Alii Drive. The plans for the widening of Kuakini Highway from Palani Road to Hualalai Road are 90% competed.

153. The County acknowledged that the utilization of fair share contributions collected from fair share assessments imposed pursuant to Hawaii County Code Section 12-162 needs improvement to insure that the funds are utilized for specific projects through the CIP process and to insure that the fair share payments do not languish in the accounts. The County committed to develop and improve systems to track the fair share assessments, to verify payments made and disposition of the payments, to develop an accounting system that is linked

to the Planning Department's permit-tracking system and CIP data base system to assure that the fair share assessments are spent for appropriate projects in the vicinity of the contributing project, and to optimize the use of matching funds to leverage federal or State grants.

154. To alleviate the increased traffic congestion in the region, the County is implementing alternatives such as Transportation Systems Management and Transportation Demand Management, which contemplate coordination of traffic signals, HOV and adjustments to peak hour travel by addressing hours of work. The County is also concentrating on implementing increased mass transit, bikeway and pedestrian travel to minimize traffic.

155. The Cultural Center and Hualalai Village are envisioned as separate projects, related only in their mutual affiliation with the University. The primary entry to Hualalai Village will be on Hualalai Road. Additional egress and ingress for Hualalai Village residents as well as emergency public access is planned through a gated entrance mauka-makai from Hualalai Road to Kuakini Highway. The only ingress and egress to the Cultural Center will be on Kuakini Highway. Any through roads would be subjected to traffic calming devices, such as speed bumps, that discourage traffic between the two developments and ensure pedestrian safety between Hillcrest Park and the proposed park of the Petition Area. The Cultural Center will be designed to include elements that mitigate noise, light, and traffic impacts on the surrounding residential areas.

156. Based upon a Traffic Impact Analysis Report by M&E Pacific ("TIAR") that analyzed ambient and projected levels of traffic at: (a) Hualalai/Kuakini; (b) Kuakini/Oni oni; (c) Hualalai/Queen Ka`ahumanu; and (d) Queen Ka`ahumanu/Nani Kailua, ambient traffic can be expected to increase due to regional growth and new projects in the area during the period between 2002 through 2007.

157. The Cultural Center is expected to generate peak traffic volumes at about noon, tapering off until closing at 6:00 p.m. Between 500 to 1100 midday visitors per day are projected to experience the Cultural Center. Cruise line passengers will be shuttled via buses from the pier to the Cultural Center and will represent approximately 75% of the daily visitor count to the Cultural Center. In addition, 50 tour patrons will arrive by van transport, and 50 kamaaina and 200 independent travelers will arrive by private automobiles. By catering to the

cruise ship business, the hours of operation for the Cultural Center will bring most visitors in by bus at off-peak traffic hours, thus minimizing the traffic impacts on the region. The Hualalai Village is expected to generate peak traffic of 150 trips during the morning and 190 trips in the afternoon commuter hours.

158. The Addendum to the TIAR dated February 17, 2003, reanalyzed the traffic forecasts and traffic impacts to include the cumulative traffic impacts of several proposed developments in the vicinity of Hualalai Village and Cultural Center. The reanalysis indicated that traffic generated by other proposed developments (Kona Hawaiian Village, Kona Sea Ridge, Alii Cove) could have significant adverse impact at the Kuakini Highway/Walua Road intersection. The opening of the proposed Kahului to Keauhou Parkway is expected to decrease through traffic problems on Kuakini Highway and decrease delay times/improve level of service on Walua Road. Estimated traffic flows from Cultural Center and Hualalai Village are not expected to have a significant adverse traffic impact on the neighboring road system.

159. The State Department of Transportation ("DOT") reviewed the TIAR and raised concerns regarding the interaction of the entire master planned development at build-out, compliance with standard practices in preparation of a TIAR, supporting documentation and justification, and mitigation of project generated traffic impacts.

160. To address the DOT's concerns with Petitioner's TIAR, Petitioner will prepare a revised TIAR for subsequent DOT review and approval.

Water Service

161. The Project will be served by the County Department of Water Supply system. The County Department of Water Supply has indicated that 297 water units will be allocated for the portion of the Hualalai Village within the Petition Area. Discussions between Petitioner and the County regarding any water unit balance needed for future Educational Facility and Cultural Center needs are currently underway.

162. The water infrastructure for the Project will be constructed incrementally as each development unit (including Hualalai Village, Cultural Center and Educational Facility) is developed. However, the overall system for all three development units is planned in an

integrated fashion with storage capacity for all three units maintained in the planned tanks in the Villages and at an off-site location adjacent to Hualalai Road.

<u>Wastewater</u>

163. Wastewater for the Project will be collected via an on-site gravity system. The on-site system will discharge to a trunk sewer line that has been constructed in Kuakini Highway. The flow is tributary to the County's municipal wastewater treatment plant at Kealakehe.

<u>Solid Waste/Sanitation</u>

164. Solid waste for the Project will be handled by private solid waste hauling contractors. Each development unit is expected to have a separate solid waste management program unless coordination allows the opportunity for a more efficient system. Waste reduction will be incorporated into the Project design of the Project. A solid waste management plan will be prepared as required by the County.

<u>Drainage</u>

165. There are no known drainage ways on the Property. The nearest major drainage way is the Waiaha drainage way located about 600 feet from the edge of the Property on the opposite side of the Hillcrest subdivision. The low rainfall, site drainage plan and any drainage mitigation measures to be implemented pursuant to requirements of the County Department of Public Works will minimize the problems associated with storm water runoff. The FIRM map indicates the Petition Area is not in a flood prone zone.

166. The drainage area directly mauka of the Property (above Queen Ka`ahumanu Highway) is divided into four (4) smaller drainage basins. Impacts from off-site runoff for the Hualalai Village and Cultural Center will be mitigated through the construction of retention basins with drywells. The retention basins will be designed with the potential to increase capacity should it be warranted in the future. In addition, emergency overflow from the retention basins will be directed toward the street and driveway drainage systems. All anticipated off-site flows will be handled by existing drains along Queen Ka`ahumanu Highway and the proposed new drywells along the mauka boundary of Hualalai Village. Increase in runoff from impervious surfaces within the Petition Area will be disposed of through drywells.

By letter dated March 4, 2003, the Department of Public Works, accepted the Drainage Report for Hualalai Village dated September, 2002 as satisfying Condition G of Ordinance No. 02-01.

Power and Telephone

167. Utility poles along both Hualalai Road and Kuakini Highway provide electrical power. By letter dated January 31, 2003, Hawaii Electric Light Company (HELCO) indicated to the Public Utilities Commission that HELCO will have sufficient capacity available on its system to serve the Project into the foreseeable future and to cover the projected annual system peaks.

168. Alternative energy options discussed with HELCO representatives to improve the reliability of power in HELCO's grid include co-generation system and solar water heating system. Noise impacts and the siting of the buildings do not make these options viable during the development of Phase 1 of Hualalai Village currently underway. The Petitioner has committed to pursue alternate energy sources in the development of the Project, such as co-generation and solar sources.

169. Telephone service is also available to the Project along the same pole lines. Telephone service is provided by Verizon Hawaii.

Police and Fire Protection

170. The County of Hawaii provides police and fire protection for the entire island. The Petition Area is well served due to its proximity to existing urban areas and location along major roadways. The nearest fire station is located near the corner of Palani Road and Queen Ka`ahumanu Highway about a mile away. Additionally, all buildings will be built to meet life safety and fire code requirements.

Schools

171. TheUniversity campus is immediately adjacent to the Petition Area. The proposed Educational Facility will be a part of this campus. Several private and public schools serve the Kailua-Kona area. They include Hualalai Academy, Kahakai Elementary, Kealakehe Elementary, Kealakehe Intermediate, Kalakehe High School, Kona Montessori School, Hualalai Academy, Kona Christian Academy, and Makua Lani Christian High School. The nearest public

high school is Kealakehe High School several miles to the north. The West Hawaii Branch of the University of Hawaii Center at West Hawaii, a branch of the Community College System is located to the south in Kealakekua.

Parks

172. There are few parks in the Kona region. The nearest large park is the State of Hawaii's Old Kona Airport Park just north of Kailua Kona past the industrial park. A smaller County beach park, Hale Halawai is closer to the Property near the terminus of Hualalai Road. Immediately adjacent to the Property is a small community park in the Hillcrest subdivision.

173. The University has recreational amenities scattered through its campus including children's play areas and a soccer field. A passive park is planned for the area between Hualalai Village and the Cultural Center.

174. A two to three acre passive park will be developed between the Hualalai Village and the Cultural Center for possible dedication to the County of Hawaii. The park is sited adjacent to the existing Hillcrest Community Park, creating expanded and improved recreational facilities. Walking paths and recreational landscaping will be provided. Native species and Polynesian introductions suited to the area will be emphasized in the park landscaping

Health Facilities

175. The nearest hospital is Kona Community Hospital which is located to the south in Kealakekua about 10 miles away. Several private clinics are located in Kailua Kona near the Property.

COMMITMENT OF STATE FUNDS AND RESOURCES

176. The on-site development of the Project will be funded through a combination of niche financing and conventional financing, and donors from the friends, faculty and staff of the University affiliates, and will not require direct expenditures by either the State of Hawaii or the County of Hawaii.

177. State of Hawaii and/or County of Hawaii funds are being committed to local and regional traffic improvements in the area of the Project, and Petitioner committed to pay its pro rata share /fair share of off-site traffic improvements that are required as a direct result of development of the Project.

CONFORMANCE TO APPLICABLE DISTRICT STANDARDS

178. The proposed reclassification is in general conformance to Section 15-15-18(1) to (8) of the Land Use Commission rules, standards for determining "U" Urban District boundaries.

CONFORMANCE WITH GOALS, OBJECTIVES AND POLICIES OF HAWAII STATE PLAN

179. Pursuant to Section 205-17(1), HRS and Section 15-15-77(b)(1), HAR, and subject to the conditions of approval set forth herein, the reclassification of the Property conforms to the applicable goals, objectives and policies of the Hawaii State Plan, Chapter 226, HRS, as amended with respect to the following State Plan objectives and policies, based upon the following:

> Section 226-5: Objective and Policies for Population: Hualalai Village represents an increase of less than two percent in the population of North Kona and an increase of around three percent in the population of Kailua-Kona and Holualoa combined.
>
> Section 226-6: Objectives and Policies for the Economy – In General: The Hualalai Village-Cultural Center project will create temporary jobs in construction and ongoing jobs in operation of the Cultural Center.
>
> Section 226-7: Objectives and Policies for the Economy – Agriculture: The proposed project will reclassify the approximately 62 acre parcel from Agricultural to Urban State Land Use District. While the parcel has a history of use for cattle grazing, the land is poorly suited for agricultural production. The County of Hawaii had 1,214,732 acres of land in the Agricultural land use designation in 2000; North Kona had 158,853. The proposed reclassification of 62 acres to the urban land use district is a relatively insignificant change, especially in this case, where the land is poorly suited to agriculture.
>
> Section 226-8: Objectives and Policies for the Economy – Visitor Industries: The Kona coast has relatively few visitor destinations besides its traditional beaches, newer deluxe hotels, and world-class billfishing. The Cultural Center will provide a new destination that reinforces respect for traditional culture and cultural diversity as it attracts visitors to the Kona region. Because the Cultural Center will provide an experience appropriate for all age groups, individuals and families, it can be expected

to have a broad appeal to visitors from both sides of the Pacific, and add to Kona's growing appeal as a visitor destination. The development is expected to serve visitors traveling to the Kona coast and other regional attractions while remaining sensitive to the local rural flavor.

Section 226-12: Objectives and Policies for the Physical Environment – Scenic, Natural Beauty, and Historic Resources: The planning and design of the Project reflects the history, location, topography and setting of the Property. Prominent view corridors and major topographical features will be maintained in the Project's design. The historical setting of the region will be reflected in its traditionally based planning, architecture, site amenities and operation. The DLNR-SHPD will be consulted regarding treatment of any historic sites that are identified within the Property. No rare or endangered plant and animal species or habitats are present on-site. Native habitats do not exist on the Property given its history as an agricultural parcel and the introduction of non-native species over time.

Section 226-13: Objectives and Policies for the Physical Environment – Land, Air, and Water Quality: Developing the Project is consistent with the intent of this objective as the Petition Area is adjacent to existing urban community and commercial developments. The Project is intended to cluster development and compatible activities and facilities in this area.

Section 226-14: Objectives and Policies for Facility Systems/In General: Existing roadway systems are generally adequate to accommodate the Project. Left turn lanes are planned for safety reasons on both Hualalai Road and Kuakini Highway. The water system will tie into the County's water system. At the present time capacity seems sufficient to meet the projected demand of the Project. The wastewater system will connect to the existing County system. System capacity is adequate to accommodate the projected loads from Hualalai Village and the Cultural Center. Drainage designs will meet County standards for runoff. No offsite impacts are expected.

Section 226-19: Objectives and Policies for Socio-Cultural Advancement - Housing: Approximately 400 units of multi-family housing are proposed as a major component of this development. The addition of 400 new units will raise the number of North Kona housing units by 3%, from 13,330 to 13,730. It will increase the total number in Kailua and Holualoa by 5%, from 7,652 to 8,052. The units will be situated adjacent to the University facilities, within the unique Kona setting and at a pedestrian scale. The University hosts international students from 30 – 50 nations at any one time. This institution makes a significant contribution to cultural diversity as well as training in cross-cultural relationships. Additionally, Hualalai Village will be closely linked to the University and provide much needed additional housing opportunities for the staff.

Section 226-23: Objectives and Policies for Socio-Cultural Advancement – Leisure: The Cultural Center will be a place intended to, pass on the history and culture of Hawaii. It will provide family-oriented activities related to different elements of native Hawaiian culture and history for all age groups. Activities may include performances in outdoor areas and the enclosed mainstage; outdoor activities around the central water feature; displays and exhibits; the education center; and the restaurant or other food outlets. As discussed earlier, it is anticipated that the main stage and perhaps other Cultural Center facilities will be available for community events. Many of the activities provided for by the Cultural Center are unavailable currently on the Big Island.

CONFORMANCE WITH APPLICABLE PRIORITY GUIDELINES AND FUNCTIONAL PLANS

180. *State Education and Higher Education Plan*: The University is a mission-based educational institution, founded in Kona in the late 70's . This non-traditional, globally networked university offers viable university-level learning opportunities for emerging leaders in Kona and other locations worldwide. The Project is intended to support University's mission. The Petitioner has committed to cooperate with the College of Hawaiian Language in providing distance learning opportunities in Kona.

181. *State Transportation Plan*: Roadway improvements will conform to projections for growth in this region. Transportation standards will be observed during development. The Petitioner has agreed to contribute its pro rata/fair share of off-site traffic impacts necessary to address the impacts of development of the Project.

182. *State Recreation Plan*: Hualalai Village has made appropriate provision for recreation within the development through development of the 2 to 3 acre passive park. There will also be a recreation center with exercise facilities and a swimming pool for residents and guests, and a landscape design that encourages walking and biking.

183. *State Water Resources Development Plan*: The State Water Resources Development Plan is a plan with a broad mandate and agenda to "guide the development, conservation, and administration of Hawaii's water and related land resources on a comprehensive and coordinated basis." As such, new development must be located logically and the short term and long term impacts should promote resource availability and water quality. The Project is located in an urban infill area between two existing urban developments, the Hillcrest subdivision and the University campus. By its location, it consolidates and minimizes the expansion of water infrastructure for urban development. In addition to suitable native species, the landscaping will consider xeriscape concepts and species to reduce water demand.

The drainage plans for the Project will include drywells that will enhance percolation into the ground and help recharge the aquifer and that will have capacity for expansion. The overall concept calls for management of rainwater on site through filtration within the landscaping or dry wells. The water feature in the Cultural Center will consist of recirculating ponds to minimize water loss. Also, within the education program at both the University and in the programs in the Cultural Center lessons on appropriate technologies and conservation of resources will be part of the ethic and curriculum.

184. *State Agriculture Plan*: The Project proposes the reclassification of an approximately 62-acre parcel from the Agricultural to Urban State Land Use District. While the Petition Area has a history of use for cattle grazing, it is not well-suited for agricultural production.

185. *State Tourism Plan*: The primary programmatic goals of the Cultural Center are to introduce and educate visitors and local families to the authentic story of the native Hawaiian culture and its historical relationship with the introduction of Christianity, its impact upon the monarchy, the people of Hawaii and the region of Kona. Inherent in this authentic telling is how Christianity changed the Hawaiian culture, which promotes respect for differences among cultures and the value of community. The Cultural Center will do this through a set of experiences that are fun, intellectually and creatively stimulating, and appealing to families and across generations, all in the context of a landscaped park that takes full advantage of setting and view planes. In the absence of any comparable attraction currently existing in the Kona region or on the Big Island, the Cultural Center will add a wholly new dimension to the attractiveness and economy of the region while not competing with any similar existing enterprise.

186. *State Housing Plan*: Two different housing segments will be served by the Project: University affiliates, including donors and friends, faculty and staff, and some students; and the general public. These sectors will likely be financially segmented, with those who are able to purchase: friends and donors of the University and the target general public; and those less able to purchase: faculty, staff and students. Petitioner intends to pursue mechanisms to aid less affluent University affiliates to own in Hualalai Village. Other mechanisms will be sought to enable Hualalai Village to accommodate the housing needs of some of the University

student body, including, for example, the purchase by donors and friends of some number of units that could then be managed as a limited pool of rental housing for students. The Petitioner has agreed to comply with the affordable housing requirements of the State and County in the development of the Project.

187. *State Employment Plan*: The Project is intended to reflect the needs and desires of the Kona and University communities through the creation of new housing opportunities and a unique cultural center. The Project will be appropriate, in a scale and theme that will provide additional employment opportunities for area residents. As proposed, the Cultural Center will consist of approximately 28,900 square-feet of commercial space and a total area of 49,400 square feet. This use, along with the residential component of the Project is anticipated to generate up to 400 – 500 temporary and permanent part-time and full-time jobs and increase employment in the Kona area.

CONFORMANCE WITH OBJECTIVES AND POLICIES OF THE HAWAII GENERAL PLAN

188. The Hualalai Village and Cultural Center components of the Project are clearly consistent with the Medium Density Urban designation of the Hawaii County Land Use Pattern Allocation Guide Map. The Hualalai Village proposes to build approximately 11 residential units per acre. The Cultural Center is also consistent because the County's Multiple-Family Residential (RM), Village Commercial (CV) and Residential – Commercial Mixed Use (RCX) districts allow major outdoor amusement and recreation facilities through the Use Permit procedure. In the words of the General Plan, "[t]he land use pattern is a broad, flexible design intended to guide the direction and quality of future developments in a coordinated and rational manner." The Cultural Center complements the existing land uses in the area and will add to the vibrancy of Kailua-Kona's urban core.

> Economic: University of the Nations-Kona hosts international students of over 30 nations. The University makes a significant contribution to cultural diversity as well as training in cross-cultural relationships. Hualalai Village and the Cultural Center will be closely linked to the University and provide expanded cultural activities and enrichment programs for residents and visitors, and potential housing opportunities for faculty, students, and affiliates. Staff and students associated with the University also make substantial contributions to the West Hawaii economy. This Project will

enhance further growth of the University and add opportunities for residents to improve their quality of life through further educational opportunities.

Environmental Quality: Drainage will be disposed of through the use of drywells. Wastewater will be tributary to the County of Hawaii's sewer system and wastewater treatment plant. Throughout construction and operation, the Project will remain in compliance with all applicable Federal, State and County air, water solid waste and noise control standards.

Flood Control and Drainage: the Flood Insurance Rate Map (FIRM) for this vicinity, shows the Waiaha Drainage way located approximately 1,000 to 1,500 feet south of and separated from the Petition Area by the Hillcrest Subdivision. Consequently, no known drainage ways are located on the Property. Off-site runoff that enters the Property will be disposed of through retention basins and drywells. This will mitigate any existing drainage problems that occur downstream of the project as well as protect the Property from storm damage. Increased runoff generated by the Property will be disposed of in drywells. Best Management Practices will be used to prevent soil erosion.

Historic Sites: An archaeological assessment survey was conducted by Paul H. Rosendahl, Ph.D., Inc. in April 2002, and an Archaeological Inventory Survey was conducted by Rechtman Consulting in February, 2003 for the portion of the Petition Area not reviewed and cleared by DLNR-SHPD. In its letter dated May 7, 2003, DLNR-SHPD concurred with the site significance evaluations as addressed in the Archaeological Inventory Survey, and recommended five sites for preservation and 10 sites for data recovery.

Natural Beauty: The philosophy of the entire Project is to "build to the land," avoiding major cuts and fills, design to facilitate pedestrian access, and build to a lower residential density than the site would allow, to provide a better quality of life for residents over the long term. The landscaping and design through the Project will encourage residents to leave their cars at home and walk to and from Kailua Village. The Cultural Center will provide education and entertainment, culturally based activities, and presentations of music and dance, indoor and outdoor performances in a landscaped park setting.

Housing: The Project will provide additional residential inventory for West Hawaii and include units targeted for individuals affiliated with the University thereby reducing the demand for other local housing. Hualalai Village will provide residents with an alternative market product to housing in the area. The project is located within close proximity to all necessary urban services and facilities, and will help complete the urban core for that area of Kailua-Kona. The Project will be completed in compliance with required codes and standards.

Public Facilities: The Project includes recreational amenities for Hualalai Village residents and guests and the establishment of a two to three-acre park adjacent to the existing Hillcrest Community Park.

Public Utilities: The Project is located adjacent to Kuakini Highway, Hualalai Road and the University. Water, telephone, electricity, sewer, services are available as described in the following sections.

Water: As discussed previously 297 water units will be allocated for the portion of the Hualalai Village within the Petition Area. Additional water units needed for the Cultural Center and the Educational Facility are being discussed by the Petitioner and the County.

Telephone: Existing telephone lines and poles are available along the property lines of the Project.

Electricity: Electrical utility poles and lines exist along the boundary of the Property.

Sewer: Wastewater will be serviced through a private sewer line, connecting to an existing sewer line through the University and then connecting to the County sewer at Kuakini Highway. The County of Hawaii has constructed the Kuakini Interceptor Sewer from the University to the Kailua-Kona sewage treatment plant. An extension of the interceptor sewer has been designed and has been constructed to service Pualani Estates subdivision. Hualalai Village and Cultural Center will connect to this system at the northwest corner of the Property at Kuakini Highway.

Recreation: The plan for the Project includes recreational amenities for Hualalai Village residents and guests and the Project park. In addition, the Cultural Center may be used as a community recreational amenity, available on a fee basis for residents and guests to experience cultural and educational activities.

Transportation: The existing roadway system, as improved by projected State and County programs, has sufficient capacity to accommodate the growth in ambient traffic and the traffic that will be generated by the Cultural Center and the Hualalai Village. Left turn lanes are planned for safety reasons on both Hualalai Road and Kuakini Highway.

Land Use – Multiple-Family Residential: Hualalai Village residences will provide new housing units on medium-density parcels in close proximity to similarly zoned urban areas. The Project access points are on collector and arterial roads. Traffic from the Project will not be routed through areas of lesser density to reach regional transportation facilities.

CUSTOMARY AND TRADITIONAL NATIVE HAWAIIAN RIGHTS

189. The Property is located within the Kula zone, and thus was probably not heavily settled in comparison to the shoreline and mauka regions. The historic clearing of much of the Property for cattle grazing and ranching further impacted the Property. The Petitioner and its consultants have uncovered substantial evidence of significant cultural, historical or natural resources within the Property, but have not found any traditional and customary native Hawaiian rights being exercised within the Property. As such, it is unlikely that any valued resources,

including traditional and customary native Hawaiian rights, will be affected or impaired by the proposed action. Additional archaeological survey and mitigation work will be undertaken on the Property. If in the future, any valued cultural, historical, natural resources and/or traditional and customary native Hawaiian rights are discovered in the Property, the Petitioner will report this matter to the DLNR-SHPD for review and assessment.

INCREMENTAL DISTRICTING

190. Pursuant to Section 15-15-78 of the Land Use Commission Rules, incremental districting is not required because full development of the subject Property can be completed within ten years after the date of the Land Use Commission's approval.

RULING ON PROPOSED FINDINGS OF FACT

Any of the proposed findings of fact submitted by the Petitioners, and the other parties not already ruled upon by the Commission by adoption herein, or rejected by clearly contrary findings herein, are hereby denied and rejected.

Any conclusion of law herein improperly designated as a finding of fact shall be deemed or construed as a conclusion of law, any finding of fact herein improperly designated as a conclusion of law shall be deemed or construed as a finding of fact.

CONCLUSIONS OF LAW

191. The Commission finds upon the clear preponderance of the evidence that the reclassification of the Property, consisting of approximately 62 acres situate at Waiaha 1st, Kailua-Kona, District of North Kona, Island and State of Hawaii, identified as Tax Map Key Nos.: (3) 7-5-10:85 and 7-5-17:06, from the Agricultural District to the Urban District, upon the conditions set forth in this Decision and Order, is reasonable, conforms to the standards for establishing the Urban District boundaries, is not violative of Section 205-2, HRS, is consistent with the Hawaii State Plan as set forth in Chapter 226, HRS, the policies and criteria established pursuant to Section 205-17, HRS, and conforms to Chapter 15-15, HAR.

192. Article XII, Section 7 of the Hawaii Constitution requires the Commission to protect native Hawaiian traditional and customary rights. The Commission affirms and shall

protect all rights, customarily and traditionally exercised for subsistence, cultural and/or religious purposes on the Property, subject to the right of the State to regulate such rights.

193. The State's power to regulate the exercise of customary and traditional native Hawaiian rights allows the Commission to permit development that interferes with such rights if the preservation and protection of such rights would result in actual harm to the recognized interests of others. Nevertheless, the State is obligated to protect the reasonable exercise of customarily and traditionally exercised rights of native Hawaiians to the extent feasible. Public Access Shoreline Hawaii v. Hawaii County Planning Commission, 79 Hawai`i 425, 450, n. 43, 903 P.2d 1246 (1995).

DECISION AND ORDER

IT IS HEREBY ORDERED that the Reclassified Area being the subject of Docket No. A02-737, filed by Petitioner U of N Bencorp, consisting of approximately 62 acres of land in the State Land Use Agricultural District at Hualalai, North Kona, Island, County and State of Hawaii, identified as Tax Map Key:(3) 7-5-10:85 and (3) 7-5-17:06, and approximately shown on Exhibit "A", attached hereto and incorporated herein by reference ("Reclassified Area") is hereby reclassified from the State Land Use Agricultural District to the State Land Use Urban District, and the State Land Use District boundaries are amended accordingly.

Based upon the findings of fact and conclusions of law stated herein, it is hereby determined that the valued cultural, historical or natural resources and any customary and traditional native Hawaiian rights and practices within the Reclassified Area that have been identified herein shall be protected in perpetuity; that the reclassification shall not significantly affect or impair the continued exercise of those right and practices; and that the reasonable exercise of those rights and practices shall be protected, to the extent feasible, by the conditions of approval set forth herein.

IT IS HEREBY FURTHER ORDERED that the reclassification of the Reclassified Area from the State Land Use Agricultural District to the State Land Use Urban District shall be subject to the following conditions:

1. Affordable Housing. Petitioner shall provide affordable housing opportunities for residents of the State of Hawaii in accordance with applicable housing requirements for the Project of the County of Hawaii. The location and distribution of the affordable housing or other provisions for affordable housing shall be under such terms as may be mutually agreeable between the Petitioner and the County of Hawaii.

2. Drainage Improvements. Petitioner shall design and construct on-site and regional drainage improvements required as a result of the development of the Reclassified Area to the satisfaction of the State Department of Health, the Commission on Water Resource Management of the State Department of Land and Natural Resources, and the County of Hawaii. The Petitioner shall prepare a Drainage Study meeting with the approval of the County of Hawaii Department of Public Works. The Drainage Study shall consider regional drainage issues.

3. Public School Facilities. Petitioner shall contribute to the development, funding, and/or construction of school facilities for the Project, on a fair-share basis, as determined by and to the satisfaction of the Department of Education. Terms of the contribution shall be agreed upon in writing by the Petitioner and the Department of Education prior to seeking building permits for any portion of the Reclassified Area.

4. Water Resources. Petitioner shall provide adequate water supply facilities and improvements or equivalent funding to accommodate the Project. The water supply facilities, improvements and/or equivalent funding shall be coordinated and approved by the Commission on Water Resource Management of the State Department of Land and Natural Resources, and the County of Hawaii Department of Water Supply.

5. Wastewater Facilities. Petitioner shall provide adequate wastewater treatment, transmission, and disposal facilities for the Project as determined by the State Department of Health and the County of Hawaii Department of Environmental Management.

6. Archaeology

a. Petitioner shall submit a complete inventory survey report of the Reclassified Area for the review and approval of the State Historic Preservation Division of the Department of Land and Natural Resources (“DLNR-SHPD”). Petitioner shall prepare and implement a data recovery plan, a preservation plan, a burial treatment plan, and a monitoring plan to be reviewed and approved by the DLNR-SHPD. The submittal of these plans shall be accompanied by the design plans for the Project to facilitate the development of appropriate mitigation measures.

b. Should any previously unidentified human burials, archaeological or historic sites such as artifacts, marine shell concentrations, charcoal deposits, stone platforms, pavings or walls be found, Petitioner shall stop work in the immediate vicinity and the DLNR-SHPD shall be notified immediately. The significance of these finds shall then be determined and approved by the DLNR-SHPD. Subsequent work shall proceed upon an archaeological clearance from the DLNR-SHPD when it finds that mitigative measures have been implemented to its satisfaction. Petitioner shall also comply with all applicable statutory provisions and administrative rules regarding inadvertent burial finds within the Reclassified Area. Any mitigation and preservation shall be monitored by the KWC as described below.

c. The proposed mitigation commitments for all identified sites with burials shall be submitted to the DLNR-SHPD for review and comment. A burial treatment plan for those sites, to include without limitation Sites 23683, 23684 and 23685, shall then be approved by DLNR-SHPD, and a certified copy of said plan shall be filed with the Commission prior to any land alteration in the vicinity of these sites. Mitigation commitments shall be monitored by the Kahu Wai`aha Committee ("KWC").

d. For all sites approved by the DLNR-SHPD to undergo archaeological data recovery, an archaeological data recovery plan (scope of work) shall be prepared by Petitioner. This plan shall be approved by the DLNR-SHPD and a certified copy of said plan shall be filed with the Commission prior to any land alteration in the vicinity of these sites. The approved plan shall be monitored by the KWC.

e. For all sites approved for preservation by the DLNR-SHPD, to include without limitation the Great Wall of Kuakini (Site 6302), the papamu or rough square game board (Site 23682), the agricultural heiau (Site 23681), and after completion of the finished grade for the area, at least one of the alignments for the ancient trails (Site 23679 or Site 23680), a preservation plan shall be prepared by Petitioner. (Burial sites are covered under the burial treatment plan.) This plan shall include buffer zones/interim protection measures during construction, and long-range preservation (including public access and interpretation, where appropriate). The plan shall include input from the KWC and relevant Hawaiian groups. The plan shall be approved by the DLNR-SHPD and a certified copy of said plan shall be filed with the Commission prior to any land alteration in the vicinity of these sites. The approved preservation plan shall be monitored by the KWC.

f. Petitioner shall preserve the approximate alignment of at least one of the mauka-makai trail segments. Due to the difficulty of development on this site, the site grading would occur first, then the Petitioner shall reestablish a minimum of one of the two trail segments, Site 23679 (20 meter segment) or Site 23680 (ten meter segment), at a mutually agreeable site, giving allowances for building footprints, on finished grade, in consultation with the Office of Hawaiian Affairs.

7. Cultural, Historical, Customary and Traditional Rights and Resources.

a. Petitioner shall initially establish and annually provide reasonable operating and capital expenditure costs or facilities through revenues from the Project, the KWC composed of: (1) a person of Native Hawaiian ancestry who is a lineal descendent and knowledgeable regarding the type of cultural resources and practices within the Reclassified Area, as selected by the Executive Officer of the Commission from a list of three names based on a review of their resumes, and (2) a management member knowledgeable regarding the type of cultural resources and practices within the Reclassified Area, as selected by the Petitioner. The individuals making up the KWC shall operate on an equal vote basis.

b. The KWC shall be established by Petitioner no later than six months from the issuance of this Decision and Order. Upon establishment of the KWC, Petitioner shall provide a written report to the Commission, the Office of Planning, and the County of Hawaii with details as to its composition, structure, operating costs and compensation for members and staff, procedures, and plan of action.

c. The KWC shall jointly decide, on an equal vote basis, monitoring and dispute resolution decisions related to the protection of native Hawaiian practitioners’ exercise of customary and traditional practices and rights within the Reclassified Area; the availability of natural and cultural resources for present and future generations; and appropriate access within the Reclassified Area to the extent that these rights are protected by PASH vs. Hawaii County Planning Commission, 79 Haw. 425 (1995), in perpetuity. In the event that the two person KWC cannot agree on a specific decision, they shall jointly select a third person to break the tie. A certified description of any action requiring selection of a third member of the KWC shall be filed with the Commission.

d. The KWC shall monitor the quality of the Petitioner's actions to provide access to and/or preserve and maintain traditional and customary native Hawaiian practices and cultural resources. The KWC shall provide recommendations consistent with this Decision and Order to the Commission with respect to maintenance and/or preservation of those traditional and customary native Hawaiian practices and cultural resources.

e. The KWC shall provide reports to the Commission on an annual basis describing items and issues covered in their deliberations and any other findings and recommendations.

f. Petitioner shall preserve and protect rights to gathering for cultural purposes, including religious practice, by providing appropriate access to burial sites and other archaeological sites within the Reclassified Area consistent with this Decision and Order. Petitioner shall adhere to prevailing and/or published protocols of the DLNR-SHPD where these sites are found to exist, as monitored by the KWC.

8. Soil Erosion and Dust Control. Petitioner shall implement efficient soil erosion and dust control measures during and after the development process to the satisfaction of the State Department of Health.

9. Transportation. Petitioner shall participate in the pro-rata funding and construction of local and regional transportation improvements and programs necessitated by the proposed development in designs and schedules accepted and determined by the State Department of Transportation (DOT) and County of Hawaii Department of Public Works (DPW). Agreement between the Petitioner and the DOT and DPW as to the level of funding and

participation shall be obtained prior to the Petitioner obtaining County zoning, or prior to the Petitioner securing County building permits if County zoning is not required.

10. Traffic. Petitioner shall, prior to the Petitioner obtaining County zoning, submit a revised Traffic Impact Analysis Report for the review and approval of the DOT and DPW, which shall include an analysis of the entire development of the existing/proposed University of the Nations-Kona, Hualalai Village project, and the Cultural Center, as well as existing and potential future developments in the immediate area as required by the DOT and DPW.

11. Cultural Center. The Petitioner shall develop the Cultural Center with sensitivity to the host native Hawaiian culture, and provide for outreach and educational opportunities for the children of Hawaii. The Petitioner shall consult with the KWC and the Ka Haka ‘Ula O Ke’elikolani, College of Hawaiian Language at University of Hawaii-Hilo to promote cultural sensitivity in the development of programs for the Cultural Center. Petitioner shall, prior to commencement of operations for the Cultural Center, submit a status report to the Commission for its approval on the Petitioner's traffic mitigation efforts for development of the Reclassified Area. If, for any reason, the Cultural Center does not commence operations by January 1, 2008, the Petitioner shall return to the Commission for a hearing to review compliance with the requirements of this Condition.

12. Ka Haka ‘Ula O Ke’elikolani, College of Hawaiian Language at University of Hawaii-Hilo. Petitioner shall cooperate with the College of Hawaiian Language at University of Hawaii-Hilo in promoting the perpetuation of the Hawaiian language by providing distance learning opportunities for teaching the native Hawaiian language, as well as cooperating in activities that promote Hawaiian cultural authenticity.

13. Civil Defense. Petitioner shall fund and construct adequate civil defense measures serving the Reclassified Area as determined by the State of Hawaii Department of Defense-Office of Civil Defense, and the County of Hawaii Civil Defense Agency.

14. Solid Waste. Petitioner shall develop a Solid Waste Management Plan in conformance with the Integrated Solid Waste Management Act, Chapter 342G, Hawaii Revised

Statutes. Petitioner's Solid Waste Management Plan shall be approved by the County of Hawaii Department of Environmental Management, Solid Waste Division. The Plan shall address and encourage an awareness of the need to divert the maximum amount of waste material caused by developments away from the County's landfills.

15. Compliance with Representations to the Commission. Petitioner shall develop the Reclassified Area in substantial compliance with the representations made by the Petitioner to the Commission in this Docket, as proposed in its Petition and in documentary evidence and testimony before the Commission. Failure to do so for any reason including economic feasibility, may result in the imposition of fines as provided by law, removal of improvements by Petitioner at Petitioner's own expense, reversion of the Reclassified Area to its former classification, a change to a more appropriate classification, or any other legal remedies.

16. Notice of Change to Ownership Interests. Petitioner shall give notice to the Commission of any intent to sell, lease, assign, place in trust, or otherwise voluntarily alter the ownership interests in the Property, prior to development of the Property.

17. Annual Reports. Petitioner shall timely provide without prior notice, annual reports to the Commission, the Office of Planning, and the County of Hawaii Planning Department in connection with the status of the development proposed for the Reclassified Area, and Petitioner's progress in complying with the conditions imposed. The annual report shall be submitted in a form prescribed by the Executive Officer of the Commission. The annual report shall be due prior to or on the anniversary date of the Commission's approval of the Petition.

18. Release of Conditions Imposed by the Commission. Petitioner may seek from the Commission full or partial release of the conditions provided herein as to all or any portion of the Reclassified Area upon evidence acceptable to the Commission of satisfaction of these conditions.

19. Recording of Conditions. Within seven (7) days of the issuance of the Commission's Decision and Order for the subject reclassification, Petitioner shall (a) record with Bureau of Conveyances and/or the Assistant Registrar of the Land Court of State of Hawaii, as applicable, a statement that the Reclassified Area is subject to conditions imposed by the

Commission in the reclassification of the Reclassified Area, and (b) file a copy of such recorded statement with the Commission. Petitioner shall record the conditions imposed herein by the Commission with the Bureau of Conveyances and/or the Assistant Registrar of the Land Court of the State of Hawaii, as applicable, pursuant to Section 15-15-92, Hawaii Administrative Rules.

Done at Honolulu, Hawaii, this 8th day of August, 2003, per motion on August 7, 2003.

APPROVED AS TO FORM

Deputy Attorney General

LAND USE COMMISSION
STATE OF HAWAII

By
LAWRENCE N.C. ING
Chairperson and Commissioner

By
P. ROY CATALANI
Vice-Chairperson and Commissioner

By
BRUCE A. COPPA
Commissioner

By ABSENT
PRAVIN DESAI
Commissioner

By
ISAAC FIESTA, JR.
Commissioner

ADOPTION OF ORDER

The undersigned Commissioners, being familiar with the record and proceedings, hereby adopt and approve the foregoing ORDER this 7th day of August, 2003. This ORDER and its ADOPTION shall take effect upon the date this ORDER is certified and filed by this Commission.

By [signature]
STEVEN LEE MONTGOMERY
Commissioner

By [signature]
RANDALL F. SAKUMOTO
Commissioner

By ABSENT
RAE MCCORKLE SULTAN
Commissioner

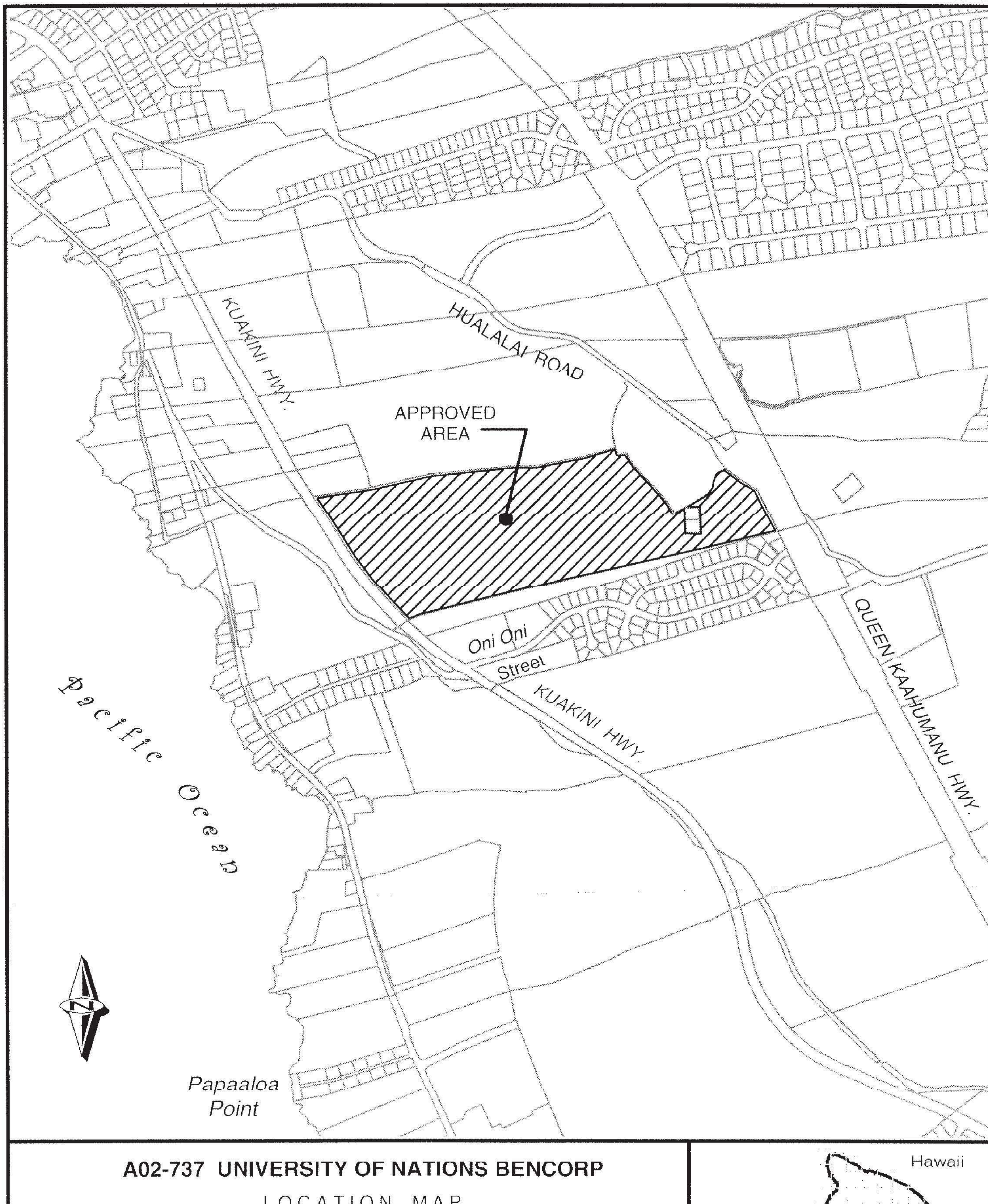
By [signature]
PETER YUKIMURA
Commissioner

Filed and effective on
August 8, 2003

Certified by:

[signature]
Executive Officer

J:/USERS/LUCPLAN/GISARCMAP/A02-737HID&O.MXD

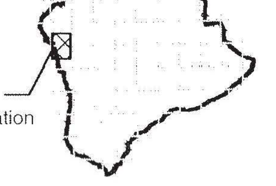


A02-737 UNIVERSITY OF NATIONS BENCORP

LOCATION MAP

TMK No: 7-5-10: 85 & 7-5-17: 06
HUALALAI, NORTH KONA, HAWAII
SCALE: 1" = 1,000 ft.

EXHIBIT "A"



BEFORE THE LAND USE COMMISSION

OF THE STATE OF HAWAII

In the Matter of the Petition of U of N BENCORP To Amend the Agricultural Land Use District to the Urban Land Use District for approximately 62 acres, Tax Map Key Nos.: (3) 7-5-10:85 and 7-5-17:06 situate at Waiaha 1st, North Kona, Island, County and State of Hawaii. ________________________________	)))))))))))	DOCKET NO. A02-737 CERTIFICATE OF SERVICE

CERTIFICATE OF SERVICE

I hereby certify that a copy of the Findings of Fact, Conclusions of Law, and Decision and Order for a State Land Use District Boundary Amendment and Exhibit A was served upon the following by either hand delivery or depositing the same in the U. S. Postal Service by regular or certified mail as noted:

DEL. MARY LOU KOBAYASHI
Office of Planning
P. O. Box 2359
Honolulu, Hawaii 96804-2359

CERT. JOHN CHANG, Esq.
Deputy Attorney General
Hale Auhau, Third Floor
425 Queen Street
Honolulu, Hawaii 96813

CERT. STEVEN S. C. LIM, Esq.
Carlsmith Ball LLP
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CERT. MARK R. SPENGLER, President and CEO
University of the Nations Bencorp
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Kailua-Kona, Hawaii 96740

CERT. GEORGE ATTA, AICP
Group 70 International, Inc.
925 Bethel Street, Fifth Floor
Honolulu, Hawaii 96813-4307

Dated: Honolulu, Hawaii, August 8, 2003.

ANTHONY J. H. CHING
Executive Officer

Appendix B

Order Granting Petitioner's Motion Requesting the Land Use Commission (a) To be the Accepting Authority for an EIS; (b) Determine that the Proposed Action Warrants the Preparation of an EIS, to be Initiated with the Preparation of an EISPN and Certificate of Service, February 2021

BEFORE THE LAND USE COMMISSION

OF THE STATE OF HAWAI`I

In the Matter of the Petition of U of N BENCORP To Amend the Agricultural Land Use District to the Urban Land Use District for approximately 62 acres, Tax Map Key Nos.: (3) 7-5-10:85 and 7-5-17:06 situated at Wai`aha 1st, North Kona, Island, County and State of Hawaii.	DOCKET NO. A02-737 ORDER GRANTING PETITIONER'S MOTION REQUESTING THE LAND USE COMMISSION (A) TO BE THE ACCEPTING AUTHORITY FOR AN ENVIRONMENTAL IMPACT STATEMENTT; (B) DETERMINE THAT THE PROPOSED ACTION WARRANTS THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT, TO BE INITIATED WITH THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE; AND CERTIFICATE OF SERVICE

ORDER GRANTING PETITIONER'S MOTION REQUESTING THE LAND USE COMMISSION (1) TO BE THE ACCEPTING AUTHORITY FOR AN ENVIRONMENTAL IMPACT STATEMENT; (2) DETERMINE THAT THE PROPOSED ACTION WARRANTS THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT, TO BE INITIATED WITH THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE

AND

CERTIFICATE OF SERVICE

LAND USE COMMISSION
STATE OF HAWAII

2021 FEB 18 A 7:23

BEFORE THE LAND USE COMMISSION

OF THE STATE OF HAWAI`I

In the Matter of the Petition of U of N BENCORP To Amend the Agricultural Land Use District to the Urban Land Use District for approximately 62 acres, Tax Map Key Nos.: (3) 7-5-10:85 and 7-5-17:06 situated at Wai`aha 1st, North Kona, Island, County and State of Hawaii.	)	DOCKET NO. A02-737 ORDER GRANTING PETITIONER'S MOTION REQUESTING THE LAND USE COMMISSION (A) TO BE THE ACCEPTING AUTHORITY FOR AN ENVIRONMENTAL IMPACT STATEMENTT; (B) DETERMINE THAT THE PROPOSED ACTION WARRANTS THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT, TO BE INITIATED WITH THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE; AND CERTIFICATE OF SERVICE

<u>ORDER GRANTING PETITIONER'S MOTION REQUESTING THE LAND USE COMMISSION (1) TO BE THE ACCEPTING AUTHORITY FOR AN ENVIRONMENTAL IMPACT STATEMENT; (2) DETERMINE THAT THE PROPOSED ACTION WARRANTS THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT, TO BE INITIATED WITH THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE</u>

<u>AND</u>

<u>CERTIFICATE OF SERVICE</u>

BEFORE THE LAND USE COMMISSION

OF THE STATE OF HAWAI`I

In the Matter of the Petition of U of N BENCORP To Amend the Agricultural Land Use District to the Urban Land Use District for approximately 62 acres, Tax Map Key Nos.: (3) 7-5-10:85 and 7-5-17:06 situated at Wai`aha 1st, North Kona, Island, County and State of Hawaii.	DOCKET NO. A02-737 ORDER GRANTING PETITIONER'S MOTION REQUESTING THE LAND USE COMMISSION (A) TO BE THE ACCEPTING AUTHORITY FOR AN ENVIRONMENTAL IMPACT STATEMENT; (B) DETERMINE THAT THE PROPOSED ACTION WARRANTS THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT, TO BE INITIATED WITH THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE

ORDER GRANTING PETITIONER'S MOTION REQUESTING THE LAND USE COMMISSION (1) TO BE THE ACCEPTING AUTHORITY FOR AN ENVIRONMENTAL IMPACT STATEMENT; (2) DETERMINE THAT THE PROPOSED ACTION WARRANTS THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT, TO BE INITIATED WITH THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE

On January 21, 2021, the University of the Nations Kona Inc., ("Petitioner") filed a Motion Requesting The Land Use Commission (A) To Be The Accepting Authority For An Environmental Impact Statement; (B) Determine That The Proposed Action Warrants The Preparation Of An Environmental Impact Statement, To Be Initiated With The Preparation Of An Environmental Impact Statement Preparation

Notice ("Motion"), pursuant to Hawai`i Administrative Rules ("HAR") §§15-15-70, 11-200.1-4, 11-200.1-5,11-200.1-14, and Hawai`i Revised Statutes ("HRS") §343-5(a)(1).

On March 23, 2020, Petitioner filed a Motion to Amend Findings of Fact, Conclusions of Law and Decision and Order for Land Use District Boundary Amendment dated August 8, 2003. ("Petition").

In its Motion to Amend , Petitioner proposes to revise the land use plan and development proposal for the approximately 62 acres of land ("Petition Area") in the State Land Use Urban District at Wai`aha, North Kona, County and State of Hawai`i, to allow for expansion of the existing campus in the Petition Area to accommodate its projected future growth.

Petitioner notes that before the Commission can act on the Motion to Amend, UNK must first comply with HRS Chapter 343 Hawai`i Revised Statutes.

In its Motion, Petitioner requested that the State Land Use Commission ("Commission") (A) determine that it will be the accepting authority for the environmental assessment under HRS Chapter 343; and (B) determine, through its judgement and experience, that an Environmental Impact Statement ("EIS") is warranted and that the environmental review process should be initiated by the preparation of an Environmental Impact Statement Preparation Notice ("EISPN").

On January 29, 2021, the State Office of Planning ("OP") filed a written response expressing no opposition to Petitioner's Motion.

On February 1, 2021, the County of Hawai`i Planning Department ("Planning Department") noted that it had reviewed UNK's Motion with its associated documents, including the EISPN and was in support of it.

On February 6, 2021, the Commission met via ZOOM virtual meeting platform, to determine (A) whether this Commission should be the accepting authority pursuant to HRS Chapter 343; (B) whether the proposed action may have a significant effect upon the environment to warrant the preparation of an EIS; and (3) whether to authorize Petitioner to prepare an EISPN pursuant to HRS §343-5(e). Derek Simon, Esq., appeared on behalf of Petitioner. Diana Mellon-Lacey, Esq., Zendo Kern, Maija Jackson and Jeff Darrow appeared on behalf of the Planning Department. Bryan Yee, Esq., and Rodney Funakoshi were present on behalf of OP.

At the meeting, Petitioner summarized its position in support of its Motion that this Commission is the appropriate accepting authority for the EIS pursuant to HRS Chapter 343, that the proposed action may have a significant effect upon the environment such that an EIS is likely to be required, and that Petitioner be allowed to proceed directly to the preparation of an EIS commencing with the preparation of an EISPN.

Both OP and the Planning Department stated that they had no objections to Petitioner's Motion.

Following discussion, a motion was made and seconded to have this Commission (A) agree to be the accepting authority pursuant to HRS chapter 343; (B) find that the proposed action may have a significant effect upon the environment to warrant the preparation of an EIS and authorized Petitioner to prepare an EISPN pursuant to HRS §343-5(e). The Commission also authorized the Commission's Executive Officer to notify and submit a record of the Commission's decision to Petitioner and the State Office of Environmental Quality Control ("OEQC"), and to sign the Order on this matter on behalf of the Commission. There being a vote tally of 8 ayes and 0 nays the motion carried.

ORDER

This Commission, having duly considered Petitioner's Motion, the comments of OP and the Planning Department, and a motion having been made at its meeting on February 6, 2021, via ZOOM virtual interactive conference platform, and the motion having received the affirmative votes required by HAR §15-15-13, and there being good cause for the motion,

HEREBY ORDERS (A) that it agrees to be the accepting authority pursuant to HRS Chapter 343; (B) that the proposed action may have a significant effect upon the environment to warrant the preparation of an EIS; and that Petitioner is authorized to prepare an EISPN pursuant to HRS §343-5(e).

IT IS ALSO ORDERED that Petitioner shall make the EISPN available for a 30-day public review and comment period pursuant to HRS §343-5(e) and HAR §11-200.1-4.

IT IS FURTHER ORDERED that the Commission's Executive Officer shall notify and submit a record of the Commission's decision to Petitioner and the OEQC, and shall sign the Order on this matter on behalf of the Commission.

ADOPTION OF ORDER

This ORDER shall take effect upon the date this ORDER is certified by this Commission.

Done at Honolulu, Hawai`i, this 18th, day of February, per motion on February 6, 2021.

LAND USE COMMISSION
STATE OF HAWAI`I

APPROVED AS TO FORM

Deputy Attorney General

By____________________________
DANIEL ORODENKER
Executive Officer

Filed and effective on:

2/18/2021

Certified by:

DANIEL ORODENKER
Executive Officer

BEFORE THE LAND USE COMMISSION

OF THE STATE OF HAWAI`I

In the matter of the Motion of U of N BENCORP To Amend the Agricultural Land Use District to the Urban Land Use District for approximately 62 acres, Tax Map Key Nos.: (3) 7-5-010: 085 and 7-5-017: 006 situated at Wai`aha 1st, North Kona, County and State of Hawai`i	)	DOCKET NO. A02-737 CERTIFICATE OF SERVICE

CERTIFICATE OF SERVICE

I hereby certify that a certified copy of the ORDER GRANTING PETITIONER'S MOTION REQUESTING THE LAND USE COMMISSION (1) TO BE THE ACCEPTING AUTHORITY FOR AN ENVIRONMENTAL IMPACT STATEMENT; (2) DETERMINE THAT THE PROPOSED ACTION WARRANTS THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT, TO BE INITIATED WITH THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE was served upon the following by depositing the same in the U. S. Postal Service by registered or certified mail as noted:

DEL. MARY ALICE EVANS, Director
Office of Planning
P. O. Box 2359
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Attorney for State Office of Planning

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Co-Counsel for
UNIVERSITY OF THE
NATIONS, KONA, INC.

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1001 Bishop Street
Honolulu, HI 96813
Co-Counsel for
UNIVERSITY OF THE
NATIONS, KONA, INC.

Dated: Honolulu, Hawai'i, February 18, 2021

DANIEL E. ORODENKER
Executive Officer

Appendix C

Preliminary Engineering Assessment, February 2025

PRELIMINARY ENGINEERING REPORT

For:

University of the Nations, Kona

75-5952 Kuakini Highway

Kailua-Kona, Hawaii 96740

TMKs: (3) 7-5-010:003: 085 and (3) 7-5-017: 006

Prepared for:

University of the Nations, Kona
75-5952 Kuakini Highway
Kailua-Kona, Hawaii 96740

Prepared by:

G70

111 South King Street, Suite 170
Honolulu Hawaii, 96813
Phone: (808) 523-5866

April 2025

Contents

FIGURES

ATTACHMENTS

ABBREVIATIONS AND ACRONYMS

CWDA	Critical Wastewater Disposal Area
CZM	Hawai‘i Coastal Zone Management
CZMA	Coastal Zone Management Act
DBEDT	State of Hawai‘i Department of Business Economic Development and Tourism
DHHL	State of Hawai‘i Department of Hawaiian Homelands
DLNR	State of Hawai‘i Department of Land and Natural Resources
DOH	State of Hawai‘i Department of Health
DWS	County Department of Water Supply
EIS	Environmental Impact Statement
EISPN	Environmental Impact Statement Preparation Notice
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
HAR	Hawai‘i Administrative Rules
HCC	Hawai‘i County Code
HELCO	Hawai‘i Electric Light Company, Inc.
HRS	Hawai‘i Revised Statutes
HTCO	Hawaiian Telcom
kV	Kilovolt
Mgd	Million gallons per day
MP	Milepost
Msl	mean sea level
NEPA	National Environmental Policy Act
NGPC	Notice of General Permit Coverage
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination Systems
NRCS	U.S. Department of Agriculture Natural Resources Conservation Services
NWS	National Weather Service
OEQC	Office of Environmental Quality Control
OTWC	Oceanic Time Warner Cable
ppm	parts per million
ROW	Right-of-Way
SHPD	State Historic Preservation Division
SMA	Special Management Area
TIAR	Traffic Impact Analysis Report
TWT	TW Telecom
UHM	University of Hawai‘i at Manoa
USGS	United States Geological Survey
WWTP	Wastewater Treatment Plant

1 INTRODUCTION

1.1 PROJECT DESCRIPTION

University of the Nations, Kona, Inc. (UNK) is a 501(c)(3) non-profit corporation and faith-based educational institution located in the North Kona District, County of Hawai'i and just south of the town of Kailua-Kona (see **Figure 1, Project Location Map)**. The current campus encompasses 40 acres, bounded by privately-owned, undeveloped land to the north, County-owned Kuakini Highway to the west, County-owned Hualalai Road and privately-owned condos to the east, and the undeveloped land owned by UNK to the south (see **Figure 2, Existing Site Plan**).

UNK proposes a campus expansion encompassing TMK parcels 7-5-010:003, :085 and (3) 7-5-017:006 totaling 102.3 acres (see **Figure 3, TMK Parcel Map**) including the present campus and two parcels which abut it to the south. The proposed expansion includes the addition of a K-12 school, university-level classroom spaces, athletic facilities, and housing for students and staff members.

1.1.1 EXISTING USES

The project parcels are presently vacant undeveloped land which enclose two isolated parcels containing potable water tanks, operated by the Hawaii County Department of Water Supply. Properties surrounding the project site have been developed into commercial, community recreation and residential uses.

Lands surrounding the two parcels of the proposed expansion to the north, south and west, are designated within the State Land Use Urban District (see **Figure 4, State Land Use District Map**). At the County level, parcel TMK :003 is designated Apartment, :085 is designated A-1a Agricultural, and parcel :006 is split zoned RD-3.5 and RS- 7.5 as shown in **Figure 5, County of Hawaii Zoning Map**.

1.1.2 PROPOSED USES

UNK has been successful in establishing and growing its programs, such that the expansion of the campus onto the adjoining 62-acre proposed expansion area is necessary to support the projected growth. G70 prepared a 2023 UNK Master Plan Update for campus expansion in three phases with 5-10 years allocated for each phase.

The existing UNK campus, future buildings and projects fall into three categories as shown schematically in **Figure 6 Concept Master Plan.**

Space allocations over three planned development phases are tabulated below.

Phase 1 – 5-10 Years	Footprint (SF)	Acres
Discipleship Learning Center		
Chapel	3,629	0.1
Instruction Bldgs. (1)	9,056	0.2
Student Resident Dormitory Bldgs. (3)	19,117	0.4
Lower School		
Instruction Building	8,096	0.2
Café	5,250	0.1

Maintenance/Storage Facilities		
Maintenance/Storage Warehouse	3,136	0.1
Subtotal Building Footprint Area	48,284	1.1
Roadway Connections to Existing Campus Site and Existing Access Points	47,916	1.1
ADA Compliant Pathways	43,560	1.0
Subtotal Roadway & Pathway Area	91,476	2.1
Parking Area for Instruction and Dormitories	29,197	0.7
Parking Area for Café, Meditation Garden, Lower School	16,832	0.4
Subtotal Parking Area	46,029	1.1
Areas above upper Dormitories, Café, Meditation Garden, Lower School, Instructional, Campus Courtyard	866,844	19.9
Discipleship Learning Center Courtyard	45,000	1.0
Lower School Play Field	22,774	0.5
Archaeological Preservation Sites	31,250	0.7
Subtotal Open Space/Pervious Area	938,895	21.9
TOTAL PHASE 1 AREA	**1,112,717**	**26.2**

Phase 2 – Beyond 10 Yrs.	**Footprint (SF)**	**Acres**
Discipleship Learning Center		
Student Resource Center	8,770	0.2
Instruction Building (1)	6,198	0.1
Student Resident Dormitory Bldgs. (3)	19,127	0.4
Long-Term Staff Dormitories (5)	31,103	0.7
Community Athletic Complex		
Athletic Courts	31,384	0.7
Gym (Community)	9,800	0.2
Locker Rooms	4,345	0.1
Cross Fit Gym	9,856	0.2
Middle School		
Instruction Bldgs.	11,354	0.3
High School		
Instruction Bldgs.	13,599	0.3
Maintenance/Storage Facilities		
Maintenance/Storage Warehouse	5,000	0.1
Garage/Storage Warehouse	5,208	0.1
Food & Supply Storage Warehouse	18,120	0.4
Subtotal Building Footprint Area	173,864	4.0
Roadways and Pathways	191,664	4.4
Subtotal Roadway & Pathway Area	191,664	4.4
Parking Area for upper Dormitory Bldgs.	34,848	0.8
Parking Area for Community Athletic Complex	65,340	1.5
Parking for Handicap	8,712	0.20.1
Subtotal Parking Area	108,900	2.5
Community Athletic/Soccer Field	102,249	2.3
Practice Field	56,628	1.3
Middle School Play Field	16,560	0.4

Open Space and Landscaping	309,276	7.1
Subtotal Open Space/Pervious Area	483,516	11.1
TOTAL PHASE 2 AREA	**958,320**	**22.0**

Phase 3 – Beyond 20 Yrs.	Footprint (SF)	Acres
Discipleship Learning Center		
Instruction Bldgs. (2)	17,718	0.4
Student Resident Dormitory Bldgs. (6)	38,254	0.9
Community Athletic Complex		
Aquatic Center Pool Complex	17,100	0.4
MULTIPURPOSE COMPLEX WITH AMPHITHEATER		
Complex	68,889	1.6
Amphitheater	17,817	0.4
Theater	6,599	0.2
Discovery Center		
Exhibit Bldgs.	19,008	0.4
Lower School		
Instruction Bldgs.	8,096	0.2
Middle School		
Instruction Bldgs.	11,412	0.3
High School		
Instruction Bldgs.	10,400	0.2
Subtotal Building Footprint Area	215,293	4.9
Roadways and Pathways	43,560	1.0
Subtotal Roadway & Pathway Area	43,560	1.0
Parking Area for Multipurpose and Discovery Center	46,644	1.1
Subtotal Parking Area	46,644	1.1
Lower School Play Field	21,780	0.5
Open Space and Landscaping	283,140	6.5
Subtotal Open Space/Pervious Area	304,920	7.0
TOTAL PHASE 3 AREA	**609,840**	**14.0**

Current and estimated campus population growth are tabulated below.

	Current*		Phase 1		Phase 2		Phase 3	
PK - 12 Children Total	**294**		**340**	59%	**469**	82%	**575**	100%
PK - 12 Children Commuting	148		110		155		175	100%
PK - 12 Children Dorming	146		230		314		400	100%
University Students Total	**480**	40%	**718**	60%	**955**	80%	**1,200**	100%
University Students Commuting	17		11		6		-	100%
University Students Dorming	463		706		949		1,200	100%
TOTAL Children & Students	**774**	44%	**1,057**	60%	**1,424**	80%	**1,775**	100%
TOTAL Children and Students Commuting	165		121		161		175	100%
TOTAL Children and Students Dorming	609		936		1,263		1,600	100%
Staff Total (NIC Staff on outreach)	**602**	75%	**667**	83%	**716**	90%	**800**	100%
Staff Commuting	322		282		225		200	100%
Staff Dorming	280		386		491		600	100%
Mission Builders, Volunteers, Speakers, Seminar Guests, Visitors,	**25**	8%	**115**	38%	**207**	69%	**300**	100%
Commuting	5		3		2		-	100%
Dorming	20		112		205		300	100%
Total Commuting	492		406		387		375	100%
Total Dorming	909	36%	1,434	57%	1,959	78%	2,500	100%
Total Campus Population	**1,401**	49%	**1,841**	64%	**2,347**	82%	**2,875**	100%

1.1.3 CLIMATE

The project site is located on the leeward side of Hualalai along the Kona coast. Morning winds are typically light, becoming onshore breezes from mid-day to sunset. Rainfall is relatively light with the chance of rainfall increasing in the summertime.

1.1.4 TOPOGRAPHY AND GEOLOGY

Hualalai is the westernmost, third youngest and third most active volcano on the island of Hawaii. It last erupted about 220 years ago, and much of the site is covered in ʻaʻā rock. The project area is classified by USGS as Lava Hazard Zone 4.

The Site generally slopes from mauka to makai in the east to west direction. Elevations onsite range from approximately 360 to 90 feet above mean sea level (MSL) with the lowest point located at the main campus entrance along Kuakini Highway. The site generally slopes at about 7% from Queen Kaahumanu Highway to Kuakini Highway but local slopes may exceed that amount in limited areas as shown in **Figure 7, Existing Grading and Drainage Pan.**

1.1.5 SOILS

The USDA Natural Resources Conservation Service (NRCS) identifies soils at both the existing campus and expansion area in two soil groups: Waiaha-Punaluu-Lava flows complex and Kainaliu cobbly silty clay loam. Both soils are typically well-drained silty clay loams that formed in basic volcanic ash over ʻaʻā lava (see **Figure 8 Soils Map**). Slopes are ten to 20 percent and the soils are well drained with very low to low runoff. Permeability is moderately rapid in the soil and very slow in the underlying bedrock. Both are members of Hydrologic Soil Group B.

The ground surface is primarily covered by very rough and uneven ʻaʻā lava flows with some pāhoehoe and cinder land. Where present, the soil layer typically consists of a thin layer of organic material. Due to the minimal rainfall and permeability of the lava rock, the existing ground surface has not eroded, and there are no defined drainageways through the property.

Due to the predominance of lava flows on site, the earthwork activities may include pneumatic hammering to excavate lava rock and rock crushing operations to produce aggregate material for use during construction. Import of soil will be required for all areas that will be landscaped due to the lack of available topsoil on site.

The proposed development and final grades shall closely follow the existing topography to minimize earthwork activities. Earthwork activities will include roadway excavation and embankment, rough grading and landscaping, utility installation and access roads, and site grading for educational and related uses.

2 ROADWAYS

2.1 EXISTING ROADWAYS

The campus is accessed via a gated driveway off Kuakini Highway through a security booth and key card entry that allows controlled and monitored access to the campus. A series of onsite roadways and parking lots connect different areas of interest as shown in **Figure 2 Existing Site Plan**.

The privately-owned Hualalai Village condominiums located just mauka of the campus have privately-owned perimeter roads that abut the UNK campus. A portion of this roadway is on UNK property and there are currently two existing access points to the campus.

A traffic consultant prepared a Mobility Analysis Report (MAR)[1] for the phases of the campus development. The MAR found that seven of eight existing intersections operate at Level of Service (LOS) D or better during AM and PM peak hours. The intersection of Kuakini and Queen Ka‘ahumanu Highways operates at LOS E for the eastbound left turn movement in the AM peak hour.

2.2 PROPOSED ROADWAYS

Additional roadways and parking facilities will be constructed in each phase of the project to integrate the expansion area into the Campus and for more holistic circulation and operations onsite. The complete proposed development is shown in **Figure 6 Concept Master Plan**.

Along its mauka boundary, the expansion area lies adjacent to Hualalai Road and Queen Kaahumanu Highway. The State of Hawaii Department of Transportation (HDOT) has not confirmed if there are any mapped access restrictions along the borderlines along Queen Kaahumanu Highway, but the campus is located within 250 feet of the Hualalai Road intersection and this limited distance makes a connection from the campus to Queen Kaahumanu Highway infeasible. Additionally, there is a steep bank separating the highway and the campus and the considerable elevation change makes a driveway undesirable.

UNK is primarily a walking campus with primary gathering points or circulation hubs at the Cafeteria, Banyan Tree Café and the Ohana Courts which frequently host campus-wide events. A vast majority of students are anticipated to live on campus, so most traffic will be comprised of staff and visitors. A system of walkways, ramps, stairs, trails and accessible routes will be developed to provide a network of

[1] “Mobility Analysis Report for the University of the Nations Kona Master Plan Update, Kona, HI” Fehr & Peers, June 19, 2023

transportation routes through campus. Vehicular and non-vehicular crossing points will be designed and designated along the primary and secondary driveways to provide safe points of intersection.

The existing Kuakini Highway secured point of entry with a gate, guard and card key system will remain the primary access to the Campus for staff and students, and another unsignalized vehicular entry point from Kuakini Highway will be provided.

A secondary access connection will provide mauka-to-makai access via joint use of the Hualalai Village condominium roadway connection to Kuakini Highway. This will be a limited access point, possibly restricted to emergency and maintenance access with some form of security control or presence. This access point may be utilized during campus-wide events.

Interior access throughout the expansion area will be constructed in three phases as shown in **Figure 6**, linking new construction to the mauka-makai road. Secondary driveways will be two-way, two-lane paved access roads, one of which will provide a complete loop around the expansion area to enable both vehicular and fire/emergency access throughout the campus. The driveways will allow staff and student vehicular movement to parking lots distributed throughout the expansion area. Secondary driveways may be limited access and not open to public use.

Tertiary driveways will be primarily non-vehicular access ways designated for staff and student pedestrian, bicycle or cart access through the campus. These driveways accommodate fire/emergency access vehicles, but may be designed with permeable pavers, grass pavers or other special pavements more suited to a walkway or promenade through campus.

The MAR evaluated traffic flows forecast for each phase and made recommendations for improvements:

- Kuakini/Main Campus Driveway: Install left turn refuge lane serving westbound left turn traffic exiting the campus. No additional improvements were needed in Phases 2 and 3.
- Queen Kaahumanu/Hualalai Road: Traffic signal not required in Phase 2 but may be needed to provide adequate gaps in traffic to enhance safety. Intersection should be re-evaluated prior to Phase 2.
- Queen Kaahumanu/Kuakini Highway: Traffic signal not warranted in Phase 2 but may be needed to provide adequate gaps in traffic to enhance safety. Intersection should be re-evaluated prior to Phase 2.
- Kuakini/Campus North Entrance: Will operate at LOS 3 in Phase 1 during the PM peak hour. It does not warrant a traffic signal but should be restriped. A traffic signal is not warranted in Phase 2 but may be needed to provide adequate gaps in traffic to enhance safety.

Additional improvements are suggested for multi-modal access at the existing entry driveway, and for on-campus pedestrian and bicycle traffic improvements.

3 GRADING AND EROSION CONTROL

3.1 EXISTING CONDITIONS

3.1.1 GRADING

The UNK site and proposed expansion area soils consist of a thin surface layer broken by outcrops of the underlying rock, with slopes of 10 to 20 percent, making site excavation expensive. Existing improvements are constructed generally with a minimum of excavation. Proposed improvements will similarly be designed to largely minimize excavation.

3.1.2 EROSION CONTROL

Erosion and sedimentation requirements will be met by use of construction Best Management Practices (BMPs) implemented to minimize and control erosion of soils and dust during construction. BMPs are pollution control measures, applied to nonpoint sources, on-site or off-site, to control erosion and the transport of sediments and other pollutants which have an adverse impact on waters of the state. Construction BMPs are temporary measures installed before construction commences and removed after construction completion. Potential construction BMPs include but are not limited to gravel entrance, water trucks, dust screen, silt fence, retention basins, diversion berm/ditches, and grading procedures that follow Hawaii County Code Chapter 10 – Erosion and Sediment Control.

4 DRAINAGE

4.1 EXISTING CONDITIONS

4.1.1 FLOODING AND TSUNAMI HAZARDS

The Federal Emergency Management Agency's Flood Rate Insurance Maps indicate that UNK is within Zone X, which represents areas with minimal flood hazards. Zone X is defined as areas determined to be outside the 500-year flood limits.

4.1.2 COUNTY OF HAWAII DRAINAGE STANDARDS

The proposed drainage system hydrologic criteria are evaluated using the Rational Method, in conformance with Hawaii County *Storm Drainage Standards*, except that NOAA Atlas 14 Volume 4 v2.1 is used in lieu of Plates 1 and 2 (Intensity of 1-hr Rainfall for 10 and 50 year Return Periods), which provide isopluvial (rainfall intensity) maps from interpolation of frequency estimates of a larger sample of rain stations with longer years of record than the *Storm Drainage Standards*.

4.1.3 EXISTING HYDROLOGY

UNK has not reported drainage issues onsite. **Figure 7 Existing Grading and Drainage** depicts the present drainage patterns for the existing campus and proposed expansion area,

A drainage report prepared by Ross Engineering, Inc. for U of N Bencorp was completed in September 2002 to analyze offsite stormwater drainage conditions that affect the proposed expansion area. Concentrated stormwater run-on enters both the campus and the proposed expansion area at four locations from the mauka direction. Three culverts discharge runoff onto the proposed expansion area: an 84-inch pipe culvert crosses Queen Kaahumanu Highway and discharges runoff at the southeastern (mauka) corner of the campus and 36-inch and 30-inch culverts at the intersection of Queen Kaahumanu Highway and Hualalai Road discharge runoff onto the expansion area. On the campus, stormwater run-on sheet flows across Hualalai Road and enters the campus north of the Hualalai Village Condominiums where it enters and existing infiltration basin with six drywells and infiltrates into the ground.

Runoff from the Hualalai Village Condominiums appears to be routed to multiple drywells located onsite and along the private road along the makai edge of the condo property adjacent to the campus. It is assumed that these drywells dispose of the majority of runoff generated and collected on the condominium site and only excess runoff during large storm events flows onto the proposed expansion area.

The runoff that flows onto the proposed expansion area from the mauka culverts flows through the proposed expansion area and to an existing 24-inch culvert which conveys runoff across Kuakini Highway. Immediately downstream of the culvert, there is a series of six drywells located on TMK (3) 7-5-018:094 (owner: Walua Professional Center). No other culverts or drain structures were identified along Kuakini Highway. It is assumed run-on as well as runoff at the proposed expansion area is either disposed of by onsite or off-site drywells (across Kuakini Highway) or is slowed by heavy vegetation and natural terrain and infiltrates into the ground.

4.1.4 EXISTING DRAINAGE INFRASTRUCTURE

Runoff flowing onto the existing campus is captured in an existing infiltration basin with any overflow continuing as sheet flow through the undeveloped expansion area before flowing off the property onto (as sheet flow) or across Kuakini Highway in a 24-inch culvert.

4.2 DEVELOPED CONDITION DRAINAGE

4.2.1 DEVELOPED CONDITION HYDROLOGY

For drainage areas of 100 acres or less, the *Storm Drainage Standards* require the drainage system be designed for return periods of 10 years for runoff conditions or 50 years for sump conditions. Due to potential sumps in the developed area, the 50-year return period will be used for design of site drainage. To determine the runoff quantity for these areas, the Rational Method will be used, based on the drainage area, runoff coefficient (ground cover conditions) and the rainfall intensity for duration equal to the time of concentration.

4.2.2 LOW IMPACT DEVELOPMENT (LID) AND BEST MANAGEMENT PRACTICES (BMPS)

Runoff increase anticipated to result from development of impervious surfaces may be mitigated by infiltrating excess runoff into the ground and implementing Low Impact Development (LID) strategies and BMPs to the extent possible, such that the project will not create adverse impacts to downslope areas or nearshore waters.

LID strategies consist of storm water management methods that promote conservation of existing natural features and use of localized small-scale stormwater systems, to mimic natural hydrologic patterns, while minimizing stormwater infrastructure.

A menu of LID BMPs will be developed with various sizing criteria to aid in design of individual site elements, buildings and facilities. LID BMPs will also need to be coordinated with landscape design, irrigation design and incorporated into water resource management on project area if runoff will be harvested and reused for non-potable water uses throughout the site. Offsetting irrigation demand by rainwater capture and xeriscape design will result in significant reduction in demand for potable water, which is very limited in allocated quantity, and will reduce the size of additional infrastructure needed to serve the campus expansion.

Applicable practices and methods include:

- Minimize impervious areas, using permeable surfaces where possible, including sidewalks and roadway/driveway paving.
- Plan site around existing site features – retain and incorporate natural topography.
- Minimize grading and disturbed area – maximize existing undisturbed areas.
- Narrow roads and minimize driveway lengths/widths, wheel strips and shared driveways to minimize impervious areas.
- Sidewalks on one side of street.

- Plant trees – especially large canopies, in locations selected to accommodate future tree growth.
- Use source control of stormwater for pollutant control and groundwater recharge.
- Minimize conventional infrastructure (curb and gutter, drain inlets/catch basins and culverts).
- Utilize onsite lava rock in sumps, swales, trenches, shallow drywells, detention and retention basins.

Implementation of LID stormwater strategies will focus on storm runoff management at the source. Sizing of stormwater facilities will be site-specific, depending on land use and characteristics of individual developed drainage areas, with the intent to detain, retain and infiltrate post-development runoff onsite to the maximum extent possible.

4.2.3 DRAINAGE INFRASTRUCTURE

Developed condition drainage infrastructure requires consideration of the overall pattern of development, noting that improvements in each of the three phases will be distributed throughout the expansion area. Drainage improvements may thus need to be constructed ahead of their immediate need.

Given relatively steep expansion area slopes, porous surface conditions with underlying hard material and lack of apparent natural drainageways, the most practical means of runoff management will mimic the natural condition, i.e., encourage use of LID BMPs focusing on minimizing creation of impervious areas, and maximizing onsite runoff retention and infiltration, which will enhance water quality management and treatment. A series of linked drywells extending from near the Kuakini Highway culvert to the mauka edge of the campus is proposed as depicted on **Figure 9, Proposed Grading and Drainage Plan**. Open undeveloped areas will be retained undisturbed, to provide additional infiltration.

For larger events, excess runoff may be discharged to primary or secondary conveyances running along the central mauka/makai road through the expansion area and along the southern perimeter road. These conveyances are envisioned to be natural unlined surface channels where possible, since those provide opportunities for additional runoff disposal through the fractured rock subgrade to attenuate peak flows and runoff volumes, and provide groundwater recharge, effectively becoming large-scale infiltration BMPs. Discharges from each channel will be routed to the existing drainage culvert crossing Kuakini Highway.

This integrated approach to stormwater management will require that site planning, building design, landscape design and other water infrastructure design be highly coordinated. Site landscaping should focus on xeriscapes, native plantings, functional and edible landscapes placed in areas in coordination with the grading and drainage plan. Building concepts will focus on integrating BMPs on the perimeter of the building in the façade, fenestration and structural and plumbing systems. Water management systems will need to account for and integrate storm water as a resource by physical capture and infiltration.

5 WATER

5.1 EXISTING CONDITIONS

UNK's water is supplied by the County of Hawaii, Department of Water Supply (DWS) from the DWS 325 reservoir with service zone limits from sea level to the 235-foot elevation. The elevations of the proposed expansion area range from approximately 90 feet msl near Kuakini Highway up to 360 feet msl .

UNK is served from two DWS meters: a 6"x3" master FM meter located near the main campus entrance along Kuakini Highway connected to a 6" DWS main in Kuakini Highway and an 8"x2" master FM meter located near the top of the center road, connected to an 8” DWS main in the Hualalai Village lower driveway. The 6”x3” meter is assigned to the TMK for the campus and the 8”x2” meter is assigned to the proposed expansion area, although currently both meters are servicing the campus. The water system is looped, and the master meters reflect two service connection points to the existing DWS system. See **Figure 10 Existing Water System**

Water is distributed onsite via a system of private water lines. The age of the existing onsite system is not specifically known but the campus was founded in 1978 and it is assumed that the infrastructure was developed no later than 1980, with expansion over the years. An 8”x2” meter assigned to the proposed expansion area was installed in 2013 to provide a second point of connection to maintain adequate pressure and flow for planned expansion of the campus.

5.2 WATER DEMAND

UNK installed water meters on 17 major buildings and irrigation meters on 21 irrigation zones to collect data relative to water consumption. Data collected was summarized and reported to DWS[2]. The main conclusions of the report are:

- Average per capita resident water consumption across 12 dorm buildings over six-month study period was 30 gpcd or less.
- Kindergarten through Grade 8 students and off-campus daily visitors use 12-14 gpcd.
- Irrigation use averages 8,600 gpd or 1,000 gallons per irrigated acre.
- Cafeteria use is about 2 gpcd.
- Based on DWS bi-monthly billings, overall water consumption for maximum population of 1,158 residents equaled 39 gallons per resident per day.

UNK requested and was granted approval via email by DWS on May 18, 2023 for reduced per capita water demand rates, based on actual consumption data described above.

BWS standard and UNK adjusted demand rates:

Criteria	Unit	DWS Standard Rate	UNK Adjusted Rate
Resident, including Cafeteria	gpd	80	35
Day Visitors including K-12 students, staff, guests	gpd	60	20

Based on the population projections and the approved reduced demand rates above, daily potable water demands are calculated for the current condition and future phased improvements below.

[2] Memorandum to DWS from UNK, May 8, 2023.

Domestic Water Demand	Current		Phase 1		Phase 2		Phase 3	
Day Users	Population	Gallons	Population	Gallons	Population	Gallons	Population	Gallons
PK-12 Commuting	148	2,960	110	2,200	155	3,100	175	3,500
University Students Commuting	17	340	11	228	6	116	-	-
Staff Commuting	322	6,440	282	5,635	225	4,500	200	4,000
Guests Commuting	5	100	3	67	2	34	-	-
Subtotals	492	9,840	406	8,130	387	7,750	375	7,500
PK-12 Students	146	5,110	230	8,044	314	10,977	400	14,000
University Students	463	16,205	706	24,717	949	33,230	1,200	42,000
Staff	280	9,800	386	13,496	491	17,192	600	21,000
Guests	20	700	112	3,934	205	7,168	300	10,500
Subtotals	909	31,815	1,434	50,191	1,959	68,567	2,500	87,500
Total Domestic Water Demand		41,655		58,321		76,317		95,000

Irrigation water requirements for the expansion area are tabulated below using an irrigation rate of 1,500 gpd per acre for landscape areas which is roughly equivalent to irrigating once or twice a week for a total of 0.4” of water per week. Irrigation water requirements for the playfields are estimated using an irrigation rate of 4,500 gpd per acre which is roughly equivalent to irrigating several times per week for a total of 1.25” of water per week. It is also assumed that the open spaces will not be irrigated and will remain in their existing condition or renaturalized with lava rock or xeriscape if disturbed during development.

Irrigation Water Demand	Current		Phase 1		Phase 2		Phase 3	
Irrigation Areas	Area	Gallons	Area	Gallons	Area	Gallons	Area	Gallons
Open Space	6.0	-	25.9	-	32.2	-	38.0	-
Landscaping	1.2	1,800	2.7	4,050	3.5	5,250	4.2	6,300
Playfields	0.5	2,250	1.0	4,500	5.0	22,500	5.5	24,750
Total Irrigation Water Demand	7.7	4,050	29.6	8,550	40.7	27,750	47.7	31,050

UNK has submitted a request to DWS to obtain potable water from the DWS public water system. Due to limited capacity on that system, offsite water source development is required to provide water supply for the project. UNK does not intend to drill a well on its own property due to basal lens insufficiency, potential sea water intrusion and environmental challenges. Alternatives for the offsite water well development are described in the attached, “Memorandum from Tom Nance Water Resource Engineering, June 7, 2023”.

Nonpotable water sources for irrigation will be investigated for use on campus to provide the required irrigation water demand. On the existing campus, there are some existing catchment systems already in place and operating that can be used and expanded. In addition, there are a number of different potential strategies to minimize use of potable water for irrigation by irrigating from nonpotable sources. There are also strategies used to minimize irrigation demand. The following various strategies will be considered and implemented during development of the campus to reduce potable water use.

- Rainwater Catchment
- Downspout Disconnects – discharge of runoff direct to landscaping for irrigation water
- Graywater Treatment and Reuse
- Condensate Water Reuse
- Xeriscaping – Install plantings and ground cover that required little to no irrigation water
- Synthetic Turf – install playfields that do not require irrigation

5.2.1 PROPOSED WATER DEVELOPMENT

Hawaii County DWS has indicated that a new water source will be required to serve the proposed expansion area. The new source is presumed to be a new well capable of providing 184 gpm to the expansion area. The alternatives for the offsite water well development identified in the attached, “Memorandum from Tom Nance Water Resource Engineering, June 7, 2023” include two potential locations for a new well and reservoir to be dedicated to DWS. The two potential locations have been identified for a new well and related infrastructure, one on TMK 7-5-003:023 owned by Mr. Wheelock, and another on TMK 7-5-017:044 owned by Mr. Bolton.

UNK and Bolton have an agreement to share capacity of a proposed well planned to tap a water resource whose presence has been established by results of four test wells in the area, and which could be tapped for over 1 million gallons per day. In the event such a well does not produce potable water or has a yield too low to warrant development, a new well on the Wheelock property would have to be developed.

Exploratory well drilling and pump testing suggest that the least risky alternative is to drill and develop a well on the Wheelock property. In either case, UNK will develop an additional water source and storage offsite and dedicate the improvements to DWS in exchange for a water commitment to support the proposed campus expansion.

5.2.2 PROPOSED WATER DISTRIBUTION

Hawaii County DWS “Water System Standards” will govern layout and design of the potable water system. Significant requirements are to have looped mains wherever possible, 8-inches in diameter to provide adequate fire flow, with main valves not greater than 500 feet apart and approved fire hydrants located not farther than 300 feet apart.

The proposed schematic water distribution for the expansion area is shown in **Figure 11 Proposed Water System Plan**. Due to the gap between the upper and lower reservoir service area elevations, a portion of the expansion area will require connection to the DWS 595 system, whose service limits are 272 to 503 feet msl. Water service between the limits of the DWS 325 and DWS 595 reservoirs will be served from the upper reservoir via pressure reducing valves.

6 WASTEWATER

6.1 EXISTING CONDITIONS

The existing UNK sanitary wastewater collection system collects wastewater from a neighboring condo project and its own campus improvements in its sewer collection system and discharges to a sewer manhole on Kuakini Highway, near the makai site entrance (**Figure 12 Existing Wastewater System**). Wastewater is conveyed to the Kealakehe Wastewater Treatment Plant, from which treated septage is discharged to a constructed wetland located immediately south of Honokohau Small Boat Harbor, north of Kailua.

6.2 WASTEWATER FLOW PROJECTIONS

In 2019, the County of Hawaii Department of Environmental Management, Wastewater Division (DEM) approved a wastewater exemption request (DEM, December 10, 2019) to allow UNK to use reduced sewer generation rates, conditioned on installation and reporting of wastewater flows with UNK DWS water meter readings and invoices. UNK has installed and is now monitoring wastewater meters to record incoming wastewater from the neighboring Hualalai Village condominiums and flows discharged to a DEM sewer manhole on Kuakini Highway. Flow measurements from November 2022 to May 2023 suggest that wastewater flows are typically 60% to 80% of water usage (water use 20 gpcd for visitors, 35 gpcd for residents, thus wastewater generation 16 gpcd for visitors and 28 gpcd for residents). The total projected wastewater flow for both the existing campus and expanded campus wastewater flows are presented below for each development phase. This wastewater flow data was recently submitted to DEM for review and comment in response to the exemption request (UNK email May 22, 2023).

Projected Wastewater Flows	Current		Phase 1		Phase 2		Phase 3	
University Land Use	Persons	Flow	Persons	Flow	Persons	Flow	Persons	Flow
PK-12 Students	148	2,368	110	1,760	155	2,480	175	2,800
University Students	17	272	11	182	6	92	-	-
Staff	322	5,152	282	4,508	225	3,600	200	3,200
Guests	5	80	3	54	2	27	-	-
Subtotal	492	7,872	406	6,504	387	6,200	375	6,000
Residential Land Use	Persons	Flow	Persons	Flow	Persons	Flow	Persons	Flow
PK-12 Dorming Students	146	4,088	230	6,435	314	8,782	400	11,200
University Dorming Students	463	12,964	706	19,774	949	26,584	1,200	33,600
University and PK-12 Staff	280	7,840	386	10,797	491	13,754	600	16,800
Guests	20	560	112	3,147	205	5,734	300	8,400
Subtotal	909	25,452	1,434	40,153	1,959	54,854	2,500	70,000
Total Average Daily Flow		33,324		46,657		61,053		76,000

6.3 PROPOSED WASTEWATER SYSTEM

Sanitary wastewater will continue to be discharged from UNK to the Kuakini Highway sewer manhole, conveyed and treated at the Kealakehe Wastewater Treatment Plant. The County of Hawaii has confirmed[3] the UNK campus is within the service area of the Kealakehe Wastewater Treatment plant, and the plant has the capacity for the estimated additional flows from the UNK expansion, but has not made a commitment to treat such flows. On June 15, 2023 UNK submitted a wastewater capacity request for service for the proposed project using the project flows above for discharge from the UNK campus to the County wastewater collection system at the existing Kuakini Highway sewer manhole connection point.

A conceptual sketch of wastewater infrastructure proposed to serve the expansion area, with a second connection to the County system along Kuakini Highway is shown in **Figure 13 Proposed Wastewater System Plan**.

7 SOLID WASTE

7.1 EXISTING CONDITIONS

The County of Hawaii Department of Environmental Management Solid Waste Division is responsible for the operation and maintenance of the County's solid waste and recycling facilities. These facilities include a network of 21 recycling and transfer and transfer stations and two landfills. The County of Hawaii does not have a curbside pickup system and instead depends on private waste collection companies to transport waste to the nearest transfer station. The County then transports waste from the transfer stations to either the South Hilo Sanitary Landfill or the West Hawaii Sanitary Landfill in Puuanahulu. UNK is located between two existing transfer stations, the Kealakehe Transfer Station (3.1 miles northwest) and the Keauhou Transfer station (7.1 miles southeast). The West Hawaii Sanitary Landfill in Puuanahulu receives UNK solid waste.

[3] Undated letter from County of Hawaii to UNK

7.2 PROPOSED WASTE GENERATION AND DISPOSAL

Hawaii County has updated the Integrated Resources and Solid Waste Management Plan (IRSWMP), which evaluates the County's existing waste management practices and programs and provides options and recommendations for both short- and long-term implementation of the proposed improvements to the County's waste management system. Recommendations include programmatic improvements to reduce, reuse and recycle waste, and infrastructure improvements to upgrade, repair and reconstruct transfer stations and landfills.

The draft IRSWMP estimates the total Hawaii island population at 201,389 persons and total disposal weight (including recycling) for the 2017-2018 period at 283,021 pounds, or about 1.4 pounds/person-day, which rate was growing at about 4.6 percent annually. Based on those estimates, solid waste disposal based on projected campus and visitor population at the midpoint of the three development phases can be estimated in the following table.

SOLID WASTE GENERATION, TONS/DAY								
	Current (2023)		Phase 1 (2030)		Phase 2 (2035)		Phase 3 (2040)	
Population Segment	Capita	Solid Waste	Capita	Solid Waste	Capita	Solid Waste	Capita	Solid Waste
Dormitories	909	0.8	1,434.0	1.7	1,959.0	2.9	2,500.0	4.7
Day Users	492	0.4	406.0	0.5	387.0	0.6	375.0	0.7
Total, tons/day =		1.2		2.2		3.5		5.4

The West Hawaii Sanitary Landfill in Puuanahulu will continue to receive UNK solid waste.

8 POWER AND COMMUNICATIONS

8.1 EXISTING CONDITIONS

Electrical service to the campus is currently provided by Hawaiian Electric (HE) and communication services are provided by both Hawaiian Tel (HTCO) and Spectrum. As State Public Utility Commission (PUC) regulated public utilities, HE and HTCO are responsible for the development of off-site facilities that meet island-wide needs, such as power generating plants and power and signal transmission lines, and facilities that serve regional needs of Kailua-Kona. Presently, the campus is served by these utilities off of Kuakini Highway. The HE electrical service is at the primary distribution voltage of 12.47kV, three phase, through a single metering point. The power is further distributed at 480/277v, 208/120v, three and single phase, to the campus buildings and facilities. This electrical infrastructure is owned and maintained by UNK.

8.2 PROPOSED ELECTRICAL SYSTEM

Electrical service for the expansion of the campus will require a service request to Hawaiian Electric. The upgrade of the existing service would likely occur in phases as each portion of the expansion area is developed. As a State Public Utility Commission (PUC) regulated public utility, HE is responsible for the development of off-site facilities that meet island-wide needs, such as power generating plants and power and signal transmission lines, and facilities that serve regional needs of Kailua-Kona. At the appropriate time a service request for the proposed improvements will be submitted to HE and the required infrastructure will be installed to serve the proposed project.

8.3 PROPOSED TELECOMMUNICATIONS

Telecommunications service for the expansion of the campus will require a service request to HTCO or Spectrum or other service provider. The upgrade of the existing service would likely occur in phases as each portion of the expansion area is developed and will likely be expanded off of the network currently on the existing campus. At the appropriate time a service request for the proposed improvements will be submitted to one or more of the telecommunications service providers and the required infrastructure will be installed to serve the proposed project.

REFERENCES

G70 International LLC, *University of the Nations, Kona, Inc. 2020 Master Plan Update*, February 2021.

County of Hawaii, Department of Public Works, *Storm Drainage Standards*, October 1972.

County of Hawaii, *County of Hawaii General Plan*, February 2005

County of Hawaii, *Integrated Resources and Solid Waste Management Plan*, 2019

County of Hawaii, Department of Water Supply, *Water Use and Development Plan Update, Hawaii Water Plan*, August 2010

County of Hawaii, Department of Water Supply, *Water System Standards*, 2002

City and County of Hawaii, Department of Public Works, Division of Wastewater Management, *Design Standards of the Department of Wastewater Management*, Volume 1, July 1993

Email from DWS to UNK, May 15, 2023

Memorandum from Tom Nance Water Resource Engineering, June 7, 2023

Memorandum to DWS from UNK, May 8, 2023

“Mobility Analysis Report for the University of the Nations Kona Master Plan Update, Kona, HI” Fehr & Peers, June 19, 2023

State of Hawaii, Department of Health, *2006 State of Hawaii Quality Monitoring and Assessment Report: Integrated Report to the U.S. Environmental Protection Agency and The U.S. Congress Pursuant to Sections §303(D) and §305(B) Clean Water Act (P.L. 97-117),* January 11, 2008.

State of Hawaii, Department of Health, Hawaii Administrative Rules, Title 11, Chapter 62, Wastewater Systems, January 14, 2004.

State of Hawaii, Department of Health, Hawaii Administrative Rules, Title 11, Chapter 62, Appendix A, Individual and General Permit Standard Conditions, April 15, 1997.

State of Hawaii, Department of Health, Safe Drinking Water Branch, Hawaii Administrative Rules, Title 11, Chapter 23, Underground Injection Control, January 14, 2004.

State of Hawaii, Department of Health, Wastewater Branch, *Guidelines for the Treatment and Use of Recycled Water*, May 15, 2002

U.S. Department of Agriculture, Soil Conservation Service, *Soil Survey for the Island of Hawaii, State of Hawaii,* December 1972

U.S. Department of Commerce, Weather Bureau, *Technical Paper No. 43 – Rainfall Frequency Atlas of the Hawaiian Islands for Areas to 200 Square Miles, Durations to 24 Hours, and Return Periods from 1 to 100 Years*, 1962

Department of Land and Natural Resources, Flood Hazard Assessment Report for TMK (3) 7-5-010:085

U.S. Geological Survey, 7.5 Minute Topographic Map, North Kona, HI 1995

U.S. National Oceanic and Atmospheric Administration, National Weather Service, *Precipitation Frequency Atlas of the United States*, NOAA Atlas 14, Volume 4, Version 2, 2009

Websites Accessed:

State of Hawaii, Department of Business, Economic Development and Tourism
Hawaii Statewide GIS Program
http://hawaii.gov/dbedt/gis/

U.S. Department of Agriculture, Natural Resource Conservation Service
Soil Data Mart
http://soildatamart.nrcs.usda.gov/

U.S. National Oceanic and Atmospheric Administration, National Weather Service
HDSC Precipitation Frequency Data Server
http://hdsc.nws.noaa.gov/hdsc/pfds/hi/hi_pfds.html

State of Hawaii, Department of Health
Hawaii Statewide GIS Program
https://geoportal.hawaii.gov/datasets/HiStateGIS::underground-injection-control-line-uic-line/explore?location=19.627796%2C-155.973733%2C15.04

Figure 1: Project Location Map

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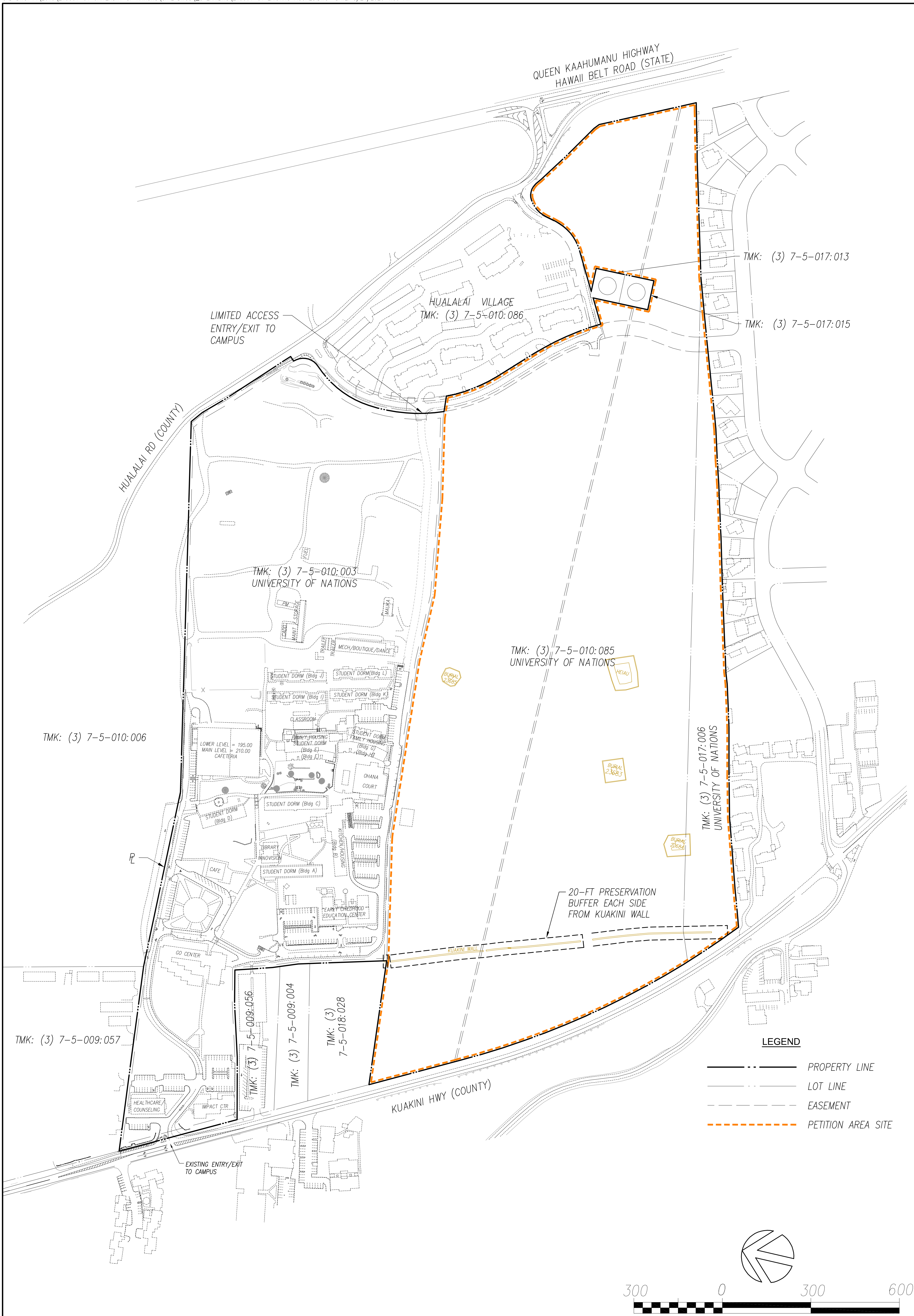

Figure 2: Existing Site Plan

Figure 3: TMK Parcel Map

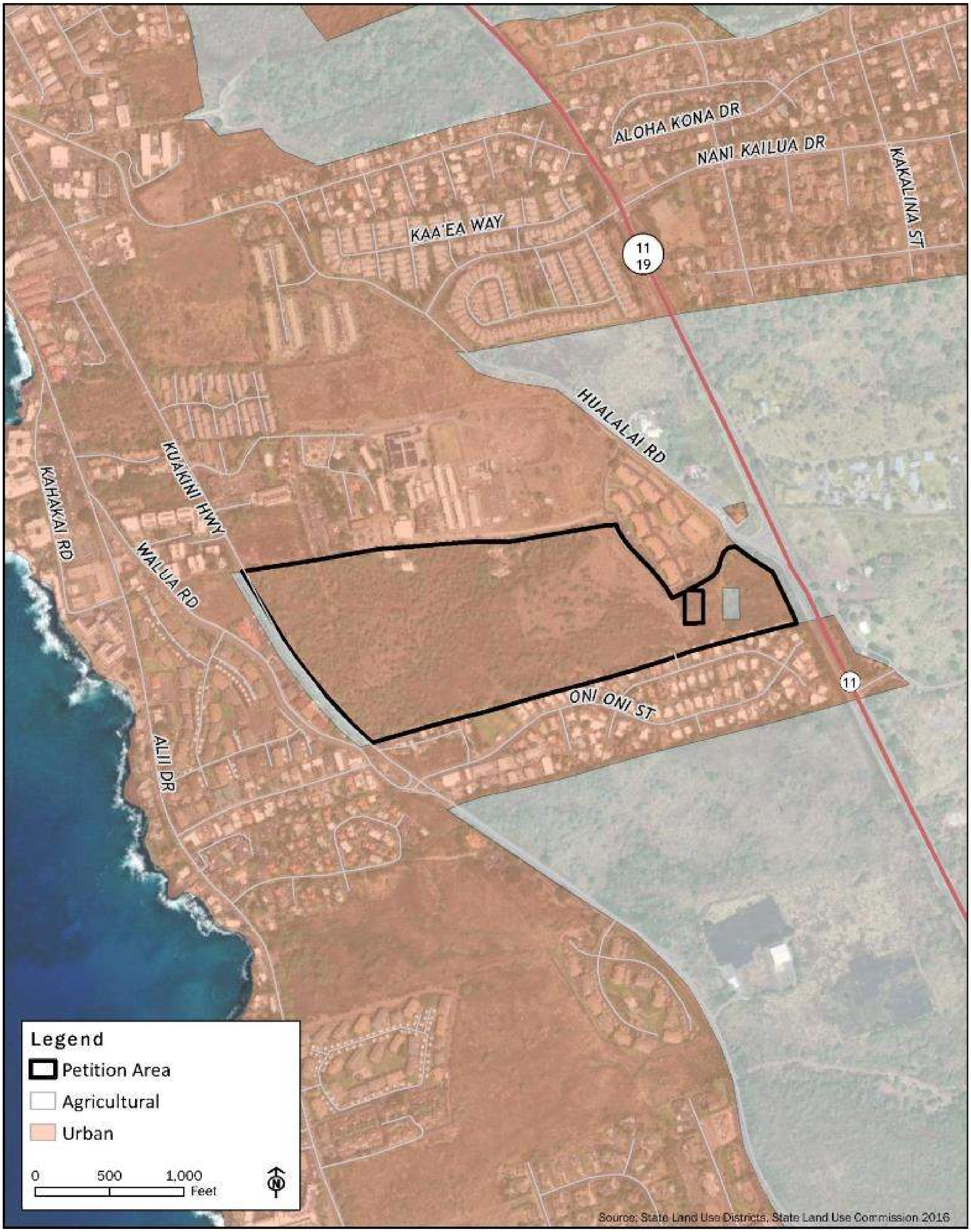

Figure 4: State Land Use District Designation Map

Figure 5: County of Hawaii Zoning Map

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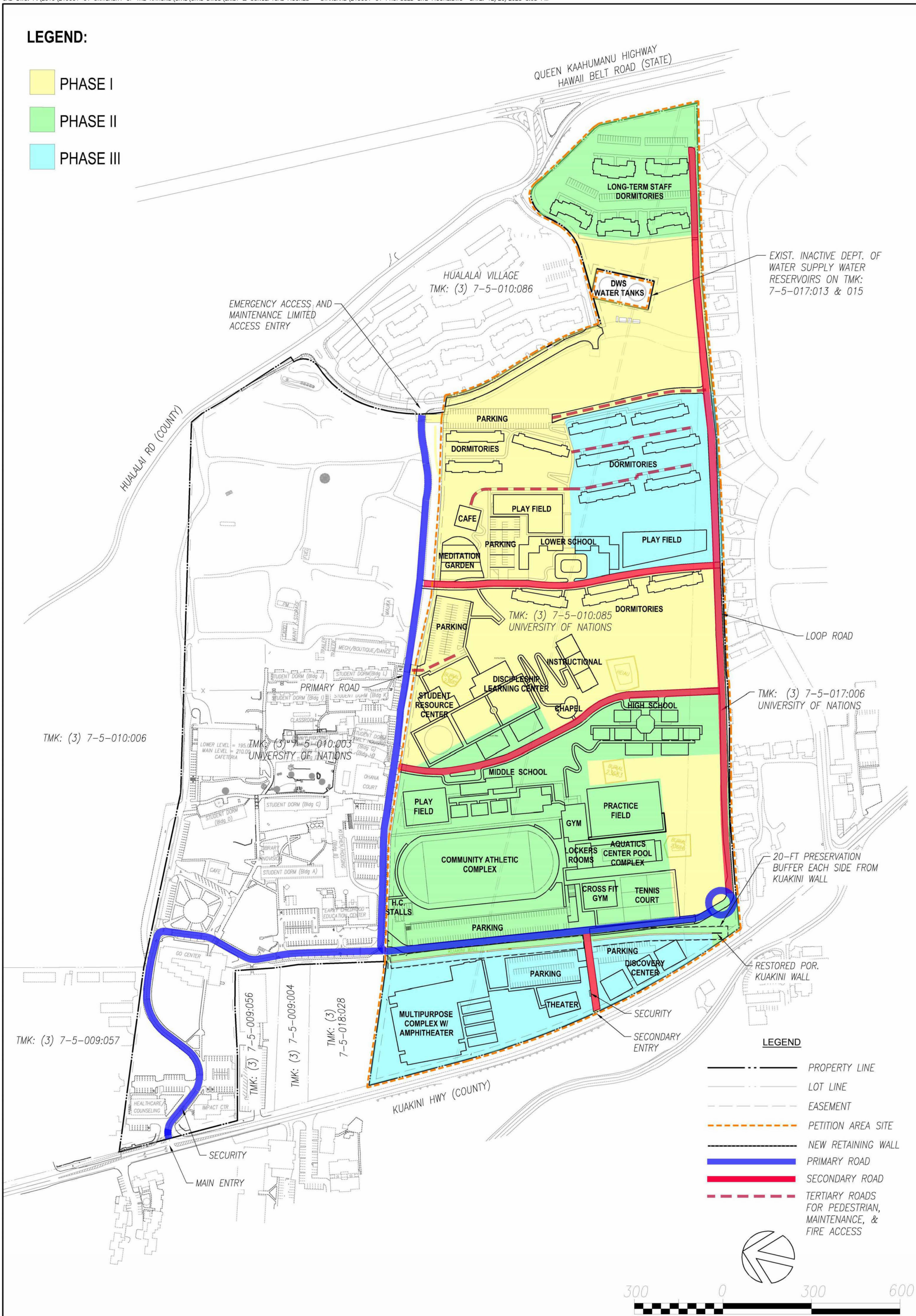

FIG 6	SCALE: 1" = 300' DATE: DECEMBER 15, 2023 PROJECT: 219061-01	CONCEPT MASTER PLAN UNIVERSITY OF NATIONS TMK: (3)7-5-010:003 & 085 KONA, HAWAII	G70 111 S. KING STREET, SUITE 170 HONOLULU, HAWAII 96813 808.523.5866 WWW.G70.DESIGN

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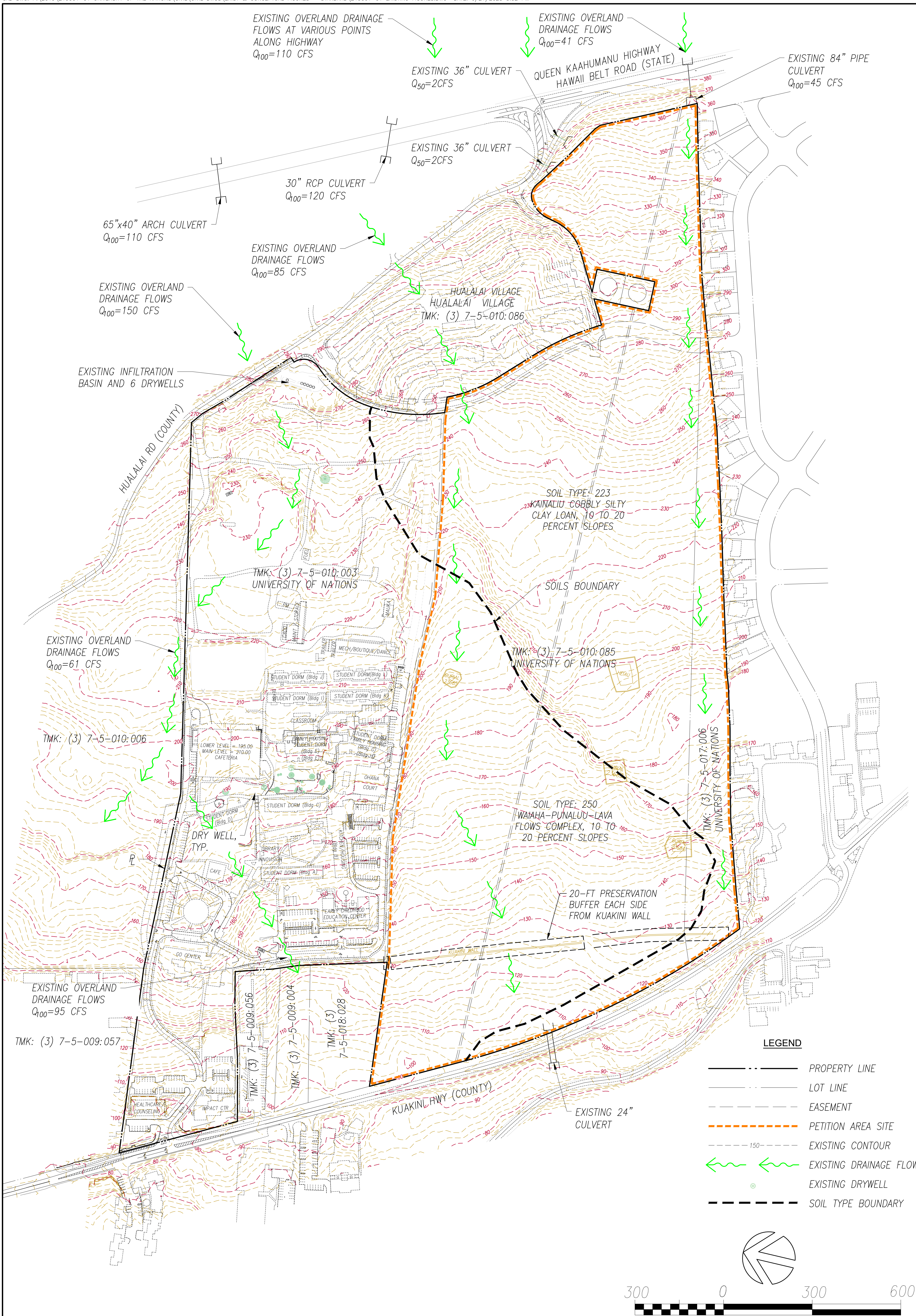
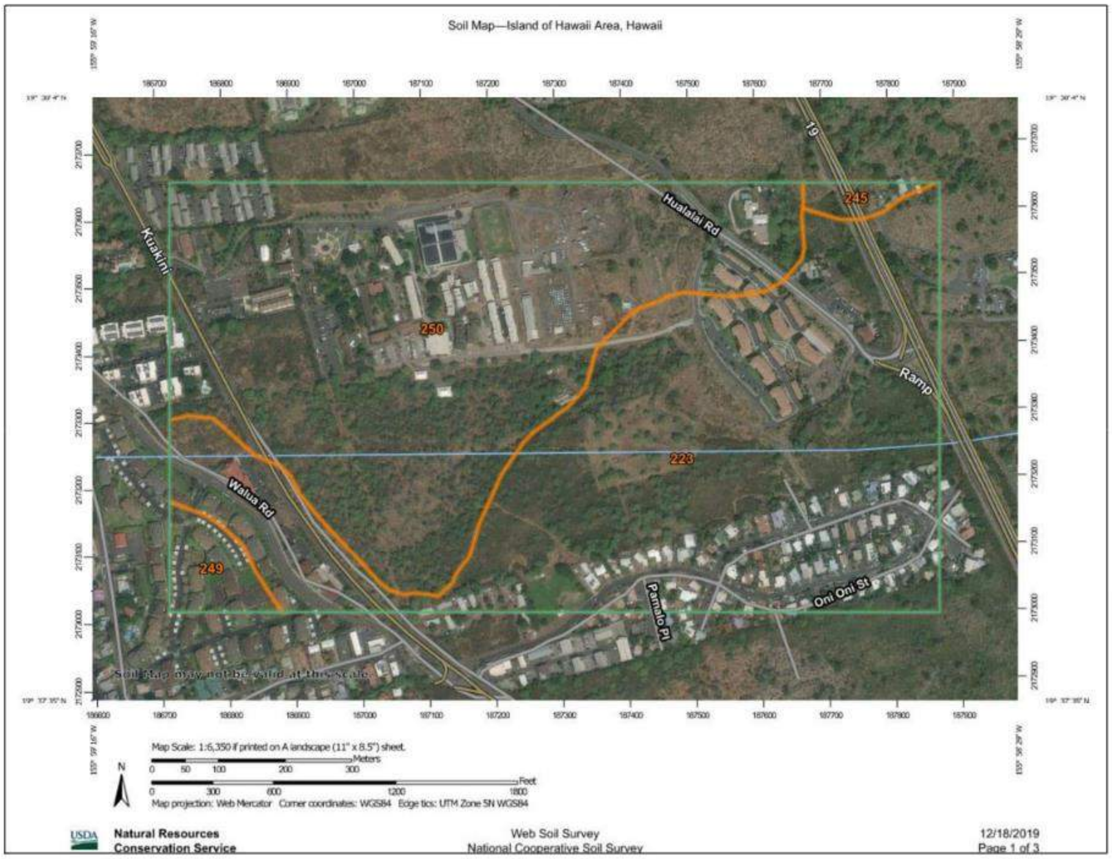


FIG 7	SCALE: 1" = 300' DATE: DECEMBER 15, 2023 PROJECT: 219061-01	EXISTING GRADING & DRAINAGE PLAN UNIVERSITY OF NATIONS TMK: (3)7-5-010:003 & 085 KONA, HAWAII	G70	111 S. KING STREET, SUITE 170 HONOLULU, HAWAII 96813 808.523.5866 WWW.G70.DESIGN



Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
223	Kainaliu cobbly silty clay loam, 10 to 20 percent slopes	90.6	49.4%
245	Waiaha cobbly medial silt loam, 10 to 20 percent slopes	1.9	1.0%
249	Waiaha-Punaluu-Lava flows complex, 2 to 10 percent slopes	4.4	2.4%
250	Waiaha-Punaluu-Lava flows complex, 10 to 20 percent slopes	86.4	47.1%
Totals for Area of Interest		**183.4**	**100.0%**

FIGURE 8 NRCS SOILS MAP AND LEGEND

CAD DWG: P:\2019\219061-01 UNIVERSITY OF THE NATIONS\CIVIL\CIVIL DWGS\EXIST & CONCEPTUAL FIGURES - STANDARD\219061-01 PROPOSED GRADING DRAINAGE FIGURE.DWG DATE: 12/14/2023 9:28 AM

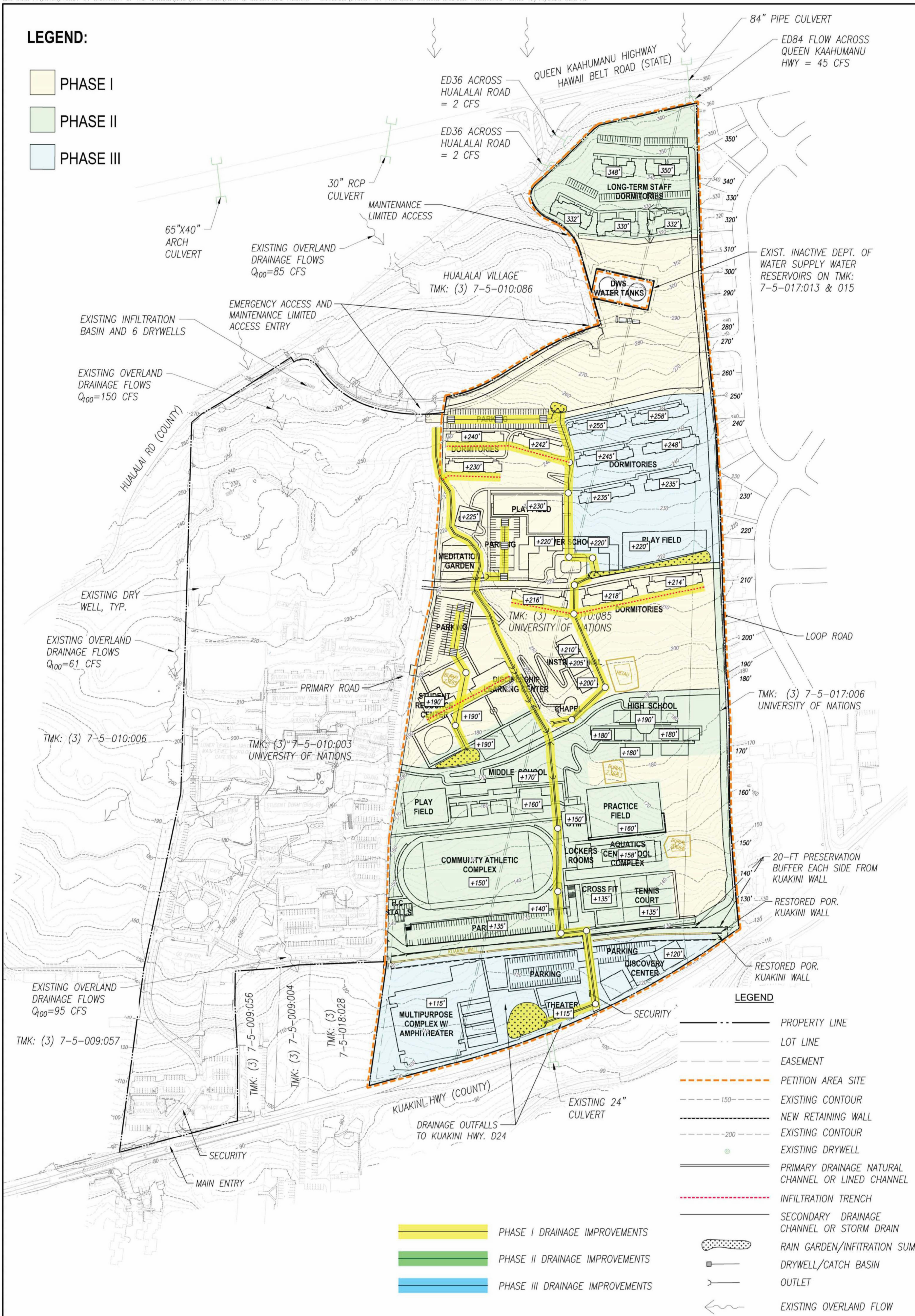


FIG 9a

SCALE: 1" = 300' (11" x 17")
DATE: DECEMBER 15, 2023
PROJECT: 219061-01

PROPOSED GRADING & DRAINAGE PH I

UNIVERSITY OF NATIONS
TMK: (3)7-5-010:003 & 085
KONA, HAWAII

G70

111 S. KING STREET, SUITE 170
HONOLULU, HAWAII 96813
808.523.5866
WWW.G70.DESIGN

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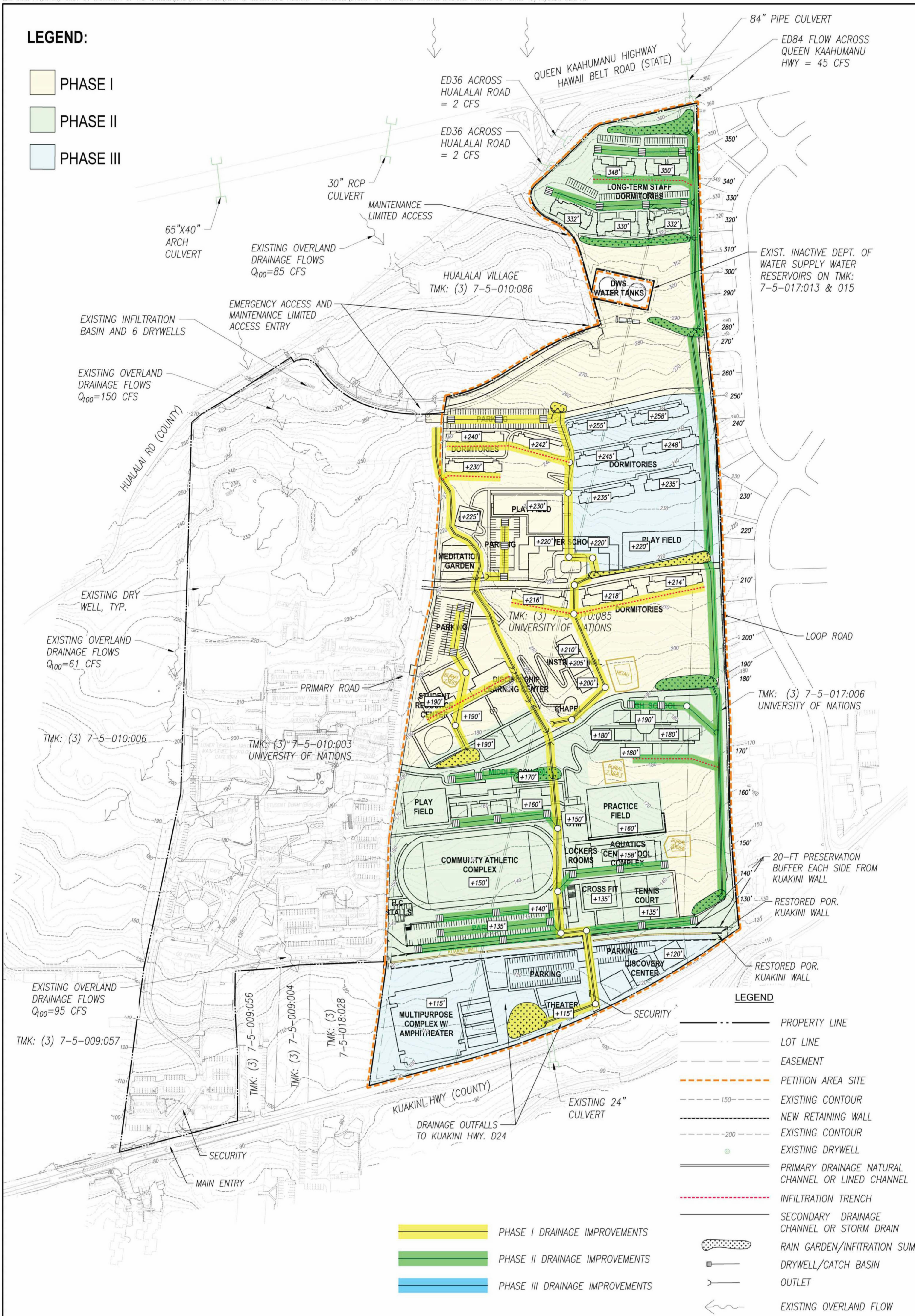


FIG 9b

SCALE: 1" = 300' (11" x 17")
DATE: DECEMBER 15, 2023
PROJECT: 219061-01

PROPOSED GRADING & DRAINAGE PH II

UNIVERSITY OF NATIONS
TMK: (3)7-5-010:003 & 085
KONA, HAWAII

G70

111 S. KING STREET, SUITE 170
HONOLULU, HAWAII 96813
808.523.5866
WWW.G70.DESIGN

CAD DWG: P:\2019\219061-01 UNIVERSITY OF THE NATIONS\CIVIL\CIVIL DWGS\EXIST & CONCEPTUAL FIGURES - STANDARD\219061-01 PROPOSED GRADING DRAINAGE FIGURE.DWG DATE: 12/14/2023 9:28 AM

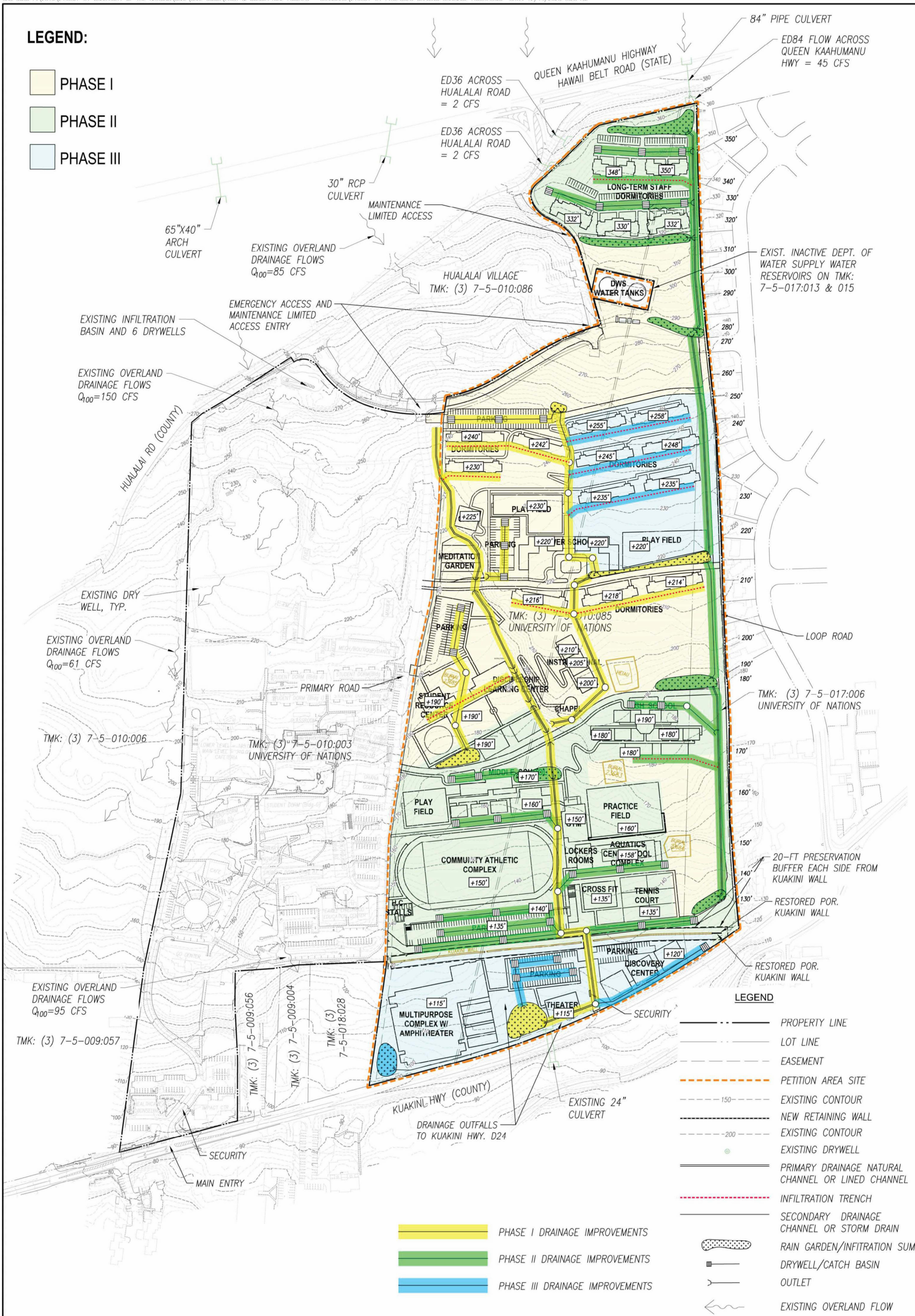


FIG 9c	SCALE: 1" = 300' (11" x 17") DATE: DECEMBER 15, 2023 PROJECT: 219061-01	PROPOSED GRADING & DRAINAGE PH III UNIVERSITY OF NATIONS TMK: (3)7-5-010:003 & 085 KONA, HAWAII	G70	111 S. KING STREET, SUITE 170 HONOLULU, HAWAII 96813 808.523.5866 WWW.G70.DESIGN

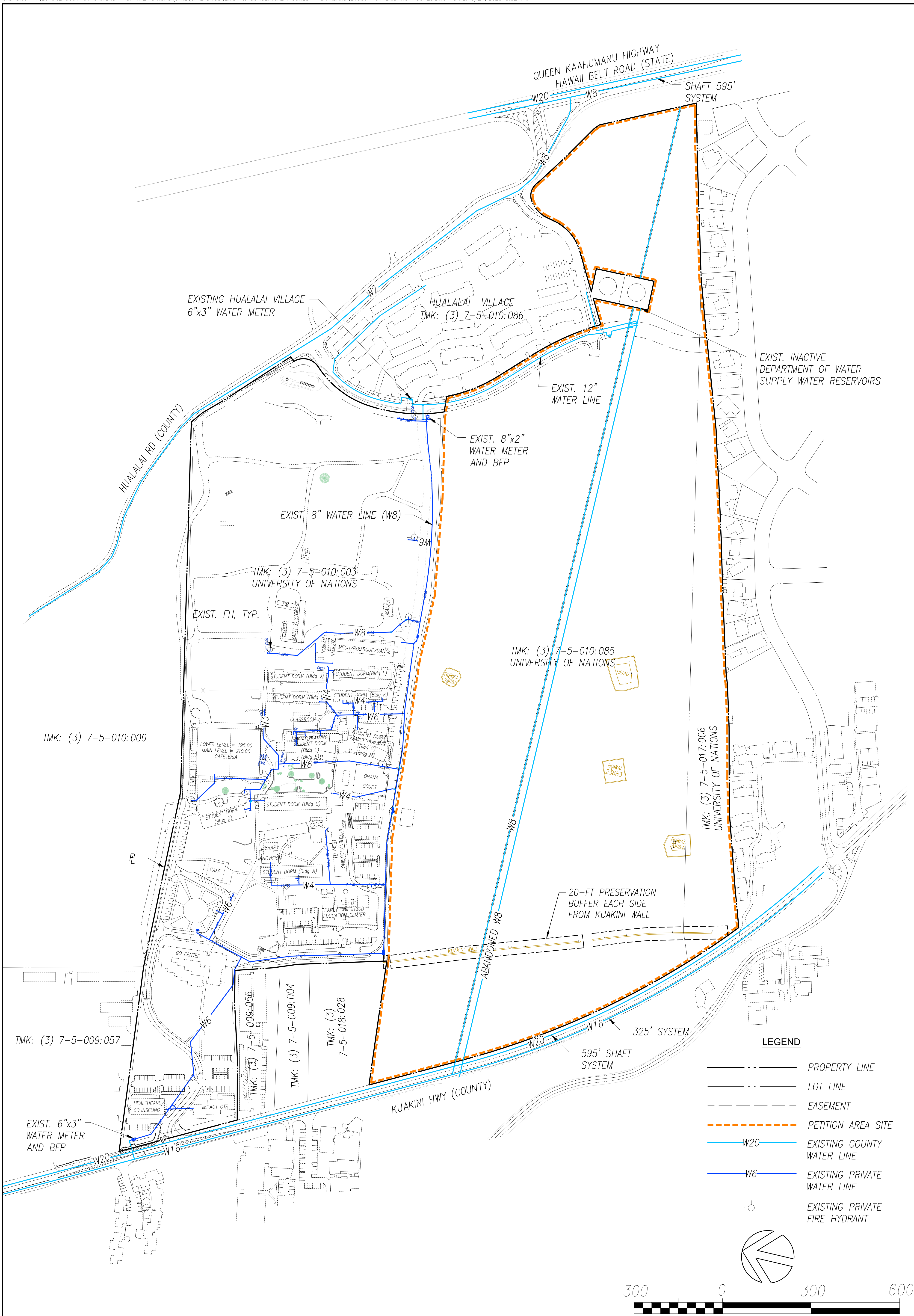


FIG 10

SCALE: 1" = 300'

DATE: DECEMBER 15, 2023

PROJECT: 219061-01

EXISTING WATER SYSTEM PLAN

UNIVERSITY OF NATIONS
TMK: (3)7-5-010:003 & 085
KONA, HAWAII

G70
111 S. KING STREET, SUITE 170
HONOLULU, HAWAII 96813
808.523.5866
WWW.G70.DESIGN

CAD DWG: P:\2019\219061-01 UNIVERSITY OF THE NATIONS\CIVIL\CIVIL DWGS\EXIST & CONCEPTUAL FIGURES - STANDARD\219061-01 PROPOSED WATER FIGURE.DWG DATE: 12/14/2023 9:19 AM

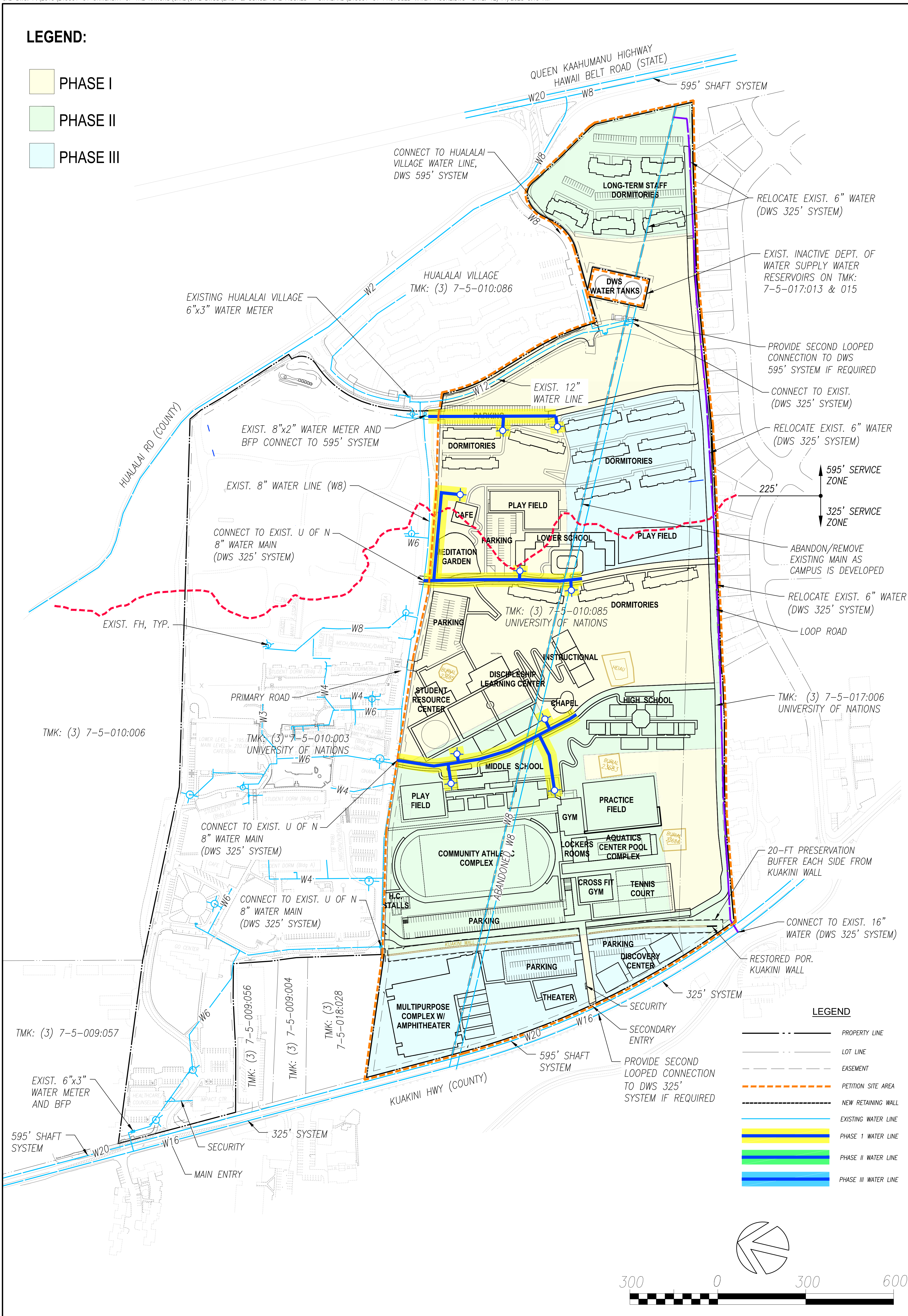


FIG 11a	SCALE: 1" = 300' DATE: DECEMBER 15, 2023 PROJECT: 219061-01	PROPOSED WATER SYSTEM PH I UNIVERSITY OF NATIONS TMK: (3)7-5-010:003 & 085 KONA, HAWAII	G70	111 S. KING STREET, SUITE 170 HONOLULU, HAWAII 96813 808.523.5866 WWW.G70.DESIGN

CAD DWG: P:\2019\219061-01 UNIVERSITY OF THE NATIONS\CIVIL\CIVIL DWGS\EXIST & CONCEPTUAL FIGURES - STANDARD\219061-01 PROPOSED WATER FIGURE.DWG DATE: 12/14/2023 9:19 AM

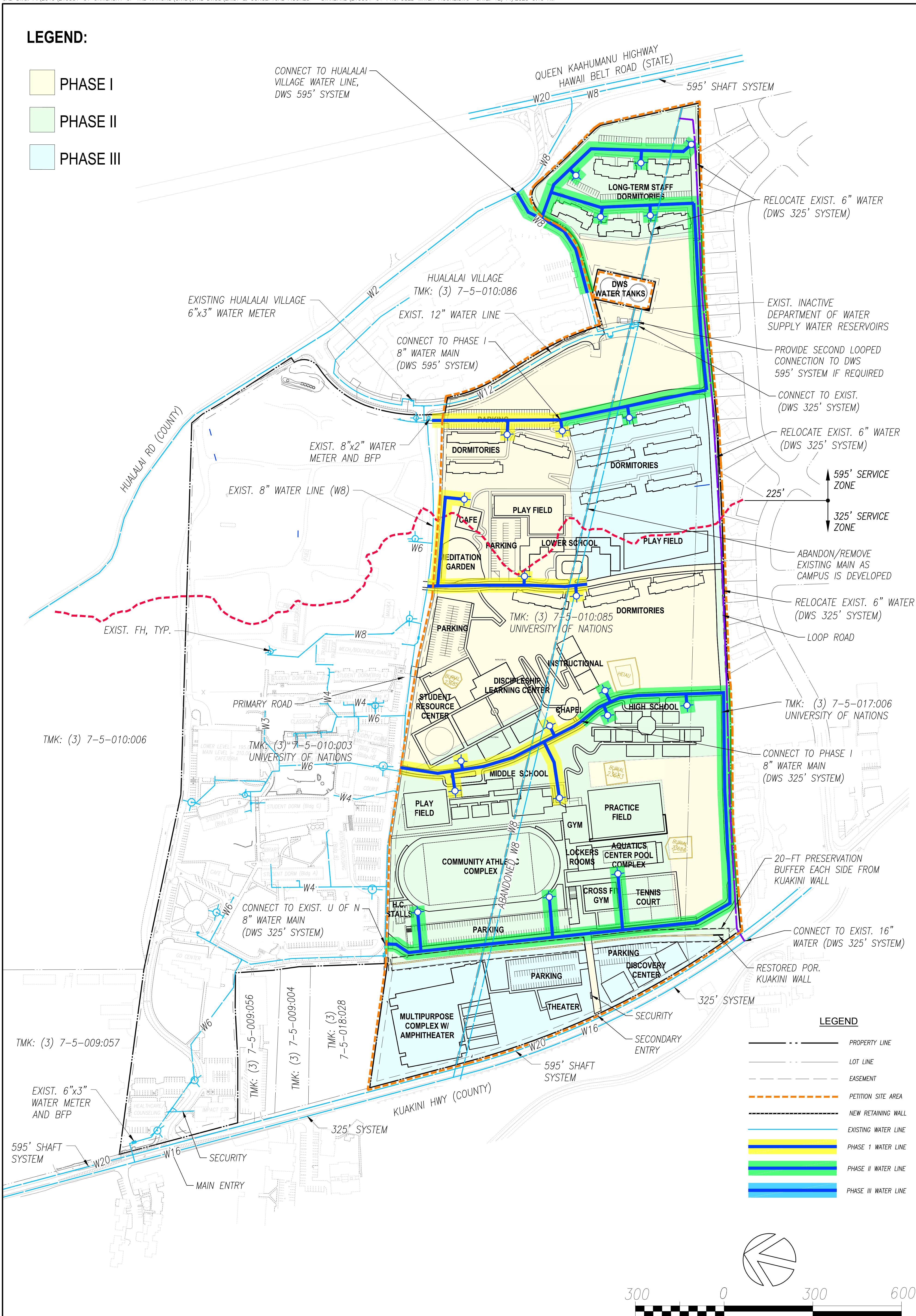


FIG 11b	SCALE: 1" = 300' DATE: DECEMBER 15, 2023 PROJECT: 219061-01	PROPOSED WATER SYSTEM PH II UNIVERSITY OF NATIONS TMK: (3)7-5-010:003 & 085 KONA, HAWAII	G70	111 S. KING STREET, SUITE 170 HONOLULU, HAWAII 96813 808.523.5866 WWW.G70.DESIGN

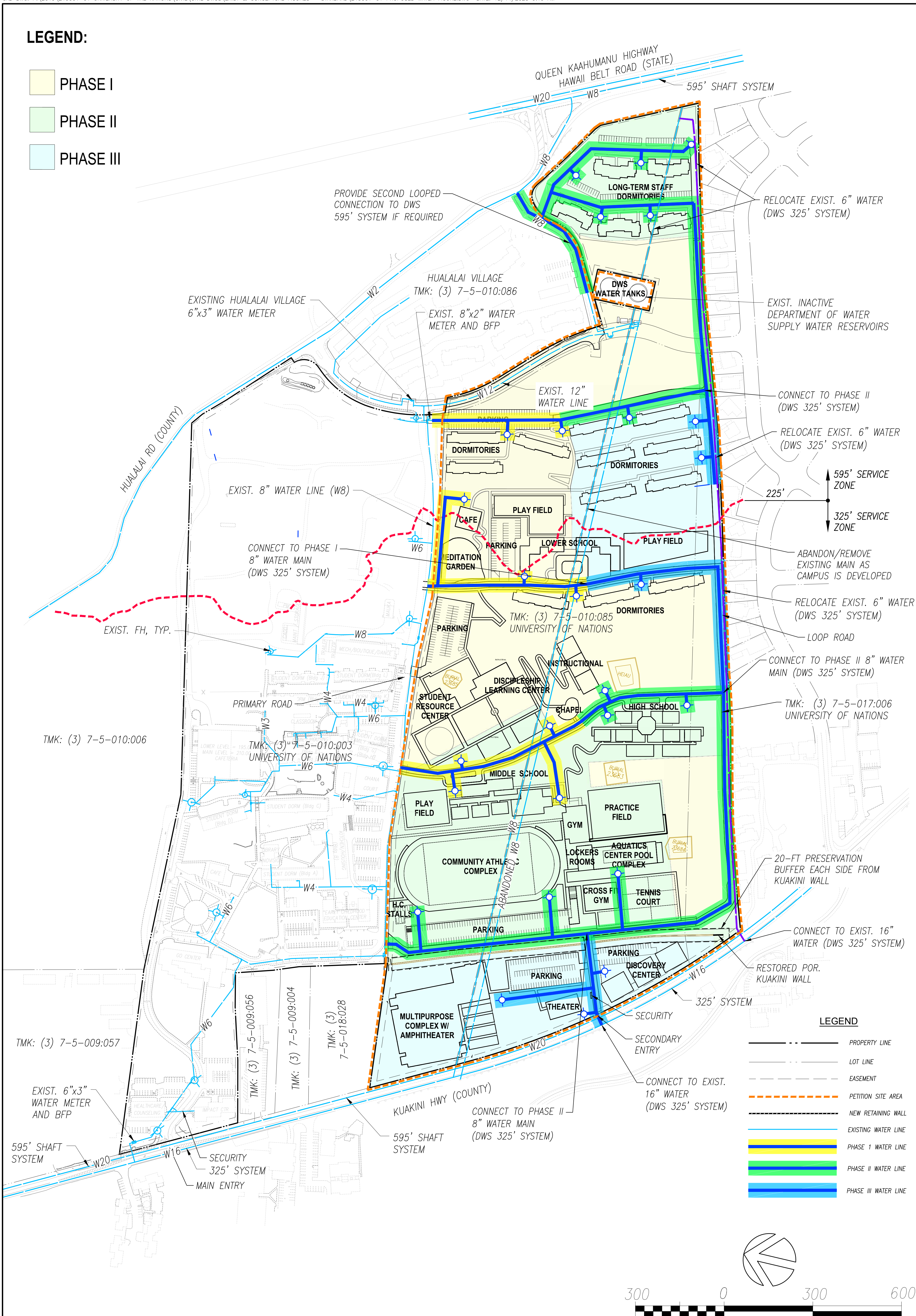


FIG 11c	SCALE: 1" = 300' DATE: DECEMBER 15, 2023 PROJECT: 219061-01	PROPOSED WATER SYSTEM PH III UNIVERSITY OF NATIONS TMK: (3)7-5-010:003 & 085 KONA, HAWAII	G70 111 S. KING STREET, SUITE 170 HONOLULU, HAWAII 96813 808.523.5866 WWW.G70.DESIGN

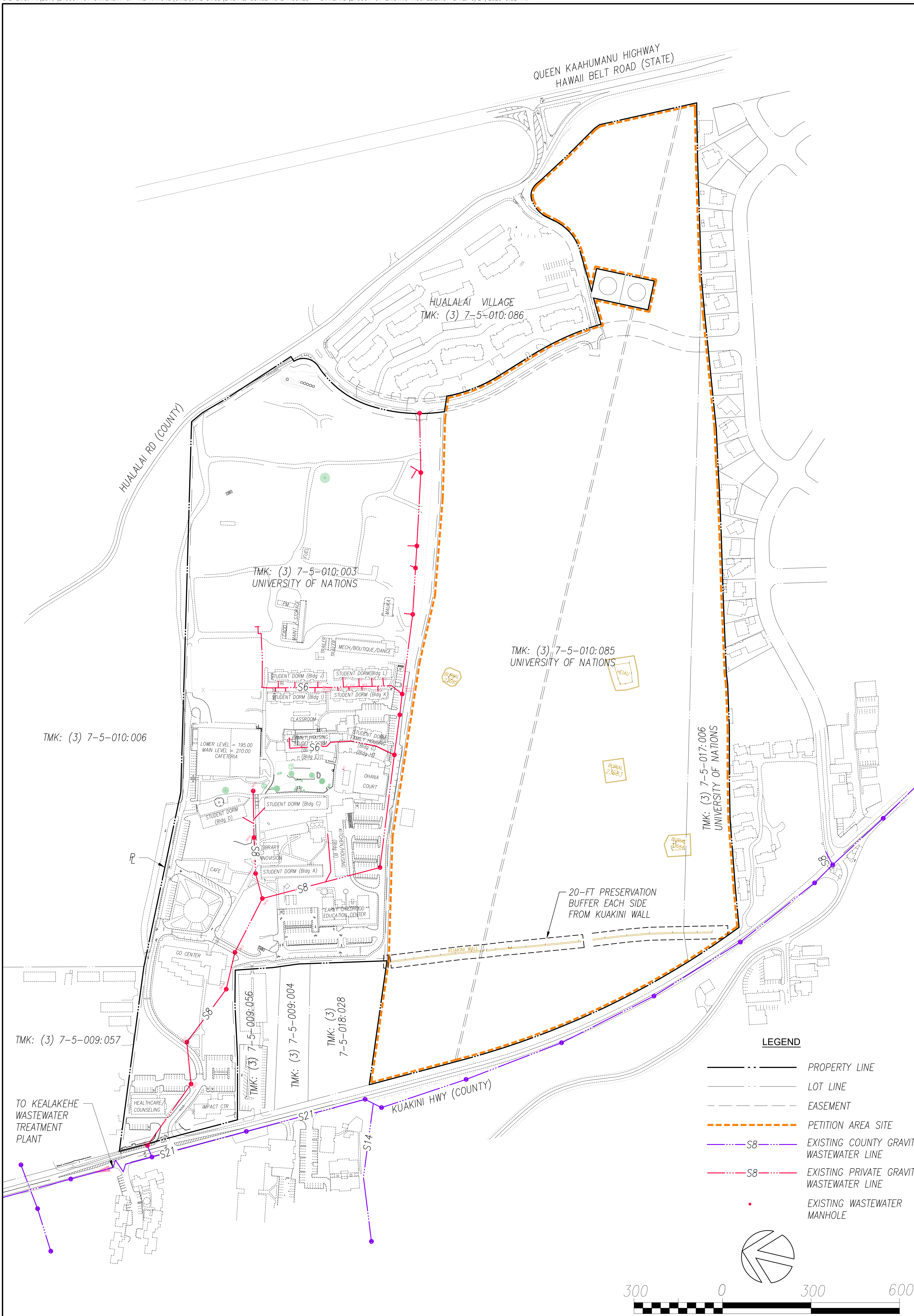


FIG 12	SCALE: 1" = 300' DATE: DECEMBER 15, 2023 PROJECT: 219061-01	EXISTING WASTEWATER SYSTEM PLAN UNIVERSITY OF NATIONS TMK: (3)7-5-010:003 & 085 KONA, HAWAII	G70	111 S. KING STREET, SUITE 170 HONOLULU, HAWAII 96813 808.523.5866 WWW.G70.DESIGN

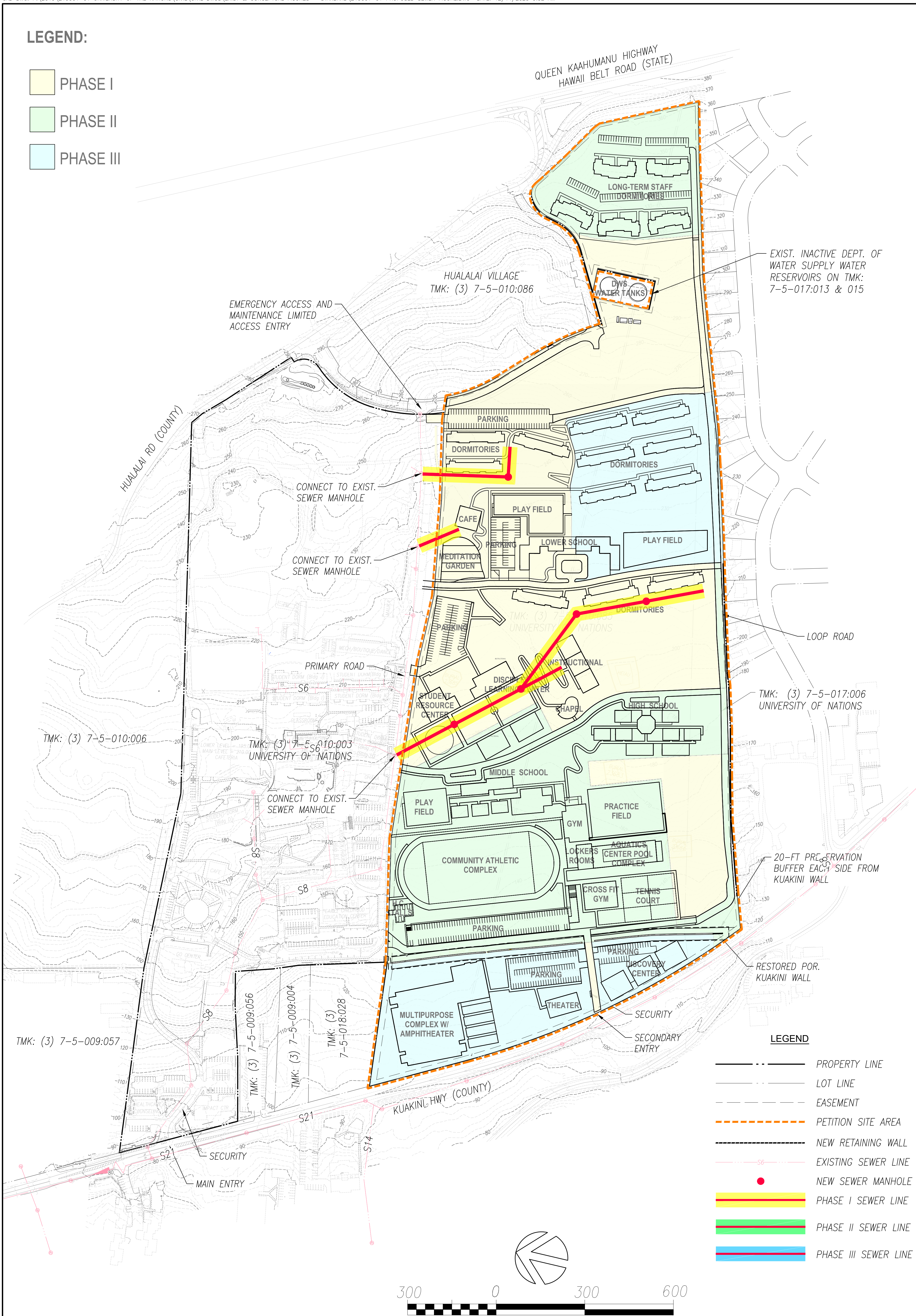


FIG 13a	SCALE: 1" = 300' DATE: DECEMBER 15, 2023 PROJECT: 219061-01	PROPOSED WASTEWATER SYSTEM PH I UNIVERSITY OF NATIONS TMK: (3)7-5-010:003 & 085 KONA, HAWAII	G70	111 S. KING STREET, SUITE 170 HONOLULU, HAWAII 96813 808.523.5866 WWW.G70.DESIGN

CAD DWG: P:\2019\219061-01 UNIVERSITY OF THE NATIONS\CIVIL\CIVIL DWGS\EXIST & CONCEPTUAL FIGURES - STANDARD\219061-01 PROPOSED SEWER FIGURE.DWG DATE: 12/14/2023 9:32 AM

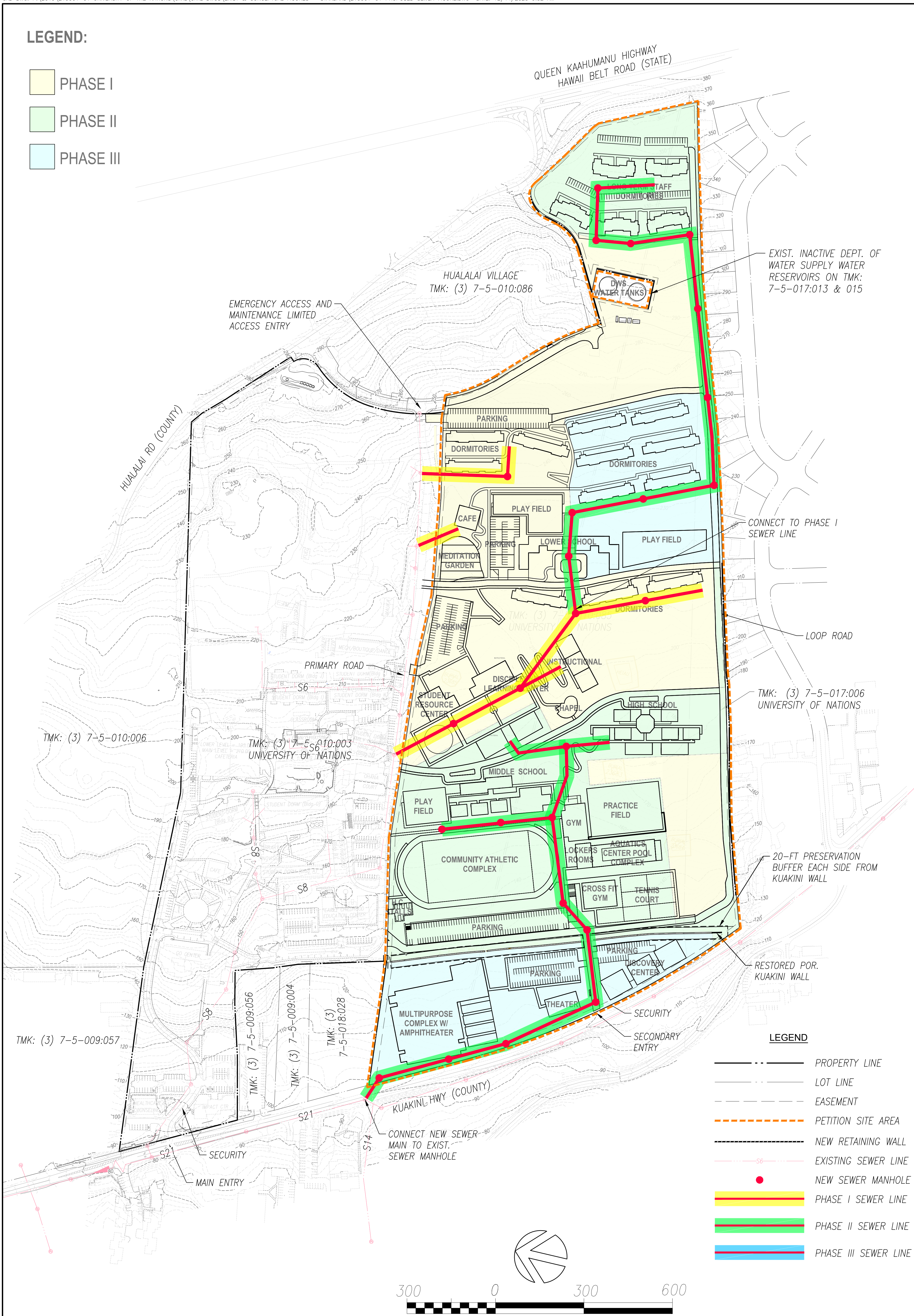


FIG 13b	SCALE: 1" = 300' DATE: DECEMBER 15, 2023 PROJECT: 219061-01	PROPOSED WASTEWATER SYSTEM PH II UNIVERSITY OF NATIONS TMK: (3)7-5-010:003 & 085 KONA, HAWAII	G70	111 S. KING STREET, SUITE 170 HONOLULU, HAWAII 96813 808.523.5866 WWW.G70.DESIGN

CAD DWG: P:\2019\219061-01 UNIVERSITY OF THE NATIONS\CIVIL\CIVIL DWGS\EXIST & CONCEPTUAL FIGURES - STANDARD\219061-01 PROPOSED SEWER FIGURE.DWG DATE: 12/14/2023 9:32 AM

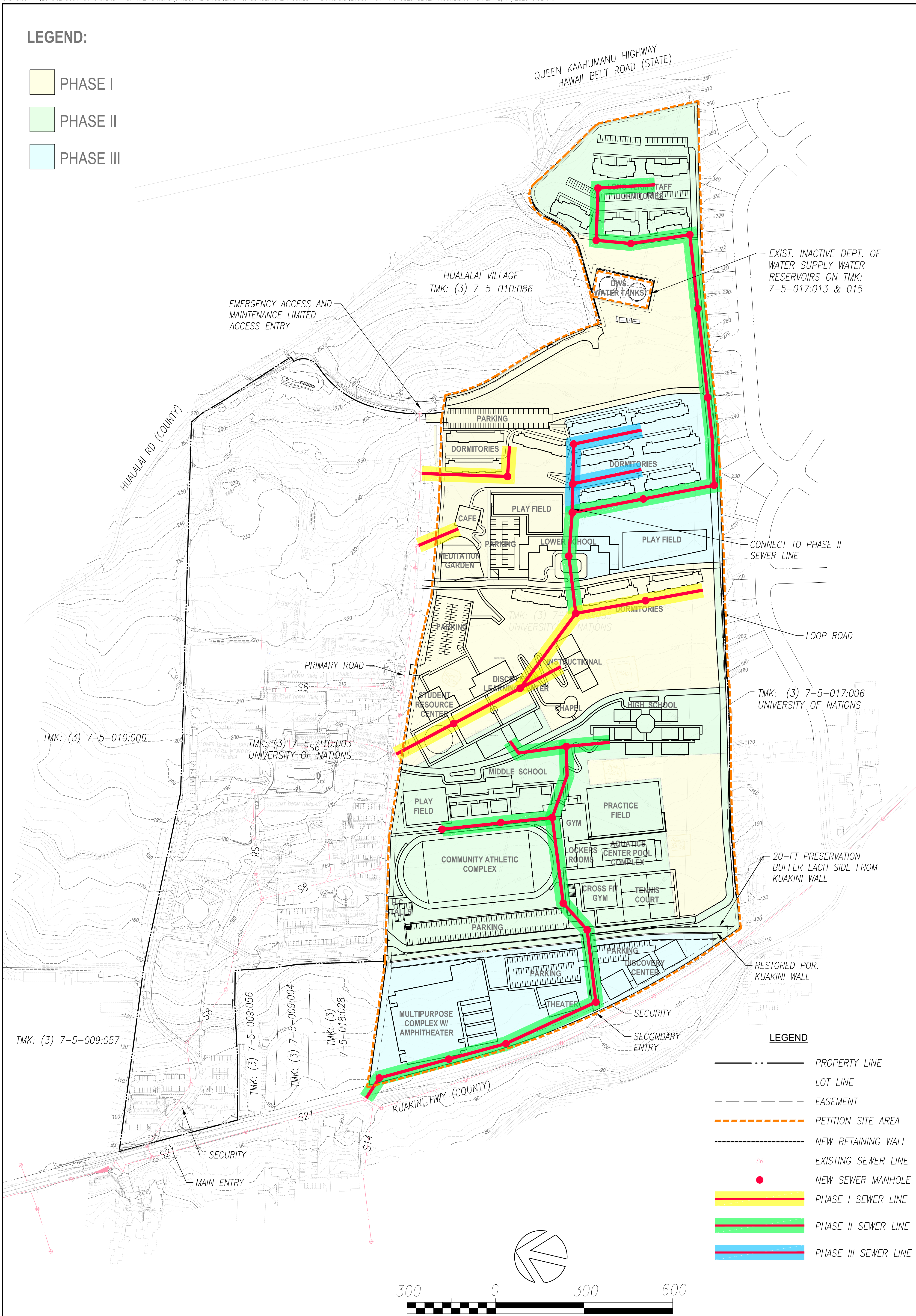


FIG 13c	SCALE: 1" = 300' DATE: DECEMBER 15, 2023 PROJECT: 219061-01	PROPOSED WASTEWATER SYSTEM PH III UNIVERSITY OF NATIONS TMK: (3)7-5-010:003 & 085 KONA, HAWAII	G70	111 S. KING STREET, SUITE 170 HONOLULU, HAWAII 96813 808.523.5866 WWW.G70.DESIGN

Appendix D

Water Supply for the Planning Expansion of the University of the Nations Kona, June 2023

TNWRE
Tom Nance Water
Resource Engineering

No. of pages: 12
Email: paulm@g70.design
jeff@g70.design
jonathan.d.lowe@gmail.com
greg@tnwre.com

Original will not be mailed to you.

June 7, 2023
23-105 | 20-03

MEMORANDUM

To: Paul Matsuda and Jeff Overton – Group 70 International, Inc.

From: Tom Nance

Subject: Water Supply for the Planned Expansion of University of the Nations Kona in the Land Use Commission (LUC) Petition Area

Introduction

As I understand it, the Hawaii County Department of Water Supply (HDWS) has indicated that a new source of supply will need to be developed in order to supply the LUC petition area for the planned expansion of the University of the Nations Kona (UNK). The portion of the planned expansion in the LUC petition area is on two adjacent parcels identified as TMKs 7-5-010:085 and 7-5-017:006. These two parcels are shown on Figure 1 and the concept plan for the proposed expansion on these parcels is illustrated on Figure 2. Development would occur in three phases.

Required Supply for the Expansion

Table 1, prepared by Jonathan Lowe of UNK, is a tabulation of the potable and irrigation supply required for the expansion of the campus(refer to the tabulation below). The current campus has 63 water credits. TMK 7-5-010:085 has 50 credits, bringing the total to 113 water credits. The ultimate total additional supply is projected to be 118,300 gallons per day (GPD). The intent is for a new well source to provide both the domestic use and the irrigation. According to HDWS Standards, the required well pumping capacity must be able to deliver the maximum day demand (defined as 1.5 times the average demand) in a 24-hour pumping day. Assuming this well would be dedicated to the County Department of Water Supply (DWS), 1/3 of its capacity would be reserved for DWS. Based on this, the new well source would need to provide 184 gallons per minute (GPM) to supply the UNK expansion.

Projected Average Day Required Supply (GPD)

	Current	Phase 1	Phase 2	Phase 3
Potable	41,655	58,321	76,317	95,000
Irrigation	10,050	35,450	57,050	68,500
Total	51,705	93,771	133,367	163,500
Water Credits Available	25,200	45,200	45,200	45,200
Required Additional Supply	26,505	48,571	88,167	118,300

Identified Alternatives for New Source Development

Two potential new well source alternatives have been identified to supply the UNK expansion. One is a new well and related infrastructure on TMK 7-5-003:023, a property owned by Mr. Richard Wheelock who is actively seeking a partner for well development on his property. The other is to share the supply from a well Dan Bolton intends to develop on TMK 7-5-017:044. Each is described in the sections following.

Well Development on TMK 7-5-003:023, the Wheelock Property

In 2001, the Keopu Deep Monitor Well (State No. 3858-001) was completed. In a completely unexpected result, extremely fresh artesian water was encountered about 400 feet below sea level, lying beneath the basal lens and saline water below the basal lens. In 2017, a second monitor well was developed about 60 feet away from the first and was completed to isolate the artesian water from the overlying brackish and saline water. Once isolated in this manner, the static water level stood at 28 feet above sea level and, somewhat surprisingly, varied significantly with the ocean tide (Figure 3). Pump tests were run, including a 48-hour constant rate test at an average of 820 GPM. The drawdown was essentially constant and recovery was very rapid (Figure 4). It is important to note that there was no evidence in the drawdown or recovery of a boundary effect. Such an effect might have occurred if the water body tapped by the well was of modest areal extent. The pumped water salinity was constant and comparable to the HDWS wells which draw high-level groundwater from locations above Mamalahoa Highway (Figure 5 and Table 2). Specific conductance was about 140 µS/cm and chlorides were less than five (5) MG/L. Further, isotope analysis confirmed that the artesian water at depth below sea level in this well was the same as the high-level groundwater pumped by the inland HDWS wells (Dr. Donald Thomas, UH Hilo, personal communication). The pump test demonstrated that a viable source of drinking water from the artesian water at depth could be developed at this location.

On Figure 6, the location of the two Keopu monitor wells and the location of a potential well on the Wheelock property are shown. Although the areal extent of the developable artesian water at depth is not known, the distance to a well on the Wheelock property is modest enough (about 1200 feet) to warrant drilling an exploratory well and, if successful, completing it as a production well of 700 GPM capacity. The advantage of this location is: the modest infrastructure improvements that would be required to integrate the well into the HDWS System. The well water could be delivered directly downslope into HDWS' 20-inch transmission main in Queen Kaahumanu Highway; and the pumping lift (i.e., required electrical power) would be about half the requirement of HDWS' high-level wells above Mamalahoa Highway.

Intended Well Development by Dan Bolton

As I understand it, UNK has an understanding with Dan Bolton to share in the capacity of a well Dan Bolton intends to develop. That well's location is shown on Figure 7. In that location, it would be drilled to tap into the fresh water at depth below sea level that has been encountered in four other test holes drilled in Kailua, Kona: State Well Nos. 3858-001 and 3858-002 at Keopu on State land; State Well No. 4159-001 in the DWS Tank site at 600-foot elevation along Hina Lani Street; and State Well No.

3959-001 at Kamakana. All four encountered fresh water between 400 and 1000 feet below sea level. State Well No. 3858-002 was pump tested for 48 hours at 820 GPM. It established that the water was identical to that tapped by DWS' wells above Mamalahoa Highway and at that location, a production well of more than 1.0 million gallons per day (MG) could be successfully developed.

In the event that the fresh water below sea level is not encountered in the Bolton Well, or that its yield is too low to warrant development as a production well, then the new well on the Wheelock property described previously would have to be developed.

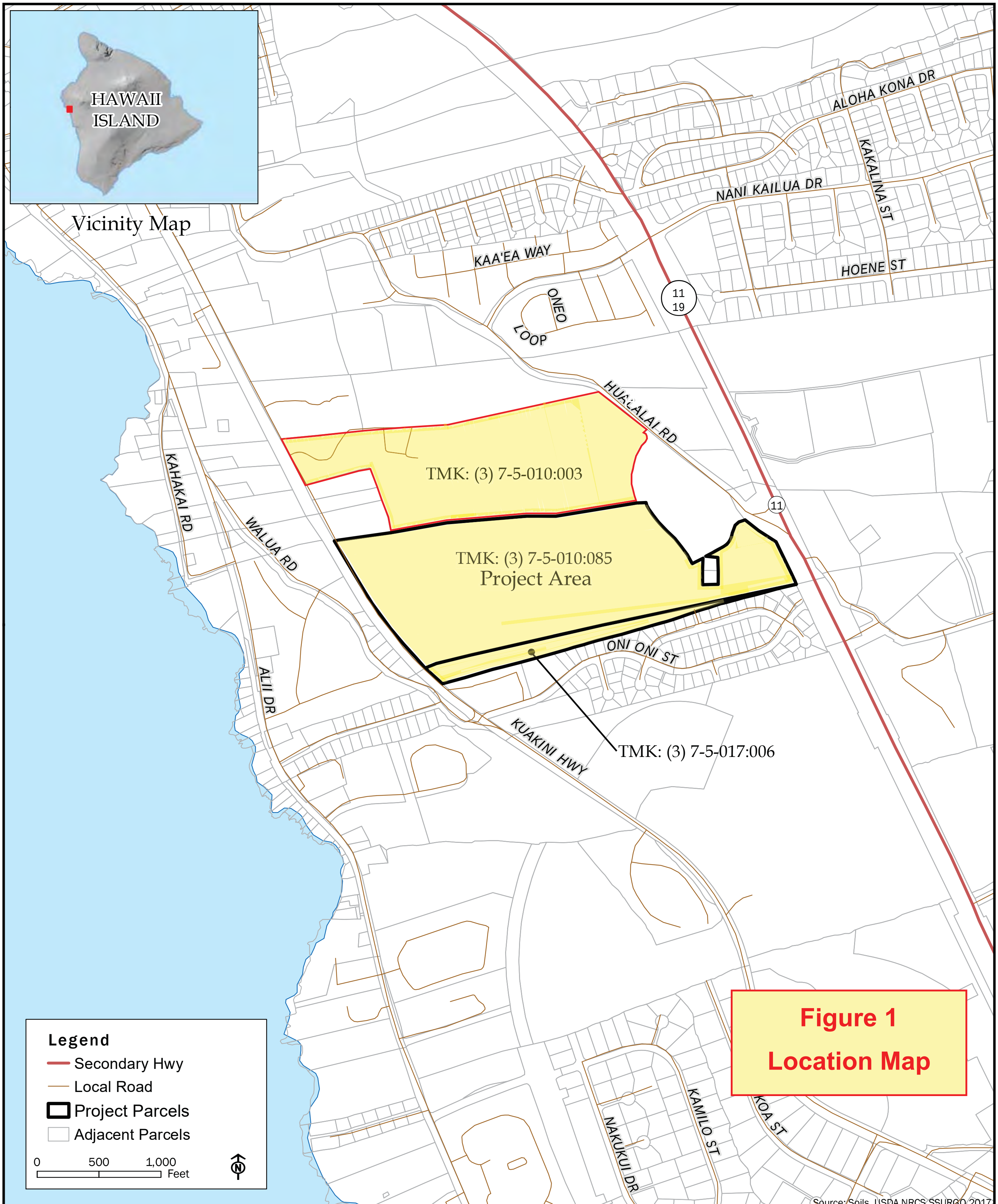
Concluding Comments

Both well alternatives described herein have the risk that the freshwater below sea level will not be encountered or that its yield will not be sufficient. From this perspective, the least risky alternative would be to develop a well on the Wheelock property due to its proximity to the Keopu Wells. This well would be in the Keauhou Aquifer System, for which there has been considerable scrutiny regarding the possibility that pumpage of potable wells may adversely impact the flowrate and salinity of the brackish basal lens in the nearshore area. Such an impact would not be the case for a well on the Wheelock for the following two reasons:

- The well would draw fresh water from 400 to 600 feet below sea level. This body of water is hydrologically isolated from the overlying saline groundwater and brackish basal groundwater. Based on the piezometric head level and measured tidal response, water drawn by the well would otherwise discharge at great depth and distance offshore without ever coming in contact with the basal groundwater.
- I have in the past and continue to monitor the potential impact the pumpage of HDWS' inland potable wells are having on the nominally downgradient basal lens. The monitoring is at two fortuitously located basal wells directly downgradient of the HDWS wells. Monitoring consists of water level recording and salinity profiling. The HDWS pumpage began in 1994 (26 years ago) and has varied between four (4) and six (6) MGD for the last 15 years. To date, no impact on the basal groundwater has been identified by the monitoring that I have undertaken.

Attached: Figures 1-7 and Tables 1-2

Email Copy: Jonathan Lowe – University of the Nations Kona
Greg Fukumitsu – TNWRE Inc.



219061-01
University of the Nations Campus Expansion

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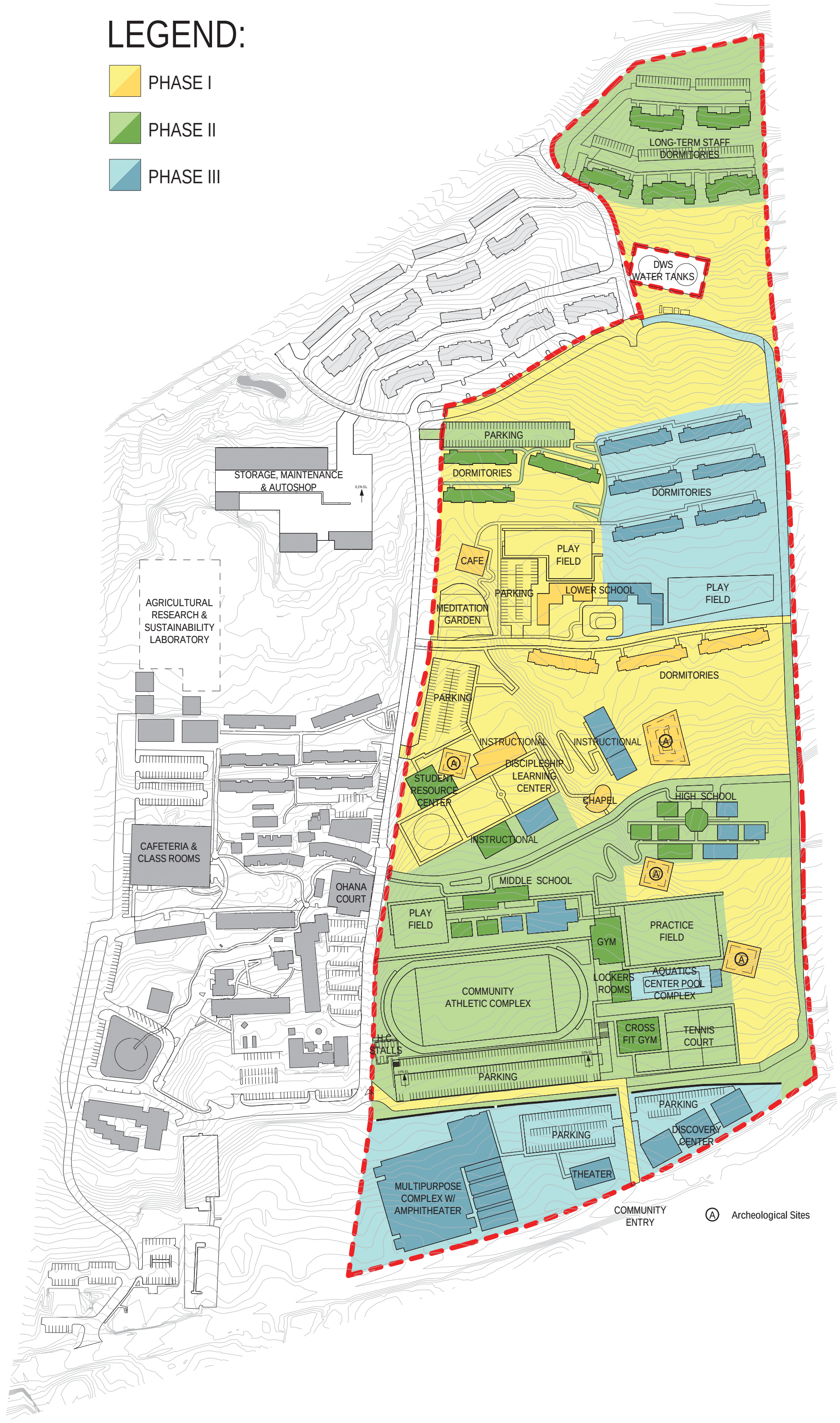

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UON MASTER PLAN

CONCEPT MASTER PLAN

UNIVERSITY OF THE NATIONS - KONA

Figure 2

May 12, 2023

Table 1: Population Projections	Current*		Phase 1		Phase 2		Phase 3	
PK - 12 Children Total	**294**		**340**	59%	**469**	82%	**575**	100%
PK - 12 Children Commuting	148		110		155		175	100%
PK - 12 Children Dorming	146		230		314		400	100%
University Students Total	**480**	40%	**718**	60%	**955**	80%	**1,200**	100%
University Students Commuting	17		11		6		-	100%
University Students Dorming	463		706		949		1,200	100%
TOTAL Children & Students	**774**	44%	**1,057**	60%	**1,424**	80%	**1,775**	100%
TOTAL Children and Students Commuting	165		121		161		175	100%
TOTAL Children and Students Dorming	609		936		1,263		1,600	100%
Staff Total (NIC Staff on outreach)	**602**	75%	**667**	83%	**716**	90%	**800**	100%
Staff Commuting	322		282		225		200	100%
Staff Dorming	280		386		491		600	100%
Mission Builders, Volunteers, Speakers, Seminar Guests, Visitors,	**25**	8%	**115**	38%	**207**	69%	**300**	100%
Commuting	5		3		2		-	100%
Dorming	20		112		205		300	100%
Total Commuting	492		406		387		375	100%
Total Dorming	909	36%	1,434	57%	1,959	78%	2,500	100%
Total Campus Population	**1,401**	49%	**1,841**	64%	**2,347**	82%	**2,875**	100%

Marital status	Percent of total	Number per room	Number of rooms
single students	87.5	4	263
married students	12.5	2	75
single staff	75.0	4	131
married staff	25.0	2	75
single others	66.7	4	50
married others	33.3	2	50
Total rooms needed			644

children are included in married couples room #s

Table 1: Water Demand Projections

Domestic Water Demand	Current		Phase 1		Phase 2		Phase 3	
Day Users								
PK-12 Commuting	148	2,960	110	2,200	155	3,100	175	3,500
University Students Commuting	17	340	11	228	6	116	-	-
Staff Commuting	322	6,440	282	5,635	225	4,500	200	4,000
Guests Commuting	5	100	3	67	2	34	-	-
Subtotal	492	9,840	406	8,130	387	7,750	375	7,500
Residents								
PK-12 Students	146	5,110	230	8,044	314	10,977	400	14,000
University Students	463	16,205	706	24,717	949	33,230	1,200	42,000
Staff	280	9,800	386	13,496	491	17,192	600	21,000
Guests	20	700	112	3,934	205	7,168	300	10,500
Subtotal	909	31,815	1,434	50,191	1,959	68,567	2,500	87,500
Total Domestic		41,655		58,321		76,317		95,000
Irrigation Water Demand	**Current**		**Phase 1**		**Phase 2**		**Phase 3**	
Irrigation Area								
Open Space	6.0	6,000	16.7	16,700	17.0	17,000	19.0	19,000
Landscaping	1.2	1,800	9.5	14,250	14.7	22,050	19.2	28,800
Playfields	0.5	2,250	1.0	4,500	4.0	18,000	4.6	20,700
Total Irrigation	7.7	10,050	27.2	35,450	35.7	57,050	42.8	68,500
Water Units								
Domestic Water Units		104		146		191		238
Irrigation Water Units		25		89		143		171
Water Units Available		113		113		113		113
Water Units Required		16		121		220		296

Total water demand above is a running total by phase

Domestic Demand Per Capita	Demand (GPD)	Comments
K-12 Day Student	20	UofN provided rate from Water Assessment Memo to DWS issued May 8, 2023
University Day Students	20	UofN provided rate from Water Assessment Memo to DWS issued May 8, 2023
Day Guests	20	UofN provided rate from Water Assessment Memo to DWS issued May 8, 2023
Residents (Staff, Students & Guests)	35	UofN provided rate from Water Assessment Memo to DWS issued May 8, 2023
Irrigation Demand Per Acre	**Demand (GPD)**	**Comments**
Average Daily Demand for Open Space	1,000	Assumed 0.25" per week irrigation rate - majority of open space will not be irrigate
Average Daily Demand for Landscaping	1,500	Assumed 0.5" per week irrigation rate
Average Daily Demand for Playfields	4,500	Assumed 1.25" per week irrigation rate

Table 1

Projected Supply Requirements for the Expansion of the University of the Nations Kona Campus

Figure 3
Tidal Response in the Keopu 2 Monitor Well from March 9 to 12, 2018

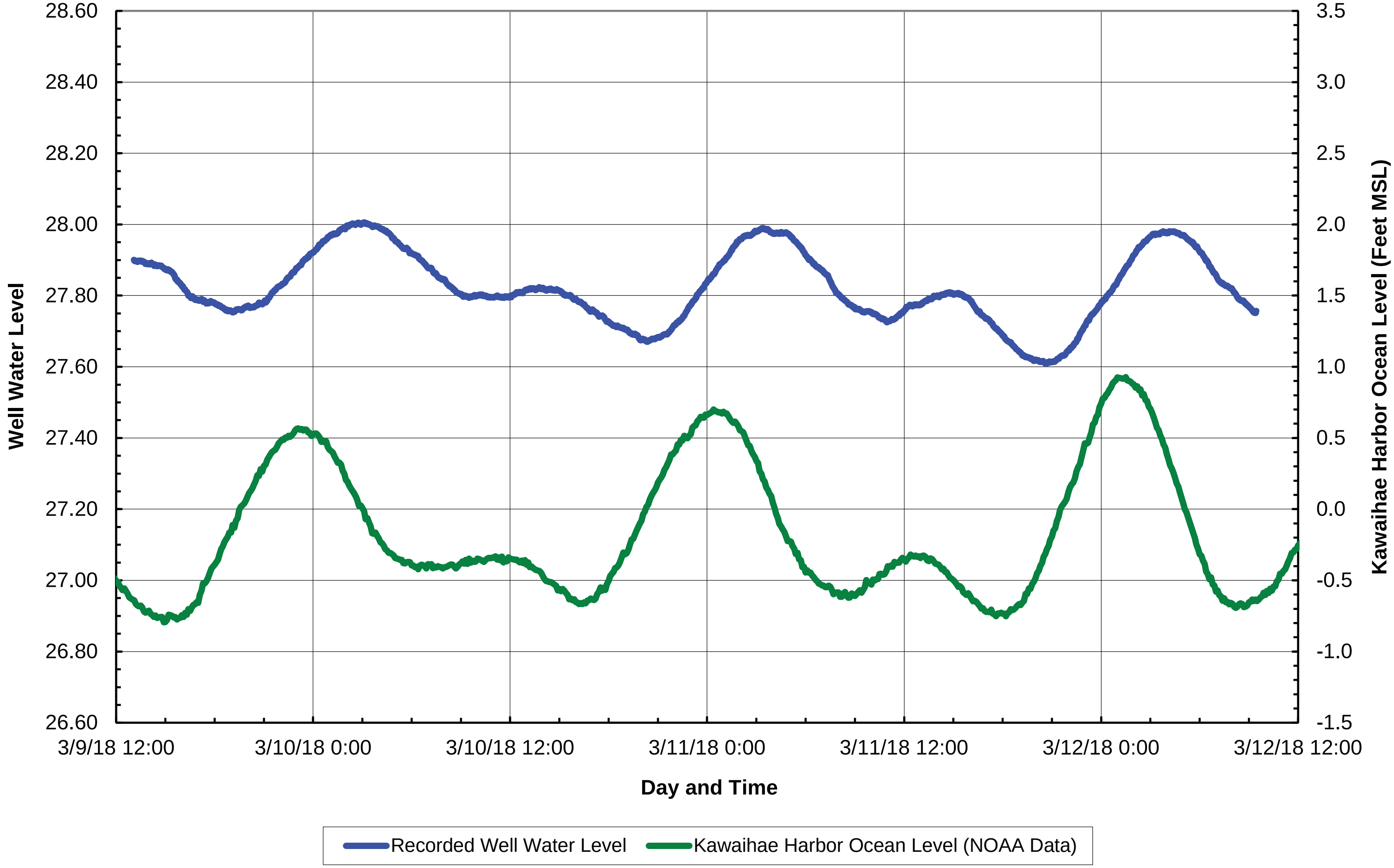


Figure 4
Pumping Rate and Recorded Water Level Response During the 48-Hour Constant Rate Test on March 12 to 14, 2018

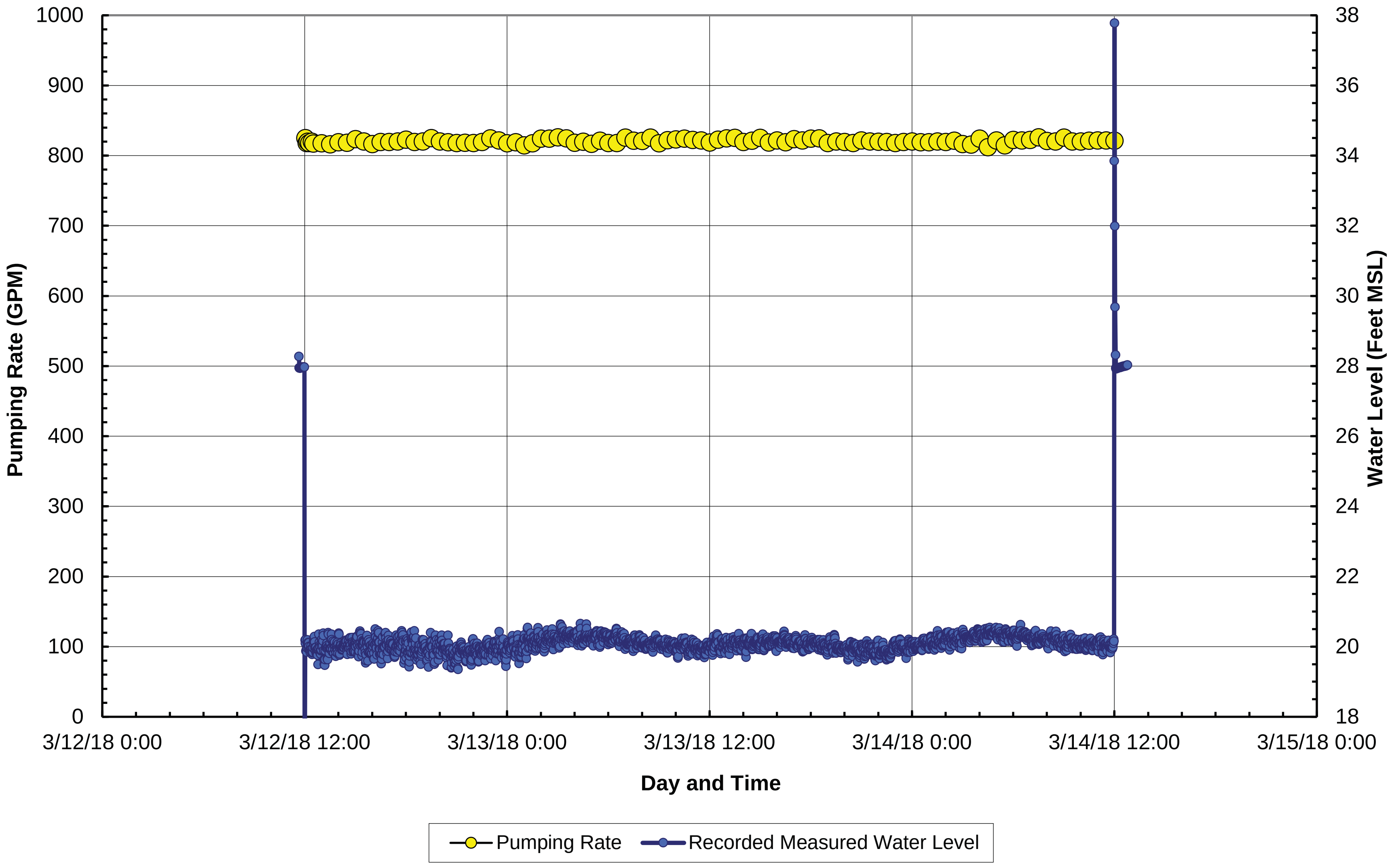
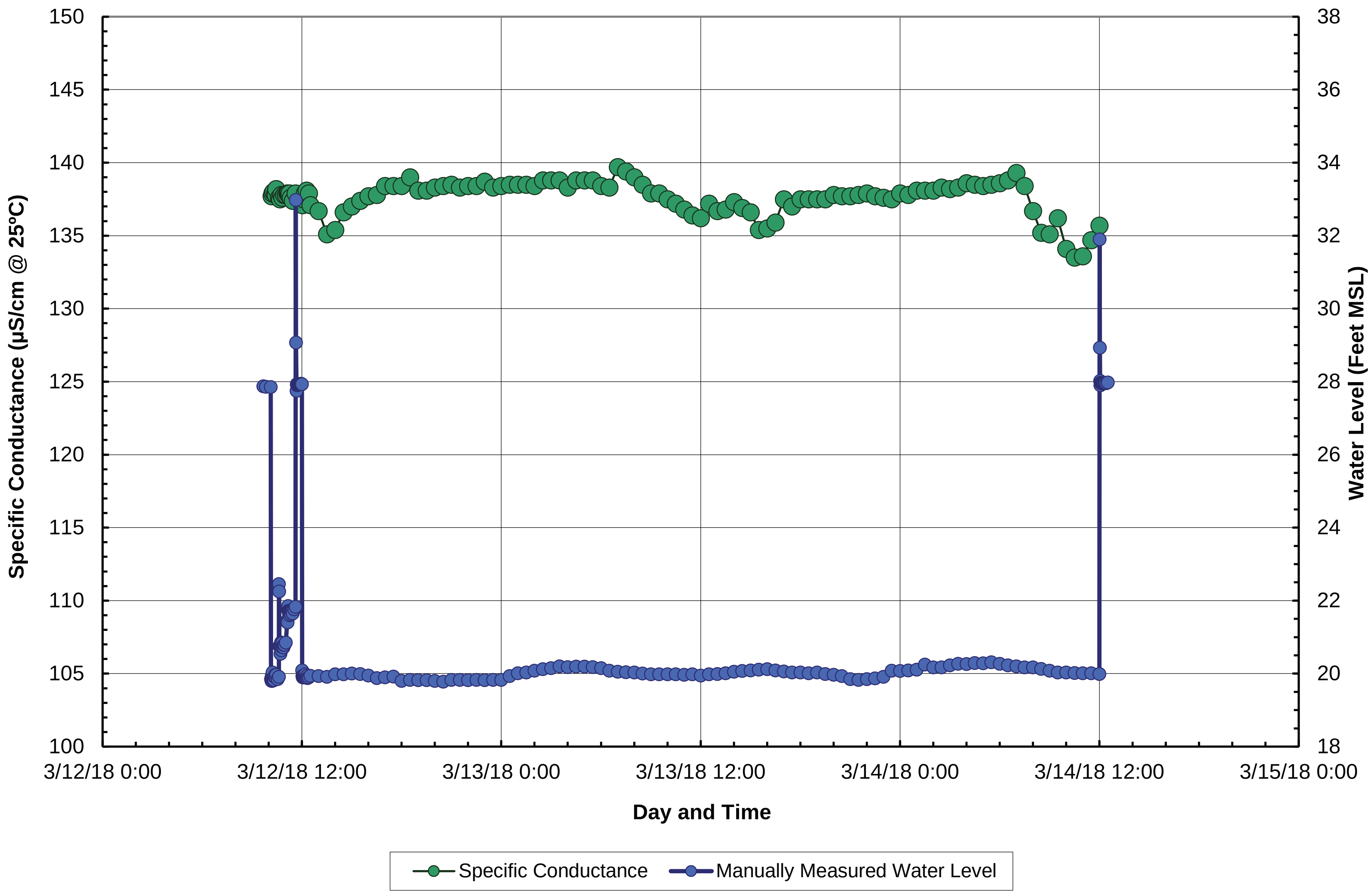


Figure 5
Pumped Water Specific Conductance During the
Step Drawdown and Constant Rate Pump Tests on March 12 to 14, 2018



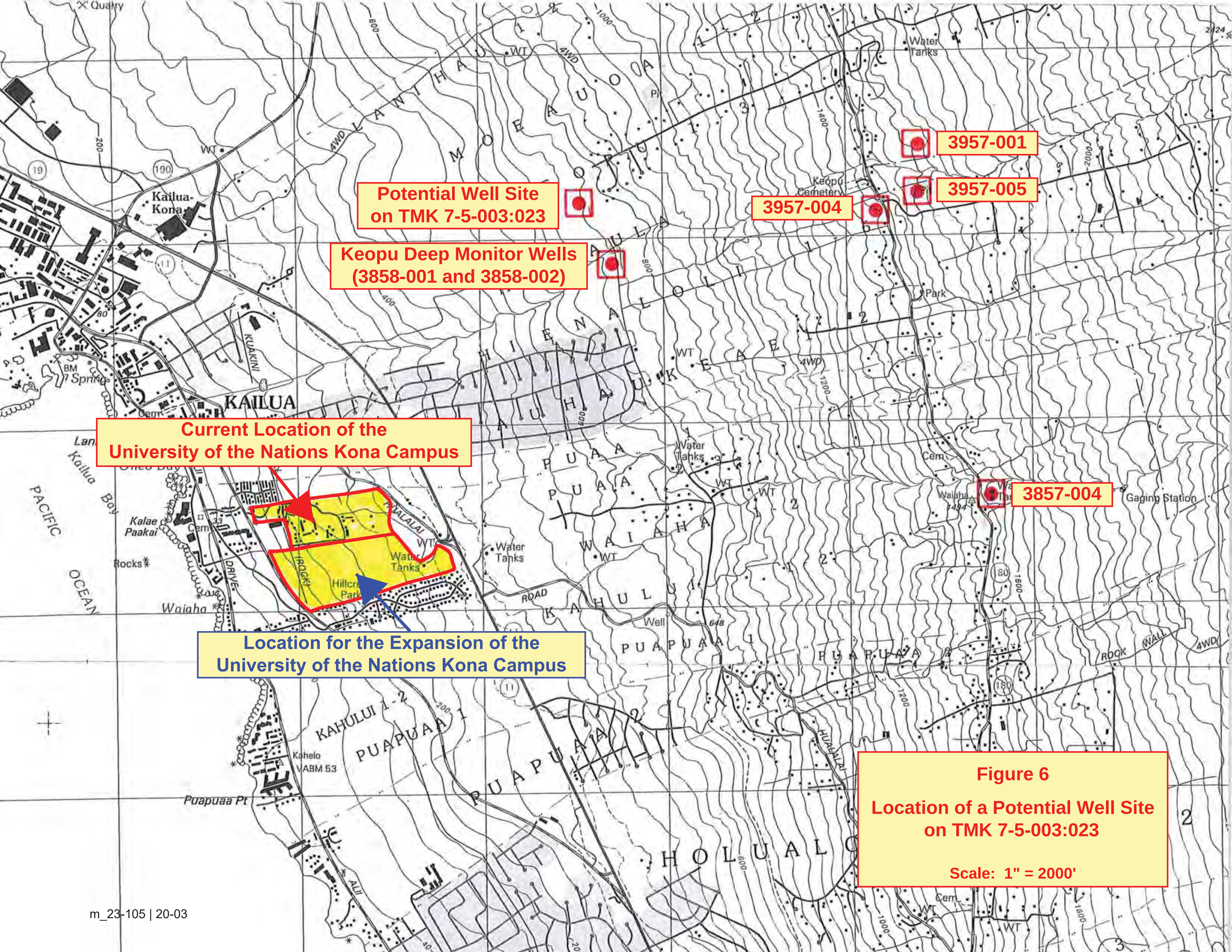
m_23-105 | 20-03

Table 2

Specific Conductance and Chlorides of Samples Collected During the Step and Constant Rate Pump Tests of the Keopu 2 Monitor Well

Test	Sample		Specific Conductance (µS/cm @ 25° C.)	Chlorides (MG/L)
	Day	Time		
Step Drawdown	03/12/18	10:12	143.2	4.5
		10:37	140.6	4.5
		11:07	139.9	4.0
		11:37	139.9	4.0
Constant Rate	03/12/18	12:05	140.0	4.1
		18:00	138.8	3.2
	03/13/18	00:00	139.3	3.5
		06:00	139.1	3.4
		12:00	140.0	4.1
		18:00	139.0	3.3
	03/14/18	00:00	139.0	3.3
		06:00	139.1	3.4
		12:00	139.2	3.5

Notes:
1. Specific conductance was measured in the TNWRE office using a HACH Sension 5 meter calibrated with a 447 µS/cm standard.
2. Chlorides determined by mercuric nitrate titration in the TNWRE office.


Potential Well Site
on TMK 7-5-003:023
Keopu Deep Monitor Wells
(3858-001 and 3858-002)
3957-001
3957-005
3957-004
3857-004
Current Location of the
University of the Nations Kona Campus
Location for the Expansion of the
University of the Nations Kona Campus
KAILUA
Kailua-Kona
PACIFIC OCEAN
Kailua Bay
Water Tanks
Gaging Station
Keopu Cemetery
Park
Kahelo
VABM 53
Puapuaa Pt
Rocks
Figure 6
Location of a Potential Well Site
on TMK 7-5-003:023
Scale: 1" = 2000'

m_23-105 | 20-03

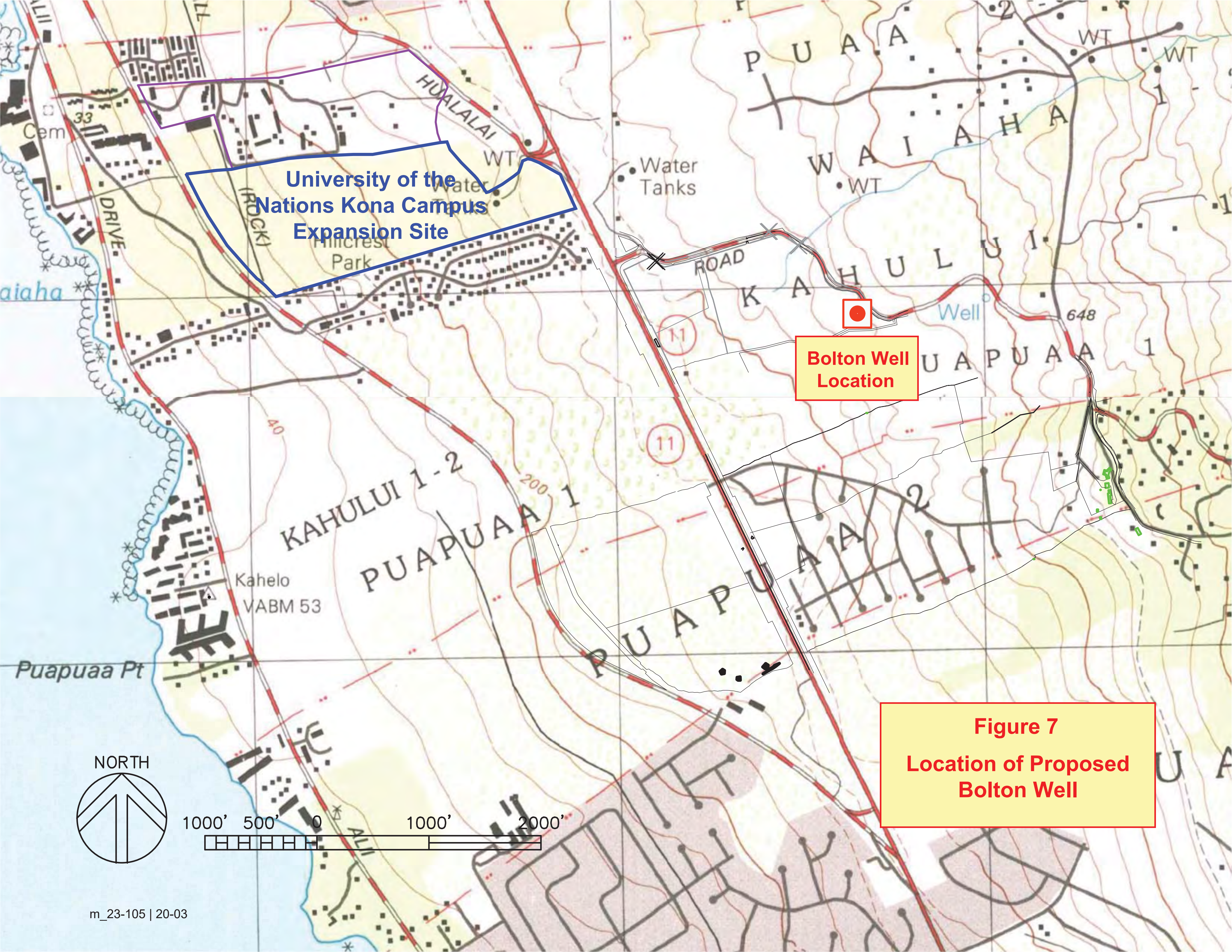


Figure 7

Location of Proposed Bolton Well

Appendix E

Ka Wai Kiekie Well Memorandum of Agreement, September 2024

LAND COURT | REGULAR SYSTEM

Return By Mail ¨ Pick-Up X To:

WAIAHA SYSTEM, LLC
P.O. Box 909
Kailua-Kona, Hawaii 96745
Hilo, Hawaii 96721-0686

TITLE OF DOCUMENT:

KA WAI KIEKIE WELL
MEMORANDUM OF AGREEMENT

This document consists of __ pages

PARTIES TO DOCUMENT:

WAIAHA SYSTEM, LLC, a Hawaii limited liability company, whose mailing address P. O. Box 909, Kailua-Kona, HI 96745.

WATER BOARD OF THE COUNTY OF HAWAII, whose principal place of business and mailing address is 345 Kekuanaoa Street, Room 20, Hilo, Hawaii 96720

TAX MAP KEY(S): (3) 7-5 (por.) and 7-6 (por.)

KA WAI KIEKIE WELL
MEMORANDUM OF AGREEMENT

THIS KA WAI KIEKIE WELL MEMORANDUM OF AGREEMENT ("MOA") dated this 24th day of September, 2024 is made by and between Waiaha System, LLC, a Hawaii limited liability company, whose mailing address is P. O. Box 909, Kailua-Kona, HI 96745 ("WAIAHA") and the WATER BOARD OF THE COUNTY OF HAWAII, whose principal place of business and mailing address is 345 Kekuanaoa Street, Hilo, Hawaii 96720 ("Water Board").

WHEREAS, WAIAHA intends to drill and develop a well ("KA WAI KIEKIE Well") on TMK No. (3) 7-5-017-044 (" Property"), which well would be drilled to tap into fresh water at a depth below sea level that has been encountered in four other test wells drilled in Kailua-Kona.

WHEREAS, various developers and landowners, wish to develop certain lands within the service limits of the County of Hawaii Department of Water Supply ("DWS") water system between the Kona Airport to the north and the intersection of Queen Kaahumanu Highway and Kuakini Highway to the south, and up to the 500 foot elevation to the east and the shoreline to the west in North Kona, Hawaii, which includes, but is not limited to, Tax Map Key Nos (3) 7-5-017-044, 7-5-017-031, 7-5-010-085, 7-5-017-006 and 7-5-010-003 (the "Lands");

WHEREAS, due to a limited supply of potable water to serve the Kailua-Kona area, the DWS is desirous of exploring new source development in the Kona area that does not draw from the basal water source;

WHEREAS, the Property is located along a DWS transmission corridor that connects the DWS water main on Queen Kaahumanu Highway to Kuakini Highway such that if the Well is drilled, encounters fresh water, and is developed into a production well, the KA WAI KIEKIE Well will have ability to service the Lands as well as other properties with minimal storage and transmission improvements;

WHEREAS, WAIAHA wishes to install and pay for the development of the KA WAI KIEKIE Well and necessary infrastructure that meet DWS-dedicable standards to serve the Lands (the "Water System");

WHEREAS, DWS concludes that upon final approval and acceptance of the Water System by DWS, and the dedication to, and acceptance of the Water System by the Water Board, the operation and maintenance of the Water System by the DWS would be in their best interests;

WHEREAS, in consideration of the construction of the Water System and grant of all appurtenant interests in real estate at no cost to DWS or the Water Board, DWS and the Water Board have agreed to award the following towards development of the Lands: (1) two-thirds (2/3) of the production capacity of the KA WAI KIEKIE Well; and (2) credits against the prevailing facilities charges and capital assessment fees in accordance with DWS' Rules and Regulations, as applicable;

WHEREAS, in order to formalize the number of water commitments, the Water System design criteria, and the credits available, the parties have agreed that upon approval of this KA WAI KIEKIE Well System Memorandum of Agreement by the Water Board, the parties will proceed to negotiate an Agreement regarding development of KA WAI KIEKIE Well ("Agreement") acceptable to both parties;

WHEREAS, upon execution of the final Agreement by all parties, the DWS agrees to write comment letters to the Planning Department on all change of zone applications, or to any other federal, state, or county governmental agencies, commissions, or departments as requested for real property within the Lands to the effect that water sufficient to serve the number of units allocated to that portion of the real property within the Lands, in accordance with the final Agreement, and depending on the well's performance, will be available when the Water System is completed and dedicated to the Water Board;

WHEREAS, WAIAHA understands and agrees that no water will be available and no water meters will be issued by DWS under the Agreement until construction of the Water System is completed and tested to DWS's satisfaction, and dedicated to the Water Board; and

WHEREAS, the parties herein wish to memorialize their negotiations regarding the construction and dedication of the Water System and the recognition of credits against the applicable DWS fees and charges for development of a water system to serve the Lands in order to allow WAIAHA to expend funds on the design, engineering, and development of the Water System.

NOW, THEREFORE, the parties, in consideration of the mutual covenant and conditions set forth herein, incorporating the above recitals by reference hereto, agree as follows:

1. WAIAHA agrees to design and construct the Water System pursuant to DWS dedicable standards, and under such terms and conditions as defined herein and in the applicable Rules and Regulations of the Department of Water Supply, County of Hawaii ("DWS Rules"), and the applicable rules and/or requirements of the Commission on Water Resource Management for the development of the KA WAI KIEKIE Well; subject, however, to the prior approval by DWS of the construction plans and project phasing, and further subject to DWS inspections during the course of the construction phase.

2. WAIAHA agrees to secure all real property rights, title, and interests required for the Water System and shall provide evidence of the same satisfactory to DWS and the Water Board prior to the Water Board entering the Agreement.

3. The parties hereto agree to expeditiously negotiate an Agreement under such terms acceptable to all parties, which Agreement shall be subject to the approval of the Water Board.

4. If an Agreement cannot be reached within two (2) years from the date of this MOA, this MOA shall be null and void and of no further force or effect.

5. WAIAHA and the Water Board agree that this MOA is a product of arms-length negotiations. Pursuant thereto, this MOA shall be interpreted according to its fair construction and shall not be construed against either party as the drafter hereof.

6. This MOA shall be governed by and construed and interpreted in accordance with the laws of the State of Hawaii. The venue for any action brought on this MOA shall be in the Circuit Court of the Third Circuit of the State of Hawaii.

7. This MOA constitutes the entire agreement between WAIAHA and the Water Board with respect to the subject matter hereof, and, with the specific exceptions noted herein, replaces and supersedes any and all prior written or oral agreement(s) with respect to the subject matter contained in this MOA.

IN WITNESS WHEREOF, WAIAHA and the Water Board have executed these presents on the day and year first above written.

WAIAHA SYSTEM, LLC
a Hawaii limited liability company

By______________________________
Daniel B. Bolton, President of MGMT Corp.
Manager of Waiaha System, LLC

RECOMMEND APPROVAL:

____
Manager-Chief Engineer, Department of Water Supply
Date: SEP 16 2024

APPROVED AS TO FORM AND CONTENT

____
Deputy Corporation Counsel
Date: 09-19-2024

WATER BOARD OF THE COUNTY OF HAWAIʻI

By______________________________
Its Chairman

STATE OF HAWAIʻI)
) ss.
COUNTY OF HAWAIʻI)

On this 11th day of July, 2024, before me personally appeared Daniel B. Bolton, to me known (or proved to me on the basis of satisfactory evidence) who, being by me duly sworn or affirmed, did say that such person executed the foregoing instrument as the free act and deed of such person, and if applicable in the capacity shown, having been duly authorized to execute such instrument in such capacity.

Sandy Caldwell
Name: Sandy Caldwell
Notary Public
State of Hawaiʻi

My commission expires: 2/12/25

NOTARY CERTIFICATION STATEMENT	
Document Identification or Description: KA NAI KIEKIE WELL MEMORANDUM OF AGREEMENT	
Document Date: Undated at signing No. of Pages: 7 Jurisdiction (in which notarial act is performed): Third Sandy Caldwell Signature of Notary 7/11/25 Date of Notarization and Certification Statement Sandy Caldwell Printed Name of Notary Date of Notary Commission Expiration:	SANDY CALDWELL NOTARY PUBLIC Comm. No. 97-34 STATE OF HAWAIʻI (Notary Stamp or Seal)

STATE OF HAWAIʻI)
) ss.
COUNTY OF HAWAIʻI)

On this 24 day of September, 2024, before me personally appeared Stephen Lopez, to me known (or proved to me on the basis of satisfactory evidence) who, being by me duly sworn or affirmed, did say that such person executed the foregoing instrument as the free act and deed of such person, and if applicable in the capacity shown, having been duly authorized to execute such instrument in such capacity.

EMILY V. HIRAYAMA
NOTARY
16-106
PUBLIC
STATE OF HAWAII

Emily V. Hirayama
Name: Emily V. Hirayama
Notary Public
State of Hawaiʻi

My commission expires: 03/20/2028

NOTARY CERTIFICATION STATEMENT	
Document Identification or Description: Ka Wai Kiekie Well Memorandum of Agreement	
Document Date: Undated at Signing	EMILY V. HIRAYAMA NOTARY 16-106 PUBLIC STATE OF HAWAII
No. of Pages: 7	
Jurisdiction (in which notarial act is performed): Third Circuit	
Signature of Notary: Emily V. Hirayama	Date of Notarization and Certification Statement: September 24, 2024
Printed Name of Notary	(Notary Stamp or Seal)
Date of Notary Commission Expiration:	

Appendix F

Greenhouse Gas Analysis for the University of the Nations Kona Master Plan Update, June 2023

UNK
Statewide , Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
University/College (4Yr)	1,401.00	Student	3.34	145,453.00	0
Place of Worship	96.93	1000sqft	2.23	96,934.00	0
Other Asphalt Surfaces	254.64	1000sqft	5.85	254,641.00	0
Parking Lot	206.56	1000sqft	4.74	206,560.00	0
City Park	44.30	Acre	44.30	1,929,708.00	0
Apartments Low Rise	1,591.00	Dwelling Unit	2.47	322,803.00	1591
Arena	55.38	1000sqft	17.80	55,385.00	0
Recreational Swimming Pool	17.10	1000sqft	0.39	17,100.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.7	**Precipitation Freq (Days)**	86
Climate Zone	13			**Operational Year**	2050
Utility Company	Statewide Average				
CO2 Intensity (lb/MWhr)	1001.57	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics - Windspeed: Kailua Kona windspeed average assumed as 6.1 miles per hour (2.7 meters per second)

Land Use - Change in pop: 1,474 (faculty and students). Dorming pop: 1,591

Vehicle Trips - Defaults used for all but resedential. Note that these numbers will be high. These default values assume that all facilities are public.
For reseditial trip mix: assume students will walk to class (work). Most trips off campus will be for shopping or other.

Road Dust -

Woodstoves - No woodstoves or fireplaces

Energy Use -

Land Use Change -

Sequestration -

Construction Off-road Equipment Mitigation -

Mobile Land Use Mitigation -

Area Mitigation -

Energy Mitigation -

Water Mitigation -

Table Name	Column Name	Default Value	New Value
tblConstDustMitigation	WaterUnpavedRoadVehicleSpeed	0	15
tblLandUse	LandUseSquareFeet	1,591,000.00	322,803.00
tblLandUse	LandUseSquareFeet	96,930.00	96,934.00
tblLandUse	LandUseSquareFeet	257,500.25	145,453.00
tblLandUse	LandUseSquareFeet	254,640.00	254,641.00
tblLandUse	LandUseSquareFeet	55,380.00	55,385.00
tblLandUse	LotAcreage	99.44	2.47
tblLandUse	LotAcreage	5.91	3.34
tblLandUse	Population	4,550.00	1,591.00
tblProjectCharacteristics	PrecipitationFrequency	54	86
tblProjectCharacteristics	WindSpeed	2.2	2.7
tblSequestration	NumberOfNewTrees	0.00	100.00

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2027																562.6298
2028																3,215.4867
2029																3,830.2578
2030																3,823.6621
2031																3,786.9246
2032																3,767.7270
2033																3,710.4005
2034																821.9660
Maximum																**3,830.2578**

2.1 Overall Construction

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2027																562.6291
2028																3,215.4863
2029																3,830.2574
2030																3,823.6617
2031																3,786.9242
2032																3,767.7266
2033																3,710.4001
2034																821.9657
Maximum																**3,830.2574**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Quarter	**Start Date**	**End Date**	**Maximum Unmitigated ROG + NOX (tons/quarter)**	**Maximum Mitigated ROG + NOX (tons/quarter)**
		Highest		

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area																2,428.901 8
Energy																5,609.910 7
Mobile																13,694.19 26
Waste																826.1867
Water																1,179.509 7
Total																**23,738.70 16**

2.2 Overall Operational

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area																16.7800
Energy																5,603.9109
Mobile																10,025.2330
Waste																826.1867
Water																1,153.1850
Total																**17,625.2956**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**25.75**

2.3 Vegetation

Vegetation

	CO2e
Category	MT
New Trees	70.8000
Vegetation Land Change	-90.5100
Total	**-19.7100**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Architectural Coating	Architectural Coating	7/28/2034	12/28/2034	5	110	
2	Building Construction	Building Construction	3/17/2028	2/23/2034	5	1550	
3	Demolition	Demolition	1/1/2027	5/20/2027	5	100	
4	Grading	Grading	8/13/2027	3/16/2028	5	155	
5	Paving	Paving	2/24/2034	7/27/2034	5	110	
6	Site Preparation	Site Preparation	5/21/2027	8/12/2027	5	60	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 387.5

Acres of Paving: 10.59

Residential Indoor: 653,676; Residential Outdoor: 217,892; Non-Residential Indoor: 446,658; Non-Residential Outdoor: 148,886; Striped Parking Area: 27,672 (Architectural Coating sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Architectural Coating	Air Compressors	1	6.00	78	0.48
Demolition	Excavators	3	8.00	158	0.38
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Grading	Excavators	2	8.00	158	0.38
Building Construction	Cranes	1	7.00	231	0.29
Building Construction	Forklifts	3	8.00	89	0.20
Building Construction	Generator Sets	1	8.00	84	0.74
Paving	Pavers	2	8.00	130	0.42
Paving	Rollers	2	8.00	80	0.38
Demolition	Rubber Tired Dozers	2	8.00	247	0.40
Grading	Rubber Tired Dozers	1	8.00	247	0.40
Building Construction	Tractors/Loaders/Backhoes	3	7.00	97	0.37
Grading	Graders	1	8.00	187	0.41
Grading	Tractors/Loaders/Backhoes	2	8.00	97	0.37
Paving	Paving Equipment	2	8.00	132	0.36
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Site Preparation	Rubber Tired Dozers	3	8.00	247	0.40
Grading	Scrapers	2	8.00	367	0.48
Building Construction	Welders	1	8.00	46	0.45

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Architectural Coating	1	456.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction	9	2,282.00	614.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Demolition	6	15.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Grading	8	20.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Paving	6	15.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Site Preparation	7	18.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

Use Soil Stabilizer

Replace Ground Cover

Water Exposed Area

Water Unpaved Roads

Reduce Vehicle Speed on Unpaved Roads

3.2 Architectural Coating - 2034

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Archit. Coating																0.0000
Off-Road																14.0571
Total																**14.0571**

3.2 Architectural Coating - 2034

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																0.0000
Worker																118.4090
Total																**118.4090**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Archit. Coating																0.0000
Off-Road																14.0571
Total																**14.0571**

3.2 Architectural Coating - 2034

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																0.0000
Worker																118.4090
Total																**118.4090**

3.3 Building Construction - 2028

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road																240.2809
Total																**240.2809**

3.3 Building Construction - 2028

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																1,559.3966
Worker																1,264.5474
Total																**2,823.9440**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road																240.2806
Total																**240.2806**

3.3 Building Construction - 2028

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																1,559.3966
Worker																1,264.5474
Total																**2,823.9440**

3.3 Building Construction - 2029

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road																304.4335
Total																**304.4335**

3.3 Building Construction - 2029

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																1,967.9185
Worker																1,557.9058
Total																**3,525.8243**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road																304.4331
Total																**304.4331**

3.3 Building Construction - 2029

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																1,967.918 5
Worker																1,557.905 8
Total																**3,525.824 3**

3.3 Building Construction - 2030

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road																343.3777
Total																**343.3777**

3.3 Building Construction - 2030

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																1,961.513 5
Worker																1,518.771 0
Total																**3,480.284 4**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road																343.3773
Total																**343.3773**

3.3 Building Construction - 2030

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																1,961.5135
Worker																1,518.7710
Total																**3,480.2844**

3.3 Building Construction - 2031

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road																343.3777
Total																**343.3777**

3.3 Building Construction - 2031

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																1,958.078 2
Worker																1,485.468 7
Total																**3,443.546 9**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road																343.3773
Total																**343.3773**

3.3 Building Construction - 2031

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																1,958.0782
Worker																1,485.4687
Total																**3,443.5469**

3.3 Building Construction - 2032

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road																344.6933
Total																**344.6933**

3.3 Building Construction - 2032

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																1,962.252 6
Worker																1,460.781 1
Total																**3,423.033 7**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road																344.6929
Total																**344.6929**

3.3 Building Construction - 2032

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																1,962.252 6
Worker																1,460.781 1
Total																**3,423.033 7**

3.3 Building Construction - 2033

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road																342.0621
Total																**342.0621**

3.3 Building Construction - 2033

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																1,944.917 6
Worker																1,423.420 8
Total																**3,368.338 4**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road																342.0617
Total																**342.0617**

3.3 Building Construction - 2033

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																1,944.9176
Worker																1,423.4208
Total																**3,368.3384**

3.3 Building Construction - 2034

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road																51.3093
Total																**51.3093**

3.3 Building Construction - 2034

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																291.5018
Worker																210.0911
Total																**501.5928**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road																51.3093
Total																**51.3093**

3.3 Building Construction - 2034

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																291.5018
Worker																210.0911
Total																**501.5928**

3.4 Demolition - 2027

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road																171.1749
Total																**171.1749**

3.4 Demolition - 2027

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																0.0000
Worker																4.1609
Total																**4.1609**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road																171.1747
Total																**171.1747**

3.4 Demolition - 2027

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																0.0000
Worker																4.1609
Total																**4.1609**

3.5 Grading - 2027

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust																0.0000
Off-Road																277.4820
Total																**277.4820**

3.5 Grading - 2027

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																0.0000
Worker																5.6034
Total																**5.6034**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust																0.0000
Off-Road																277.4816
Total																**277.4816**

3.5 Grading - 2027

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																0.0000
Worker																5.6034
Total																**5.6034**

3.5 Grading - 2028

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust																0.0000
Off-Road																148.3567
Total																**148.3567**

3.5 Grading - 2028

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																0.0000
Worker																2.9052
Total																**2.9052**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust																0.0000
Off-Road																148.3565
Total																**148.3565**

3.5 Grading - 2028

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																0.0000
Worker																2.9052
Total																**2.9052**

3.6 Paving - 2034

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road																132.7027
Paving																0.0000
Total																**132.7027**

3.6 Paving - 2034

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																0.0000
Worker																3.8950
Total																**3.8950**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road																132.7025
Paving																0.0000
Total																**132.7025**

3.6 Paving - 2034

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																0.0000
Worker																3.8950
Total																**3.8950**

3.7 Site Preparation - 2027

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust																0.0000
Off-Road																101.2128
Total																**101.2128**

3.7 Site Preparation - 2027

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																0.0000
Worker																2.9959
Total																**2.9959**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust																0.0000
Off-Road																101.2126
Total																**101.2126**

3.7 Site Preparation - 2027

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling																0.0000
Vendor																0.0000
Worker																2.9959
Total																**2.9959**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

Increase Density

Increase Diversity

Improve Destination Accessibility

Improve Pedestrian Network

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated																10,025.23 30
Unmitigated																13,694.19 26

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Arena	593.12	593.12	593.12	1,151,803	798,200
Apartments Low Rise	10,484.69	11,391.56	9657.37	29,943,649	20,750,949
Other Asphalt Surfaces	0.00	0.00	0.00		
City Park	83.73	1,007.83	741.58	661,207	458,217
Parking Lot	0.00	0.00	0.00		
Place of Worship	883.03	1,005.16	3550.55	2,397,385	1,661,388
Recreational Swimming Pool	578.32	155.61	232.56	846,783	586,821
University/College (4Yr)	2,395.71	1,821.30	0.00	4,979,046	3,450,479
Total	15,018.60	15,974.58	14,775.18	39,979,874	27,706,053

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Arena	9.50	7.30	7.30	0.00	81.00	19.00	66	28	6
Apartments Low Rise	10.80	7.30	7.50	41.40	19.30	39.30	86	11	3
Other Asphalt Surfaces	9.50	7.30	7.30	0.00	0.00	0.00	0	0	0
City Park	9.50	7.30	7.30	33.00	48.00	19.00	66	28	6
Parking Lot	9.50	7.30	7.30	0.00	0.00	0.00	0	0	0
Place of Worship	9.50	7.30	7.30	0.00	95.00	5.00	64	25	11
Recreational Swimming Pool	9.50	7.30	7.30	33.00	48.00	19.00	52	39	9
University/College (4Yr)	9.50	7.30	7.30	6.40	88.60	5.00	91	9	0

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
Recreational Swimming Pool	0.566532	0.035693	0.194989	0.102188	0.010338	0.004896	0.021704	0.053597	0.002230	0.001367	0.005102	0.000748	0.000615
Apartments Low Rise	0.566532	0.035693	0.194989	0.102188	0.010338	0.004896	0.021704	0.053597	0.002230	0.001367	0.005102	0.000748	0.000615
Arena	0.566532	0.035693	0.194989	0.102188	0.010338	0.004896	0.021704	0.053597	0.002230	0.001367	0.005102	0.000748	0.000615
City Park	0.566532	0.035693	0.194989	0.102188	0.010338	0.004896	0.021704	0.053597	0.002230	0.001367	0.005102	0.000748	0.000615
Other Asphalt Surfaces	0.566532	0.035693	0.194989	0.102188	0.010338	0.004896	0.021704	0.053597	0.002230	0.001367	0.005102	0.000748	0.000615
Parking Lot	0.566532	0.035693	0.194989	0.102188	0.010338	0.004896	0.021704	0.053597	0.002230	0.001367	0.005102	0.000748	0.000615
Place of Worship	0.566532	0.035693	0.194989	0.102188	0.010338	0.004896	0.021704	0.053597	0.002230	0.001367	0.005102	0.000748	0.000615
University/College (4Yr)	0.566532	0.035693	0.194989	0.102188	0.010338	0.004896	0.021704	0.053597	0.002230	0.001367	0.005102	0.000748	0.000615

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

Install Energy Efficient Appliances

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated																4,266.916 5
Electricity Unmitigated																4,272.916 3
NaturalGas Mitigated																1,336.994 5
NaturalGas Unmitigated																1,336.994 5

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
Apartments Low Rise	1.78598e +007																958.7281
Arena	640251																34.3692
City Park	0																0.0000
Other Asphalt Surfaces	0																0.0000
Parking Lot	0																0.0000
Place of Worship	1.12056e +006																60.1525
Recreational Swimming Pool	0																0.0000
University/College (4Yr)	5.28576e +006																283.7446
Total																	**1,336.9945**

5.2 Energy by Land Use - NaturalGas

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
Apartments Low Rise	1.78598e +007																958.7281
Arena	640251																34.3692
City Park	0																0.0000
Other Asphalt Surfaces	0																0.0000
Parking Lot	0																0.0000
Place of Worship	1.12056e +006																60.1525
Recreational Swimming Pool	0																0.0000
University/College (4Yr)	5.28576e +006																283.7446
Total																	**1,336.9945**

5.3 Energy by Land Use - Electricity

Unmitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Apartments Low Rise	6.75217e +006				3,075.238 9
Arena	460249				209.6180
City Park	0				0.0000
Other Asphalt Surfaces	0				0.0000
Parking Lot	72296				32.9268
Place of Worship	805522				366.8703
Recreational Swimming Pool	0				0.0000
University/College (4Yr)	1.29162e +006				588.2623
Total					**4,272.916 3**

5.3 Energy by Land Use - Electricity

Mitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Apartments Low Rise	6.739e +006				3,069.239 1
Arena	460249				209.6180
City Park	0				0.0000
Other Asphalt Surfaces	0				0.0000
Parking Lot	72296				32.9268
Place of Worship	805522				366.8703
Recreational Swimming Pool	0				0.0000
University/College (4Yr)	1.29162e +006				588.2623
Total					**4,266.916 5**

6.0 Area Detail

6.1 Mitigation Measures Area

Use Electric Lawnmower

Use Electric Leafblower

Use Electric Chainsaw

No Hearths Installed

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated																16.7800
Unmitigated																2,428.9018

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating																0.0000
Consumer Products																0.0000
Hearth																2,409.1062
Landscaping																19.7956
Total																**2,428.9018**

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating																0.0000
Consumer Products																0.0000
Hearth																0.0000
Landscaping																16.7800
Total																**16.7800**

7.0 Water Detail

7.1 Mitigation Measures Water

Use Water Efficient Irrigation System

	Total CO2	CH4	N2O	CO2e
Category	MT/yr			
Mitigated				1,153.1850
Unmitigated				1,179.5097

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
Apartments Low Rise	103.66 / 65.3509				793.6221
Arena	23.856 / 1.52273				137.6709
City Park	0 / 52.7826				175.6089
Other Asphalt Surfaces	0 / 0				0.0000
Parking Lot	0 / 0				0.0000
Place of Worship	3.03283 / 4.74366				32.6404
Recreational Swimming Pool	1.01135 / 0.619858				7.6839
University/College (4Yr)	2.99968 / 4.69181				32.2836
Total					**1,179.5097**

7.2 Water by Land Use

Mitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
Apartments Low Rise	103.66 / 61.3645				780.3592
Arena	23.856 / 1.42984				137.3618
City Park	0 / 49.5629				164.8968
Other Asphalt Surfaces	0 / 0				0.0000
Parking Lot	0 / 0				0.0000
Place of Worship	3.03283 / 4.4543				31.6777
Recreational Swimming Pool	1.01135 / 0.582047				7.5581
University/College (4Yr)	2.99968 / 4.40561				31.3314
Total					**1,153.1850**

8.0 Waste Detail

8.1 Mitigation Measures Waste

Category/Year

	Total CO2	CH4	N2O	CO2e
	MT/yr			
Mitigated				826.1867
Unmitigated				826.1867

8.2 Waste by Land Use

Unmitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
Apartments Low Rise	731.86				368.0535
Arena	1.52				0.7644
City Park	3.81				1.9161
Other Asphalt Surfaces	0				0.0000
Parking Lot	0				0.0000
Place of Worship	552.5				277.8531
Recreational Swimming Pool	97.47				49.0178
University/College (4Yr)	255.68				128.5819
Total					**826.1867**

8.2 Waste by Land Use

Mitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
Apartments Low Rise	731.86				368.0535
Arena	1.52				0.7644
City Park	3.81				1.9161
Other Asphalt Surfaces	0				0.0000
Parking Lot	0				0.0000
Place of Worship	552.5				277.8531
Recreational Swimming Pool	97.47				49.0178
University/College (4Yr)	255.68				128.5819
Total					**826.1867**

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

	Total CO2	CH4	N2O	CO2e
Category	MT			
Unmitigated				-19.7100

11.1 Vegetation Land Change

Vegetation Type

	Initial/Final	Total CO2	CH4	N2O	CO2e
	Acres	MT			
Grassland	65 / 44				-90.5100
Total					**-90.5100**

11.2 Net New Trees

Species Class

	Number of Trees	Total CO2	CH4	N2O	CO2e
		MT			
Miscellaneous	100				70.8000
Total					**70.8000**

UNK

Statewide , Mitigation Report

Construction Mitigation Summary

Phase	ROG	NOx	CO	SO2	Exhaust PM10	Exhaust PM2.5	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Percent Reduction												
Architectural Coating	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Building Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Demolition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grading	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Site Preparation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

OFFROAD Equipment Mitigation

Equipment Type	Fuel Type	Tier	Number Mitigated	Total Number of Equipment	DPF	Oxidation Catalyst
Air Compressors	Diesel	No Change	0	1	No Change	0.00
Excavators	Diesel	No Change	0	5	No Change	0.00
Concrete/Industrial Saws	Diesel	No Change	0	1	No Change	0.00
Cranes	Diesel	No Change	0	1	No Change	0.00
Forklifts	Diesel	No Change	0	3	No Change	0.00
Graders	Diesel	No Change	0	1	No Change	0.00
Pavers	Diesel	No Change	0	2	No Change	0.00
Rollers	Diesel	No Change	0	2	No Change	0.00
Rubber Tired Dozers	Diesel	No Change	0	6	No Change	0.00
Tractors/Loaders/Backhoes	Diesel	No Change	0	9	No Change	0.00
Generator Sets	Diesel	No Change	0	1	No Change	0.00
Paving Equipment	Diesel	No Change	0	2	No Change	0.00
Scrapers	Diesel	No Change	0	2	No Change	0.00
Welders	Diesel	No Change	0	1	No Change	0.00

Equipment Type	ROG	NOx	CO	SO2	Exhaust PM10	Exhaust PM2.5	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
	Unmitigated tons/yr						Unmitigated mt/yr					
Air Compressors												1.40571E+001
Concrete/Industrial Saws												2.69124E+001
Cranes												3.93281E+002
Excavators												1.39559E+002
Forklifts												3.58049E+002
Generator Sets												4.38373E+002
Graders												4.53772E+001
Pavers												5.46761E+001
Paving Equipment												4.75842E+001
Rollers												3.04424E+001
Rubber Tired Dozers												2.02303E+002
Scrapers												2.08111E+002
Tractors/Loaders/ Backhoes												7.09642E+002
Welders												1.46155E+002

Equipment Type	ROG	NOx	CO	SO2	Exhaust PM10	Exhaust PM2.5	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
	Mitigated tons/yr						Mitigated mt/yr					
Air Compressors												1.40571E+001
Concrete/Industrial Saws												2.69124E+001
Cranes												3.93280E+002
Excavators												1.39558E+002
Forklifts												3.58048E+002
Generator Sets												4.38373E+002
Graders												4.53771E+001
Pavers												5.46761E+001
Paving Equipment												4.75841E+001
Rollers												3.04424E+001
Rubber Tired Dozers												2.02302E+002
Scrapers												2.08110E+002
Tractors/Loaders/Backhoes												7.09641E+002
Welders												1.46155E+002

Equipment Type	ROG	NOx	CO	SO2	Exhaust PM10	Exhaust PM2.5	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Percent Reduction												
Air Compressors	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	7.11384E-007
Concrete/Industrial Saws	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	1.11473E-006
Cranes	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	1.19508E-006
Excavators	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	1.14647E-006
Forklifts	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	1.20095E-006
Generator Sets	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	1.18620E-006
Graders	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	1.10188E-006
Pavers	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	1.28027E-006
Paving Equipment	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	1.05077E-006
Rollers	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	9.85468E-007
Rubber Tired Dozers	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	1.18634E-006
Scrapers	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	1.20128E-006
Tractors/Loaders/Backhoes	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	1.19779E-006
Welders	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	1.16315E-006

Fugitive Dust Mitigation

Yes/No	Mitigation Measure	Mitigation Input		Mitigation Input		Mitigation Input	
Yes	Soil Stabilizer for unpaved Roads	PM10 Reduction	0.00	PM2.5 Reduction	0.00		
Yes	Replace Ground Cover of Area Disturbed	PM10 Reduction	0.00	PM2.5 Reduction	0.00		
Yes	Water Exposed Area	PM10 Reduction	55.00	PM2.5 Reduction	55.00	Frequency (per day)	2.00

Yes	Unpaved Road Mitigation	Moisture Content %	0.00	Vehicle Speed (mph)	15.00		
No	Clean Paved Road	% PM Reduction	0.00				

		Unmitigated		Mitigated		Percent Reduction	
Phase	Source	PM10	PM2.5	PM10	PM2.5	PM10	PM2.5
Architectural Coating	Fugitive Dust	0.00	0.00	0.00	0.00	0.00	0.00
Architectural Coating	Roads	0.00	0.00	0.00	0.00	0.00	0.00
Building Construction	Fugitive Dust	0.00	0.00	0.00	0.00	0.00	0.00
Building Construction	Roads	0.00	0.00	0.00	0.00	0.00	0.00
Demolition	Fugitive Dust	0.00	0.00	0.00	0.00	0.00	0.00
Demolition	Roads	0.00	0.00	0.00	0.00	0.00	0.00
Grading	Fugitive Dust	0.00	0.00	0.00	0.00	0.00	0.00
Grading	Roads	0.00	0.00	0.00	0.00	0.00	0.00
Paving	Fugitive Dust	0.00	0.00	0.00	0.00	0.00	0.00
Paving	Roads	0.00	0.00	0.00	0.00	0.00	0.00
Site Preparation	Fugitive Dust	0.00	0.00	0.00	0.00	0.00	0.00
Site Preparation	Roads	0.00	0.00	0.00	0.00	0.00	0.00

Operational Percent Reduction Summary

Category	ROG	NOx	CO	SO2	Exhaust PM10	Exhaust PM2.5	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Percent Reduction												
Architectural Coating	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Consumer Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
Hearth	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Landscaping	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.23
Mobile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.79
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water Indoor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.23
Water Outdoor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Operational Mobile Mitigation

Project Setting: Urban Center

Mitigation	Category	Measure	% Reduction	Input Value 1	Input Value 2	Input Value
Yes	Land Use	Increase Density	0.00		23.00	
Yes	Land Use	Increase Diversity	0.20	0.48		
No	Land Use	Improve Walkability Design	0.00			
Yes	Land Use	Improve Destination Accessibility	0.19	0.50		
No	Land Use	Increase Transit Accessibility	0.25			
No	Land Use	Integrate Below Market Rate Housing	0.00			
	Land Use	Land Use SubTotal	0.30			

Yes	Neighborhood Enhancements	Improve Pedestrian Network	1.00	Project Site		
No	Neighborhood Enhancements	Provide Traffic Calming Measures				
No	Neighborhood Enhancements	Implement NEV Network	0.00			
	Neighborhood Enhancements	Neighborhood Enhancements Subtotal	0.01			
Yes	Parking Policy Pricing	Limit Parking Supply	0.00			
No	Parking Policy Pricing	Unbundle Parking Costs	0.00			
No	Parking Policy Pricing	On-street Market Pricing	0.00			
	Parking Policy Pricing	Parking Policy Pricing Subtotal	0.00			
No	Transit Improvements	Provide BRT System	0.00			
No	Transit Improvements	Expand Transit Network	0.00			
No	Transit Improvements	Increase Transit Frequency	0.00			
	Transit Improvements	Transit Improvements Subtotal	0.00			
		Land Use and Site Enhancement Subtotal	0.31			
No	Commute	Implement Trip Reduction Program				
No	Commute	Transit Subsidy				
No	Commute	Implement Employee Parking "Cash Out"	7.70			
No	Commute	Workplace Parking Charge				
No	Commute	Encourage Telecommuting and Alternative Work Schedules	0.00			
No	Commute	Market Commute Trip Reduction Option	0.00			
No	Commute	Employee Vanpool/Shuttle	0.00		2.00	
No	Commute	Provide Ride Sharing Program	15.00			
	Commute	Commute Subtotal	0.00			

No	School Trip	Implement School Bus Program	0.00			
		Total VMT Reduction	0.31			

Area Mitigation

Measure Implemented	Mitigation Measure	Input Value
No	Only Natural Gas Hearth	
Yes	No Hearth	
No	Use Low VOC Cleaning Supplies	
No	Use Low VOC Paint (Residential Interior)	250.00
No	Use Low VOC Paint (Residential Exterior)	250.00
No	Use Low VOC Paint (Non-residential Interior)	250.00
No	Use Low VOC Paint (Non-residential Exterior)	250.00
No	Use Low VOC Paint (Parking)	250.00
Yes	% Electric Lawnmower	50.00
Yes	% Electric Leafblower	50.00
Yes	% Electric Chainsaw	50.00

Energy Mitigation Measures

Measure Implemented	Mitigation Measure	Input Value 1	Input Value 2
No	Exceed Title 24		
No	Install High Efficiency Lighting		
No	On-site Renewable		

Appliance Type	Land Use Subtype	% Improvement
ClothWasher	Apartments Low Rise	30.00
DishWasher		15.00
Fan		50.00
Refrigerator		15.00

Water Mitigation Measures

Measure Implemented	Mitigation Measure	Input Value 1	Input Value 2
No	Apply Water Conservation on Strategy	0.00	0.00
No	Use Reclaimed Water	0.00	0.00
No	Use Grey Water	0.00	
No	Install low-flow bathroom faucet	32.00	
No	Install low-flow Kitchen faucet	18.00	
No	Install low-flow Toilet	20.00	
No	Install low-flow Shower	20.00	
No	Turf Reduction	0.00	
Yes	Use Water Efficient Irrigation Systems	6.10	
No	Water Efficient Landscape	0.00	0.00

Solid Waste Mitigation

Mitigation Measures	Input Value

Institute Recycling and Composting Services Percent Reduction in Waste Disposed	

Appendix G

Natural Resources Survey for University of Nations Expansion Property, January 2020

Natural resources surveys for University of Nations expansion property (TMK: (3) 7-5-010:085) North Kona District, Island of Hawai'i

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Introduction

The University of Nations Kona is starting a process to expand the existing campus ("Project"). The expansion entails a 62-ac (~25-ha) parcel (TMK: 7-5-010:085) directly adjacent on the south to the existing campus off Kuakini Highway in Kailua-Kona (see Figures 1 and 2). This report[2] presents results of a survey of the expansion parcel for natural resources that may be of concern during the construction process, including initial land clearing (grading and grubbing).

The survey area (Fig. 2) is undulating, sloping ground (slopes down to the west), at the upper end bordering on Hawaii Belt Road (Rte 11) approximately 100 ft (30 m) above sea level. Much of the site is rocky with shallow soil accumulation. Although covered mostly by vegetation, parts are disturbed with a former quarry, two house structures, two water reservoirs (on a separate included parcel that project plans show as moved to a new location), and numerous fences of various types, presumably for raising of livestock (although no farm animals were seen).

[1] Rana Biological Consulting, Kailua-Kona, Hawai'i.
[2] This report was prepared for use by g70 to become part of the public record of the entitlements process.

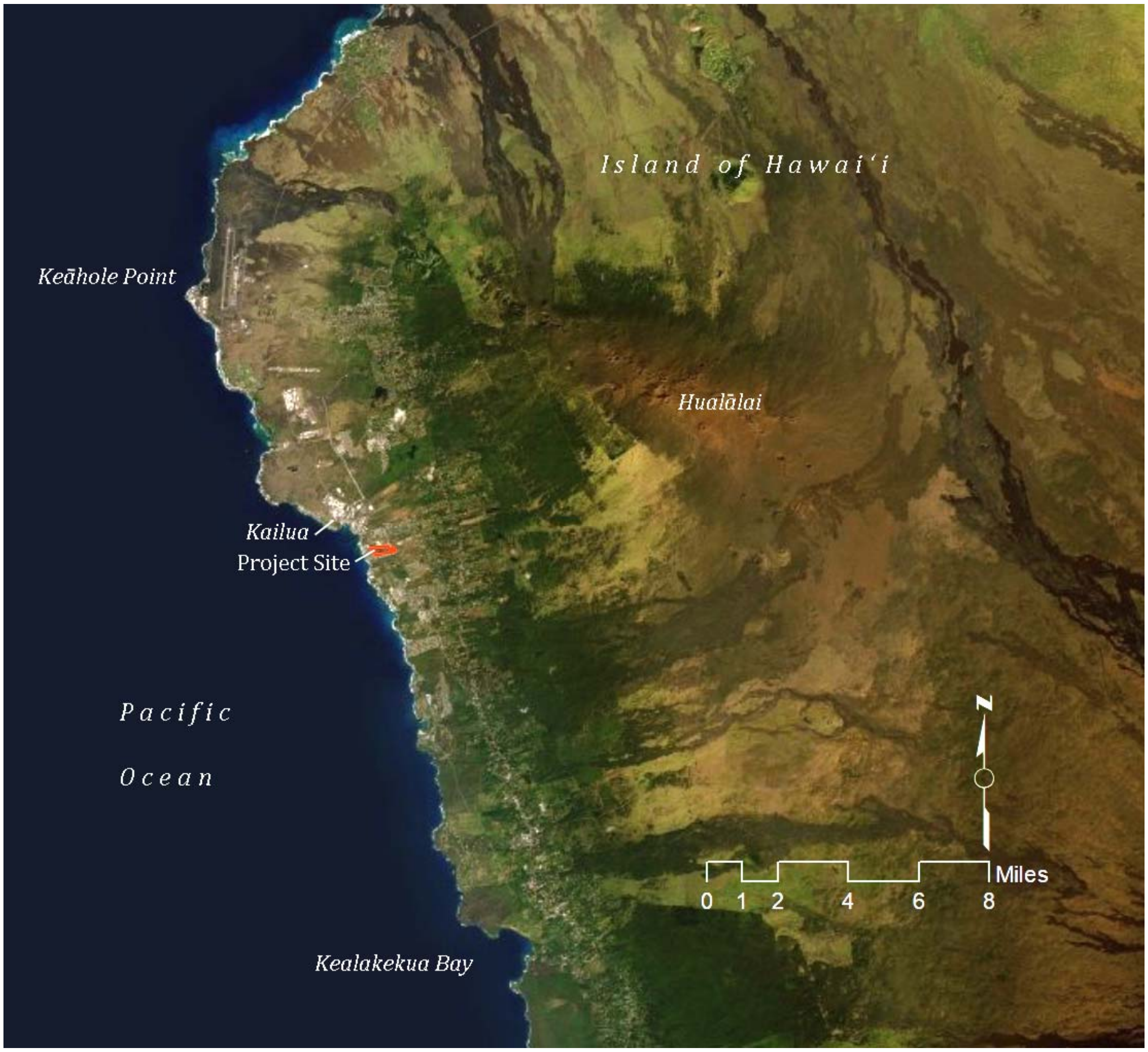

Figure 1. University of Nations Kailua-Kona expansion Project location (in red) on the leeward side of the Island of Hawai'i.

Methods

Jurisdictional Waters Reconnaissance

The site presented no expectations of wetland or stream presence that might raise an issue of federal jurisdiction (waters of the U.S.).

Figure 2. University of Nations survey area outlined in red.

Plant Survey

A property boundary (survey area) map was loaded on a Trimble 6000 Series GNSS unit (GeoXH) for use during the botanical survey conducted by Eric Guinther and David Miranda on September 3, 2019. The GNSS unit recorded the progress tracks of the lead botanist, providing real time feedback on location and adequacy of coverage during a wandering (pedestrian) transect survey and served as a guide to the survey area (property line) limits. Plant species were identified as they were encountered and notes taken to develop a relative abundance for each species recorded. Any plant not immediately recognized during the survey was photographed and/or a representative feature (flower, fruit, etc.) collected for later identification at the laboratory.

Plant species names in this report follow *Manual of the Flowering Plants of Hawai'i* (Wagner, Herbst, & Sohmer, 1990; Wagner & Herbst, 1999) for native and naturalized flowering plants and *A Tropical Garden Flora* (Staples & Herbst,

2005) for ornamental plants. More recent name changes for naturalized plant species follow Imada (2012).

Bird and Mammal Survey

Reginald David conducted the bird and mammal survey during the morning of September 3, 2019. Eight, roughly equidistant, avian point-count stations were established within the survey property. A single eight-minute avian point-count was made at each of the eight stations. The avian counts were conducted in the early morning hours with the aid of Leica 8 X 42 binoculars and by listening for vocalizations. Mr. David walked the entire site and time not spent counting at point-count stations was used to search for species and habitats not detected during station counts. Weather conditions were excellent with unlimited visibility and winds of between 2 and 5 kilometers per hour, and no precipitation. Avian phylogenetic order and nomenclature used in this report follows the AOS Check-List of North and Middle American Birds 2018 (Chesser et al., 2018, 2019).

The survey of mammals was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal sign. A running tally was kept of all terrestrial vertebrate mammalian species detected within the survey area. Mammal scientific names follow *Mammal species of the world: a taxonomic and geographic reference* (Wilson and Reeder, 2005).

Results

Vegetation

The site is characterized by a mixture of scattered *kiawe* (*Prosopis pallida*) and short-stature *koa haole* (*Leucaena leucocephala*) with moderately dense Guinea grass (*Megathyrsus maximus*) at the upper end and more open *koa haole* and areas of dense herbaceous growths of coffee senna (*Senna occidentalis*) and ʻ*uhaloa* (*Waltheria americana*) in disturbed areas (Figure 3).

Flora

A listing of the plant species observed during the botanical survey is given in Table 2. Included in this list are plants identified by Terry and Hart (2002) for a survey of the same area conducted in July 2002. The "Notes" column indicates those species common to the two surveys ("<2>") and those species only seen in 2002 ("<3>"). Plant species recorded in 2019 total 62 taxa and have an

Figure 3. Two views of the vegetation typical of a majority of the site.

Table 1. Listing of plants (flora) for a proposed campus expansion area, University of Nations Kona.

Species	Common name	Status	Abundance	Notes
FLOWERING PLANTS				
DICOTYLEDONES				
ACANTHACEAE				
Asystasia gangetica (L.) T. Anderson	Chinese violet	Nat	R	
AMARANTHACEAE				
Alternanthera pungens Kunth	khaki weed	Nat	R	
ANACARDIACEAE				
Schinus terebinthefolius Raddi	Christmasberry	Nat	--	<3>
APOCYNACEAE				
Catharanthus roseus (L.) G. Don	Madagascar periwinkle	Nat	R	<2>
ARALIACEAE				
Polycias guilfoyleri (W. Bull) L.H. Bailey	panax	Orn	R	
ASCLEPIADACEAE				
Calotropus cf. *gigantea* (L.) W.T. Aiton	crown flower	Nat	R	<4>
Stapelia gigantea N. E. Brown	giant toad plant	Nat	Rc	
ASTERACEAE (COMPOSITAE)				
Bidens cynapiifolia Kunth	---	Nat	R	<1>
Bidens pilosa L.	*kī*	Nat	U	<1>
Senecio mikanioides Otto ex Walp.	German ivy	Nat	R	
Tridax procumbans L.	coat buttons	Nat	R	<1>
Verbesina encelioides (Cav.) Benth. & Hook.	golden crown-beard	Nat	R	
BIGNONIACEAE				
Spathodea campanulata P. Beauv.	African tulip tree	Nat	U	<2>
BUDDLEIACEAE				
Buddleia asiatica Lour.	dog tail	Nat	R	
CAPPARACEAE				
Cleome gynandra L.	wild spider flower	Nat	U	
CARICACEAE				
Carica papaya L.	*mīkana,* papaya	Nat	R	
CHENOPODIACEAE				
Chenopodium ambrosioides L.	Mexican tea	Nat	Oa	
Chenopodium murale L.	*ʻāheahea*	Nat	--	<3>

Table 1 (continued).

Species	Common name	Status	Abundance	Notes
CLUSIACEAE				
Clusia rosea Jacq.	autograph tree, copey	Nat	O	<2>
CONVOLVULACEAE				
Ipomoea obscura (L.) KerGawl.	---	Nat	U	
Ipomoea triloba L.	little bell	Nat	--	<3>
CRASSULACEAE				
Kalanchoë pinnata (Lam.) Pers.	air plant	Nat	--	<3>
CUCURBITACEAE				
Coccinia grandis (L.) Voigt	scarlet-fruited gourd	Nat	--	<3>
Cucumis dipsaceus Ehrenb. & Spach	teasel gourd	Nat	--	<3>
Momordica charantia L.	wild bittermelon	Nat	C	<2>
EUPHORBIACEAE				
Euphorbia heterophylla L.	*kaliko*	Nat	--	<3>
Euphorbia hirta L.	garden spurge	Nat	Uc	<1>
Euphorbia prostrata L.	prostrate spurge	Nat	R	
Ricinus communis L.	castor bean	Nat	U	<2>
FABACEAE				
Abrus precatorius L.	black-eyed Susan	Nat	R	
Albizia lebbeck (L.) Benth.	siris tree	Nat	R	
Albizia saman (Jacq.) F. Muell.	monkey pod	Nat	R	
Chamaecrista nictitans (L.) Moench	*lauki,* partridge pea	Nat	--	<3>
Crotalaria incana L.	fuzzy rattlepod	Nat	R	
Desmanthus virgatus (L.) Willd.	virgate mimosa	Nat	R	<2>
Desmodium tortuosum (Sw.) DC.	Florida beggarweed	Nat	R	
Indigofera suffruticosa Mill.	indigo	Nat	O	<2>
Leucaena leucocephala (Lam.) deWit	*koa haole*	Nat	AA	<2>
Macroptilium lathyroides (L.) Urb.	wild bean, cow pea	Nat	R	<1>
Mimosa pudica L.	sensitive plant	Nat	U	<1>
Pithecellobium dulce (Roxb.) Benth.	*'opiuma*	Nat	U	<2>
Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth	*kiawe*	Nat	C	<2>
Senna occidentalis (L.) Link	coffee senna	Nat	AA	<2>
Vachellia farnesiana (L.) Wight & Arnott	*klu*	Nat	U	<2>

Table 1 (continued).

Species	Common name	Status	Abundance	Notes
LAMIACEAE				
Leonotis nepetifolia (L.) R. Br.	lion's ear	Nat	U	<2>
Ocimum gratissimum L.	wild basil	Nat	R	<2,4>
MALVACEAE				
Abutilon grandifolium (Willd.) Sweet	hairy abutilon	Nat	C	<2,4>
Malvastrum coromandelianum (L.) Garcke	false mallow	Nat	--	<3>
Sida ciliaris L.	---	Nat	O	
Sida fallax Walp.	*'ilima*	**Ind**	Oc	
Sida rhombifolia L.	Cuba jute	Nat	R	<1>
Sida spinosa L.	pickly sida	Nat	R	<1>
Waltheria indica L.	*'uhaloa*	**Ind**	AA	<2>
MORACEAE				
Ficus benjamina L.	weeping fig	Orn	--	<3>
MORINGACEAE				
Moringa oleifera Lam.	horseradish tree, *malunggay*	Orn	R	
NYCTAGINACEAE				
Boerhavia coccinea Mill.	false alena	Nat	R	
PHYTOLACCACEAE				
Rivina humilis L.	coral berry	Nat	--	<3>
PLUMBAGINACEAE				
Plumbago auriculata Lam.	blue plumbago	Orn	R	
Plumbago zeylanica L.	*'ilie'e*	**Ind**	--	<3>
POLYGONACEAE				
Polygonum captatum F. Ham.		Nat	R	<4>
PORTULACACEAE				
Portulaca oleracea L.	pig weed	Nat	--	<3>
Portulaca pilosa L.	---	Nat	Uo	<2>
Talinum fruticosum (L.) Juss.	---	Nat	Oc	
PHYTOLACCACEAE				
Rivina humilis L.	coral berry	Nat	--	<3>
RUBIACEAE				
Spermacoce assurgens Ruiz & Pav.	buttonweed	Nat	O	
RUTACEAE				
Murraya paniculata (L.) W. Jack	mock orange	Nat	R	
VERBINACEAE				
Lantana camara L.	lantana	Nat	Uo	<2>

Table 1 (continued).

Species	Common name	Status	Abundance	Notes
MONOCOTYLEDONES				
COMMELINACEAE				
Commelina diffusa N.L. Burm.	*honohono*	Nat	--	<3>
CYPERACEAE				
Cyperus polystachyos Rottb.	---	**Ind**	R	<1>
POACEAE (GRAMINEAE)				
Cenchrus ciliaris L.	bufflegrass	Nat	Ua	<1,2>
Chloris barbata (L.) Sw.	swollen fingergrass	Nat	R	<1>
Digiteria ciliaris (Retz) Koeler	Henry's crabgrass	Nat	R	<1>
Digitaria insularis (L.) Mez ex Ekman	sourgrass	Nat	U	
Eregrostis amabilis (L.) Wight & Arnott	Japanese lovegrass	Nat	Uo	
Megathyrsus maximus (Jacq.) B.K. Simon & W.L. Jacobs	Guinea grass	Nat	AA	<2>
Melinus repens (Willd.) Zizka	Natal redtop	Nat	O	
Pennisetum setaceum (Forssk.) Chiov.	fountain grass	Nat	U	<1>

Legend to Table 1

Status = distributional status

- **End** = endemic; native to Hawaii and found naturally nowhere else.
- **Ind** = indigenous; native to Hawaii, but not unique to the Hawaiian Islands.
- Nat = naturalized, exotic, plant introduced to the Hawaiian Islands since the arrival of Cook Expedition in 1778, and well-established outside of cultivation.
- Orn = exotic, ornamental or cultivated; plant not naturalized (not well-established outside of cultivation).
- **Pol.** = Polynesian introduction before 1778.

Abundance = occurrence ratings for plants in Project area on September 5, 2019

- R – Rare - only one or two plants seen.
- U - Uncommon - several to a dozen plants observed.
- O - Occasional - found regularly, but not abundant anywhere.
- C - Common - considered an important part of the vegetation and observed numerous times.
- A - Abundant - found in large numbers; may be locally dominant.
- AA - Abundant - abundant and dominant; defining vegetation type.

Lowercase letters (u, o, c, or a) following qualitative rating of abundance indicate a localized abundance that is greater than the occurrence rating. For example, Ra would be a plant encountered perhaps only once or twice, but very numerous where encountered.

Notes:

<1> Only seen in road verge areas such as along Hawaii Belt Road (mostly ruderal species).

Table 1 (continued).

<2> Also reported from this site by Terry and Hart (2002).
<3> Reported from site by Terry and Hart (2002), but not observed in 2019.
<4> Observed plant lacked flowers or fruit; identification uncertain.

abundance value provided in the table. Included in Table 1 are 13 species only observed along the verge of Kuakini Highway, presumably just off the property. These are marked with note “<1>” if not recorded from the property, although their proximity to the site indicates a good possibility that one or more of these species could occur in disturbed areas on the site.

Considering the entire list of species in Table 1, only four native (indigenous) plants were recorded: *‘ilima* (*Sida fallax*), *‘uhaloa* (Waltheria indica), *‘ilie‘e* (*Plumbago zeylanica*), and a common sedge (*Cyperus polystachyos*). All three are widespread in the Islands and of no conservation concern. *‘uhaloa* is particular abundant across the lower half of the site. This native is known to be common in disturbed areas as well as areas of marginal growing conditions.

Avian Survey

A total of 349 individual birds of 21 species and representing 12 separate families, was recorded during station counts (Table 2). The Hawaiian Hawk (*Buteo solitarius*)—one individual of which species was observed flying over the site—was listed as an endangered species (DLNR 2015; USFWS, n.d.). However, the Hawaiian Hawk has been delisted (effective February 3, 2020; USFWS, 2020) by the U.S. Fish and wildlife Service, yet remains listed by the State of Hawai‘i. The remaining 20 species recorded across the site are all established alien or domestic species.

Table 2. Avian Species Detected During Point Counts for the University of the Nations Kona expansion site in September 2019.

Common Name	Scientific Name	ST	*RA*
	PHASIANIDAE - Pheasants & Partridges		
	Phasianinae - Pheasants & Allies		
Gray Francolin	*Francolinus pondicerianus*	A	0.25
Chicken	*Gallus sp.*	D	0.75

Table 2 (continued).

Common Name	Scientific Name	ST	*RA*
	COLUMBIFORMES		
	COLUMBIDAE – Pigeons & Doves		
Spotted Dove	*Streptopelia chinensis*	A	2.88
Zebra Dove	*Geopelia striata*	A	5.00
	PELECANIFORMES		
	ARDEIDAE - Herons, Bitterns & Allies		
Cattle Egret	*Bubulcus ibis*	A	0.25
	ACCIPITRIFORMES		
	ACCIPITRIDAE - Kites, Eagles & Hawks		
Hawaiian Hawk	*Buteo solitarius*	**EE**	0.13
	PSITTACIFORMES		
	PSITTACIDAE – African and New World Parrots		
	Arinae – New World Parakeets, Macaws & Parrots		
Red-masked Parakeet	*Psittacara erythrogenys*	A	1.50
	PASSERIFORMES		
	ZOSTEROPIDAE – White-eyes		
Japanese White-eye	*Zosterops japonicus*	A	8.13
	MIMIDAE - Mockingbirds & Thrashers		
Northern Mockingbird	*Mimus polyglottos*	A	0.25
	STURNIDAE – Starlings		
Common Myna	*Acridotheres tristis*	A	2.75
	FRINGILLIDAE – Fringilline and Carduline Finches & Allies		
	Carduelinae – Carduline Finches and Hawaiian Honeycreepers		
House Finch	*Haemorhous mexicanus*	A	1.25
Yellow-fronted Canary	*Ceithagra mozambica*	A	2.00
	PASSERIDAE – Old World Sparrows		
House Sparrow	*Passer domesticus*	A	1.63
	CARDINALIDAE – Cardinals & Allies		
Northern Cardinal	*Cardinalis cardinalis*	A	2.00
	THRAUPIDAE – Tanagers		
	Thraupinae – Core Tanagers		
Yellow-billed Cardinal	*Paroaria capitata*	A	1.88

Table 2 (continued).

Common Name	Scientific Name	ST	*RA*
	THRAUPIDAE (cont.)		
	Thraupinae (cont.)		
Saffron Finch	*Sicalis flaveola*	A	4.25
	ESTRILDIDAE – Estrildid Finches		
Common Waxbill	*Estrilda astrild*	A	3.00
Red Avadavat	*Amandava amandava*	A	0.25
African Silverbill	*Euodice cantans*	A	1.13
Java Sparrow	*Lonchura oryzivora*	A	4.38

Legend to Table 2

ST Status
- A Alien – Introduced to the Hawaiian Islands by humans
- D Domesticated – support by humans, not established in the wild on the Island of Hawaiʻi
- **EE** Endangered Endemic – native and unique to the Hawaiian Islands, listed as an endangered species

RA Relative Abundance – Number of birds detected divided by the number of count stations ~ (8)

Avian diversity and densities recorded were generally as expected. Four species: Japanese White-eye (*Zosterops japonicus*), Zebra Dove (*Geopelia striata*), Java Sparrow (*Lonchura oryzivora*), and Saffron Finch (*Sicalis flaveola*), accounted for 50 percent of all birds recorded during station counts. The most frequently recorded species was Japanese White-eye, which accounted for 19 percent of the total number of individual birds recorded during station point-counts. No other avian species were recorded while transiting between count stations.

Mammalian Survey

We recorded five terrestrial mammalian species while on the site. In Table 3 the type of detections recorded is shown for each species. No mammalian species currently proposed for listing or listed under either the federal or State of Hawaiʻi endangered species statutes was observed in this survey (DLNR 2015; USFWS, n.d.).

Table 3 – Mammalian species detected at the University of the Nations Kona expansion site in September 2019.

Common name	Scientific name	ST	DT
	CARNIVORA Flesh Eaters		
	Canidae - Wolves, Jackals & Allies		
Domestic dog	*Canis lupus familiaris*	A	Sc, Tr,
	Viverridae - Civets & Allies		
Small Indian mongoose	*Herpestes javanicus auropunctatus*	A	V, Tr., Sc
	Felidae - Cats		
House cat	*Felis catus*	A	V, Tr
	ATRIODACTYLA Even-Toed Ungulates		
	Suicidae - Old World Swine		
Pig	*Sus scrofa*	A	Sc, Tr, Si
	Bovidae - Hollow-horned Ruminants		
Domestic sheep	*Ovis aries*	A	Sc, Tr

Legend to Table 3

ST Status
A Alien – introduced to the Hawaiian Islands by humans
DT Detection type:
V Visual – an animal seen
A Audio – an animal heard
Sc Scat – an animal detected by fecal droppings
Tr Tracks -an animal detected by the presence of tracks
Si Sign – an animal detected by sign, i.e., tunnels, beds, tree scrapping etc.

Discussion

Botanical Resources

A previous survey of the same property was conducted in 2002 (Terry & Hart, 2002). This survey listed 35 species of plants, reasonably comparable with our 49 species (as listed in Table 1 minus species seen only on the highway verge). Although the 2002 survey provides no indication of qualitative abundance, 15 (43%) of the recorded plant species were not observed in 2019. If these were mostly rare species on the site and conditions at the time were somewhat wetter than in 2019, it is not unusual that the floras of essentially naturalized, herbaceous species is as dissimilar as this comparison suggests. Certainly a perhaps somewhat unusual aspect of our results is the number of plant species listed as "rare" (61%), meaning a species encountered no more than two or three times over the course of the survey. However, the 2002 list includes Christmasberry and weeping fig, trees that presumably could still be present and rare on the site. Including both survey results in Table 1 is justified for the reasons that not all rare species are going to be encountered in a pedestrian survey and the suite of smaller, herbaceous species is very likely to change over time.

Avian Resources

The findings of the avian survey are consistent with the location of the site and the vegetation present. A previous flora and fauna survey conducted on the site in 2002 only recorded eight avian species (Terry and Hart, 2002). Given that we recorded 21 avian species, it is difficult to compare the 2002 results with those of the current survey.

Although not detected during this survey, Hawaiian Petrel (*Pterodroma sandwichensis*), Band-rumped Storm-Petrel (*Hydrobates castro*), and Newell's Shearwater (*Puffinus newelli*) may over-fly the Project vicinity between April and the end of November each year. The petrel and storm-petrel are listed as endangered, and the shearwater as threatened under both federal and State of Hawaiʻi endangered species statutes. The primary cause of mortality for these three ground nesting seabirds is thought to be predation by alien mammalian species at the nesting colonies (USFWS, 1983; Simons and Hodges, 1998; Ainley et al., 2001). Collision with man-made structures is considered to be second-most significant cause of mortality of these seabirds in Hawaiʻi. Nocturnally flying seabirds, especially fledglings on their way to sea in the summer and fall, can become disoriented by exterior lighting. When disoriented, seabirds can collide with man-made structures and, if not killed outright, dazed or injured birds become prey to feral mammals (Hadley, 1961; Telfer, 1979; Sincock, 1981; Reed et al., 1985; Telfer et al., 1987; Cooper and Day, 1998; Podolsky et al., 1998; Ainley et al., 2001; Hue et al., 2001; Day et al., 2003). Neither nesting colonies nor appropriate nesting habitat for either of these listed seabird species occur within or close to the current Project site.

Potential for impact on protected seabirds that the Project poses is an increased threat to transiting birds disoriented by lights associated with the Project during the seabird nesting season from September 15 through December 1 each year. If, during construction, it is deemed expedient to conduct night-time construction activities, or if streetlights are installed as part of the proposed action, these must be shielded (Reed et al. 1985, Telfer et al. 1987). Shielding of lights would serve the dual purpose of minimizing disorientation and downing of petrels and shearwaters, and complying with Hawaiʻi County Code §14 – 50 et seq., which requires shielding of exterior lights to lower ambient glare reaching the astronomical observatories located on Mauna Kea.

Mammalian Resources

The findings of the mammalian survey are consistent with the location of the property and the vegetation present. One previous flora and fauna survey conducted on the site, did not record any mammalian species (Terry and Hart, 2002). Given that we recorded five mammalian species, the previous survey results cannot be compared with those recorded during the current survey. All of the introduced mammalian species recorded during the course of this survey are deleterious to native ecosystems and the native faunal species dependent on them.

Although, no rodents were recorded during the course of this survey, it is likely that one or more of the four established alien Muridae found on the Island of Hawaiʻi—European house mouse (*Mus musculus domesticus*), roof rat (*Rattus rattus*), brown rat (*Rattus norvegicus*), and black rat (*Rattus exulans hawaiiensis*)—use various resources within the general project area on a seasonal basis. These human commensal species are drawn to areas of human habitation and activity. All of these introduced rodents are deleterious to native ecosystems and the native faunal species dependent on them.

No Hawaiian hoary bats were detected during the course of this survey. It is possible that this species forages over the site on a seasonal basis. The vegetation on the site is not typical of that which one would expect Hawaiian hoary bats to roost in. It is not expected that the proposed actions will result in deleterious impacts to this listed endemic species.

Protected Species

With one exception as noted, no plant or animal species currently protected or proposed for protection under either the federal or State of Hawaiʻi endangered species programs (HDLNR, 1998, 2015; USFWS, nd) was detected on the subject property during the course of this survey[3].

[3] The Hawaiian Hawk observed flying over the property has been delisted by U.S. Fish and Wildlife Service, effective February 3, 2020 (USFWS, 2020). Although likely to also be delisted by the state, the process could take several years. Consequently, the Hawaiian hawk remains as a state listed species (HDLNR, 2015).

Critical Habitat

No federally delineated Critical Habitat for any species is included in or is located close to the surveyed property. Thus, modifications of habitats on the site will not result in impacts to federally designated Critical Habitat. There is no equivalent statute under state law.

Recommendations

- If nighttime construction activity or equipment maintenance is proposed during the construction phases of the project, all associated lights should be shielded, and when large flood/work lights are used, they should be placed on poles that are high enough to allow the lights to be pointed directly at the ground.

- If streetlights or exterior facility lighting is installed in conjunction with the project, it is recommended that the lights be shielded to reduce the potential for interactions of nocturnally flying seabirds with external lights and man-made structures (Reed et al., 1985; Telfer et al., 1987).

References

Ainley, D. G, R. Podolsky, L. Deforest, G. Spencer, and N. Nur. 2001. The Status and Population Trends of the Newell's Shearwater on Kaua'i: Insights from Modeling, *in:* Scott, J. M, S. Conant, and C. Van Riper III (eds) *Evolution, Ecology, Conservation, and Management of Hawaiian Birds: A Vanishing Avifauna. Studies in Avian Biology No. 22*. Cooper's Ornithological Society, Allen Press, Lawrence, Kansas. Pp. 108-123.

Chesser, R. T., K. J. Burns, C. Cicero, J. L. Dunn, A. W. Kratter, I. J. Lovette, P. C. Rasmussen, J. V. Remsen, Jr., D. F. Stotz, B. M. Winger, and K. Winker. 2018. Check-list of North American Birds (online). American Ornithological Society. Online at URL: http://checklist.aou.org/taxa.

______, ______, ______, ______, ______, ______, ______, ______, ______, and K. Winker. 2019. Sixtieth Supplement to the Check-list of North American Birds. *The Auk Ornithological Advances*, 136: 1-23.

Cooper, B. A. and R. H. Day. 1998. Summer behavior and mortality of Dark-rumped Petrels and Newell's Shearwaters at power lines on Kauai. *Colonial Waterbirds*, 21(1): 11-19.

______ and ______. 1998. Summer Behavior and Mortality of Dark-rumped Petrels and Newells' Shearwaters at Power Lines on Kauai. *Colonial Waterbirds*, 21(1): 11-19.

Day, R. H., B. A. Cooper, and T. C. Telfer. 2003. Decline of Townsend's (Newell's Shearwaters (*Puffinus auricularis newelli*) on Kauai, Hawaii. *The Auk,* 120: 669-679.

Hawaii Department of Land and Natural Resources (DLNR). 1998. Indigenous Wildlife, Endangered And Threatened Wildlife And Plants, And Introduced Wild Birds. Department of Land and Natural Resources. State of Hawaii. Administrative Rule §13-134-1 through §13-134-10, dated March 02, 1998.

______. 2015. Chapter 124. Indigenous Wildlife, Endangered, Injurious Wildlife, Introduced Wild Birds, and Introduced Wildlife. Department of Land and Natural Resources. State of Hawaii. Administrative Rule under Title 13. Subtitle 5, Part 2, dated February 17, 2015.

Hadley, T. H. 1961. Shearwater calamity on Kauai. *Elepaio*, 21: 60.

Hue, D., C. Glidden, J. Lippert, L. Schnell, J. MacIvor and J. Meisler. 2001. Habitat Use and Limiting Factors in a Population of Hawaiian Dark-rumped Petrels on Mauna Loa, Hawaiʻi. Pp. 234-242, *in:* : Scott, J. M, S. Conant, and C. Van Riper III (editors) *Evolution, Ecology, Conservation, and Management of Hawaiian Birds: A Vanishing Avifauna*. Studies in Avian Biology No. 22. Cooper's Ornithological Society, Allen Press, Lawrence, Kansas.

Podolsky, R., D. G. Ainley, G. Spencer, L. de Forest, and N. Nur. 1998. Mortality of Newell's Shearwaters Caused by Collisions with Urban Structures on Kauaʻi. *Colonial Waterbirds*, 21: 20-34.

Reed, J. R., J. L Sincock, and J. P. Hailman 1985. Light Attraction in Endangered Procellariform Birds: Reduction by Shielding Upward Radiation. *The Auk*, 102: 377-383.

Simons, T. R., and C. N. Hodges. 1998. Dark-rumped Petrel (*Pterodroma phaeopygia*). *In:* A. Poole and F. Gill (editors). The Birds of North

America, No. 345. The Academy of Natural Sciences,Philadelphia, PA. and the American Ornithologists Union, Washington, D.C.

Sincock, J. L. 1981. Saving the Newell‘s Shearwater. Pp. 76-78 in: Proceedings of the Hawaii Forestry and Wildllife Conference, 2-4 October 1980. Department of Land and Natural Resources, State of Hawaii, Honolulu.

Telfer, T. C. 1979. Successful Newell's Shearwater Salvage on Kauai. ‘Elepaio 39:71

______, J. L. Sincock, G. V. Byrd, and J. R. Reed. 1987. Attraction of Hawaiian seabirds to lights: conservation efforts and effects of moon phase. Wildlife Soc. Bull., 15: 406-413.

Terry, R. and P. Hart. 2002. Flora and fauna report, University of Nations Bencorp property, Waiaha, TMK 7-5-17:07 (por.), North Kona, Island of Hawai‘i. 4 pp.

U.S. Fish & Wildlife Service (USFWS). 1983. Hawaiian Dark-Rumped Petrel & Newell's Manx Shearwater Recovery Plan. USFWS, Portland, Oregon. February 1983.

______. undated websites (nd). USFWS Endangered Species. Available online at URL: https://www.fws.gov/endangered/; last visited on September 4, 2019 and Environmental Conservation Online System (ECOS), online at URL: https://ecos.fws.gov/ecp/species-reports; last visited on September 4, 2019.

______. 2020. Endangered and Threatened Wildlife and Plants; Removing the Hawaiian Hawk From the Federal List of Endangered and Threatened Wildlife. *Federal Register*, 85 (164): 164-189.

Wilson, D. E., and D. M. Reeder (Editors). 2005. *Mammal species of the world: a taxonomic and geographic reference.* 3rd edition. 2 vols. John Hopkins University Press, Baltimore, Maryland. 2142 pp.

IPaC **U.S. Fish & Wildlife Service**

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

Hawaii County, Hawaii

Local office

Pacific Islands Fish And Wildlife Office

(808) 792-9400
(808) 792-9580

MAILING ADDRESS

300 Ala Moana Boulevard, Box 50088
Honolulu, HI 96850-5000

PHYSICAL ADDRESS

300 Ala Moana Boulevard, Room 3-122
Honolulu, HI 96850-0056

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

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1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information. IPaC only shows species that are regulated by USFWS (see FAQ).

2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS
Hawaiian Hoary Bat Lasiurus cinereus semotus Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/770	Endangered

Birds

NAME	STATUS
Band-rumped Storm-petrel Hydrobates castro No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/1226	Endangered
Hawaiian Coot (alae Ke`oke`o) Fulica alai Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/7233	Endangered
Hawaiian Duck Anas wyvilliana Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/7712	Endangered
Hawaiian Goose Branta (=Nesochen) sandvicensis Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/1627	Threatened
Hawaiian Petrel Pterodroma sandwichensis Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6746	Endangered

Hawaiian Stilt Himantopus mexicanus knudseni | Endangered

Wherever found

No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/2082

Newell''s Shearwater Puffinus newelli | Threatened

Wherever found

No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/2048

Reptiles

NAME	STATUS
Hawksbill Sea Turtle Eretmochelys imbricata Wherever found There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/3656	Endangered

Insects

NAME	STATUS
Blackburn's Sphinx Moth Manduca blackburni Wherever found There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/4528	Endangered

Flowering Plants

NAME	STATUS
`aiea Nothocestrum breviflorum Wherever found There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/7493	Endangered
Carter's Panicgrass Panicum fauriei var. carteri Wherever found There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/5578	Endangered

Hala Pepe Dracaena konaensis — Endangered

Wherever found

There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
https://ecos.fws.gov/ecp/species/2910

Ihi Portulaca villosa — Endangered

Wherever found

No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/4886

Ko`oko`olau Bidens micrantha ssp. ctenophylla — Endangered

Wherever found

There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
https://ecos.fws.gov/ecp/species/1585

Loulu Pritchardia maideniana — Endangered

Wherever found

No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/4945

Neraudia ovata — Endangered

Wherever found

There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
https://ecos.fws.gov/ecp/species/3669

Ohai Sesbania tomentosa — Endangered

Wherever found

There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
https://ecos.fws.gov/ecp/species/8453

Po`e Portulaca sclerocarpa — Endangered

Wherever found

There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
https://ecos.fws.gov/ecp/species/1719

Uhiuhi Mezoneuron kavaiense — Endangered

Wherever found

There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
https://ecos.fws.gov/ecp/species/7129

Wahine Noho Kula Isodendrion pyrifolium — Endangered

Wherever found

There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
https://ecos.fws.gov/ecp/species/2235

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

There are no critical habitats at this location.

You are still required to determine if your project(s) may have effects on all above listed species.

Bald & Golden Eagles

There are no documented cases of eagles being present at this location. However, if you believe eagles may be using your site, please reach out to the local Fish and Wildlife Service office.

Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-

golden-eagles-may-occur-project-action

What does IPaC use to generate the potential presence of bald and golden eagles in my specified location?

The potential for eagle presence is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply). To see a list of all birds potentially present in your project area, please visit the Rapid Avian Information Locator (RAIL) Tool.

What does IPaC use to generate the probability of presence graphs of bald and golden eagles in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the Rapid Avian Information Locator (RAIL) Tool.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur. Please contact your local Fish and Wildlife Service Field Office if you have questions.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats[3] should follow appropriate regulations and consider implementing appropriate conservation measures, as described in the links below. Specifically, please review the "Supplemental Information on Migratory Birds and Eagles".

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1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the PROBABILITY OF PRESENCE SUMMARY below to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
'apapane Himatione sanguinea This is a Bird of Conservation Concern (BCC) throughout its range in Hawaii and the Pacific Islands.	Breeds Dec 1 to Jul 31
'oma'o Myadestes obscurus This is a Bird of Conservation Concern (BCC) throughout its range in Hawaii and the Pacific Islands.	Breeds Feb 20 to Oct 31
Black Noddy Anous minutus melanogenys This is a Bird of Conservation Concern (BCC) throughout its range in Hawaii and the Pacific Islands.	Breeds Apr 1 to Nov 30

Hawai'i 'amakihi Chlorodrepanis virens — Breeds Nov 15 to Aug 15

This is a Bird of Conservation Concern (BCC) throughout its range in Hawaii and the Pacific Islands.

Red-tailed Tropicbird Phaethon rubricauda melanorhynchos — Breeds Dec 15 to Oct 15

This is a Bird of Conservation Concern (BCC) throughout its range in Hawaii and the Pacific Islands.

Wandering Tattler Tringa incana — Breeds elsewhere

This is a Bird of Conservation Concern (BCC) throughout its range in Hawaii and the Pacific Islands.

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.

3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

Breeding Season ( )

Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)

Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

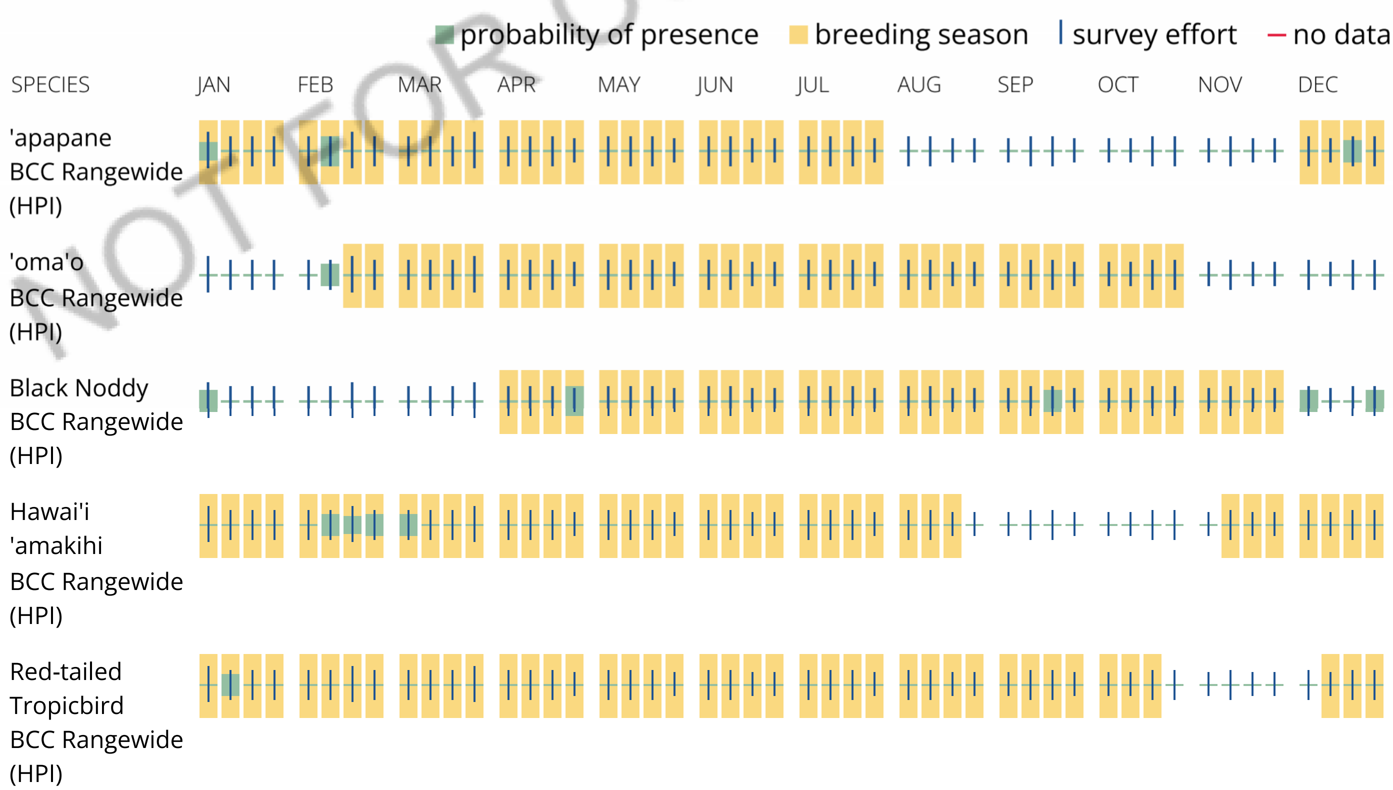
To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)

A week is marked as having no data if there were no survey events for that week.

Survey Timeframe

Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



Wandering Tattler
BCC Rangewide (HPI)

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the list of migratory birds that potentially occur in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the Rapid Avian Information Locator (RAIL) Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets.

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may query your location using the RAIL Tool and look at the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

There are no refuge lands at this location.

Fish hatcheries

There are no fish hatcheries at this location.

Wetlands in the National Wetlands Inventory (NWI)

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

This location did not intersect any wetlands mapped by NWI.

NOTE: This initial screening does **not** replace an on-site delineation to determine whether wetlands occur. Additional information on the NWI data is provided below.

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

Appendix H

Acoustic Study for the University of the Nations Kona, Kailua-Kona, Hawaii, June 2023

ACOUSTIC STUDY FOR THE UNIVERSITY OF THE NATIONS, KONA KAILUA-KONA, HAWAII

Prepared for:

G70

Prepared by:

Y. EBISU & ASSOCIATES
1126 12th Avenue, Room 305
Honolulu, Hawaii 96816

JUNE 2023

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CHAPTER 1. SUMMARY

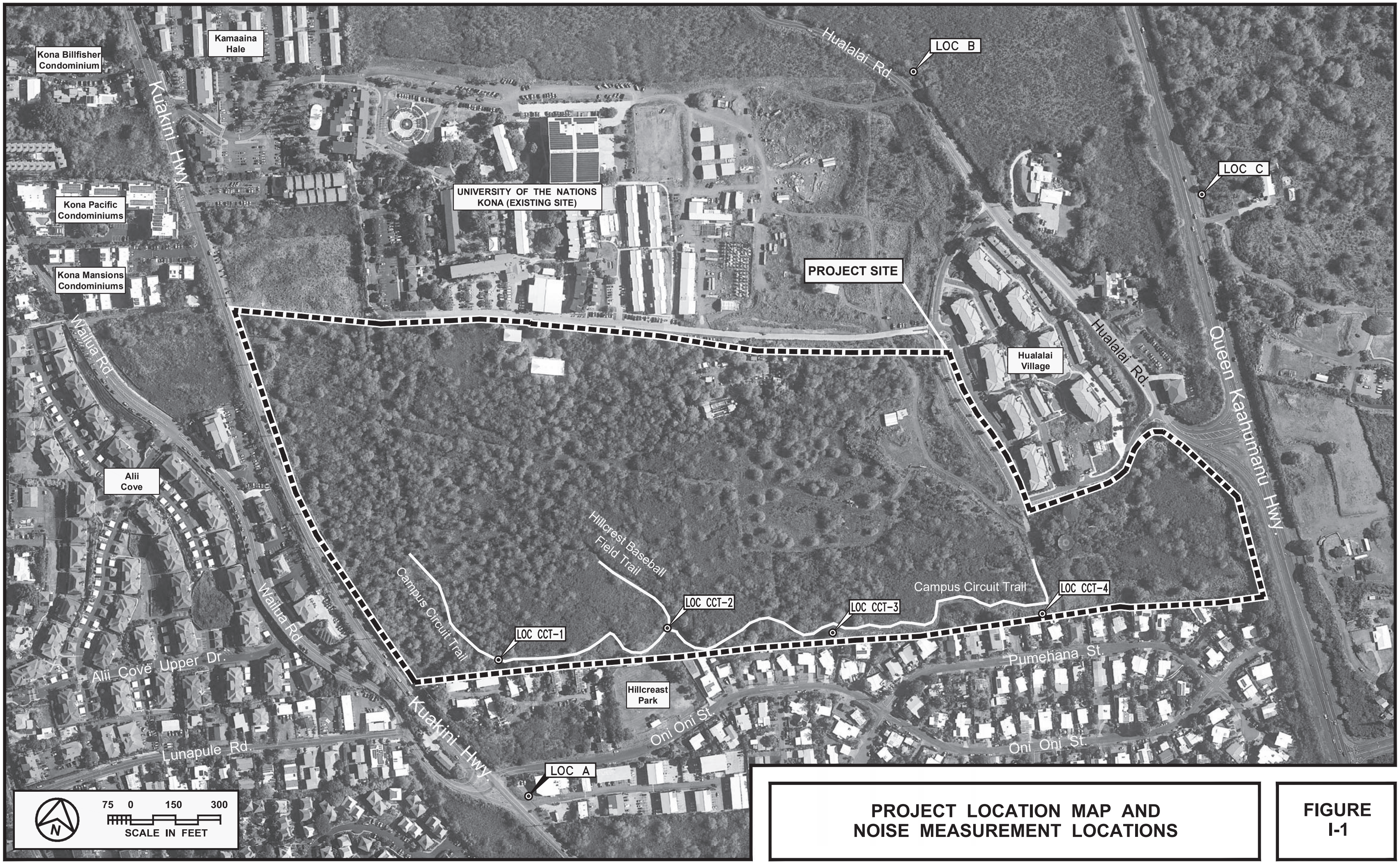
The existing and future traffic noise levels in the vicinity of the planned University of the Nations, Kona Hawaii were evaluated for their potential impacts and their relationship to the current FHA/HUD noise standard. The traffic noise level increases along the roadways servicing the project site (see Figure I-1) were calculated. No significant increases in traffic noise levels are predicted to occur as a result of project traffic following project build-out by CY 2050.

Along Queen Kaahumanu Highway fronting the school site, traffic noise levels are expected to increase from approximately 67.2 to 68.5 DNL at 100 foot distance from the centerline by CY 2050. The 1.3 DNL increase will result from increases in non-project traffic by CY 2050. Project traffic should not increase future traffic noise levels along Queen Kaahumanu Highway in the immediate vicinity of the project between the Kuakini Highway and Nani Kailua Road intersections. Along Kuakini Highway, traffic noise levels are expected to increase by 1.5 DNL by CY 2050 as a result of both project and non-project traffic, with future traffic noise levels of 64.5 DNL at 100 foot distance from the Kuakini Highway centerline by 2050. Along Hualalai Road north of the project, traffic noise levels are expected to remain relatively low at 55.2 DNL at 100 feet from the Hualalai Road centerline by CY 2050. Non-project traffic will be the sole cause of the increase in future traffic noise levels by 0.8 DNL along Hualalai Road. Project traffic is anticipated to cause increases along Kuakini Highway of 0.6 DNL or less by CY 2050. These levels of traffic noise increases resulting from project generated traffic are not considered to be significant, and will be difficult to measure or perceive between CY 2023 and 2050.

The school site is planned such that noise sensitive buildings of the school are situated at very large setback distances from Queen Kaahumanu and Kuakini Highways, where existing and future traffic noise levels are predicted to be less than 55 DNL. The large buffer distances to both highways will allow for the use of naturally ventilated buildings on the school campus. The planned new student dormitory buildings at the east end of the project site are located near but just outside the forecasted 65 DNL traffic noise contour. If air conditioning is included in these buildings for thermal comfort, exterior-to-interior noise reductions in the order of 20 dBA should result.

Potential noise impacts or complaint risks from outdoor activities and central plant equipment are possible on adjacent properties. Compliance with State Department of Health noise regulations for fixed equipment are recommended to minimize adverse noise impacts on adjacent properties from central plant equipment. Complaints may occur from the planned outdoor activity areas, particularly those play and practice fields closest to the south boundary. The addition of sound attenuating walls and community outreach are possible noise mitigation measures.

Unavoidable, but temporary, noise impacts may occur during construction of the



PROJECT LOCATION MAP AND NOISE MEASUREMENT LOCATIONS

FIGURE I-1

proposed project, particularly during the excavation and earth moving activities on the project site. Because construction activities are predicted to be audible within the project site and at nearby properties, the quality of the acoustic environment may be degraded to unacceptable levels during periods of construction. Mitigation measures to reduce construction noise to inaudible levels will not be practical in all cases, but the use of quiet equipment and compliance with State Department of Health construction noise regulations are recommended as standard mitigation measures.

CHAPTER II. PURPOSE

The primary objective of this study was to describe the existing and future traffic noise environment in the environs of the proposed University of the Nations, Kona facility in Kailua-Kona on the island of Hawaii. Traffic forecasts for 2050 were used. Traffic noise level increases and impacts associated with the proposed development were to be determined within the project site as well as along the public roadways which are expected to service the project traffic. A specific objective was to determine future traffic noise level increases associated with both project and non-project traffic, and the potential noise impacts associated with these increases.

Impacts from on-site activities and short term construction noise at the project site were also included as noise study objectives. Recommendations for minimizing identified noise impacts were also to be provided as required.

CHAPTER III. NOISE DESCRIPTORS AND THEIR RELATIONSHIP TO LAND USE COMPATIBILITY

The noise descriptor currently used by federal agencies (such as FHA/HUD) to assess environmental noise is the Day-Night Average Sound Level (DNL). This descriptor incorporates a 24-hour average of instantaneous A-Weighted Sound Levels as read on a standard Sound Level Meter. By definition, the minimum averaging period for the DNL descriptor is 24 hours. Additionally, sound levels which occur during the nighttime hours of 10:00 PM to 7:00 AM are increased by 10 decibels (dB) prior to computing the 24-hour average by the DNL descriptor. A more complete list of noise descriptors is provided in APPENDIX B to this report.

Table III-1, derived from Reference 1, presents current federal noise standards and acceptability criteria for residential land uses. Table III-2, also extracted from Reference 1, presents the general effects of noise on people in residential use situations. Land use compatibility guidelines for various levels of environmental noise as measured by the DNL descriptor system are shown in Figure III-1 (from Reference 2). As a general rule, noise levels of 55 DNL or less occur in rural areas, or in areas which are removed from high volume roadways. In urbanized areas which are shielded from high volume roadways, DNL levels generally range from 55 to 65 DNL, and are usually controlled by motor vehicle traffic noise. Receptors which front major roadways are generally exposed to levels of 65 DNL, and as high as 75 DNL when the roadway is a high speed freeway. In the project area, traffic noise levels associated with Queen Kaahumanu Highway and Kuakini Highway are typically greater than 65 DNL along their Rights-of-Way due to the relatively large volumes of traffic on these major thoroughfares.

For purposes of determining noise acceptability for funding assistance from federal agencies (FHA/HUD and VA), an exterior noise level of 65 DNL or less is considered acceptable for residences and noise sensitive receptors. This standard is applied nationally (Reference 3), including Hawaii. Because of our open-living conditions, the predominant use of naturally ventilated dwellings, and the relatively low exterior-to-interior sound attenuation afforded by these naturally ventilated structures, an exterior noise level of 65 DNL does not eliminate all risks of noise impacts. Because of these factors, and as recommended in Reference 4, a lower level of 55 DNL is considered as the "Unconditionally Acceptable" (or "Near-Zero Risk") level of exterior noise. However, after considering the cost and feasibility of applying the lower level of 55 DNL, government agencies such as FHA/HUD and VA have selected 65 DNL as a more appropriate regulatory standard.

For commercial, industrial, and other non-noise sensitive land uses, exterior noise levels as high as 75 DNL are generally considered acceptable. Exceptions to this occur when naturally ventilated office and other commercial establishments are exposed to exterior levels which exceed 65 DNL.

TABLE III-1

EXTERIOR NOISE EXPOSURE CLASSIFICATION (RESIDENTIAL LAND USE)

NOISE EXPOSURE CLASS	DAY–NIGHT SOUND LEVEL	EQUIVALENT SOUND LEVEL	FEDERAL (1) STANDARD
Minimal Exposure	Not Exceeding 55 DNL	Not Exceeding 55 Leq	Unconditionally Acceptable
Moderate Exposure	Above 55 DNL But Not Above 65 DNL	Above 55 Leq But Not Above 65 Leq	Acceptable(2)
Significant Exposure	Above 65 DNL But Not Above 75 DNL	Above 65 Leq But Not Above 75 Leq	Normally Unacceptable
Severe Exposure	Above 75 DNL	Above 75 Leq	Unacceptable

Notes: (1) Federal Housing Administration, Veterans Administration, Department of Defense, and Department of Transportation.

(2) FHWA uses the Leq instead of the Ldn descriptor. For planning purposes, both are equivalent if: (a) heavy trucks do not exceed 10 percent of total traffic flow in vehicles per 24 hours, and (b) traffic between 10:00 PM and 7:00 AM does not exceed 15 percent of average daily traffic flow in vehicles per 24 hours. The noise mitigation threshold used by FHWA for residences is 67 Leq.

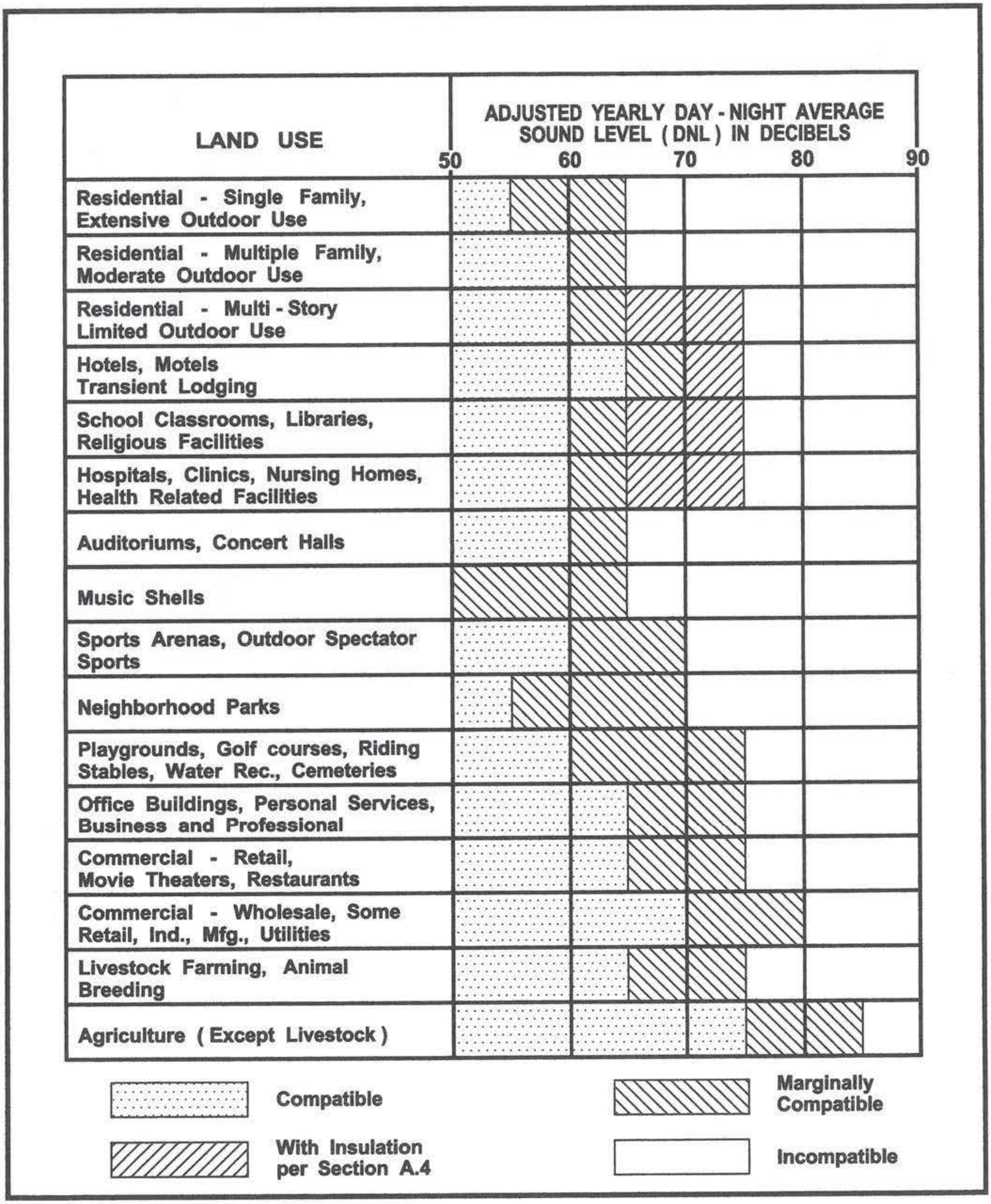
TABLE III-2

EFFECTS OF NOISE ON PEOPLE
(Residential Land Uses Only)

EFFECTS[1] / DAY-NIGHT AVERAGE SOUND LEVEL IN DECIBELS	Hearing Loss	Speech Interference		Annoyance[2]	Average Community Reaction[4]	General Community Attitude Towards Area
		Indoor	Outdoor			
	Qualitative Description	%Sentence Intelligibility	Distance In Meters for 95% Sentence Intelligibility	% of Population Highly Annoyed[3]		
75 and above	May Begin to Occur	98%	0.5	37%	Very Severe	Noise is likely to be the most Important of all adverse aspects of the community environment.
70	Will Not Likely Occur	99%	0.9	25%	Severe	Noise is one of the most Important adverse aspects of the community environment.
65	Will Not Occur	100%	1.5	15%	Significant	Noise is one of the important adverse aspects of the community environment.
60	Will Not Occur	100%	2.0	9%	Moderate to Slight	Noise may be considered an adverse aspect of the community environment.
55 and below	Will Not Occur	100%	3.5	4%		Noise considered no more important than various other environmental factors.

1. "Speech Interference" data are drawn from the following tables in EPA's "Levels Document": Table 3, Fig. D-1, Fig. D-2, Fig. D-3. All other data from National Academy of Science 1977 report "Guidelines for Preparing Environmental Impact Statements on Noise, Report of Working Group 69 on Evaluation of Environmental Impact of Noise."
2. Depends on attitudes and other factors.
3. The percentages of people reporting annoyance to lesser extents are higher in each case. An unknown small percentage of people will report being "highly annoyed" even in the quietest surroundings. One reason is the difficulty all people have in intergrating annoyance over a very long time.
4. Attitudes or other non-acoustic factors can modify this. Noise at low levels can still be an important problem, particularly when it intrudes into a quiet environment.

NOTE: Research implicates noise as a facor producing stress-related health effects such as heart disease, high-blood pressure and stroke, ulcers and other digestive disorders. The relationships between noise and these effects, however, have not as yet been quantified.



LAND USE COMPATIBILITY WITH YEARLY AVERAGE DAY - NIGHT SOUND LEVEL (DNL) AT A SITE FOR BUILDINGS AS COMMONLY CONSTRUCTED.
(Source: American National Standards Institute S12.9 - 1988/Part 5)

FIGURE III-1

On the island of Hawaii, the State Department of Health (DOH) regulates noise from construction activities through the issuance of permits for allowing excessive noise during limited time periods. State DOH noise regulations are expressed in maximum allowable property line noise limits rather than DNL (see Reference 5). Although they are not directly comparable to noise criteria expressed in DNL, State DOH noise limits for residential, commercial, and industrial lands equate to approximately 55, 60, and 76 DNL, respectively.

CHAPTER IV. GENERAL STUDY METHODOLOGY

Existing traffic noise levels were measured at seven locations (A, B, C, and CCT-1 through CCT-4) in the project environs to provide a basis for developing the project's traffic noise contributions along the roadways which will service the proposed development, and for describing the existing background noise levels at neighboring residences along the south boundary of the project site. The locations of the measurement sites are shown in Figure I-1. Noise measurements were performed during the month of May 2023. The results of the traffic noise measurements at Locations A, B, and C were compared with calculations of existing traffic noise levels to validate the computer model used. The traffic noise measurement results, and their comparisons with computer model predictions of existing traffic noise levels are summarized in Table IV-1. Daytime background noise measurement results on a Sunday at locations along the project's south boundary are shown in Figures IV-1 through IV-4 in statistical histogram format, where Lmax, Leq, and Lmin represent the maximum, average, and minimum dBA values measured during each 15-minute recording period. The L10 and L50 values shown in the figures represent the sound levels which where exceeded 10 and 50 percent of the time.

Traffic noise calculations for the existing conditions as well as noise predictions for the Year 2050 were performed using the Federal Highway Administration (FHWA) Traffic Noise Model, Version 3.5 (Reference 6). Traffic data entered into the noise prediction model were: roadway and receiver locations; hourly traffic volumes, average vehicle speeds; estimates of traffic mix; and "Hard Soil" propagation loss factor. The traffic data and forecasts for the project (Reference 7), plus the spot traffic counts obtained during the noise measurement periods were the primary sources of data inputs to the model. Appendix C summarizes the AM and PM peak hour traffic volumes for CY 2023 and 2050 which were used to model existing and future traffic noise along the roadways in the vicinity of the project site. For existing and future traffic along the roadways in the vicinity of the project site, it was assumed that the average noise levels, or Leq(h), during the AM peak traffic hour were 0.8 dB less than the 24-hour DNL along Queen Kaahumanu Highway. The PM peak hour Leq were were assumed to be 0.5 dB greater than the 24-hour DNL along Kuakini Highway. These assumptions were based on computations of both the hourly Leq and the 24-hour DNL of traffic noise on Queen Kaahumanu and Kuakini Highways (see Figures IV-5 and IV-6) using State of Hawaii hourly traffic counts from References 8 and 9. Along Hualalai Road, it was assumed that the peak hour Leq's were equal to the 24-hour DNL.

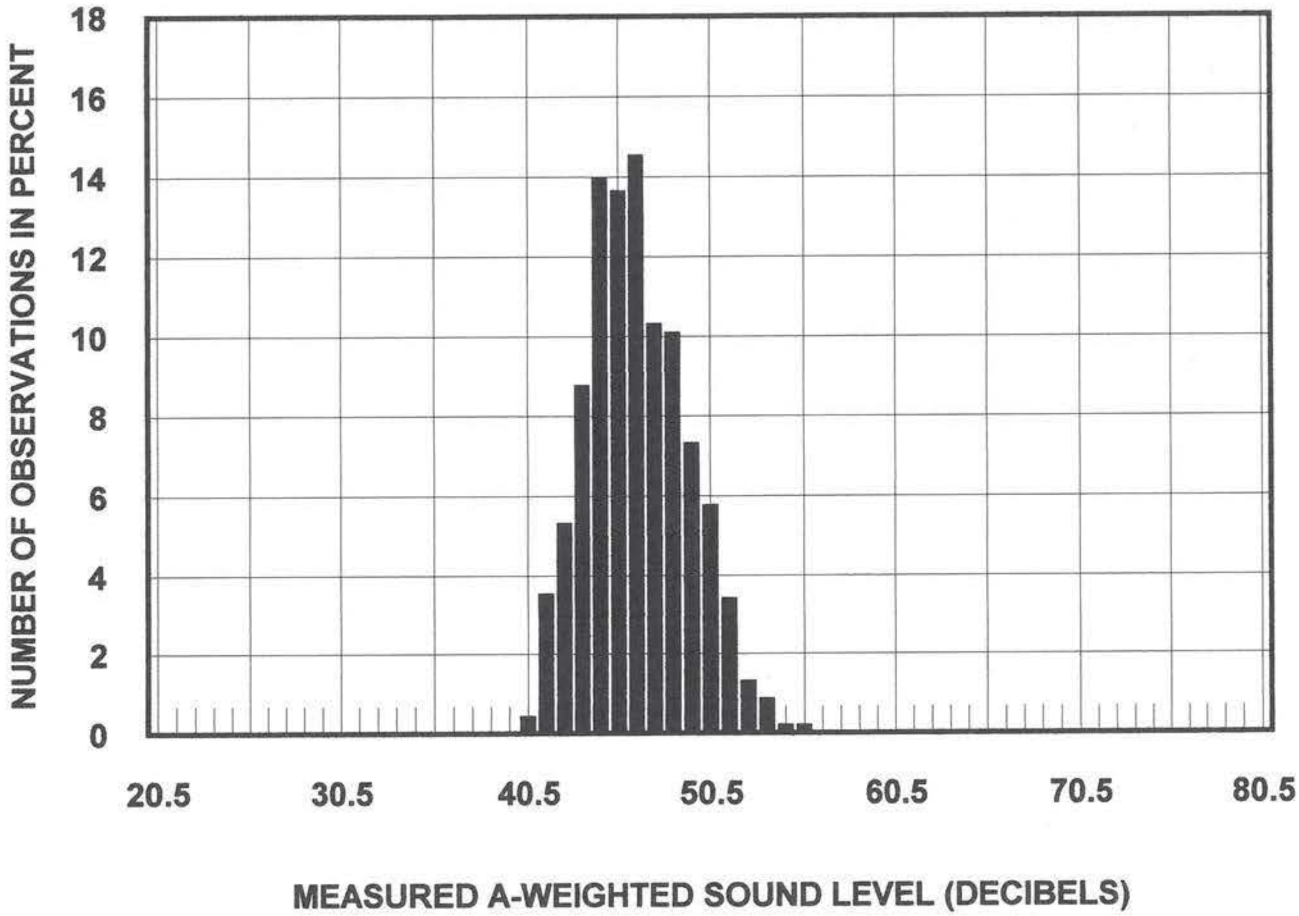
Traffic noise calculations for both the existing and future conditions in the project environs were developed for ground level receptors with and without the benefit of shielding from natural terrain features or man made obstructions. Traffic noise levels were also calculated for future conditions with and without the proposed project. The forecasted changes in traffic noise levels over existing levels were calculated with and without the project, and noise impact risks evaluated. The relative contributions of non-project and project traffic to the total noise levels were also calculated, and an

TABLE IV-1
TRAFFIC NOISE MEASUREMENT AND TRAFFIC NOISE MODEL VALIDATION RESULTS

LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	-------- Hourly Traffic Volume -------- AUTO	M.TRUCK	H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
C. 50 FT from the center-line of Q. Kaahumanu Hwy. (5/15/23)	0645 TO 0745	43	1,787	31	22	69.8	69.8
A. 50 FT from the center-line of Kuakini Hwy. (5/15/23)	0759 TO 0859	42	520	6	3	63.7	63.9
B. 50 FT from the center-line of Hualalai Rd. (5/15/23)	1151 TO 1251	30	144	7	0	54.8	54.8
A. 50 FT from the center-line of Kuakini Hwy. (5/15/23)	1455 TO 1555	42	696	8	5	65.0	65.0
C. 50 FT from the center-line of Q. Kaahumanu Hwy. (5/15/23)	1610 TO 1702	43	1,907	14	7	69.4	69.6

FIGURE IV-1
HISTOGRAM OF MEASURED SOUND LEVELS AT UNIVERSITY OF THE NATIONS KONA; LOC CCT-1

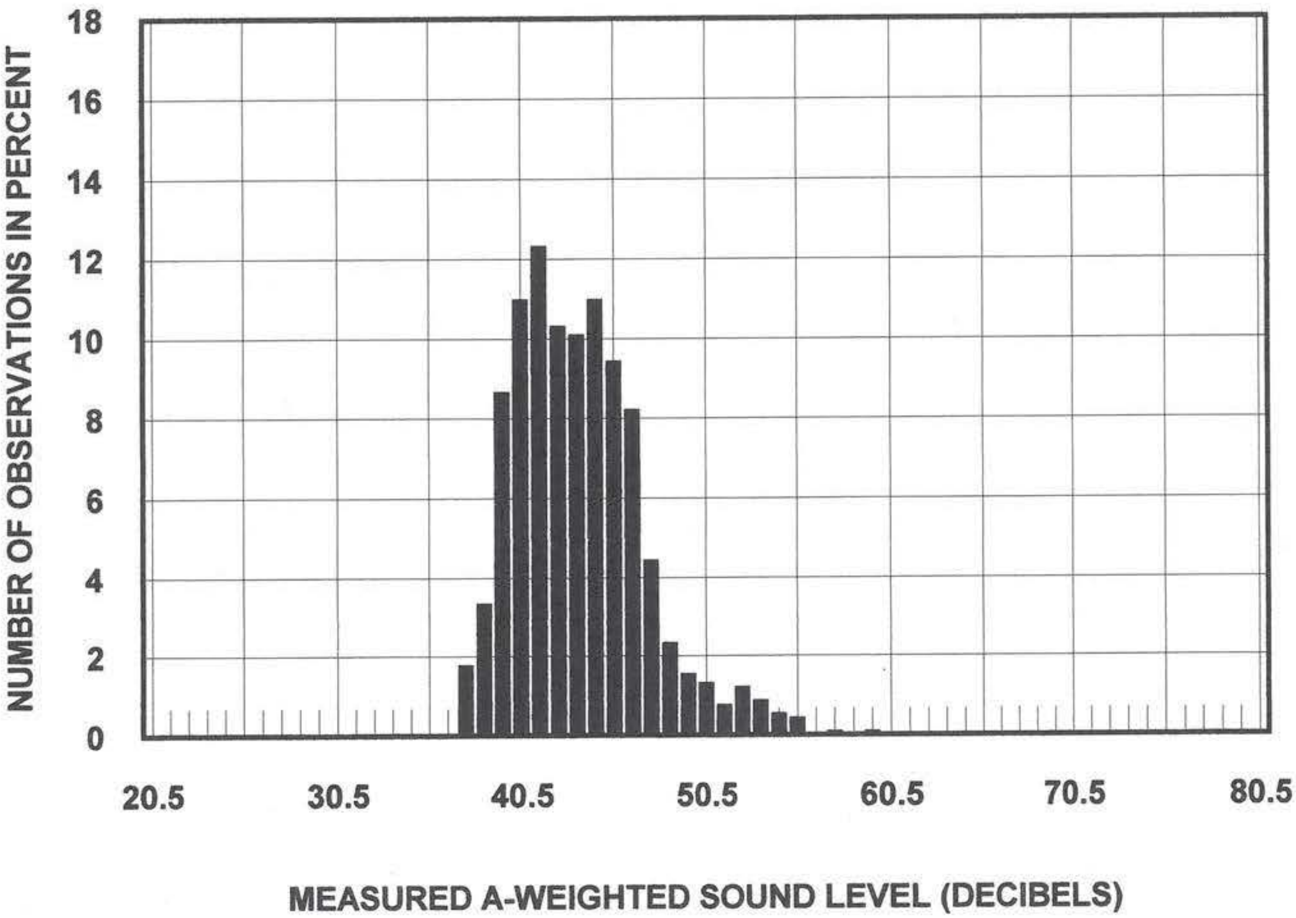
DATE: MAY 15, 2023
TIME: 1059 - 1114 HOURS
METER RESPONSE: LAEQ



Lmax:	55.5 dBA
L10:	50.2 dBA
L50:	46.3 dBA
Leq:	47.4 dBA
Lmin:	40.1 dBA

FIGURE IV-2
HISTOGRAM OF MEASURED SOUND LEVELS AT UNIVERSITY OF THE NATIONS KONA; LOC CCT-2

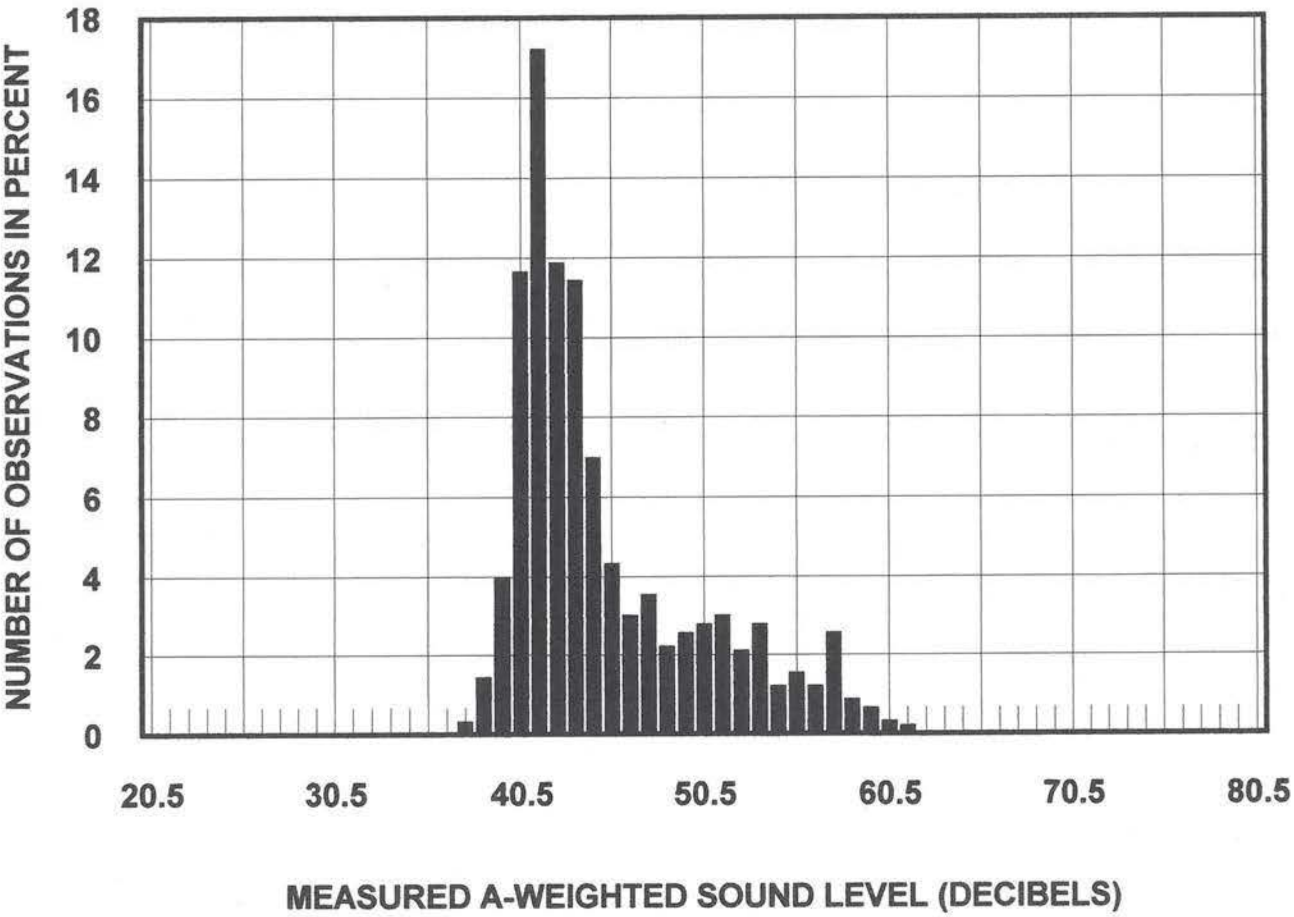
DATE: MAY 15, 2023
TIME: 1037 - 1052 HOURS
METER RESPONSE: LAEQ



Lmax:	59.1 dBA
L10:	47.9 dBA
L50:	43.3 dBA
Leq:	45.4 dBA
Lmin:	37.1 dBA

FIGURE IV-3
HISTOGRAM OF MEASURED SOUND LEVELS AT UNIVERSITY OF THE NATIONS KONA; LOC CCT-3

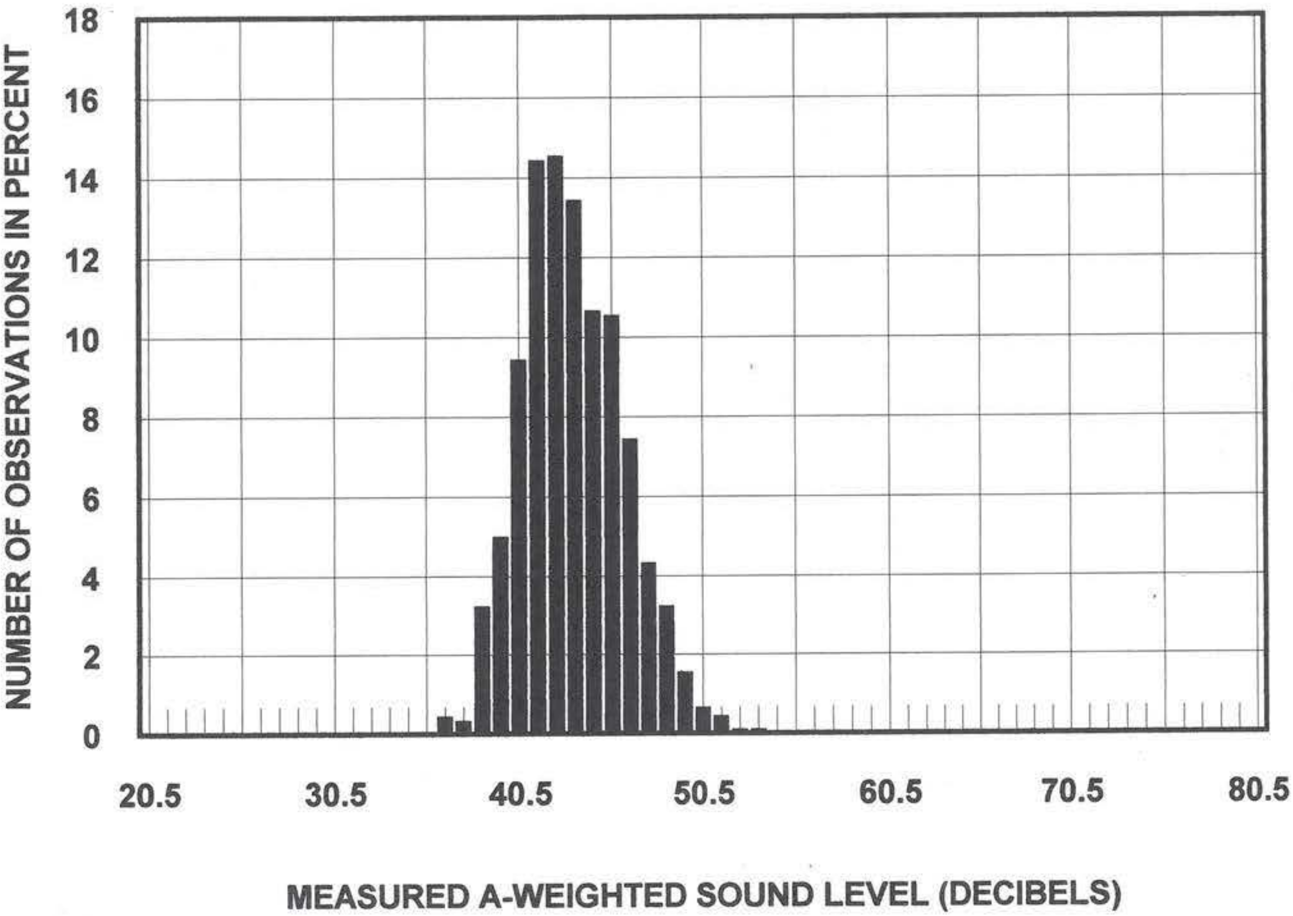
DATE: MAY 15, 2023
TIME: 1015 - 1030 HOURS
METER RESPONSE: LAEQ



Lmax: 62.0 dBA
L10: 53.6 dBA
L50: 43.3 dBA
Leq: 49.3 dBA
Lmin: 37.9 dBA

FIGURE IV-4
HISTOGRAM OF MEASURED SOUND LEVELS AT UNIVERSITY OF THE NATIONS KONA; LOC CCT-4

DATE: MAY 15, 2023
TIME: 0950 - 1005 HOURS
METER RESPONSE: LAEQ

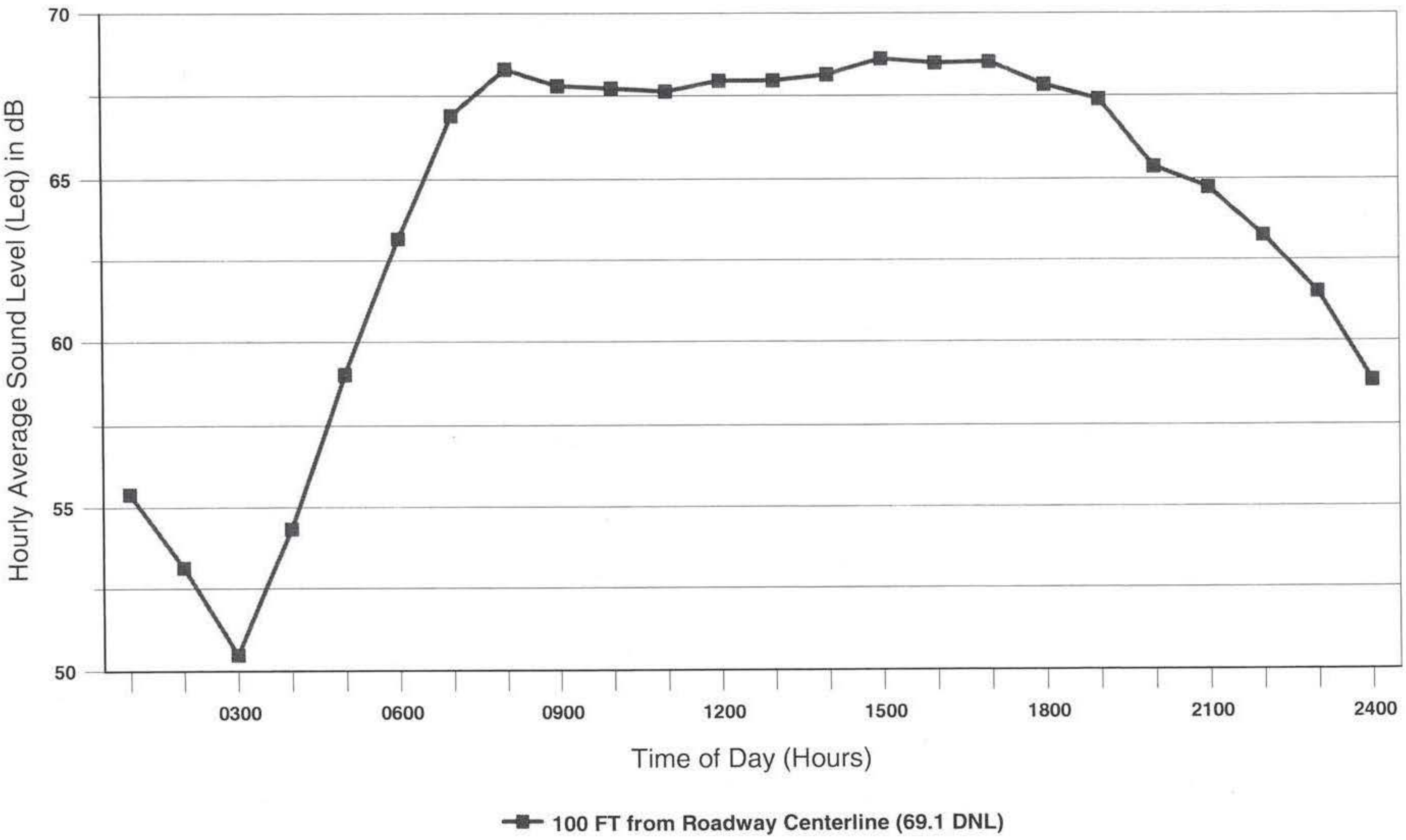


Lmax: 53.2 dBA
L10: 47.1 dBA
L50: 43.2 dBA
Leq: 44.4 dBA
Lmin: 36.1 dBA

FIGURE IV-5

HOURLY TRAFFIC NOISE LEVELS VS. TIME OF DAY

STA. B71001112038; QUEEN KAAHUMANU HWY. BETWEEN HUALALAI RD. AND NANI KAILUA DR.; OCTOBER 24, 2019



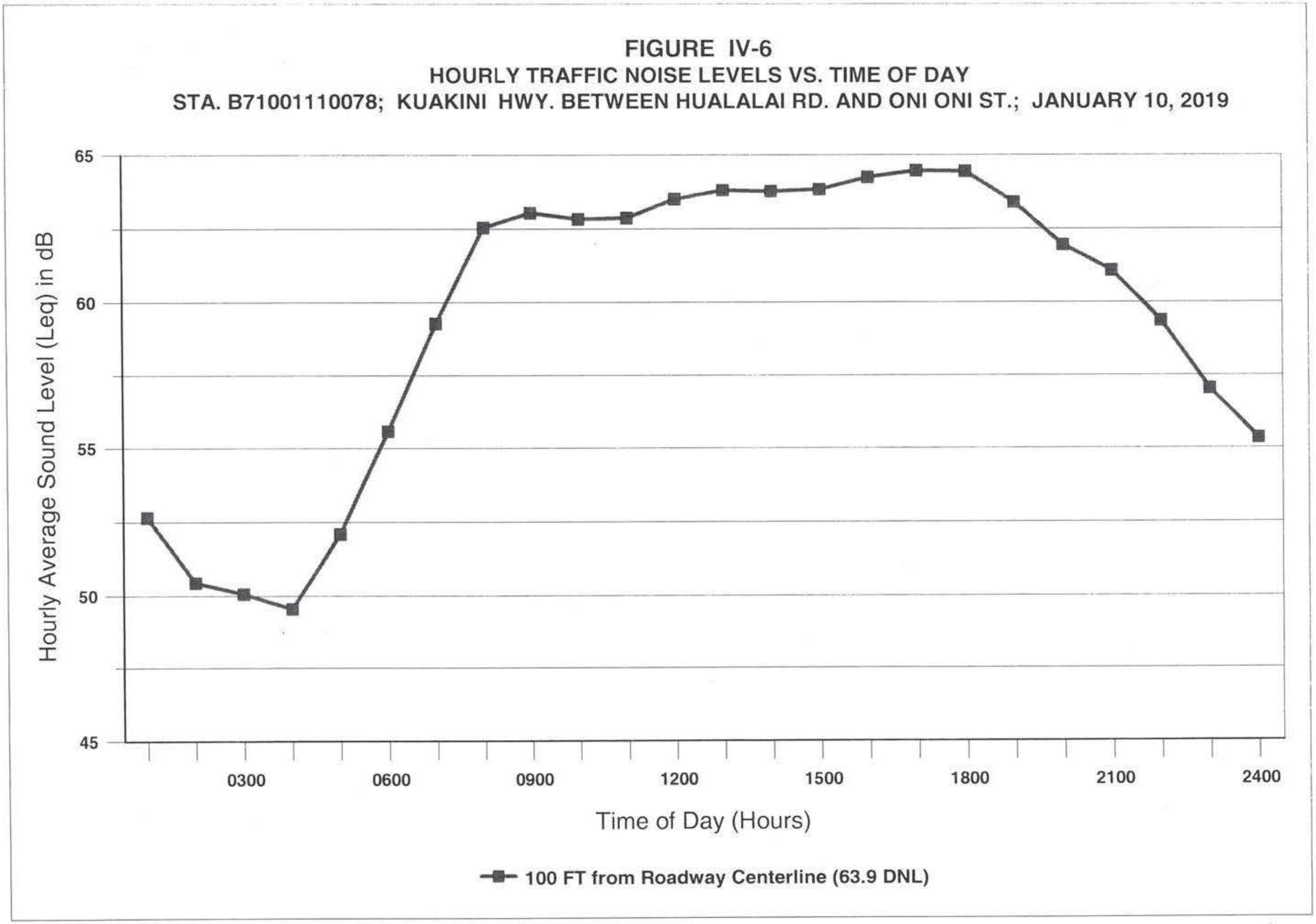
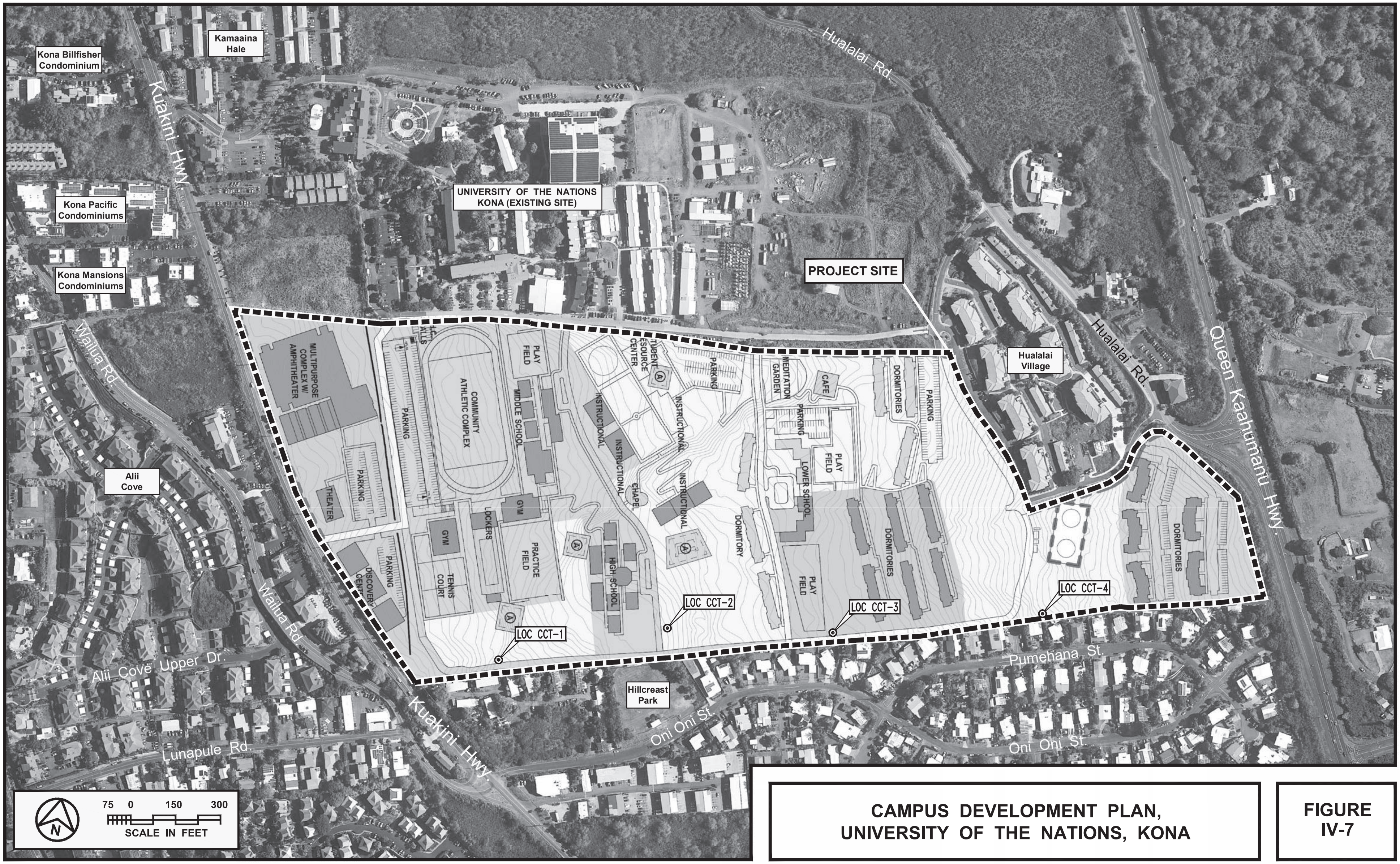


FIGURE IV-6
HOURLY TRAFFIC NOISE LEVELS VS. TIME OF DAY
STA. B71001110078; KUAKINI HWY. BETWEEN HUALALAI RD. AND ONI ONI ST.; JANUARY 10, 2019
Hourly Average Sound Level (Leq) in dB
65
60
55
50
45
0300
0600
0900
1200
1500
1800
2100
2400
Time of Day (Hours)
100 FT from Roadway Centerline (63.9 DNL)

evaluation of possible traffic noise impacts was made.

Estimates of potential noise levels from proposed project outdoor facilities (play fields, tennis courts, practice field, and community athletic complex) shown in Figure IV-7 were made and compared with existing background noise levels. Risks of potential noise impacts from the proposed outdoor facilities at neighboring noise sensitive receptors were provided.

Calculations of average exterior and interior noise levels from construction activities were performed for typical naturally ventilated and air conditioned dwellings. Predicted noise levels were compared with existing background ambient noise levels, and the potential for noise impacts was assessed.



CAMPUS DEVELOPMENT PLAN,
UNIVERSITY OF THE NATIONS, KONA

FIGURE IV-7

CHAPTER V. EXISTING ACOUSTICAL ENVIRONMENT

The existing background ambient noise levels within the project site are slightly greater than the FHA/HUD 65 DNL standard for noise sensitive receptors along the mauka (east) and makai (west) ends of the project site. Traffic along Queen Kaahumanu Highway controls the background noise levels at the mauka end of the project site, and diminishes to approximately 65 DNL at the location of the planned dormitories fronting the highway. On the makai side of the project site, traffic along Kuakini Highway controls existing noise levels which also diminish from approximately 65 DNL at approximately 68 feet from that highway's centerline with increasing distances from Kuakini Highway toward the center of the project site. Beyond the existing university campus to the north, traffic on Hualalai Road controls existing background noise levels between its intersections with Queen Kaahumanu Highway and Kuakini Highway.

Traffic and background ambient noise measurements were obtained in May 2023 at seven locations (A, B, C, CCT-1, CCT-2, CCT-3, and CCT-4) in the project environs. These measurement locations are shown in Figure I-1. The results of the traffic and background ambient noise measurements are summarized in Table IV-1 and Figures IV-1 through IV-4, with measurement locations shown in Figures I-1 and IV-7. The measurement locations were all located at ground level. As shown in Table IV-1, correlation between measured and predicted traffic noise levels was good at traffic noise measurement locations A, B, and C. The Traffic Noise Model's "Hard Soil" propagation loss factor was used to obtain the good correlation. The measurement results along the south boundary of the project area were obtained on a Sunday afternoon, and did not include significant contributions from traffic noise. Intermittently audible construction and traffic noise were present at Location CCT-1, with aircraft flyovers causing the higher noise levels at Location CCT-2. Dog barking and human activities at a nearby residence were the sources of the louder noise events measured at Location CCT-3. Traffic noise from Queen Kaahumanu Highway was not audible at Location CCT-4.

Calculations of existing traffic noise levels during the AM and PM peak traffic hours are presented in Table V-1. The hourly Leq (or Equivalent Sound Level) contribution from each roadway section in the project environs was calculated for comparison with forecasted traffic noise levels with and without the project. The existing setback distances from the roadways' centerlines to their associated 65, 70, and 75 DNL contours were also calculated as shown in Table V-2. The contour line setback distances do not take into account noise shielding effects or the additive contributions of traffic noise from intersecting street sections.

The existing traffic noise levels in the project environs along Queen Kaahumanu Highway are in the "Significant Exposure, Normally Unacceptable" category, and at or greater than 65 DNL at the first row of existing homes within approximately 148 feet from the centerline and on the mauka and makai sides of that highway. Along Kuakini

TABLE V-1

EXISTING (CY 2023) TRAFFIC VOLUMES AND NOISE LEVELS ALONG ROADWAYS IN PROJECT AREA (AM OR PM PEAK HOUR)

LOCATION	SPEED (MPH)	TOTAL VPH	******* VOLUMES (VPH) ********* AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	200' Leq
Kuakini Hwy. N. of Hualalai Rd. (PM)	42	1,993	1,957	22	14	69.9	66.2	62.2
Kuakini Hwy. S. of Hualalai Rd. (PM)	42	1,434	1,408	16	10	68.3	64.4	60.6
Kuakini Hwy. N. of North Entrance Rd. (PM)	42	1,250	1,227	14	9	67.7	63.8	60.0
Kuakini Hwy. S. of North Entrance Rd. (PM)	42	1,155	1,134	13	8	67.2	63.4	59.5
Kuakini Hwy. N. of South Entrance Rd. (PM)	42	1,155	1,134	13	8	67.2	63.4	59.5
Kuakini Hwy. S. of South Entrance Rd. (PM)	42	1,155	1,134	13	8	67.2	63.4	59.5
Kuakini Hwy. W. of Q. Kaahumanu Hwy. (PM)	42	967	949	11	7	66.4	62.6	58.7
Q. Kaahumanu Hwy. S. of Kuakini Hwy. (PM)	43	2,547	2,473	43	31	71.3	67.6	63.7
Q. Kaahumanu Hwy. N. of Kuakini Hwy. (AM)	43	1,748	1,697	30	21	69.6	66.0	62.0
Q. Kaahumanu Hwy. S. of Hualalai Rd. (AM)	43	2,081	2,021	35	25	70.4	66.7	62.8
Q. Kaahumanu Hwy. N. of Hualalai Rd. (AM)	43	1,931	1,875	33	23	70.0	66.4	62.5
Q. Kaahumanu Hwy. S. of Nani Kailua Dr. (AM)	43	1,896	1,841	32	23	70.0	66.3	62.4
Q. Kaahumanu Hwy. N. of Nani Kailua Dr. (AM)	43	2,083	2,023	35	25	70.4	66.7	62.8
Hualalai Rd. W. of Kuakini Hwy. (PM)	30	508	485	23	0	60.1	56.5	52.7
Hualalai Rd. E. of Kuakini Hwy. (PM)	30	503	480	23	0	60.0	56.5	52.7
Hualalai Rd. W. of Nani Kailua Rd. (AM)	30	393	375	18	0	59.0	55.4	51.6
Hualalai Rd. E. of Nani Kailua Rd. (AM)	30	266	254	12	0	57.3	53.7	49.9
Hualalai Rd. W. of Driveway (AM)	30	270	258	12	0	57.3	53.7	49.9
Hualalai Rd. E. of Driveway (AM)	30	262	250	12	0	57.2	53.6	49.8
Hualalai Rd. W. of Q. Kaahumanu Hwy. (AM)	30	262	250	12	0	57.2	53.6	49.8
North Entrance Driveway E. of Kuakini Hwy. (AM	25	226	216	10	0	54.8	51.3	47.5
South Entrance Driveway E. of Kuakini Hwy. (PM	N/A	0	0	0	0	0	0	0

Notes:

1. Traffic noise levels calculated for ground level receptors.
2. Hard soil and unobstructed field-of-view conditions assumed.

TABLE V-2

EXISTING AND CY 2050 DISTANCES TO 65, 70, AND 75 DNL CONTOURS

STREET SECTION	65 DNL SETBACK (FT)		70 DNL SETBACK (FT)		75 DNL SETBACK (FT)	
	EXISTING	CY 2050	EXISTING	CY 2050	EXISTING	CY 2050
Kuakini Hwy. N. of Hualalai Rd.	113	140	45	56	18	21
Kuakini Hwy. S. of Hualalai Rd.	82	106	34	43	14	18
Kuakini Hwy. N. of North Entrance Rd.	74	97	30	40	13	16
Kuakini Hwy. S. of North Entrance Rd.	68	91	27	36	< 12	14
Kuakini Hwy. N. of South Entrance Rd.	68	91	27	36	< 12	14
Kuakini Hwy. S. of South Entrance Rd.	68	86	27	35	< 12	14
Kuakini Hwy. W. of Q. Kaahumanu Hwy.	59	74	24	29	< 12	11
Q. Kaahumanu Hwy. S. of Kuakini Hwy.	180	222	73	93	29	35
Q. Kaahumanu Hwy. N. of Kuakini Hwy.	137	171	54	69	21	26
Q. Kaahumanu Hwy. S. of Hualalai Rd.	156	193	63	79	25	30
Q. Kaahumanu Hwy. N. of Hualalai Rd.	148	183	58	75	22	29
Q. Kaahumanu Hwy. S. of Nani Kailua Dr.	145	183	58	74	23	29
Q. Kaahumanu Hwy. N. of Nani Kailua Dr.	156	196	63	80	25	31
Hualalai Rd. W. of Kuakini Hwy.	18	21	< 12	< 12	< 12	< 12
Hualalai Rd. E. of Kuakini Hwy.	17	21	< 12	< 12	< 12	< 12
Hualalai Rd. W. of Nani Kailua Rd.	18	21	< 12	< 12	< 12	< 12
Hualalai Rd. E. of Nani Kailua Rd.	13	15	< 12	< 12	< 12	< 12
Hualalai Rd. W. of Driveway	13	15	< 12	< 12	< 12	< 12
Hualalai Rd. E. of Driveway	13	15	< 12	< 12	< 12	< 12
Hualalai Rd. W. of Q. Kaahumanu Hwy.	13	15	< 12	< 12	< 12	< 12
North Entrance Driveway E. of Kuakini Hwy.	< 12	< 12	< 12	< 12	< 12	< 12
South Entrance Driveway E. of Kuakini Hwy.	N/A	< 12	N/A	< 12	N/A	< 12

Highway, where the majority of front row receptors are in the commercial or resort category, existing traffic noise levels are in the "Moderate Exposure, Normally Acceptable" category at distances beyond 68 to 82 feet from the centerline of that roadway. The existing traffic noise levels in the project environs along Hualalai Road are also in the "Moderate Exposure, Normally Acceptable" category and less than 65 DNL at 13 to 18 feet from that roadway's centerline.

Existing traffic noise levels probably exceed the FHA/HUD 65 DNL standard at the front row homes of Kamaaina Hale located beyond the northwest corner of the existing University of the Nations, Kona campus. Exceedances of the 65 DNL standard probably occurs at the front row midrise units makai of the campus and across Kuakini Highway (Kona Pacific and Kona Mansions). Existing traffic noise levels also exceed the FHA/HUD 65 DNL standard at the front row lots of the residences at the Nani Kailua Drive intersection of Queen Kaahumanu Highway, and possibly at the elevated residences which front Queen Kaahumanu Highway at the mauka end of Oni Oni Street. Front row lots on the makai side of Queen Kaahumanu Highway are typically depressed from the highway surface, and ground floor receptors at these lots probably benefit from the noise shielding effects of the elevated highway's makai shoulder.

In the center portion of the project site and in areas removed from the highways to the east and west, existing background noise levels drop to levels below 50 dBA with steady noise levels of approximately 45 dBA. The sounds of birds and intermittent distant traffic and aircraft noise sources are the louder noise sources. Existing background noise levels should be compatible with the planned school and dormitory buildings on the project site.

CHAPTER VI. FUTURE NOISE ENVIRONMENT

Predictions of future traffic noise levels were made using the traffic volume assignments of Reference 7 for CY 2050 with and without the proposed project. The future projections of project plus non-project traffic noise levels on the roadways which would service the project are shown in Table VI-1 for the AM and PM peak hours of traffic, under the Build Alternative. Predicted increases in the setback distances to the 65, 70, and 75 DNL contours are shown in Table V-2. The separate non-project and project traffic noise contributions under the Build Alternative are shown in Table VI-2.

Very small changes in traffic noise levels (0.0 to 0.1 DNL) are expected along Queen Kaahumanu Highway in the project environs between CY 2023 and 2050 as a result of project traffic. The growth in non-project traffic by CY 2050 is predicted to result in traffic noise level increases of 1.1 to 1.3 DNL along Queen Kaahumanu Highway. Slightly smaller increases in future traffic noise levels from non-project traffic (0.8 to 0.9 DNL) are predicted to occur along Kuakini Highway. Project traffic along Kuakini Highway are predicted to increase existing traffic noise levels by 0.4 to 0.6 DNL at project build-out in CY 2050. The very small increases in future traffic noise levels caused by the project will be difficult to measure or perceive over the 27 year forecast period.

Along Hualalai Road, increases in future traffic noise levels will be difficult to measure, with future increases by CY 2050 associated primarily with non-project traffic. Very small increases (0 to 0.1 DNL) in traffic noise levels from project traffic are predicted along Hualalai Road, with non-project traffic increasing noise levels by 0.7 to 0.8 DNL.

The dominant traffic noise sources in the project environs will continue to be traffic along Queen Kaahumanu Highway and Kuakini Highway, with the increases in future traffic noise levels being relatively small along these two roadways over a 27 year period. Future traffic noise levels at the planned Middle School and High School buildings are not expected to exceed 55 DNL, and are not expected to exceed 50 DNL at the Lower School buildings. Both the planned upper and lower Dormitory buildings are predicted to be outside the 65 DNL traffic noise contour, with the lower Dormitory buildings located near the 55 DNL traffic noise contour.

The planned Multi-Purpose Complex is anticipated to be air conditioned, which should attenuate traffic noise entering the building as well as attenuate any sound splillover to neighboring properties outside that building. The Discovery Center buildings will probably be exposed to future traffic noise levels greater than 65 DNL, and they should also be closed and air conditioned if noise sensitive uses are planned within those buildings. Overall, the school facilities are planned to be located near the central portion of the property and at relatively large distances from the two highways along the mauka and makai ends of the property, at locations which will be removed from highway traffic noise sources.

TABLE VI-1

FUTURE (CY 2050) TRAFFIC VOLUMES AND NOISE LEVELS ALONG ROADWAYS IN PROJECT AREA (AM OR PM PEAK HOUR, WITH THE PROJECT)

LOCATION	SPEED (MPH)	TOTAL VPH	******* VOLUMES (VPH) *********			50' Leq	100' Leq	200' Leq
			AUTOS	M TRUCKS	H TRUCKS			
Kuakini Hwy. N. of Hualalai Rd. (PM)	42	2,640	2,593	29	18	71.1	67.5	63.4
Kuakini Hwy. S. of Hualalai Rd. (PM)	42	2,000	1,964	22	14	69.7	65.8	62.1
Kuakini Hwy. N. of North Entrance Rd. (PM)	42	1,780	1,748	20	12	69.2	65.3	61.6
Kuakini Hwy. S. of North Entrance Rd. (PM)	42	1,661	1,631	18	12	68.7	65.0	61.0
Kuakini Hwy. N. of South Entrance Rd. (PM)	42	1,661	1,631	18	12	68.7	65.0	61.0
Kuakini Hwy. S. of South Entrance Rd. (PM)	42	1,578	1,550	17	11	68.5	64.7	60.8
Kuakini Hwy. W. of Q. Kaahumanu Hwy. (PM)	42	1,291	1,268	14	9	67.6	63.9	59.9
Q. Kaahumanu Hwy. S. of Kuakini Hwy. (PM)	43	3,417	3,318	58	41	72.5	68.9	64.9
Q. Kaahumanu Hwy. N. of Kuakini Hwy. (AM)	43	2,350	2,282	40	28	70.9	67.3	63.3
Q. Kaahumanu Hwy. S. of Hualalai Rd. (AM)	43	2,770	2,690	47	33	71.6	68.0	64.0
Q. Kaahumanu Hwy. N. of Hualalai Rd. (AM)	43	2,592	2,517	44	31	71.3	67.7	63.7
Q. Kaahumanu Hwy. S. of Nani Kailua Dr. (AM)	43	2,544	2,470	43	31	71.3	67.6	63.7
Q. Kaahumanu Hwy. N. of Nani Kailua Dr. (AM)	43	2,792	2,711	47	34	71.7	68.0	64.1
Hualalai Rd. W. of Kuakini Hwy. (PM)	30	617	589	28	0	60.9	57.3	53.5
Hualalai Rd. E. of Kuakini Hwy. (PM)	30	619	591	28	0	60.9	57.3	53.5
Hualalai Rd. W. of Nani Kailua Rd. (AM)	30	481	459	22	0	59.8	56.3	52.5
Hualalai Rd. E. of Nani Kailua Rd. (AM)	30	319	304	15	0	58.1	54.5	50.7
Hualalai Rd. W. of Driveway (AM)	30	321	306	15	0	58.1	54.5	50.7
Hualalai Rd. E. of Driveway (AM)	30	311	297	14	0	57.9	54.3	50.5
Hualalai Rd. W. of Q. Kaahumanu Hwy. (AM)	30	312	298	14	0	57.9	54.3	50.6
North Entrance Driveway E. of Kuakini Hwy. (AM)	25	273	260	13	0	55.8	52.2	48.5
South Entrance Driveway E. of Kuakini Hwy. (PM)	25	327	312	15	0	56.5	53.0	49.2

Notes:

1. Traffic noise levels calculated for ground level receptors.
2. Hard soil and unobstructed field-of-view conditions assumed.

TABLE VI-2

CALCULATIONS OF PROJECT AND NON-PROJECT TRAFFIC NOISE CONTRIBUTIONS (CY 2050) (AM OR PM PEAK HOUR LEQ OR DNL)

STREET SECTION	NOISE LEVEL INCREASE DUE TO: NON-PROJECT TRAFFIC	PROJECT TRAFFIC
Kuakini Hwy. N. of Hualalai Rd. (PM)	0.8	0.4
Kuakini Hwy. S. of Hualalai Rd. (PM)	0.8	0.6
Kuakini Hwy. N. of North Entrance Rd. (PM)	0.9	0.6
Kuakini Hwy. S. of North Entrance Rd. (PM)	0.9	0.6
Kuakini Hwy. N. of South Entrance Rd. (PM)	0.9	0.6
Kuakini Hwy. S. of South Entrance Rd. (PM)	0.9	0.4
Kuakini Hwy. W. of Q. Kaahumanu Hwy. (PM)	0.8	0.4
Q. Kaahumanu Hwy. S. of Kuakini Hwy. (PM)	1.1	0.1
Q. Kaahumanu Hwy. N. of Kuakini Hwy. (AM)	1.3	0.0
Q. Kaahumanu Hwy. S. of Hualalai Rd. (AM)	1.2	0.0
Q. Kaahumanu Hwy. N. of Hualalai Rd. (AM)	1.3	0.0
Q. Kaahumanu Hwy. S. of Nani Kailua Dr. (AM)	1.3	0.0
Q. Kaahumanu Hwy. N. of Nani Kailua Dr. (AM)	1.2	0.1
Hualalai Rd. W. of Kuakini Hwy. (PM)	0.8	0.0
Hualalai Rd. E. of Kuakini Hwy. (PM)	0.8	0.1
Hualalai Rd. W. of Nani Kailua Rd. (AM)	0.8	0.0
Hualalai Rd. E. of Nani Kailua Rd. (AM)	0.8	0.0
Hualalai Rd. W. of Driveway (AM)	0.8	0.0
Hualalai Rd. E. of Driveway (AM)	0.7	0.0
Hualalai Rd. W. of Q. Kaahumanu Hwy. (AM)	0.7	0.0
North Entrance Driveway E. of Kuakini Hwy. (AM)	0.0	1.0
South Entrance Driveway E. of Kuakini Hwy. (PM)	N/A	56.5

Note: Large increase for South Entrance Driveway represents future traffic noise level at 50 feet from new roadway's centerline.

CHAPTER VII. DISCUSSION OF PROJECT RELATED NOISE IMPACTS AND POSSIBLE MITIGATION MEASURES

Traffic Noise. Existing traffic noise levels along Queen Kaahumanu Highway and Kuakini Highway are expected to remain the dominant noise sources in the project environs through CY 2050. Traffic noise impacts along those two roadways will continue to occur at existing noise sensitive receptors which are not provided with noise mitigation measures such as sound attenuating walls and/or closure and air conditioning. The noise sensitive receptors previously identified along Queen Kaahumanu Highway and Kuakini Highway where traffic noise levels exceed the FHA/HUD 65 DNL standard will continue to remain as such, with future traffic noise levels increasing by 1 to 2 DNL by CY 2050. In addition, front row buildings at the Kona Billfisher will be exposed to traffic noise levels greater then 65 DNL from Kuakini Highway by CY 2050.

Project related traffic along Queen Kaahumanu Highway and Kuakini Highway are not expected to cause significant increases in future traffic noise levels. The largest increases (of 0.6 DNL) in project related traffic noise are predicted to occur along Kuakini Highway, with project related traffic noise increases limited to 0.1 DNL along Queen Kaahumanu Highway. For these reasons, traffic noise mitigation measures should not be required.

On-Site Noise Sources. The potential noise from activities at the outdoor play fields, practice field, tennis courts, and Community Athletic Complex may disturb neighboring residences along the project's south property line. Noise levels associated with these outdoor facilities can be intermittently high due to the shouting and screaming which may occur during activities at these outdoor facilities. The residents at the neighboring properties to the south (where background noise levels are relatively low) may be annoyed by these outdoor activities. Noise sensitive neighbors to the west across Kuakini Highway are less likely to be annoyed by these outdoor activities due to their larger buffer distances from the outdoor facilities and their higher background noise levels associated with traffic along Kuakini Highway. In addition, commercial properties are the closest neighbors to the southwest.

Evaluations of the potential risk of noise complaints (or community reaction) from the residents south of the project were made by comparing the estimated DNL value of potential noise from the outdoor activity areas shown in Figure IV-7 with non-project background noise levels in accordance with the methodology described in Reference 4. The number of noise complaints tend to be less than the number of persons annoyed by a noise source, and no community reaction can be expected if the normalized DNL of the objectionable noise source(s) are 5 DNL less than the DNL of the background noise level without the objectionable noise source (see Page D-17, Reference 4). Adjacent lands across the other project boundaries contain properties to the north and east which are owned by the university. Existing background noise levels along the project's south property line at the neighboring residences were estimated to range from 44 to 49 DNL based on the measurement results shown in Figures IV-1 to IV-4, where their measured Leq values were assumed to be equal to their DNL values. Figures VII-1 through VII-4 depict the relationships between the measured instantaneous background noise levels and their resulting Leq (or average) values at the four measurement locations along the south property boundary of the project site. The sounds of human voices or during tennis court play will exhibit similar variations in their instantaneous sound levels and their average (or Leq) values.

Table VII-1 presents the results of the predicted average (or Leq) and normalized DNL values from the University of the Nations Kona's planned six outdoor activity areas at a common reference distance of 200 feet from the geometric centers of the six planned activity areas. The DNL values are typically lower than the average noise levels during a period of noisy activity because of the DNL metric is based on annually averaged (over 365 days of the year) sound levels rather than average noise levels during the activity period. The estimated hours of noisy activities per day of usage at each or the planned activity areas are shown in Table VII-1, as well as the estimated number of days per calendar year that each activity area may be used.

The reference DNL values shown in Table VII-1 from each of the six planned activity areas were used to calculate the total DNL value from all planned activities at each of the four background noise measurement locations (CCT-1 through CCT-4) along the south property line. These total normalized DNL values associated with the planned outdoor activity areas are shown in Table VII-2 and compared to the measured background noise levels. Where the total normalized DNL values are not at least 5 DNL lower than the background noise levels shown in the table, community responses in the form of a noise complaint may occur, as indicated from the methodology contained in Reference 4. Noise mitigation measures in the form of sound attenuating walls along the south property line and in the vicinity of the Lower School's South Play Field and the High School Practice Field should be evaluated. In addition, a 5 DNL reduction in the normalized DNL values of the outdoor activities shown in Table VII-2 may occur if the neighboring community "are aware that bona fide efforts are being made to control the noise" and " the noise maker's relations with the community are good" (from Table D-7 of Reference 4). While risks of noise complaints apparently exist from the outdoor activities on the play and practice fields, the predicted DNL values associated with these are well below the unconditionally acceptable 55 DNL level identified in Reference 4.

The planned Amphitheater is anticipated to be fully enclosed which should allow for sound attenuation measures which eliminate sound spillover to adjacent land uses and neighboring properties.

Noise mitigation measures which limit the noise from fixed mechanical equipment to those allowed by the State Department of Health (Reference 5) should be incorporated into the project. In addition, a public address system, if installed at the Community Athletic Complex should be designed to minimize sound spillover into adjacent properties.

FIGURE VII-1. 15 MINUTE DBA VS. TIME RECORD AT UNIVERSITY OF THE NATIONS KONA; LOC CCT-1 (1059 TO 1114 HOURS; MAY 15, 2023; LEQ = 47.4)

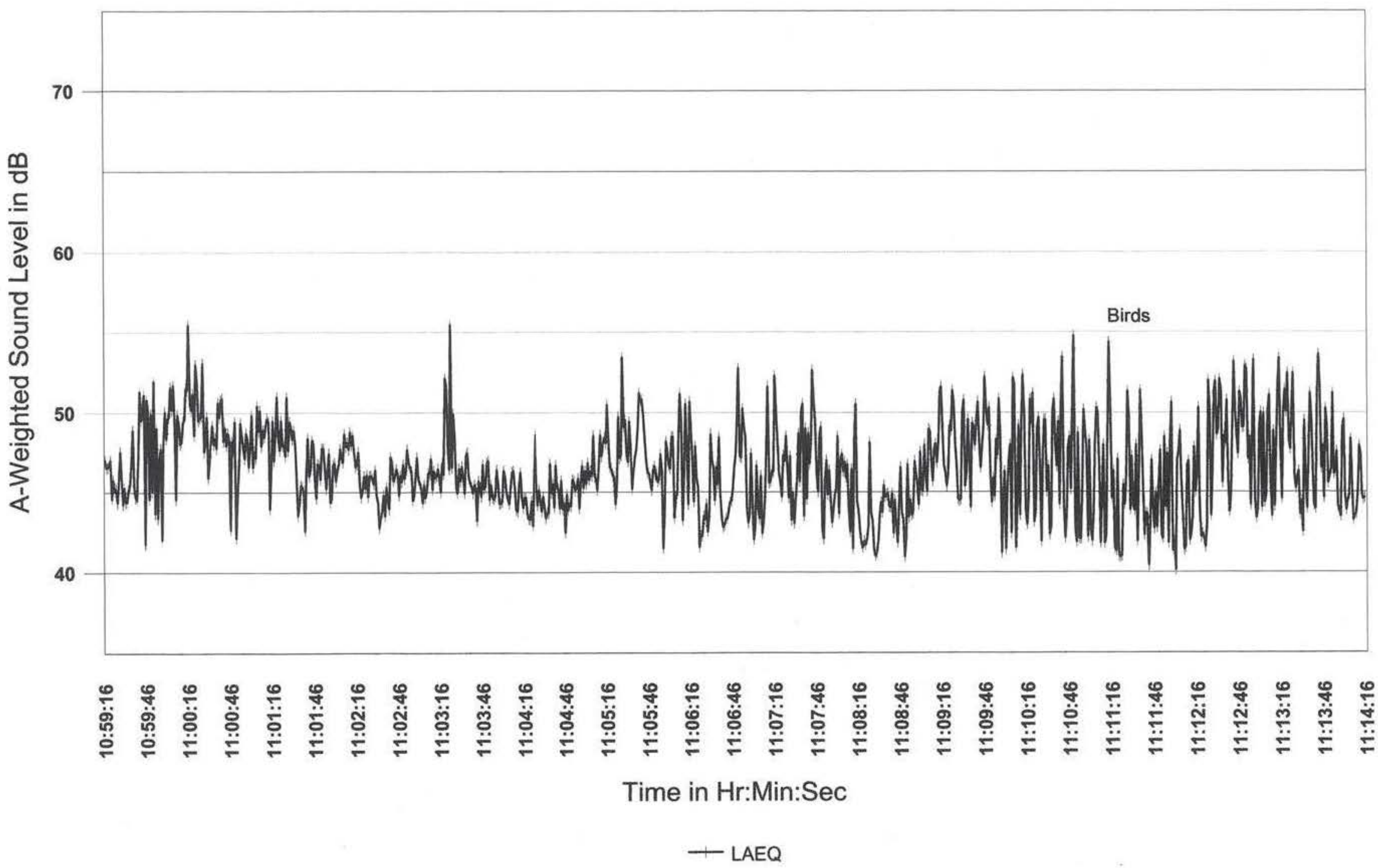


FIGURE VII-2. 15 MINUTE DBA VS. TIME RECORD AT UNIVERSITY OF THE NATIONS KONA; LOC CCT-2 (1037 TO 1052 HOURS; MAY 15, 2023; LEQ = 45.4)

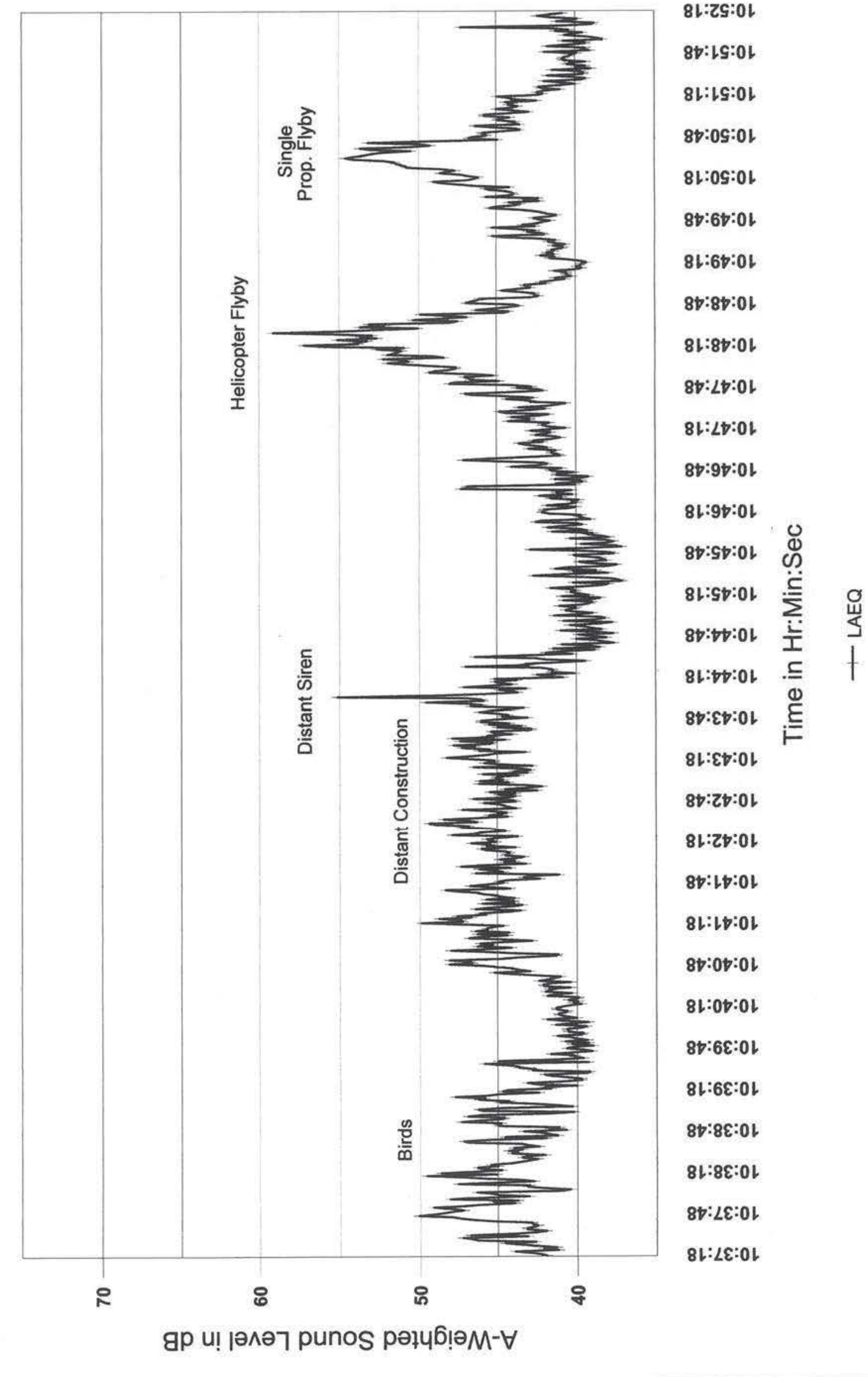


FIGURE VII-3. 15 MINUTE DBA VS. TIME RECORD AT UNIVERSITY OF THE NATIONS KONA; LOC CCT-3 (1015 TO 1030 HOURS; MAY 15, 2023; LEQ = 49.3)

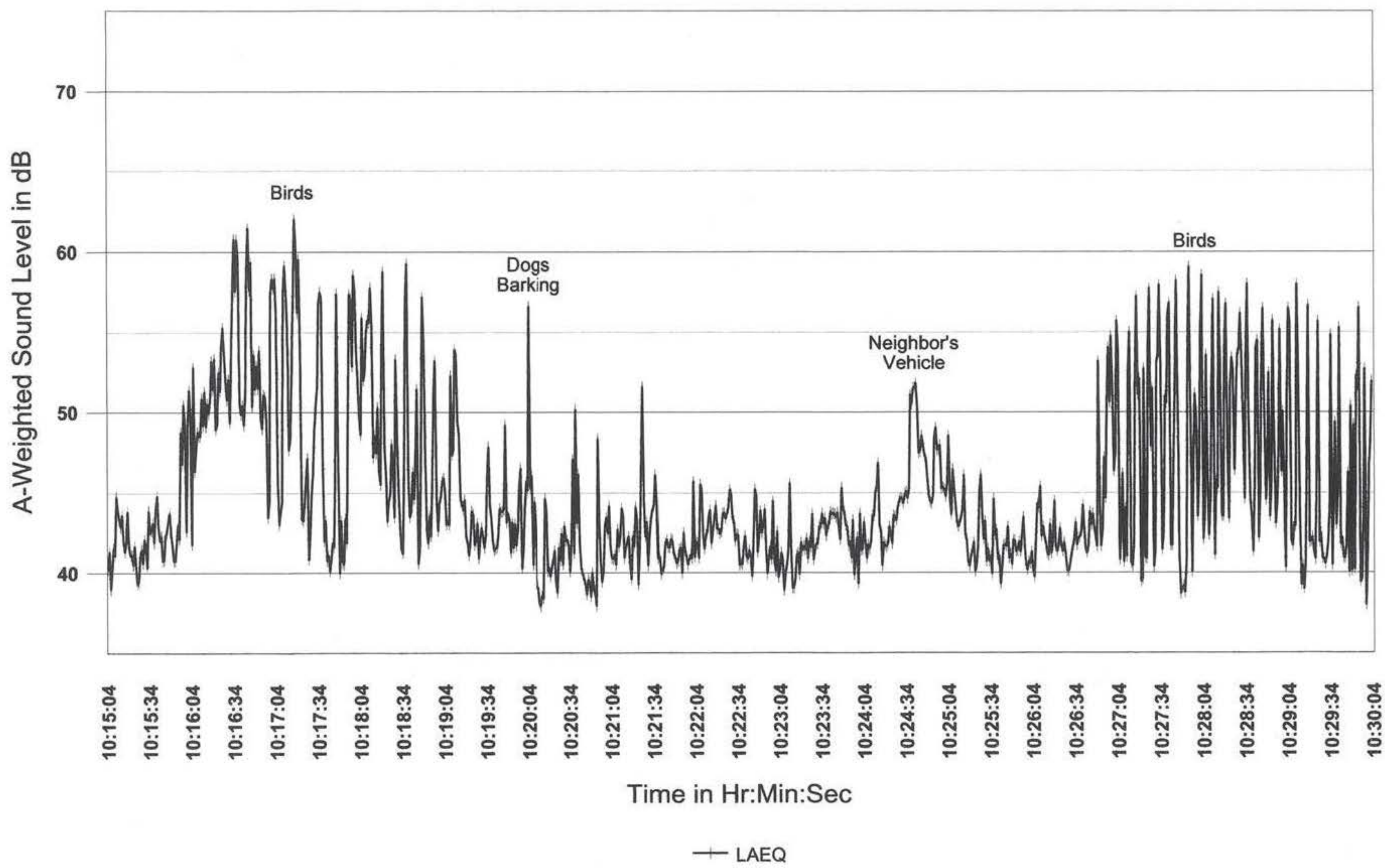


FIGURE VII-4. 15 MINUTE DBA VS. TIME RECORD AT UNIVERSITY OF THE NATIONS KONA; LOC CCT-4
(0950 TO 1005 HOURS; MAY 15, 2023; LEQ = 44.4)

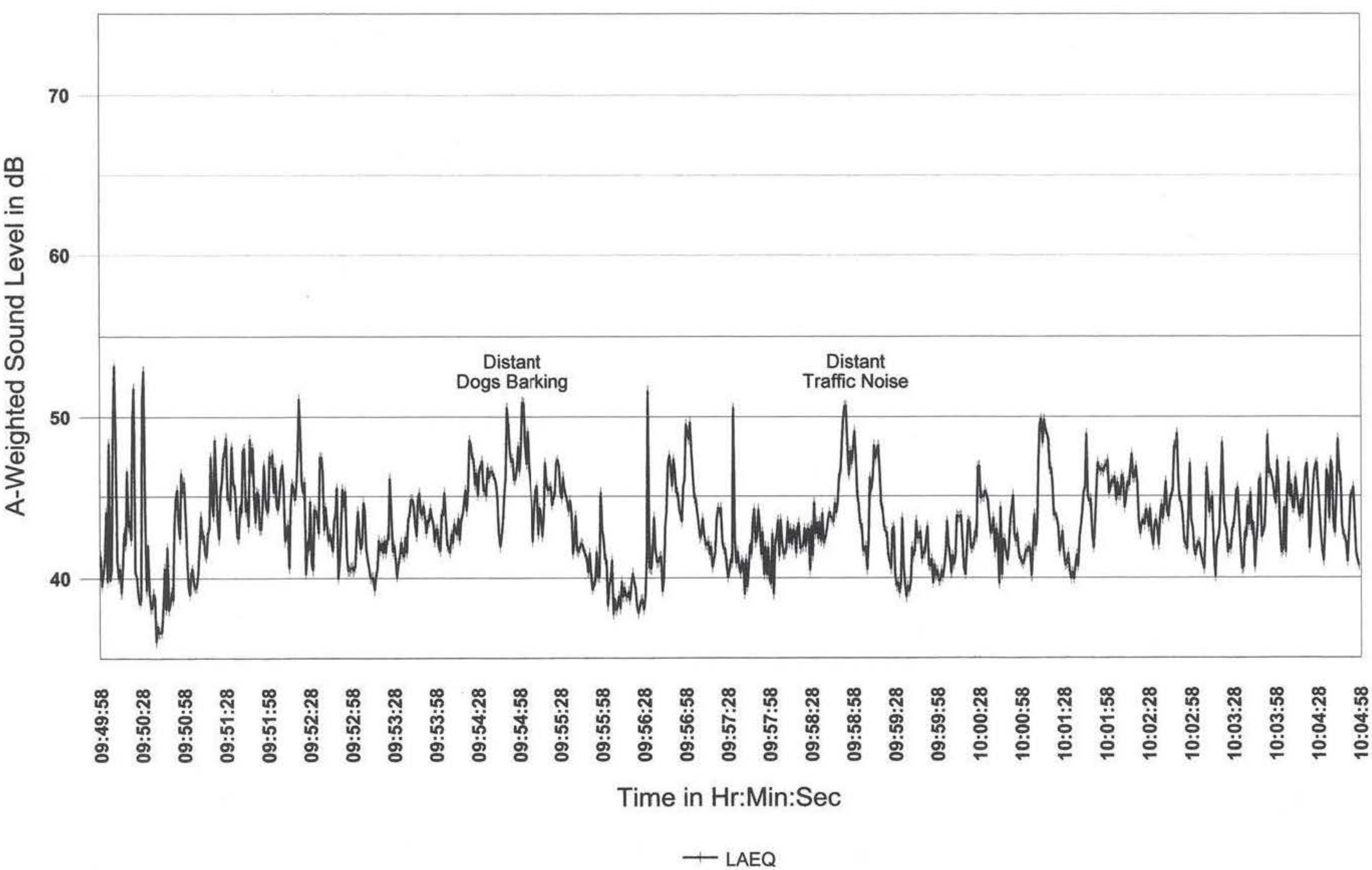


TABLE VII-1
OUTDOOR ACTIVITY AREAS AND PREDICTED AVERAGE
AND NORMALIZED DNL SOUND LEVELS AT 200 FEET DISTANCE

OUTDOOR ACTIVITY AREA	HOURS OF NOISY ACTIVITY PER DAY OF USE	AVERAGE (LEQ) OF ACTIVITY	TOTAL DAYS OF USE PER YEAR	NORMALIZED DNL OF ACTIVITY
Lower School Play Field (North)	3.96	58.4	250	48.9
Lower School Play Field (South)	3.96	58.4	250	48.9
Middle School Play Field	3.96	58.4	250	48.9
High School Practice Field	8.00	52.3	300	46.7
Community Athletic Complex (200 seat)	6.00	64.4	300	57.5
Tennis Courts	4.00	52.3	150	40.7

Note:
1. Average Activity Noise Levels (Leq and DNL) Predicted at 200 Feet from Center of Activity Area.
2. For Tennis Court play, DNL values normalized (increased by 5 dB) due to impulsive noise characteristic.

TABLE VII-2

COMPARISONS OF MEASURED BACKGROUND AND NORMALIZED ACTIVITY DNL VALUES AT SOUTH PROPERTY LINE MEASUREMENT LOCATIONS

MEASUREMENT	BACKGROUND	------ NORMALIZED DNL FROM OUTDOOR ACTIVITIES ------		COMMUNITY REACTION
LOCATION	NOISE DNL	DNL from All Sources	DNL from Dominant Noise Sources	THRESHOLD EXCEEDED?
CCT-1	47.4	49.7	47 DNL from H.S. Practice Field	YES
CCT-2	45.4	47.1	44 DNL from H.S. Practice Field	YES
CCT-3	49.3	50.6	50 DNL from L.S. Play Field (S.)	YES
CCT-4	44.4	38.8	35 DNL from L.S. Play Field (S.)	NO

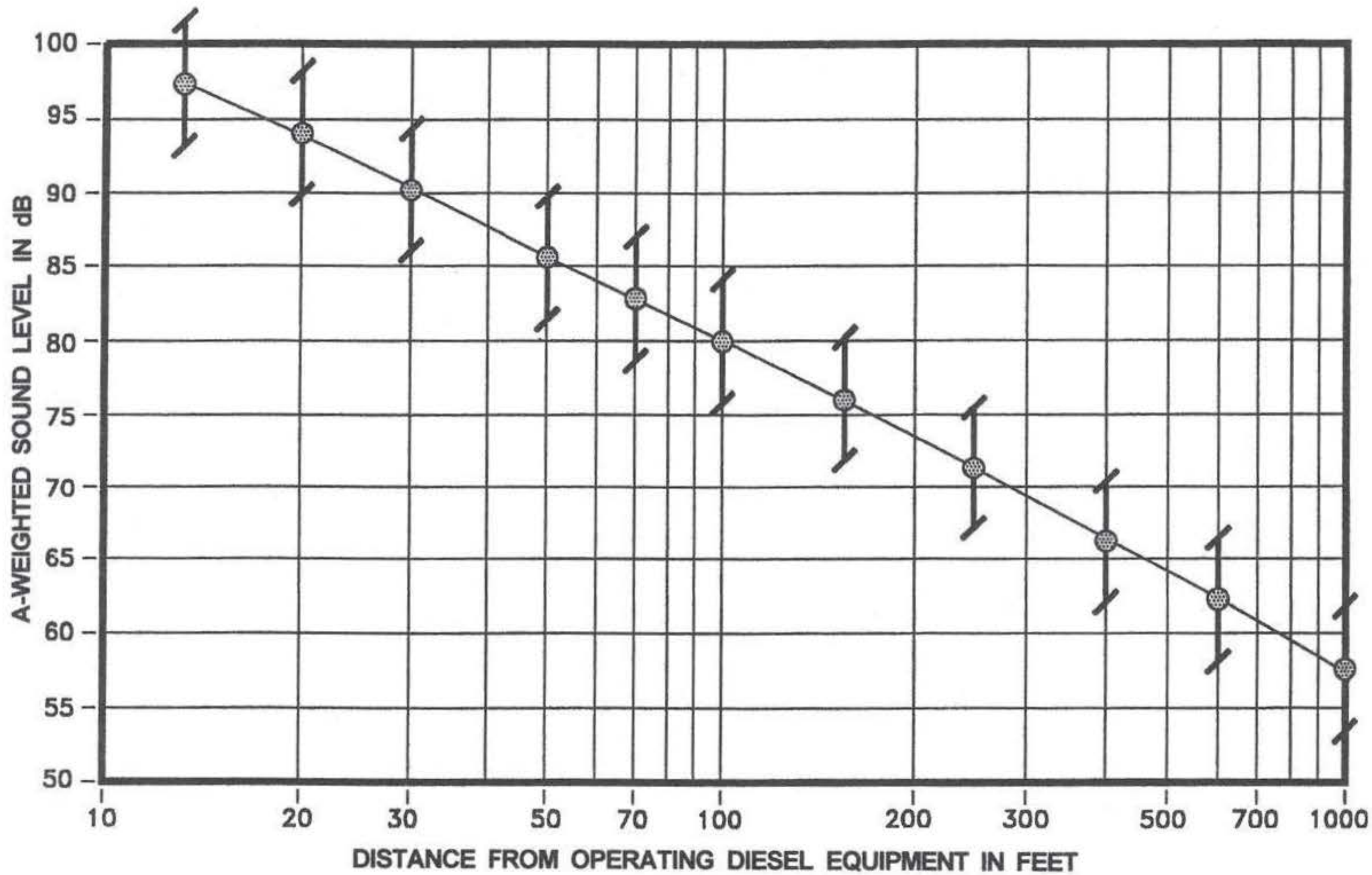
Note: L.S. Play Field (S.) is the south field.

General Construction Noise. Audible construction noise will probably be unavoidable during the entire project construction period. The final build out of the project elements as shown in Figure IV-7 will occur in phases. The total time period for construction is unknown, but it is anticipated that the actual work will be moving from one location on the project site to another during that period. Actual length of exposure to construction noise at any receptor location will probably be less than the total construction period for the entire project. Typical levels of exterior noise from construction activity (excluding pile driving activity) at various distances from the job site are shown in Figure VII-5. The impulsive noise levels of impact pile drivers are approximately 15 dB higher than the levels shown in Figure VII-5, while the intermittent noise levels of vibratory pile drivers are at the upper end of the noise level ranges depicted in the figure. Figure VII-5 is useful for predicting exterior noise levels at short distances (within 100 FT) from the work when visual line of sight exists between the construction equipment and the receptor. Direct line-of-sight distances from the construction equipment to existing residential buildings will range from less than 100 FT to greater than 2,000 FT, with corresponding average noise levels of greater than 80 dBA to less than 50 dBA (plus or minus 5 dBA). Typical levels of construction noise inside naturally ventilated and air conditioned structures are approximately 10 and 20 dB less, respectively, than the levels shown in Figure VII-5.

Unavoidable noise impacts during the noisier site preparation phase of construction are expected, particularly along the perimeters of the project site wherever buffer distances to existing noise sensitive receptors are 200 feet or less. Construction noise levels of 73 dBA and higher could occur within 200 feet of earth moving equipment or roadway construction. These highest noise levels are expected at existing receptors along the south project boundary, along the east project boundary adjoining Hualalai Village, along the north project boundary adjoining the existing school facilities, and at commercial properties across Kuakini Highway. As buffer distances increase to 1,000 feet or greater, the louder construction activities should decrease to 58 dBA or less, and be less disruptive. Adverse impacts from construction noise are not expected to be in the "public health and welfare" category due to the temporary nature of the work, and due to the administrative controls available for regulation of construction noise. Instead, these impacts will probably be limited to the temporary degradation of the quality of the acoustic environment in the immediate vicinity of the project site.

Mitigation of construction noise to inaudible levels will not be practical in all cases due to the intensity of construction noise sources (80 dB at 100 FT distance), and due to the exterior nature of the work (rock breaking, grading and earth moving, trenching, concrete pouring, hammering, etc.). The use of properly muffled construction equipment should be required on the job site.

Peak airborne noise levels from pile diving may be as much as 15 dBA greater than noise levels shown in Figure VII-5 for non-impulsive (steady) construction noise sources. Although the pile driving can produce more intense noise levels, each pulse is



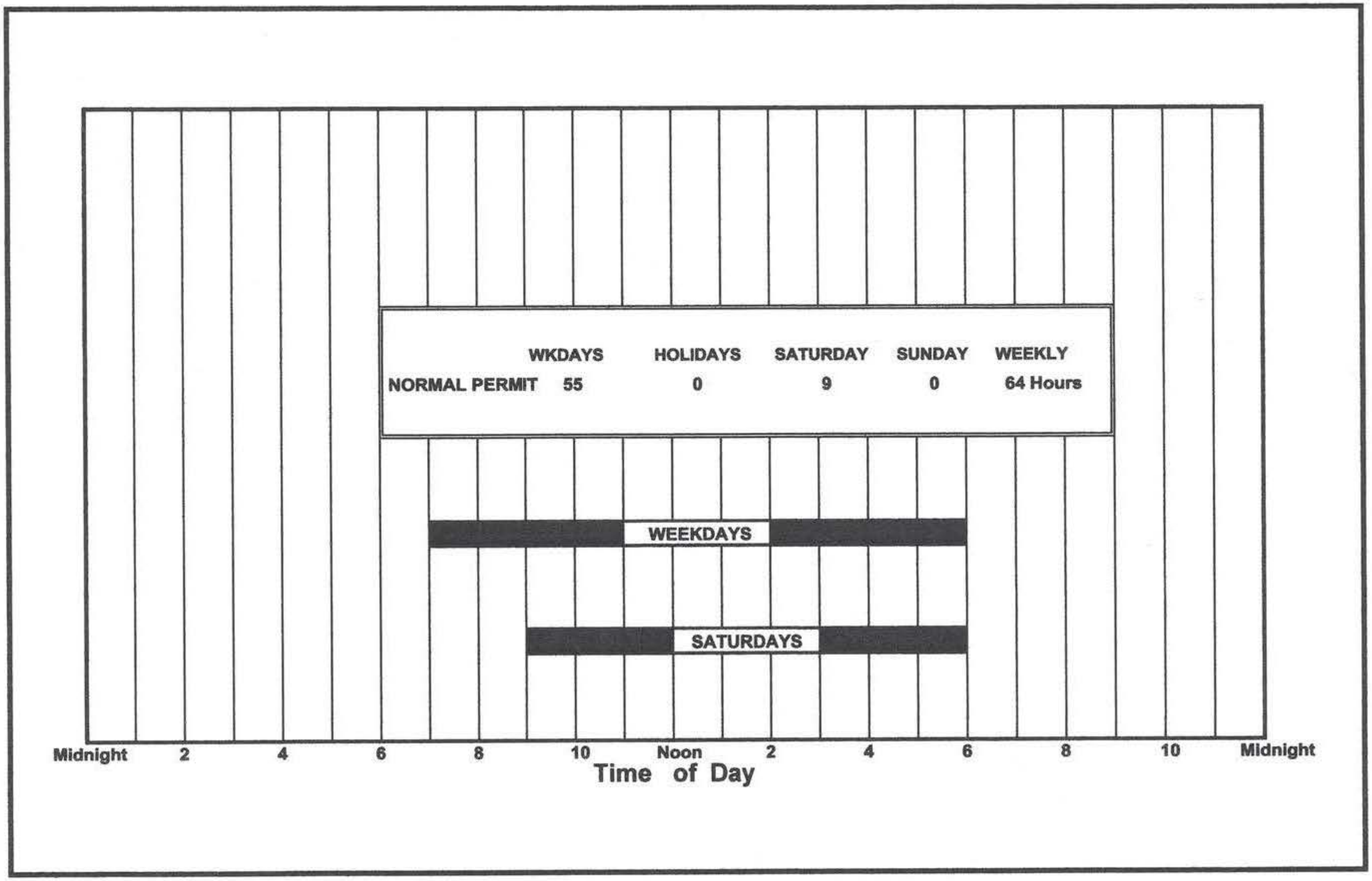
ANTICIPATED RANGE OF CONSTRUCTION NOISE LEVELS VS. DISTANCE

FIGURE VII-5

of short individual duration (less than one second). Therefore, its impact on speech communication is not as severe as that of a steady source of the same noise level.

Severe noise impacts are not expected to occur inside air conditioned structures which are beyond 200 FT of the project construction site. Inside naturally ventilated structures, interior noise levels (with windows or doors opened) are estimated to range between 64 to 49 dBA at 200 FT to 1,000 FT distances from the construction site. Closure of all doors and windows facing the construction site would generally reduce interior noise levels by an additional 5 to 10 dBA.

The incorporation of State Department of Health construction noise limits and curfew times, which are applicable throughout the State of Hawaii (Reference 5), is another noise mitigation measure which is normally applied to construction activities. Figure VII-6 depicts the normally permitted hours of construction. Noisy construction activities are not allowed on Sundays and holidays, during the early morning, and during the late evening and nighttime periods under the DOH permit procedures.



AVAILABLE WORK HOURS UNDER DOH PERMIT PROCEDURES FOR CONSTRUCTION NOISE

FIGURE VII-6

APPENDIX A. REFERENCES

(1) "Guidelines for Considering Noise in Land Use Planning and Control;" Federal Interagency Committee on Urban Noise; June 1980.

(2) American National Standard, "Sound Level Descriptors for Determination of Compatible Land Use," ANSI S12.9-1998/ Part 5; Acoustical Society of America.

(3) "Environmental Criteria and Standards, Noise Abatement and Control, 24 CFR, Part 51, Subpart B;" U.S. Department of Housing and Urban Development; July 12, 1979.

(4) "Information on Levels of Environmental Noise Requisite to Protect the Public Health and Welfare with an Adequate Margin of Safety;" U.S. Environmental Protection Agency; EPA 550/9-74- 004; March 1974.

(5) "Title 11, Administrative Rules, Chapter 46, Community Noise Control;" Hawaii State Department of Health; September 23, 1996.

(6) "FHWA Highway Traffic Noise Model User's Guide;" FHWA-PD-96-009, Federal Highway Administration; Washington, D.C.; January 1998 and Version 2.5 Upgrade (April 14, 2004).

(7) Existing and Year 2050 Traffic Turning Movement Diagrams for The University of the Nations, Kona Project; Fehr & Peers Transportation Consultants; May 19, 2023.

(8) Hourly Traffic Counts At Station B71001112038, Queen Kaahumanu Highway Between Hualalai Rd., and Nani Kailua Dr.; October 25, 2019.

(9) Hourly Traffic Counts At Station B71001110078, Kuakini Highway Between Hualalai Rd. and Oni Oni St.; January 10, 2019.

APPENDIX B

EXCERPTS FROM EPA'S ACOUSTIC TERMINOLOGY GUIDE

Descriptor Symbol Usage

The recommended symbols for the commonly used acoustic descriptors based on A-weighting are contained in Table I. As most acoustic criteria and standards used by EPA are derived from the A-weighted sound level, almost all descriptor symbol usage guidance is contained in Table I.

Since acoustic nomenclature includes weighting networks other than "A" and measurements other than pressure, an expansion of Table I was developed (Table II). The group adopted the ANSI descriptor-symbol scheme which is structured into three stages. The first stage indicates that the descriptor is a level (i.e., based upon the logarithm of a ratio), the second stage indicates the type of quantity (power, pressure, or sound exposure), and the third stage indicates the weighting network (A, B, C, D, E.....). If no weighting network is specified, "A" weighting is understood. Exceptions are the A-weighted sound level and the A-weighted peak sound level which require that the "A" be specified. For convenience in those situations in which an A-weighted descriptor is being compared to that of another weighting, the alternative column in Table II permits the inclusion of the "A". For example, a report on blast noise might wish to contrast the LCdn with the LAdn.

Although not included in the tables, it is also recommended that "Lpn" and "LepN" be used as symbols for perceived noise levels and effective perceived noise levels, respectively.

It is recommended that in their initial use within a report, such terms be written in full, rather than abbreviated. An example of preferred usage is as follows:

The A-weighted sound level (LA) was measured before and after the installation of acoustical treatment. The measured LA values were 85 and 75 dB respectively.

Descriptor Nomenclature

With regard to energy averaging over time, the term "average" should be discouraged in favor of the term "equivalent". Hence, Leq, is designated the "equivalent sound level". For Ld, Ln, and Ldn, "equivalent" need not be stated since the concept of day, night, or day-night averaging is by definition understood. Therefore, the designations are "day sound level", "night sound level", and "day-night sound level", respectively.

The peak sound level is the logarithmic ratio of peak sound pressure to a reference pressure and not the maximum root mean square pressure. While the latter is the maximum sound pressure level, it is often incorrectly labelled peak. In that sound level meters have "peak" settings, this distinction is most important.

"Background ambient" should be used in lieu of "background", "ambient", "residual", or "indigenous" to describe the level characteristics of the general background noise due to the contribution of many unidentifiable noise sources near and far.

With regard to units, it is recommended that the unit decibel (abbreviated dB) be used without modification. Hence, DBA, PNdB, and EPNdB are not to be used. Examples of this preferred usage are: the Perceived Noise Level (Lpn was found to be 75 dB. Lpn = 75 dB). This decision was based upon the recommendation of the National Bureau of Standards, and the policies of ANSI and the Acoustical Society of America, all of which disallow any modification of bel except for prefixes indicating its multiples or submultiples (e.g., deci).

Noise Impact

In discussing noise impact, it is recommended that "Level Weighted Population" (LWP) replace "Equivalent Noise Impact" (ENI). The term "Relative Change of Impact" (RCI) shall be used for comparing the relative differences in LWP between two alternatives.

Further, when appropriate, "Noise Impact Index" (NII) and "Population Weighed Loss of Hearing" (PHL) shall be used consistent with CHABA Working Group 69 Report Guidelines for Preparing Environmental Impact Statements (1977).

APPENDIX B (CONTINUED)

TABLE I

A-WEIGHTED RECOMMENDED DESCRIPTOR LIST

TERM	SYMBOL
1. A-Weighted Sound Level	L_A
2. A-Weighted Sound Power Level	L_{WA}
3. Maximum A-Weighted Sound Level	L_{max}
4. Peak A-Weighted Sound Level	L_{Apk}
5. Level Exceeded x% of the Time	L_x
6. Equivalent Sound Level	L_{eq}
7. Equivalent Sound Level Over Time (T) [(1)]	$L_{eq(T)}$
8. Day Sound Level	L_d
9. Night Sound Level	L_n
10. Day-Night Sound Level	L_{dn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$
12. Sound Exposure Level	L_{SE}

(1) Unless otherwise specified, time is in hours (e.g. the hourly equivalent level is $L_{eq(1)}$). Time may be specified in non-quantitative terms (e.g., could be speficied as $L_{eq(WASH)}$ to mean the washing cycle noise for a washing machine).

SOURCE: EPA ACCOUSTIC TERMINOLOGY GUIDE, BNA 8-14-78,

TABLE II

RECOMMENDED DESCRIPTOR LIST

TERM	A-WEIGHTING	ALTERNATIVE[1] A-WEIGHTING	OTHER[2] WEIGHTING	UNWEIGHTED
1. Sound (Pressure)[3] Level	L_A	L_{pA}	L_B, L_{pB}	L_p
2. Sound Power Level	L_{WA}		L_{WB}	L_W
3. Max. Sound Level	L_{max}	L_{Amax}	L_{Bmax}	L_{pmax}
4. Peak Sound (Pressure) Level	L_{Apk}		L_{Bpk}	L_{pk}
5. Level Exceeded x% of the Time	L_x	L_{Ax}	L_{Bx}	L_{px}
6. Equivalent Sound Level	L_{eq}	L_{Aeq}	L_{Beq}	L_{peq}
7. Equivalent Sound Level[4] Over Time(T)	$L_{eq(T)}$	$L_{Aeq(T)}$	$L_{Beq(T)}$	$L_{peq(T)}$
8. Day Sound Level	L_d	L_{Ad}	L_{Bd}	L_{pd}
9. Night Sound Level	L_n	L_{An}	L_{Bn}	L_{pn}
10. Day-Night Sound Level	L_{dn}	L_{Adn}	L_{Bdn}	L_{pdn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$	$L_{Adn(Y)}$	$L_{Bdn(Y)}$	$L_{pdn(Y)}$
12. Sound Exposure Level	L_S	L_{SA}	L_{SB}	L_{Sp}
13. Energy Average Value Over (Non-Time Domain) Set of Observations	$L_{eq(e)}$	$L_{Aeq(e)}$	$L_{Beq(e)}$	$L_{peq(e)}$
14. Level Exceeded x% of the Total Set of (Non-Time Domain) Observations	$L_{x(e)}$	$L_{Ax(e)}$	$L_{Bx(e)}$	$L_{px(e)}$
15. Average L_x Value	L_x	L_{Ax}	L_{Bx}	L_{px}

(1) "Alternative" symbols may be used to assure clarity or consistency.

(2) Only B-weighting shown. Applies also to C,D,E,.....weighting.

(3) The term "pressure" is used only for the unweighted level.

(4) Unless otherwise specified, time is in hours (e.g., the hourly equivalent level is Leq(1). Time may be specified in non-quantitative terms (e.g., could be specified as Leq(WASH) to mean the washing cycle noise for a washing machine.

APPENDIX C
SUMMARY OF BASE YEAR AND FUTURE YEAR TRAFFIC VOLUMES

ROADWAY LANES	**** CY 2023*****		CY 2050 (NO BUILD)		CY 2050 (BUILD)	
	AM VPH	PM VPH	AM VPH	PM VPH	AM VPH	PM VPH
Kuakini Hwy. N. of Hualalai Rd. (NB)	951	859	1,153	1,036	1,206	1,169
Kuakini Hwy. N. of Hualalai Rd. (SB)	627	1134	746	1,379	821	1,471
Two-Way	1,578	1,993	1,899	2,415	2,027	2,640
Kuakini Hwy. S. of Hualalai Rd. (NB)	611	617	744	745	805	897
Kuakini Hwy. S. of Hualalai Rd. (SB)	434	817	514	998	600	1,103
Two-Way	1,045	1,434	1,258	1,743	1,405	2,000
Kuakini Hwy. N. of North Entrance (NB)	558	513	682	619	742	771
Kuakini Hwy. N. of North Entrance (SB)	382	737	451	903	537	1,009
Two-Way	940	1,250	1,133	1,522	1,279	1,780
Kuakini Hwy. S. of North Entrance (NB)	573	454	697	560	755	693
Kuakini Hwy. S. of North Entrance (SB)	295	701	364	867	439	968
Two-Way	868	1,155	1,061	1,427	1,194	1,661
Kuakini Hwy. N. of South Entrance (NB)	573	454	697	560	755	693
Kuakini Hwy. N. of South Entrance (SB)	295	701	364	867	439	968
Two-Way	868	1,155	1,061	1,427	1,194	1,661
Kuakini Hwy. S. of South Entrance (NB)	573	454	697	560	748	622
Kuakini Hwy. S. of South Entrance (SB)	295	701	364	867	400	956
Two-Way	868	1,155	1,061	1,427	1,148	1,578
Kuakini Hwy. W. of Q. Kaahumanu Hwy. (EB)	295	701	352	835	383	912
Kuakini Hwy. W. of Q. Kaahumanu Hwy. (WB)	421	266	508	326	552	379
Two-Way	716	967	860	1,161	935	1,291
Q. Kaahumanu Hwy. S. of Kuakini Hwy. (NB)	1,280	1,017	1,673	1,341	1,714	1,391
Q. Kaahumanu Hwy. S. of Kuakini Hwy. (SB)	1,058	1,530	1,380	1,954	1,409	2,026
Two-Way	2,338	2,547	3,053	3,295	3,123	3,417
Q. Kaahumanu Hwy. N. of Kuakini Hwy. (NB)	922	796	1,241	1,069	1,243	1,074
Q. Kaahumanu Hwy. N. of Kuakini Hwy. (SB)	826	874	1,104	1,173	1,107	1,176
Two-Way	1,748	1,670	2,345	2,242	2,350	2,250
Q. Kaahumanu Hwy. S. of Hualalai Rd. (NB)	1,226	892	1,628	1,190	1,628	1,190
Q. Kaahumanu Hwy. S. of Hualalai Rd. (SB)	855	1,049	1,142	1,400	1,142	1,400
Two-Way	2,081	1,941	2,770	2,590	2,770	2,590

APPENDIX C (CONTINUED)
SUMMARY OF BASE YEAR AND FUTURE YEAR TRAFFIC VOLUMES

ROADWAY LANES	**** CY 2023*****		CY 2050 (NO BUILD)		CY 2050 (BUILD)	
	AM VPH	PM VPH	AM VPH	PM VPH	AM VPH	PM VPH
Q. Kaahumanu Hwy. N. of Hualalai Rd. (NB)	1,113	839	1,494	1,127	1,494	1,127
Q. Kaahumanu Hwy. N. of Hualalai Rd. (SB)	818	985	1,098	1,323	1,098	1,323
Two-Way	1,931	1,824	2,592	2,450	2,592	2,450
Q. Kaahumanu Hwy. S. of Nani Kailua Dr. (NB)	1,078	842	1,448	1,130	1,448	1,130
Q. Kaahumanu Hwy. S. of Nani Kailua Dr. (SB)	818	989	1,096	1,330	1,096	1,330
Two-Way	1,896	1,831	2,544	2,460	2,544	2,460
Q. Kaahumanu Hwy. N. of Nani Kailua Dr. (NB)	1,222	938	1,634	1,255	1,636	1,260
Q. Kaahumanu Hwy. N. of Nani Kailua Dr. (SB)	861	1,138	1,153	1,522	1,156	1,525
Two-Way	2,083	2,076	2,787	2,777	2,792	2,785
Hualalai Rd. W. of Kuakini Hwy. (EB)	274	202	326	240	330	245
Hualalai Rd. W. of Kuakini Hwy. (WB)	207	306	246	365	249	372
Two-Way	481	508	572	605	579	617
Hualalai Rd. E. of Kuakini Hwy. (EB)	208	237	246	282	251	294
Hualalai Rd. E. of Kuakini Hwy. (WB)	288	266	343	317	350	325
Two-Way	496	503	589	599	601	619
Hualalai Rd. W. of Nani Kailua Rd. (EB)	120	159	143	189	148	201
Hualalai Rd. W. of Nani Kailua Rd. (WB)	273	202	326	241	333	249
Two-Way	393	361	469	430	481	450
Hualalai Rd. E. of Nani Kailua Rd. (EB)	90	85	107	102	107	102
Hualalai Rd. E. of Nani Kailua Rd. (WB)	176	97	212	117	212	117
Two-Way	266	182	319	219	319	219
Hualalai Rd. W. of Driveway (EB)	79	112	93	132	93	132
Hualalai Rd. W. of Driveway (WB)	191	100	228	120	228	120
Two-Way	270	212	321	252	321	252
Hualalai Rd. E. of Driveway (EB)	77	94	91	111	91	111
Hualalai Rd. E. of Driveway (WB)	185	94	220	112	220	112
Two-Way	262	188	311	223	311	223
Hualalai Rd. W. of Q. Kaahumanu Hwy. (EB)	93	93	111	112	111	112
Hualalai Rd. W. of Q. Kaahumanu Hwy. (WB)	169	82	201	98	201	98
Two-Way	262	175	312	210	312	210

APPENDIX C (CONTINUED)
SUMMARY OF BASE YEAR AND FUTURE YEAR TRAFFIC VOLUMES

ROADWAY LANES	**** CY 2023*****		CY 2050 (NO BUILD)		CY 2050 (BUILD)	
	AM VPH	PM VPH	AM VPH	PM VPH	AM VPH	PM VPH
North Entrance Driveway E. of Kuakini Hwy. (EB)	164	82	164	82	192	116
North Entrance Driveway E. of Kuakini Hwy. (WB)	62	105	62	105	81	153
Two-Way	226	187	226	187	273	269
South Entrance Driveway E. of Kuakini Hwy. (EB)	0	0	0	0	109	134
South Entrance Driveway E. of Kuakini Hwy. (WB)	0	0	0	0	77	193
Two-Way	0	0	0	0	186	327

Appendix I

Mobility Analysis Report for the University of the Nations Kona Master Plan Update, Kona, HI, June 2023

Mobility Analysis Report for the University of the Nations Kona Master Plan Update
Kona, HI

Prepared for:
University of the Nations Kona

June 19, 2023

SD19-0323

FEHR PEERS

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1.0 EXECUTIVE SUMMARY

This report documents the assessment of traffic, mobility, and access for an update to the 2003 University of the Nations (UofN) Kona Master Plan (Project). The Project site is on tax map key parcels TMK (3) 7-5-010: 085 and (3) 7-5-017: 006, between Kuakini Highway and Hualalai Road on the Island of Hawai'i. The Project site is within the Kona Community Plan area. The existing site includes mainly the U of N which serves as a training center to prepare followers for Christian service throughout the world, specifically for Asia and the Pacific. A preschool also resides on the southwest corner of the campus.

Impacts of the proposed Master Plan Update were evaluated following guidelines established by the County of Hawai'i Department of Public Works-Engineering Division and the State of Hawai'i Department of Transportation (HDOT), which has jurisdiction over Hawai'i Belt Road/Queen Ka'ahumanu Highway (Highway 11). The operations of nine (9) intersections [eight (8) existing and one (1) future] were evaluated during the weekday morning (AM) and evening (PM) peak hours for Existing (2023), Master Plan Phase 1 (2030), Phase 2 (2040), and Phase 3 (2050) conditions. Master Plan Phase 1, 2, and 3 conditions were evaluated without and with the Project.

To estimate Project trip generation, multimodal counts of vehicles, bicyclists, and pedestrians were collected at the existing University of the Nations site driveway. The traffic counts obtained were instrumental in determining the trip rates for students, faculty, and staff residing on the site, as well as those commuting to the site. Estimated rates were then applied to future student enrollment and faculty/staff employment forecasts to estimate future Project trips. Using this approach, the following peak hour volumes are anticipated to be generated by the site during AM and PM peak hours:

- Phase 1 (2030): 41 new AM peak hour trips (11 inbound/30 outbound) and 44 new PM peak hour trips (36 inbound/8 outbound)
- Phase 1+2 (2040): 75 new AM peak hour trips (15 inbound/60 outbound) and 88 new PM peak hour trips (71 inbound/17 outbound)
- Phase 1+2+3 (2050): 122 new AM peak hour trips (29 inbound/93 outbound) and 139 new PM peak hour trips (107 inbound /32 outbound)

Project trip distribution was estimated using the location of complementary land uses and existing travel patterns, and trips were subsequently assigned to the adjacent streets. Intersection operations were evaluated for existing and future conditions, and potential changes to active transportation and transit were also assessed. The key findings of the mobility analysis are summarized below.

1.1 INTERSECTION OPERATIONS

1.1.1 EXISTING CONDITIONS

Under Existing Conditions, all but one (1) study intersections operate at LOS D or better during both AM and PM peak hours. The two locations with operations at undesirable levels include the following:

- Intersection #7 - Queen Ka'ahumanu Highway and Kuakini Highway (LOS E for the eastbound left-turn movement during AM peak hour)

1.1.2 PHASE 1, PHASE, AND PHASE 3 CONDITIONS

No direct impacts were calculated at any of the study intersections under Phase 1 (Year 2030) conditions, Phase 2 (Year 2040) conditions, and Phase 3 (Year 2050) conditions.

1.2 RECOMMENDED INTERSECTION IMPROVEMENTS

Recommendations are provided at locations where a significant traffic impact was not identified, but improvements may become necessary in the future. The emphasis was to identify physical and/or operational improvements that could be implemented within the existing or planned roadway rights-of-way and determine if improvements would be ultimately feasible. **Table** 1-1 provides a summary of the proposed intersection improvements and locations where future analysis is recommended prior to occupancy of selected development phases. Improvements are discussed in more detail under **Section 7.1**.

Table 1-1. Summary of Intersection Improvement Recommendations

Intersection	Phase 1 (Year 2030)	Phase 2 (Year 2040)	Phase 3 (Year 2050)
Intersection #2 Kuakini Highway and Main Driveway	Install a left-turn refuge lane serving the westbound left-turn traffic out of the campus.	No additional improvements required	No additional improvements required

Intersection #6 Queen Ka'ahumanu Highway and Hualalai Road	No improvements required	Based on projected traffic volumes, a traffic signal is not warranted under this scenario, but it may be needed to provide adequate gaps in traffic on the highway and to enhance safety. Intersection conditions should be evaluated prior to occupancy of Phase 2 to determine if a traffic signal is warranted.	Based on projected traffic volumes, a traffic signal is not warranted under this scenario, but it may be needed to provide adequate gaps in traffic on the highway and to enhance safety. Intersection conditions should be evaluated prior to occupancy of Phase 3 to determine if a traffic signal is warranted.
Intersection #7 Queen Ka'ahumanu Highway and Kuakini Highway	No improvements required	Based on projected traffic volumes, a traffic signal is not warranted under this scenario, but it may be needed to provide adequate gaps in traffic on the highway and to enhance safety. Intersection conditions should be evaluated prior to occupancy of Phase 2 to determine if a traffic signal is warranted.	Based on projected traffic volumes, a traffic signal is not warranted under this scenario, but it may be needed to provide adequate gaps in traffic on the highway and to enhance safety. Intersection conditions should be evaluated prior to occupancy of Phase 3 to determine if a traffic signal is warranted.

1.3 PROJECT SITE ASSESSMENT

Site Access

Direct access to the project site is provided by a driveway located on Kuakini Highway and is controlled by an access gate located approximately 125 feet east of Kuakini Highway. During peak travel periods or special events, campus-bound traffic could potentially queue up while waiting to pass through the access gate and spill back onto Kuakini Highway impeding through traffic. To reduce the potential for spillback, it is recommended that the access gate be relocated to a point further east.

Under Phase 1 (Year 2030) conditions, a second access point will be provided off of the Kuakini Highway via a new unsignalized intersection and driveway leading to the project site. The proposed new access point is recommended to be constructed with an exclusive left-turn lane on the southbound approach and the south leg to be striped to accommodate a refuge lane serving the westbound left-turn vehicles. Due to the relatively low volume of vehicles on this roadway and the limited land uses served by it, no vehicular site access or operational issues are expected as a result of the implementation of this access point. In general, providing multiple access points to the project site will distribute the traffic and minimize the potential for intermittent congestion issues during peak hours.

On-Site Circulation

Under Phase 1, the proposed site plan includes the extension of multiple on-site internal campus roadways. First, there are three new north-south roadways proposed along the development area that connects new buildings and facilities to the center east-west on-campus roadway. In addition, a new east-west campus roadway is planned to be located along the southern edge of the developed campus. The roadway will be extended from the western edge of the campus to the existing roadway that serves Hualalai Village Apartments. The proposed access at the Hualalai Village Apartments is planned to be operating as emergency access only. To manage travel speeds along the proposed roadways, it is recommended that stop signs and other traffic calming devices be included at key points along these roadways.

Parking

Vehicle parking will be provided via on- and off-street parking throughout campus. Insufficient parking was not noted as an issue by the project development team at the time this report was prepared. As such, it is assumed that the existing parking inventory is sufficient to accommodate the parking demand generated by current levels of campus students, faculty, staff, and visitors. Therefore, it is recommended that the parking supply provided in each phase of the project maintain (or reduce if feasible) the current ratio of parking spaces to the number of campus students, faculty, staff, and visitors. Reduced parking supplies are a key incentive to minimizing the number of vehicle trips generated by land uses, but they must be supported by services and facilities to accommodate non-automobile travel such as, but not limited to, increased transit accessibility, bicycle lanes, and dedicated walking paths.

1.4 MULTIMODAL ASSESSMENT

Bicycle and Pedestrian Facilities

Implementation of the proposed Project will not conflict with any existing pedestrian or bicycle facilities and will not preclude the implementation of any planned pedestrian or bicycle facilities within the study area.

A proposed bike lane along Kuakini Highway from Lako Street to Hualalai Road is identified as a high-priority project in Bike Plan Hawai'i. When completed, this facility will enhance bicycle connectivity to and from the University of the Nations Kona west entrance. No pedestrian improvements are planned along roadways adjacent to the University of the Nations Kona campus.

While the project-generated pedestrian and bicycle volumes are initially expected to be low, the addition of any active travelers along Kuakini Highway may result in people walking or biking along the roadway, which could result in a potential safety issue and a significant multimodal impact. To address this issue, the following pedestrian improvements are proposed at this location:

- A raised sidewalk or path separated from traffic by a raised asphalt berm should be installed between the existing sidewalk on the east side of Kuakini Highway from the existing sidewalk's terminus near the site to the existing crosswalk located approximately 600 feet north of the University of the Nations Kona Driveway.
- A high-visibility crosswalk, adequate nighttime lighting levels, and crosswalk warning signs should be added on the north and east legs of the Kuakini Highway/North Entrance and Kuakini Highway/South Entrance intersections.
- The existing striped triangle on the east leg of the intersection should be converted to a raised median to provide a pedestrian refuge area.

Direct pedestrian and bicycle connections between campus facilities and parking lots would be provided via pedestrian and bicycle pathways throughout the campus. The following improvements are planned along on-site campus roadways:

- A shared-use path should be included on one side of both on-site campus roadways to further enhance pedestrian and bicycle connectivity and safety throughout the campus.
- An enhanced bicycle facility (e.g. bike lanes, shared-use-path, or "sharrows") should be included along the Makai north-south campus roadway between the northern and central roadways.
- Pedestrian-level lighting is recommended along any shared-use path or pedestrian-only sidewalk or path.
- Raised crosswalks should be provided at several locations on the new spine road through the center of the site where higher levels of pedestrian activity are expected.

We also recommend the provision of secure bike parking – including bike racks near building entrance(s) – be provided to encourage the use of non-motorized travel. Specific locations for bike racks should be determined by the project team in consultation with the University of the Nations Kona planning and security staff. A summary of recommended on-site pedestrian and bicycle improvements is shown in **Figure 9-1**.

Transit

The Pahala-Kailua-Kona-South Kohala Resorts Route provides daily transit service along Queen Kaahumanu Highway. The nearest bus stop would require transit patrons from the project site to walk or bike at least 2,000 feet from campus to use the transit service. One potential improvement would be to provide a multi-use connection directly to Hualalai Road to reduce the overall distance transit riders would have to walk or bike to access the campus.

The project is anticipated to generate a relatively low number of transit riders through Project buildout. As site-generated transit ridership is anticipated to be low, no project impacts to transit facilities or services are anticipated, and no modifications to transit stop locations or services would be required.

2.0 INTRODUCTION

This mobility analysis report (MAR) presents the study conducted by Fehr & Peers for the University of the Nations (UofN) Kona Master Plan Update. The UofN in the Kona Community Plan area of Kailua-Kona on the Island of Hawai'i. This update replaces the previous Master Plan approved in 2003. The project site is located on tax map key parcels TMK (4) 7-5-010: 085 and (4) 7-5-017: 006, between Kuakini Highway and Hualalai Road. This MAR was conducted in accordance with the guidelines and standards of the affected government agencies, and it addresses the potential impact of the project on vehicular, bicycle, pedestrian, and transit conditions.

2.1 PROJECT DESCRIPTION

The University of the Nations is a Christian university with over 600 locations across 160 countries. With approximately 500 university students, 340 Pre-K-12 students, and 750 staff members, the Kona campus is one of the largest UofN campuses worldwide. The existing site includes residential, religious, educational, recreational, and commercial uses.

The 2023 Master Plan Update was prepared for UofN Kona and includes plans for the Existing Campus Site as well as the Petition Area (approximately 62 acres of land adjacent to the Existing Campus). The purpose is to update the Master Plan and to reflect current and upcoming priorities since the 2002-2005 master planning and land use entitlements were completed. Future buildings and projects planned in roughly 10-year increments, with emphasis given to the next 5-10 years, are projected into the 2023 Master Plan Update.

The projected population after the completion of each phase is as follows:

- Phase 1: Within the next 5-7 years
  - 340 Pre-K-12 Students
  - 718 University Students
  - 783 Faculty/Staff Members
- Phase 2: Within the next 17 years
  - Potentially up to 469 Pre-K-12 Students
  - 955 University Students
  - 923 Faculty/Staff Members
- Phase 3: Within the next 27 years.
  - Potentially up to 575 Pre-K-12 Students
  - 1,200 University Students
  - 1,100 Faculty/Staff Members

Phase 1 of the project Master Plan includes the addition of new roadways, parking, instructional space, a student resource center, dormitories, a cafeteria, and a chapel. During the first phase of the Master Plan (by the Year 2030), a second campus access point is planned that is located on the south side of the existing access point along Kuakini Highway.

Phase 2 of the Master Plan includes additional parking and dormitories, Middle and High-School, a gymnasium area, a community athletic complex, practice fields, tennis courts, and lockers. Phase 3 of the Master Plan includes a multipurpose complex with an amphitheater, Discovery Center, expansion of instructional spaces, and additional dormitories and parking space.

Direct access to the project site is provided by a driveway located on Kuakini Highway and is controlled by an access gate located approximately 125 feet east of Kuakini Highway. A secondary access point will also be provided off of Kuakini Highway approximately 1,200 feet south of the existing access via a new unsignalized intersection. Additionally, the intersection of Hualalai Village South Driveway and Hualalai Road will function as emergency access only.

The university expects to host weekly community and athletic events throughout the year. Attendees would include campus students, faculty, and visitors, as well as community members. A general overview of the potential effects of these events is described in **Section 6.66.6**.

The location of the project site and immediate study area is shown in **Figure** 2-1. The proposed site plan showing building locations and campus access is illustrated in **Figure** 2-2.

2.2 PROJECT STUDY AREA

The project site is located in Kailua-Kona, bounded by Kuakini Highway and Hualalai Road. The campus is currently accessible via one driveway along Kuakini Highway, approximately one-half mile north of the intersection of Kuakini Highway and Walua Road/Oni Oni Street. The University of the Nations Driveway is a two-lane road that provides controlled access to university visitors. Land uses along Kuakini Highway in the vicinity of the project include commercial, single-family residential, and multi-family residential uses. Other surrounding land uses include residential neighborhoods and agricultural uses.

The mobility analysis evaluated the operations at a total of nine (9) intersections [eight (8) existing and one (1) future] in the vicinity of the proposed project which are listed below and shown in **Figure 2-1**.

1. Kuakini Highway and Hualalai Road
2. Kuakini Highway and North Campus Entrance
3. Hualalai Road and Nani Kailua Drive

4. Queen Kaahumanu Hwy & Nani Kailua Drive
5. Hualalai Road and Hualalai Village North Driveway
6. Hualalai Road and Queen Kaahumanu Highway (Route 11)
7. Kuakini Highway and Queen Kaahumanu Highway (Route 11)
8. Hualalai Road and Hualalai Village South Driveway (emergency access only)
9. Kuakini Highway and South Campus Entrance (Future Intersection)

The study analyzed the potential project-related traffic impacts under typical weekday AM and PM peak-hour traffic conditions. The AM and PM peak hours for each intersection are identified as the highest one-hour totals of traffic at the intersection from 6:00 to 9:00 AM and from 3:00 to 6:00 PM on a weekday. Note the Project is not expected to add any traffic volume to the intersections on Hualalai Road south of Nani Kailua Drive, but these locations were originally studied when the project included a different access configuration. Thus, they were included here for informational purposes.

2.3 STUDY SCENARIOS

This report includes the following types of analysis:

Existing (2023) Conditions – The analysis of existing traffic conditions was based on 2023 counts collected for the weekday peak hours. The existing conditions analysis includes a description of key area streets and an assessment of bicycle, pedestrian, and transit facilities and services in the study area.

Baseline Conditions – Future traffic volumes in the anticipated completion year of each phase of the project (Phase 1, 2, or 3) were projected by increasing the existing volumes using an annual growth factor to account for ambient growth. This scenario does not include any project traffic.

Baseline Plus Project Conditions – Traffic projections from baseline Conditions plus traffic estimated from the completion of each phase (Phase 1, 2, and 3) of the project. The impact of the project under this scenario was also assessed for bicycle, pedestrian, and transit facilities and services.

2.4 ANALYSIS METHODOLOGY

The analysis of roadway operations performed for this study is based on procedures presented in the *Highway Capacity Manual 6th Edition* (HCM), published by the Transportation Research Board in 2016. The operations of roadway facilities are described with the term level of service (LOS). LOS is a qualitative description of traffic flow based on such factors as speed, travel time, delay, and freedom to maneuver. Six (6) levels are defined; from LOS A, with the least congested operating conditions, to LOS F, with the most congested operating conditions. LOS E represents "at-capacity" operations. Operations are designated as LOS F when volumes exceed capacity, resulting in stop-and-go conditions. The methodologies for signalized and unsignalized intersections are described below.

2.4.1 SIGNALIZED INTERSECTIONS

Signalized intersection operations were analyzed using the method described in Chapter 19: Signalized Intersections of the HCM. This LOS method analyzes a signalized intersection's operation based on average control delay per vehicle. Control delay alone is used to characterize LOS for the entire intersection or an approach. Control delay includes the initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. The average control delay for signalized intersections is calculated using Synchro 11.0 analysis software and is correlated to a LOS designation as shown in **Table 2-1**.

2.4.2 UNSIGNALIZED INTERSECTIONS

Unsignalized intersection operations were evaluated using the method contained in Chapter 20: Two-Way Stop-Controlled Intersections of the HCM. LOS ratings for stop-sign-controlled intersections are based on the average control delay expressed in seconds per vehicle. At two-way or side-street-controlled (SSSC) intersections, the average control delay is calculated for each minor-street-stopped movement and the major street left turns; not for the intersection as a whole. For approaches composed of a single lane, the control delay is computed as the average of all movements in that lane. For approaches with multiple lanes, the control delay is computed for each movement; the movement with the worst (i.e., longest) delay is presented for two-way stop-controlled (TWSC). The average control delay for unsignalized intersections is calculated using Synchro 11.0 analysis software and is correlated to a LOS designation as shown in **Table 2-2**.

Table 2-1. Signalized Intersection Level of Service Definitions

Level of Service	Description	Delay in Seconds
A	Progression is extremely favorable, and most vehicles arrive during the green phase. Most vehicles do not stop at all. Short cycle lengths may also contribute to low delay.	≤ 10.0
B	Progression is good, cycle lengths are short, or both. More vehicles stop than with LOS A, causing higher levels of average delay.	> 10.0 to 20.0

C	Higher congestion may result from fair progression, longer cycle lengths, or both. Individual cycle failures may begin to appear at this level, though many still pass through the intersection without stopping.	> 20.0 to 35.0
D	The influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, or high V/C ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.	> 35.0 to 55.0
E	This level is considered by many agencies to be the limit of desirable delay. These high delay values generally indicate poor progression, long cycle lengths, and high V/C ratios. Individual cycle failures are frequent occurrences.	> 55.0 to 80.0
F	This level is considered undesirable with oversaturation, which is when arrival flow rates exceed the capacity of the intersection. This level may also occur at high V/C ratios below 1.0 with many individual cycle failures. Poor progression and long cycle lengths may also be contributing factors to such delay levels.	> 80.0

Source: *Highway Capacity Manual*, Transportation Research Board, 2016.

Table 2-2. Unsignalized Intersection Level of Service Definitions

Level of Service	Description	Average Control Delay Per Vehicle (Seconds)
A	Little or no delay	≤10.0
B	Short traffic delay	> 10.0 to 15.0
C	Average traffic delays	> 15.0 to 25.0
D	Long traffic delays	> 25.0 to 35.0
E	Very long traffic delays	> 35.0 to 50.0
F	Extreme traffic delays with capacity exceeded	> 50.0

Source: *Highway Capacity Manual*, Transportation Research Board, 2016.

2.4.3 TRANSIT AND ACTIVE TRANSPORTATION MODES

The assessments of planned pedestrian, bicycle, and transit facilities were conducted using the information in planning documents, such as the *Bike Plan Hawai'i Master Plan (2012)*, *Statewide Pedestrian Master Plan (2013),* and *County of Hawai'i Transit and Multi-Modal Transportation Master Plan (2018)*. In addition, best practices for transit and active transportation planning and engineering were applied to determine if deficiencies currently exist or are projected in the future.

2.4.4 SIGNIFICANT IMPACT CRITERIA

The analysis of future conditions compares the "no project" condition with conditions that include project-generated traffic assuming full development of Phase 1, 2, and 3 uses. This is done to determine if the addition of project traffic is expected to result in a significant impact on the surrounding roadways. Based on previous studies conducted for the County of Hawai'i, the minimum desired operating standard for a signalized intersection is LOS D for the overall intersection. Additionally, the Hawai'i Department of Transportation (HDOT) strives to universally maintain LOS D intersection operations and in their *Draft, HDOT Best Practices for Traffic Impact Report* (June 2012) defines a significant impact when the operations of an intersection, turning movement, or roadway segment change from LOS D or better to LOS E or F. Also, when evaluating intersection approach LOS at any location, other factors should be considered in the analysis, such as traffic volumes and potential secondary impacts to pedestrian, bicycle, and transit travel.

Any identified significant impact is further categorized as either a direct or cumulative impact. At a signalized intersection, if the addition of project traffic is expected to degrade acceptable service levels (LOS D or better) to unacceptable service levels (LOS E or F), then the project is considered to have a direct impact. Alternatively, if the intersection LOS is determined to be LOS E or F without the project and the project adds traffic to this location, causing the delay to increase by five (5) seconds or more, then this result would be characterized as a cumulative impact.

For unsignalized intersections, the criterion for a direct impact is similar to that of signalized intersections as described above, but one or more signal warrants must also be met. The signal warrants used for this evaluation are those described in Chapter 4C of the Manual of Uniform Control Devices (MUTCD, 2009) published by the U.S. Department of Transportation Federal Highway Administration (FHWA). However, the project is determined to have a potentially significant cumulative impact when it adds traffic to a study location that includes a controlled approach already operating at an unacceptable level (i.e., LOS E or F) *and* one or more volume-based signal warrants are met.

The County of Hawai'i and HDOT does not publish impact criteria for pedestrian, bicycle, and transit impacts. For this analysis, these impacts were evaluated based on whether the proposed Project would: 1) conflict with the existing or planned pedestrian, bicycle, or transit facilities and services, or 2) create substantive walking, bicycling, or transit use demand without providing adequate and appropriate facilities for non-motorized mobility. If either of these criteria were satisfied, then the project would be determined to have a project-specific impact on non-motorized modes of transportation.

N:\Projects\2019 Projects\0323 University of the Nations Kona MAR\Graphics\GIS\StudyIntersections.mxd

Legend

Project Study Area

X Study Intersections

X Future Study Intersections

Figure 2-1

Project Site & Study Intersections

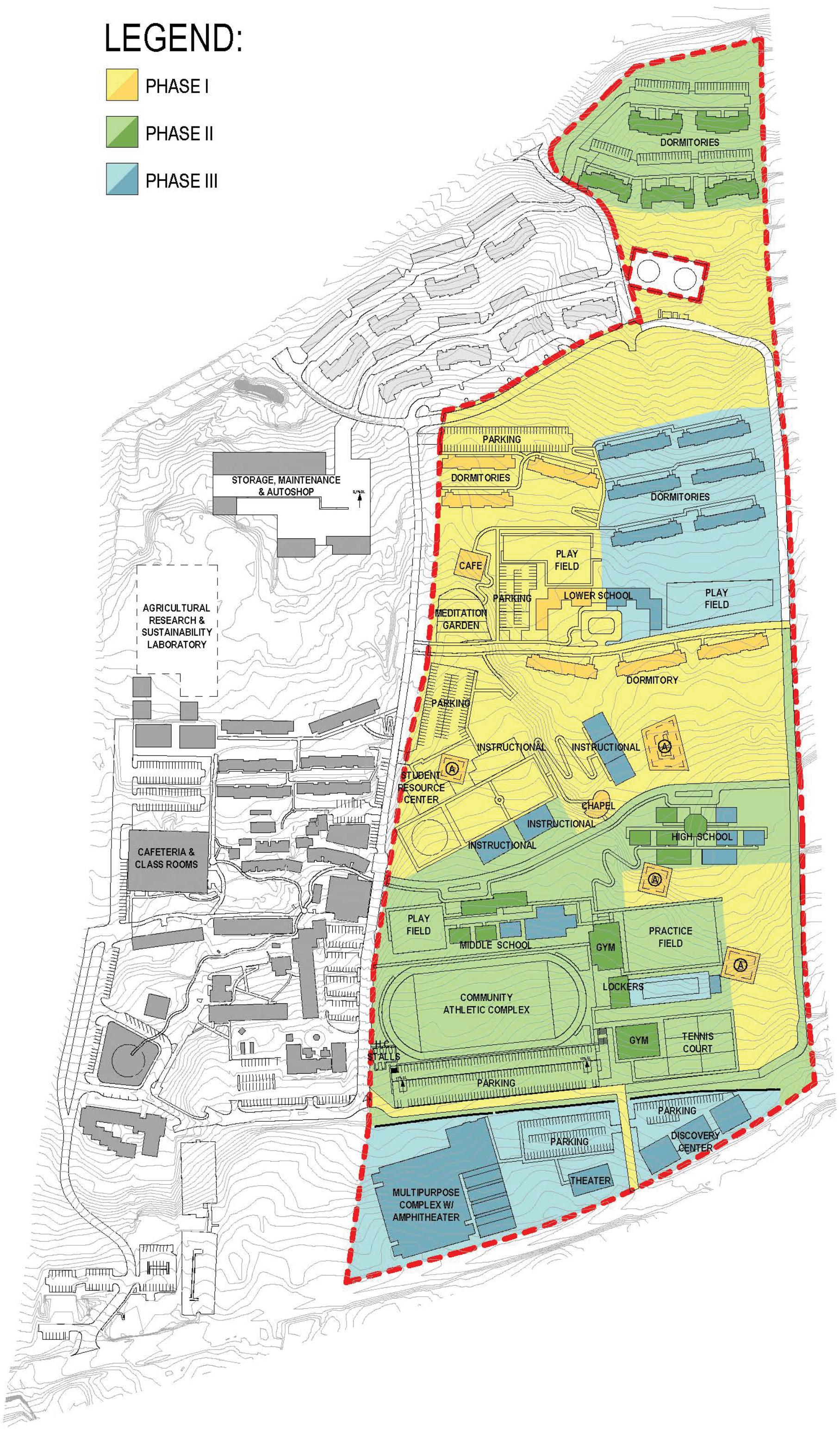


Figure 2-2

Proposed Site Plan

3.0 EXISTING CONDITIONS

This chapter describes the existing transportation network and includes a discussion of pedestrian, bicycle, and transit facilities located within the project study area. This chapter also includes a discussion of the existing intersection LOS operation results.

3.1 EXISTING SITE

The University of the Nations campus is located at 75-5952 Kuakini Highway in the community of Kona in Hawai'i County. The project site is on tax map key parcels TMK (4) 7-5-010: 085 and (4) 7-5-017: 006, between Kuakini Highway and Hualalai Road. The existing campus includes the following mix of uses:

- Residential land use (e.g., student and faculty housing)
- Religious land use (i.e., chapel)
- Educational land use (e.g., classrooms, campus services)
- Recreational land use (e.g., sports complex, swimming pool)
- Commercial land use (e.g., coffee shop, convenience store)

3.2 EXISTING TRANSPORTATION FACILITIES

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 system, traffic volumes on these facilities, and operating conditions at key intersections. Existing public transit, bicycle, and pedestrian facilities are also described.

3.2.1 EXISTING ROADWAY SYSTEM

The key roadways providing access to or in the vicinity of the study area are described below.

The University of the Nations Driveway provides direct access from Kuakini Highway to the University of the Nations campus and serves as the primary internal campus roadway providing access to existing campus facilities. The roadway terminates just west of the Aloha Lanai Cafeteria. The unnamed road has speed bumps and is currently two lanes. The posted speed limit is 15 miles per hour (mph).

Kuakini Highway is the primary street that provides access to the project site. Adjacent to the project site, it is a two-lane collector roadway that extends generally from the north end of the town of Kailua-Kona to

Queen Kaahumanu Highway. The posted speed limit is 35 mph. Kuakini Highway is under the jurisdiction of the County of Hawai'i Department of Public Works (DPW). Sidewalks are not provided on either side of Kuakini Highway. No bicycle facilities exist along Kuakini Highway within the study area. Crosswalks are provided at the intersection of Kuakini Highway and Hualalai Road.

Hualalai Road is a two-lane local roadway that is under the jurisdiction of DPW. It runs east-west between Ali'i Drive and Queen Kaahumanu Hwy. The posted speed limit is 25 mph. Sidewalks are provided on both sides of the roadway makai of Kuakini Highway, on the north side of the roadway between Kuakini Highway and the Regency at Hualalai, and the south side of the roadway just makai of Queen Kaahumanu Hwy. No bicycle facilities exist along Hualalai Road within the study area. On-street parking is not provided.

Queen Kaahumanu Highway is a two-lane highway that is under the jurisdiction of the State of Hawai'i Department of Transportation (HDOT). It is a major component of the Hawai'i Belt Road and runs from Hwy 19 in Kailua-Kona to Hwy 19 in Hilo. The posted speed limit within the study area is 35 mph. Neither sidewalks nor bicycle facilities are provided along the roadway. On-street parking is not provided.

Nani Kailua Drive is a two-lane local roadway that is under the jurisdiction of DPW. It runs east-west and extends from Hualalai Road to just mauka of Pikake Place. The posted speed limit is 25 mph. Neither sidewalks nor bicycle facilities are provided along the roadway. On-street parking is provided on both sides of the roadway.

3.2.2 EXISTING TRANSIT FACILITIES AND SERVICES

The County of Hawai'i Mass Transit Agency provides island-wide commuter and fixed-route service on the Island of Hawai'i, where it served over 800,000 riders in the fiscal year of 2016-2017.[1] Hele-On offers fixed-route transit service in the Hilo and Kona areas Monday through Saturday, and limited commuter services to the South Kohala Resort (SKR) areas seven days a week. Within the project study area, the Pahala-Kailua-Kona-South Kohala Resorts Route provides daily service along Queen Kaahumanu Highway with transit stops both north and south of the project site[2]. Detailed route schedule information, such as operating hours and frequencies, was not available at the time this was written.

[1] County of Hawai'i Mass Transit Agency Transit Agency Profile. National Transit Database, 2017. Accessed online at https://www.transit.dot.gov/sites/fta.dot.gov/files/transit_agency_profile_doc/2017/9R03-91080.pdf

[2] County of Hawai'i Mass Transit Agency. Accessed online at https://www.hawaiicounty.gov/departments/mass-transit.

3.2.3 EXISTING BICYCLE ACTIVITY

The study area has a low level of bicycle activity. Based on the peak hour traffic counts, a range of 0-2 bicyclists were observed at the study location during the AM and PM peak hours. The highest level of bicycle activity occurred in the study area from 3:35 to 4:35 PM.

3.2.4 EXISTING PEDESTRIAN ACTIVITY

The study area generally has a low level of pedestrian activity, except for the intersection of Kuakini Highway and Hualalai Road, where pedestrian activity is high. During the AM peak hour, 12 pedestrians were observed at the intersection of Kuakini Highway and Hualalai Road, and between 0 and 9 pedestrians were observed at the other study intersections. During the PM peak hour, 37 pedestrians were observed at the intersection of Kuakini Highway and Hualalai Road, and between 0 and 7 pedestrians were observed at the other study intersections.

3.3 EXISTING TRAFFIC VOLUMES/LANE CONFIGURATIONS

Operations of the seven (8) existing study intersections were evaluated for the weekday AM and PM peak hours. Traffic counts were collected during the weekday AM and PM peak periods in April 2023 while university classes were in session. The weekday peak hours of traffic for the study area generally occurred between 7:15 to 8:15 AM and 3:15 to 4:15 PM. Existing lane configurations and signal controls were obtained through field observations.

Additionally, the Synchro analysis was calibrated by incorporating local saturation rates observed at the critical movements within the study area to accurately replicates real-world traffic conditions. Saturation rates represent the maximum flow of vehicles a movement or intersection can handle before experiencing congestion. The process included capturing traffic volume and the time it took for vehicles to pass through specific movements during peak traffic periods.

Figure 3-1 presents the existing peak-hour turning movement volumes, corresponding lane configurations, and traffic control devices. Raw traffic count data sheets are provided in **Appendix A**.

3.4 FIELD OBSERVATIONS

As noted, a site visit was conducted by the project team in April 2023. During this visit, the project team observed vehicular traffic conditions (e.g. intersection operations, queuing, and travel speeds) to better understand how the development of Phase 1 of the project could affect future traffic operations. During this visit, the following key operational issues were observed:

- Kuakini Highway/Hualalai Road: Vehicular congestion along Kuakini Highway limited the number of vehicles that can pass through this intersection during the peak hour than would in free-flow conditions.
- Queen Ka'ahumanu Highway & Nani Kailua: Vehicular congestion along Queen Ka'ahumanu Highway limits the number of vehicles that can pass through this intersection during the peak hour than would in free-flow conditions.
- Queen Ka'ahumanu Highway & Lako Street: Though not located within the study area, delays at this intersection cause substantive amounts of queuing in the southbound direction along Queen Ka'ahumanu Highway. This queuing spills back into the intersection of Queen Ka'ahumanu Highway & Kuakini Highway and can disrupt intersection operations.
- Queen Ka'ahumanu Highway & Hualalai Road: Making a left turn from Hualalai Road during the morning hours was observed challenging. Northbound queues originating from Nani Kailua often spill back and contribute to the congestion at the intersection with Hualalai Road.
- Queen Ka'ahumanu Highway & Kuakini Highway: Queues extending almost to the point of spillback to Kuakini Highway. The southbound flow remained consistent. Making a left turn from Kuakini Highway to Queen Ka'ahumanu Highway during peak hours was observed challenging.

3.5 EXISTING INTERSECTION LEVELS OF SERVICE

Peak hour intersection capacity analysis was performed for the study intersections using the methodology described in **Section 2.4** and the recently collected peak hour traffic count data. **Table 3-1** summarizes the results of the intersection operations analysis for Existing Conditions. Detailed LOS worksheets are provided in **Appendix B**.

Table 3-1. Existing Peak Hour Intersection Level of Service

Intersection	Traffic Control	Peak Hour	Existing Conditions	
			(sec/veh)[1,3]	LOS[2,3]
1. Kuakini Highway & Hualalai Road	Signalized	AM	33.5	C
		PM	28.0	C
2. Kuakini Highway & North Campus Entrance [4]	SSSC	AM	27.4	D
		PM	31.1	D
3. Hualalai Road & Nani Kailua Road	SSSC	AM	10.6	B
		PM	9.7	A
4. Queen Ka'ahumanu Highway & Nani Kailua Drive	Signalized	AM	47.7	D
		PM	35.8	D
5. Hualalai Road & Hualalai Village North Driveway	SSSC	AM	10.6	B
		PM	10.1	B
6. Queen Ka'ahumanu Highway & Hualalai Road	SSSC	AM	32.6	D
		PM	22.4	C
7. Queen Ka'ahumanu Highway & Kuakini Highway	SSSC	AM	**37.9**	**E**
		PM	27.4	D
8. Hualalai Road & Hualalai Village South Driveway	SSSC	Hualalai Village South Driveway is currently closed. This access is assumed to be used as emergency access only under plus project conditions		

Source: Fehr & Peers, 2023

Notes:

[1] Whole intersection weighted average stopped delay expressed in seconds per vehicle for signalized intersections. The vehicular delay for the worst movement is reported for the side-street stop-controlled (SSSC) intersection, and traffic along the main roadways typically moves more efficiently.
[2] LOS calculations were performed using the Highway Capacity Manual (HCM) method.
[3] Unacceptable seconds of delay per vehicle and LOS are highlighted in **bold**.
[4] Eastbound left-turn movement operates at LOS F during AM, and LOS E during PM peak hours.

As shown in **Table 3-1,** the following intersection operates at less-than-desirable LOS:

- (7) Queen Ka'ahumanu Highway and Kuakini Highway: LOS E during AM peak hour

Intersection results are generally consistent with field observations. The intersections of Kuakini Highway/Hualalai Road and Nani Kailua/Queen Ka'ahumanu Highway could occasionally operate worse than average conditions, primarily because congestion along Kuakini Highway and Queen Ka'ahumanu Highway limits the number of vehicles that can pass through the intersection during the peak hour than would pass in free-flow conditions. Saturation flow rates were reduced by 20% in the Synchro model along Queen Ka'ahumanu Highway and Kuakini Highway to account for this variation in flow rates.

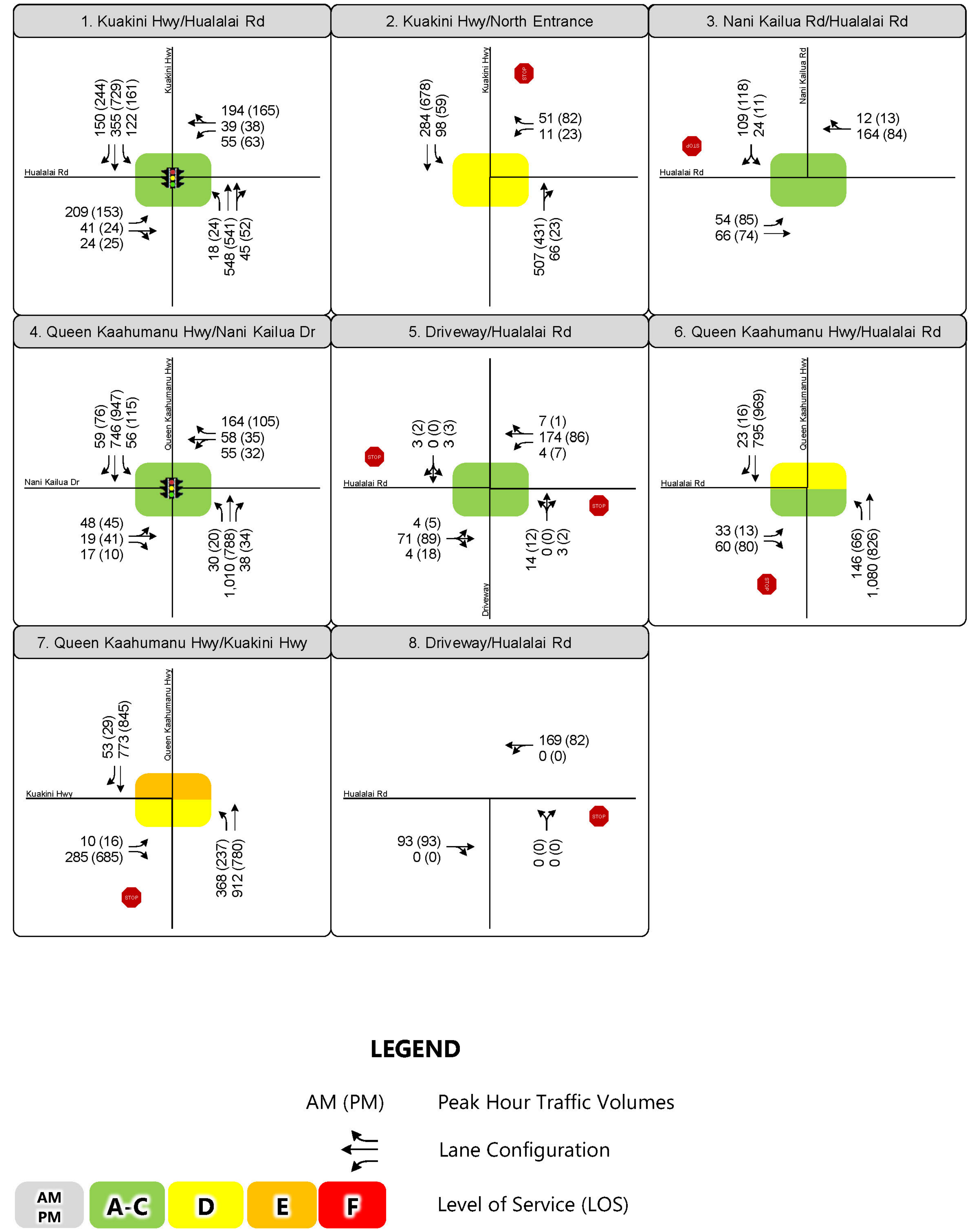


Figure 3-1
Peak Hour Traffic Volumes and Lane Configurations
Existing Conditions

4.0 PHASE 1, 2, AND 3 NO PROJECT CONDITIONS

To evaluate the potential impacts of traffic generated by the proposed project on the surrounding street system, it was necessary to first develop estimates of future traffic conditions in the area without the project. Future traffic conditions without the project reflect traffic increases due to regional growth and development. The forecasted future traffic volumes were then used to identify impacts on the roadway system from the project.

4.1 NO PROJECT TRAFFIC ESTIMATES

The following section summarizes growth assumptions used to estimate the amount of traffic that would be added to existing intersection volumes to develop Phase 1 (2030), Phase 2 (2040), and Phase 3 (2050) No Project volume estimates.

4.1.1 AREAWIDE OR AMBIENT TRAFFIC GROWTH

A growth factor was applied to existing traffic volumes to account for future study area growth. This factor was derived using the travel demand forecasting model (TDFM), which was developed for the *Federal-Aid Highways 2035 Transportation Plan for the District of Hawaii (July 2014)* published by HDOT. The TDFM uses land use and socioeconomic data to assign traffic across the planned roadway network for the base and horizon years. Future year (2035) model volumes were compared to base year (2007) model volumes to develop growth factors along study area roadways. A comparison of these daily roadway volumes demonstrated that traffic near the project site would increase annually by 2.5% along Queen Kaahumanu Highway, 1.5% along Kuakini Highway, 2% along Nani Kailua Drive, and 1% along Hualalai Road. Growth rates were compounded over the future-year timeframe for Phase 1 (2023 to 2030) and applied to each of the existing intersection turning movement traffic volumes collected in April 2023.

To estimate traffic volumes in the years 2040 and 2050, volumes from 2030 were grown using a compounded rate of 0.5% over 10 years applied to each intersection movement. It should be noted that before growth factors are applied, existing campus volumes were removed from the network volumes as the growth of campus traffic will be accounted for in Phase 1 through 3 development vehicle trip estimates described in **Chapter 5.0**.

Figure 4-1, **Figure** 4-2, and **Figure** 4-3 illustrate the forecasted peak hour traffic volumes respectively for Phase 1 (Year 2030), Phase 2 (Year 2040), and Phase 3 (Year 2050) No Project Conditions.

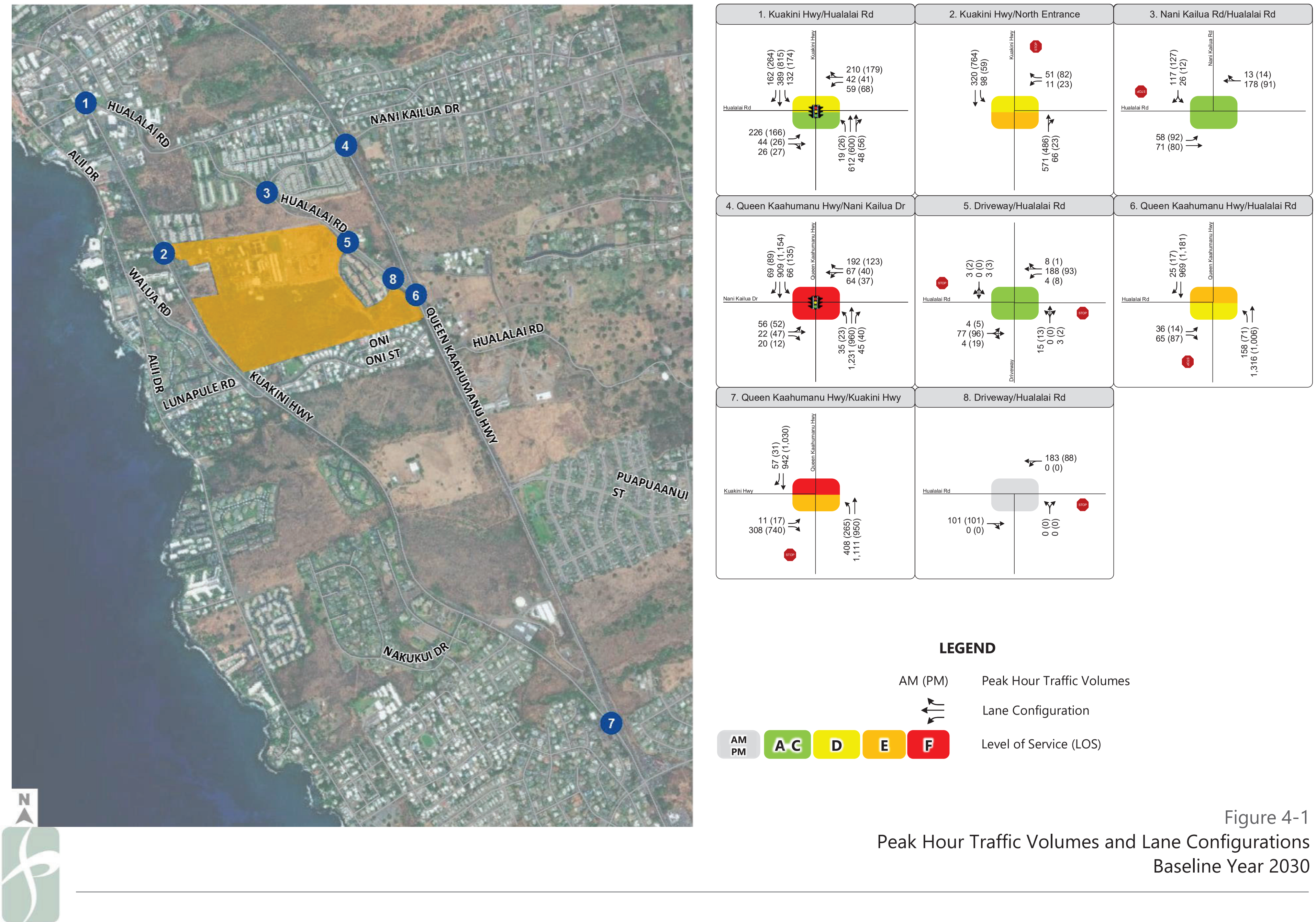
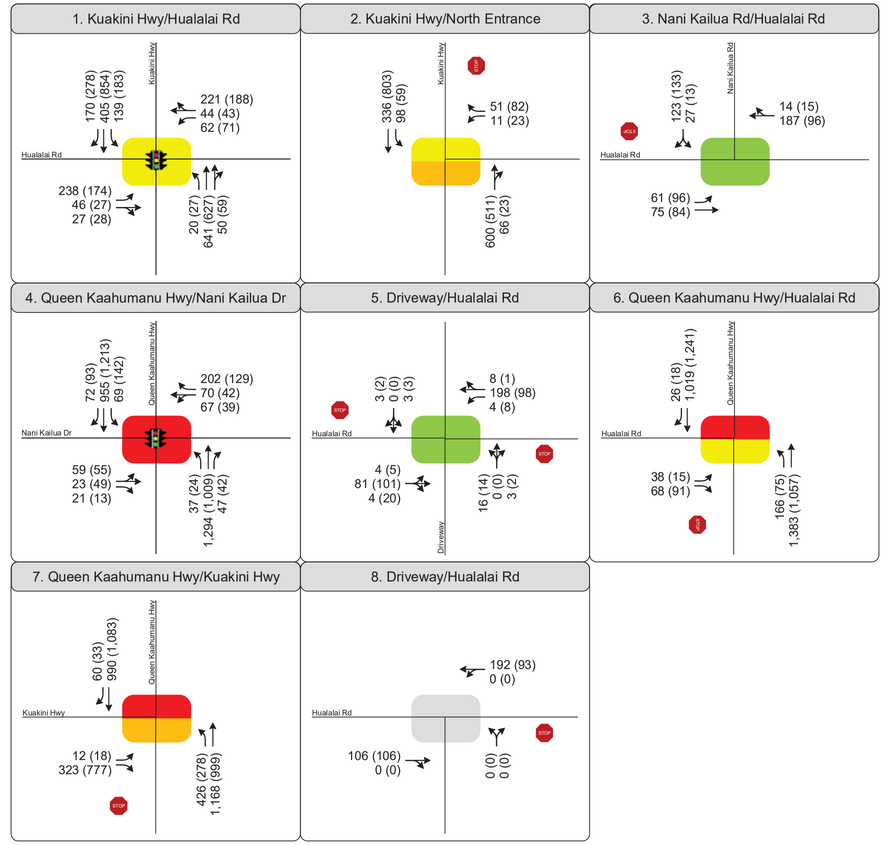


Figure 4-1
Peak Hour Traffic Volumes and Lane Configurations
Baseline Year 2030



LEGEND

AM (PM) — Peak Hour Traffic Volumes

Lane Configuration

AM/PM | A C | D | E | F — Level of Service (LOS)

Figure 4-2

Peak Hour Traffic Volumes and Lane Configurations

Baseline Year 2040

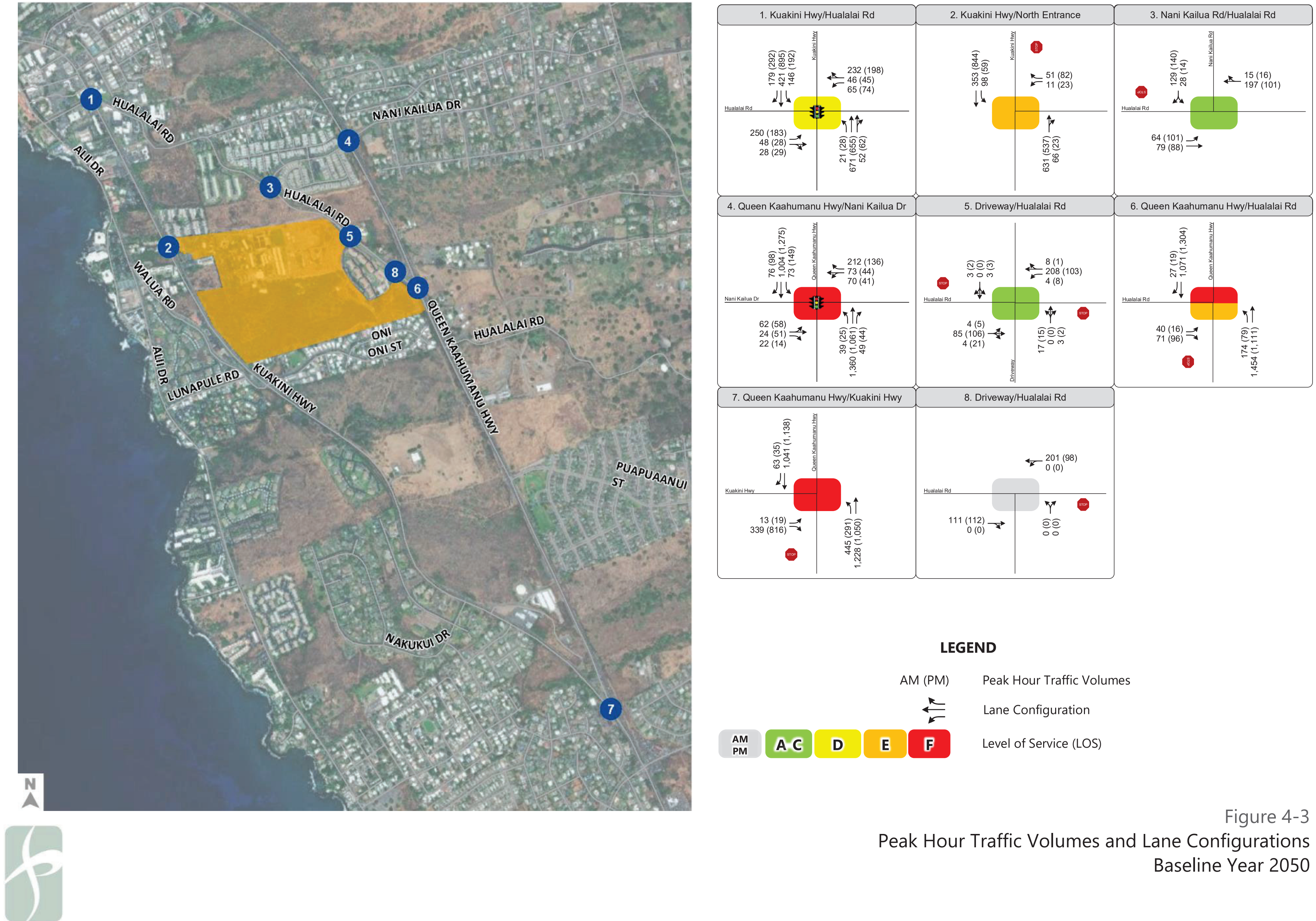


Figure 4-3
Peak Hour Traffic Volumes and Lane Configurations
Baseline Year 2050

4.1.2 FUTURE TRANSPORTATION IMPROVEMENTS

The project team coordinated with HDOT and the Hawai'i County Department of Public Works (DPW) to identify any transportation improvements within the study area that could affect vehicular traffic operations. Hawai'i County DPW noted that Kuakini Highway is planned to be widened within the study area, but this improvement does not have secured funding at the time this report was prepared. No other planned and funded improvements were identified in the study area through 2050. Therefore, intersection lane configurations and traffic control devices are expected to remain the same in Phase 1, 2, and 3 No Project conditions as under Existing Conditions.

4.2 PHASE 1 (2030) NO PROJECT LEVELS OF SERVICE

Peak hour intersection capacity analysis was performed for the study intersections using the volumes generated by the methodology described in **Section 4.1**. **Table 4-1** summarizes the results of the intersection operations analysis for Phase 1 (2030). Detailed LOS worksheets are provided in **Appendix B**.

Table 4-1. Phase 1 (2030) No Project Peak Hour Intersection Level of Service

Intersection	Traffic Control	Peak Hour	Phase 1 Conditions	
			(sec/veh)[1,3]	LOS[2,3]
1. Kuakini Highway & Hualalai Road	Signalized	AM	37.7	D
		PM	31.5	C
2. Kuakini Highway & North Campus Entrance [4]	SSSC	AM	32.1	D
		PM	**38.7**	**E**
3. Hualalai Road & Nani Kailua Road	SSSC	AM	10.9	B
		PM	9.9	A
4. Queen Ka'ahumanu Highway & Nani Kailua Drive	Signalized	AM	**114.6**	**F**
		PM	**100.5**	**F**
5. Hualalai Road & Hualalai Village North Driveway	SSSC	AM	10.9	B
		PM	10.3	B
6. Queen Ka'ahumanu Highway & Hualalai Road	SSSC	AM	**49.4**	**E**
		PM	28.8	D
7. Queen Ka'ahumanu Highway & Kuakini Highway	SSSC	AM	**58.2**	**F**
		PM	**38.2**	**E**
8. Hualalai Road & Hualalai Village South Driveway	Hualalai Village South Driveway is currently closed. This access is assumed to be used as emergency access only under plus project conditions			

Source: Fehr & Peers, 2023

Notes:

[1] Whole intersection weighted average stopped delay expressed in seconds per vehicle for signalized intersections. The vehicular delay for the worst movement is reported for the side-street stop-controlled (SSSC) intersection, and traffic along the main roadways typically moves more efficiently.

[2] LOS calculations were performed using the Highway Capacity Manual (HCM) method.

[3] Unacceptable seconds of delay per vehicle and LOS are highlighted in **bold**.

[4] Eastbound left-turn movement operates at LOS F during AM and PM peak hours.

As shown in **Table 4-1,** the following intersections operate at less-than-desirable LOS in 2030 without the Project:

- (2) Kuakini Highway and North Campus Entrance: LOS E during the PM peak hour
- (4) Queen Ka'ahumanu Highway & Nani Kailua Driveway: LOS F during the AM and PM peak hour
- (6) Queen Ka'ahumanu Highway and Hualalai Road: LOS E during AM peak hour
- (7) Queen Ka'ahumanu Highway and Kuakini Highway: LOS F during AM and LOS E during PM peak hour

Similar to the existing conditions, results are generally consistent with field observations. The intersections of Kuakini Highway/Hualalai Road and Nani Kailua/Queen Ka'ahumanu Highway could occasionally operate worse than average conditions, primarily because congestion along Kuakini Highway and Queen Ka'ahumanu Highway limits the number of vehicles that can pass through the intersection during the peak hour than would pass in free-flow conditions. Saturation flow rates were reduced by 20% in the Synchro model along Queen Ka'ahumanu Highway and Kuakini Highway to account for this variation in flow rates.

4.3 PHASE 2 (2040) NO PROJECT LEVELS OF SERVICE

Peak hour intersection capacity analysis was performed for the study intersections using the volumes generated by the methodology described in **Section 4.1**. **Table** 4-2 summarizes the results of the intersection operations analysis for Phase 2 (2040). Detailed LOS worksheets are provided in **Appendix B**.

Table 4-2. Phase 2 (2040) No Project Peak Hour Intersection Level of Service

Intersection	Traffic Control	Peak Hour	Phase 2 Conditions	
			(sec/veh)[1,3]	LOS[2,3]
1. Kuakini Highway & Hualalai Road	Signalized	AM	41.1	D
		PM	35.6	D
2. Kuakini Highway & North Campus Entrance	SSSC	AM	34.5	D
		PM	**42.9**	**E**
3. Hualalai Road & Nani Kailua Road	SSSC	AM	11.1	B
		PM	10.0	B
4. Queen Ka'ahumanu Highway & Nani Kailua Drive [4]	Signalized	AM	**136.2**	**F**
		PM	**129.3**	**F**
5. Hualalai Road & Hualalai Village North Driveway	SSSC	AM	11.0	B
		PM	10.4	B
6. Queen Ka'ahumanu Highway & Hualalai Road [4]	SSSC	AM	**58.4**	**F**
		PM	31.7	D
7. Queen Ka'ahumanu Highway & Kuakini Highway [4]	SSSC	AM	**70.8**	**F**
		PM	**43.5**	**E**
8. Hualalai Road & Hualalai Village South Driveway	Hualalai Village South Driveway is currently closed. This access is assumed to be used as emergency access only under plus project conditions			

Source: Fehr & Peers, 2023

Notes:
[1] Whole intersection weighted average stopped delay expressed in seconds per vehicle for signalized intersections. The vehicular delay for the worst movement is reported for the side-street stop-controlled (SSSC) intersection, and traffic along the main roadways typically moves more efficiently.
[2] LOS calculations were performed using the Highway Capacity Manual (HCM) method.
[3] Unacceptable seconds of delay per vehicle and LOS are highlighted in **bold**.
[4] Eastbound left-turn movement operates at LOS F during AM and PM peak hours.

As shown in **Table 4-2**Table 4-1 the following intersections operate at less-than-desirable LOS in 2040 without the project:

- (2) Kuakini Highway and North Campus Entrance: LOS E during the PM peak hour
- (4) Queen Ka'ahumanu Highway & Nani Kailua Driveway: LOS F during AM and PM peak hours
- (6) Queen Ka'ahumanu Highway and Hualalai Road: LOS F during AM peak hour
- (7) Queen Ka'ahumanu Highway and Kuakini Highway: LOS F during AM and LOS E during PM peak hour

Similar to the existing conditions, results are generally consistent with field observations. The intersections of Kuakini Highway/Hualalai Road and Nani Kailua/Queen Ka'ahumanu Highway could occasionally operate worse than average conditions, primarily because congestion along Kuakini Highway and Queen Ka'ahumanu Highway limits the number of vehicles that can pass through the intersection during the peak hour than would pass in free-flow conditions. Saturation flow rates were reduced by 20% in the Synchro model along Queen Ka'ahumanu Highway and Kuakini Highway to account for this variation in flow rates.

4.4 PHASE 3 (2050) NO PROJECT LEVELS OF SERVICE

Peak hour intersection capacity analysis was performed for the study intersections using the volumes generated by the methodology described in Section 4.1. Table 4-3 summarizes the results of the intersection operations analysis for Phase 3 (2050). Detailed LOS worksheets are provided in **Appendix B**.

Table 4-3. Phase 3 (2050) No Project Peak Hour Intersection Level of Service

Intersection	Traffic Control	Peak Hour	Phase 3 Conditions	
			(sec/veh)[1,3]	LOS[2,3]
1. Kuakini Highway & Hualalai Road	Signalized	AM	44.6	D
		PM	42.3	D
2. Kuakini Highway & North Campus Entrance [4]	SSSC	AM	**37.4**	**E**
		PM	**48.3**	**E**
3. Hualalai Road & Nani Kailua Road	SSSC	AM	11.3	B
		PM	10.1	B
4. Queen Ka'ahumanu Highway & Nani Kailua Drive	Signalized	AM	**160.4**	**E**
		PM	**156.7**	**F**
5. Hualalai Road & Hualalai Village North Driveway	SSSC	AM	11.2	B
		PM	10.6	B
6. Queen Ka'ahumanu Highway & Hualalai Road	SSSC	AM	**70.4**	**F**
		PM	**35.0**	**E**
7. Queen Ka'ahumanu Highway & Kuakini Highway	SSSC	AM	**92.9**	**F**
		PM	**50.8**	**F**
8. Hualalai Road & Hualalai Village South Driveway	Hualalai Village South Driveway is currently closed. This access is assumed to be used as emergency access only under plus project conditions			

Source: Fehr & Peers, 2023

Notes:

[1] Whole intersection weighted average stopped delay expressed in seconds per vehicle for signalized intersections. The vehicular delay for the worst movement is reported for the side-street stop-controlled (SSSC) intersection, and traffic along the main roadways typically moves more efficiently.
[2] LOS calculations were performed using the Highway Capacity Manual (HCM) method.
[3] Unacceptable seconds of delay per vehicle and LOS are highlighted in **bold**.
[4] Eastbound left-turn movement operates at LOS F during AM and PM peak hours.

As shown in Table 4-3, the following intersections operate at less-than-desirable LOS in 2050 without the project:

- (2) Kuakini Highway and North Entrance: LOS E during AM and PM peak hours
- (4) Queen Ka'ahumanu Hwy & Nani Kailua Driveway: LOS E during AM peak hour and LOS F during the PM peak hour
- (6) Queen Ka'ahumanu Highway and Hualalai Road: LOS F during AM peak hour and LOS E during the PM peak hour
- (7) Queen Ka'ahumanu Highway and Kuakini Highway: LOS F during AM and PM peak hours

Similar to the existing conditions, results are generally consistent with field observations. The intersections of Kuakini Highway/Hualalai Road and Nani Kailua/Queen Ka'ahumanu Highway could occasionally operate worse than average conditions, primarily because congestion along Kuakini Highway and Queen Ka'ahumanu Highway limits the number of vehicles that can pass through the intersection during the peak hour than would pass in free-flow conditions. Saturation flow rates were reduced by 20% in the Synchro model along Queen Ka'ahumanu Highway and Kuakini Highway to account for this variation in flow rates.

5.0 PROJECT TRAFFIC ESTIMATES

This section describes the anticipated number of vehicle trips and the directionality of those trips that would result from the implementation of Phase 1 (Year 2030), Phase 2 (Year 2040), and Phase 3 (Year 2050) of the Campus Master Plan. Future traffic added to the roadway system by the project is estimated using a three-step process: (1) project trip generation, (2) trip distribution, and (3) trip assignment. The first step estimates the amount of project-generated traffic that would be added to the roadway network. The second step estimates the direction of travel to and from the project site. The third step assigns trips generated by the project to specific street segments and intersection turning movements. This process is described in more detail in the following sections.

5.1 PROJECT TRIP GENERATION ESTIMATES

Since the existing campus is self-contained, and existing access is limited to one location, it can be assumed that any growth in student and/or faculty/staff levels would directly result in an increase in trips to and from the university campus and that any trips entering or exiting the University of the Nations Driveway are those generated by the university itself. Table 5-1 lists the projected student, faculty, and staff numbers during each phase of the project.

Table 5-1. Projected University Population

	Existing	Phase 1	Phase 2	Phase 3
PK - 12 Children Total	**294**	**340**	**469**	**575**
PK - 12 Children commuting	148	110	155	175
PK - 12 Children in student housing	146	230	314	400
University Students Total	**480**	**718**	**955**	**1,200**
University students commuting	17	11	6	-
University students in student housing	463	706	949	1,200
Faculty/Staff Total	**602**	**667**	**716**	**800**
Staff commuting	322	282	225	200
Staff in faculty/staff housing	280	386	491	600
Mission Builders, Volunteers, Speakers, Seminar Guests, and Visitors	**25**	**116**	**207**	**300**
Commuting	5	3	2	-
Guest housing	20	112	205	300
Total commuting population (Not including PK-12 Children)	*344*	*296*	*232*	*200*
Total population in campus housing (Not including PK-12 Children)	*763*	*1,204*	*1,645*	*2,100*
Total Campus Population	*1,401*	*1,841*	*1,347*	*2,875*

Source: G70 International and the University of Nations Kona

To estimate Project trip generation, multimodal counts of vehicles, bicyclists, and pedestrians were collected at the existing University of the Nations Kona site driveway. The traffic counts obtained were instrumental in determining the trip rates for students, faculty, and staff residing on the site, as well as those commuting to the site.

General campus trips were divided into two main groups: *Dorming Population* and *Commuting Population*. Daily and peak hour trips associated with the Dorming Population were estimated using an average daily trip rate of 2.25 per person per day, and 0.13 trips per person per each peak hour. The peak hour trip rates were determined through a meticulous process that involved the review of comparable land uses from the Institute of Transportation Engineers (ITE) Trip Generation Manual (11th edition) in conjunction with the expertise of our engineering judgment and a thorough evaluation of the existing driveway counts at the university.

Trips associated with the commuting population were estimated by subtracting estimated trips for the dorm population from the driveway counts. Commuting trip numbers were then used to calculate approximate trips per commuting population for each peak hour. Estimated rates were then applied to future student enrollment and faculty/staff employment forecasts to estimate future Project trips. Total peak hour trips were then split into inbound and outbound trips. For this step, the ratio of inbound and outbound trips is assumed to be the same as under existing conditions.

Table 5-2 summarizes the forecasted trip generation for the proposed project under each Phase.

Table 5-2. Project Trip Generation

Land Use	Input		Average Trip Rate			Total Daily Trips	Peak Hour									
							AM					PM				
	Quantity	Unit	Daily	AM Peak	PM Peak		In %	Out %	In	Out	Total	In %	Out %	In	Out	Total
Existing																
Total housing population	763	Person	2.25	0.13	0.13	1,717	45%	60%	45	55	100	65%	35%	65	35	100
Total commuting population [1]	344	Person	1.41	0.37	0.25	484	94%	6%	119	7	126	20%	80%	17	70	87
Existing Driveway Counts	1,107	Person	-	-	-	2,201	73%	27%	**164**	**62**	226	44%	56%	**82**	**105**	187
Phase I																
Total housing population	1,204	Person	-	-	-	2,709	45%	55%	71	86	157	65%	35%	103	54	157
Total commuting population	296	Person	-	-	-	417	94%	6%	104	6	110	20%	80%	15	59	74
Subtotal	1,500	-	-	-	-	3,126	-	-	**175**	**92**	267	-	-	**118**	**113**	231
Phase I + II																
Total housing population	1,645	Person	-	-	-	3,701	45%	55%	98	118	216	65%	35%	141	75	216
Total commuting population	232	Person	-	-	-	327	94%	6%	81	4	85	20%	80%	12	47	59
Subtotal	1,877	-	-	-	-	4,028	-	-	**179**	**122**	301	-	-	**153**	**122**	275
Phase I + II + III																
Total housing population	2,100	Person	-	-	-	4,725	45%	55%	124	151	275	65%	35%	179	96	275
Total commuting population	200	Person	-	-	-	282	94%	6%	69	4	73	20%	80%	10	41	51
Subtotal	2,300	-	-	-	-	5,007	-	-	**193**	**155**	348	-	-	**189**	**137**	326

[1] To estimate trip numbers for the commuting population, estimated trips for the housing population were subtracted from the existing driveway counts. Trip rates were then calculated by using the commuting population and estimated total trips during each peak hour.

5.2 PROJECT TRIP DISTRIBUTION AND ASSIGNMENT

The geographic distribution of project trips is primarily dependent on the roadway circulation network and the location of residential, commercial, and other land uses that would either produce trips destined for campus (e.g. faculty/staff housing) or attract trips from campus (e.g. commercial shopping centers).

As noted in **Section 2.1**, a second access point is planned on the Mauka side of campus along Kuakini Hwy. Once this connection is completed, campus students, faculty/staff, and visitors will be able to access campus via this driveway. The proposed new access point is recommended to be constructed with the exclusive left-turn lane on the southbound approach and the south leg is striped to accommodate a refuge lane serving the westbound left-turn vehicles.

Project trip distribution was developed using existing travel patterns and anticipated growth areas and assumed no substantive changes to the surrounding roadway circulation network. **Figure 5-1** illustrates the project trip distribution pattern in the study area.

Using the estimated trip generation and trip distribution approach discussed above, the traffic forecast to be generated by the proposed project was assigned to individual turning movements at each of the study intersections. **Figure 5-2**, **Figure 5-3**, and **Figure 5-4** illustrate the assignment of new project-generated trips for each turning movement at the study intersections.

It should be noted that no project-generated trips were assigned to (#6) Queen Ka'ahumanu Highway & Hualalai Road, and (#5) Hualalai Road/Hualalai Village North Driveway. However, these intersections were evaluated to better understand the traffic conditions and circulation along Hualalai Road where the Master Plan proposes to utilize the Hualalai Village South Driveway as an emergency access.

Legend

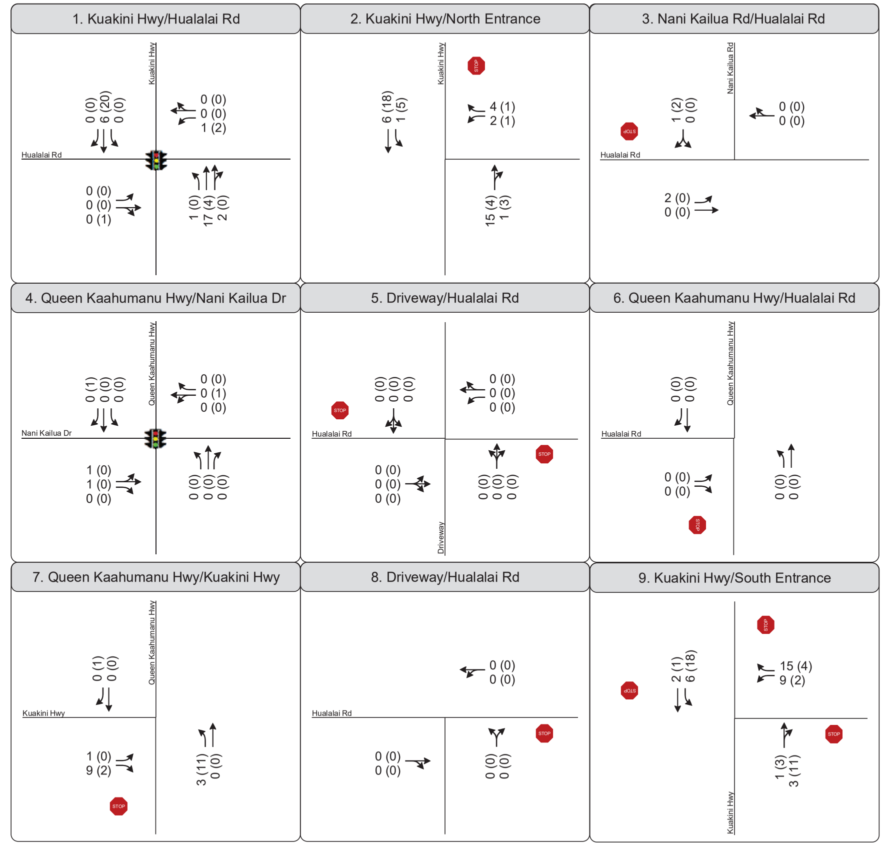
Project Study Area

X Study Intersections

X Future Study Intersections

Figure 5-1

Project Trip Distribution

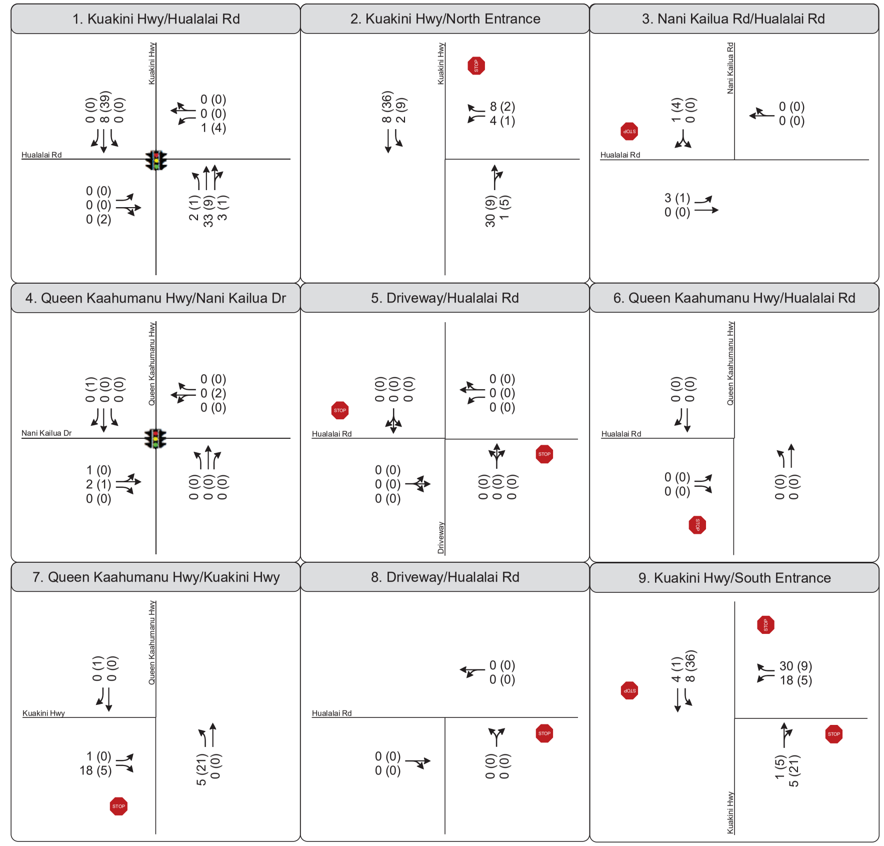


LEGEND

AM (PM) Peak Hour Traffic Volumes

Lane Configuration

Figure 5-2
Peak Hour Traffic Volumes and Lane Configurations
Project Phase 1

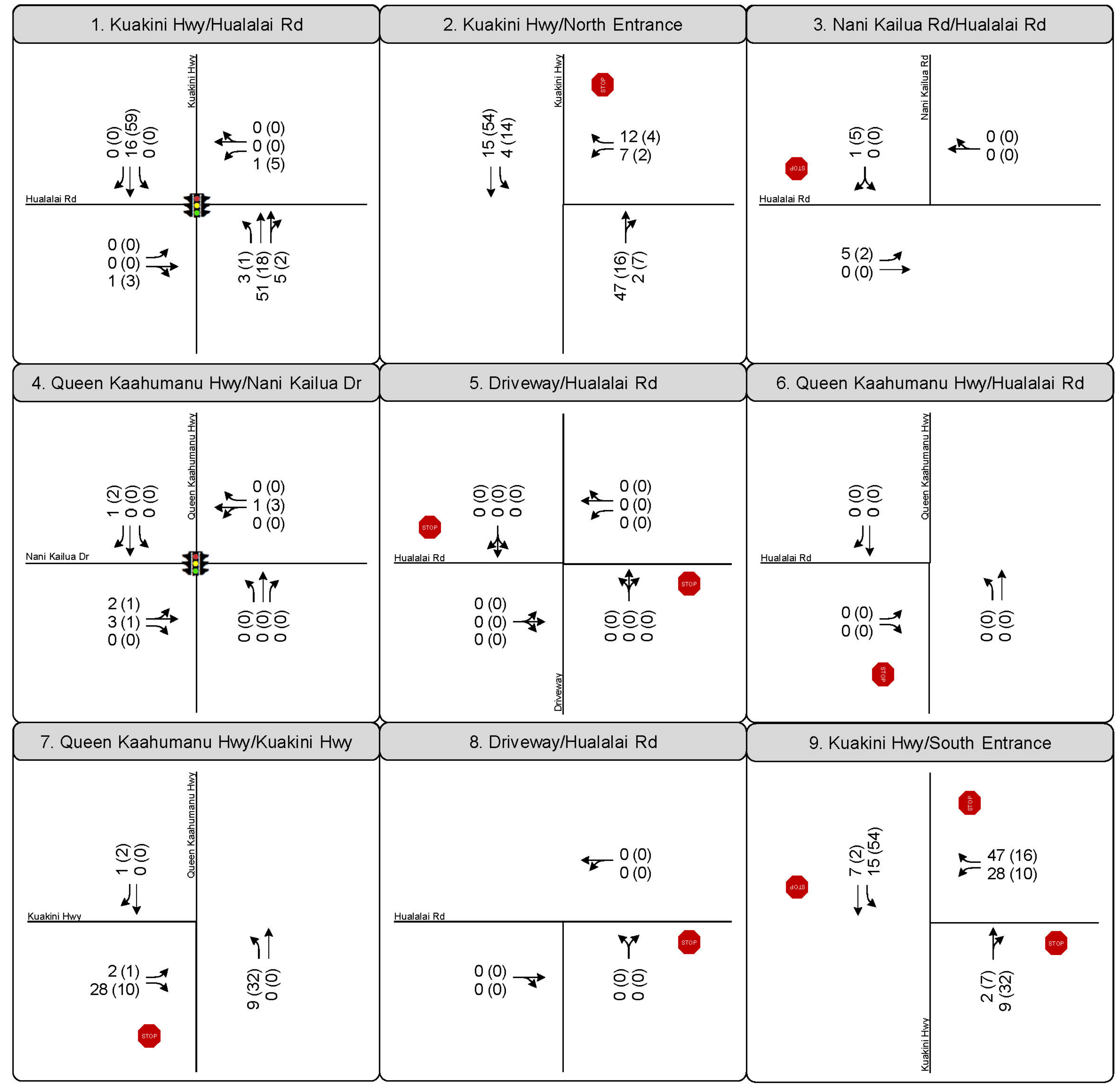


LEGEND

AM (PM) Peak Hour Traffic Volumes

Lane Configuration

Figure 5-3
Peak Hour Traffic Volumes and Lane Configurations
Project Phase 2



LEGEND

AM (PM) Peak Hour Traffic Volumes

Lane Configuration

Figure 5-4

Peak Hour Traffic Volumes and Lane Configurations

Project Phase 3

6.0 PHASE 1, 2, AND 3 PLUS PROJECT CONDITIONS

This section describes the analysis of potential impacts on the roadway system due to projected future increases in traffic, including traffic generated by Phase 1 (2030), Phase 2 (2040), and Phase 3 (2050). The Plus Project roadway network is the same network assumed under the Existing Conditions scenario except for the addition of the proposed South Campus Entrance along the Kuakini Highway planned as a part of the Phase 1 development. The analysis compares the project delays and levels of service (LOS) at each study intersection with and without the addition of project-generated trips to identify potentially significant impacts to the transportation network resulting from Master Plan implementation.

To forecast the peak hour operating conditions at each study intersection, project trip volumes were added to No Project traffic volumes in each phase to derive Plus Project volumes. **Figure 6-1**, **Figure** 6-2, and **Figure** 6-3 illustrate respectively the forecasted Phase 1 (2030) Plus Project, Phase 2 (2040) Plus Project, and Phase 3 (2050) Plus Project AM and PM peak hour volumes. The peak hour volumes were used to analyze operations using the LOS methodology described in **Section 2.4**.

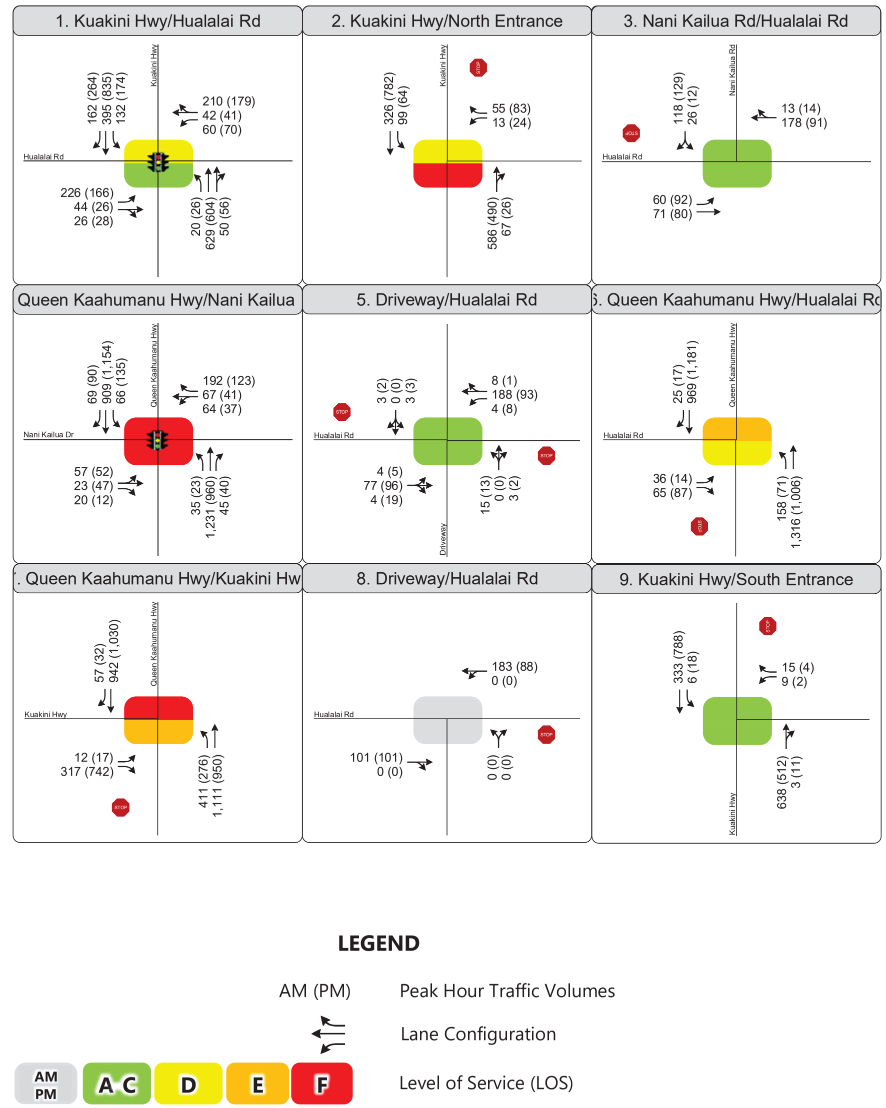


Figure 6-1
Peak Hour Traffic Volumes and Lane Configurations
Year 2030 + Phase 1

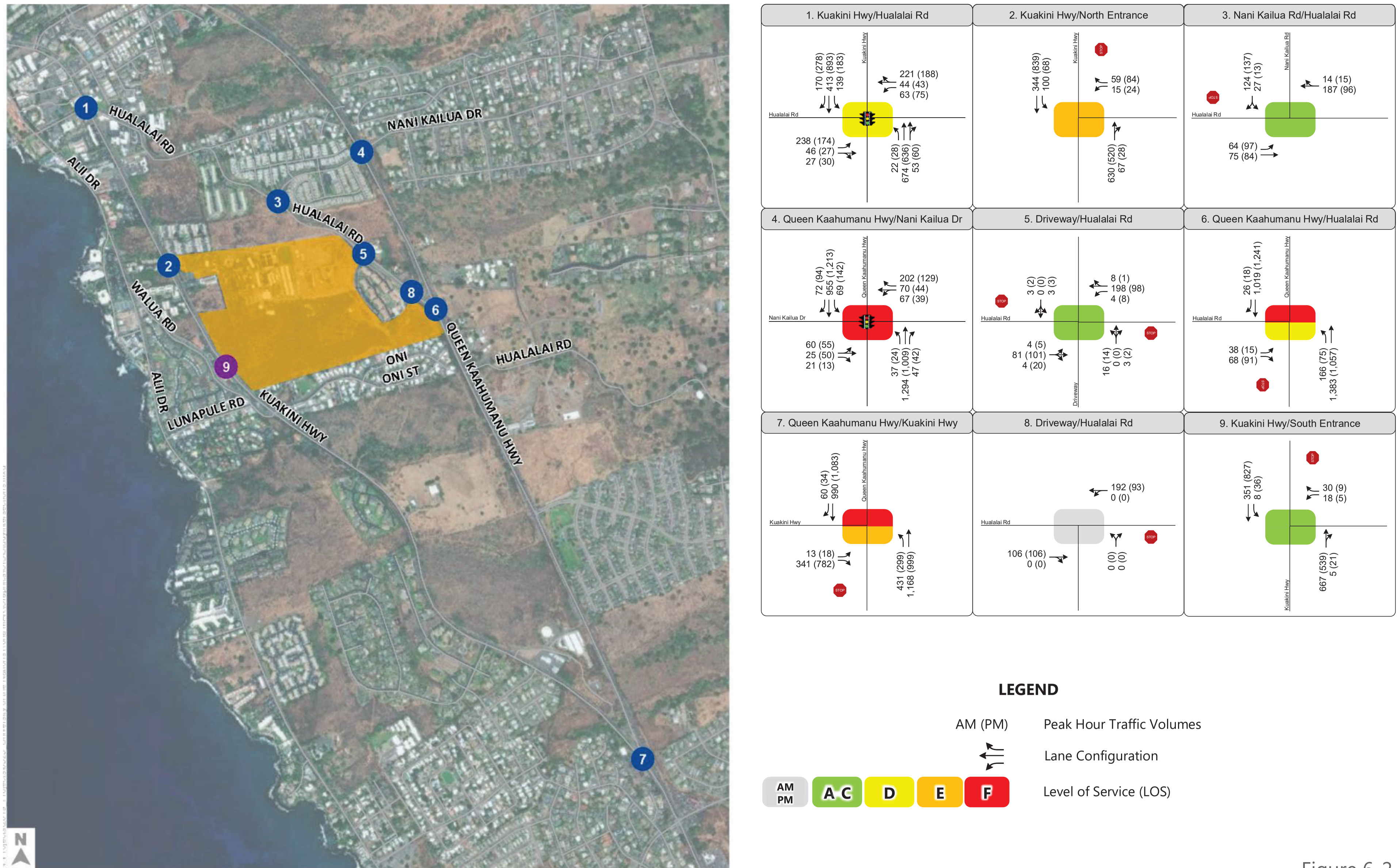


Figure 6-2
Peak Hour Traffic Volumes and Lane Configurations
Year 2040 + Phase 1 + Phase 2

Figure 6-3
Peak Hour Traffic Volumes and Lane Configurations
Year 2050 + Phase 1 + Phase 2 + Phase 3

6.1 PHASE 1 (2030) PLUS PROJECT INTERSECTION LEVEL OF SERVICE

The comparative LOS analysis results for the study intersections under Phase 1 (2030) Without and With Project conditions are presented in **Table 6-1**. Detailed LOS results for intersection movements and corresponding LOS calculation sheets are included in **Appendix B**.

Table 6-1. Phase 1 (2030) With and Without Project Peak Hour Intersection Level of Service

Intersection	Traffic Control	Peak Hour	Year 2030 No Project Conditions		Year 2030 + Project Conditions		Change in Delay[4]
			(sec/veh)[1,3]	LOS[2,3]	(sec/veh)[1,3]	LOS[2,3]	
1. Kuakini Highway & Hualalai Road [5]	Signalized	AM	37.7	D	39.5	D	1.8
		PM	31.5	C	32.4	C	0.9
2. Kuakini Highway & North Campus Entrance	SSSC	AM	32.1	D	33.9	D	1.8
		PM	**38.7**	**E**	**41.4**	**F**	2.7
3. Hualalai Road & Nani Kailua Road	SSSC	AM	10.9	B	10.9	B	0.0
		PM	9.9	A	9.9	A	0.0
4. Queen Ka'ahumanu Highway & Nani Kailua Drive	Signalized	AM	**114.6**	**F**	**114.6**	**F**	0.0
		PM	**100.5**	**F**	**105.3**	**F**	0.3
5. Hualalai Road & Hualalai Village North Driveway	SSSC	AM	10.9	B	10.9	B	0.0
		PM	10.3	B	10.3	B	0.0
6. Queen Ka'ahumanu Highway & Hualalai Road	SSSC	AM	**49.4**	**E**	**49.4**	**E**	0.0
		PM	28.8	D	28.8	D	0.0
7. Queen Ka'ahumanu Highway & Kuakini Highway	SSSC	AM	**58.2**	**F**	**59.9**	**F**	1.7
		PM	**38.2**	**E**	**39.5**	**E**	1.3
8. Hualalai Rd & Hualalai Village South Drwy	Hualalai Village South Driveway is currently closed. This access is assumed to be used as emergency access only under plus project conditions						
9. Kuakini Hwy and South Campus Entrance	SSSC	AM	-	-	13.6	C	-
		PM	-	-	16.0	C	-

Source: Fehr & Peers, 2023

[1] Whole intersection weighted average stopped delay expressed in seconds per vehicle for signalized intersections. The vehicular delay for the worst movement is reported for the side-street stop-controlled (SSSC) intersection, and traffic along the main roadways typically moves more efficiently.

[2] LOS calculations were performed using the Highway Capacity Manual (HCM) method.

[3] Unacceptable seconds of delay per vehicle and LOS are highlighted in **bold**.

[4] Delay increases of more than five seconds or degradation from LOS A, B, C, or D to E/F are colored in **red**.

[5] Eastbound left-turn movement operates at LOS F during AM and PM peak hours.

The results presented in **Table 6-1** indicate that under Phase 1 (2030) Plus Project conditions, four of the study intersections are anticipated to operate at a less than desirable level (i.e., LOS E or F) during the AM and PM peak hours with the addition of project-generated traffic. These include:

- (2) Kuakini Highway & North Campus Entrance: LOS E during AM peak hour and LOS F during PM peak hour
- (4) Queen Ka'ahumanu Highway & Nani Kailua Drive: LOS F during AM and PM peak hours
- (6) Queen Ka'ahumanu Highway and Hualalai Road: LOS E during AM peak hour
- (7) Queen Ka'ahumanu Highway and Kuakini Highway: LOS F during AM peak hour and LOS E during PM peak hour

As noted in **Section 2.4.3**, one or more signal warrants must also be met at unsignalized intersections for a significant impact to occur. An overview of signal warrant analysis is included in **Section 6.4**.

Similar to the existing conditions, results are generally consistent with field observations. The intersections of Kuakini Highway/Hualalai Road and Nani Kailua/Queen Ka'ahumanu Highway could occasionally operate worse than average conditions, primarily because congestion along Kuakini Highway and Queen Ka'ahumanu Highway limits the number of vehicles that can pass through the intersection during the peak hour than would pass in free-flow conditions. Saturation flow rates were reduced by 20% in the Synchro model along Queen Ka'ahumanu Highway and Kuakini Highway to account for this variation in flow rates.

6.2 PHASE 2 (2040) PLUS PROJECT INTERSECTION LEVEL OF SERVICE

To forecast the peak hour operating conditions at each study intersection, project trip volumes were added to Phase 2 (2040) No Project traffic volumes to derive Phase 2 (2040) Plus Project volumes.

The comparative LOS analysis results for the study intersections under Phase 2 (2040) Without and With Project conditions are presented in **Table 6-2**. Detailed LOS results for intersection movements and corresponding LOS calculation sheets are included in **Appendix B**.

Table 6-2. Phase 2 (2040) With and Without Project Peak Hour Intersection Level of Service

Intersection	Traffic Control	Peak Hour	Year 2040 No Project Conditions		Year 2040 + Project Conditions		Change in Delay[4]
			(sec/veh)[1,3]	LOS[2,3]	(sec/veh)[1,3]	LOS[2,3]	
1. Kuakini Highway & Hualalai Road [5]	Signalized	AM	41.1	D	43.2	D	2.1
		PM	35.6	D	38.9	D	3.3
2. Kuakini Highway & North Campus Entrance	SSSC	AM	34.5	D	**38.5**	**E**	4.0
		PM	**42.9**	**E**	**48.9**	**E**	**6.0**
3. Hualalai Road & Nani Kailua Road	SSSC	AM	11.1	B	11.1	B	0.0
		PM	10.0	B	10.0	B	0.0
4. Queen Ka'ahumanu Highway & Nani Kailua Drive	Signalized	AM	**136.2**	**F**	**136.2**	**F**	0.0
		PM	**129.3**	**F**	**129.9**	**F**	0.6
5. Hualalai Road & Hualalai Village North Driveway	SSSC	AM	11.0	B	11.0	B	0.0
		PM	10.4	B	10.4	B	0.0
6. Queen Ka'ahumanu Highway & Hualalai Road	SSSC	AM	**58.4**	**F**	**58.4**	**F**	0.0
		PM	31.7	D	31.7	D	0.0
7. Queen Ka'ahumanu Highway & Kuakini Highway	SSSC	AM	**70.8**	**F**	**74.6**	**F**	3.8
		PM	**43.5**	**E**	**46.6**	**E**	3.1
8. Hualalai Rd & Hualalai Village South Drwy	Hualalai Village South Driveway is currently closed. This access is assumed to be used as emergency access only under plus project conditions						
9. Kuakini Hwy and South Campus Entrance	SSSC	AM	-	-	14.2	B	-
		PM	-	-	17.3	C	-

Source: Fehr & Peers, 2023

Notes:

[1] Whole intersection weighted average stopped delay expressed in seconds per vehicle for signalized intersections. The vehicular delay for the worst movement is reported for the side-street stop-controlled (SSSC) intersection, and traffic along the main roadways typically moves more efficiently.
[2] LOS calculations were performed using the Highway Capacity Manual (HCM) method.
[3] Unacceptable seconds of delay per vehicle and LOS are highlighted in **bold**.
[4] Delay increases of more than five seconds or degradation from LOS A, B, C, or D to E/F are colored in **red**.
[5] Eastbound left-turn movement operates at LOS F during AM and PM peak hours.

The results presented in **Table 6-2** indicate that under Phase 1 (2040) Plus Project conditions, all study intersections are anticipated to continue to operate at LOS D or better during the AM and PM peak hours with the addition of project-generated traffic except for the following intersections:

- (2) Kuakini Highway and North Campus Entrance: LOS E during AM peak hour and LOS F during PM peak hour
  - (4) Queen Ka'ahumanu Hwy and Nani Kailua Driveway: LOS E during AM peak hour and LOS F during PM peak hour

- (6) Queen Ka'ahumanu Highway and Hualalai Road: LOS F during AM peak hour
- (7) Queen Ka'ahumanu Highway and Kuakini Highway: LOS F during AM and PM peak hours

As noted in **Section 2.4.3**, one or more signal warrants must also be met at unsignalized intersections for a direct impact to occur. An overview of signal warrant analysis is included in **Section 6.4**.

Similar to the existing conditions, results are generally consistent with field observations. The intersections of Kuakini Highway/Hualalai Road and Nani Kailua/Queen Ka'ahumanu Highway could occasionally operate worse than average conditions, primarily because congestion along Kuakini Highway and Queen Ka'ahumanu Highway limits the number of vehicles that can pass through the intersection during the peak hour than would pass in free-flow conditions. Saturation flow rates were reduced by 20% in the Synchro model along Queen Ka'ahumanu Highway and Kuakini Highway to account for this variation in flow rates.

6.3 PHASE 3 (2050) PLUS PROJECT INTERSECTION LEVEL OF SERVICE

To forecast the peak hour operating conditions at each study intersection, project trip volumes were added to Phase 3 (2050) No Project traffic volumes to derive Phase 3 (2050) Plus Project volumes.

The comparative LOS analysis results for the study intersections under Phase 3 (2050) Without and With Project conditions are presented in **Table 6-3**. Detailed LOS results for intersection movements and corresponding LOS calculation sheets are included in **Appendix B**.

Table 6-3. Phase 3 (2050) With and Without Project Peak Hour Intersection Level of Service

Intersection	Traffic Control	Peak Hour	Year 2050 No Project Conditions		Year 2050+ Project Conditions		Change in Delay[4]
			(sec/veh)[1,3]	LOS[2,3]	(sec/veh)[1,3]	LOS[2,3]	
1. Kuakini Highway & Hualalai Road [5]	Signalized	AM	44.6	D	46.9	D	2.3
		PM	42.3	D	50.0	D	7.7
2. Kuakini Highway & North Campus Entrance	SSSC	AM	**37.4**	**E**	**46.4**	**E**	**9.0**
		PM	**48.3**	**E**	**60.1**	**F**	**11.8**
3. Hualalai Road & Nani Kailua Road	SSSC	AM	11.3	B	11.4	B	0.1
		PM	10.1	B	10.2	B	0.1
4. Queen Ka'ahumanu Highway & Nani Kailua Drive	Signalized	AM	**160.4**	**E**	**160.4**	**F**	0.0
		PM	**156.7**	**F**	**158.4**	**F**	1.7
5. Hualalai Road & Hualalai Village North Driveway	SSSC	AM	11.2	B	11.2	B	0.0
		PM	10.6	B	10.6	B	0.0
6. Queen Ka'ahumanu Highway & Hualalai Road	SSSC	AM	**70.4**	**F**	**70.4**	**F**	0.0
		PM	**35.0**	**E**	**35.0**	**E**	0.0
7. Queen Ka'ahumanu Highway & Kuakini Highway	SSSC	AM	**92.9**	**F**	**102.0**	**F**	**9.1**
		PM	**50.8**	**F**	**58.2**	**F**	**7.4**
8. Hualalai Rd & Hualalai Village South Drwy	Hualalai Village South Driveway is currently closed. This access is assumed to be used as emergency access only under plus project conditions						
9. Kuakini Hwy and South Campus Entrance	SSSC	AM	-	-	15.2	C	-
		PM	**-**	**-**	19.1	C	-

Source: Fehr & Peers, 2021

Notes:
[1] Whole intersection weighted average stopped delay expressed in seconds per vehicle for signalized intersections. The vehicular delay for the worst movement is reported for the side-street stop-controlled (SSSC) intersection, and traffic along the main roadways typically moves more efficiently.
[2] LOS calculations were performed using the Highway Capacity Manual (HCM) method.
[3] Unacceptable seconds of delay per vehicle and LOS are highlighted in **bold**.
[4] Delay increases of more than five seconds or degradation from LOS A, B, C, or D to E/F are colored in **red**.
[5] Eastbound left-turn movement operates at LOS F during AM and PM peak hours.

The results presented in **Table** 6-3 indicate that under Phase 3 (2050) Plus Project conditions, all study intersections are anticipated to continue to operate at LOS D or better during the AM and PM peak hours with the addition of project-generated traffic except for the following intersections:

- (2) Kuakini Highway and North Campus Entrance: LOS E during AM and F during PM peak hour
- (4) Queen Ka'ahumanu Hwy & Nani Kailua Driway: LOS F during AM and PM peak hours

- (6) Queen Ka'ahumanu Highway and Hualalai Road: LOS F during AM peak hour and LOS E during the PM peak hour
- (7) Queen Ka'ahumanu Highway and Kuakini Highway: LOS F during AM and PM peak hours

As noted in **Section 2.4.3**, one or more signal warrants must also be met at unsignalized intersections for a direct impact to occur. An overview of signal warrant analysis is included in **Section 6.4**.

Similar to the existing conditions, results are generally consistent with field observations. The intersections of Kuakini Highway/Hualalai Road and Nani Kailua/Queen Ka'ahumanu Highway could occasionally operate worse than average conditions, primarily because congestion along Kuakini Highway and Queen Ka'ahumanu Highway limits the number of vehicles that can pass through the intersection during the peak hour than would pass in free-flow conditions. Saturation flow rates were reduced by 20% in the Synchro model along Queen Ka'ahumanu Highway and Kuakini Highway to account for this variation in flow rates.

6.4 SIGNAL WARRANT ANALYSIS

As noted in **Section 2.4.4**, a significant impact is determined to occur at unsignalized intersections if operations change from LOS D or better to LOS E or F, and one or more signal warrants are met.

As noted in **Sections 6.1**, **6.2**, and **6.3** the intersections of Kuakini Highway and the North Campus Entrance Driveway (#2) and Queen Ka'ahumanu Highway and Kuakini Highway intersection (#7) operate at an unacceptable LOS (LOS E or F) during one or both peak hours under Plus Project conditions. To determine whether significant impacts would occur at any of these intersections, Eight-Hour Vehicular Volume and Peak-Hour Vehicular Volume signal warrants analyses were performed based on the methodology described in Chapter 4C of the Manual of Uniform Control Devices (MUTCD, 2009) published by the U.S. Department of Transportation Federal Highway Administration (FHWA). Table 6-4 summarizes the signal warrant analysis.

Table 6-4. Signal Warrant Review Summary

Intersection	Warrant	Scenario		
		YR 2030 + P	YR 2040 + P	YR 2050 + P
(2) Kuakini Hwy & North Campus Entrance	8-Hour Vehicular Volumes Warrant	Not Met	Not Met	Not Met
	Peak-Hour Vehicular Volumes	Not Met	Not Met	Not Met
(7) Queen Ka'ahumanu Hwy & Kuakini Hwy	8-Hour Vehicular Volumes Warrant	Not Met	Not Met	Not Met
	Peak-Hour Vehicular Volumes	Not Met	Not Met	Not Met

Intersections of Kuakini Highway / North Campus Entrance (#2) and Queen Ka'ahumanu Highway / Kuakini Highway (#7) intersections did not meet any of the signal warrants in any of the three Master Plan phases. Signal warrant worksheets are included in **Appendix C**.

6.5 POTENTIAL INTERSECTION IMPACTS

Based upon the impact significance criteria and the results of the operations analysis no direct impact was calculated at any of the study intersections.

6.6 SPECIAL EVENTS

As noted in **Section 2.1**, the University of the Nations Kona plans to host weekly community and athletic events throughout the year. Because these events generate low volumes compared to day-to-day operations and would occur mostly on weekends, it is not reasonable to conduct a detailed impact analysis for these conditions.

It is recommended that the University of the Nations Kona develop a transportation management plan (TMP) – which should include a transportation demand management (TDM) program – to reduce potential temporary impacts to study area intersections during special events. Potential TDM strategies include the use of event shuttles/buses, dynamic event parking pricing, remote parking, and incentives to encourage attendees to carpool to and/or from events. In addition to TDM, it is also expected that manual traffic control and focused enforcement will be needed to effectively manage special event traffic and minimize adjacent neighborhood intrusion.

7.0 TRAFFIC IMPROVEMENTS

7.1 IMPROVEMENTS AND RECOMMENDATIONS

Recommendations are provided at locations where a significant traffic impact was not identified, but improvements may become necessary in the future. The emphasis was to identify physical and/or operational improvements that could be implemented within the existing or planned roadway rights-of-way and determine if improvements would be ultimately feasible.

Intersection #2 Kuakini Highway and Campus North Entrance – is estimated to operate at LOS E during PM peak hour under 2030 Plus Project conditions. This intersection, however, does not meet signal warrant analysis. Recommended improvements to improve intersection operation include restriping the south leg to include a refuge lane for the westbound left turn traffic. **Table** 7-1 summarizes intersection operations before and after the proposed improvement. LOS calculation sheets are included in **Appendix D**.

Table 7-1 Intersection #2 Kuakini Highway and Main Driveway mitigation results

Peak Hour	Phase 1 (Year 2030)				Phase 2 (Year 2040)				Phase 3 (Year 2050)			
	No Mitigation		With Mitigation		No Mitigation		With Mitigation		No Mitigation		With Mitigation	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
AM	33.9	D	18.8	C	34.5	D	19.9	C	37.4	E	21.3	C
PM	41.4	E	21.1	C	42.9	E	22.7	C	48.3	E	24.7	C

Intersection #6 Queen Ka'ahumanu Highway and Hualalai Road – Based on projected traffic volumes, a traffic signal is not warranted under this scenario, but it may be needed to provide adequate gaps in traffic on the highway and to enhance safety. We recommend that intersection conditions be evaluated prior to occupancy of Phase 2 and Phase 3 to determine if a traffic signal is warranted.

Intersection #7 Queen Ka'ahumanu Highway and Kuakini Highway – Based on projected traffic volumes, a traffic signal is not warranted under this scenario, but it may be needed to provide adequate gaps in traffic on the highway and to enhance safety. We recommend that intersection conditions be evaluated prior to occupancy of Phase 2 to determine if a traffic signal is warranted.

Table 7-2 provides a summary of the proposed improvement at the end of the section.

Table 7-2. Summary of Proposed Improvements

Intersection	Phase 1 (Year 2030)	Phase 2 (Year 2040)	Phase 3 (Year 2050)
Intersection #2 Kuakini Highway and North Entrance	Install a refuge lane serving the westbound left-turn traffic out of the campus.	No additional improvements required	No additional improvements required
Intersection #6 Queen Ka'ahumanu Highway and Hualalai Road	No improvements required	Based on projected traffic volumes, a traffic signal is not warranted under this scenario, but it may be needed to provide adequate gaps in traffic on the highway and to enhance safety. Intersection conditions should be evaluated prior to occupancy of Phase 2 to determine if a traffic signal is warranted.	Based on projected traffic volumes, a traffic signal is not warranted under this scenario, but it may be needed to provide adequate gaps in traffic on the highway and to enhance safety. Intersection conditions should be evaluated prior to occupancy of Phase 3 to determine if a traffic signal is warranted.
Intersection #7 Queen Ka'ahumanu Highway and Kuakini Highway	No improvements required	Based on projected traffic volumes, a traffic signal is not warranted under this scenario, but it may be needed to provide adequate gaps in traffic on the highway and to enhance safety. Intersection conditions should be evaluated prior to occupancy of Phase 2 to determine if a traffic signal is warranted.	Based on projected traffic volumes, a traffic signal is not warranted under this scenario, but it may be needed to provide adequate gaps in traffic on the highway and to enhance safety. Intersection conditions should be evaluated prior to occupancy of Phase 3 to determine if a traffic signal is warranted.

8.0 VEHICLE ACCESS, CIRCULATION, AND PARKING

This chapter includes a review of the proposed site plan to evaluate site access and on-site circulation. The site plan was reviewed to determine if adequate vehicle circulation would be provided so that turning vehicles to and from site driveways would not substantially impact operations on adjacent roadways. Additional recommendations are also provided, where applicable. All recommended improvements shall be designed in conformance with policies and principles established and maintained by the County of Hawaii Public Works Department Traffic Division.

8.1 VEHICULAR SITE ACCESS

Direct access to the project site is provided by a driveway located on Kuakini Highway and is controlled by an access gate located approximately 125 feet east of Kuakini Highway. During peak travel periods or special events, campus-bound traffic could potentially queue up while waiting to pass through the access gate and spill back onto Kuakini Highway impeding through traffic. To reduce the potential for spillback, it is recommended that the access gate be relocated to a point further east.

Under Phase 1 (Year 2030) conditions, a second access point will be provided off of the Kuakini Highway via a new unsignalized intersection and driveway leading to the project site. The proposed new access point is recommended to be constructed with an exclusive left-turn lane on the southbound approach and the south leg to be striped to accommodate a refuge lane serving the westbound left-turn vehicles. Due to the relatively low volume of vehicles on this roadway and the limited land uses served by it, no vehicular site access or operational issues are expected as a result of the implementation of this access point. In general, providing multiple access points to the project site will distribute the traffic and minimize the potential for intermittent congestion issues during peak hours.

8.2 ON-SITE VEHICLE CIRCULATION

Under Phase 1, the proposed site plan includes the extension of multiple on-site internal campus roadways. First, there are three new north-south roadways proposed along the development area that connects new buildings and facilities to the center east-west on-campus roadway. In addition, a new east-west campus roadway is planned to be located along the southern edge of the developed campus. The roadway will be extended from the western edge of the campus to the existing roadway that is serving Hualalai Village Apartments. The proposed access at the Hualalai Village Apartments is planned to be operating as emergency access only. To manage travel speeds along the proposed roadways, it is recommended that stop signs and other traffic calming devices be included at key points along these roadways.

8.3 PARKING

As shown on the project site plan, vehicle parking will be provided via on- and off-street parking throughout campus. Insufficient parking was not noted as an issue by the project development team at the time this report was prepared. As such, it is assumed that the existing parking inventory is sufficient to accommodate the parking demand generated by current levels of campus students, faculty, staff, and visitors. Therefore, it is recommended that the parking supply provided in each phase of the project maintain (or reduce if feasible) the current ratio of parking spaces to the number of campus students, faculty, staff, and visitors. Reduced parking supplies are a key incentive to minimizing the number of vehicle trips generated by land uses, but they must be supported by services and facilities to accommodate non-automobile travel such as, but not limited to, increased transit accessibility, bicycle lanes, and dedicated walking paths..

9.0 MULTIMODAL ASSESSMENT

This section summarizes potential project impacts from the Project to off- and on-site pedestrian, bicycle, and transit facilities and services, and identifies recommended improvements.

9.1 PEDESTRIAN AND BICYCLE ACCESS AND CIRCULATION

9.1.1 OFF-SITE PEDESTRIAN AND BICYCLE ACCESS

Pedestrian:

Pedestrians and cyclists can access the university from Kuakini Highway at the existing campus driveway. A pedestrian sidewalk runs along the east side of Kuakini Highway, beginning at the University of the Nations Kona Driveway and terminating approximately 150 feet north of the driveway. A pedestrian crosswalk exists approximately 600 feet north of the University of the Nations Driveway and provides connectivity across Kuakini Highway.

No pedestrian improvements are planned along roadways adjacent to the University of the Nations Kona campus. However, the gap in formal pedestrian facilities between the campus and the crosswalk on Kuakini Highway identified above will continue to exist.

Bicyclists:

Bicycle facilities do not exist along Kuakini Highway near the campus. The following bicycle improvements, identified as high-priority projects in Bike Plan Hawai'i, are proposed within the study area:

- Hualalai Road from Kuakini Highway to Old Mamaloha: Signed shared path
- Kuakini Highway from Lako Street to Hualalai Road: Bike lanes
- Queen Ka'ahumanu Highway from Henry Road to Kuakini Highway: Signed shared path

The proposed bike lane along Kuakini Highway will enhance bicycle connectivity to and from the University of the Nations Kona via the existing and future driveways.

Implementation of the Master Plan will not conflict with any existing pedestrian or bicycle facilities and will not preclude the implementation of any planned pedestrian or bicycle facilities within the study area. The proposed Master Plan is expected to generate some bicycle and pedestrian trips to and from the project site. Most of these trips would occur along Kuakini Highway by university students, faculty/staff, or visitors traveling between campus and nearby residential, commercial, and retail land uses. As project-generated pedestrian and bicycle trips are projected to be low, no significant project impacts are anticipated. However, we recommend the enhancement of the pedestrian route on Kuakini Highway as it will directly serve campus students, faculty/staff, and visitors. See **Section 9.3** below for a description of the recommended enhancement.

9.1.2 ON-SITE PEDESTRIAN AND BICYCLE CIRCULATION

Direct connections between campus facilities and parking lots would be provided via unrestricted pedestrian and bicycle pathways throughout campus. Pedestrians and bicyclists would travel throughout campus via the shared-use path and crosswalks provided. Bicyclists may also share the on-campus roadway with vehicular traffic. The proposed unrestricted pedestrian and bicycle pathways are expected to provide adequate connectivity between buildings on campus.

9.2 TRANSIT ACCESS

As noted in **Section 3.2.2**, The Pahala-Kailua-Kona-South Kohala Resorts Route provides daily transit service along Queen Kaahumanu Highway. The nearest bus stop would require transit patrons from the project site to walk or bike at least 2,000 feet from campus to use the transit service. One potential improvement would be to provide a multi-use connection directly to Hualalai Road to reduce the overall distance transit riders would have to walk or bike to access the campus.

The project is anticipated to generate a relatively low number of transit riders through Project buildout. As site-generated transit ridership is anticipated to be low, no project impacts to transit facilities or services are anticipated, and no modifications to transit stop locations or services would be required.

9.3 RECOMMENDED IMPROVEMENTS

9.3.1 OFF-SITE PEDESTRIAN AND BICYCLE IMPROVEMENTS

Using Federal Highway Administration (FHWA) guidelines and the Fehr & Peers proprietary Crosswalk + tool, the project team identified potential pedestrian improvements that can be considered at the intersection of Kuakini Highway and the existing University of the Nations Driveway. The following improvements are proposed at this location:

- A raised sidewalk or path separated from traffic by a raised asphalt berm should be installed between the existing sidewalk on the east side of Kuakini Highway from the existing sidewalk's terminus near the site to the existing crosswalk located approximately 600 feet north of the University of the Nations Kona Driveway.

- Addition of a high-visibility crosswalk, adequate nighttime lighting levels, and crosswalk warning signs on the north and east legs of the Kuakini Highway/North Entrance and Kuakini Highway/South Entrance intersections.
- The existing striped triangle on the east leg of the intersection should be converted to an raised median to provide a pedestrian refuge area.
- A Pedestrian Hybrid Beacon (PHB) could also be installed on the north leg of the intersection, however, a warrant would need to be conducted to determine whether it would be necessary. If it is not warranted, a Rectangular Rapid-Flashing Beacon (RRFB) could be added.

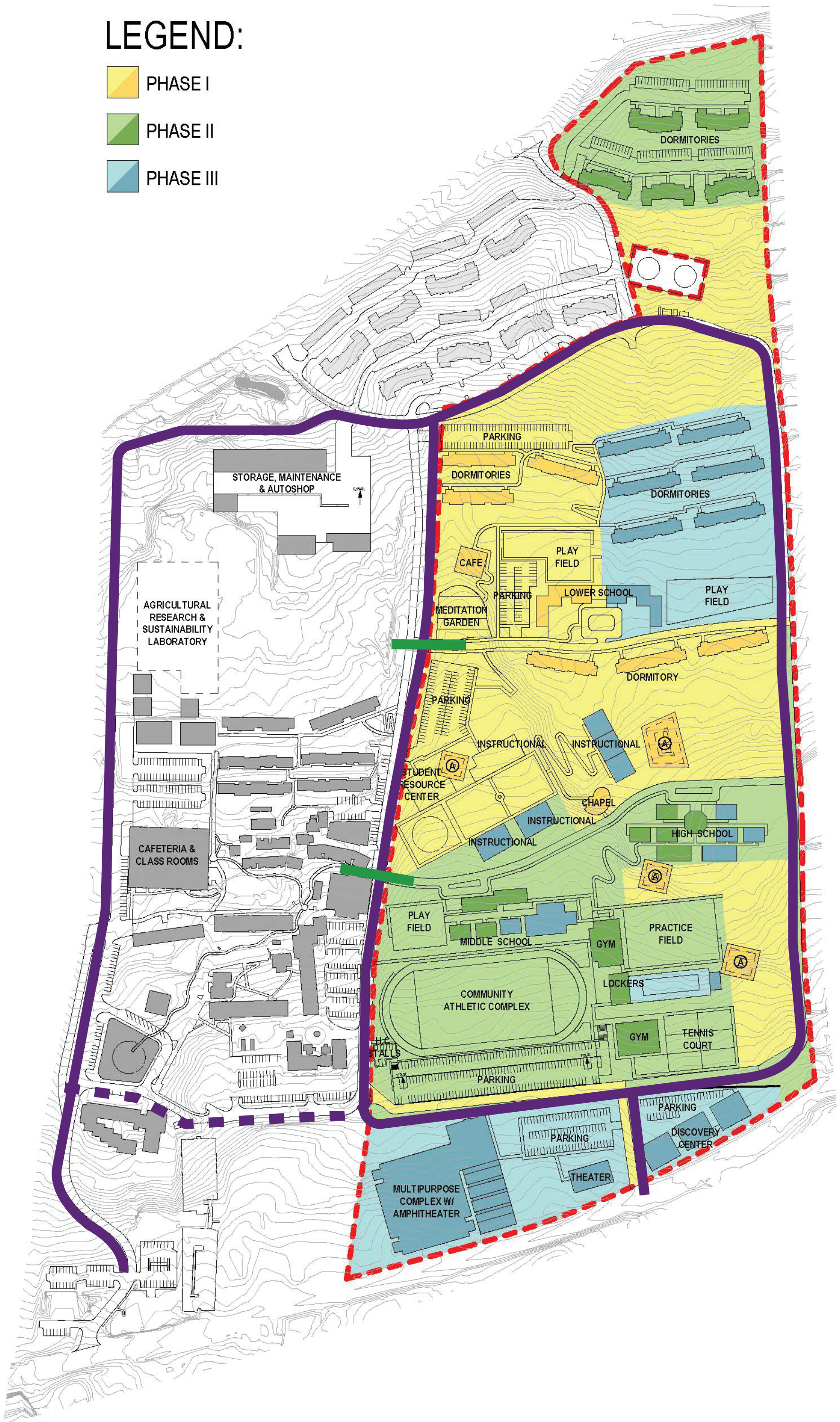
While the project-generated pedestrian and bicycle volumes are initially expected to be low, the addition of any active travelers along Kuakini Highway may result in people walking or biking along the roadway, which could result in a potential safety issue and a significant multimodal impact. To address this issue and encourage non-automobile travel and provide greater connectivity to nearby land uses, it is recommended that an elevated or raised sidewalk be installed on the east side of Kuakini Highway from the existing sidewalk's terminus (closest to the campus driveway) to the existing crosswalk approximately 600 feet north of the University of the Nations Driveway. Alternatively, an asphalt berm could be installed to physically separate vehicle traffic and pedestrians. This ADA-compliant path should be a minimum of five (5) feet wide plus a two-foot buffer between the roadway edge and the path.

9.3.2 ON-SITE PEDESTRIAN AND BICYCLE IMPROVEMENTS

As noted, the project site plan does not include any pedestrian or bicycle facilities along the on-site campus roadways. As such, the following recommendations are recommended:

- A shared-use path should be included on one side of both on-site campus roadways to further enhance pedestrian and bicycle connectivity and safety throughout the campus.
- An enhanced bicycle facility (e.g. bike lanes, shared use paths, or "sharrows") should be included along the Makai north-south campus roadway between the northern and central roadways.
- Pedestrian-level lighting is recommended along any shared-use path or pedestrian-only sidewalk or path.
- Raised crosswalks should be provided at several locations on the new spine road through the center of the site where higher levels of pedestrian activity are expected.

We also recommend the provision of secure bike parking – including bike racks near building entrance(s) – be provided to encourage the use of non-motorized travel. Specific locations for bike racks should be determined by the project team in consultation with the University of the Nations Kona planning and security staff. A summary of recommended on-site pedestrian and bicycle improvements is shown in **Figure 9-1**.



Legend

- Recommended Shared Use Paths
- Potential Bicycle Route Enhancement
- Potential Raised Crosswalk Locations

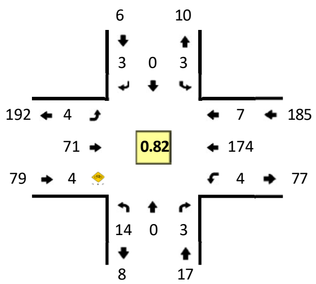
Figure 9-1

On-site Improvements

APPENDIX A: TRAFFIC COUNT DATA

Type of peak hour being reported: Intersection Peak | Method for determining peak hour: Total Entering Volume

LOCATION: Hualalai Village North Driveway -- Hualalai Rd | **QC JOB #:** 16145007
CITY/STATE: Kailua, HI | **DATE:** Wed, Apr 19 2023



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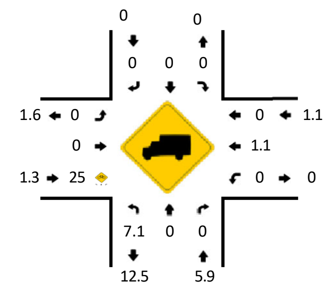
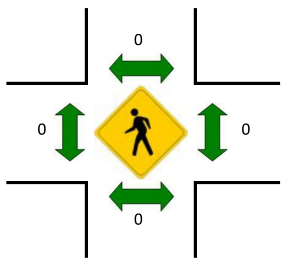
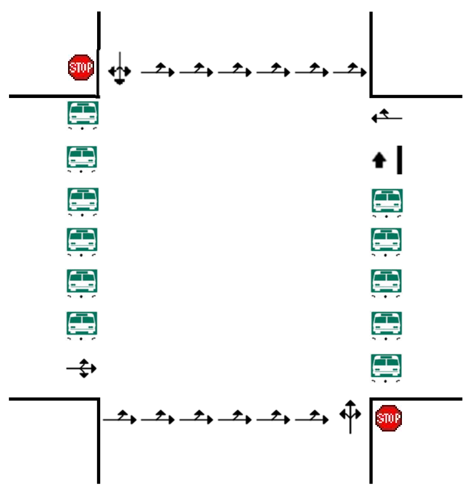
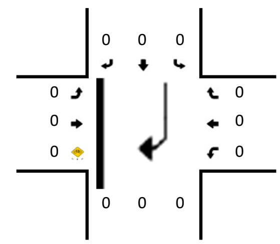
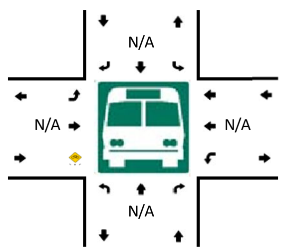
Peak 15-Min: 7:45 AM -- 8:00 AM

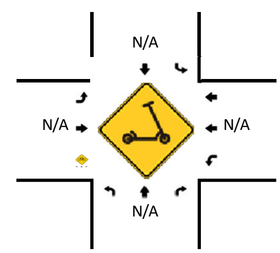












5-Min Count Period Beginning At	Hualalai Village North Driveway (Northbound)				Hualalai Village North Driveway (Southbound)				Hualalai Rd (Eastbound)				Hualalai Rd (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
7:00 AM	1	0	0	0	0	0	0	0	0	1	1	0	1	4	0	0	8	
7:05 AM	2	0	0	0	1	0	0	0	0	5	1	0	1	5	0	0	15	
7:10 AM	1	0	2	0	0	0	0	0	0	4	1	0	0	3	0	0	11	
7:15 AM	3	0	0	0	0	0	0	0	0	1	0	0	1	6	0	0	11	
7:20 AM	5	0	0	0	0	0	0	0	0	8	0	0	0	11	0	0	24	
7:25 AM	1	0	0	0	0	0	1	0	0	9	0	0	0	4	0	0	15	
7:30 AM	1	0	0	0	0	0	0	0	1	7	0	0	0	10	0	0	19	
7:35 AM	1	0	0	0	0	0	0	0	1	13	0	0	0	9	0	0	24	
7:40 AM	1	0	1	0	0	0	0	0	0	5	0	0	0	21	0	0	28	
7:45 AM	2	0	1	0	0	0	0	0	0	6	0	0	1	11	1	0	22	
7:50 AM	2	0	0	0	0	0	0	0	0	10	1	0	0	18	1	0	32	
7:55 AM	1	0	0	0	0	0	1	0	0	5	0	1	0	24	1	0	33	242
8:00 AM	1	0	1	0	0	0	0	0	0	6	0	0	0	8	2	0	18	252
8:05 AM	0	0	0	0	0	0	0	0	0	5	0	0	0	11	1	0	17	254
8:10 AM	0	0	0	0	1	0	0	0	0	6	2	0	1	11	0	0	21	264
8:15 AM	3	0	0	0	0	0	0	0	0	3	1	0	1	16	1	0	25	278
8:20 AM	0	0	0	0	1	0	0	0	0	2	0	0	0	10	0	0	13	267
8:25 AM	2	0	0	0	1	0	0	0	0	3	0	0	0	15	0	0	21	273
8:30 AM	1	0	0	0	0	0	2	0	2	7	0	0	1	20	0	0	33	287
8:35 AM	3	0	0	0	0	0	0	0	0	5	0	0	0	9	1	0	18	281
8:40 AM	3	0	0	0	1	0	0	0	0	6	0	0	0	6	0	0	16	269
8:45 AM	3	0	0	0	0	0	1	0	0	1	2	0	2	7	1	0	17	264
8:50 AM	1	0	1	0	0	0	1	0	0	6	1	0	0	5	0	0	15	247
8:55 AM	2	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	13	227

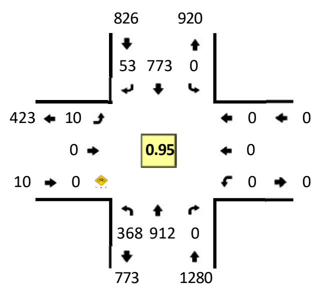
Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	
All Vehicles	20	0	4	0	0	0	4	0	0	84	4	4	4	212	12	0	348
Heavy Trucks	0	0	0		0	0	0		0	0	0		0	0	0		0
Buses																	
Pedestrians		0				0				0				0			0
Bicycles	0	0	0		0	0	0		0	0	0		0	0	0		0
Scooters																	

Comments:

Report generated on 4/28/2023 3:00 PM | SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

LOCATION: Queen Kaahumanu Hwy -- Kuakini Hwy
CITY/STATE: Kailua, HI

QC JOB #: 16145009
DATE: Wed, Apr 19 2023



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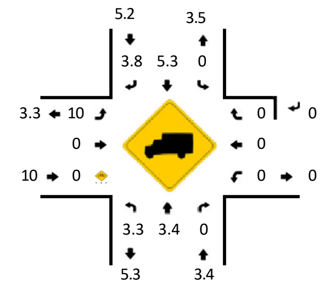
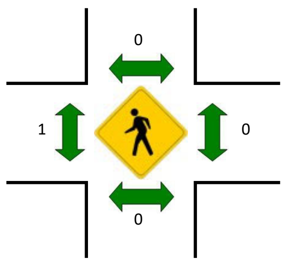
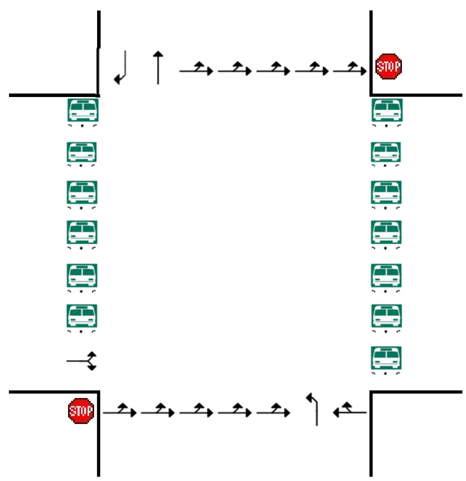
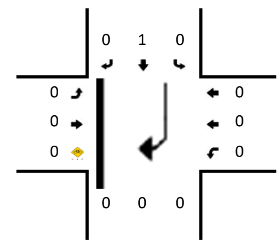
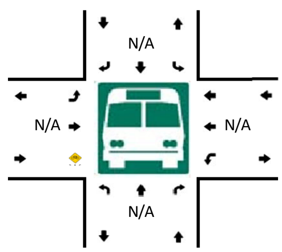
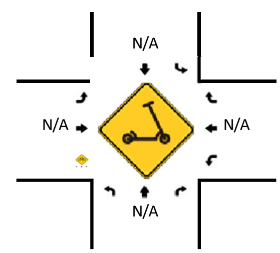












5-Min Count Period Beginning At	Queen Kaahumanu Hwy (Northbound)				Queen Kaahumanu Hwy (Southbound)				Kuakini Hwy (Eastbound)				Kuakini Hwy (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
7:00 AM	18	68	0	0	0	57	1	0	1	0	0	0	0	0	0	0	145	
7:05 AM	27	83	0	0	0	42	2	0	1	0	0	0	0	0	0	0	155	
7:10 AM	19	89	0	0	0	56	1	0	1	0	0	0	0	0	0	0	166	
7:15 AM	23	72	0	0	0	64	4	0	0	0	0	0	0	0	0	0	163	
7:20 AM	23	80	0	0	0	73	1	0	2	0	0	0	0	0	0	0	179	
7:25 AM	19	77	0	0	0	66	7	0	1	0	0	0	0	0	0	0	170	
7:30 AM	24	83	0	0	0	68	4	0	2	0	0	0	0	0	0	0	181	
7:35 AM	30	83	0	0	0	61	5	0	0	0	0	0	0	0	0	0	179	
7:40 AM	34	67	0	0	0	72	4	0	0	0	0	0	0	0	0	0	177	
7:45 AM	52	66	0	0	0	59	6	0	1	0	0	0	0	0	0	0	184	
7:50 AM	43	62	0	0	0	73	9	0	0	0	0	1	0	0	0	0	188	
7:55 AM	38	72	0	0	0	69	6	0	0	0	0	0	0	0	0	0	185	2072
8:00 AM	28	82	0	0	0	54	3	0	1	0	0	0	0	0	0	0	168	2095
8:05 AM	35	79	0	0	0	58	3	0	0	0	0	1	0	0	0	0	176	2116
8:10 AM	30	58	0	0	0	56	3	0	0	0	1	0	0	0	0	0	148	2098
8:15 AM	28	74	0	0	0	53	4	0	1	0	0	0	0	0	0	0	160	2095
8:20 AM	23	78	0	0	0	47	3	0	0	0	0	0	0	0	0	0	151	2067
8:25 AM	15	80	0	0	0	50	5	0	1	0	0	0	0	0	0	0	151	2048
8:30 AM	10	81	0	0	0	60	4	0	0	0	0	0	0	0	0	0	155	2022
8:35 AM	14	75	0	0	0	54	3	0	0	0	0	0	0	0	0	0	146	1989
8:40 AM	33	69	0	0	0	49	5	0	0	0	0	0	0	0	0	0	156	1968
8:45 AM	29	61	0	0	0	49	7	0	2	0	1	1	0	0	0	0	150	1934
8:50 AM	34	67	0	0	0	64	6	0	0	0	0	0	0	0	0	0	171	1917
8:55 AM	21	77	0	0	0	47	2	0	1	0	0	0	0	0	0	0	148	1880

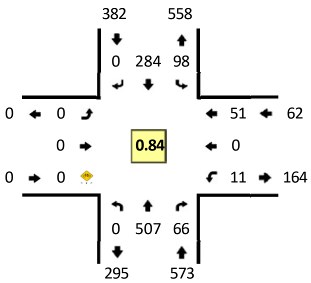
Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	
All Vehicles	532	800	0	0	0	804	84	0	4	0	0	4	0	0	0	0	2228
Heavy Trucks	8	40	0		0	36	0		0	0	0		0	0	0		84
Buses																	
Pedestrians		0				0				0				0			0
Bicycles	0	0	0		0	0	0		0	0	0		0	0	0		0
Scooters																	

Comments:

Report generated on 4/28/2023 3:00 PM

SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

LOCATION: Kuakini Hwy -- YWAM Driveway | **QC JOB #:** 16145011
CITY/STATE: Kailua, HI | **DATE:** Wed, Apr 19 2023



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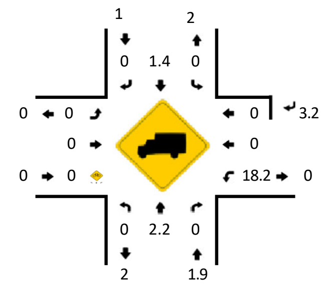
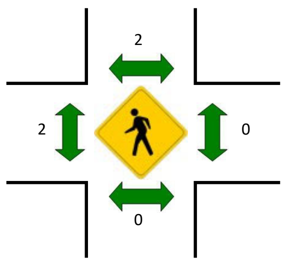
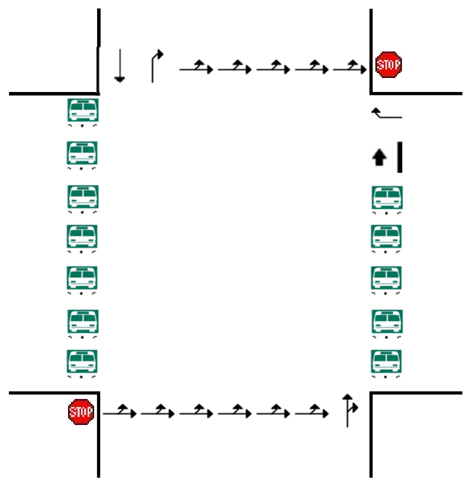
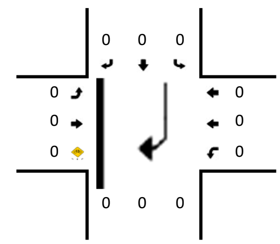
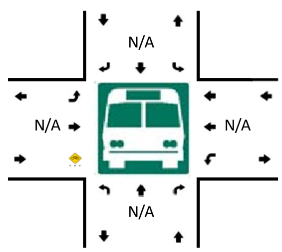
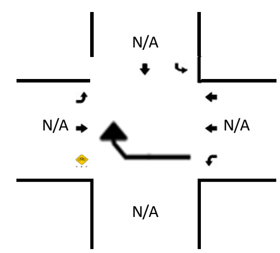










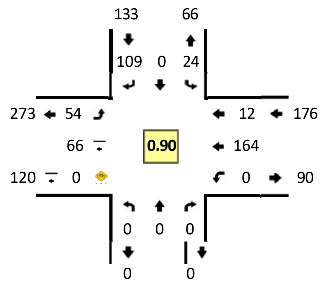


5-Min Count Period Beginning At	Kuakini Hwy (Northbound)				Kuakini Hwy (Southbound)				YWAM Driveway (Eastbound)				YWAM Driveway (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
7:00 AM	0	48	3	0	2	12	0	0	0	0	0	0	1	0	1	0	67	
7:05 AM	0	42	2	0	3	13	0	0	0	0	0	0	1	0	0	0	61	
7:10 AM	0	42	0	0	2	8	0	0	0	0	0	0	0	0	0	0	52	
7:15 AM	0	31	2	0	4	23	0	0	0	0	0	0	0	0	1	0	61	
7:20 AM	0	36	2	0	7	24	0	0	0	0	0	0	1	0	1	0	71	
7:25 AM	0	41	4	0	6	19	0	0	0	0	0	0	1	0	2	0	73	
7:30 AM	0	38	5	0	5	26	0	0	0	0	0	0	1	0	3	0	78	
7:35 AM	0	41	2	0	6	24	0	0	0	0	0	0	0	0	2	0	75	
7:40 AM	0	46	4	0	8	26	0	0	0	0	0	0	1	0	7	0	92	
7:45 AM	0	54	6	0	13	25	0	0	0	0	0	0	0	0	1	0	99	
7:50 AM	0	48	14	0	14	23	0	0	0	0	0	0	0	0	4	0	103	
7:55 AM	0	42	13	0	10	21	0	0	0	0	0	0	3	0	13	0	102	934
8:00 AM	0	33	10	0	12	19	0	0	0	0	0	0	1	0	5	0	80	947
8:05 AM	0	39	2	0	6	25	0	0	0	0	0	0	0	0	5	0	77	963
8:10 AM	0	38	3	0	0	27	0	0	0	0	0	0	1	0	4	0	73	984
8:15 AM	0	38	2	0	11	27	0	0	0	0	0	0	1	0	2	0	81	1004
8:20 AM	0	49	1	0	7	22	0	0	0	0	0	0	2	0	3	0	84	1017
8:25 AM	0	34	2	0	2	27	0	0	0	0	0	0	2	0	2	0	69	1013
8:30 AM	0	28	2	0	5	16	0	0	0	0	0	0	0	0	4	0	55	990
8:35 AM	0	36	1	0	6	14	0	0	0	0	0	0	0	0	3	0	60	975
8:40 AM	0	42	1	0	1	29	0	0	0	0	0	0	0	0	4	0	77	960
8:45 AM	0	34	1	0	6	14	0	0	0	0	0	0	1	0	4	0	60	921
8:50 AM	0	30	1	0	5	24	0	0	0	0	0	0	0	0	2	0	62	880
8:55 AM	0	62	3	0	7	15	0	1	0	0	0	0	0	0	2	0	90	868

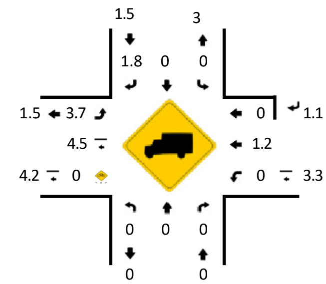
Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	
All Vehicles	0	576	132	0	148	276	0	0	0	0	0	0	12	0	72	0	1216
Heavy Trucks	0	12	0		0	0	0		0	0	0		0	0	0		12
Buses																	
Pedestrians		0				8				0				0			8
Bicycles	0	0	0		0	0	0		0	0	0		0	0	0		0
Scooters																	

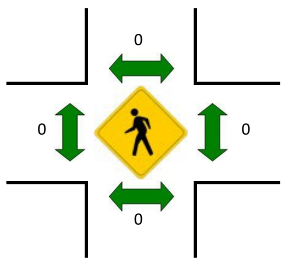
Comments:

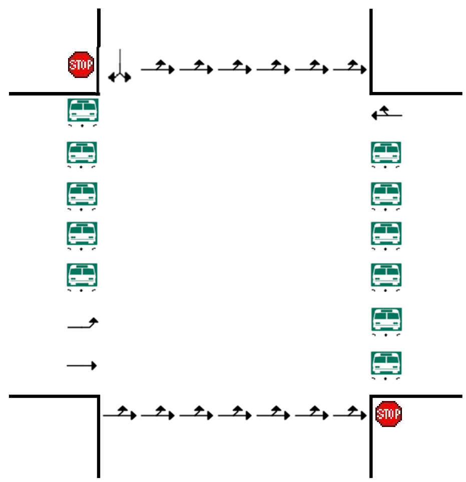
LOCATION: Nani Kailua Drive -- Hualalai Rd **QC JOB #:** 16145013
CITY/STATE: Kailua, HI **DATE:** Wed, Apr 19 2023

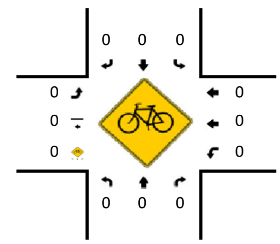


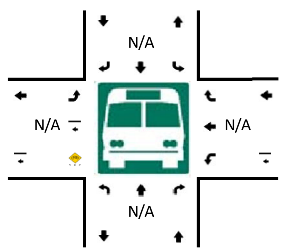
Peak-Hour: 7:20 AM -- 8:20 AM
Peak 15-Min: 7:50 AM -- 8:05 AM

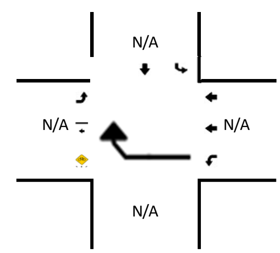












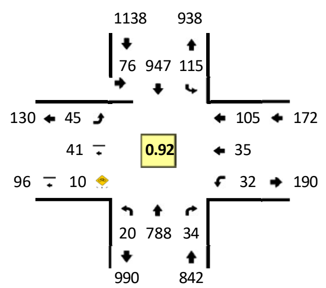
5-Min Count Period Beginning At	Nani Kailua Drive (Northbound)				Nani Kailua Drive (Southbound)				Hualalai Rd (Eastbound)				Hualalai Rd (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
7:00 AM	0	0	0	0	1	0	10	0	6	1	0	0	0	4	1	0	23	
7:05 AM	0	0	0	0	0	0	3	0	6	7	0	0	0	5	2	0	23	
7:10 AM	0	0	0	0	4	0	4	0	3	1	0	0	0	4	0	0	16	
7:15 AM	0	0	0	0	0	0	4	0	2	1	0	0	0	7	1	0	15	
7:20 AM	0	0	0	0	4	0	12	0	2	5	0	0	0	14	2	0	39	
7:25 AM	0	0	0	0	3	0	10	0	4	5	0	0	0	5	1	0	28	
7:30 AM	0	0	0	0	4	0	6	0	6	8	0	0	0	10	0	0	34	
7:35 AM	0	0	0	0	5	0	8	0	6	6	0	0	0	10	1	0	36	
7:40 AM	0	0	0	0	1	0	6	0	4	3	0	0	0	22	0	0	36	
7:45 AM	0	0	0	0	2	0	8	0	3	5	0	0	0	11	1	0	30	
7:50 AM	0	0	0	0	1	0	7	0	3	9	0	0	0	18	1	0	39	
7:55 AM	0	0	0	0	2	0	11	0	3	4	0	0	0	27	0	0	47	366
8:00 AM	0	0	0	0	0	0	9	0	7	6	0	0	0	8	3	0	33	376
8:05 AM	0	0	0	0	0	0	12	0	6	5	0	0	0	11	0	0	34	387
8:10 AM	0	0	0	0	2	0	13	0	5	6	0	0	0	11	0	0	37	408
8:15 AM	0	0	0	0	0	0	7	0	5	4	0	0	0	17	3	0	36	429
8:20 AM	0	0	0	0	0	0	10	0	5	2	0	0	0	11	0	0	28	418
8:25 AM	0	0	0	0	0	0	4	0	7	6	0	0	0	15	1	0	33	423
8:30 AM	0	0	0	0	1	0	4	0	2	5	0	0	0	21	1	0	34	423
8:35 AM	0	0	0	0	0	0	2	0	6	6	0	0	0	11	1	0	26	413
8:40 AM	0	0	0	0	1	0	3	0	1	4	0	0	0	8	2	0	19	396
8:45 AM	0	0	0	0	2	0	4	0	7	0	0	0	0	8	2	0	23	389
8:50 AM	0	0	0	0	2	0	12	0	3	5	0	0	0	5	0	0	27	377
8:55 AM	0	0	0	0	0	0	14	0	5	1	0	0	0	14	1	0	35	365

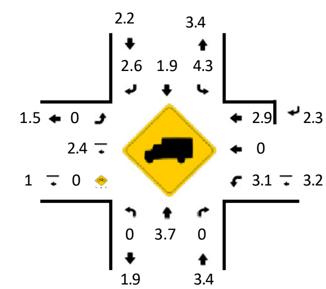
Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	
All Vehicles	0	0	0	0	12	0	108	0	52	76	0	0	0	212	16	0	476
Heavy Trucks	0	0	0		0	0	4		4	0	0		0	0	0		8
Buses																	
Pedestrians		0				0				0				0			0
Bicycles	0	0	0		0	0	0		0	0	0		0	0	0		0
Scooters																	

Comments:

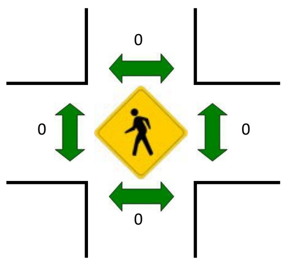
LOCATION: Queen Kaahumanu Hwy -- Nani Kailua Dr
QC JOB #: 16145015
CITY/STATE: Kailua, HI
DATE: Wed, Apr 19 2023

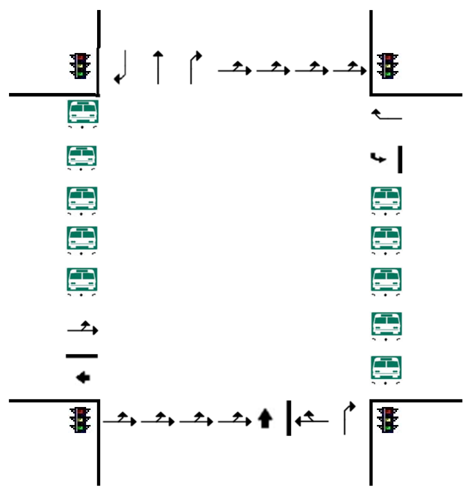
Peak-Hour: 3:05 PM -- 4:05 PM
Peak 15-Min: 3:05 PM -- 3:20 PM

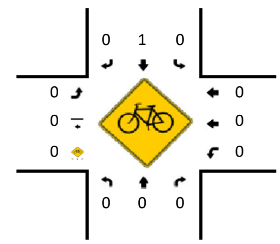


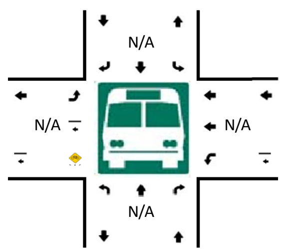


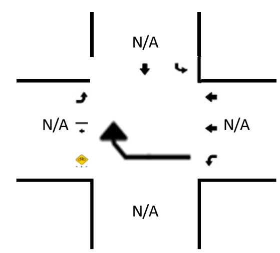
Quality Counts
DATA THAT DRIVES COMMUNITIES











5-Min Count Period Beginning At	Queen Kaahumanu Hwy (Northbound)				Queen Kaahumanu Hwy (Southbound)				Nani Kailua Dr (Eastbound)				Nani Kailua Dr (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
3:00 PM	2	74	5	0	3	80	7	0	2	2	1	0	1	1	7	0	185	
3:05 PM	1	76	2	0	15	89	12	0	1	3	1	0	1	1	8	0	210	
3:10 PM	1	73	3	0	7	84	2	0	3	13	3	0	2	1	5	0	197	
3:15 PM	0	73	3	0	10	87	6	0	4	1	1	0	3	3	14	0	205	
3:20 PM	2	60	5	1	7	75	3	0	3	2	0	0	0	6	12	0	176	
3:25 PM	4	67	1	0	7	70	4	0	4	1	0	0	4	3	7	0	172	
3:30 PM	1	78	3	0	16	75	13	0	2	0	1	0	0	5	9	0	203	
3:35 PM	2	49	3	0	9	68	5	0	4	6	0	0	4	1	5	0	156	
3:40 PM	1	63	2	0	14	64	5	0	6	4	0	0	6	1	11	0	177	
3:45 PM	2	69	3	0	6	85	6	0	3	2	2	0	5	6	13	0	202	
3:50 PM	3	55	2	0	6	80	2	0	8	2	0	0	3	5	8	0	174	
3:55 PM	2	65	4	0	9	84	8	0	3	4	1	0	2	0	5	0	187	2244
4:00 PM	0	60	3	0	9	86	10	0	4	3	1	0	2	3	8	0	189	2248
4:05 PM	3	66	1	0	9	81	2	0	5	6	4	0	3	2	5	0	187	2225
4:10 PM	0	58	4	0	9	55	4	0	5	7	4	0	2	3	6	0	157	2185
4:15 PM	1	52	2	0	9	75	5	0	10	3	0	0	2	7	7	0	173	2153
4:20 PM	1	59	3	0	7	76	8	0	2	7	0	0	2	2	5	0	172	2149
4:25 PM	2	68	3	0	16	78	5	0	1	8	0	0	1	1	9	0	192	2169
4:30 PM	2	74	3	0	14	75	5	0	1	5	2	0	3	5	8	0	197	2163
4:35 PM	4	56	4	0	14	67	8	0	1	2	0	0	4	2	10	0	172	2179
4:40 PM	2	52	3	1	4	69	6	0	5	4	0	0	4	4	5	0	159	2161
4:45 PM	3	74	2	0	12	79	6	0	4	8	0	0	0	1	8	0	197	2156
4:50 PM	2	62	1	0	11	84	5	1	3	4	0	0	1	1	6	0	181	2163
4:55 PM	0	69	0	0	8	69	6	0	2	3	0	0	2	4	3	0	166	2142
5:00 PM	0	55	2	0	7	69	3	0	5	3	3	0	3	3	8	0	161	2114
5:05 PM	2	47	4	0	4	65	4	0	2	3	2	0	2	2	6	0	143	2070
5:10 PM	0	46	2	0	8	65	8	0	3	5	2	0	2	1	9	0	151	2064
5:15 PM	2	69	1	0	12	77	7	0	1	1	0	0	1	2	1	0	174	2065
5:20 PM	0	53	0	0	13	74	8	0	3	4	0	0	5	3	6	0	169	2062
5:25 PM	0	59	0	0	6	68	3	0	7	5	1	0	4	4	3	0	160	2030
5:30 PM	0	41	3	0	9	59	3	0	2	3	2	0	2	2	7	0	133	1966
5:35 PM	3	52	3	0	8	60	1	0	1	6	0	0	1	1	2	0	138	1932
5:40 PM	1	31	4	0	3	73	4	0	1	0	1	0	2	2	6	0	128	1901
5:45 PM	0	42	1	0	5	74	4	0	4	2	3	0	1	4	8	0	148	1852
5:50 PM	0	42	3	0	6	55	1	0	8	5	0	0	3	2	6	0	131	1802
5:55 PM	0	47	2	0	11	71	4	0	3	3	0	0	1	1	6	0	149	1785

Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	
All Vehicles	8	888	32	0	128	1040	80	0	32	68	20	0	24	20	108	0	2448
Heavy Trucks	0	48	0		4	28	4		0	0	0		0	0	4		88
Buses																	
Pedestrians		0				0				0				0			0
Bicycles	0	0	0		0	0	0		0	0	0		0	0	0		0
Scooters																	

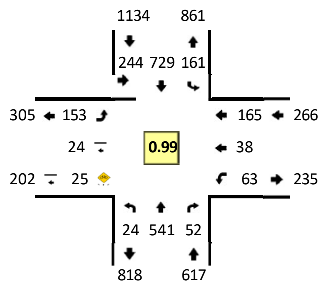
Comments:

Report generated on 4/28/2023 3:00 PM

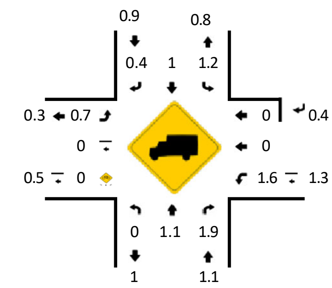
SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

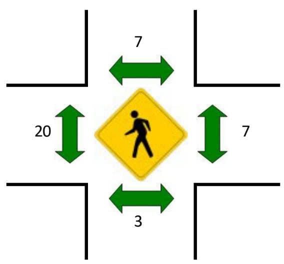
Type of peak hour being reported: Intersection Peak | Method for determining peak hour: Total Entering Volume

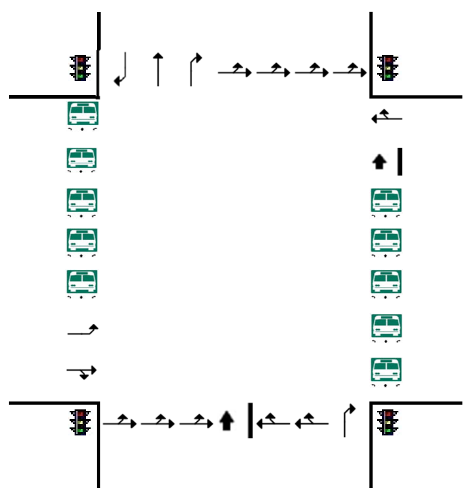
LOCATION: Kuakini Hwy -- Hualalai Rd | **QC JOB #:** 16145016
CITY/STATE: Kailua, HI | **DATE:** Wed, Apr 19 2023

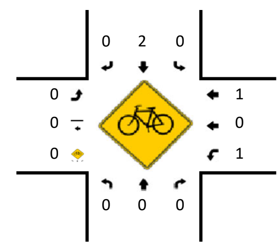


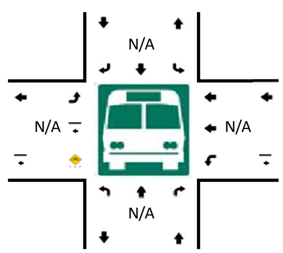
Peak-Hour: 3:35 PM -- 4:35 PM
Peak 15-Min: 3:35 PM -- 3:50 PM

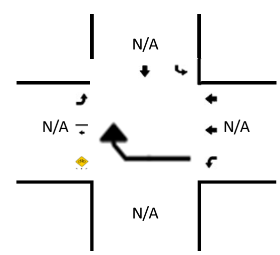












5-Min Count Period Beginning At	Kuakini Hwy (Northbound)				Kuakini Hwy (Southbound)				Hualalai Rd (Eastbound)				Hualalai Rd (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
3:00 PM	0	38	8	0	26	57	19	0	15	1	1	0	8	1	20	0	194	
3:05 PM	5	43	9	0	23	49	17	0	14	3	0	0	4	2	19	0	188	
3:10 PM	2	46	8	0	14	59	21	0	14	3	2	0	6	6	12	0	193	
3:15 PM	1	50	4	0	16	55	13	0	14	1	0	0	5	2	8	0	169	
3:20 PM	0	47	4	0	14	47	19	1	15	4	6	0	6	3	19	0	185	
3:25 PM	3	40	0	0	12	53	17	1	16	1	1	0	6	3	21	0	174	
3:30 PM	2	38	5	0	10	50	19	0	15	1	4	0	5	1	8	0	158	
3:35 PM	4	48	6	0	17	63	20	0	19	1	1	0	6	7	14	0	206	
3:40 PM	2	49	7	0	11	50	20	0	8	4	4	0	5	5	14	0	179	
3:45 PM	3	43	3	0	11	55	19	0	14	0	1	0	5	6	18	0	178	
3:50 PM	1	46	4	0	17	57	28	1	11	0	1	0	4	1	9	0	180	
3:55 PM	3	45	11	1	7	73	20	0	10	4	3	0	5	1	16	0	199	2203
4:00 PM	1	38	0	0	14	56	21	1	11	3	2	0	6	4	16	0	173	2182
4:05 PM	1	41	4	0	17	62	15	0	14	1	2	0	6	0	15	0	178	2172
4:10 PM	2	56	2	0	12	69	21	0	14	2	2	0	4	2	10	0	196	2175
4:15 PM	4	43	3	0	9	61	17	0	8	4	1	0	6	5	14	0	175	2181
4:20 PM	0	44	4	0	17	60	21	0	14	1	2	0	3	3	17	0	186	2182
4:25 PM	0	49	1	0	13	59	26	0	16	3	4	0	9	3	12	0	195	2203
4:30 PM	2	39	7	0	14	64	16	0	14	1	2	0	4	1	10	0	174	2219
4:35 PM	1	42	4	0	9	70	17	0	14	1	2	0	8	7	13	0	188	2201
4:40 PM	2	37	3	0	14	59	21	0	19	4	0	0	5	0	10	0	174	2196
4:45 PM	3	47	6	0	13	54	17	0	18	2	2	0	9	1	9	0	181	2199
4:50 PM	2	45	5	0	6	54	15	0	15	2	3	0	6	6	15	0	174	2193
4:55 PM	4	44	1	0	16	64	17	0	11	4	0	0	4	3	17	0	185	2179
5:00 PM	2	48	5	0	6	57	19	0	10	1	3	0	4	4	11	0	170	2176
5:05 PM	6	37	4	0	11	63	9	0	15	2	1	0	6	3	15	0	172	2170
5:10 PM	3	52	4	0	5	68	15	0	13	3	1	0	4	1	9	0	178	2152
5:15 PM	4	40	4	0	8	55	11	0	12	0	3	0	8	2	6	0	153	2130
5:20 PM	5	25	5	0	9	55	18	0	11	3	2	0	4	1	8	0	146	2090
5:25 PM	2	54	9	0	6	50	19	0	10	0	1	0	5	5	7	0	168	2063
5:30 PM	1	34	5	0	4	48	12	0	14	4	1	0	1	2	13	0	139	2028
5:35 PM	2	35	1	0	6	49	11	0	11	2	2	0	7	0	7	0	133	1973
5:40 PM	2	25	2	0	5	54	26	0	12	5	2	0	1	1	5	0	140	1939
5:45 PM	2	40	6	0	10	57	18	0	8	3	1	0	5	0	7	0	157	1915
5:50 PM	2	30	3	0	4	39	13	0	9	0	1	0	3	0	7	0	111	1852
5:55 PM	1	38	4	0	7	41	10	0	9	1	2	0	3	6	7	0	129	1796

Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	
All Vehicles	36	560	64	0	156	672	236	0	164	20	24	0	64	72	184	0	2252
Heavy Trucks	0	20	4		8	8	0		0	0	0		4	0	0		44
Buses																	
Pedestrians		4				4				16				16			40
Bicycles	0	0	0		0	4	0		0	0	0		4	0	4		12
Scooters																	

Comments:

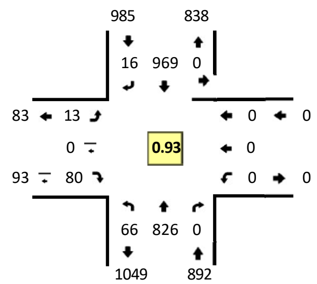
Report generated on 4/28/2023 3:00 PM

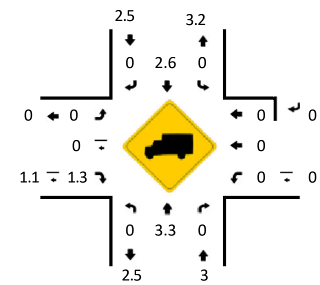
SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

LOCATION: Queen Kaahumanu Hwy -- Hualalai Rd
CITY/STATE: Kailua, HI

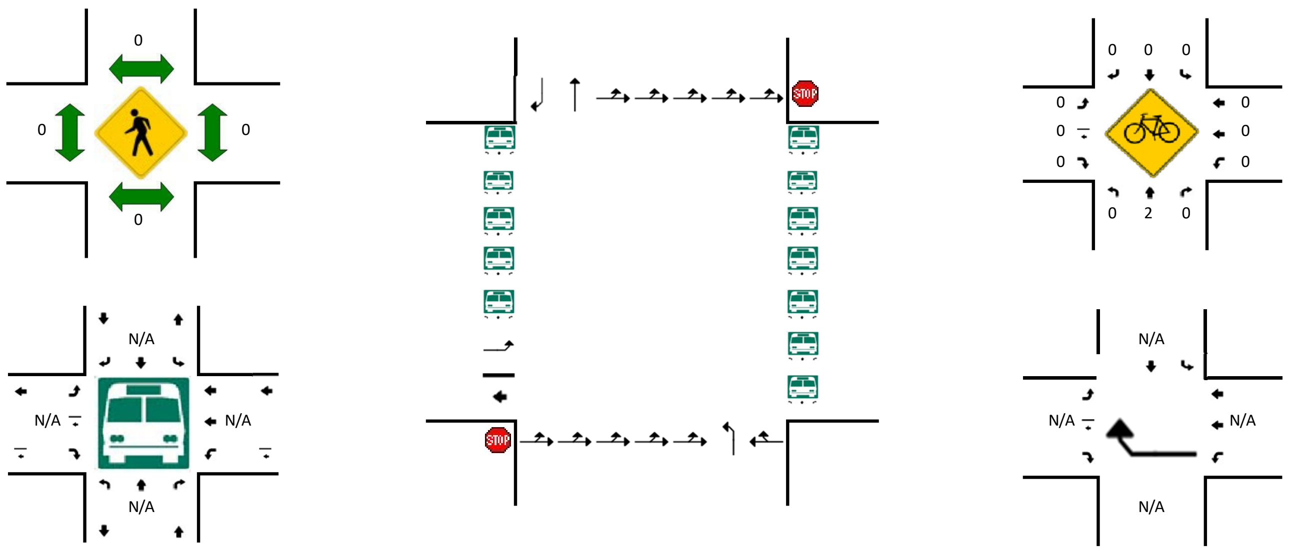
QC JOB #: 16145017
DATE: Wed, Apr 19 2023

Peak-Hour: 3:00 PM -- 4:00 PM
Peak 15-Min: 3:00 PM -- 3:15 PM





Quality Counts
DATA THAT DRIVES COMMUNITIES



5-Min Count Period Beginning At	Queen Kaahumanu Hwy (Northbound)				Queen Kaahumanu Hwy (Southbound)				Hualalai Rd (Eastbound)				Hualalai Rd (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
3:00 PM	4	83	0	0	0	88	3	0	1	0	10	0	0	0	0	0	189	
3:05 PM	5	65	0	0	0	87	0	0	0	0	6	0	0	0	0	0	163	
3:10 PM	4	80	0	0	0	84	0	0	2	0	8	0	0	0	0	0	178	
3:15 PM	5	71	0	0	0	88	1	0	2	0	9	1	0	0	0	0	177	
3:20 PM	15	68	0	0	0	78	0	0	0	0	7	0	0	0	0	0	168	
3:25 PM	5	72	0	0	0	79	3	0	2	0	4	0	0	0	0	0	165	
3:30 PM	4	67	0	0	0	62	1	0	2	0	8	0	0	0	0	0	144	
3:35 PM	2	60	0	0	0	75	0	0	1	0	3	0	0	0	0	0	141	
3:40 PM	8	59	0	0	0	69	2	0	0	0	3	0	0	0	0	0	141	
3:45 PM	3	81	0	0	0	91	2	0	0	0	9	0	0	0	0	0	186	
3:50 PM	6	66	0	0	0	84	4	0	0	0	9	0	0	0	0	0	169	
3:55 PM	5	54	0	0	0	84	0	0	2	0	4	0	0	0	0	0	149	1970
4:00 PM	3	66	0	0	0	86	1	0	0	0	9	0	0	0	0	0	165	1946
4:05 PM	5	59	0	0	0	91	3	0	0	0	2	0	0	0	0	0	160	1943
4:10 PM	1	72	0	0	0	52	0	0	0	0	5	0	0	0	0	0	130	1895
4:15 PM	6	58	0	0	0	81	2	0	2	0	5	0	0	0	0	0	154	1872
4:20 PM	2	64	0	0	0	79	0	0	0	0	5	0	0	0	0	0	150	1854
4:25 PM	7	70	0	0	0	73	1	0	2	0	4	0	0	0	0	0	157	1846
4:30 PM	3	77	0	0	0	78	1	0	1	0	5	0	0	0	0	0	165	1867
4:35 PM	2	53	0	0	0	78	2	0	0	0	5	0	0	0	0	0	140	1866
4:40 PM	3	74	0	0	0	67	1	0	0	0	4	0	0	0	0	0	149	1874
4:45 PM	5	69	0	0	0	83	3	0	1	0	10	0	0	0	0	0	171	1859
4:50 PM	6	50	0	0	0	81	0	0	0	0	5	0	0	0	0	0	142	1832
4:55 PM	3	75	0	0	0	70	2	0	0	0	5	0	0	0	0	0	155	1838
5:00 PM	2	55	0	0	0	78	1	0	1	0	7	0	0	0	0	0	144	1817
5:05 PM	8	49	0	0	0	70	0	0	0	0	4	0	0	0	0	0	131	1788
5:10 PM	6	53	0	0	0	68	0	0	0	0	5	0	0	0	0	0	132	1790
5:15 PM	4	69	0	0	0	78	0	0	0	0	5	0	0	0	0	0	156	1792
5:20 PM	7	57	0	0	0	76	1	0	2	0	8	0	0	0	0	0	151	1793
5:25 PM	3	52	0	0	0	80	0	0	0	0	6	0	0	0	0	0	141	1777
5:30 PM	4	51	0	0	0	51	0	0	0	0	6	0	0	0	0	0	112	1724
5:35 PM	4	45	0	0	0	64	0	0	0	0	5	0	0	0	0	0	118	1702
5:40 PM	2	40	0	0	0	80	1	0	0	0	7	0	0	0	0	0	130	1683
5:45 PM	2	39	0	0	0	73	0	0	0	0	3	0	0	0	0	0	117	1629
5:50 PM	2	46	0	0	0	59	3	0	0	0	4	0	0	0	0	0	114	1601
5:55 PM	3	53	0	0	0	71	1	0	0	0	3	0	0	0	0	0	131	1577

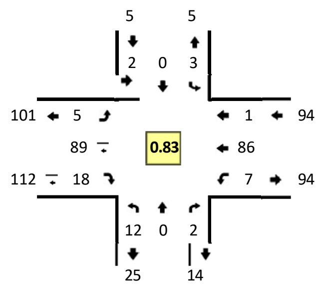
Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	
All Vehicles	52	912	0	0	0	1036	12	0	12	0	96	0	0	0	0	0	2120
Heavy Trucks	0	28	0		0	60	0		0	0	0		0	0	0		88
Buses																	
Pedestrians		0				0				0				0			0
Bicycles	0	4	0		0	0	0		0	0	0		0	0	0		4
Scooters																	

Comments:

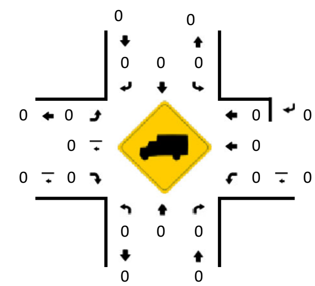
Report generated on 4/28/2023 3:00 PM

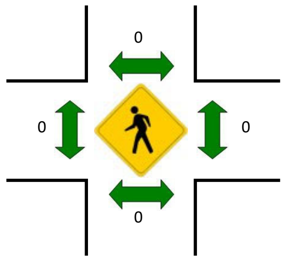
SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

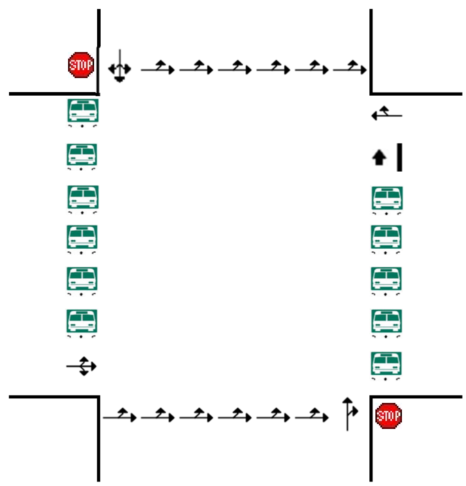
LOCATION: Hualalai Village North Driveway -- Hualalai Rd
CITY/STATE: Kailua, HI
QC JOB #: 16145018
DATE: Wed, Apr 19 2023

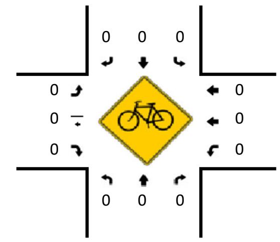


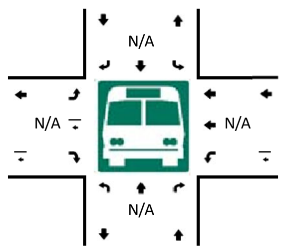
Peak-Hour: 3:00 PM -- 4:00 PM
Peak 15-Min: 3:00 PM -- 3:15 PM

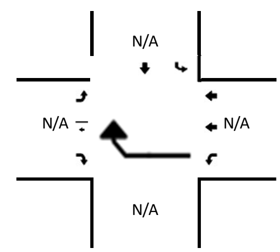












5-Min Count Period Beginning At	Hualalai Village North Driveway (Northbound)				Hualalai Village North Driveway (Southbound)				Hualalai Rd (Eastbound)				Hualalai Rd (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
3:00 PM	1	0	0	0	0	0	0	0	1	11	3	1	1	4	0	0	22	
3:05 PM	1	0	1	0	0	0	1	0	1	13	3	0	1	7	0	0	28	
3:10 PM	1	0	1	0	0	0	0	0	1	7	1	0	0	7	0	0	18	
3:15 PM	1	0	0	0	0	0	0	0	0	12	1	0	1	6	0	0	21	
3:20 PM	1	0	0	0	1	0	0	0	0	6	3	0	0	15	0	0	26	
3:25 PM	1	0	0	0	0	0	0	0	0	5	0	0	1	6	0	0	13	
3:30 PM	2	0	0	0	1	0	0	0	0	7	0	0	0	7	1	0	18	
3:35 PM	1	0	0	0	0	0	0	0	1	5	0	0	0	3	0	0	10	
3:40 PM	0	0	0	0	0	0	0	0	0	4	3	0	0	11	0	0	18	
3:45 PM	0	0	0	0	0	0	0	0	0	7	2	0	1	7	0	0	17	
3:50 PM	2	0	0	0	0	0	1	0	0	9	1	0	2	6	0	0	21	
3:55 PM	1	0	0	0	1	0	0	0	0	3	1	0	0	7	0	0	13	225
4:00 PM	0	0	0	0	0	0	0	0	0	8	1	0	1	7	1	0	18	221
4:05 PM	2	0	0	0	0	0	0	0	0	3	0	0	1	7	0	0	13	206
4:10 PM	1	1	0	0	0	0	1	0	0	4	1	0	0	1	0	0	9	197
4:15 PM	2	0	0	0	0	0	0	0	0	7	1	0	0	6	1	0	17	193
4:20 PM	1	0	0	0	1	0	1	0	0	4	1	0	0	3	0	0	11	178
4:25 PM	0	0	0	0	0	0	0	0	0	6	1	0	1	7	0	0	15	180
4:30 PM	2	0	0	0	0	0	0	0	1	6	2	0	1	4	0	0	16	178
4:35 PM	1	0	1	0	0	0	0	0	0	5	4	0	1	2	1	0	15	183
4:40 PM	0	0	0	0	0	0	1	0	0	4	2	0	0	4	1	0	12	177
4:45 PM	1	0	0	0	0	0	0	0	0	11	1	0	2	6	0	0	21	181
4:50 PM	2	0	0	0	0	0	2	0	0	6	2	1	0	6	0	0	19	179
4:55 PM	1	0	0	0	0	0	0	0	0	4	0	0	2	3	0	0	10	176
5:00 PM	1	0	0	0	0	0	0	0	0	6	2	0	1	2	0	0	12	170
5:05 PM	2	0	0	0	0	0	0	0	0	5	4	0	1	7	0	0	19	176
5:10 PM	2	0	0	0	0	0	1	0	0	3	0	0	0	7	0	0	13	180
5:15 PM	0	0	0	0	0	0	0	0	0	7	0	0	0	3	1	0	11	174
5:20 PM	1	0	1	0	0	0	0	0	0	4	2	0	2	5	0	0	15	178
5:25 PM	3	0	0	0	0	0	2	0	0	7	0	0	0	3	0	0	15	178
5:30 PM	0	0	0	0	0	0	0	0	0	7	3	0	0	4	0	0	14	176
5:35 PM	1	0	1	0	0	0	1	0	0	2	0	0	0	2	0	0	7	168
5:40 PM	4	0	0	0	0	0	0	0	0	7	3	0	1	3	0	0	18	174
5:45 PM	0	0	0	0	1	0	2	0	0	3	1	0	0	2	0	0	9	162
5:50 PM	3	0	0	0	0	0	1	0	0	3	2	0	1	3	0	0	13	156
5:55 PM	0	0	0	0	0	0	0	0	0	3	0	0	1	3	0	0	7	153

Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	
All Vehicles	12	0	8	0	0	0	4	0	12	124	28	4	8	72	0	0	272
Heavy Trucks	0	0	0		0	0	0		0	0	0		0	0	0		0
Buses																	
Pedestrians		0				0				0				0			0
Bicycles	0	0	0		0	0	0		0	0	0		0	0	0		0
Scooters																	

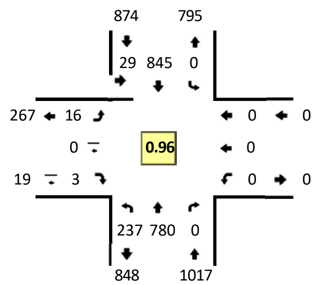
Comments:

Report generated on 4/28/2023 3:00 PM

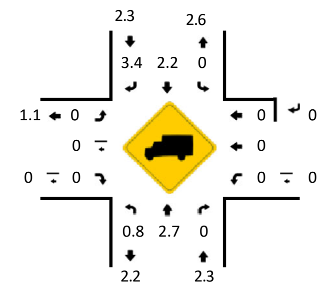
SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

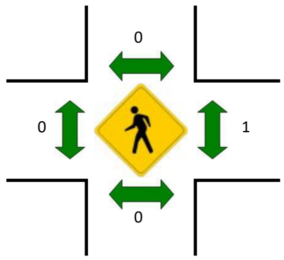
Type of peak hour being reported: Intersection Peak — Method for determining peak hour: Total Entering Volume

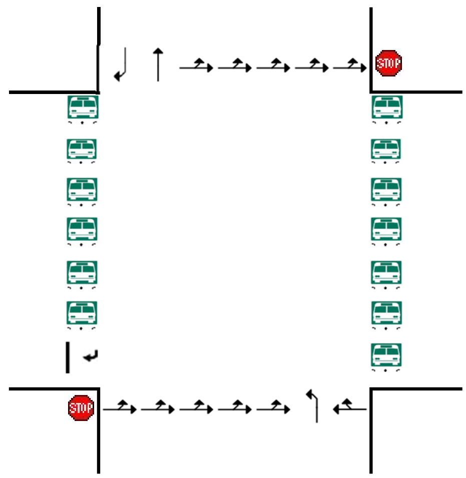
LOCATION: Queen Kaahumanu Hwy -- Kuakini Hwy — **QC JOB #:** 16145019
CITY/STATE: Kailua, HI — **DATE:** Wed, Apr 19 2023

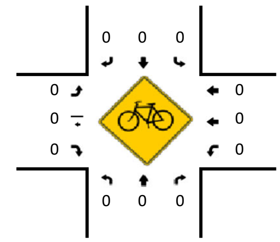


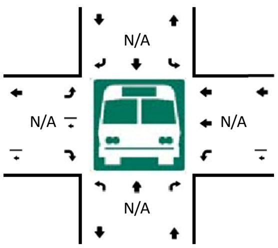
Peak-Hour: 3:05 PM -- 4:05 PM
Peak 15-Min: 3:05 PM -- 3:20 PM

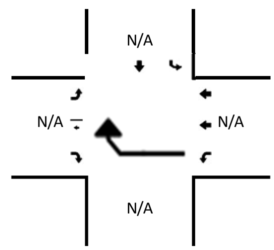












5-Min Count Period Beginning At	Queen Kaahumanu Hwy (Northbound)				Queen Kaahumanu Hwy (Southbound)				Kuakini Hwy (Eastbound)				Kuakini Hwy (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
3:00 PM	12	63	0	0	0	71	4	0	2	0	0	0	0	0	0	0	152	
3:05 PM	19	73	0	0	0	82	3	0	3	0	0	0	0	0	0	0	180	
3:10 PM	17	60	0	0	0	79	1	0	0	0	0	0	0	0	0	0	157	
3:15 PM	11	69	0	0	0	76	2	0	1	0	0	0	0	0	0	0	159	
3:20 PM	24	69	0	0	0	73	1	0	3	0	0	1	0	0	0	0	171	
3:25 PM	17	71	0	0	0	56	3	0	2	0	0	0	0	0	0	0	149	
3:30 PM	23	61	0	0	0	66	1	0	2	0	0	0	0	0	0	0	153	
3:35 PM	18	65	0	0	0	56	2	0	2	0	0	0	0	0	0	0	143	
3:40 PM	21	59	0	0	0	69	1	0	0	0	0	0	0	0	0	0	150	
3:45 PM	18	71	0	0	0	72	1	0	0	0	0	0	0	0	0	0	162	
3:50 PM	20	61	0	0	0	78	5	0	0	0	0	0	0	0	0	0	164	
3:55 PM	30	55	0	0	0	69	3	0	0	0	2	0	0	0	0	0	159	1899
4:00 PM	19	66	0	0	0	69	6	0	2	0	1	0	0	0	0	0	163	1910
4:05 PM	14	54	0	0	0	78	6	0	2	0	0	0	0	0	0	0	154	1884
4:10 PM	19	56	0	0	0	59	2	0	2	0	0	0	0	0	0	0	138	1865
4:15 PM	16	70	0	0	0	71	2	0	0	0	0	0	0	0	0	0	159	1865
4:20 PM	16	62	0	0	0	65	2	0	2	0	0	0	0	0	0	0	147	1841
4:25 PM	22	67	0	0	0	61	2	0	1	0	0	0	0	0	0	0	153	1845
4:30 PM	17	53	0	0	0	64	3	0	3	0	0	0	0	0	0	0	140	1832
4:35 PM	13	67	0	0	0	59	5	0	0	0	0	0	0	0	0	0	144	1833
4:40 PM	20	63	0	0	0	73	0	0	1	0	0	1	0	0	0	0	158	1841
4:45 PM	18	69	0	0	0	65	2	0	1	0	0	0	0	0	0	0	155	1834
4:50 PM	21	66	0	0	0	63	6	0	2	0	0	1	0	0	0	0	159	1829
4:55 PM	9	44	0	0	0	57	2	0	0	0	0	0	0	0	0	0	112	1782
5:00 PM	15	52	0	0	0	72	3	0	0	0	0	0	0	0	0	0	142	1761
5:05 PM	9	46	0	0	0	67	1	0	0	0	0	0	0	0	0	0	123	1730
5:10 PM	23	62	0	0	0	60	1	0	0	0	0	1	0	0	0	0	147	1739
5:15 PM	15	55	0	0	0	69	3	0	1	0	1	0	0	0	0	0	144	1724
5:20 PM	18	60	0	0	0	71	3	0	0	0	0	0	0	0	0	0	152	1729
5:25 PM	11	33	0	0	0	71	1	0	0	0	0	0	0	0	0	0	116	1692
5:30 PM	23	46	0	0	0	55	1	0	2	0	0	0	0	0	0	0	127	1679
5:35 PM	8	37	0	0	0	56	2	0	3	0	0	0	0	0	0	0	106	1641
5:40 PM	15	44	0	0	0	66	1	0	2	0	0	0	0	0	0	0	128	1611
5:45 PM	12	35	0	0	0	56	1	0	1	0	0	0	0	0	0	0	105	1561
5:50 PM	20	39	0	0	0	54	2	0	1	0	0	0	0	0	0	0	116	1518
5:55 PM	14	40	0	0	0	74	0	0	1	0	0	0	0	0	0	0	129	1535

Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	
All Vehicles	188	808	0	0	0	948	24	0	16	0	0	0	0	0	0	0	1984
Heavy Trucks	0	32	0		0	40	4		0	0	0		0	0	0		76
Buses																	
Pedestrians		0				0				0				0			0
Bicycles Scooters	0	0	0		0	0	0		0	0	0		0	0	0		0

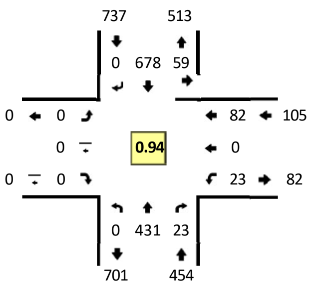
Comments:

Report generated on 4/28/2023 3:00 PM

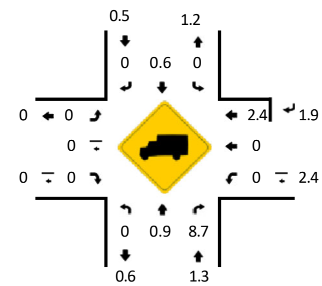
SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

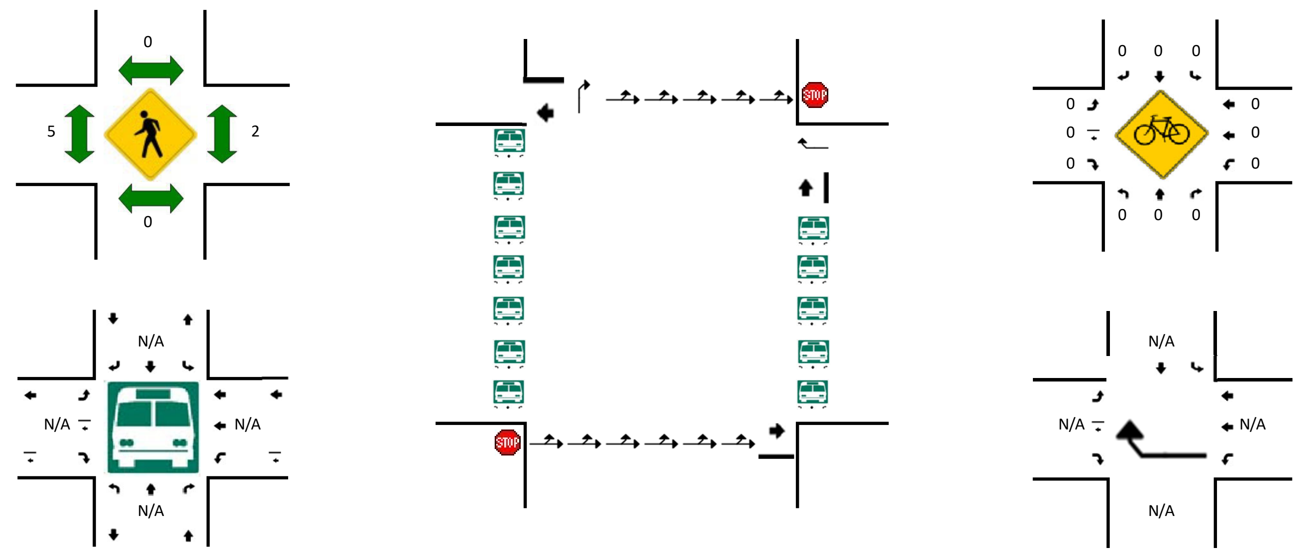
Type of peak hour being reported: Intersection Peak   Method for determining peak hour: Total Entering Volume

LOCATION: Kuakini Hwy -- YWAM Driveway   **QC JOB #:** 16145020
CITY/STATE: Kailua, HI   **DATE:** Wed, Apr 19 2023



Peak-Hour: 4:25 PM -- 5:25 PM
Peak 15-Min: 4:35 PM -- 4:50 PM





5-Min Count Period Beginning At	Kuakini Hwy (Northbound)				Kuakini Hwy (Southbound)				YWAM Driveway (Eastbound)				YWAM Driveway (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
3:00 PM	0	27	6	0	2	58	0	0	0	0	0	0	2	0	14	0	109	
3:05 PM	0	42	1	0	4	45	0	0	0	0	0	0	1	0	10	0	103	
3:10 PM	0	35	1	0	4	50	0	0	0	0	0	0	0	0	11	0	101	
3:15 PM	0	34	1	0	4	49	0	0	0	0	0	0	1	0	13	0	102	
3:20 PM	0	23	2	0	6	48	0	0	0	0	0	0	5	0	4	0	88	
3:25 PM	0	32	1	0	3	42	0	0	0	0	0	0	0	0	3	0	81	
3:30 PM	0	35	3	0	5	55	0	0	0	0	0	0	1	0	11	0	110	
3:35 PM	0	31	1	0	1	50	0	0	0	0	0	0	3	0	10	0	96	
3:40 PM	0	43	1	0	4	48	0	0	0	0	0	0	5	0	4	0	105	
3:45 PM	0	27	2	0	2	70	0	1	0	0	0	0	0	0	5	0	107	
3:50 PM	0	35	1	0	7	52	0	0	0	0	0	0	2	0	3	0	100	
3:55 PM	0	32	0	0	6	56	0	0	0	0	0	0	2	0	6	0	102	1204
4:00 PM	0	39	0	0	2	61	0	0	0	0	0	0	1	0	3	0	106	1201
4:05 PM	0	39	1	0	5	49	0	0	0	0	0	0	1	0	2	0	97	1195
4:10 PM	0	43	0	0	4	64	0	0	0	0	0	0	0	0	4	0	115	1209
4:15 PM	0	26	1	0	7	64	0	0	0	0	0	0	1	0	3	0	102	1209
4:20 PM	0	33	1	0	7	47	0	0	0	0	0	0	1	0	2	0	91	1212
4:25 PM	0	32	4	0	0	67	0	0	0	0	0	0	2	0	7	0	112	1243
4:30 PM	0	36	3	0	4	57	0	0	0	0	0	0	3	0	10	0	113	1246
4:35 PM	0	31	4	0	4	61	0	0	0	0	0	0	2	0	5	0	107	1257
4:40 PM	0	37	2	0	6	62	0	0	0	0	0	0	1	0	7	0	115	1267
4:45 PM	0	47	1	0	6	52	0	0	0	0	0	0	4	0	11	0	121	1281
4:50 PM	0	27	3	0	6	51	0	0	0	0	0	0	1	0	4	0	92	1273
4:55 PM	0	37	1	0	11	57	0	0	0	0	0	0	0	0	7	0	113	1284
5:00 PM	0	32	1	0	7	60	0	0	0	0	0	0	2	0	12	0	114	1292
5:05 PM	0	39	0	0	1	55	0	0	0	0	0	0	1	0	3	0	99	1294
5:10 PM	0	42	1	0	5	55	0	0	0	0	0	0	3	0	6	0	112	1291
5:15 PM	0	29	1	0	4	52	0	0	0	0	0	0	2	0	6	0	94	1283
5:20 PM	0	42	2	0	5	49	0	0	0	0	0	0	2	0	4	0	104	1296
5:25 PM	0	33	1	0	4	57	0	0	0	0	0	0	1	0	11	0	107	1291
5:30 PM	0	31	3	0	2	46	0	0	0	0	0	0	3	0	7	0	92	1270
5:35 PM	0	23	2	0	3	53	0	0	0	0	0	0	0	0	2	0	83	1246
5:40 PM	0	27	1	0	6	42	0	0	0	0	0	0	2	0	5	0	83	1214
5:45 PM	0	28	1	0	5	51	0	0	0	0	0	0	0	0	6	0	91	1184
5:50 PM	0	27	5	0	4	37	0	0	0	0	0	0	1	0	4	0	78	1170
5:55 PM	0	33	2	0	7	39	0	0	0	0	0	0	1	0	3	0	85	1142

Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	
All Vehicles	0	460	28	0	64	700	0	0	0	0	0	0	28	0	92	0	1372
Heavy Trucks	0	4	0		0	0	0		0	0	0		0	0	8		12
Buses																	
Pedestrians		0				0				8				4			12
Bicycles	0	0	0		0	0	0		0	0	0		0	0	0		0
Scooters																	

Comments:

Report generated on 4/28/2023 3:00 PM

SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

Type of peak hour being reported: Intersection Peak

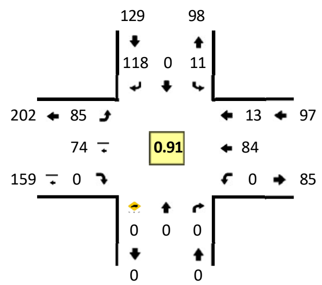
Method for determining peak hour: Total Entering Volume

LOCATION: Nani Kailua Drive -- Hualalai Rd

CITY/STATE: Kailua, HI

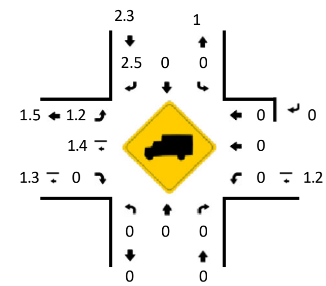
QC JOB #: 16145021

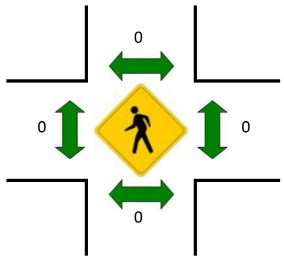
DATE: Wed, Apr 19 2023

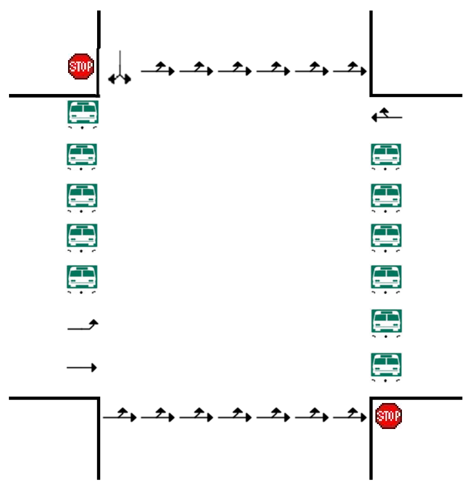


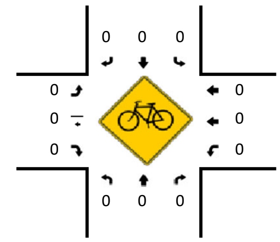
Peak-Hour: 3:20 PM -- 4:20 PM

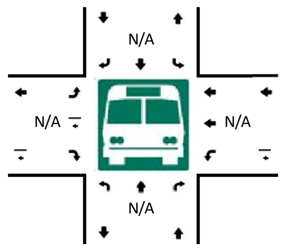
Peak 15-Min: 3:45 PM -- 4:00 PM

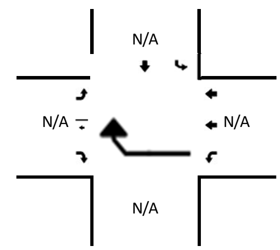












5-Min Count Period Beginning At	Nani Kailua Drive (Northbound)				Nani Kailua Drive (Southbound)				Hualalai Rd (Eastbound)				Hualalai Rd (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
3:00 PM	0	0	0	0	2	0	5	0	7	15	0	0	0	6	0	0	35	
3:05 PM	0	0	0	0	2	0	9	0	4	10	0	0	0	7	1	0	33	
3:10 PM	0	0	0	0	1	0	6	0	6	12	0	0	0	2	6	0	33	
3:15 PM	0	0	0	0	0	0	7	0	2	9	0	0	0	6	0	0	24	
3:20 PM	0	0	0	0	2	0	9	0	5	7	0	0	0	15	2	0	40	
3:25 PM	0	0	0	0	1	0	6	0	1	5	0	0	0	6	1	0	20	
3:30 PM	0	0	0	0	3	0	12	0	8	5	0	0	0	7	2	0	37	
3:35 PM	0	0	0	0	1	0	9	0	1	5	0	0	0	3	1	0	20	
3:40 PM	0	0	0	0	0	0	8	0	7	7	0	0	0	11	0	0	33	
3:45 PM	0	0	0	0	3	0	13	0	8	9	0	0	0	4	1	0	38	
3:50 PM	0	0	0	0	0	0	8	0	8	7	0	0	0	8	1	0	32	
3:55 PM	0	0	0	0	0	0	13	0	10	5	0	0	0	8	0	0	36	381
4:00 PM	0	0	0	0	0	0	14	0	8	8	0	0	0	6	1	0	37	383
4:05 PM	0	0	0	0	0	0	6	0	6	3	0	0	0	7	0	0	22	372
4:10 PM	0	0	0	0	0	0	9	0	13	6	0	0	0	3	2	0	33	372
4:15 PM	0	0	0	0	1	0	11	0	10	7	0	0	0	6	2	0	37	385
4:20 PM	0	0	0	0	0	0	10	0	11	5	0	0	0	3	2	0	31	376
4:25 PM	0	0	0	0	2	0	5	0	5	5	0	0	0	7	0	0	24	380
4:30 PM	0	0	0	0	3	0	8	0	9	10	0	0	0	4	0	0	34	377
4:35 PM	0	0	0	0	0	0	9	0	4	3	0	0	0	3	1	0	20	377
4:40 PM	0	0	0	0	1	0	9	0	7	8	0	0	0	4	1	0	30	374
4:45 PM	0	0	0	0	1	0	10	0	11	10	0	0	0	7	0	0	39	375
4:50 PM	0	0	0	0	2	0	8	0	7	4	0	0	0	8	2	0	31	374
4:55 PM	0	0	0	0	0	0	7	0	6	7	0	0	0	5	0	0	25	363
5:00 PM	0	0	0	0	1	0	5	0	7	5	0	0	0	3	0	0	21	347
5:05 PM	0	0	0	0	3	0	9	0	9	5	0	1	0	9	0	0	36	361
5:10 PM	0	0	0	0	0	0	8	0	5	4	0	0	0	10	0	0	27	355
5:15 PM	0	0	0	0	1	0	12	0	6	7	0	1	0	3	0	0	30	348
5:20 PM	0	0	0	0	0	0	5	0	9	6	0	0	0	5	1	0	26	343
5:25 PM	0	0	0	0	0	0	8	0	4	9	0	0	0	6	2	0	29	348
5:30 PM	0	0	0	0	1	0	3	0	9	5	0	0	0	4	0	0	22	336
5:35 PM	0	0	0	0	1	0	2	0	2	4	0	0	0	3	1	0	13	329
5:40 PM	0	0	0	0	1	0	3	0	3	6	0	0	0	3	3	0	19	318
5:45 PM	0	0	0	0	0	0	7	0	11	5	0	0	0	4	1	0	28	307
5:50 PM	0	0	0	0	0	0	4	0	3	4	0	0	0	4	2	0	17	293
5:55 PM	0	0	0	0	0	0	4	0	8	3	0	0	0	3	0	0	18	286

Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	
All Vehicles	0	0	0	0	12	0	136	0	104	84	0	0	0	80	8	0	424
Heavy Trucks	0	0	0		0	0	4		0	0	0		0	0	0		4
Buses																	
Pedestrians		0				0				0				0			0
Bicycles	0	0	0		0	0	0		0	0	0		0	0	0		0
Scooters																	

Comments:

Report generated on 4/28/2023 3:00 PM

SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

APPENDIX B: LOS WORKSHEETS

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	209	41	24	55	39	194	18	548	45	122	355	150
Future Volume (veh/h)	209	41	24	55	39	194	18	548	45	122	355	150
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	0.99		0.98	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1453	1477	1870	1870	1477	1856	1870	1477	1870	1870	1477	1841
Adj Flow Rate, veh/h	220	43	17	58	41	69	19	577	0	128	374	53
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	4	2	2	2	2	3	2	2	2	2	2	4
Cap, veh/h	229	245	97	307	61	103	485	1454		488	808	853
Arrive On Green	0.17	0.24	0.23	0.05	0.13	0.11	0.03	0.52	0.00	0.06	0.55	0.55
Sat Flow, veh/h	1384	1005	398	1781	488	820	1781	2879	0	1781	1477	1559
Grp Volume(v), veh/h	220	0	60	58	0	110	19	577	0	128	374	53
Grp Sat Flow(s),veh/h/ln	1384	0	1403	1781	0	1308	1781	1403	0	1781	1477	1559
Q Serve(g_s), s	19.7	0.0	4.2	3.5	0.0	10.1	0.6	15.6	0.0	4.0	19.2	2.0
Cycle Q Clear(g_c), s	19.7	0.0	4.2	3.5	0.0	10.1	0.6	15.6	0.0	4.0	19.2	2.0
Prop In Lane	1.00		0.28	1.00		0.63	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	229	0	342	307	0	164	485	1454		488	808	853
V/C Ratio(X)	0.96	0.00	0.18	0.19	0.00	0.67	0.04	0.40		0.26	0.46	0.06
Avail Cap(c_a), veh/h	229	0	342	517	0	272	657	1454		608	808	853
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	51.7	0.0	37.5	44.4	0.0	52.6	14.1	18.3	0.0	13.0	17.2	13.3
Incr Delay (d2), s/veh	48.1	0.0	0.1	0.1	0.0	1.8	0.0	0.8	0.0	0.1	1.9	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	9.9	0.0	1.5	1.6	0.0	3.4	0.3	5.3	0.0	1.6	7.0	0.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	99.8	0.0	37.6	44.5	0.0	54.4	14.1	19.1	0.0	13.1	19.1	13.4
LnGrp LOS	F	A	D	D	A	D	B	B		B	B	B
Approach Vol, veh/h		280			168			596			555	
Approach Delay, s/veh		86.5			51.0			18.9			17.2	
Approach LOS		F			D			B			B	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	7.9	72.4	25.0	19.7	11.5	68.8	10.3	34.4
Change Period (Y+Rc), s	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Max Green Setting (Gmax), s	14.5	44.5	19.5	24.5	14.5	44.5	19.5	24.5
Max Q Clear Time (g_c+I1), s	2.6	21.2	21.7	12.1	6.0	17.6	5.5	6.2
Green Ext Time (p_c), s	0.0	1.8	0.0	0.2	0.1	2.4	0.0	0.1

Intersection Summary	
HCM 6th Ctrl Delay	33.5
HCM 6th LOS	C

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	1.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	11	51	507	66	98	284
Future Vol, veh/h	11	51	507	66	98	284
Conflicting Peds, #/hr	0	2	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Stop	-	None	-	None
Storage Length	0	100	-	-	120	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	84	84	84	84	84	84
Heavy Vehicles, %	2	2	3	2	2	2
Mvmt Flow	13	61	604	79	117	338

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1216	646	0	0	683	0
Stage 1	644	-	-	-	-	-
Stage 2	572	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	200	472	-	-	910	-
Stage 1	523	-	-	-	-	-
Stage 2	565	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	174	471	-	-	910	-
Mov Cap-2 Maneuver	174	-	-	-	-	-
Stage 1	523	-	-	-	-	-
Stage 2	492	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	16.2	0	2.4
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	174	471	910	-
HCM Lane V/C Ratio	-	-	0.075	0.129	0.128	-
HCM Control Delay (s)	-	-	27.4	13.8	9.5	-
HCM Lane LOS	-	-	D	B	A	-
HCM 95th %tile Q(veh)	-	-	0.2	0.4	0.4	-

Intersection	
Int Delay, s/veh	4.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	54	66	164	12	24	109
Future Vol, veh/h	54	66	164	12	24	109
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	120	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	60	73	182	13	27	121

Major/Minor	Major 1		Major 2		Minor 2	
Conflicting Flow All	195	0	-	0	382	189
Stage 1	-	-	-	-	189	-
Stage 2	-	-	-	-	193	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1378	-	-	-	620	853
Stage 1	-	-	-	-	843	-
Stage 2	-	-	-	-	840	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1378	-	-	-	593	853
Mov Cap-2 Maneuver	-	-	-	-	593	-
Stage 1	-	-	-	-	806	-
Stage 2	-	-	-	-	840	-

Approach	EB	WB	SB
HCM Control Delay, s	3.5	0	10.6
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1378	-	-	-	790
HCM Lane V/C Ratio	0.044	-	-	-	0.187
HCM Control Delay (s)	7.7	-	-	-	10.6
HCM Lane LOS	A	-	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	48	19	17	55	58	164	30	1010	38	56	746	59
Future Volume (veh/h)	48	19	17	55	58	164	30	1010	38	56	746	59
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1477	1870	1870	1477	1856	1477	1259	1870	1477	1239	1870
Adj Flow Rate, veh/h	50	20	0	57	60	0	31	1052	0	58	777	0
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Percent Heavy Veh, %	2	2	2	2	2	3	2	4	2	2	6	2
Cap, veh/h	111	37		94	74		315	984		91	974	
Arrive On Green	0.11	0.11	0.00	0.11	0.11	0.00	0.03	0.78	0.00	0.03	0.79	0.00
Sat Flow, veh/h	647	323	1585	575	688	1572	1406	1259	1585	1406	1239	1585
Grp Volume(v), veh/h	70	0	0	117	0	0	31	1052	0	58	777	0
Grp Sat Flow(s),veh/h/ln	970	0	1585	1264	0	1572	1406	1259	1585	1406	1239	1585
Q Serve(g_s), s	0.0	0.0	0.0	3.1	0.0	0.0	0.7	126.5	0.0	1.4	58.3	0.0
Cycle Q Clear(g_c), s	11.6	0.0	0.0	14.8	0.0	0.0	0.7	126.5	0.0	1.4	58.3	0.0
Prop In Lane	0.71		1.00	0.49		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	148	0		168	0		315	984		91	974	
V/C Ratio(X)	0.47	0.00		0.70	0.00		0.10	1.07		0.64	0.80	
Avail Cap(c_a), veh/h	167	0		189	0		325	984		94	974	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	68.6	0.0	0.0	71.1	0.0	0.0	14.0	17.7	0.0	52.2	10.0	0.0
Incr Delay (d2), s/veh	2.3	0.0	0.0	9.3	0.0	0.0	0.1	49.2	0.0	12.9	4.7	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.9	0.0	0.0	5.3	0.0	0.0	0.4	41.7	0.0	2.1	13.9	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	71.0	0.0	0.0	80.4	0.0	0.0	14.1	66.9	0.0	65.0	14.7	0.0
LnGrp LOS	E	A		F	A		B	F		E	B	
Approach Vol, veh/h		70			117			1083			835	
Approach Delay, s/veh		71.0			80.4			65.4			18.2	
Approach LOS		E			F			E			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.9	130.8		22.3	9.7	130.0		22.3
Change Period (Y+Rc), s	5.5	5.5		5.5	5.5	5.5		5.5
Max Green Setting (Gmax), s	4.5	124.5		19.5	4.5	124.5		19.5
Max Q Clear Time (g_c+I1), s	2.7	60.3		16.8	3.4	128.5		13.6
Green Ext Time (p_c), s	0.0	6.1		0.1	0.0	0.0		0.1

Intersection Summary	
HCM 6th Ctrl Delay	47.7
HCM 6th LOS	D

Notes

Unsignalized Delay for [NBR, EBR, WBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	1.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	4	71	4	4	174	7	14	0	3	3	0	3
Future Vol, veh/h	4	71	4	4	174	7	14	0	3	3	0	3
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	120	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	82	82	82	82	82	82	82	82	82	82	82	82
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	87	5	5	212	9	17	0	4	4	0	4

Major/Minor	Major1			Major 2			Minor 1			Minor 2		
Conflicting Flow All	221	0	0	92	0	0	329	331	90	329	329	217
Stage 1	-	-	-	-	-	-	100	100	-	227	227	-
Stage 2	-	-	-	-	-	-	229	231	-	102	102	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1348	-	-	1503	-	-	624	588	968	624	590	823
Stage 1	-	-	-	-	-	-	906	812	-	776	716	-
Stage 2	-	-	-	-	-	-	774	713	-	904	811	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1348	-	-	1503	-	-	618	584	968	618	586	823
Mov Cap-2 Maneuver	-	-	-	-	-	-	618	584	-	618	586	-
Stage 1	-	-	-	-	-	-	902	809	-	773	714	-
Stage 2	-	-	-	-	-	-	768	711	-	897	808	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.4	0.2	10.6	10.2
HCM LOS			B	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	660	1348	-	-	1503	-	-	706
HCM Lane V/C Ratio	0.031	0.004	-	-	0.003	-	-	0.01
HCM Control Delay (s)	10.6	7.7	0	-	7.4	-	-	10.2
HCM Lane LOS	B	A	A	-	A	-	-	B
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0

Intersection	
Int Delay, s/veh	1.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	33	60	146	1080	795	23
Future Vol, veh/h	33	60	146	1080	795	23
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	130	0	420	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	3	3	6	2
Mvmt Flow	36	65	159	1174	864	25

Major/Minor	Minor2		Major 1		Major 2	
Conflicting Flow All	2356	-	864	0	-	0
Stage 1	864	-	-	-	-	-
Stage 2	1492	-	-	-	-	-
Critical Hdwy	6.42	-	4.13	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.227	-	-	-
Pot Cap-1 Maneuver	39	0	774	-	-	-
Stage 1	413	0	-	-	-	-
Stage 2	206	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 31	-	774	-	-	-
Mov Cap-2 Maneuver	166	-	-	-	-	-
Stage 1	328	-	-	-	-	-
Stage 2	206	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	32.6	1.3	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	774	-	166	-	-	-
HCM Lane V/C Ratio	0.205	-	0.216	-	-	-
HCM Control Delay (s)	10.8	-	32.6	0	-	-
HCM Lane LOS	B	-	D	A	-	-
HCM 95th %tile Q(veh)	0.8	-	0.8	-	-	-

Notes

~: Volume exceeds $: Delay exceeds +: Computation Not *: All major volume in platoon

capacity	300s	Defined

Intersection						
Int Delay, s/veh	2.5					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	285	368	912	773	53
Future Vol, veh/h	10	285	368	912	773	53
Conflicting Peds, #/hr	0	0	1	0	0	1
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	150	0	450	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	4	4	6	2
Mvmt Flow	11	300	387	960	814	56

Major/Minor	Minor2		Major 1		Major 2	
Conflicting Flow All	2549	-	815	0	-	0
Stage 1	815	-	-	-	-	-
Stage 2	1734	-	-	-	-	-
Critical Hdwy	6.42	-	4.14	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.236	-	-	-
Pot Cap-1 Maneuver	29	0	804	-	-	-
Stage 1	435	0	-	-	-	-
Stage 2	156	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	15	-	803	-	-	-
Mov Cap-2 Maneuver	120	-	-	-	-	-
Stage 1	225	-	-	-	-	-
Stage 2	156	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	37.9	3.9	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	803	-	120	-	-	-
HCM Lane V/C Ratio	0.482	-	0.088	-	-	-
HCM Control Delay (s)	13.6	-	37.9	0	-	-
HCM Lane LOS	B	-	E	A	-	-
HCM 95th %tile Q(veh)	2.7	-	0.3	-	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	153	24	25	63	38	165	24	541	52	161	729	244
Future Volume (veh/h)	153	24	25	63	38	165	24	541	52	161	729	244
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		0.98	1.00		1.00	1.00		0.96
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1477	1477	1870	1870	1477	1870	1870	1477	1870	1870	1477	1870
Adj Flow Rate, veh/h	155	24	17	64	38	38	24	546	0	163	736	145
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	184	143	101	268	65	65	263	1685		581	926	958
Arrive On Green	0.13	0.18	0.17	0.05	0.10	0.09	0.03	0.60	0.00	0.06	0.63	0.63
Sat Flow, veh/h	1406	801	567	1781	668	668	1781	2879	0	1781	1477	1527
Grp Volume(v), veh/h	155	0	41	64	0	76	24	546	0	163	736	145
Grp Sat Flow(s),veh/h/ln	1406	0	1368	1781	0	1337	1781	1403	0	1781	1477	1527
Q Serve(g_s), s	15.6	0.0	3.7	4.6	0.0	7.9	0.7	14.0	0.0	4.9	53.7	5.7
Cycle Q Clear(g_c), s	15.6	0.0	3.7	4.6	0.0	7.9	0.7	14.0	0.0	4.9	53.7	5.7
Prop In Lane	1.00		0.41	1.00		0.50	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	184	0	244	268	0	131	263	1685		581	926	958
V/C Ratio(X)	0.84	0.00	0.17	0.24	0.00	0.58	0.09	0.32		0.28	0.79	0.15
Avail Cap(c_a), veh/h	249	0	293	494	0	286	464	1685		735	926	958
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	61.5	0.0	50.8	54.8	0.0	63.0	19.1	14.4	0.0	10.0	20.1	11.1
Incr Delay (d2), s/veh	17.1	0.0	0.1	0.2	0.0	1.5	0.1	0.5	0.0	0.1	7.0	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.5	0.0	1.3	2.1	0.0	2.8	0.3	4.7	0.0	1.9	19.9	2.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	78.6	0.0	50.9	55.0	0.0	64.5	19.1	14.9	0.0	10.0	27.1	11.5
LnGrp LOS	E	A	D	D	A	E	B	B		B	C	B
Approach Vol, veh/h		196			140			570			1044	
Approach Delay, s/veh		72.8			60.1			15.1			22.3	
Approach LOS		E			E			B			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	8.6	94.9	23.3	18.2	12.5	91.1	11.6	29.8
Change Period (Y+Rc), s	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Max Green Setting (Gmax), s	19.5	49.5	24.5	29.5	19.5	49.5	24.5	29.5
Max Q Clear Time (g_c+I1), s	2.7	55.7	17.6	9.9	6.9	16.0	6.6	5.7
Green Ext Time (p_c), s	0.0	0.0	0.2	0.2	0.1	2.3	0.0	0.1

Intersection Summary			
HCM 6th Ctrl Delay			28.0
HCM 6th LOS			C

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	1.7

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	23	82	431	23	59	678
Future Vol, veh/h	23	82	431	23	59	678
Conflicting Peds, #/hr	0	0	0	2	2	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Stop	-	None	-	None
Storage Length	0	100	-	-	120	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	24	87	459	24	63	721

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1320	473	0	0	485	0
Stage 1	473	-	-	-	-	-
Stage 2	847	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	173	591	-	-	1078	-
Stage 1	627	-	-	-	-	-
Stage 2	420	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	162	590	-	-	1076	-
Mov Cap-2 Maneuver	162	-	-	-	-	-
Stage 1	626	-	-	-	-	-
Stage 2	395	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	16.3	0	0.7
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	162	590	1076	-
HCM Lane V/C Ratio	-	-	0.151	0.148	0.058	-
HCM Control Delay (s)	-	-	31.1	12.2	8.6	-
HCM Lane LOS	-	-	D	B	A	-
HCM 95th %tile Q(veh)	-	-	0.5	0.5	0.2	-

Intersection	
Int Delay, s/veh	4.9

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	85	74	84	13	11	118
Future Vol, veh/h	85	74	84	13	11	118
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	120	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	91	91	91	91	91	91
Heavy Vehicles, %	2	2	2	2	2	3
Mvmt Flow	93	81	92	14	12	130

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	106	0	-	0	366	99
Stage 1	-	-	-	-	99	-
Stage 2	-	-	-	-	267	-
Critical Hdwy	4.12	-	-	-	6.42	6.23
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.327
Pot Cap-1 Maneuver	1485	-	-	-	634	954
Stage 1	-	-	-	-	925	-
Stage 2	-	-	-	-	778	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1485	-	-	-	594	954
Mov Cap-2 Maneuver	-	-	-	-	594	-
Stage 1	-	-	-	-	867	-
Stage 2	-	-	-	-	778	-

Approach	EB	WB	SB
HCM Control Delay, s	4.1	0	9.7
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1485	-	-	-	907
HCM Lane V/C Ratio	0.063	-	-	-	0.156
HCM Control Delay (s)	7.6	-	-	-	9.7
HCM Lane LOS	A	-	-	-	A
HCM 95th %tile Q(veh)	0.2	-	-	-	0.6

HCM 6th Signalized Intersection Summary

4: Queen Kaahumanu Hwy & Nani Kailua Dr

06/15/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	45	41	10	32	35	105	20	788	34	115	947	76
Future Volume (veh/h)	45	41	10	32	35	105	20	788	34	115	947	76
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1477	1870	1870	1477	1856	1477	1259	1870	1442	1280	1870
Adj Flow Rate, veh/h	49	45	0	35	38	0	22	857	0	125	1029	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	3	2	4	2	5	2	2
Cap, veh/h	91	62		77	67		81	995		262	1024	
Arrive On Green	0.10	0.10	0.00	0.09	0.09	0.00	0.03	0.79	0.00	0.04	0.80	0.00
Sat Flow, veh/h	569	625	1585	467	723	1572	1406	1259	1585	1373	1280	1585
Grp Volume(v), veh/h	94	0	0	73	0	0	22	857	0	125	1029	0
Grp Sat Flow(s),veh/h/ln	1193	0	1585	1190	0	1572	1406	1259	1585	1373	1280	1585
Q Serve(g_s), s	3.0	0.0	0.0	0.0	0.0	0.0	0.5	70.8	0.0	2.8	126.5	0.0
Cycle Q Clear(g_c), s	12.3	0.0	0.0	9.3	0.0	0.0	0.5	70.8	0.0	2.8	126.5	0.0
Prop In Lane	0.52		1.00	0.48		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	153	0		145	0		81	995		262	1024	
V/C Ratio(X)	0.61	0.00		0.50	0.00		0.27	0.86		0.48	1.00	
Avail Cap(c_a), veh/h	195	0		186	0		96	1008		262	1024	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	69.6	0.0	0.0	68.9	0.0	0.0	51.5	10.9	0.0	24.0	15.8	0.0
Incr Delay (d2), s/veh	3.9	0.0	0.0	2.7	0.0	0.0	1.8	7.7	0.0	1.3	29.2	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.9	0.0	0.0	3.0	0.0	0.0	0.7	17.4	0.0	2.8	35.1	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	73.5	0.0	0.0	71.6	0.0	0.0	53.3	18.6	0.0	25.3	45.0	0.0
LnGrp LOS	E	A		E	A		D	B		C	F	
Approach Vol, veh/h		94			73			879			1154	
Approach Delay, s/veh		73.5			71.6			19.5			42.8	
Approach LOS		E			E			B			D	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.3	130.0		19.7	10.0	128.3		19.7
Change Period (Y+Rc), s	5.5	5.5		5.5	5.5	5.5		5.5
Max Green Setting (Gmax), s	4.5	124.5		19.5	4.5	124.5		19.5
Max Q Clear Time (g_c+I1), s	2.5	128.5		11.3	4.8	72.8		14.3
Green Ext Time (p_c), s	0.0	0.0		0.2	0.0	7.1		0.2

Intersection Summary			
HCM 6th Ctrl Delay			35.8
HCM 6th LOS			D

Notes

Unsignalized Delay for [NBR, EBR, WBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	1.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	89	18	7	86	1	12	0	2	3	0	2
Future Vol, veh/h	5	89	18	7	86	1	12	0	2	3	0	2
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	120	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	83	83	83	83	83	83	83	83	83	83	83	83
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	6	107	22	8	104	1	14	0	2	4	0	2

Major/Minor	Major1			Major 2			Minor 1			Minor 2		
Conflicting Flow All	105	0	0	129	0	0	252	251	118	252	262	105
Stage 1	-	-	-	-	-	-	130	130	-	121	121	-
Stage 2	-	-	-	-	-	-	122	121	-	131	141	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1486	-	-	1457	-	-	701	652	934	701	643	949
Stage 1	-	-	-	-	-	-	874	789	-	883	796	-
Stage 2	-	-	-	-	-	-	882	796	-	873	780	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1486	-	-	1457	-	-	694	646	934	694	637	949
Mov Cap-2 Maneuver	-	-	-	-	-	-	694	646	-	694	637	-
Stage 1	-	-	-	-	-	-	871	786	-	879	792	-
Stage 2	-	-	-	-	-	-	875	792	-	867	777	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	0.6	10.1	9.7
HCM LOS			B	A

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	720	1486	-	-	1457	-	-	778
HCM Lane V/C Ratio	0.023	0.004	-	-	0.006	-	-	0.008
HCM Control Delay (s)	10.1	7.4	0	-	7.5	-	-	9.7
HCM Lane LOS	B	A	A	-	A	-	-	A
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0

Intersection	
Int Delay, s/veh	0.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	13	80	66	826	969	16
Future Vol, veh/h	13	80	66	826	969	16
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	130	0	420	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	2	2	2	4	3	2
Mvmt Flow	14	86	71	888	1042	17

Major/Minor	Minor2		Major 1		Major 2	
Conflicting Flow All	2072	-	1042	0	-	0
Stage 1	1042	-	-	-	-	-
Stage 2	1030	-	-	-	-	-
Critical Hdwy	6.42	-	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.218	-	-	-
Pot Cap-1 Maneuver	59	0	667	-	-	-
Stage 1	340	0	-	-	-	-
Stage 2	344	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	53	-	667	-	-	-
Mov Cap-2 Maneuver	221	-	-	-	-	-
Stage 1	304	-	-	-	-	-
Stage 2	344	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	22.4	0.8	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	667	-	221	-	-	-
HCM Lane V/C Ratio	0.106	-	0.063	-	-	-
HCM Control Delay (s)	11	-	22.4	0	-	-
HCM Lane LOS	B	-	C	A	-	-
HCM 95th %tile Q(veh)	0.4	-	0.2	-	-	-

Intersection	
Int Delay, s/veh	1.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	16	685	237	780	845	29
Future Vol, veh/h	16	685	237	780	845	29
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	150	0	450	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	2	3	3	2
Mvmt Flow	17	714	247	813	880	30

Major/Minor	Minor2		Major 1		Major 2	
Conflicting Flow All	2187	-	880	0	-	0
Stage 1	880	-	-	-	-	-
Stage 2	1307	-	-	-	-	-
Critical Hdwy	6.42	-	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.218	-	-	-
Pot Cap-1 Maneuver	50	0	768	-	-	-
Stage 1	406	0	-	-	-	-
Stage 2	253	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	34	-	768	-	-	-
Mov Cap-2 Maneuver	177	-	-	-	-	-
Stage 1	275	-	-	-	-	-
Stage 2	253	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	27.4	2.8	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	768	-	177	-	-	-
HCM Lane V/C Ratio	0.321	-	0.094	-	-	-
HCM Control Delay (s)	11.9	-	27.4	0	-	-
HCM Lane LOS	B	-	D	A	-	-
HCM 95th %tile Q(veh)	1.4	-	0.3	-	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	226	44	26	59	42	210	19	612	48	132	389	162
Future Volume (veh/h)	226	44	26	59	42	210	19	612	48	132	389	162
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	0.99		0.98	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1453	1477	1870	1870	1477	1856	1870	1477	1870	1870	1477	1841
Adj Flow Rate, veh/h	238	46	19	62	44	86	20	644	0	139	409	66
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	4	2	2	2	2	3	2	2	2	2	2	4
Cap, veh/h	229	252	104	327	61	119	434	1406		443	788	831
Arrive On Green	0.17	0.25	0.24	0.05	0.14	0.13	0.03	0.50	0.00	0.06	0.53	0.53
Sat Flow, veh/h	1384	991	409	1781	441	861	1781	2879	0	1781	1477	1558
Grp Volume(v), veh/h	238	0	65	62	0	130	20	644	0	139	409	66
Grp Sat Flow(s),veh/h/ln	1384	0	1401	1781	0	1302	1781	1403	0	1781	1477	1558
Q Serve(g_s), s	20.7	0.0	4.6	3.7	0.0	12.0	0.7	18.6	0.0	4.5	22.3	2.6
Cycle Q Clear(g_c), s	20.7	0.0	4.6	3.7	0.0	12.0	0.7	18.6	0.0	4.5	22.3	2.6
Prop In Lane	1.00		0.29	1.00		0.66	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	229	0	356	327	0	180	434	1406		443	788	831
V/C Ratio(X)	1.04	0.00	0.18	0.19	0.00	0.72	0.05	0.46		0.31	0.52	0.08
Avail Cap(c_a), veh/h	229	0	356	533	0	271	605	1406		557	788	831
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	52.1	0.0	36.6	42.9	0.0	52.0	15.4	20.2	0.0	14.3	18.8	14.2
Incr Delay (d2), s/veh	69.8	0.0	0.1	0.1	0.0	2.0	0.0	1.1	0.0	0.1	2.4	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	11.7	0.0	1.6	1.7	0.0	4.1	0.3	6.3	0.0	1.8	8.2	1.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	122.0	0.0	36.7	43.0	0.0	54.0	15.4	21.3	0.0	14.4	21.3	14.4
LnGrp LOS	F	A	D	D	A	D	B	C		B	C	B
Approach Vol, veh/h		303			192			664			614	
Approach Delay, s/veh		103.7			50.5			21.1			19.0	
Approach LOS		F			D			C			B	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	8.0	70.7	25.0	21.3	12.0	66.7	10.5	35.8
Change Period (Y+Rc), s	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Max Green Setting (Gmax), s	14.5	44.5	19.5	24.5	14.5	44.5	19.5	24.5
Max Q Clear Time (g_c+I1), s	2.7	24.3	22.7	14.0	6.5	20.6	5.7	6.6
Green Ext Time (p_c), s	0.0	2.0	0.0	0.3	0.1	2.7	0.0	0.1

Intersection Summary	
HCM 6th Ctrl Delay	37.7
HCM 6th LOS	D

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

Intersection						
Int Delay, s/veh	1.9					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	11	51	571	66	98	320
Future Vol, veh/h	11	51	571	66	98	320
Conflicting Peds, #/hr	0	2	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Stop	-	None	-	None
Storage Length	0	100	-	-	120	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	84	84	84	84	84	84
Heavy Vehicles, %	2	2	3	2	2	2
Mvmt Flow	13	61	680	79	117	381

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1335	722	0	0	759	0
Stage 1	720	-	-	-	-	-
Stage 2	615	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	169	427	-	-	852	-
Stage 1	482	-	-	-	-	-
Stage 2	539	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	146	426	-	-	852	-
Mov Cap-2 Maneuver	146	-	-	-	-	-
Stage 1	482	-	-	-	-	-
Stage 2	465	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	18	0	2.3
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	146	426	852	-
HCM Lane V/C Ratio	-	-	0.09	0.143	0.137	-
HCM Control Delay (s)	-	-	32.1	14.9	9.9	-
HCM Lane LOS	-	-	D	B	A	-
HCM 95th %tile Q(veh)	-	-	0.3	0.5	0.5	-

Intersection						
Int Delay, s/veh	4.3					

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	58	71	178	13	26	117
Future Vol, veh/h	58	71	178	13	26	117
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	120	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	64	79	198	14	29	130

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	212	0	-	0	412	205
Stage 1	-	-	-	-	205	-
Stage 2	-	-	-	-	207	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1358	-	-	-	596	836
Stage 1	-	-	-	-	829	-
Stage 2	-	-	-	-	828	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1358	-	-	-	568	836
Mov Cap-2 Maneuver	-	-	-	-	568	-
Stage 1	-	-	-	-	790	-
Stage 2	-	-	-	-	828	-

Approach	EB	WB	SB
HCM Control Delay, s	3.5	0	10.9
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1358	-	-	-	770
HCM Lane V/C Ratio	0.047	-	-	-	0.206
HCM Control Delay (s)	7.8	-	-	-	10.9
HCM Lane LOS	A	-	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.8

HCM 6th Signalized Intersection Summary
4: Queen Kaahumanu Hwy & Nani Kailua Dr 06/15/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	56	22	20	64	67	192	35	1231	45	66	909	69
Future Volume (veh/h)	56	22	20	64	67	192	35	1231	45	66	909	69
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1477	1870	1870	1477	1856	1477	1259	1870	1477	1239	1870
Adj Flow Rate, veh/h	58	23	0	67	70	0	36	1282	0	69	947	0
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Percent Heavy Veh, %	2	2	2	2	2	3	2	4	2	2	6	2
Cap, veh/h	119	39		104	81		96	963		93	955	
Arrive On Green	0.13	0.13	0.00	0.12	0.12	0.00	0.03	0.76	0.00	0.04	0.77	0.00
Sat Flow, veh/h	634	307	1585	586	667	1572	1406	1259	1585	1406	1239	1585
Grp Volume(v), veh/h	81	0	0	137	0	0	36	1282	0	69	947	0
Grp Sat Flow(s),veh/h/ln	941	0	1585	1253	0	1572	1406	1259	1585	1406	1239	1585
Q Serve(g_s), s	0.0	0.0	0.0	3.7	0.0	0.0	0.9	125.5	0.0	2.8	122.0	0.0
Cycle Q Clear(g_c), s	14.0	0.0	0.0	17.7	0.0	0.0	0.9	125.5	0.0	2.8	122.0	0.0
Prop In Lane	0.72		1.00	0.49		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	158	0		185	0		96	963		93	955	
V/C Ratio(X)	0.51	0.00		0.74	0.00		0.38	1.33		0.74	0.99	
Avail Cap(c_a), veh/h	158	0		185	0		112	963		101	955	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	68.2	0.0	0.0	71.0	0.0	0.0	50.6	19.3	0.0	55.4	18.3	0.0
Incr Delay (d2), s/veh	2.8	0.0	0.0	14.5	0.0	0.0	2.4	156.1	0.0	22.8	27.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.4	0.0	0.0	6.5	0.0	0.0	1.2	71.1	0.0	3.4	34.9	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	71.0	0.0	0.0	85.5	0.0	0.0	53.0	175.4	0.0	78.2	45.3	0.0
LnGrp LOS	E	A		F	A		D	F		E	D	
Approach Vol, veh/h		81			137			1318			1016	
Approach Delay, s/veh		71.0			85.5			172.0			47.5	
Approach LOS		E			F			F			D	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	9.1	130.0		25.0	10.1	129.0		25.0
Change Period (Y+Rc), s	5.5	5.5		5.5	5.5	5.5		5.5
Max Green Setting (Gmax), s	5.5	123.5		19.5	5.5	123.5		19.5
Max Q Clear Time (g_c+I1), s	2.9	124.0		19.7	4.8	127.5		16.0
Green Ext Time (p_c), s	0.0	0.0		0.0	0.0	0.0		0.1

Intersection Summary			
HCM 6th Ctrl Delay			114.6
HCM 6th LOS			F

Notes

Unsignalized Delay for [NBR, EBR, WBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	4	77	4	4	188	8	15	0	3	3	0	3
Future Vol, veh/h	4	77	4	4	188	8	15	0	3	3	0	3
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	120	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	82	82	82	82	82	82	82	82	82	82	82	82
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	94	5	5	229	10	18	0	4	4	0	4

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	239	0	0	99	0	0	353	356	97	353	353	234
Stage 1	-	-	-	-	-	-	107	107	-	244	244	-
Stage 2	-	-	-	-	-	-	246	249	-	109	109	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1328	-	-	1494	-	-	602	570	959	602	572	805
Stage 1	-	-	-	-	-	-	898	807	-	760	704	-
Stage 2	-	-	-	-	-	-	758	701	-	896	805	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1328	-	-	1494	-	-	596	566	959	597	568	805
Mov Cap-2 Maneuver	-	-	-	-	-	-	596	566	-	597	568	-
Stage 1	-	-	-	-	-	-	894	804	-	757	702	-
Stage 2	-	-	-	-	-	-	752	699	-	889	802	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.4	0.1	10.9	10.3
HCM LOS			B	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	636	1328	-	-	1494	-	-	686
HCM Lane V/C Ratio	0.035	0.004	-	-	0.003	-	-	0.011
HCM Control Delay (s)	10.9	7.7	0	-	7.4	-	-	10.3
HCM Lane LOS	B	A	A	-	A	-	-	B
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0

Intersection	
Int Delay, s/veh	1.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	36	65	158	1316	969	25
Future Vol, veh/h	36	65	158	1316	969	25
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	130	0	420	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	3	3	6	2
Mvmt Flow	39	71	172	1430	1053	27

Major/Minor	Minor2		Major 1		Major 2	
Conflicting Flow All	2827	-	1053	0	-	0
Stage 1	1053	-	-	-	-	-
Stage 2	1774	-	-	-	-	-
Critical Hdwy	6.42	-	4.13	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.227	-	-	-
Pot Cap-1 Maneuver	~ 20	0	657	-	-	-
Stage 1	336	0	-	-	-	-
Stage 2	149	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 15	-	657	-	-	-
Mov Cap-2 Maneuver	119	-	-	-	-	-
Stage 1	248	-	-	-	-	-
Stage 2	149	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	49.4	1.3	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	657	-	119	-	-	-
HCM Lane V/C Ratio	0.261	-	0.329	-	-	-
HCM Control Delay (s)	12.4	-	49.4	0	-	-
HCM Lane LOS	B	-	E	A	-	-
HCM 95th %tile Q(veh)	1	-	1.3	-	-	-

Notes			
~: Volume exceeds	$: Delay exceeds	+: Computation Not	*: All major volume in platoon

capacity	300s	Defined

Intersection	
Int Delay, s/veh	3.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	11	308	408	1111	942	57
Future Vol, veh/h	11	308	408	1111	942	57
Conflicting Peds, #/hr	0	0	1	0	0	1
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	150	0	450	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	4	4	6	2
Mvmt Flow	12	324	429	1169	992	60

Major/Minor	Minor2		Major 1		Major 2	
Conflicting Flow All	3020	-	993	0	-	0
Stage 1	993	-	-	-	-	-
Stage 2	2027	-	-	-	-	-
Critical Hdwy	6.42	-	4.14	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.236	-	-	-
Pot Cap-1 Maneuver	15	0	689	-	-	-
Stage 1	359	0	-	-	-	-
Stage 2	111	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 6	-	688	-	-	-
Mov Cap-2 Maneuver	79	-	-	-	-	-
Stage 1	135	-	-	-	-	-
Stage 2	111	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	58.2	5	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	688	-	79	-	-	-
HCM Lane V/C Ratio	0.624	-	0.147	-	-	-
HCM Control Delay (s)	18.5	-	58.2	0	-	-
HCM Lane LOS	C	-	F	A	-	-
HCM 95th %tile Q(veh)	4.4	-	0.5	-	-	-

Notes			
~: Volume exceeds	$: Delay exceeds	+: Computation Not	*: All major volume in platoon

capacity	300s	Defined

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	166	26	27	68	41	179	26	600	56	174	815	264
Future Volume (veh/h)	166	26	27	68	41	179	26	600	56	174	815	264
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		0.98	1.00		1.00	1.00		0.96
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1477	1477	1870	1870	1477	1870	1870	1477	1870	1870	1575	1870
Adj Flow Rate, veh/h	168	26	19	69	41	52	26	606	0	176	823	166
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	197	154	113	287	63	80	203	1615		530	955	925
Arrive On Green	0.14	0.20	0.19	0.05	0.11	0.10	0.03	0.58	0.00	0.06	0.61	0.61
Sat Flow, veh/h	1406	790	577	1781	584	740	1781	2879	0	1781	1575	1526
Grp Volume(v), veh/h	168	0	45	69	0	93	26	606	0	176	823	166
Grp Sat Flow(s),veh/h/ln	1406	0	1367	1781	0	1324	1781	1403	0	1781	1575	1526
Q Serve(g_s), s	16.9	0.0	4.0	4.9	0.0	9.8	0.9	17.0	0.0	5.6	62.5	7.0
Cycle Q Clear(g_c), s	16.9	0.0	4.0	4.9	0.0	9.8	0.9	17.0	0.0	5.6	62.5	7.0
Prop In Lane	1.00		0.42	1.00		0.56	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	197	0	267	287	0	144	203	1615		530	955	925
V/C Ratio(X)	0.85	0.00	0.17	0.24	0.00	0.65	0.13	0.38		0.33	0.86	0.18
Avail Cap(c_a), veh/h	249	0	292	508	0	283	403	1615		675	955	925
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	60.9	0.0	48.8	53.3	0.0	62.4	23.7	16.7	0.0	11.5	23.5	12.6
Incr Delay (d2), s/veh	20.0	0.0	0.1	0.2	0.0	1.8	0.1	0.7	0.0	0.1	10.1	0.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.2	0.0	1.4	2.2	0.0	3.4	0.4	5.7	0.0	2.3	25.4	2.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	80.9	0.0	48.9	53.4	0.0	64.2	23.8	17.3	0.0	11.6	33.6	13.0
LnGrp LOS	F	A	D	D	A	E	C	B		B	C	B
Approach Vol, veh/h		213			162			632			1165	
Approach Delay, s/veh		74.1			59.6			17.6			27.4	
Approach LOS		E			E			B			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	8.7	91.9	24.6	19.7	13.2	87.5	12.0	32.3
Change Period (Y+Rc), s	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Max Green Setting (Gmax), s	19.5	49.5	24.5	29.5	19.5	49.5	24.5	29.5
Max Q Clear Time (g_c+I1), s	2.9	64.5	18.9	11.8	7.6	19.0	6.9	6.0
Green Ext Time (p_c), s	0.0	0.0	0.2	0.2	0.1	2.6	0.0	0.1

Intersection Summary			
HCM 6th Ctrl Delay			31.5
HCM 6th LOS			C

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	1.7

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	23	82	486	23	59	764
Future Vol, veh/h	23	82	486	23	59	764
Conflicting Peds, #/hr	0	0	0	2	2	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Stop	-	None	-	None
Storage Length	0	100	-	-	120	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	24	87	517	24	63	813

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1470	531	0	0	543	0
Stage 1	531	-	-	-	-	-
Stage 2	939	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	140	548	-	-	1026	-
Stage 1	590	-	-	-	-	-
Stage 2	380	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	131	547	-	-	1024	-
Mov Cap-2 Maneuver	131	-	-	-	-	-
Stage 1	589	-	-	-	-	-
Stage 2	356	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	18.5	0	0.6
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	131	547	1024	-
HCM Lane V/C Ratio	-	-	0.187	0.159	0.061	-
HCM Control Delay (s)	-	-	38.7	12.8	8.7	-
HCM Lane LOS	-	-	E	B	A	-
HCM 95th %tile Q(veh)	-	-	0.7	0.6	0.2	-

Intersection	
Int Delay, s/veh	5

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	92	80	91	14	12	127
Future Vol, veh/h	92	80	91	14	12	127
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	120	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	91	91	91	91	91	91
Heavy Vehicles, %	2	2	2	2	2	3
Mvmt Flow	101	88	100	15	13	140

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	115	0	-	0	398	108
Stage 1	-	-	-	-	108	-
Stage 2	-	-	-	-	290	-
Critical Hdwy	4.12	-	-	-	6.42	6.23
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.327
Pot Cap-1 Maneuver	1474	-	-	-	607	943
Stage 1	-	-	-	-	916	-
Stage 2	-	-	-	-	759	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1474	-	-	-	565	943
Mov Cap-2 Maneuver	-	-	-	-	565	-
Stage 1	-	-	-	-	853	-
Stage 2	-	-	-	-	759	-

Approach	EB	WB	SB
HCM Control Delay, s	4.1	0	9.9
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1474	-	-	-	892
HCM Lane V/C Ratio	0.069	-	-	-	0.171
HCM Control Delay (s)	7.6	-	-	-	9.9
HCM Lane LOS	A	-	-	-	A
HCM 95th %tile Q(veh)	0.2	-	-	-	0.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	52	47	12	37	40	123	23	960	40	135	1154	89
Future Volume (veh/h)	52	47	12	37	40	123	23	960	40	135	1154	89
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1856	1477	1259	1870	1442	1280	1870
Adj Flow Rate, veh/h	57	51	0	40	43	0	25	1043	0	147	1254	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	3	2	4	2	5	2	2
Cap, veh/h	106	69		88	77		83	1002		95	1030	
Arrive On Green	0.09	0.09	0.00	0.09	0.09	0.00	0.03	0.80	0.00	0.04	0.81	0.00
Sat Flow, veh/h	762	736	1585	623	881	1572	1406	1259	1585	1373	1280	1585
Grp Volume(v), veh/h	108	0	0	83	0	0	25	1043	0	147	1254	0
Grp Sat Flow(s),veh/h/ln	1498	0	1585	1504	0	1572	1406	1259	1585	1373	1280	1585
Q Serve(g_s), s	2.9	0.0	0.0	0.0	0.0	0.0	0.5	126.5	0.0	5.7	128.0	0.0
Cycle Q Clear(g_c), s	11.4	0.0	0.0	8.4	0.0	0.0	0.5	126.5	0.0	5.7	128.0	0.0
Prop In Lane	0.53		1.00	0.48		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	176	0		166	0		83	1002		95	1030	
V/C Ratio(X)	0.61	0.00		0.50	0.00		0.30	1.04		1.56	1.22	
Avail Cap(c_a), veh/h	235	0		226	0		96	1002		95	1030	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	70.4	0.0	0.0	69.8	0.0	0.0	52.4	16.2	0.0	62.1	15.5	0.0
Incr Delay (d2), s/veh	3.5	0.0	0.0	2.3	0.0	0.0	2.0	39.6	0.0	295.0	106.6	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.5	0.0	0.0	3.4	0.0	0.0	0.8	37.8	0.0	11.6	57.2	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	73.9	0.0	0.0	72.1	0.0	0.0	54.4	55.8	0.0	357.1	122.1	0.0
LnGrp LOS	E	A		E	A		D	F		F	F	
Approach Vol, veh/h		108			83			1068			1401	
Approach Delay, s/veh		73.9			72.1			55.8			146.8	
Approach LOS		E			E			E			F	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.5	131.5		19.0	10.0	130.0		19.0
Change Period (Y+Rc), s	5.5	5.5		5.5	5.5	5.5		5.5
Max Green Setting (Gmax), s	4.5	124.5		19.5	4.5	124.5		19.5
Max Q Clear Time (g_c+I1), s	2.5	130.0		10.4	7.7	128.5		13.4
Green Ext Time (p_c), s	0.0	0.0		0.2	0.0	0.0		0.2

Intersection Summary	
HCM 6th Ctrl Delay	105.0
HCM 6th LOS	F

Notes

Unsignalized Delay for [NBR, EBR, WBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	1.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	96	19	8	93	1	13	0	2	3	0	2
Future Vol, veh/h	5	96	19	8	93	1	13	0	2	3	0	2
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	120	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	83	83	83	83	83	83	83	83	83	83	83	83
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	6	116	23	10	112	1	16	0	2	4	0	2

Major/Minor	Major1			Major 2			Minor 1			Minor 2		
Conflicting Flow All	113	0	0	139	0	0	274	273	128	274	284	113
Stage 1	-	-	-	-	-	-	140	140	-	133	133	-
Stage 2	-	-	-	-	-	-	134	133	-	141	151	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1476	-	-	1445	-	-	678	634	922	678	625	940
Stage 1	-	-	-	-	-	-	863	781	-	870	786	-
Stage 2	-	-	-	-	-	-	869	786	-	862	772	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1476	-	-	1445	-	-	671	627	922	671	618	940
Mov Cap-2 Maneuver	-	-	-	-	-	-	671	627	-	671	618	-
Stage 1	-	-	-	-	-	-	860	778	-	867	780	-
Stage 2	-	-	-	-	-	-	861	780	-	856	769	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	0.6	10.3	9.8
HCM LOS			B	A

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	696	1476	-	-	1445	-	-	758
HCM Lane V/C Ratio	0.026	0.004	-	-	0.007	-	-	0.008
HCM Control Delay (s)	10.3	7.4	0	-	7.5	-	-	9.8
HCM Lane LOS	B	A	A	-	A	-	-	A
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0

Intersection	
Int Delay, s/veh	0.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	14	87	71	1006	1181	17
Future Vol, veh/h	14	87	71	1006	1181	17
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	130	0	420	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	2	2	2	4	3	2
Mvmt Flow	15	94	76	1082	1270	18

Major/Minor	Minor2		Major 1		Major 2	
Conflicting Flow All	2504	-	1270	0	-	0
Stage 1	1270	-	-	-	-	-
Stage 2	1234	-	-	-	-	-
Critical Hdwy	6.42	-	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.218	-	-	-
Pot Cap-1 Maneuver	32	0	547	-	-	-
Stage 1	264	0	-	-	-	-
Stage 2	275	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	28	-	547	-	-	-
Mov Cap-2 Maneuver	166	-	-	-	-	-
Stage 1	227	-	-	-	-	-
Stage 2	275	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	28.8	0.8	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	547	-	166	-	-	-
HCM Lane V/C Ratio	0.14	-	0.091	-	-	-
HCM Control Delay (s)	12.6	-	28.8	0	-	-
HCM Lane LOS	B	-	D	A	-	-
HCM 95th %tile Q(veh)	0.5	-	0.3	-	-	-

Intersection						
Int Delay, s/veh	2					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	17	740	265	950	1030	31
Future Vol, veh/h	17	740	265	950	1030	31
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	150	0	450	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	2	3	3	2
Mvmt Flow	18	771	276	990	1073	32

Major/Minor	Minor2		Major 1		Major 2	
Conflicting Flow All	2615	-	1073	0	-	0
Stage 1	1073	-	-	-	-	-
Stage 2	1542	-	-	-	-	-
Critical Hdwy	6.42	-	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.218	-	-	-
Pot Cap-1 Maneuver	27	0	650	-	-	-
Stage 1	328	0	-	-	-	-
Stage 2	194	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 16	-	650	-	-	-
Mov Cap-2 Maneuver	126	-	-	-	-	-
Stage 1	189	-	-	-	-	-
Stage 2	194	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	38.2	3.2	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	650	-	126	-	-	-
HCM Lane V/C Ratio	0.425	-	0.141	-	-	-
HCM Control Delay (s)	14.6	-	38.2	0	-	-
HCM Lane LOS	B	-	E	A	-	-
HCM 95th %tile Q(veh)	2.1	-	0.5	-	-	-

Notes			
~: Volume exceeds	$: Delay exceeds	+: Computation Not	*: All major volume in platoon

capacity	300s	Defined

HCM 6th Signalized Intersection Summary
1: Kuakini Hwy & Hualalai Rd

06/16/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	226	44	26	60	42	210	20	629	50	132	395	162
Future Volume (veh/h)	226	44	26	60	42	210	20	629	50	132	395	162
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	0.99		0.98	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1453	1477	1870	1870	1477	1856	1870	1477	1870	1870	1477	1841
Adj Flow Rate, veh/h	238	46	19	63	44	86	21	662	0	139	416	66
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	4	2	2	2	2	3	2	2	2	2	2	4
Cap, veh/h	218	244	101	328	61	119	439	1430		442	798	843
Arrive On Green	0.16	0.25	0.23	0.05	0.14	0.13	0.03	0.51	0.00	0.06	0.54	0.54
Sat Flow, veh/h	1384	991	409	1781	441	861	1781	2879	0	1781	1477	1558
Grp Volume(v), veh/h	238	0	65	63	0	130	21	662	0	139	416	66
Grp Sat Flow(s),veh/h/ln	1384	0	1401	1781	0	1302	1781	1403	0	1781	1477	1558
Q Serve(g_s), s	19.7	0.0	4.6	3.7	0.0	12.0	0.7	18.9	0.0	4.4	22.5	2.5
Cycle Q Clear(g_c), s	19.7	0.0	4.6	3.7	0.0	12.0	0.7	18.9	0.0	4.4	22.5	2.5
Prop In Lane	1.00		0.29	1.00		0.66	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	218	0	344	328	0	180	439	1430		442	798	843
V/C Ratio(X)	1.09	0.00	0.19	0.19	0.00	0.72	0.05	0.46		0.31	0.52	0.08
Avail Cap(c_a), veh/h	218	0	344	519	0	271	608	1430		556	798	843
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	52.6	0.0	37.5	42.9	0.0	52.0	14.9	19.7	0.0	13.9	18.4	13.8
Incr Delay (d2), s/veh	87.4	0.0	0.1	0.1	0.0	2.0	0.0	1.1	0.0	0.1	2.4	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	12.2	0.0	1.6	1.7	0.0	4.1	0.3	6.4	0.0	1.8	8.2	1.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	140.0	0.0	37.6	43.0	0.0	54.0	15.0	20.7	0.0	14.1	20.8	14.0
LnGrp LOS	F	A	D	D	A	D	B	C		B	C	B
Approach Vol, veh/h		303			193			683			621	
Approach Delay, s/veh		118.1			50.4			20.6			18.6	
Approach LOS		F			D			C			B	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	8.1	71.6	24.0	21.3	11.9	67.7	10.6	34.7
Change Period (Y+Rc), s	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Max Green Setting (Gmax), s	14.5	45.5	18.5	24.5	14.5	45.5	18.5	24.5
Max Q Clear Time (g_c+I1), s	2.7	24.5	21.7	14.0	6.4	20.9	5.7	6.6
Green Ext Time (p_c), s	0.0	2.1	0.0	0.3	0.1	2.8	0.0	0.1

Intersection Summary	
HCM 6th Ctrl Delay	39.5
HCM 6th LOS	D

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

Intersection						
Int Delay, s/veh	2					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	13	55	586	67	99	326
Future Vol, veh/h	13	55	586	67	99	326
Conflicting Peds, #/hr	0	2	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Stop	-	None	-	None
Storage Length	0	100	-	-	120	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	84	84	84	84	84	84
Heavy Vehicles, %	2	2	3	2	2	2
Mvmt Flow	15	65	698	80	118	388

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1362	740	0	0	778	0
Stage 1	738	-	-	-	-	-
Stage 2	624	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	163	417	-	-	839	-
Stage 1	473	-	-	-	-	-
Stage 2	534	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	140	416	-	-	839	-
Mov Cap-2 Maneuver	140	-	-	-	-	-
Stage 1	473	-	-	-	-	-
Stage 2	459	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	18.9	0	2.3
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	140	416	839	-
HCM Lane V/C Ratio	-	-	0.111	0.157	0.14	-
HCM Control Delay (s)	-	-	33.9	15.3	10	-
HCM Lane LOS	-	-	D	C	A	-
HCM 95th %tile Q(veh)	-	-	0.4	0.6	0.5	-

Intersection	
Int Delay, s/veh	4.4

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	60	71	178	13	26	118
Future Vol, veh/h	60	71	178	13	26	118
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	120	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	67	79	198	14	29	131

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	212	0	-	0	418	205
Stage 1	-	-	-	-	205	-
Stage 2	-	-	-	-	213	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1358	-	-	-	591	836
Stage 1	-	-	-	-	829	-
Stage 2	-	-	-	-	823	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1358	-	-	-	562	836
Mov Cap-2 Maneuver	-	-	-	-	562	-
Stage 1	-	-	-	-	788	-
Stage 2	-	-	-	-	823	-

Approach	EB	WB	SB
HCM Control Delay, s	3.6	0	10.9
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1358	-	-	-	768
HCM Lane V/C Ratio	0.049	-	-	-	0.208
HCM Control Delay (s)	7.8	-	-	-	10.9
HCM Lane LOS	A	-	-	-	B
HCM 95th %tile Q(veh)	0.2	-	-	-	0.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	57	23	20	64	67	192	35	1231	45	66	909	69
Future Volume (veh/h)	57	23	20	64	67	192	35	1231	45	66	909	69
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1477	1870	1870	1477	1856	1477	1259	1870	1477	1239	1870
Adj Flow Rate, veh/h	59	24	0	67	70	0	36	1282	0	69	947	0
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Percent Heavy Veh, %	2	2	2	2	2	3	2	4	2	2	6	2
Cap, veh/h	118	40		104	81		96	963		93	955	
Arrive On Green	0.13	0.13	0.00	0.12	0.12	0.00	0.03	0.76	0.00	0.04	0.77	0.00
Sat Flow, veh/h	629	313	1585	584	664	1572	1406	1259	1585	1406	1239	1585
Grp Volume(v), veh/h	83	0	0	137	0	0	36	1282	0	69	947	0
Grp Sat Flow(s),veh/h/ln	943	0	1585	1248	0	1572	1406	1259	1585	1406	1239	1585
Q Serve(g_s), s	0.0	0.0	0.0	3.5	0.0	0.0	0.9	125.5	0.0	2.8	122.0	0.0
Cycle Q Clear(g_c), s	14.3	0.0	0.0	17.8	0.0	0.0	0.9	125.5	0.0	2.8	122.0	0.0
Prop In Lane	0.71		1.00	0.49		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	158	0		185	0		96	963		93	955	
V/C Ratio(X)	0.52	0.00		0.74	0.00		0.38	1.33		0.74	0.99	
Avail Cap(c_a), veh/h	158	0		185	0		112	963		101	955	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	68.4	0.0	0.0	71.0	0.0	0.0	50.6	19.3	0.0	55.4	18.3	0.0
Incr Delay (d2), s/veh	3.2	0.0	0.0	14.7	0.0	0.0	2.4	156.1	0.0	22.8	27.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.5	0.0	0.0	6.5	0.0	0.0	1.2	71.1	0.0	3.4	34.9	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	71.5	0.0	0.0	85.7	0.0	0.0	53.0	175.4	0.0	78.2	45.3	0.0
LnGrp LOS	E	A		F	A		D	F		E	D	
Approach Vol, veh/h		83			137			1318			1016	
Approach Delay, s/veh		71.5			85.7			172.0			47.5	
Approach LOS		E			F			F			D	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	9.1	130.0		25.0	10.1	129.0		25.0
Change Period (Y+Rc), s	5.5	5.5		5.5	5.5	5.5		5.5
Max Green Setting (Gmax), s	5.5	123.5		19.5	5.5	123.5		19.5
Max Q Clear Time (g_c+I1), s	2.9	124.0		19.8	4.8	127.5		16.3
Green Ext Time (p_c), s	0.0	0.0		0.0	0.0	0.0		0.1

Intersection Summary		
HCM 6th Ctrl Delay		114.6
HCM 6th LOS		F

Notes

Unsignalized Delay for [NBR, EBR, WBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	4	77	4	4	188	8	15	0	3	3	0	3
Future Vol, veh/h	4	77	4	4	188	8	15	0	3	3	0	3
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	120	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	82	82	82	82	82	82	82	82	82	82	82	82
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	94	5	5	229	10	18	0	4	4	0	4

Major/Minor	Major1			Major 2			Minor 1			Minor 2		
Conflicting Flow All	239	0	0	99	0	0	353	356	97	353	353	234
Stage 1	-	-	-	-	-	-	107	107	-	244	244	-
Stage 2	-	-	-	-	-	-	246	249	-	109	109	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1328	-	-	1494	-	-	602	570	959	602	572	805
Stage 1	-	-	-	-	-	-	898	807	-	760	704	-
Stage 2	-	-	-	-	-	-	758	701	-	896	805	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1328	-	-	1494	-	-	596	566	959	597	568	805
Mov Cap-2 Maneuver	-	-	-	-	-	-	596	566	-	597	568	-
Stage 1	-	-	-	-	-	-	894	804	-	757	702	-
Stage 2	-	-	-	-	-	-	752	699	-	889	802	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.4	0.1	10.9	10.3
HCM LOS			B	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	636	1328	-	-	1494	-	-	686
HCM Lane V/C Ratio	0.035	0.004	-	-	0.003	-	-	0.011
HCM Control Delay (s)	10.9	7.7	0	-	7.4	-	-	10.3
HCM Lane LOS	B	A	A	-	A	-	-	B
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0

Intersection	
Int Delay, s/veh	1.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	36	65	158	1316	969	25
Future Vol, veh/h	36	65	158	1316	969	25
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	130	0	420	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	3	3	6	2
Mvmt Flow	39	71	172	1430	1053	27

Major/Minor	Minor2		Major 1		Major 2	
Conflicting Flow All	2827	-	1053	0	-	0
Stage 1	1053	-	-	-	-	-
Stage 2	1774	-	-	-	-	-
Critical Hdwy	6.42	-	4.13	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.227	-	-	-
Pot Cap-1 Maneuver	~ 20	0	657	-	-	-
Stage 1	336	0	-	-	-	-
Stage 2	149	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 15	-	657	-	-	-
Mov Cap-2 Maneuver	119	-	-	-	-	-
Stage 1	248	-	-	-	-	-
Stage 2	149	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	49.4	1.3	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	657	-	119	-	-	-
HCM Lane V/C Ratio	0.261	-	0.329	-	-	-
HCM Control Delay (s)	12.4	-	49.4	0	-	-
HCM Lane LOS	B	-	E	A	-	-
HCM 95th %tile Q(veh)	1	-	1.3	-	-	-

Notes			
~: Volume exceeds	$: Delay exceeds	+: Computation Not	*: All major volume in platoon

capacity	300s	Defined

Intersection	
Int Delay, s/veh	3.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	12	317	411	1111	942	57
Future Vol, veh/h	12	317	411	1111	942	57
Conflicting Peds, #/hr	0	0	1	0	0	1
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	150	0	450	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	4	4	6	2
Mvmt Flow	13	334	433	1169	992	60

Major/Minor	Minor2		Major 1		Major 2	
Conflicting Flow All	3028	-	993	0	-	0
Stage 1	993	-	-	-	-	-
Stage 2	2035	-	-	-	-	-
Critical Hdwy	6.42	-	4.14	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.236	-	-	-
Pot Cap-1 Maneuver	14	0	689	-	-	-
Stage 1	359	0	-	-	-	-
Stage 2	110	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 5	-	688	-	-	-
Mov Cap-2 Maneuver	78	-	-	-	-	-
Stage 1	133	-	-	-	-	-
Stage 2	110	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	59.9	5	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	688	-	78	-	-	-
HCM Lane V/C Ratio	0.629	-	0.162	-	-	-
HCM Control Delay (s)	18.7	-	59.9	0	-	-
HCM Lane LOS	C	-	F	A	-	-
HCM 95th %tile Q(veh)	4.5	-	0.5	-	-	-

Notes			
~: Volume exceeds	$: Delay exceeds	+: Computation Not	*: All major volume in platoon

capacity	300s	Defined

Intersection	
Int Delay, s/veh	0.4

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	9	15	638	3	6	333
Future Vol, veh/h	9	15	638	3	6	333
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	0	-
Veh in Median Storage, #	2	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	10	16	693	3	7	362

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1071	695	0	0	696	0
Stage 1	695	-	-	-	-	-
Stage 2	376	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	244	442	-	-	900	-
Stage 1	495	-	-	-	-	-
Stage 2	694	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	242	442	-	-	900	-
Mov Cap-2 Maneuver	429	-	-	-	-	-
Stage 1	495	-	-	-	-	-
Stage 2	688	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	13.5	0	0.2
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	429	442	900	-
HCM Lane V/C Ratio	-	-	0.023	0.037	0.007	-
HCM Control Delay (s)	-	-	13.6	13.5	9	-
HCM Lane LOS	-	-	B	B	A	-
HCM 95th %tile Q(veh)	-	-	0.1	0.1	0	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	166	26	28	70	41	179	26	604	56	174	835	264
Future Volume (veh/h)	166	26	28	70	41	179	26	604	56	174	835	264
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		0.98	1.00		1.00	1.00		0.96
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1477	1477	1870	1870	1477	1870	1870	1477	1870	1870	1575	1870
Adj Flow Rate, veh/h	168	26	20	71	41	52	26	610	0	176	843	166
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	197	150	115	289	63	80	189	1615		528	955	925
Arrive On Green	0.14	0.19	0.18	0.05	0.11	0.10	0.03	0.58	0.00	0.06	0.61	0.61
Sat Flow, veh/h	1406	771	593	1781	584	740	1781	2879	0	1781	1575	1526
Grp Volume(v), veh/h	168	0	46	71	0	93	26	610	0	176	843	166
Grp Sat Flow(s),veh/h/ln	1406	0	1364	1781	0	1324	1781	1403	0	1781	1575	1526
Q Serve(g_s), s	16.9	0.0	4.1	5.1	0.0	9.8	0.9	17.1	0.0	5.6	65.7	7.0
Cycle Q Clear(g_c), s	16.9	0.0	4.1	5.1	0.0	9.8	0.9	17.1	0.0	5.6	65.7	7.0
Prop In Lane	1.00		0.43	1.00		0.56	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	197	0	265	289	0	144	189	1615		528	955	925
V/C Ratio(X)	0.85	0.00	0.17	0.25	0.00	0.65	0.14	0.38		0.33	0.88	0.18
Avail Cap(c_a), veh/h	249	0	292	508	0	283	388	1615		673	955	925
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	60.9	0.0	49.0	53.2	0.0	62.4	25.1	16.7	0.0	11.5	24.2	12.6
Incr Delay (d2), s/veh	20.0	0.0	0.1	0.2	0.0	1.8	0.1	0.7	0.0	0.1	11.6	0.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.2	0.0	1.4	2.3	0.0	3.4	0.4	5.8	0.0	2.3	27.0	2.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	80.9	0.0	49.1	53.3	0.0	64.2	25.2	17.4	0.0	11.7	35.8	13.0
LnGrp LOS	F	A	D	D	A	E	C	B		B	D	B
Approach Vol, veh/h		214			164			636			1185	
Approach Delay, s/veh		74.0			59.5			17.7			29.0	
Approach LOS		E			E			B			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	8.7	91.9	24.6	19.7	13.2	87.5	12.2	32.2
Change Period (Y+Rc), s	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Max Green Setting (Gmax), s	19.5	49.5	24.5	29.5	19.5	49.5	24.5	29.5
Max Q Clear Time (g_c+I1), s	2.9	67.7	18.9	11.8	7.6	19.1	7.1	6.1
Green Ext Time (p_c), s	0.0	0.0	0.2	0.2	0.1	2.6	0.0	0.1

Intersection Summary	
HCM 6th Ctrl Delay	32.4
HCM 6th LOS	C

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

Intersection						
Int Delay, s/veh	1.8					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	24	83	490	26	64	782
Future Vol, veh/h	24	83	490	26	64	782
Conflicting Peds, #/hr	0	0	0	2	2	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Stop	-	None	-	None
Storage Length	0	100	-	-	120	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	26	88	521	28	68	832

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1505	537	0	0	551	0
Stage 1	537	-	-	-	-	-
Stage 2	968	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	133	544	-	-	1019	-
Stage 1	586	-	-	-	-	-
Stage 2	368	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	124	543	-	-	1017	-
Mov Cap-2 Maneuver	124	-	-	-	-	-
Stage 1	585	-	-	-	-	-
Stage 2	343	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	19.3	0	0.7
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	124	543	1017	-
HCM Lane V/C Ratio	-	-	0.206	0.163	0.067	-
HCM Control Delay (s)	-	-	41.4	12.9	8.8	-
HCM Lane LOS	-	-	E	B	A	-
HCM 95th %tile Q(veh)	-	-	0.7	0.6	0.2	-

Intersection	
Int Delay, s/veh	5

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	92	80	91	14	12	129
Future Vol, veh/h	92	80	91	14	12	129
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	120	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	91	91	91	91	91	91
Heavy Vehicles, %	2	2	2	2	2	3
Mvmt Flow	101	88	100	15	13	142

Major/Minor	Major 1		Major 2		Minor 2	
Conflicting Flow All	115	0	-	0	398	108
Stage 1	-	-	-	-	108	-
Stage 2	-	-	-	-	290	-
Critical Hdwy	4.12	-	-	-	6.42	6.23
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.327
Pot Cap-1 Maneuver	1474	-	-	-	607	943
Stage 1	-	-	-	-	916	-
Stage 2	-	-	-	-	759	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1474	-	-	-	565	943
Mov Cap-2 Maneuver	-	-	-	-	565	-
Stage 1	-	-	-	-	853	-
Stage 2	-	-	-	-	759	-

Approach	EB	WB	SB
HCM Control Delay, s	4.1	0	9.9
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1474	-	-	-	892
HCM Lane V/C Ratio	0.069	-	-	-	0.174
HCM Control Delay (s)	7.6	-	-	-	9.9
HCM Lane LOS	A	-	-	-	A
HCM 95th %tile Q(veh)	0.2	-	-	-	0.6

HCM 6th Signalized Intersection Summary
4: Queen Kaahumanu Hwy & Nani Kailua Dr 06/16/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	52	47	12	37	41	123	23	960	40	135	1154	90
Future Volume (veh/h)	52	47	12	37	41	123	23	960	40	135	1154	90
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1856	1477	1259	1870	1442	1280	1870
Adj Flow Rate, veh/h	57	51	0	40	45	0	25	1043	0	147	1254	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	3	2	4	2	5	2	2
Cap, veh/h	106	69		87	80		82	1002		94	1030	
Arrive On Green	0.09	0.09	0.00	0.09	0.09	0.00	0.03	0.80	0.00	0.04	0.80	0.00
Sat Flow, veh/h	755	732	1585	610	899	1572	1406	1259	1585	1373	1280	1585
Grp Volume(v), veh/h	108	0	0	85	0	0	25	1043	0	147	1254	0
Grp Sat Flow(s),veh/h/ln	1487	0	1585	1510	0	1572	1406	1259	1585	1373	1280	1585
Q Serve(g_s), s	2.8	0.0	0.0	0.0	0.0	0.0	0.5	126.5	0.0	5.7	128.0	0.0
Cycle Q Clear(g_c), s	11.5	0.0	0.0	8.6	0.0	0.0	0.5	126.5	0.0	5.7	128.0	0.0
Prop In Lane	0.53		1.00	0.47		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	176	0		167	0		82	1002		94	1030	
V/C Ratio(X)	0.62	0.00		0.51	0.00		0.30	1.04		1.56	1.22	
Avail Cap(c_a), veh/h	234	0		226	0		96	1002		94	1030	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	70.4	0.0	0.0	69.8	0.0	0.0	52.4	16.3	0.0	62.1	15.5	0.0
Incr Delay (d2), s/veh	3.5	0.0	0.0	2.4	0.0	0.0	2.0	39.8	0.0	295.5	107.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.5	0.0	0.0	3.5	0.0	0.0	0.8	37.9	0.0	11.6	57.4	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	73.9	0.0	0.0	72.2	0.0	0.0	54.4	56.1	0.0	357.6	122.5	0.0
LnGrp LOS	E	A		E	A		D	F		F	F	
Approach Vol, veh/h		108			85			1068			1401	
Approach Delay, s/veh		73.9			72.2			56.0			147.2	
Approach LOS		E			E			E			F	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.5	131.5		19.1	10.0	130.0		19.1				
Change Period (Y+Rc), s	5.5	5.5		5.5	5.5	5.5		5.5				
Max Green Setting (Gmax), s	4.5	124.5		19.5	4.5	124.5		19.5				
Max Q Clear Time (g_c+I1), s	2.5	130.0		10.6	7.7	128.5		13.5				
Green Ext Time (p_c), s	0.0	0.0		0.2	0.0	0.0		0.2				
Intersection Summary												
HCM 6th Ctrl Delay			105.3									
HCM 6th LOS			F									

Notes

Unsignalized Delay for [NBR, EBR, WBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	1.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	96	19	8	93	1	13	0	2	3	0	2
Future Vol, veh/h	5	96	19	8	93	1	13	0	2	3	0	2
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	120	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	83	83	83	83	83	83	83	83	83	83	83	83
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	6	116	23	10	112	1	16	0	2	4	0	2

Major/Minor	Major1			Major 2			Minor 1			Minor 2		
Conflicting Flow All	113	0	0	139	0	0	274	273	128	274	284	113
Stage 1	-	-	-	-	-	-	140	140	-	133	133	-
Stage 2	-	-	-	-	-	-	134	133	-	141	151	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1476	-	-	1445	-	-	678	634	922	678	625	940
Stage 1	-	-	-	-	-	-	863	781	-	870	786	-
Stage 2	-	-	-	-	-	-	869	786	-	862	772	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1476	-	-	1445	-	-	671	627	922	671	618	940
Mov Cap-2 Maneuver	-	-	-	-	-	-	671	627	-	671	618	-
Stage 1	-	-	-	-	-	-	860	778	-	867	780	-
Stage 2	-	-	-	-	-	-	861	780	-	856	769	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	0.6	10.3	9.8
HCM LOS			B	A

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	696	1476	-	-	1445	-	-	758
HCM Lane V/C Ratio	0.026	0.004	-	-	0.007	-	-	0.008
HCM Control Delay (s)	10.3	7.4	0	-	7.5	-	-	9.8
HCM Lane LOS	B	A	A	-	A	-	-	A
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0

Intersection	
Int Delay, s/veh	0.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	14	87	71	1006	1181	17
Future Vol, veh/h	14	87	71	1006	1181	17
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	130	0	420	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	2	2	2	4	3	2
Mvmt Flow	15	94	76	1082	1270	18

Major/Minor	Minor2		Major 1		Major 2	
Conflicting Flow All	2504	-	1270	0	-	0
Stage 1	1270	-	-	-	-	-
Stage 2	1234	-	-	-	-	-
Critical Hdwy	6.42	-	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.218	-	-	-
Pot Cap-1 Maneuver	32	0	547	-	-	-
Stage 1	264	0	-	-	-	-
Stage 2	275	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	28	-	547	-	-	-
Mov Cap-2 Maneuver	166	-	-	-	-	-
Stage 1	227	-	-	-	-	-
Stage 2	275	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	28.8	0.8	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	547	-	166	-	-	-
HCM Lane V/C Ratio	0.14	-	0.091	-	-	-
HCM Control Delay (s)	12.6	-	28.8	0	-	-
HCM Lane LOS	B	-	D	A	-	-
HCM 95th %tile Q(veh)	0.5	-	0.3	-	-	-

Intersection	
Int Delay, s/veh	2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	17	742	276	950	1030	32
Future Vol, veh/h	17	742	276	950	1030	32
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	150	0	450	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	2	3	3	2
Mvmt Flow	18	773	288	990	1073	33

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2639	-	1073	0	-	0
Stage 1	1073	-	-	-	-	-
Stage 2	1566	-	-	-	-	-
Critical Hdwy	6.42	-	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.218	-	-	-
Pot Cap-1 Maneuver	26	0	650	-	-	-
Stage 1	328	0	-	-	-	-
Stage 2	189	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 14	-	650	-	-	-
Mov Cap-2 Maneuver	122	-	-	-	-	-
Stage 1	183	-	-	-	-	-
Stage 2	189	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	39.5	3.3	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	650	-	122	-	-	-
HCM Lane V/C Ratio	0.442	-	0.145	-	-	-
HCM Control Delay (s)	14.9	-	39.5	0	-	-
HCM Lane LOS	B	-	E	A	-	-
HCM 95th %tile Q(veh)	2.3	-	0.5	-	-	-

Notes			
~: Volume exceeds	$: Delay exceeds	+: Computation Not	*: All major volume in platoon

capacity	300s	Defined

Intersection	
Int Delay, s/veh	0.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	2	4	512	11	18	788
Future Vol, veh/h	2	4	512	11	18	788
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	0	-
Veh in Median Storage, #	2	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	2	4	557	12	20	857

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1460	563	0	0	569	0
Stage 1	563	-	-	-	-	-
Stage 2	897	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	142	526	-	-	1003	-
Stage 1	570	-	-	-	-	-
Stage 2	398	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	139	526	-	-	1003	-
Mov Cap-2 Maneuver	328	-	-	-	-	-
Stage 1	570	-	-	-	-	-
Stage 2	390	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	13.3	0	0.2
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	328	526	1003	-
HCM Lane V/C Ratio	-	-	0.007	0.008	0.02	-
HCM Control Delay (s)	-	-	16	11.9	8.7	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0	0	0.1	-

HCM 6th Signalized Intersection Summary
1: Kuakini Hwy & Hualalai Rd

06/15/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	238	46	27	62	44	221	20	641	50	139	405	170
Future Volume (veh/h)	238	46	27	62	44	221	20	641	50	139	405	170
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	0.99		0.98	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1453	1477	1870	1870	1477	1856	1870	1477	1870	1870	1477	1841
Adj Flow Rate, veh/h	251	48	20	65	46	98	21	675	0	146	426	74
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	4	2	2	2	2	3	2	2	2	2	2	4
Cap, veh/h	229	259	108	341	61	131	406	1373		421	773	816
Arrive On Green	0.17	0.26	0.25	0.05	0.15	0.14	0.03	0.49	0.00	0.06	0.52	0.52
Sat Flow, veh/h	1384	989	412	1781	415	884	1781	2879	0	1781	1477	1558
Grp Volume(v), veh/h	251	0	68	65	0	144	21	675	0	146	426	74
Grp Sat Flow(s),veh/h/ln	1384	0	1401	1781	0	1299	1781	1403	0	1781	1477	1558
Q Serve(g_s), s	20.7	0.0	4.7	3.8	0.0	13.3	0.7	20.2	0.0	4.8	24.1	3.0
Cycle Q Clear(g_c), s	20.7	0.0	4.7	3.8	0.0	13.3	0.7	20.2	0.0	4.8	24.1	3.0
Prop In Lane	1.00		0.29	1.00		0.68	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	229	0	367	341	0	192	406	1373		421	773	816
V/C Ratio(X)	1.10	0.00	0.19	0.19	0.00	0.75	0.05	0.49		0.35	0.55	0.09
Avail Cap(c_a), veh/h	229	0	367	545	0	270	576	1373		530	773	816
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	52.1	0.0	36.0	41.9	0.0	51.6	16.4	21.5	0.0	15.2	19.9	14.9
Incr Delay (d2), s/veh	87.2	0.0	0.1	0.1	0.0	3.8	0.0	1.3	0.0	0.2	2.8	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	12.8	0.0	1.7	1.7	0.0	4.6	0.3	6.9	0.0	2.0	8.9	1.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	139.4	0.0	36.0	42.0	0.0	55.4	16.4	22.7	0.0	15.4	22.8	15.1
LnGrp LOS	F	A	D	D	A	E	B	C		B	C	B
Approach Vol, veh/h		319			209			696			646	
Approach Delay, s/veh		117.3			51.2			22.5			20.2	
Approach LOS		F			D			C			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	8.1	69.4	25.0	22.5	12.4	65.2	10.7	36.8
Change Period (Y+Rc), s	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Max Green Setting (Gmax), s	14.5	44.5	19.5	24.5	14.5	44.5	19.5	24.5
Max Q Clear Time (g_c+I1), s	2.7	26.1	22.7	15.3	6.8	22.2	5.8	6.7
Green Ext Time (p_c), s	0.0	2.1	0.0	0.3	0.1	2.8	0.0	0.1

Intersection Summary	
HCM 6th Ctrl Delay	41.1
HCM 6th LOS	D

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

Intersection						
Int Delay, s/veh	1.9					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	11	51	600	66	98	336
Future Vol, veh/h	11	51	600	66	98	336
Conflicting Peds, #/hr	0	2	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Stop	-	None	-	None
Storage Length	0	100	-	-	120	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	84	84	84	84	84	84
Heavy Vehicles, %	2	2	3	2	2	2
Mvmt Flow	13	61	714	79	117	400

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1388	756	0	0	793	0
Stage 1	754	-	-	-	-	-
Stage 2	634	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	157	408	-	-	828	-
Stage 1	465	-	-	-	-	-
Stage 2	529	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	135	407	-	-	828	-
Mov Cap-2 Maneuver	135	-	-	-	-	-
Stage 1	465	-	-	-	-	-
Stage 2	454	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	18.8	0	2.3
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	135	407	828	-
HCM Lane V/C Ratio	-	-	0.097	0.149	0.141	-
HCM Control Delay (s)	-	-	34.5	15.4	10.1	-
HCM Lane LOS	-	-	D	C	B	-
HCM 95th %tile Q(veh)	-	-	0.3	0.5	0.5	-

Intersection	
Int Delay, s/veh	4.4

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	61	75	187	14	27	123
Future Vol, veh/h	61	75	187	14	27	123
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	120	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	68	83	208	16	30	137

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	224	0	-	0	435	216
Stage 1	-	-	-	-	216	-
Stage 2	-	-	-	-	219	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1345	-	-	-	578	824
Stage 1	-	-	-	-	820	-
Stage 2	-	-	-	-	817	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1345	-	-	-	549	824
Mov Cap-2 Maneuver	-	-	-	-	549	-
Stage 1	-	-	-	-	778	-
Stage 2	-	-	-	-	817	-

Approach	EB	WB	SB
HCM Control Delay, s	3.5	0	11.1
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1345	-	-	-	756
HCM Lane V/C Ratio	0.05	-	-	-	0.22
HCM Control Delay (s)	7.8	-	-	-	11.1
HCM Lane LOS	A	-	-	-	B
HCM 95th %tile Q(veh)	0.2	-	-	-	0.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	59	23	21	67	70	202	37	1294	47	69	955	72
Future Volume (veh/h)	59	23	21	67	70	202	37	1294	47	69	955	72
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1477	1870	1870	1477	1856	1477	1259	1870	1477	1239	1870
Adj Flow Rate, veh/h	61	24	0	70	73	0	39	1348	0	72	995	0
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Percent Heavy Veh, %	2	2	2	2	2	3	2	4	2	2	6	2
Cap, veh/h	117	38		104	80		86	961		96	955	
Arrive On Green	0.13	0.13	0.00	0.12	0.12	0.00	0.03	0.76	0.00	0.04	0.77	0.00
Sat Flow, veh/h	623	300	1585	591	658	1572	1406	1259	1585	1406	1239	1585
Grp Volume(v), veh/h	85	0	0	143	0	0	39	1348	0	72	995	0
Grp Sat Flow(s),veh/h/ln	923	0	1585	1249	0	1572	1406	1259	1585	1406	1239	1585
Q Serve(g_s), s	0.0	0.0	0.0	3.8	0.0	0.0	1.0	125.5	0.0	3.1	126.7	0.0
Cycle Q Clear(g_c), s	14.9	0.0	0.0	18.7	0.0	0.0	1.0	125.5	0.0	3.1	126.7	0.0
Prop In Lane	0.72		1.00	0.49		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	155	0		184	0		86	961		96	955	
V/C Ratio(X)	0.55	0.00		0.78	0.00		0.45	1.40		0.75	1.04	
Avail Cap(c_a), veh/h	155	0		184	0		101	961		101	955	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	68.8	0.0	0.0	71.6	0.0	0.0	51.1	19.5	0.0	56.3	18.9	0.0
Incr Delay (d2), s/veh	4.0	0.0	0.0	18.4	0.0	0.0	3.7	187.5	0.0	24.8	40.7	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.7	0.0	0.0	7.0	0.0	0.0	1.3	79.5	0.0	3.6	39.6	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	72.8	0.0	0.0	90.0	0.0	0.0	54.8	206.9	0.0	81.1	59.6	0.0
LnGrp LOS	E	A		F	A		D	F		F	F	
Approach Vol, veh/h		85			143			1387			1067	
Approach Delay, s/veh		72.8			90.0			202.7			61.0	
Approach LOS		E			F			F			E	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	9.2	130.2		25.0	10.5	129.0		25.0				
Change Period (Y+Rc), s	5.5	5.5		5.5	5.5	5.5		5.5				
Max Green Setting (Gmax), s	5.5	123.5		19.5	5.5	123.5		19.5				
Max Q Clear Time (g_c+I1), s	3.0	128.7		20.7	5.1	127.5		16.9				
Green Ext Time (p_c), s	0.0	0.0		0.0	0.0	0.0		0.1				
Intersection Summary												
HCM 6th Ctrl Delay			136.2									
HCM 6th LOS			F									

Notes

Unsignalized Delay for [NBR, EBR, WBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	4	81	4	4	198	8	16	0	3	3	0	3
Future Vol, veh/h	4	81	4	4	198	8	16	0	3	3	0	3
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	120	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	82	82	82	82	82	82	82	82	82	82	82	82
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	99	5	5	241	10	20	0	4	4	0	4

Major/Minor	Major1			Major 2			Minor 1			Minor 2		
Conflicting Flow All	251	0	0	104	0	0	370	373	102	370	370	246
Stage 1	-	-	-	-	-	-	112	112	-	256	256	-
Stage 2	-	-	-	-	-	-	258	261	-	114	114	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1314	-	-	1488	-	-	587	557	953	587	560	793
Stage 1	-	-	-	-	-	-	893	803	-	749	696	-
Stage 2	-	-	-	-	-	-	747	692	-	891	801	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1314	-	-	1488	-	-	581	553	953	582	556	793
Mov Cap-2 Maneuver	-	-	-	-	-	-	581	553	-	582	556	-
Stage 1	-	-	-	-	-	-	889	800	-	746	694	-
Stage 2	-	-	-	-	-	-	741	690	-	884	798	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	0.1	11	10.4
HCM LOS			B	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	619	1314	-	-	1488	-	-	671
HCM Lane V/C Ratio	0.037	0.004	-	-	0.003	-	-	0.011
HCM Control Delay (s)	11	7.8	0	-	7.4	-	-	10.4
HCM Lane LOS	B	A	A	-	A	-	-	B
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0

Intersection	
Int Delay, s/veh	1.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	38	68	166	1383	1019	26
Future Vol, veh/h	38	68	166	1383	1019	26
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	130	0	420	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	3	3	6	2
Mvmt Flow	41	74	180	1503	1108	28

Major/Minor	Minor2		Major 1		Major 2	
Conflicting Flow All	2971	-	1108	0	-	0
Stage 1	1108	-	-	-	-	-
Stage 2	1863	-	-	-	-	-
Critical Hdwy	6.42	-	4.13	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.227	-	-	-
Pot Cap-1 Maneuver	~ 16	0	626	-	-	-
Stage 1	316	0	-	-	-	-
Stage 2	135	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 11	-	626	-	-	-
Mov Cap-2 Maneuver	107	-	-	-	-	-
Stage 1	225	-	-	-	-	-
Stage 2	135	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	58.4	1.4	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	626	-	107	-	-	-
HCM Lane V/C Ratio	0.288	-	0.386	-	-	-
HCM Control Delay (s)	13.1	-	58.4	0	-	-
HCM Lane LOS	B	-	F	A	-	-
HCM 95th %tile Q(veh)	1.2	-	1.6	-	-	-

Notes			
~: Volume exceeds	$: Delay exceeds	+: Computation Not	*: All major volume in platoon

capacity	300s	Defined

Intersection						
Int Delay, s/veh	3.7					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	12	323	426	1168	990	60
Future Vol, veh/h	12	323	426	1168	990	60
Conflicting Peds, #/hr	0	0	1	0	0	1
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	150	0	450	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	4	4	6	2
Mvmt Flow	13	340	448	1229	1042	63

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	3168	-	1043	0	-	0
Stage 1	1043	-	-	-	-	-
Stage 2	2125	-	-	-	-	-
Critical Hdwy	6.42	-	4.14	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.236	-	-	-
Pot Cap-1 Maneuver	~ 12	0	659	-	-	-
Stage 1	339	0	-	-	-	-
Stage 2	99	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 4	-	658	-	-	-
Mov Cap-2 Maneuver	67	-	-	-	-	-
Stage 1	108	-	-	-	-	-
Stage 2	99	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	70.8	5.7	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	658	-	67	-	-	-
HCM Lane V/C Ratio	0.681	-	0.189	-	-	-
HCM Control Delay (s)	21.4	-	70.8	0	-	-
HCM Lane LOS	C	-	F	A	-	-
HCM 95th %tile Q(veh)	5.3	-	0.6	-	-	-

Notes			
~: Volume exceeds	$: Delay exceeds	+: Computation Not	*: All major volume in platoon

capacity	300s	Defined

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	174	27	28	71	43	188	27	627	59	183	854	278
Future Volume (veh/h)	174	27	28	71	43	188	27	627	59	183	854	278
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		0.98	1.00		1.00	1.00		0.96
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1477	1477	1870	1870	1477	1870	1870	1477	1870	1870	1575	1870
Adj Flow Rate, veh/h	176	27	20	72	43	61	27	633	0	185	863	180
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	205	162	120	299	63	89	158	1569		506	934	905
Arrive On Green	0.15	0.21	0.20	0.05	0.12	0.11	0.03	0.56	0.00	0.07	0.59	0.59
Sat Flow, veh/h	1406	785	582	1781	545	774	1781	2879	0	1781	1575	1525
Grp Volume(v), veh/h	176	0	47	72	0	104	27	633	0	185	863	180
Grp Sat Flow(s),veh/h/ln	1406	0	1367	1781	0	1319	1781	1403	0	1781	1575	1525
Q Serve(g_s), s	17.7	0.0	4.1	5.1	0.0	11.0	0.9	18.6	0.0	6.1	71.5	7.9
Cycle Q Clear(g_c), s	17.7	0.0	4.1	5.1	0.0	11.0	0.9	18.6	0.0	6.1	71.5	7.9
Prop In Lane	1.00		0.43	1.00		0.59	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	205	0	282	299	0	152	158	1569		506	934	905
V/C Ratio(X)	0.86	0.00	0.17	0.24	0.00	0.68	0.17	0.40		0.37	0.92	0.20
Avail Cap(c_a), veh/h	249	0	292	518	0	282	357	1569		644	934	905
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	60.5	0.0	47.5	52.3	0.0	62.0	28.5	18.2	0.0	12.6	26.5	13.6
Incr Delay (d2), s/veh	21.7	0.0	0.1	0.2	0.0	2.0	0.2	0.8	0.0	0.2	15.9	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.6	0.0	1.4	2.3	0.0	3.8	0.5	6.3	0.0	2.5	30.3	2.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	82.2	0.0	47.6	52.4	0.0	64.0	28.7	19.0	0.0	12.8	42.4	14.1
LnGrp LOS	F	A	D	D	A	E	C	B		B	D	B
Approach Vol, veh/h		223			176			660			1228	
Approach Delay, s/veh		74.9			59.3			19.4			33.8	
Approach LOS		E			E			B			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	8.8	90.0	25.4	20.8	13.7	85.1	12.2	33.9
Change Period (Y+Rc), s	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Max Green Setting (Gmax), s	19.5	49.5	24.5	29.5	19.5	49.5	24.5	29.5
Max Q Clear Time (g_c+I1), s	2.9	73.5	19.7	13.0	8.1	20.6	7.1	6.1
Green Ext Time (p_c), s	0.0	0.0	0.2	0.3	0.1	2.7	0.0	0.1

Intersection Summary	
HCM 6th Ctrl Delay	35.6
HCM 6th LOS	D

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

Intersection						
Int Delay, s/veh	1.7					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	23	82	511	23	59	803
Future Vol, veh/h	23	82	511	23	59	803
Conflicting Peds, #/hr	0	0	0	2	2	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Stop	-	None	-	None
Storage Length	0	100	-	-	120	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	24	87	544	24	63	854

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1538	558	0	0	570	0
Stage 1	558	-	-	-	-	-
Stage 2	980	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	127	529	-	-	1002	-
Stage 1	573	-	-	-	-	-
Stage 2	364	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	119	528	-	-	1000	-
Mov Cap-2 Maneuver	119	-	-	-	-	-
Stage 1	572	-	-	-	-	-
Stage 2	341	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	19.7	0	0.6
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	119	528	1000	-
HCM Lane V/C Ratio	-	-	0.206	0.165	0.063	-
HCM Control Delay (s)	-	-	42.9	13.2	8.8	-
HCM Lane LOS	-	-	E	B	A	-
HCM 95th %tile Q(veh)	-	-	0.7	0.6	0.2	-

Intersection	
Int Delay, s/veh	5

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	96	84	96	15	13	133
Future Vol, veh/h	96	84	96	15	13	133
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	120	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	91	91	91	91	91	91
Heavy Vehicles, %	2	2	2	2	2	3
Mvmt Flow	105	92	105	16	14	146

Major/Minor	Major 1		Major 2		Minor 2	
Conflicting Flow All	121	0	-	0	415	113
Stage 1	-	-	-	-	113	-
Stage 2	-	-	-	-	302	-
Critical Hdwy	4.12	-	-	-	6.42	6.23
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.327
Pot Cap-1 Maneuver	1467	-	-	-	594	937
Stage 1	-	-	-	-	912	-
Stage 2	-	-	-	-	750	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1467	-	-	-	551	937
Mov Cap-2 Maneuver	-	-	-	-	551	-
Stage 1	-	-	-	-	846	-
Stage 2	-	-	-	-	750	-

Approach	EB	WB	SB
HCM Control Delay, s	4.1	0	10
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1467	-	-	-	882
HCM Lane V/C Ratio	0.072	-	-	-	0.182
HCM Control Delay (s)	7.6	-	-	-	10
HCM Lane LOS	A	-	-	-	B
HCM 95th %tile Q(veh)	0.2	-	-	-	0.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	55	49	13	39	42	129	24	1009	42	142	1213	93
Future Volume (veh/h)	55	49	13	39	42	129	24	1009	42	142	1213	93
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1856	1477	1259	1870	1442	1280	1870
Adj Flow Rate, veh/h	60	53	0	42	46	0	26	1097	0	154	1318	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	3	2	4	2	5	2	2
Cap, veh/h	109	71		90	81		83	997		94	1024	
Arrive On Green	0.10	0.10	0.00	0.09	0.09	0.00	0.03	0.79	0.00	0.04	0.80	0.00
Sat Flow, veh/h	756	717	1585	615	876	1572	1406	1259	1585	1373	1280	1585
Grp Volume(v), veh/h	113	0	0	88	0	0	26	1097	0	154	1318	0
Grp Sat Flow(s),veh/h/ln	1473	0	1585	1491	0	1572	1406	1259	1585	1373	1280	1585
Q Serve(g_s), s	3.1	0.0	0.0	0.0	0.0	0.0	0.6	126.5	0.0	5.7	127.9	0.0
Cycle Q Clear(g_c), s	12.2	0.0	0.0	9.1	0.0	0.0	0.6	126.5	0.0	5.7	127.9	0.0
Prop In Lane	0.53		1.00	0.48		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	180	0		171	0		83	997		94	1024	
V/C Ratio(X)	0.63	0.00		0.51	0.00		0.31	1.10		1.64	1.29	
Avail Cap(c_a), veh/h	231	0		223	0		95	997		94	1024	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	70.4	0.0	0.0	69.7	0.0	0.0	52.3	16.7	0.0	62.1	15.9	0.0
Incr Delay (d2), s/veh	3.6	0.0	0.0	2.4	0.0	0.0	2.1	60.1	0.0	329.9	136.5	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.8	0.0	0.0	3.6	0.0	0.0	0.9	44.0	0.0	12.4	66.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	74.0	0.0	0.0	72.1	0.0	0.0	54.4	76.7	0.0	391.9	152.4	0.0
LnGrp LOS	E	A		E	A		D	F		F	F	
Approach Vol, veh/h		113			88			1123			1472	
Approach Delay, s/veh		74.0			72.1			76.2			177.5	
Approach LOS		E			E			E			F	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.6	131.4		19.8	10.0	130.0		19.8				
Change Period (Y+Rc), s	5.5	5.5		5.5	5.5	5.5		5.5				
Max Green Setting (Gmax), s	4.5	124.5		19.5	4.5	124.5		19.5				
Max Q Clear Time (g_c+I1), s	2.6	129.9		11.1	7.7	128.5		14.2				
Green Ext Time (p_c), s	0.0	0.0		0.2	0.0	0.0		0.2				

Intersection Summary	
HCM 6th Ctrl Delay	129.3
HCM 6th LOS	F

Notes

Unsignalized Delay for [NBR, EBR, WBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	1.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	101	20	8	98	1	14	0	2	3	0	2
Future Vol, veh/h	5	101	20	8	98	1	14	0	2	3	0	2
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	120	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	83	83	83	83	83	83	83	83	83	83	83	83
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	6	122	24	10	118	1	17	0	2	4	0	2

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	119	0	0	146	0	0	286	285	134	286	297	119
Stage 1	-	-	-	-	-	-	146	146	-	139	139	-
Stage 2	-	-	-	-	-	-	140	139	-	147	158	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1469	-	-	1436	-	-	666	624	915	666	615	933
Stage 1	-	-	-	-	-	-	857	776	-	864	782	-
Stage 2	-	-	-	-	-	-	863	782	-	856	767	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1469	-	-	1436	-	-	659	617	915	659	608	933
Mov Cap-2 Maneuver	-	-	-	-	-	-	659	617	-	659	608	-
Stage 1	-	-	-	-	-	-	854	773	-	861	777	-
Stage 2	-	-	-	-	-	-	855	777	-	850	764	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	0.6	10.4	9.9
HCM LOS			B	A

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	683	1469	-	-	1436	-	-	747
HCM Lane V/C Ratio	0.028	0.004	-	-	0.007	-	-	0.008
HCM Control Delay (s)	10.4	7.5	0	-	7.5	-	-	9.9
HCM Lane LOS	B	A	A	-	A	-	-	A
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0

Intersection	
Int Delay, s/veh	0.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	15	91	75	1057	1241	18
Future Vol, veh/h	15	91	75	1057	1241	18
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	130	0	420	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	2	2	2	4	3	2
Mvmt Flow	16	98	81	1137	1334	19

Major/Minor	Minor2		Major 1		Major 2	
Conflicting Flow All	2633	-	1334	0	-	0
Stage 1	1334	-	-	-	-	-
Stage 2	1299	-	-	-	-	-
Critical Hdwy	6.42	-	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.218	-	-	-
Pot Cap-1 Maneuver	26	0	517	-	-	-
Stage 1	246	0	-	-	-	-
Stage 2	256	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	22	-	517	-	-	-
Mov Cap-2 Maneuver	151	-	-	-	-	-
Stage 1	207	-	-	-	-	-
Stage 2	256	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	31.7	0.9	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	517	-	151	-	-	-
HCM Lane V/C Ratio	0.156	-	0.107	-	-	-
HCM Control Delay (s)	13.2	-	31.7	0	-	-
HCM Lane LOS	B	-	D	A	-	-
HCM 95th %tile Q(veh)	0.5	-	0.4	-	-	-

Intersection	
Int Delay, s/veh	2.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	18	777	278	999	1083	33
Future Vol, veh/h	18	777	278	999	1083	33
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	150	0	450	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	2	3	3	2
Mvmt Flow	19	809	290	1041	1128	34

Major/Minor	Minor2		Major 1		Major 2	
Conflicting Flow All	2749	-	1128	0	-	0
Stage 1	1128	-	-	-	-	-
Stage 2	1621	-	-	-	-	-
Critical Hdwy	6.42	-	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.218	-	-	-
Pot Cap-1 Maneuver	22	0	619	-	-	-
Stage 1	309	0	-	-	-	-
Stage 2	178	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 12	-	619	-	-	-
Mov Cap-2 Maneuver	112	-	-	-	-	-
Stage 1	164	-	-	-	-	-
Stage 2	178	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	43.5	3.4	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	619	-	112	-	-	-
HCM Lane V/C Ratio	0.468	-	0.167	-	-	-
HCM Control Delay (s)	15.8	-	43.5	0	-	-
HCM Lane LOS	C	-	E	A	-	-
HCM 95th %tile Q(veh)	2.5	-	0.6	-	-	-

Notes			
~: Volume exceeds	$: Delay exceeds	+: Computation Not	*: All major volume in platoon

capacity	300s	Defined

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	238	46	27	63	44	221	22	674	53	139	413	170
Future Volume (veh/h)	238	46	27	63	44	221	22	674	53	139	413	170
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	0.99		0.98	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1453	1477	1870	1870	1477	1856	1870	1477	1870	1870	1477	1841
Adj Flow Rate, veh/h	251	48	20	66	46	98	23	709	0	146	435	74
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	4	2	2	2	2	3	2	2	2	2	2	4
Cap, veh/h	218	251	104	343	61	131	409	1397		412	783	826
Arrive On Green	0.16	0.25	0.24	0.05	0.15	0.14	0.03	0.50	0.00	0.06	0.53	0.53
Sat Flow, veh/h	1384	989	412	1781	415	884	1781	2879	0	1781	1477	1558
Grp Volume(v), veh/h	251	0	68	66	0	144	23	709	0	146	435	74
Grp Sat Flow(s),veh/h/ln	1384	0	1400	1781	0	1299	1781	1403	0	1781	1477	1558
Q Serve(g_s), s	19.7	0.0	4.8	3.9	0.0	13.3	0.8	21.2	0.0	4.8	24.5	2.9
Cycle Q Clear(g_c), s	19.7	0.0	4.8	3.9	0.0	13.3	0.8	21.2	0.0	4.8	24.5	2.9
Prop In Lane	1.00		0.29	1.00		0.68	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	218	0	355	343	0	192	409	1397		412	783	826
V/C Ratio(X)	1.15	0.00	0.19	0.19	0.00	0.75	0.06	0.51		0.35	0.56	0.09
Avail Cap(c_a), veh/h	218	0	355	531	0	270	577	1397		522	783	826
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	52.6	0.0	36.8	41.8	0.0	51.6	15.9	21.1	0.0	15.0	19.6	14.5
Incr Delay (d2), s/veh	107.6	0.0	0.1	0.1	0.0	3.8	0.0	1.3	0.0	0.2	2.8	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	13.4	0.0	1.7	1.7	0.0	4.6	0.3	7.3	0.0	2.0	9.0	1.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	160.2	0.0	36.9	41.9	0.0	55.4	15.9	22.4	0.0	15.2	22.4	14.7
LnGrp LOS	F	A	D	D	A	E	B	C		B	C	B
Approach Vol, veh/h		319			210			732			655	
Approach Delay, s/veh		133.9			51.2			22.2			19.9	
Approach LOS		F			D			C			B	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	8.3	70.3	24.0	22.5	12.3	66.2	10.8	35.7
Change Period (Y+Rc), s	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Max Green Setting (Gmax), s	14.5	45.5	18.5	24.5	14.5	45.5	18.5	24.5
Max Q Clear Time (g_c+I1), s	2.8	26.5	21.7	15.3	6.8	23.2	5.9	6.8
Green Ext Time (p_c), s	0.0	2.1	0.0	0.3	0.1	3.0	0.0	0.1

Intersection Summary	
HCM 6th Ctrl Delay	43.2
HCM 6th LOS	D

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	2.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	15	59	630	67	100	344
Future Vol, veh/h	15	59	630	67	100	344
Conflicting Peds, #/hr	0	2	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Stop	-	None	-	None
Storage Length	0	100	-	-	120	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	84	84	84	84	84	84
Heavy Vehicles, %	2	2	3	2	2	2
Mvmt Flow	18	70	750	80	119	410

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1438	792	0	0	830	0
Stage 1	790	-	-	-	-	-
Stage 2	648	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	147	389	-	-	802	-
Stage 1	447	-	-	-	-	-
Stage 2	521	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	125	388	-	-	802	-
Mov Cap-2 Maneuver	125	-	-	-	-	-
Stage 1	447	-	-	-	-	-
Stage 2	444	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	20.8	0	2.3
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	125	388	802	-
HCM Lane V/C Ratio	-	-	0.143	0.181	0.148	-
HCM Control Delay (s)	-	-	38.5	16.3	10.3	-
HCM Lane LOS	-	-	E	C	B	-
HCM 95th %tile Q(veh)	-	-	0.5	0.7	0.5	-

Intersection	
Int Delay, s/veh	4.4

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	64	75	187	14	27	124
Future Vol, veh/h	64	75	187	14	27	124
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	120	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	71	83	208	16	30	138

Major/Minor	Major 1		Major 2		Minor 2	
Conflicting Flow All	224	0	-	0	441	216
Stage 1	-	-	-	-	216	-
Stage 2	-	-	-	-	225	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1345	-	-	-	574	824
Stage 1	-	-	-	-	820	-
Stage 2	-	-	-	-	812	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1345	-	-	-	544	824
Mov Cap-2 Maneuver	-	-	-	-	544	-
Stage 1	-	-	-	-	777	-
Stage 2	-	-	-	-	812	-

Approach	EB	WB	SB
HCM Control Delay, s	3.6	0	11.1
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1345	-	-	-	755
HCM Lane V/C Ratio	0.053	-	-	-	0.222
HCM Control Delay (s)	7.8	-	-	-	11.1
HCM Lane LOS	A	-	-	-	B
HCM 95th %tile Q(veh)	0.2	-	-	-	0.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	60	25	21	67	70	202	37	1294	47	69	955	72
Future Volume (veh/h)	60	25	21	67	70	202	37	1294	47	69	955	72
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1477	1870	1870	1477	1856	1477	1259	1870	1477	1239	1870
Adj Flow Rate, veh/h	62	26	0	70	73	0	39	1348	0	72	995	0
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Percent Heavy Veh, %	2	2	2	2	2	3	2	4	2	2	6	2
Cap, veh/h	115	40		104	79		86	961		96	955	
Arrive On Green	0.13	0.13	0.00	0.12	0.12	0.00	0.03	0.76	0.00	0.04	0.77	0.00
Sat Flow, veh/h	612	316	1585	586	653	1572	1406	1259	1585	1406	1239	1585
Grp Volume(v), veh/h	88	0	0	143	0	0	39	1348	0	72	995	0
Grp Sat Flow(s),veh/h/ln	928	0	1585	1239	0	1572	1406	1259	1585	1406	1239	1585
Q Serve(g_s), s	0.0	0.0	0.0	3.5	0.0	0.0	1.0	125.5	0.0	3.1	126.7	0.0
Cycle Q Clear(g_c), s	15.4	0.0	0.0	18.9	0.0	0.0	1.0	125.5	0.0	3.1	126.7	0.0
Prop In Lane	0.70		1.00	0.49		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	156	0		183	0		86	961		96	955	
V/C Ratio(X)	0.56	0.00		0.78	0.00		0.45	1.40		0.75	1.04	
Avail Cap(c_a), veh/h	156	0		183	0		101	961		101	955	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	69.0	0.0	0.0	71.7	0.0	0.0	51.1	19.5	0.0	56.3	18.9	0.0
Incr Delay (d2), s/veh	4.7	0.0	0.0	19.2	0.0	0.0	3.7	187.5	0.0	24.8	40.7	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.8	0.0	0.0	7.0	0.0	0.0	1.3	79.5	0.0	3.6	39.6	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	73.7	0.0	0.0	90.9	0.0	0.0	54.8	206.9	0.0	81.1	59.6	0.0
LnGrp LOS	E	A		F	A		D	F		F	F	
Approach Vol, veh/h		88			143			1387			1067	
Approach Delay, s/veh		73.7			90.9			202.7			61.0	
Approach LOS		E			F			F			E	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	9.2	130.2		25.0	10.5	129.0		25.0				
Change Period (Y+Rc), s	5.5	5.5		5.5	5.5	5.5		5.5				
Max Green Setting (Gmax), s	5.5	123.5		19.5	5.5	123.5		19.5				
Max Q Clear Time (g_c+I1), s	3.0	128.7		20.9	5.1	127.5		17.4				
Green Ext Time (p_c), s	0.0	0.0		0.0	0.0	0.0		0.1				

Intersection Summary			
HCM 6th Ctrl Delay			136.2
HCM 6th LOS			F

Notes

Unsignalized Delay for [NBR, EBR, WBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	4	81	4	4	198	8	16	0	3	3	0	3
Future Vol, veh/h	4	81	4	4	198	8	16	0	3	3	0	3
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	120	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	82	82	82	82	82	82	82	82	82	82	82	82
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	99	5	5	241	10	20	0	4	4	0	4

Major/Minor	Major1			Major 2			Minor 1			Minor 2		
Conflicting Flow All	251	0	0	104	0	0	370	373	102	370	370	246
Stage 1	-	-	-	-	-	-	112	112	-	256	256	-
Stage 2	-	-	-	-	-	-	258	261	-	114	114	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1314	-	-	1488	-	-	587	557	953	587	560	793
Stage 1	-	-	-	-	-	-	893	803	-	749	696	-
Stage 2	-	-	-	-	-	-	747	692	-	891	801	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1314	-	-	1488	-	-	581	553	953	582	556	793
Mov Cap-2 Maneuver	-	-	-	-	-	-	581	553	-	582	556	-
Stage 1	-	-	-	-	-	-	889	800	-	746	694	-
Stage 2	-	-	-	-	-	-	741	690	-	884	798	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	0.1	11	10.4
HCM LOS			B	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	619	1314	-	-	1488	-	-	671
HCM Lane V/C Ratio	0.037	0.004	-	-	0.003	-	-	0.011
HCM Control Delay (s)	11	7.8	0	-	7.4	-	-	10.4
HCM Lane LOS	B	A	A	-	A	-	-	B
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0

Intersection						
Int Delay, s/veh	1.7					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	38	68	166	1383	1019	26
Future Vol, veh/h	38	68	166	1383	1019	26
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	130	0	420	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	3	3	6	2
Mvmt Flow	41	74	180	1503	1108	28

Major/Minor	Minor2		Major 1		Major 2	
Conflicting Flow All	2971	-	1108	0	-	0
Stage 1	1108	-	-	-	-	-
Stage 2	1863	-	-	-	-	-
Critical Hdwy	6.42	-	4.13	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.227	-	-	-
Pot Cap-1 Maneuver	~ 16	0	626	-	-	-
Stage 1	316	0	-	-	-	-
Stage 2	135	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 11	-	626	-	-	-
Mov Cap-2 Maneuver	107	-	-	-	-	-
Stage 1	225	-	-	-	-	-
Stage 2	135	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	58.4	1.4	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	626	-	107	-	-	-
HCM Lane V/C Ratio	0.288	-	0.386	-	-	-
HCM Control Delay (s)	13.1	-	58.4	0	-	-
HCM Lane LOS	B	-	F	A	-	-
HCM 95th %tile Q(veh)	1.2	-	1.6	-	-	-

Notes			
~: Volume exceeds	$: Delay exceeds	+: Computation Not	*: All major volume in platoon

capacity	300s	Defined

Intersection						
Int Delay, s/veh	3.9					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	13	341	431	1168	990	60
Future Vol, veh/h	13	341	431	1168	990	60
Conflicting Peds, #/hr	0	0	1	0	0	1
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	150	0	450	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	4	4	6	2
Mvmt Flow	14	359	454	1229	1042	63

Major/Minor	Minor2		Major 1		Major 2	
Conflicting Flow All	3180	-	1043	0	-	0
Stage 1	1043	-	-	-	-	-
Stage 2	2137	-	-	-	-	-
Critical Hdwy	6.42	-	4.14	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.236	-	-	-
Pot Cap-1 Maneuver	~ 11	0	659	-	-	-
Stage 1	339	0	-	-	-	-
Stage 2	98	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 3	-	658	-	-	-
Mov Cap-2 Maneuver	65	-	-	-	-	-
Stage 1	105	-	-	-	-	-
Stage 2	98	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	74.6	5.9	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	658	-	65	-	-	-
HCM Lane V/C Ratio	0.689	-	0.211	-	-	-
HCM Control Delay (s)	21.7	-	74.6	0	-	-
HCM Lane LOS	C	-	F	A	-	-
HCM 95th %tile Q(veh)	5.5	-	0.7	-	-	-

Notes			
~: Volume exceeds	$: Delay exceeds	+: Computation Not	*: All major volume in platoon

capacity	300s	Defined

Intersection						
Int Delay, s/veh	0.7					
Movement	**WBL**	**WBR**	**NBT**	**NBR**	**SBL**	**SBT**
Lane Configurations						
Traffic Vol, veh/h	18	30	667	5	8	351
Future Vol, veh/h	18	30	667	5	8	351
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	0	-
Veh in Median Storage, #	2	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	20	33	725	5	9	382

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1128	728	0	0	730	0
Stage 1	728	-	-	-	-	-
Stage 2	400	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	226	423	-	-	874	-
Stage 1	478	-	-	-	-	-
Stage 2	677	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	224	423	-	-	874	-
Mov Cap-2 Maneuver	412	-	-	-	-	-
Stage 1	478	-	-	-	-	-
Stage 2	670	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	14.2	0	0.2
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	412	423	874	-
HCM Lane V/C Ratio	-	-	0.047	0.077	0.01	-
HCM Control Delay (s)	-	-	14.2	14.2	9.2	-
HCM Lane LOS	-	-	B	B	A	-
HCM 95th %tile Q(veh)	-	-	0.1	0.2	0	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	174	27	30	75	43	188	28	636	60	183	893	278
Future Volume (veh/h)	174	27	30	75	43	188	28	636	60	183	893	278
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		0.98	1.00		1.00	1.00		0.96
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1477	1477	1870	1870	1477	1870	1870	1477	1870	1870	1575	1870
Adj Flow Rate, veh/h	176	27	22	76	43	61	28	642	0	185	902	180
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	205	153	125	303	63	89	129	1569		501	934	904
Arrive On Green	0.15	0.20	0.19	0.06	0.12	0.11	0.03	0.56	0.00	0.07	0.59	0.59
Sat Flow, veh/h	1406	750	611	1781	545	774	1781	2879	0	1781	1575	1525
Grp Volume(v), veh/h	176	0	49	76	0	104	28	642	0	185	902	180
Grp Sat Flow(s),veh/h/ln	1406	0	1361	1781	0	1319	1781	1403	0	1781	1575	1525
Q Serve(g_s), s	17.7	0.0	4.3	5.4	0.0	11.0	1.0	19.0	0.0	6.1	79.1	7.9
Cycle Q Clear(g_c), s	17.7	0.0	4.3	5.4	0.0	11.0	1.0	19.0	0.0	6.1	79.1	7.9
Prop In Lane	1.00		0.45	1.00		0.59	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	205	0	278	303	0	152	129	1569		501	934	904
V/C Ratio(X)	0.86	0.00	0.18	0.25	0.00	0.68	0.22	0.41		0.37	0.97	0.20
Avail Cap(c_a), veh/h	249	0	291	517	0	282	327	1569		640	934	904
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	60.5	0.0	47.9	52.1	0.0	62.0	32.5	18.3	0.0	12.7	28.1	13.6
Incr Delay (d2), s/veh	21.7	0.0	0.1	0.2	0.0	2.0	0.3	0.8	0.0	0.2	22.3	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.6	0.0	1.5	2.5	0.0	3.8	0.5	6.4	0.0	2.5	34.8	2.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	82.2	0.0	48.0	52.3	0.0	64.0	32.9	19.0	0.0	12.9	50.4	14.1
LnGrp LOS	F	A	D	D	A	E	C	B		B	D	B
Approach Vol, veh/h		225			180			670			1267	
Approach Delay, s/veh		74.7			59.1			19.6			39.8	
Approach LOS		E			E			B			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	8.9	90.0	25.4	20.8	13.7	85.1	12.5	33.6
Change Period (Y+Rc), s	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Max Green Setting (Gmax), s	19.5	49.5	24.5	29.5	19.5	49.5	24.5	29.5
Max Q Clear Time (g_c+I1), s	3.0	81.1	19.7	13.0	8.1	21.0	7.4	6.3
Green Ext Time (p_c), s	0.0	0.0	0.2	0.3	0.1	2.7	0.0	0.1

Intersection Summary	
HCM 6th Ctrl Delay	38.9
HCM 6th LOS	D

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

Intersection						
Int Delay, s/veh	1.9					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	24	84	520	28	68	839
Future Vol, veh/h	24	84	520	28	68	839
Conflicting Peds, #/hr	0	0	0	2	2	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Stop	-	None	-	None
Storage Length	0	100	-	-	120	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	26	89	553	30	72	893

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1607	570	0	0	585	0
Stage 1	570	-	-	-	-	-
Stage 2	1037	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	116	521	-	-	990	-
Stage 1	566	-	-	-	-	-
Stage 2	342	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	107	520	-	-	988	-
Mov Cap-2 Maneuver	107	-	-	-	-	-
Stage 1	565	-	-	-	-	-
Stage 2	317	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	21.3	0	0.7
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	107	520	988	-
HCM Lane V/C Ratio	-	-	0.239	0.172	0.073	-
HCM Control Delay (s)	-	-	48.9	13.4	8.9	-
HCM Lane LOS	-	-	E	B	A	-
HCM 95th %tile Q(veh)	-	-	0.9	0.6	0.2	-

Intersection	
Int Delay, s/veh	5.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	97	84	96	15	13	137
Future Vol, veh/h	97	84	96	15	13	137
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	120	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	91	91	91	91	91	91
Heavy Vehicles, %	2	2	2	2	2	3
Mvmt Flow	107	92	105	16	14	151

Major/Minor	Major 1		Major 2		Minor 2	
Conflicting Flow All	121	0	-	0	419	113
Stage 1	-	-	-	-	113	-
Stage 2	-	-	-	-	306	-
Critical Hdwy	4.12	-	-	-	6.42	6.23
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.327
Pot Cap-1 Maneuver	1467	-	-	-	591	937
Stage 1	-	-	-	-	912	-
Stage 2	-	-	-	-	747	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1467	-	-	-	548	937
Mov Cap-2 Maneuver	-	-	-	-	548	-
Stage 1	-	-	-	-	845	-
Stage 2	-	-	-	-	747	-

Approach	EB	WB	SB
HCM Control Delay, s	4.1	0	10
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1467	-	-	-	883
HCM Lane V/C Ratio	0.073	-	-	-	0.187
HCM Control Delay (s)	7.6	-	-	-	10
HCM Lane LOS	A	-	-	-	B
HCM 95th %tile Q(veh)	0.2	-	-	-	0.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	55	50	13	39	44	129	24	1009	42	142	1213	94
Future Volume (veh/h)	55	50	13	39	44	129	24	1009	42	142	1213	94
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1856	1477	1259	1870	1442	1280	1870
Adj Flow Rate, veh/h	60	54	0	42	48	0	26	1097	0	154	1318	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	3	2	4	2	5	2	2
Cap, veh/h	109	72		89	84		83	996		94	1023	
Arrive On Green	0.10	0.10	0.00	0.09	0.09	0.00	0.03	0.79	0.00	0.04	0.80	0.00
Sat Flow, veh/h	744	721	1585	601	892	1572	1406	1259	1585	1373	1280	1585
Grp Volume(v), veh/h	114	0	0	90	0	0	26	1097	0	154	1318	0
Grp Sat Flow(s),veh/h/ln	1466	0	1585	1493	0	1572	1406	1259	1585	1373	1280	1585
Q Serve(g_s), s	3.1	0.0	0.0	0.0	0.0	0.0	0.6	126.5	0.0	5.7	127.9	0.0
Cycle Q Clear(g_c), s	12.4	0.0	0.0	9.3	0.0	0.0	0.6	126.5	0.0	5.7	127.9	0.0
Prop In Lane	0.53		1.00	0.47		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	181	0		173	0		83	996		94	1023	
V/C Ratio(X)	0.63	0.00		0.52	0.00		0.31	1.10		1.64	1.29	
Avail Cap(c_a), veh/h	230	0		222	0		95	996		94	1023	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	70.4	0.0	0.0	69.7	0.0	0.0	52.2	16.8	0.0	62.1	16.0	0.0
Incr Delay (d2), s/veh	3.6	0.0	0.0	2.4	0.0	0.0	2.1	60.6	0.0	330.8	137.2	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.8	0.0	0.0	3.7	0.0	0.0	0.9	44.2	0.0	12.4	66.3	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	74.0	0.0	0.0	72.1	0.0	0.0	54.4	77.3	0.0	392.9	153.2	0.0
LnGrp LOS	E	A		E	A		D	F		F	F	
Approach Vol, veh/h		114			90			1123			1472	
Approach Delay, s/veh		74.0			72.1			76.8			178.3	
Approach LOS		E			E			E			F	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.6	131.4		20.0	10.0	130.0		20.0				
Change Period (Y+Rc), s	5.5	5.5		5.5	5.5	5.5		5.5				
Max Green Setting (Gmax), s	4.5	124.5		19.5	4.5	124.5		19.5				
Max Q Clear Time (g_c+I1), s	2.6	129.9		11.3	7.7	128.5		14.4				
Green Ext Time (p_c), s	0.0	0.0		0.2	0.0	0.0		0.2				

Intersection Summary	
HCM 6th Ctrl Delay	129.9
HCM 6th LOS	F

Notes

Unsignalized Delay for [NBR, EBR, WBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	1.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	101	20	8	98	1	14	0	2	3	0	2
Future Vol, veh/h	5	101	20	8	98	1	14	0	2	3	0	2
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	120	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	83	83	83	83	83	83	83	83	83	83	83	83
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	6	122	24	10	118	1	17	0	2	4	0	2

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	119	0	0	146	0	0	286	285	134	286	297	119
Stage 1	-	-	-	-	-	-	146	146	-	139	139	-
Stage 2	-	-	-	-	-	-	140	139	-	147	158	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1469	-	-	1436	-	-	666	624	915	666	615	933
Stage 1	-	-	-	-	-	-	857	776	-	864	782	-
Stage 2	-	-	-	-	-	-	863	782	-	856	767	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1469	-	-	1436	-	-	659	617	915	659	608	933
Mov Cap-2 Maneuver	-	-	-	-	-	-	659	617	-	659	608	-
Stage 1	-	-	-	-	-	-	854	773	-	861	777	-
Stage 2	-	-	-	-	-	-	855	777	-	850	764	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	0.6	10.4	9.9
HCM LOS			B	A

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	683	1469	-	-	1436	-	-	747
HCM Lane V/C Ratio	0.028	0.004	-	-	0.007	-	-	0.008
HCM Control Delay (s)	10.4	7.5	0	-	7.5	-	-	9.9
HCM Lane LOS	B	A	A	-	A	-	-	A
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0

Intersection	
Int Delay, s/veh	0.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	15	91	75	1057	1241	18
Future Vol, veh/h	15	91	75	1057	1241	18
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	130	0	420	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	2	2	2	4	3	2
Mvmt Flow	16	98	81	1137	1334	19

Major/Minor	Minor2		Major 1		Major 2	
Conflicting Flow All	2633	-	1334	0	-	0
Stage 1	1334	-	-	-	-	-
Stage 2	1299	-	-	-	-	-
Critical Hdwy	6.42	-	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.218	-	-	-
Pot Cap-1 Maneuver	26	0	517	-	-	-
Stage 1	246	0	-	-	-	-
Stage 2	256	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	22	-	517	-	-	-
Mov Cap-2 Maneuver	151	-	-	-	-	-
Stage 1	207	-	-	-	-	-
Stage 2	256	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	31.7	0.9	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	517	-	151	-	-	-
HCM Lane V/C Ratio	0.156	-	0.107	-	-	-
HCM Control Delay (s)	13.2	-	31.7	0	-	-
HCM Lane LOS	B	-	D	A	-	-
HCM 95th %tile Q(veh)	0.5	-	0.4	-	-	-

Intersection	
Int Delay, s/veh	2.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	18	782	299	999	1083	34
Future Vol, veh/h	18	782	299	999	1083	34
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	150	0	450	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	2	3	3	2
Mvmt Flow	19	815	311	1041	1128	35

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2791	-	1128	0	-	0
Stage 1	1128	-	-	-	-	-
Stage 2	1663	-	-	-	-	-
Critical Hdwy	6.42	-	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.218	-	-	-
Pot Cap-1 Maneuver	21	0	619	-	-	-
Stage 1	309	0	-	-	-	-
Stage 2	169	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 10	-	619	-	-	-
Mov Cap-2 Maneuver	105	-	-	-	-	-
Stage 1	154	-	-	-	-	-
Stage 2	169	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	46.6	3.8	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	619	-	105	-	-	-
HCM Lane V/C Ratio	0.503	-	0.179	-	-	-
HCM Control Delay (s)	16.6	-	46.6	0	-	-
HCM Lane LOS	C	-	E	A	-	-
HCM 95th %tile Q(veh)	2.8	-	0.6	-	-	-

Notes			
~: Volume exceeds	$: Delay exceeds	+: Computation Not	*: All major volume in platoon

capacity	300s	Defined

Intersection	
Int Delay, s/veh	0.4

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	5	9	539	21	36	827
Future Vol, veh/h	5	9	539	21	36	827
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	0	-
Veh in Median Storage, #	2	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	10	586	23	39	899

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1575	598	0	0	609	0
Stage 1	598	-	-	-	-	-
Stage 2	977	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	121	502	-	-	970	-
Stage 1	549	-	-	-	-	-
Stage 2	365	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	116	502	-	-	970	-
Mov Cap-2 Maneuver	297	-	-	-	-	-
Stage 1	549	-	-	-	-	-
Stage 2	350	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	14.1	0	0.4
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	297	502	970	-
HCM Lane V/C Ratio	-	-	0.018	0.019	0.04	-
HCM Control Delay (s)	-	-	17.3	12.3	8.9	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.1	0.1	0.1	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	250	48	28	65	46	232	21	671	52	146	421	179
Future Volume (veh/h)	250	48	28	65	46	232	21	671	52	146	421	179
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	0.99		0.98	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1453	1477	1870	1870	1477	1856	1870	1477	1870	1870	1477	1841
Adj Flow Rate, veh/h	263	51	21	68	48	109	22	706	0	154	443	83
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	4	2	2	2	2	3	2	2	2	2	2	4
Cap, veh/h	229	267	110	355	62	141	379	1340		401	760	802
Arrive On Green	0.17	0.27	0.26	0.05	0.16	0.14	0.03	0.48	0.00	0.07	0.51	0.51
Sat Flow, veh/h	1384	992	409	1781	396	900	1781	2879	0	1781	1477	1558
Grp Volume(v), veh/h	263	0	72	68	0	157	22	706	0	154	443	83
Grp Sat Flow(s),veh/h/ln	1384	0	1401	1781	0	1297	1781	1403	0	1781	1477	1558
Q Serve(g_s), s	20.7	0.0	5.0	3.9	0.0	14.6	0.8	21.9	0.0	5.2	26.0	3.4
Cycle Q Clear(g_c), s	20.7	0.0	5.0	3.9	0.0	14.6	0.8	21.9	0.0	5.2	26.0	3.4
Prop In Lane	1.00		0.29	1.00		0.69	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	229	0	377	355	0	202	379	1340		401	760	802
V/C Ratio(X)	1.15	0.00	0.19	0.19	0.00	0.78	0.06	0.53		0.38	0.58	0.10
Avail Cap(c_a), veh/h	229	0	377	556	0	270	548	1340		504	760	802
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	52.1	0.0	35.4	40.9	0.0	51.2	17.3	22.8	0.0	16.2	21.0	15.6
Incr Delay (d2), s/veh	105.0	0.0	0.1	0.1	0.0	6.7	0.0	1.5	0.0	0.2	3.3	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	13.9	0.0	1.7	1.8	0.0	5.2	0.3	7.6	0.0	2.1	9.7	1.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	157.2	0.0	35.5	41.0	0.0	57.8	17.3	24.3	0.0	16.4	24.3	15.8
LnGrp LOS	F	A	D	D	A	E	B	C		B	C	B
Approach Vol, veh/h		335			225			728			680	
Approach Delay, s/veh		131.0			52.7			24.0			21.5	
Approach LOS		F			D			C			C	
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	8.2	68.3	25.0	23.5	12.8	63.7	10.9	37.6				
Change Period (Y+Rc), s	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5				
Max Green Setting (Gmax), s	14.5	44.5	19.5	24.5	14.5	44.5	19.5	24.5				
Max Q Clear Time (g_c+I1), s	2.8	28.0	22.7	16.6	7.2	23.9	5.9	7.0				
Green Ext Time (p_c), s	0.0	2.1	0.0	0.3	0.1	2.9	0.0	0.2				
Intersection Summary												
HCM 6th Ctrl Delay			44.6									
HCM 6th LOS			D									
Notes												

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

Intersection						
Int Delay, s/veh	1.8					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	11	51	631	66	98	353
Future Vol, veh/h	11	51	631	66	98	353
Conflicting Peds, #/hr	0	2	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Stop	-	None	-	None
Storage Length	0	100	-	-	120	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	84	84	84	84	84	84
Heavy Vehicles, %	2	2	3	2	2	2
Mvmt Flow	13	61	751	79	117	420

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1445	793	0	0	830	0
Stage 1	791	-	-	-	-	-
Stage 2	654	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	145	389	-	-	802	-
Stage 1	447	-	-	-	-	-
Stage 2	517	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	124	388	-	-	802	-
Mov Cap-2 Maneuver	124	-	-	-	-	-
Stage 1	447	-	-	-	-	-
Stage 2	442	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	19.8	0	2.2
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	124	388	802	-
HCM Lane V/C Ratio	-	-	0.106	0.156	0.145	-
HCM Control Delay (s)	-	-	37.4	16	10.3	-
HCM Lane LOS	-	-	E	C	B	-
HCM 95th %tile Q(veh)	-	-	0.3	0.5	0.5	-

Intersection	
Int Delay, s/veh	4.4

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	64	79	197	15	28	129
Future Vol, veh/h	64	79	197	15	28	129
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	120	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	71	88	219	17	31	143

Major/Minor	Major 1		Major 2		Minor 2	
Conflicting Flow All	236	0	-	0	458	228
Stage 1	-	-	-	-	228	-
Stage 2	-	-	-	-	230	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1331	-	-	-	561	811
Stage 1	-	-	-	-	810	-
Stage 2	-	-	-	-	808	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1331	-	-	-	531	811
Mov Cap-2 Maneuver	-	-	-	-	531	-
Stage 1	-	-	-	-	767	-
Stage 2	-	-	-	-	808	-

Approach	EB	WB	SB
HCM Control Delay, s	3.5	0	11.3
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1331	-	-	-	741
HCM Lane V/C Ratio	0.053	-	-	-	0.235
HCM Control Delay (s)	7.9	-	-	-	11.3
HCM Lane LOS	A	-	-	-	B
HCM 95th %tile Q(veh)	0.2	-	-	-	0.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	62	24	22	70	73	212	39	1360	49	73	1004	76
Future Volume (veh/h)	62	24	22	70	73	212	39	1360	49	73	1004	76
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1477	1870	1870	1477	1856	1477	1259	1870	1477	1239	1870
Adj Flow Rate, veh/h	65	25	0	73	76	0	41	1417	0	76	1046	0
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Percent Heavy Veh, %	2	2	2	2	2	3	2	4	2	2	6	2
Cap, veh/h	116	37		105	79		86	958		100	955	
Arrive On Green	0.13	0.13	0.00	0.12	0.12	0.00	0.03	0.76	0.00	0.04	0.77	0.00
Sat Flow, veh/h	614	290	1585	597	651	1572	1406	1259	1585	1406	1239	1585
Grp Volume(v), veh/h	90	0	0	149	0	0	41	1417	0	76	1046	0
Grp Sat Flow(s),veh/h/ln	904	0	1585	1248	0	1572	1406	1259	1585	1406	1239	1585
Q Serve(g_s), s	0.0	0.0	0.0	3.5	0.0	0.0	1.1	125.5	0.0	3.6	127.1	0.0
Cycle Q Clear(g_c), s	16.1	0.0	0.0	19.7	0.0	0.0	1.1	125.5	0.0	3.6	127.1	0.0
Prop In Lane	0.72		1.00	0.49		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	153	0		184	0		86	958		100	955	
V/C Ratio(X)	0.59	0.00		0.81	0.00		0.47	1.48		0.76	1.10	
Avail Cap(c_a), veh/h	153	0		184	0		101	958		101	955	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	69.6	0.0	0.0	72.3	0.0	0.0	51.0	19.7	0.0	57.4	18.9	0.0
Incr Delay (d2), s/veh	5.9	0.0	0.0	23.2	0.0	0.0	4.0	221.1	0.0	27.4	58.7	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.0	0.0	0.0	7.5	0.0	0.0	1.4	88.5	0.0	3.9	44.6	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	75.5	0.0	0.0	95.5	0.0	0.0	55.0	240.9	0.0	84.8	77.6	0.0
LnGrp LOS	E	A		F	A		E	F		F	F	
Approach Vol, veh/h		90			149			1458			1122	
Approach Delay, s/veh		75.5			95.5			235.6			78.1	
Approach LOS		E			F			F			E	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	9.3	130.6		25.0	11.0	129.0		25.0				
Change Period (Y+Rc), s	5.5	5.5		5.5	5.5	5.5		5.5				
Max Green Setting (Gmax), s	5.5	123.5		19.5	5.5	123.5		19.5				
Max Q Clear Time (g_c+I1), s	3.1	129.1		21.7	5.6	127.5		18.1				
Green Ext Time (p_c), s	0.0	0.0		0.0	0.0	0.0		0.0				

Intersection Summary			
HCM 6th Ctrl Delay			160.4
HCM 6th LOS			F

Notes

Unsignalized Delay for [NBR, EBR, WBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	4	85	4	4	208	8	17	0	3	3	0	3
Future Vol, veh/h	4	85	4	4	208	8	17	0	3	3	0	3
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	120	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	82	82	82	82	82	82	82	82	82	82	82	82
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	104	5	5	254	10	21	0	4	4	0	4

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	264	0	0	109	0	0	388	391	107	388	388	259
Stage 1	-	-	-	-	-	-	117	117	-	269	269	-
Stage 2	-	-	-	-	-	-	271	274	-	119	119	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1300	-	-	1481	-	-	571	545	947	571	547	780
Stage 1	-	-	-	-	-	-	888	799	-	737	687	-
Stage 2	-	-	-	-	-	-	735	683	-	885	797	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1300	-	-	1481	-	-	565	541	947	566	543	780
Mov Cap-2 Maneuver	-	-	-	-	-	-	565	541	-	566	543	-
Stage 1	-	-	-	-	-	-	884	796	-	734	685	-
Stage 2	-	-	-	-	-	-	729	681	-	878	794	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	0.1	11.2	10.6
HCM LOS			B	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	601	1300	-	-	1481	-	-	656
HCM Lane V/C Ratio	0.041	0.004	-	-	0.003	-	-	0.011
HCM Control Delay (s)	11.2	7.8	0	-	7.4	-	-	10.6
HCM Lane LOS	B	A	A	-	A	-	-	B
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0

Intersection	
Int Delay, s/veh	1.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	40	71	174	1454	1071	27
Future Vol, veh/h	40	71	174	1454	1071	27
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	130	0	420	-	-	500
Veh in Median Storage,	# 2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	3	3	6	2
Mvmt Flow	43	77	189	1580	1164	29

Major/Minor	Minor2		Major 1		Major 2	
Conflicting Flow All	3122	-	1164	0	-	0
Stage 1	1164	-	-	-	-	-
Stage 2	1958	-	-	-	-	-
Critical Hdwy	6.42	-	4.13	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.227	-	-	-
Pot Cap-1 Maneuver	~ 13	0	597	-	-	-
Stage 1	297	0	-	-	-	-
Stage 2	120	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 9	-	597	-	-	-
Mov Cap-2 Maneuver	96	-	-	-	-	-
Stage 1	203	-	-	-	-	-
Stage 2	120	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	70.4	1.5	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	597	-	96	-	-	-
HCM Lane V/C Ratio	0.317	-	0.453	-	-	-
HCM Control Delay (s)	13.8	-	70.4	0	-	-
HCM Lane LOS	B	-	F	A	-	-
HCM 95th %tile Q(veh)	1.4	-	1.9	-	-	-

Notes			
~: Volume exceeds	$: Delay exceeds	+: Computation Not	*: All major volume in platoon

capacity	300s	Defined

Intersection	
Int Delay, s/veh	4.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	13	339	445	1228	1041	63
Future Vol, veh/h	13	339	445	1228	1041	63
Conflicting Peds, #/hr	0	0	1	0	0	1
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	150	0	450	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	4	4	6	2
Mvmt Flow	14	357	468	1293	1096	66

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	3326	-	1097	0	-	0
Stage 1	1097	-	-	-	-	-
Stage 2	2229	-	-	-	-	-
Critical Hdwy	6.42	-	4.14	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.236	-	-	-
Pot Cap-1 Maneuver	~ 9	0	629	-	-	-
Stage 1	320	0	-	-	-	-
Stage 2	88	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 2	-	628	-	-	-
Mov Cap-2 Maneuver	54	-	-	-	-	-
Stage 1	82	-	-	-	-	-
Stage 2	88	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	92.9	6.8	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	628	-	54	-	-	-
HCM Lane V/C Ratio	0.746	-	0.253	-	-	-
HCM Control Delay (s)	25.6	-	92.9	0	-	-
HCM Lane LOS	D	-	F	A	-	-
HCM 95th %tile Q(veh)	6.6	-	0.9	-	-	-

Notes			
~: Volume exceeds	$: Delay exceeds	+: Computation Not	*: All major volume in platoon

capacity	300s	Defined

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	183	28	29	74	45	198	28	655	62	192	895	292
Future Volume (veh/h)	183	28	29	74	45	198	28	655	62	192	895	292
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		0.98	1.00		1.00	1.00		0.96
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1477	1477	1870	1870	1477	1870	1870	1477	1870	1870	1575	1870
Adj Flow Rate, veh/h	185	28	21	75	45	71	28	662	0	194	904	194
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	213	171	128	312	63	99	111	1519		480	912	883
Arrive On Green	0.15	0.22	0.21	0.06	0.12	0.11	0.03	0.54	0.00	0.07	0.58	0.58
Sat Flow, veh/h	1406	781	586	1781	510	804	1781	2879	0	1781	1575	1525
Grp Volume(v), veh/h	185	0	49	75	0	116	28	662	0	194	904	194
Grp Sat Flow(s),veh/h/ln	1406	0	1366	1781	0	1314	1781	1403	0	1781	1575	1525
Q Serve(g_s), s	18.6	0.0	4.2	5.2	0.0	12.3	1.0	20.5	0.0	6.7	82.2	8.9
Cycle Q Clear(g_c), s	18.6	0.0	4.2	5.2	0.0	12.3	1.0	20.5	0.0	6.7	82.2	8.9
Prop In Lane	1.00		0.43	1.00		0.61	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	213	0	299	312	0	162	111	1519		480	912	883
V/C Ratio(X)	0.87	0.00	0.16	0.24	0.00	0.72	0.25	0.44		0.40	0.99	0.22
Avail Cap(c_a), veh/h	249	0	299	528	0	281	309	1519		611	912	883
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	60.1	0.0	46.1	51.3	0.0	61.6	34.5	19.9	0.0	13.9	30.2	14.7
Incr Delay (d2), s/veh	23.5	0.0	0.1	0.1	0.0	2.2	0.4	0.9	0.0	0.2	27.8	0.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	8.1	0.0	1.5	2.4	0.0	4.3	0.5	7.0	0.0	2.7	37.4	3.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	83.6	0.0	46.2	51.4	0.0	63.8	35.0	20.9	0.0	14.1	57.9	15.3
LnGrp LOS	F	A	D	D	A	E	C	C		B	E	B
Approach Vol, veh/h		234			191			690			1292	
Approach Delay, s/veh		75.8			58.9			21.4			45.0	
Approach LOS		E			E			C			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	8.9	88.0	26.3	21.9	14.3	82.5	12.4	35.7
Change Period (Y+Rc), s	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Max Green Setting (Gmax), s	19.5	49.5	24.5	29.5	19.5	49.5	24.5	29.5
Max Q Clear Time (g_c+I1), s	3.0	84.2	20.6	14.3	8.7	22.5	7.2	6.2
Green Ext Time (p_c), s	0.0	0.0	0.2	0.3	0.1	2.8	0.0	0.1

Intersection Summary	
HCM 6th Ctrl Delay	42.3
HCM 6th LOS	D

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

Intersection						
Int Delay, s/veh	1.8					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	23	82	537	23	59	844
Future Vol, veh/h	23	82	537	23	59	844
Conflicting Peds, #/hr	0	0	0	2	2	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Stop	-	None	-	None
Storage Length	0	100	-	-	120	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	24	87	571	24	63	898

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1609	585	0	0	597	0
Stage 1	585	-	-	-	-	-
Stage 2	1024	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	115	511	-	-	980	-
Stage 1	557	-	-	-	-	-
Stage 2	347	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	107	510	-	-	978	-
Mov Cap-2 Maneuver	107	-	-	-	-	-
Stage 1	556	-	-	-	-	-
Stage 2	325	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	21.1	0	0.6
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	107	510	978	-
HCM Lane V/C Ratio	-	-	0.229	0.171	0.064	-
HCM Control Delay (s)	-	-	48.3	13.5	8.9	-
HCM Lane LOS	-	-	E	B	A	-
HCM 95th %tile Q(veh)	-	-	0.8	0.6	0.2	-

Intersection	
Int Delay, s/veh	5.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	101	88	101	16	14	140
Future Vol, veh/h	101	88	101	16	14	140
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	120	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	91	91	91	91	91	91
Heavy Vehicles, %	2	2	2	2	2	3
Mvmt Flow	111	97	111	18	15	154

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	129	0	-	0	439	120
Stage 1	-	-	-	-	120	-
Stage 2	-	-	-	-	319	-
Critical Hdwy	4.12	-	-	-	6.42	6.23
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.327
Pot Cap-1 Maneuver	1457	-	-	-	575	929
Stage 1	-	-	-	-	905	-
Stage 2	-	-	-	-	737	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1457	-	-	-	531	929
Mov Cap-2 Maneuver	-	-	-	-	531	-
Stage 1	-	-	-	-	836	-
Stage 2	-	-	-	-	737	-

Approach	EB	WB	SB
HCM Control Delay, s	4.1	0	10.1
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1457	-	-	-	870
HCM Lane V/C Ratio	0.076	-	-	-	0.195
HCM Control Delay (s)	7.7	-	-	-	10.1
HCM Lane LOS	A	-	-	-	B
HCM 95th %tile Q(veh)	0.2	-	-	-	0.7

HCM 6th Signalized Intersection Summary
4: Queen Kaahumanu Hwy & Nani Kailua Dr 06/15/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	58	51	14	41	44	136	25	1061	44	149	1275	98
Future Volume (veh/h)	58	51	14	41	44	136	25	1061	44	149	1275	98
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1856	1477	1259	1870	1442	1280	1870
Adj Flow Rate, veh/h	63	55	0	45	48	0	27	1153	0	162	1386	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	3	2	4	2	5	2	2
Cap, veh/h	112	72		94	82		83	992		94	1019	
Arrive On Green	0.10	0.10	0.00	0.10	0.10	0.00	0.03	0.79	0.00	0.04	0.80	0.00
Sat Flow, veh/h	753	700	1585	623	848	1572	1406	1259	1585	1373	1280	1585
Grp Volume(v), veh/h	118	0	0	93	0	0	27	1153	0	162	1386	0
Grp Sat Flow(s),veh/h/ln	1453	0	1585	1470	0	1572	1406	1259	1585	1373	1280	1585
Q Serve(g_s), s	3.2	0.0	0.0	0.0	0.0	0.0	0.6	126.5	0.0	5.7	127.8	0.0
Cycle Q Clear(g_c), s	13.0	0.0	0.0	9.8	0.0	0.0	0.6	126.5	0.0	5.7	127.8	0.0
Prop In Lane	0.53		1.00	0.48		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	185	0		176	0		83	992		94	1019	
V/C Ratio(X)	0.64	0.00		0.53	0.00		0.33	1.16		1.73	1.36	
Avail Cap(c_a), veh/h	227	0		219	0		95	992		94	1019	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	70.5	0.0	0.0	69.7	0.0	0.0	52.2	17.1	0.0	62.1	16.4	0.0
Incr Delay (d2), s/veh	4.1	0.0	0.0	2.4	0.0	0.0	2.2	84.4	0.0	369.9	168.7	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.0	0.0	0.0	3.9	0.0	0.0	0.9	51.0	0.0	13.4	75.4	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	74.6	0.0	0.0	72.1	0.0	0.0	54.4	101.4	0.0	432.0	185.1	0.0
LnGrp LOS	E	A		E	A		D	F		F	F	
Approach Vol, veh/h		118			93			1180			1548	
Approach Delay, s/veh		74.6			72.1			100.4			211.0	
Approach LOS		E			E			F			F	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.7	131.3		20.6	10.0	130.0		20.6				
Change Period (Y+Rc), s	5.5	5.5		5.5	5.5	5.5		5.5				
Max Green Setting (Gmax), s	4.5	124.5		19.5	4.5	124.5		19.5				
Max Q Clear Time (g_c+I1), s	2.6	129.8		11.8	7.7	128.5		15.0				
Green Ext Time (p_c), s	0.0	0.0		0.2	0.0	0.0		0.2				
Intersection Summary												
HCM 6th Ctrl Delay			156.7									
HCM 6th LOS			F									

Notes

Unsignalized Delay for [NBR, EBR, WBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	1.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	106	21	8	103	1	15	0	2	3	0	2
Future Vol, veh/h	5	106	21	8	103	1	15	0	2	3	0	2
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	120	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	83	83	83	83	83	83	83	83	83	83	83	83
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	6	128	25	10	124	1	18	0	2	4	0	2

Major/Minor	Major1			Major 2			Minor 1			Minor 2		
Conflicting Flow All	125	0	0	153	0	0	299	298	141	299	310	125
Stage 1	-	-	-	-	-	-	153	153	-	145	145	-
Stage 2	-	-	-	-	-	-	146	145	-	154	165	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1462	-	-	1428	-	-	653	614	907	653	605	926
Stage 1	-	-	-	-	-	-	849	771	-	858	777	-
Stage 2	-	-	-	-	-	-	857	777	-	848	762	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1462	-	-	1428	-	-	646	607	907	646	598	926
Mov Cap-2 Maneuver	-	-	-	-	-	-	646	607	-	646	598	-
Stage 1	-	-	-	-	-	-	846	768	-	855	772	-
Stage 2	-	-	-	-	-	-	849	772	-	842	759	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	0.5	10.6	9.9
HCM LOS			B	A

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	669	1462	-	-	1428	-	-	735
HCM Lane V/C Ratio	0.031	0.004	-	-	0.007	-	-	0.008
HCM Control Delay (s)	10.6	7.5	0	-	7.5	-	-	9.9
HCM Lane LOS	B	A	A	-	A	-	-	A
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0

Intersection						
Int Delay, s/veh	0.6					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	16	96	79	1111	1304	19
Future Vol, veh/h	16	96	79	1111	1304	19
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	130	0	420	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	2	2	2	4	3	2
Mvmt Flow	17	103	85	1195	1402	20

Major/Minor	Minor2		Major 1		Major 2	
Conflicting Flow All	2767	-	1402	0	-	0
Stage 1	1402	-	-	-	-	-
Stage 2	1365	-	-	-	-	-
Critical Hdwy	6.42	-	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.218	-	-	-
Pot Cap-1 Maneuver	21	0	487	-	-	-
Stage 1	228	0	-	-	-	-
Stage 2	237	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 17	-	487	-	-	-
Mov Cap-2 Maneuver	137	-	-	-	-	-
Stage 1	188	-	-	-	-	-
Stage 2	237	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	35	0.9	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	487	-	137	-	-	-
HCM Lane V/C Ratio	0.174	-	0.126	-	-	-
HCM Control Delay (s)	13.9	-	35	0	-	-
HCM Lane LOS	B	-	E	A	-	-
HCM 95th %tile Q(veh)	0.6	-	0.4	-	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection						
Int Delay, s/veh	2.4					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	19	816	291	1050	1138	35
Future Vol, veh/h	19	816	291	1050	1138	35
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	150	0	450	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	2	3	3	2
Mvmt Flow	20	850	303	1094	1185	36

Major/Minor	Minor2		Major 1		Major 2	
Conflicting Flow All	2885	-	1185	0	-	0
Stage 1	1185	-	-	-	-	-
Stage 2	1700	-	-	-	-	-
Critical Hdwy	6.42	-	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.218	-	-	-
Pot Cap-1 Maneuver	~ 18	0	589	-	-	-
Stage 1	290	0	-	-	-	-
Stage 2	162	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 9	-	589	-	-	-
Mov Cap-2 Maneuver	98	-	-	-	-	-
Stage 1	141	-	-	-	-	-
Stage 2	162	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	50.8	3.8	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	589	-	98	-	-	-
HCM Lane V/C Ratio	0.515	-	0.202	-	-	-
HCM Control Delay (s)	17.4	-	50.8	0	-	-
HCM Lane LOS	C	-	F	A	-	-
HCM 95th %tile Q(veh)	2.9	-	0.7	-	-	-

Notes			
~: Volume exceeds	$: Delay exceeds	+: Computation Not	*: All major volume in platoon

capacity	300s	Defined

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	250	48	29	66	46	232	24	722	57	146	437	179
Future Volume (veh/h)	250	48	29	66	46	232	24	722	57	146	437	179
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	0.99		0.98	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1453	1477	1870	1870	1477	1856	1870	1477	1870	1870	1477	1841
Adj Flow Rate, veh/h	263	51	23	69	48	109	25	760	0	154	460	83
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	4	2	2	2	2	3	2	2	2	2	2	4
Cap, veh/h	218	251	113	355	62	141	376	1365		384	769	811
Arrive On Green	0.16	0.26	0.25	0.05	0.16	0.14	0.03	0.49	0.00	0.07	0.52	0.52
Sat Flow, veh/h	1384	962	434	1781	396	900	1781	2879	0	1781	1477	1558
Grp Volume(v), veh/h	263	0	74	69	0	157	25	760	0	154	460	83
Grp Sat Flow(s),veh/h/ln	1384	0	1396	1781	0	1297	1781	1403	0	1781	1477	1558
Q Serve(g_s), s	19.7	0.0	5.2	4.0	0.0	14.6	0.9	23.8	0.0	5.1	27.1	3.4
Cycle Q Clear(g_c), s	19.7	0.0	5.2	4.0	0.0	14.6	0.9	23.8	0.0	5.1	27.1	3.4
Prop In Lane	1.00		0.31	1.00		0.69	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	218	0	364	355	0	202	376	1365		384	769	811
V/C Ratio(X)	1.21	0.00	0.20	0.19	0.00	0.78	0.07	0.56		0.40	0.60	0.10
Avail Cap(c_a), veh/h	218	0	364	541	0	270	541	1365		488	769	811
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	52.6	0.0	36.3	40.9	0.0	51.2	16.9	22.6	0.0	16.2	20.9	15.2
Incr Delay (d2), s/veh	127.7	0.0	0.1	0.1	0.0	6.7	0.0	1.6	0.0	0.3	3.4	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	14.6	0.0	1.8	1.8	0.0	5.2	0.4	8.2	0.0	2.1	10.1	1.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	180.3	0.0	36.4	41.0	0.0	57.8	17.0	24.2	0.0	16.5	24.3	15.4
LnGrp LOS	F	A	D	D	A	E	B	C		B	C	B
Approach Vol, veh/h		337			226			785			697	
Approach Delay, s/veh		148.7			52.7			24.0			21.5	
Approach LOS		F			D			C			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	8.4	69.1	24.0	23.5	12.7	64.8	11.0	36.6
Change Period (Y+Rc), s	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Max Green Setting (Gmax), s	14.5	45.5	18.5	24.5	14.5	45.5	18.5	24.5
Max Q Clear Time (g_c+I1), s	2.9	29.1	21.7	16.6	7.1	25.8	6.0	7.2
Green Ext Time (p_c), s	0.0	2.2	0.0	0.3	0.1	3.1	0.0	0.2

Intersection Summary	
HCM 6th Ctrl Delay	46.9
HCM 6th LOS	D

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	2.3

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	18	63	678	68	102	368
Future Vol, veh/h	18	63	678	68	102	368
Conflicting Peds, #/hr	0	2	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Stop	-	None	-	None
Storage Length	0	100	-	-	120	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	84	84	84	84	84	84
Heavy Vehicles, %	2	2	3	2	2	2
Mvmt Flow	21	75	807	81	121	438

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1528	850	0	0	888	0
Stage 1	848	-	-	-	-	-
Stage 2	680	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	129	360	-	-	763	-
Stage 1	420	-	-	-	-	-
Stage 2	503	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	108	359	-	-	763	-
Mov Cap-2 Maneuver	108	-	-	-	-	-
Stage 1	420	-	-	-	-	-
Stage 2	423	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	24.1	0	2.3
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	108	359	763	-
HCM Lane V/C Ratio	-	-	0.198	0.209	0.159	-
HCM Control Delay (s)	-	-	46.4	17.7	10.6	-
HCM Lane LOS	-	-	E	C	B	-
HCM 95th %tile Q(veh)	-	-	0.7	0.8	0.6	-

Intersection						
Int Delay, s/veh	4.5					

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	69	79	197	15	28	130
Future Vol, veh/h	69	79	197	15	28	130
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	120	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	77	88	219	17	31	144

Major/Minor	Major 1		Major 2		Minor 2	
Conflicting Flow All	236	0	-	0	470	228
Stage 1	-	-	-	-	228	-
Stage 2	-	-	-	-	242	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1331	-	-	-	552	811
Stage 1	-	-	-	-	810	-
Stage 2	-	-	-	-	798	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1331	-	-	-	520	811
Mov Cap-2 Maneuver	-	-	-	-	520	-
Stage 1	-	-	-	-	763	-
Stage 2	-	-	-	-	798	-

Approach	EB	WB	SB
HCM Control Delay, s	3.7	0	11.4
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1331	-	-	-	738
HCM Lane V/C Ratio	0.058	-	-	-	0.238
HCM Control Delay (s)	7.9	-	-	-	11.4
HCM Lane LOS	A	-	-	-	B
HCM 95th %tile Q(veh)	0.2	-	-	-	0.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	64	27	22	70	74	212	39	1360	49	73	1004	77
Future Volume (veh/h)	64	27	22	70	74	212	39	1360	49	73	1004	77
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1477	1870	1870	1477	1856	1477	1259	1870	1477	1239	1870
Adj Flow Rate, veh/h	67	28	0	73	77	0	41	1417	0	76	1046	0
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Percent Heavy Veh, %	2	2	2	2	2	3	2	4	2	2	6	2
Cap, veh/h	114	38		104	79		86	958		100	955	
Arrive On Green	0.13	0.13	0.00	0.12	0.12	0.00	0.03	0.76	0.00	0.04	0.77	0.00
Sat Flow, veh/h	600	301	1585	586	648	1572	1406	1259	1585	1406	1239	1585
Grp Volume(v), veh/h	95	0	0	150	0	0	41	1417	0	76	1046	0
Grp Sat Flow(s),veh/h/ln	901	0	1585	1234	0	1572	1406	1259	1585	1406	1239	1585
Q Serve(g_s), s	0.0	0.0	0.0	2.8	0.0	0.0	1.1	125.5	0.0	3.6	127.1	0.0
Cycle Q Clear(g_c), s	17.2	0.0	0.0	20.0	0.0	0.0	1.1	125.5	0.0	3.6	127.1	0.0
Prop In Lane	0.71		1.00	0.49		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	152	0		182	0		86	958		100	955	
V/C Ratio(X)	0.63	0.00		0.82	0.00		0.47	1.48		0.76	1.10	
Avail Cap(c_a), veh/h	152	0		182	0		101	958		101	955	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	70.1	0.0	0.0	72.5	0.0	0.0	51.0	19.7	0.0	57.4	18.9	0.0
Incr Delay (d2), s/veh	7.8	0.0	0.0	25.4	0.0	0.0	4.0	221.1	0.0	27.4	58.7	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.3	0.0	0.0	7.7	0.0	0.0	1.4	88.5	0.0	3.9	44.6	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	77.9	0.0	0.0	97.9	0.0	0.0	55.0	240.9	0.0	84.8	77.6	0.0
LnGrp LOS	E	A		F	A		E	F		F	F	
Approach Vol, veh/h		95			150			1458			1122	
Approach Delay, s/veh		77.9			97.9			235.6			78.1	
Approach LOS		E			F			F			E	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	9.3	130.6		25.0	11.0	129.0		25.0				
Change Period (Y+Rc), s	5.5	5.5		5.5	5.5	5.5		5.5				
Max Green Setting (Gmax), s	5.5	123.5		19.5	5.5	123.5		19.5				
Max Q Clear Time (g_c+I1), s	3.1	129.1		22.0	5.6	127.5		19.2				
Green Ext Time (p_c), s	0.0	0.0		0.0	0.0	0.0		0.0				
Intersection Summary												
HCM 6th Ctrl Delay			160.4									
HCM 6th LOS			F									

Notes

Unsignalized Delay for [NBR, EBR, WBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	4	85	4	4	208	8	17	0	3	3	0	3
Future Vol, veh/h	4	85	4	4	208	8	17	0	3	3	0	3
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	120	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	82	82	82	82	82	82	82	82	82	82	82	82
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	104	5	5	254	10	21	0	4	4	0	4

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	264	0	0	109	0	0	388	391	107	388	388	259
Stage 1	-	-	-	-	-	-	117	117	-	269	269	-
Stage 2	-	-	-	-	-	-	271	274	-	119	119	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1300	-	-	1481	-	-	571	545	947	571	547	780
Stage 1	-	-	-	-	-	-	888	799	-	737	687	-
Stage 2	-	-	-	-	-	-	735	683	-	885	797	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1300	-	-	1481	-	-	565	541	947	566	543	780
Mov Cap-2 Maneuver	-	-	-	-	-	-	565	541	-	566	543	-
Stage 1	-	-	-	-	-	-	884	796	-	734	685	-
Stage 2	-	-	-	-	-	-	729	681	-	878	794	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	0.1	11.2	10.6
HCM LOS			B	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	601	1300	-	-	1481	-	-	656
HCM Lane V/C Ratio	0.041	0.004	-	-	0.003	-	-	0.011
HCM Control Delay (s)	11.2	7.8	0	-	7.4	-	-	10.6
HCM Lane LOS	B	A	A	-	A	-	-	B
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0

Intersection	
Int Delay, s/veh	1.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	40	71	174	1454	1071	27
Future Vol, veh/h	40	71	174	1454	1071	27
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	130	0	420	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	3	3	6	2
Mvmt Flow	43	77	189	1580	1164	29

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	3122	-	1164	0	-	0
Stage 1	1164	-	-	-	-	-
Stage 2	1958	-	-	-	-	-
Critical Hdwy	6.42	-	4.13	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.227	-	-	-
Pot Cap-1 Maneuver	~ 13	0	597	-	-	-
Stage 1	297	0	-	-	-	-
Stage 2	120	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 9	-	597	-	-	-
Mov Cap-2 Maneuver	96	-	-	-	-	-
Stage 1	203	-	-	-	-	-
Stage 2	120	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	70.4	1.5	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	597	-	96	-	-	-
HCM Lane V/C Ratio	0.317	-	0.453	-	-	-
HCM Control Delay (s)	13.8	-	70.4	0	-	-
HCM Lane LOS	B	-	F	A	-	-
HCM 95th %tile Q(veh)	1.4	-	1.9	-	-	-

Notes

~: Volume exceeds $: Delay exceeds +: Computation Not *: All major volume in platoon

capacity	300s	Defined	

Intersection	
Int Delay, s/veh	4.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	15	367	454	1228	1041	64
Future Vol, veh/h	15	367	454	1228	1041	64
Conflicting Peds, #/hr	0	0	1	0	0	1
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	150	0	450	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	4	4	6	2
Mvmt Flow	16	386	478	1293	1096	67

Major/Minor	Minor2		Major 1		Major 2	
Conflicting Flow All	3346	-	1097	0	-	0
Stage 1	1097	-	-	-	-	-
Stage 2	2249	-	-	-	-	-
Critical Hdwy	6.42	-	4.14	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.236	-	-	-
Pot Cap-1 Maneuver	~ 9	0	629	-	-	-
Stage 1	320	0	-	-	-	-
Stage 2	86	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 2	-	628	-	-	-
Mov Cap-2 Maneuver	52	-	-	-	-	-
Stage 1	76	-	-	-	-	-
Stage 2	86	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	102	7.2	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	628	-	52	-	-	-
HCM Lane V/C Ratio	0.761	-	0.304	-	-	-
HCM Control Delay (s)	26.6	-	102	0	-	-
HCM Lane LOS	D	-	F	A	-	-
HCM 95th %tile Q(veh)	7	-	1.1	-	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	1.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	28	47	699	9	15	371
Future Vol, veh/h	28	47	699	9	15	371
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	0	-
Veh in Median Storage, #	2	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	30	51	760	10	16	403

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1200	765	0	0	770	0
Stage 1	765	-	-	-	-	-
Stage 2	435	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	204	403	-	-	844	-
Stage 1	459	-	-	-	-	-
Stage 2	653	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	200	403	-	-	844	-
Mov Cap-2 Maneuver	392	-	-	-	-	-
Stage 1	459	-	-	-	-	-
Stage 2	641	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	15.1	0	0.4
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	392	403	844	-
HCM Lane V/C Ratio	-	-	0.078	0.127	0.019	-
HCM Control Delay (s)	-	-	15	15.2	9.3	-
HCM Lane LOS	-	-	C	C	A	-
HCM 95th %tile Q(veh)	-	-	0.3	0.4	0.1	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	183	28	32	79	45	198	29	673	64	192	954	292
Future Volume (veh/h)	183	28	32	79	45	198	29	673	64	192	954	292
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		0.98	1.00		1.00	1.00		0.96
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1477	1477	1870	1870	1477	1870	1870	1477	1870	1870	1575	1870
Adj Flow Rate, veh/h	185	28	24	80	45	71	29	680	0	194	964	194
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	213	158	136	316	63	99	107	1519		471	911	882
Arrive On Green	0.15	0.22	0.21	0.06	0.12	0.11	0.03	0.54	0.00	0.07	0.58	0.58
Sat Flow, veh/h	1406	731	627	1781	510	804	1781	2879	0	1781	1575	1525
Grp Volume(v), veh/h	185	0	52	80	0	116	29	680	0	194	964	194
Grp Sat Flow(s),veh/h/ln	1406	0	1358	1781	0	1314	1781	1403	0	1781	1575	1525
Q Serve(g_s), s	18.6	0.0	4.5	5.6	0.0	12.3	1.0	21.3	0.0	6.7	83.9	8.9
Cycle Q Clear(g_c), s	18.6	0.0	4.5	5.6	0.0	12.3	1.0	21.3	0.0	6.7	83.9	8.9
Prop In Lane	1.00		0.46	1.00		0.61	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	213	0	294	316	0	162	107	1519		471	911	882
V/C Ratio(X)	0.87	0.00	0.18	0.25	0.00	0.72	0.27	0.45		0.41	1.06	0.22
Avail Cap(c_a), veh/h	249	0	294	527	0	281	304	1519		603	911	882
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	60.1	0.0	46.6	51.1	0.0	61.6	34.6	20.1	0.0	14.1	30.6	14.8
Incr Delay (d2), s/veh	23.5	0.0	0.1	0.2	0.0	2.2	0.5	1.0	0.0	0.2	46.3	0.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	8.1	0.0	1.6	2.6	0.0	4.3	0.6	7.3	0.0	2.7	42.7	3.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	83.6	0.0	46.7	51.2	0.0	63.8	35.1	21.1	0.0	14.3	76.9	15.3
LnGrp LOS	F	A	D	D	A	E	D	C		B	F	B
Approach Vol, veh/h		237			196			709			1352	
Approach Delay, s/veh		75.5			58.7			21.6			59.1	
Approach LOS		E			E			C			E	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	8.9	87.9	26.3	21.9	14.3	82.5	12.8	35.3
Change Period (Y+Rc), s	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Max Green Setting (Gmax), s	19.5	49.5	24.5	29.5	19.5	49.5	24.5	29.5
Max Q Clear Time (g_c+I1), s	3.0	85.9	20.6	14.3	8.7	23.3	7.6	6.5
Green Ext Time (p_c), s	0.0	0.0	0.2	0.3	0.1	2.9	0.0	0.1

Intersection Summary	
HCM 6th Ctrl Delay	50.0
HCM 6th LOS	D

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

Intersection						
Int Delay, s/veh	2					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	25	86	553	30	73	898
Future Vol, veh/h	25	86	553	30	73	898
Conflicting Peds, #/hr	0	0	0	2	2	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Stop	-	None	-	None
Storage Length	0	100	-	-	120	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	27	91	588	32	78	955

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1717	606	0	0	622	0
Stage 1	606	-	-	-	-	-
Stage 2	1111	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	99	497	-	-	959	-
Stage 1	545	-	-	-	-	-
Stage 2	315	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	91	496	-	-	957	-
Mov Cap-2 Maneuver	91	-	-	-	-	-
Stage 1	544	-	-	-	-	-
Stage 2	289	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	24.3	0	0.7
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	91	496	957	-
HCM Lane V/C Ratio	-	-	0.292	0.184	0.081	-
HCM Control Delay (s)	-	-	60.1	13.9	9.1	-
HCM Lane LOS	-	-	F	B	A	-
HCM 95th %tile Q(veh)	-	-	1.1	0.7	0.3	-

Intersection	
Int Delay, s/veh	5.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	103	88	101	16	14	145
Future Vol, veh/h	103	88	101	16	14	145
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	120	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	91	91	91	91	91	91
Heavy Vehicles, %	2	2	2	2	2	3
Mvmt Flow	113	97	111	18	15	159

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	129	0	-	0	443	120
Stage 1	-	-	-	-	120	-
Stage 2	-	-	-	-	323	-
Critical Hdwy	4.12	-	-	-	6.42	6.23
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.327
Pot Cap-1 Maneuver	1457	-	-	-	572	929
Stage 1	-	-	-	-	905	-
Stage 2	-	-	-	-	734	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1457	-	-	-	527	929
Mov Cap-2 Maneuver	-	-	-	-	527	-
Stage 1	-	-	-	-	834	-
Stage 2	-	-	-	-	734	-

Approach	EB	WB	SB
HCM Control Delay, s	4.1	0	10.2
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1457	-	-	-	871
HCM Lane V/C Ratio	0.078	-	-	-	0.201
HCM Control Delay (s)	7.7	-	-	-	10.2
HCM Lane LOS	A	-	-	-	B
HCM 95th %tile Q(veh)	0.3	-	-	-	0.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	59	52	14	41	47	136	25	1061	44	149	1275	100
Future Volume (veh/h)	59	52	14	41	47	136	25	1061	44	149	1275	100
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1856	1477	1259	1870	1442	1280	1870
Adj Flow Rate, veh/h	64	57	0	45	51	0	27	1153	0	162	1386	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	3	2	4	2	5	2	2
Cap, veh/h	113	75		93	87		83	989		93	1015	
Arrive On Green	0.11	0.11	0.00	0.10	0.10	0.00	0.03	0.79	0.00	0.04	0.79	0.00
Sat Flow, veh/h	739	701	1585	601	871	1572	1406	1259	1585	1373	1280	1585
Grp Volume(v), veh/h	121	0	0	96	0	0	27	1153	0	162	1386	0
Grp Sat Flow(s),veh/h/ln	1441	0	1585	1471	0	1572	1406	1259	1585	1373	1280	1585
Q Serve(g_s), s	3.4	0.0	0.0	0.0	0.0	0.0	0.6	126.5	0.0	5.7	127.8	0.0
Cycle Q Clear(g_c), s	13.5	0.0	0.0	10.1	0.0	0.0	0.6	126.5	0.0	5.7	127.8	0.0
Prop In Lane	0.53		1.00	0.47		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	187	0		180	0		83	989		93	1015	
V/C Ratio(X)	0.65	0.00		0.53	0.00		0.33	1.17		1.74	1.37	
Avail Cap(c_a), veh/h	225	0		218	0		94	989		93	1015	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	70.5	0.0	0.0	69.6	0.0	0.0	52.1	17.3	0.0	62.1	16.6	0.0
Incr Delay (d2), s/veh	4.7	0.0	0.0	2.4	0.0	0.0	2.3	85.9	0.0	372.3	170.7	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.2	0.0	0.0	4.0	0.0	0.0	0.9	51.5	0.0	13.5	76.1	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	75.2	0.0	0.0	72.0	0.0	0.0	54.3	103.2	0.0	434.4	187.3	0.0
LnGrp LOS	E	A		E	A		D	F		F	F	
Approach Vol, veh/h		121			96			1180			1548	
Approach Delay, s/veh		75.2			72.0			102.1			213.2	
Approach LOS		E			E			F			F	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.7	131.3		21.1	10.0	130.0		21.1
Change Period (Y+Rc), s	5.5	5.5		5.5	5.5	5.5		5.5
Max Green Setting (Gmax), s	4.5	124.5		19.5	4.5	124.5		19.5
Max Q Clear Time (g_c+I1), s	2.6	129.8		12.1	7.7	128.5		15.5
Green Ext Time (p_c), s	0.0	0.0		0.2	0.0	0.0		0.2

Intersection Summary		
HCM 6th Ctrl Delay		158.4
HCM 6th LOS		F

Notes

Unsignalized Delay for [NBR, EBR, WBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	1.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	106	21	8	103	1	15	0	2	3	0	2
Future Vol, veh/h	5	106	21	8	103	1	15	0	2	3	0	2
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	120	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	83	83	83	83	83	83	83	83	83	83	83	83
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	6	128	25	10	124	1	18	0	2	4	0	2

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	125	0	0	153	0	0	299	298	141	299	310	125
Stage 1	-	-	-	-	-	-	153	153	-	145	145	-
Stage 2	-	-	-	-	-	-	146	145	-	154	165	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1462	-	-	1428	-	-	653	614	907	653	605	926
Stage 1	-	-	-	-	-	-	849	771	-	858	777	-
Stage 2	-	-	-	-	-	-	857	777	-	848	762	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1462	-	-	1428	-	-	646	607	907	646	598	926
Mov Cap-2 Maneuver	-	-	-	-	-	-	646	607	-	646	598	-
Stage 1	-	-	-	-	-	-	846	768	-	855	772	-
Stage 2	-	-	-	-	-	-	849	772	-	842	759	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	0.5	10.6	9.9
HCM LOS			B	A

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	669	1462	-	-	1428	-	-	735
HCM Lane V/C Ratio	0.031	0.004	-	-	0.007	-	-	0.008
HCM Control Delay (s)	10.6	7.5	0	-	7.5	-	-	9.9
HCM Lane LOS	B	A	A	-	A	-	-	A
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0

Intersection	
Int Delay, s/veh	0.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	16	96	79	1111	1304	19
Future Vol, veh/h	16	96	79	1111	1304	19
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	130	0	420	-	-	500
Veh in Median Storage,	# 2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	2	2	2	4	3	2
Mvmt Flow	17	103	85	1195	1402	20

Major/Minor	Minor2		Major 1		Major 2	
Conflicting Flow All	2767	-	1402	0	-	0
Stage 1	1402	-	-	-	-	-
Stage 2	1365	-	-	-	-	-
Critical Hdwy	6.42	-	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.218	-	-	-
Pot Cap-1 Maneuver	21	0	487	-	-	-
Stage 1	228	0	-	-	-	-
Stage 2	237	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 17	-	487	-	-	-
Mov Cap-2 Maneuver	137	-	-	-	-	-
Stage 1	188	-	-	-	-	-
Stage 2	237	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	35	0.9	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	487	-	137	-	-	-
HCM Lane V/C Ratio	0.174	-	0.126	-	-	-
HCM Control Delay (s)	13.9	-	35	0	-	-
HCM Lane LOS	B	-	E	A	-	-
HCM 95th %tile Q(veh)	0.6	-	0.4	-	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	2.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	20	826	323	1050	1138	37
Future Vol, veh/h	20	826	323	1050	1138	37
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	150	0	450	-	-	500
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	2	3	3	2
Mvmt Flow	21	860	336	1094	1185	39

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2951	-	1185	0	-	0
Stage 1	1185	-	-	-	-	-
Stage 2	1766	-	-	-	-	-
Critical Hdwy	6.42	-	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.218	-	-	-
Pot Cap-1 Maneuver	~ 16	0	589	-	-	-
Stage 1	290	0	-	-	-	-
Stage 2	150	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 7	-	589	-	-	-
Mov Cap-2 Maneuver	88	-	-	-	-	-
Stage 1	125	-	-	-	-	-
Stage 2	150	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	58.2	4.5	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	589	-	88	-	-	-
HCM Lane V/C Ratio	0.571	-	0.237	-	-	-
HCM Control Delay (s)	18.9	-	58.2	0	-	-
HCM Lane LOS	C	-	F	A	-	-
HCM 95th %tile Q(veh)	3.6	-	0.8	-	-	-

Notes			
~: Volume exceeds	$: Delay exceeds	+: Computation Not	*: All major volume in platoon

capacity	300s	Defined

Intersection	
Int Delay, s/veh	0.6

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	10	16	567	32	54	869
Future Vol, veh/h	10	16	567	32	54	869
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	0	-
Veh in Median Storage, #	2	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	11	17	616	35	59	945

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1697	634	0	0	651	0
Stage 1	634	-	-	-	-	-
Stage 2	1063	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	102	479	-	-	935	-
Stage 1	529	-	-	-	-	-
Stage 2	332	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	96	479	-	-	935	-
Mov Cap-2 Maneuver	266	-	-	-	-	-
Stage 1	529	-	-	-	-	-
Stage 2	311	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	15.2	0	0.5
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	266	479	935	-
HCM Lane V/C Ratio	-	-	0.041	0.036	0.063	-
HCM Control Delay (s)	-	-	19.1	12.8	9.1	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.1	0.1	0.2	-

APPENDIX C: SIGNAL WARRANT WORKSHEETS

FEHR PEERS

Major Street		Project	
Minor Street		Scenario	
		Peak Hour	

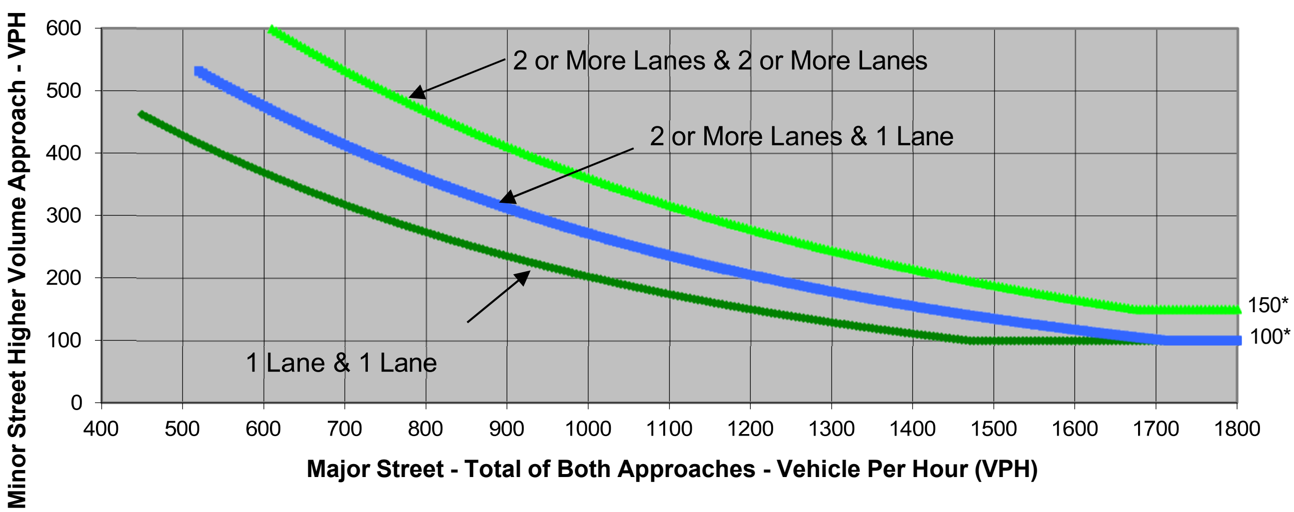
Turn Movement Volumes

	NB	SB	EB	WB
Left				
Through				
Right				
Total	1,226	1,062	17	0

Major Street Direction

x	North/South
	East/West

Warrant 3B, Peak Hour



* Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

Source: *California Manual on Uniform Traffic Control Devices*, Caltrans, 2014

	Major Street Queen Ka'ahumanu	Minor Street Kuakini Hwy	Warrant Met
Number of Approach Lanes	**2**	**1**	**NO**
Traffic Volume (VPH) *	**2,288**	**17**	

* Note: Traffic Volume for Major Street is Total Volume of Both Approches.
Traffic Volume for Minor Street is the Volume of High Volume Approach.

Major Street
Minor Street

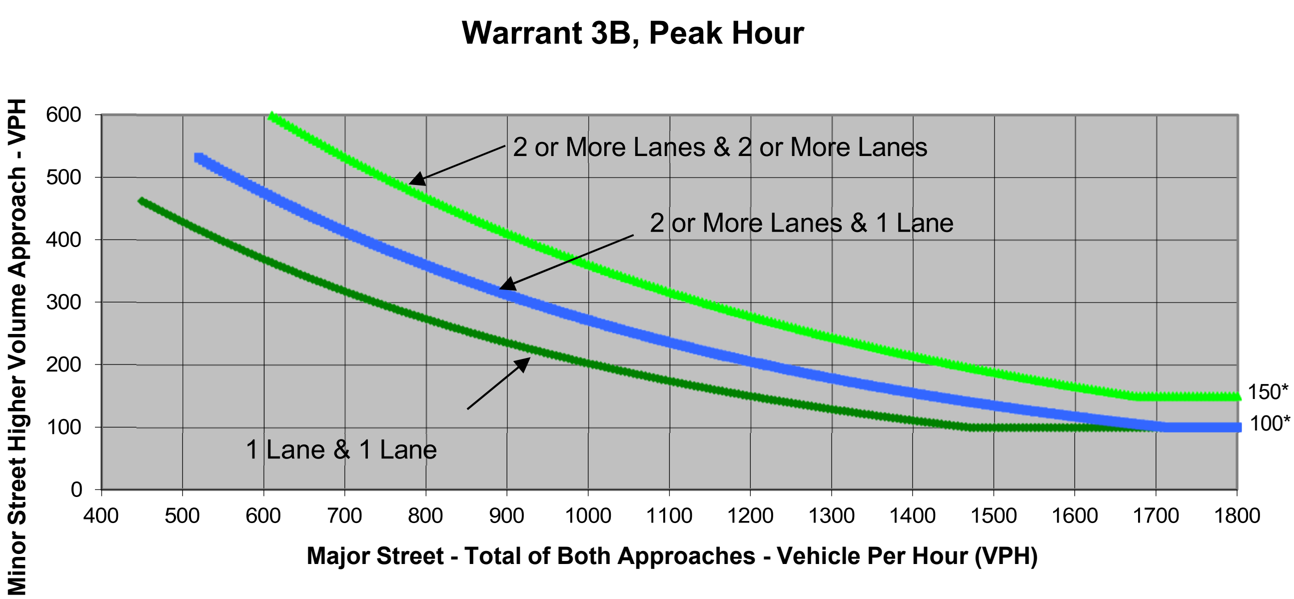
Project
Scenario
Peak Hour

Turn Movement Volumes

	NB	SB	EB	WB
Left				
Through				
Right				
Total	1,298	1,117	18	0

Major Street Direction

x	North/South
	East/West



* Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

Source: *California Manual on Uniform Traffic Control Devices*, Caltrans, 2014

	Major Street Queen Ka'ahumanu	Minor Street Kuakini Hwy	Warrant Met
Number of Approach Lanes	**2**	**1**	**<u>NO</u>**
Traffic Volume (VPH) *	**2,415**	**18**	

* Note: Traffic Volume for Major Street is Total Volume of Both Approches.
Traffic Volume for Minor Street is the Volume of High Volume Approach.

Major Street	
Minor Street	

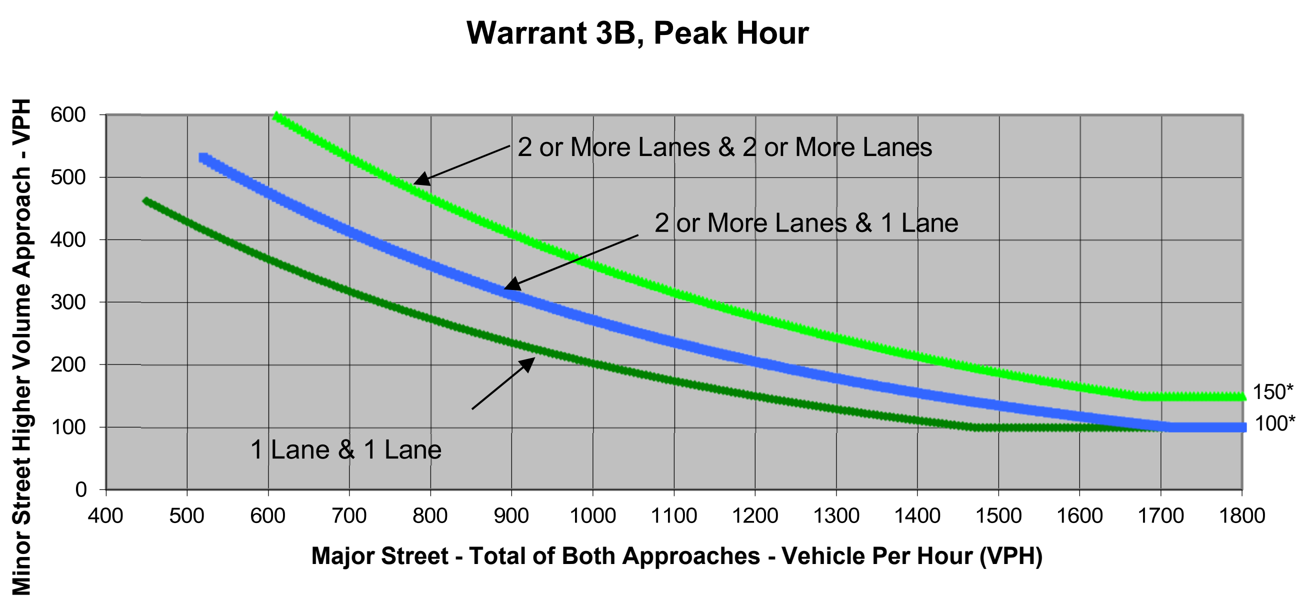
Project	
Scenario	
Peak Hour	

Turn Movement Volumes

	NB	SB	EB	WB
Left				
Through				
Right				
Total	1,373	1,175	20	0

Major Street Direction

x	North/South
	East/West



* Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

Source: *California Manual on Uniform Traffic Control Devices*, Caltrans, 2014

	Major Street Queen Ka'ahumanu	Minor Street Kuakini Hwy	Warrant Met
Number of Approach Lanes	**2**	**1**	**NO**
Traffic Volume (VPH) *	**2,548**	**20**	

* Note: Traffic Volume for Major Street is Total Volume of Both Approches.
Traffic Volume for Minor Street is the Volume of High Volume Approach.

FEHR & PEERS

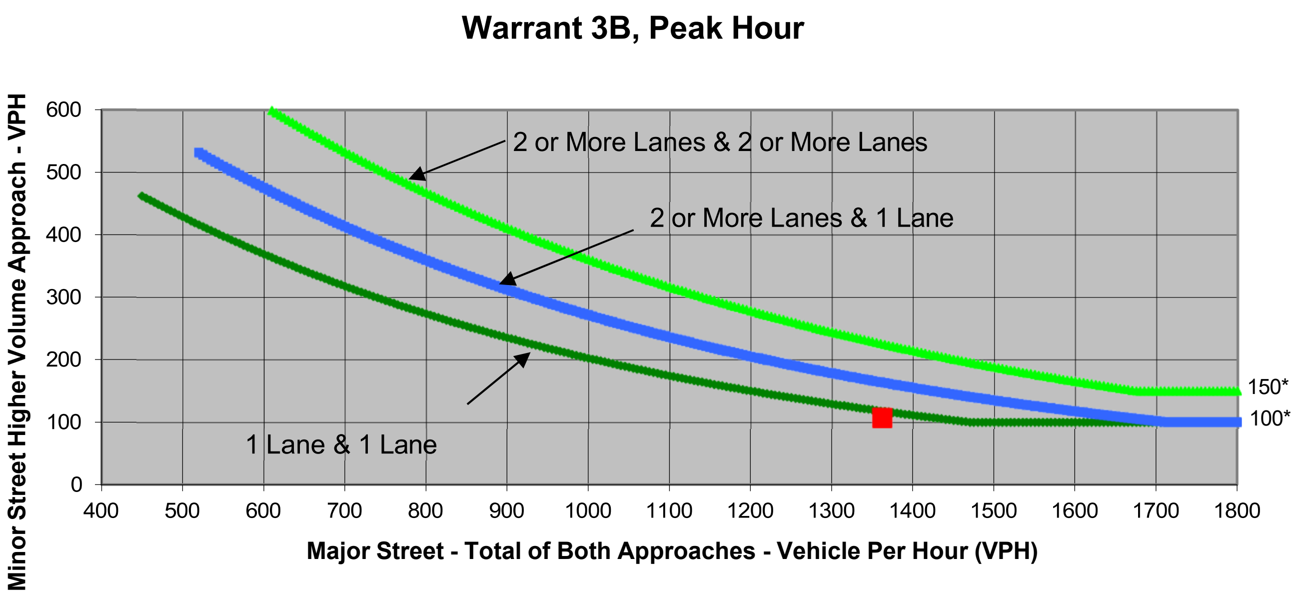
Major Street	Kuakini Hwy		Project	University of Nations Kona
Minor Street	UofN Campus North Entrance		Scenario	Year 2030 + Project
			Peak Hour	PM Peak Periods

Turn Movement Volumes

	NB	SB	EB	WB
Left	0	64	0	24
Through	490	782	0	0
Right	26	0	0	83
Total	516	846	0	107

Major Street Direction

x	North/South
	East/West



* Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

Source: *California Manual on Uniform Traffic Control Devices*, Caltrans, 2014

	Major Street Kuakini Hwy	Minor Street UofN Campus North Entrance	Warrant Met
Number of Approach Lanes	**2**	**1**	**NO**
Traffic Volume (VPH) *	**1,362**	**107**	

* Note: Traffic Volume for Major Street is Total Volume of Both Approches.
Traffic Volume for Minor Street is the Volume of High Volume Approach.

FEHR & PEERS

Major Street	Kuakini Hwy
Minor Street	UofN Campus North Entrance

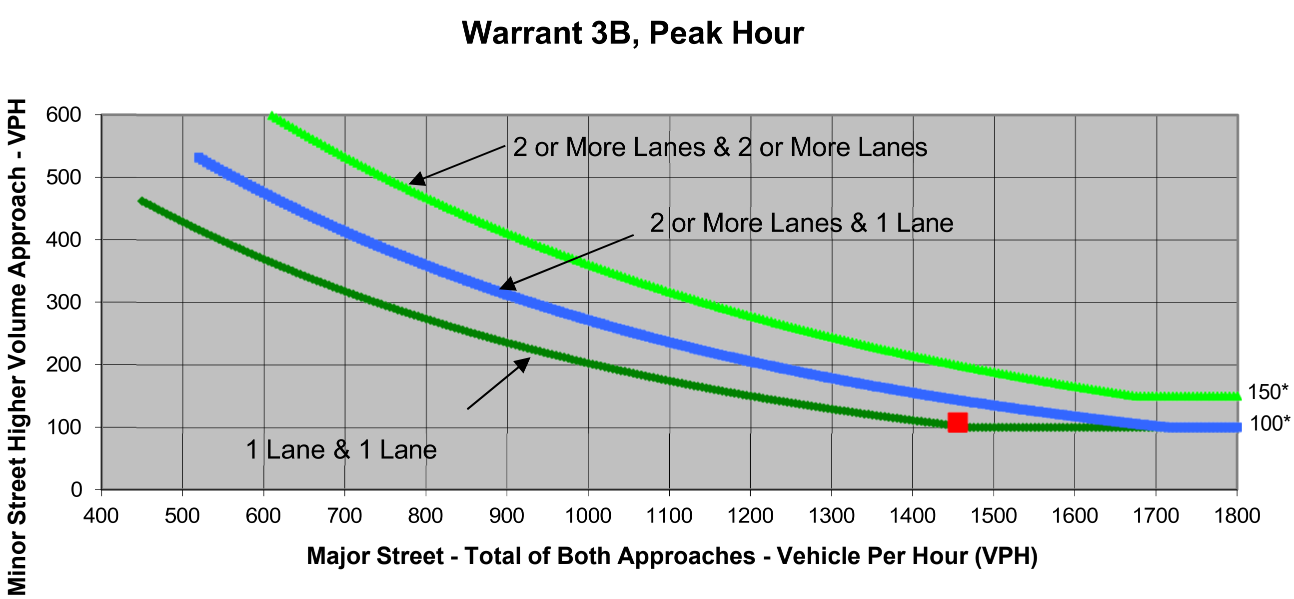
Project	University of Nations Kona
Scenario	Year 2040 + Project
Peak Hour	PM Peak Periods

Turn Movement Volumes

	NB	SB	EB	WB
Left	0	68	0	24
Through	520	839	0	0
Right	28	0	0	84
Total	548	907	0	108

Major Street Direction

x	North/South
	East/West



* Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

Source: *California Manual on Uniform Traffic Control Devices*, Caltrans, 2014

	Major Street Kuakini Hwy	Minor Street UofN Campus North Entrance	Warrant Met
Number of Approach Lanes	**2**	**1**	**NO**
Traffic Volume (VPH) *	**1,455**	**108**	

* Note: Traffic Volume for Major Street is Total Volume of Both Approches.
Traffic Volume for Minor Street is the Volume of High Volume Approach.

FEHR PEERS

Major Street	Kuakini Hwy	Project	University of Nations Kona
Minor Street	UofN Campus North Entrance	Scenario	Year 2050 + Project
		Peak Hour	PM Peak Periods

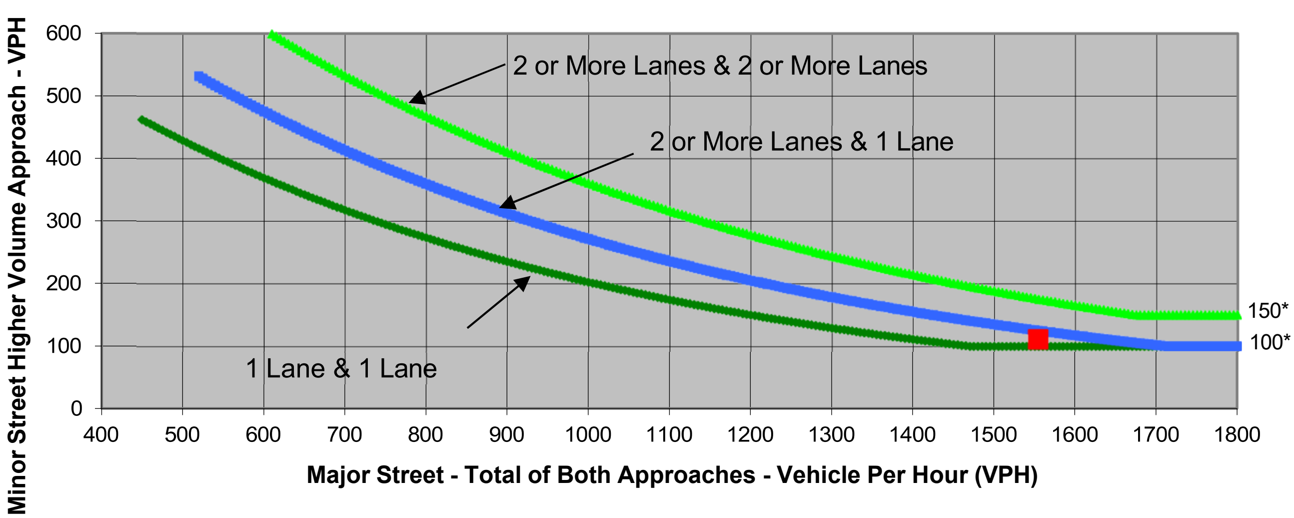
Turn Movement Volumes

	NB	SB	EB	WB
Left	0	73	0	25
Through	553	898	0	0
Right	30	0	0	86
Total	583	971	0	111

Major Street Direction

x	North/South
	East/West

Warrant 3B, Peak Hour



* Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

Source: *California Manual on Uniform Traffic Control Devices*, Caltrans, 2014

	Major Street Kuakini Hwy	Minor Street UofN Campus North Entrance	Warrant Met
Number of Approach Lanes	**2**	**1**	**NO**
Traffic Volume (VPH) *	**1,554**	**111**	

* Note: Traffic Volume for Major Street is Total Volume of Both Approches.
Traffic Volume for Minor Street is the Volume of High Volume Approach.

Eight-Hour Vehicular Volume

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1	1	750	600	525	420	75	60	53	42
2 or more	1	900	720	630	504	75	60	53	42
2 or more	2 or more	900	720	630	504	100	80	70	56
1	2 or more	750	600	525	420	100	80	70	56

[a] Basic minimum hourly volume
[b] Used for combination of Conditions A and B after adequate trial of other remedial measures
[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] May be used for combination of Conditions A and B after adequate trial of other remedial measures when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000

Intersection: 2. Kuakini Hwy & North Campus Entrance (Year 2050+Project Conditions)			
Time Period	**Major Street**	**Minor Street**	**Met Criteria?**
6:00 AM -7:00 AM	2723	15	No
7:00 AM -8:00 AM	2476	11	No
8:00 AM -9:00 AM	2599	13	No
9:00 AM -10:00 AM	2599	13	No
2:00 PM - 3:00 PM	2511	20	No
3:00 PM - 4:00 PM	2341	21	No
4:00 PM - 5:00 PM	2045	15	No
5:00 PM - 6:00 PM	2299	19	No

Intersection: 7. Queen Ka'ahumanu Hwy & Kuakini Hwy (Year 2050+Project Conditions)			
Time Period	**Major Street**	**Minor Street**	**Met Criteria?**
6:00 AM -7:00 AM	1148	18	No
7:00 AM -8:00 AM	1113	18	No
8:00 AM -9:00 AM	1130	18	No
9:00 AM -10:00 AM	1130	18	No
2:00 PM - 3:00 PM	1578	25	No
3:00 PM - 4:00 PM	1714	25	No
4:00 PM - 5:00 PM	1528	25	No
5:00 PM - 6:00 PM	1606	25	No

APPENDIX D: LOS WORKSHEETS (PLUS MITIGATION)

Intersection						
Int Delay, s/veh	1.8					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	13	55	586	67	99	326
Future Vol, veh/h	13	55	586	67	99	326
Conflicting Peds, #/hr	0	2	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Stop	-	None	-	None
Storage Length	0	100	-	-	120	-
Veh in Median Storage, #	1	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	84	84	84	84	84	84
Heavy Vehicles, %	2	2	3	2	2	2
Mvmt Flow	15	65	698	80	118	388

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1362	740	0	0	778	0
Stage 1	738	-	-	-	-	-
Stage 2	624	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	163	417	-	-	839	-
Stage 1	473	-	-	-	-	-
Stage 2	534	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	140	416	-	-	839	-
Mov Cap-2 Maneuver	277	-	-	-	-	-
Stage 1	473	-	-	-	-	-
Stage 2	459	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	16	0	2.3
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	277	416	839	-
HCM Lane V/C Ratio	-	-	0.056	0.157	0.14	-
HCM Control Delay (s)	-	-	18.8	15.3	10	-
HCM Lane LOS	-	-	C	C	A	-
HCM 95th %tile Q(veh)	-	-	0.2	0.6	0.5	-

Intersection						
Int Delay, s/veh	1.5					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	24	83	490	26	64	782
Future Vol, veh/h	24	83	490	26	64	782
Conflicting Peds, #/hr	0	0	0	2	2	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Stop	-	None	-	None
Storage Length	0	100	-	-	120	-
Veh in Median Storage, #	1	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	26	88	521	28	68	832

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1505	537	0	0	551	0
Stage 1	537	-	-	-	-	-
Stage 2	968	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	133	544	-	-	1019	-
Stage 1	586	-	-	-	-	-
Stage 2	368	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	124	543	-	-	1017	-
Mov Cap-2 Maneuver	249	-	-	-	-	-
Stage 1	585	-	-	-	-	-
Stage 2	343	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	14.7	0	0.7
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	249	543	1017	-
HCM Lane V/C Ratio	-	-	0.103	0.163	0.067	-
HCM Control Delay (s)	-	-	21.1	12.9	8.8	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.3	0.6	0.2	-

Intersection						
Int Delay, s/veh	1.9					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	15	59	630	67	100	344
Future Vol, veh/h	15	59	630	67	100	344
Conflicting Peds, #/hr	0	2	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Stop	-	None	-	None
Storage Length	0	100	-	-	120	-
Veh in Median Storage, #	1	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	84	84	84	84	84	84
Heavy Vehicles, %	2	2	3	2	2	2
Mvmt Flow	18	70	750	80	119	410

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1438	792	0	0	830	0
Stage 1	790	-	-	-	-	-
Stage 2	648	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	147	389	-	-	802	-
Stage 1	447	-	-	-	-	-
Stage 2	521	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	125	388	-	-	802	-
Mov Cap-2 Maneuver	260	-	-	-	-	-
Stage 1	447	-	-	-	-	-
Stage 2	444	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	17	0	2.3
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	260	388	802	-
HCM Lane V/C Ratio	-	-	0.069	0.181	0.148	-
HCM Control Delay (s)	-	-	19.9	16.3	10.3	-
HCM Lane LOS	-	-	C	C	B	-
HCM 95th %tile Q(veh)	-	-	0.2	0.7	0.5	-

Intersection	
Int Delay, s/veh	1.5

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	24	84	520	28	68	839
Future Vol, veh/h	24	84	520	28	68	839
Conflicting Peds, #/hr	0	0	0	2	2	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Stop	-	None	-	None
Storage Length	0	100	-	-	120	-
Veh in Median Storage, #	1	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	26	89	553	30	72	893

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1607	570	0	0	585	0
Stage 1	570	-	-	-	-	-
Stage 2	1037	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	116	521	-	-	990	-
Stage 1	566	-	-	-	-	-
Stage 2	342	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	107	520	-	-	988	-
Mov Cap-2 Maneuver	229	-	-	-	-	-
Stage 1	565	-	-	-	-	-
Stage 2	317	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	15.5	0	0.7
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	229	520	988	-
HCM Lane V/C Ratio	-	-	0.111	0.172	0.073	-
HCM Control Delay (s)	-	-	22.7	13.4	8.9	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.4	0.6	0.2	-

Intersection	
Int Delay, s/veh	2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	18	63	678	68	102	368
Future Vol, veh/h	18	63	678	68	102	368
Conflicting Peds, #/hr	0	2	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Stop	-	None	-	None
Storage Length	0	100	-	-	120	-
Veh in Median Storage, #	1	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	84	84	84	84	84	84
Heavy Vehicles, %	2	2	3	2	2	2
Mvmt Flow	21	75	807	81	121	438

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1528	850	0	0	888	0
Stage 1	848	-	-	-	-	-
Stage 2	680	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	129	360	-	-	763	-
Stage 1	420	-	-	-	-	-
Stage 2	503	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	108	359	-	-	763	-
Mov Cap-2 Maneuver	242	-	-	-	-	-
Stage 1	420	-	-	-	-	-
Stage 2	423	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	18.5	0	2.3
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	242	359	763	-
HCM Lane V/C Ratio	-	-	0.089	0.209	0.159	-
HCM Control Delay (s)	-	-	21.3	17.7	10.6	-
HCM Lane LOS	-	-	C	C	B	-
HCM 95th %tile Q(veh)	-	-	0.3	0.8	0.6	-

Intersection	
Int Delay, s/veh	1.5

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	25	86	553	30	73	898
Future Vol, veh/h	25	86	553	30	73	898
Conflicting Peds, #/hr	0	0	0	2	2	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Stop	-	None	-	None
Storage Length	0	100	-	-	120	-
Veh in Median Storage, #	1	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	27	91	588	32	78	955

Major/Minor	Minor 1		Major 1		Major 2	
Conflicting Flow All	1717	606	0	0	622	0
Stage 1	606	-	-	-	-	-
Stage 2	1111	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	99	497	-	-	959	-
Stage 1	545	-	-	-	-	-
Stage 2	315	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	91	496	-	-	957	-
Mov Cap-2 Maneuver	209	-	-	-	-	-
Stage 1	544	-	-	-	-	-
Stage 2	289	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	16.3	0	0.7
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	209	496	957	-
HCM Lane V/C Ratio	-	-	0.127	0.184	0.081	-
HCM Control Delay (s)	-	-	24.7	13.9	9.1	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.4	0.7	0.3	-

Appendix J.1

2003 Archaeological Inventory Survey of TMKs (3) 7-5-10:085 and (3) 7-5-017:06, August, 2003

RC-0153

An Archaeological Inventory Survey of TMKs: 3-7-5-10:85 and 3-7-5-17:06

Wai'aha Ahupua'a
North Kona District
Island of Hawai'i

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RC-0153

An Archaeological Inventory Survey of TMKs: 3-7-5-10:85 and 3-7-5-17:06

Wai'aha Ahupua'a
North Kona District
Island of Hawai'i

RECHTMAN CONSULTING

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INTRODUCTION

At the request of Mr. George Atta of Group 70 International, on behalf of his client Mr. Mark Spangler of U of N BENCORP, Rechtman Consulting, LLC conducted an archaeological inventory survey of a roughly 62-acre parcel (TMK:3-7-5-10:85 and 3-7-5-17:06) along Kuakini Highway in Wai'aha Ahupua'a, North Kona District, Island of Hawai'i (Figure 1). This survey was undertaken in accordance with draft Hawai'i Administrative Rules 13§13–284, dated 10/15/98, and was performed in compliance with the Rules Governing Minimal Standards for Archaeological Inventory Surveys and Reports as contained in draft Hawai'i Administrative Rules 13§13–276. Compliance with the above standards is sufficient for meeting the initial historic preservation review process requirements of both the Department of Land and Natural Resources–State Historic Preservation Division (DLNR–SHPD) and the County of Hawai'i Planning Department.

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

BACKGROUND

To generate expectations regarding the nature of the historic properties that might exist on the study parcel, and to provide an appropriate background to assess any resources that are encountered, the specific as well as general physical and cultural contexts are presented along with prior archaeological studies relevant to the project area.

Project Area Description

The current study area is bounded to the east by land (part of the same TMK parcel) that has reportedly (Corbin and Rosendahl 2002) already been inspected by a DLNR-SHPD representative (Mr. Marc Smith) and given historic preservation clearance; to the north by a stone wall along the Wai'aha 1st/Pua'a 3rd boundary; to the south by a stone wall in Wai'aha 2nd Ahupua'a just south of the Wai'aha 1st boundary along the edge of TMK: 3-7-5-17:6 and by an existing residential development where the wall no longer stands; and to the west by a stone wall along the *mauka* edge Kuakini Highway (Figure 2). Terrain in the project area is gently undulating and elevation ranges from 100 to 240 feet above sea level. Two soils characterize the project area, Wai'aha extremely stony silt loam and Punalu'u extremely rocky peat (Sato et al. 1973). Both are well-drained, thin organic soils over bedrock. The underlying bedrock is *pāhoehoe* within the western third of the project area transitioning to *'a'ā in* the eastern two-thirds; the flows date to more than 5,000 years BP (Wolfe and Morris 1996).

Despite the seemingly consistent semi-arid condition of this area, seasonality is evident. Throughout the Hawaiian Islands, the warmer and drier summer months, traditionally referenced as *kau*, extend from May to September, and the wetter, cooler months (*ho'oilo*) extend from October to April (Handy and Handy 1972). The temperatures in the Kona area are generally consistent with this seasonal pattern, ranging between 62–80 degrees in winter and 68–86 degrees in summer (Schilt 1984). However, the typical rainfall pattern differs considerably from that seen elsewhere; in all elevations along the Kona coast, rainfall during *kau* is typically greater than that during *ho'oilo* (Schilt 1984).

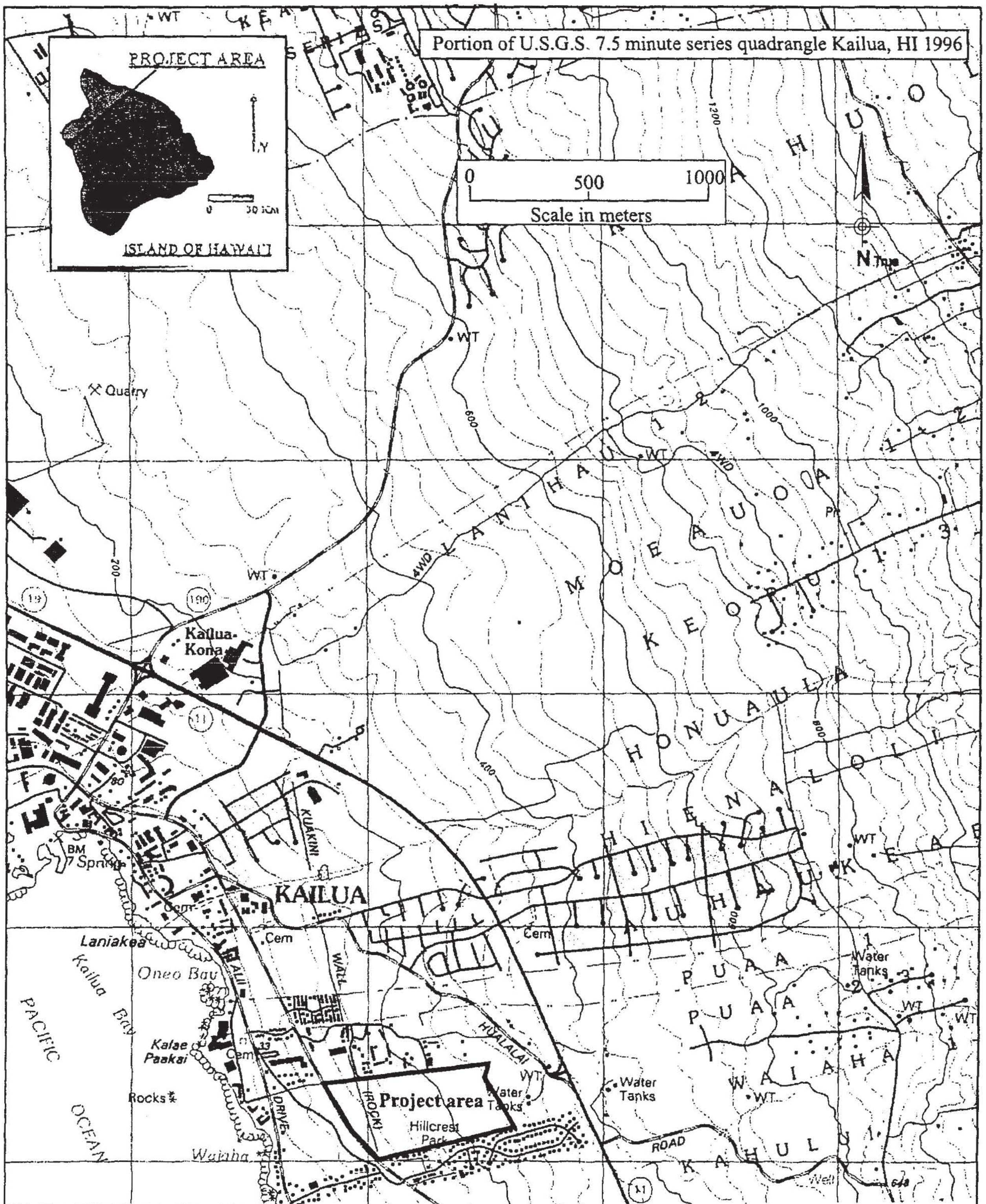
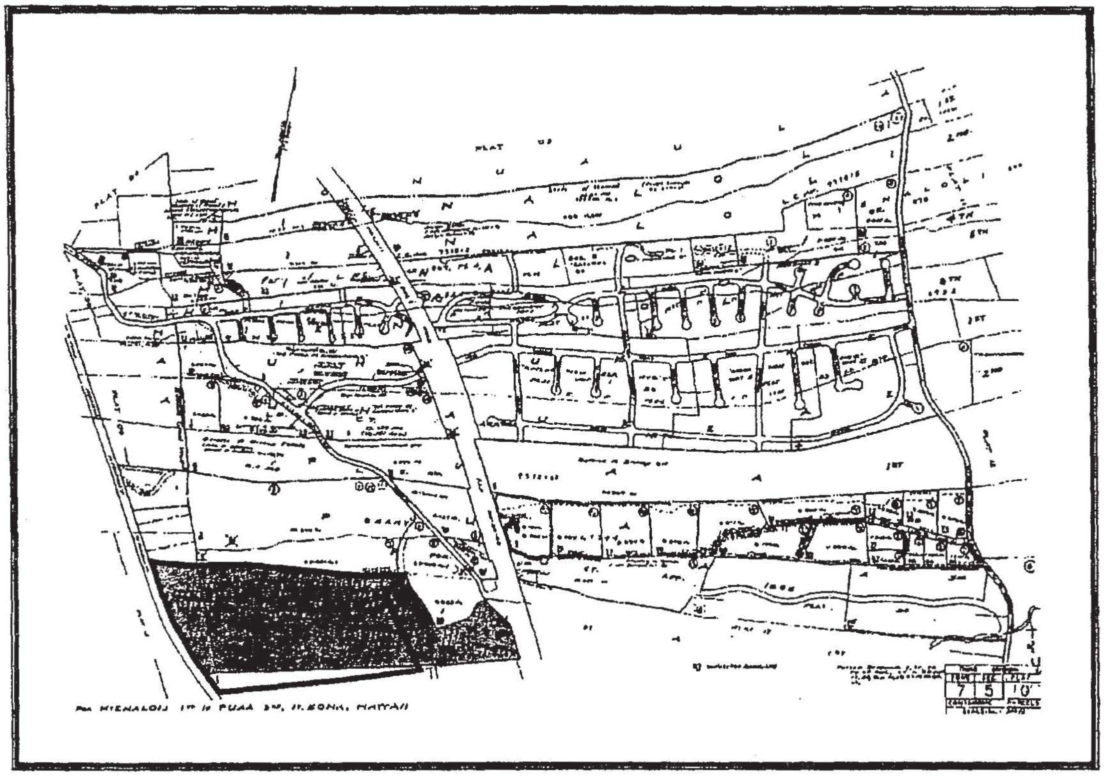


Figure 1. Project area location.



↑TMK:3-7-5-10:85 = Study area = U of N BENCORP parcels TMK:3-7-5-17:06↓

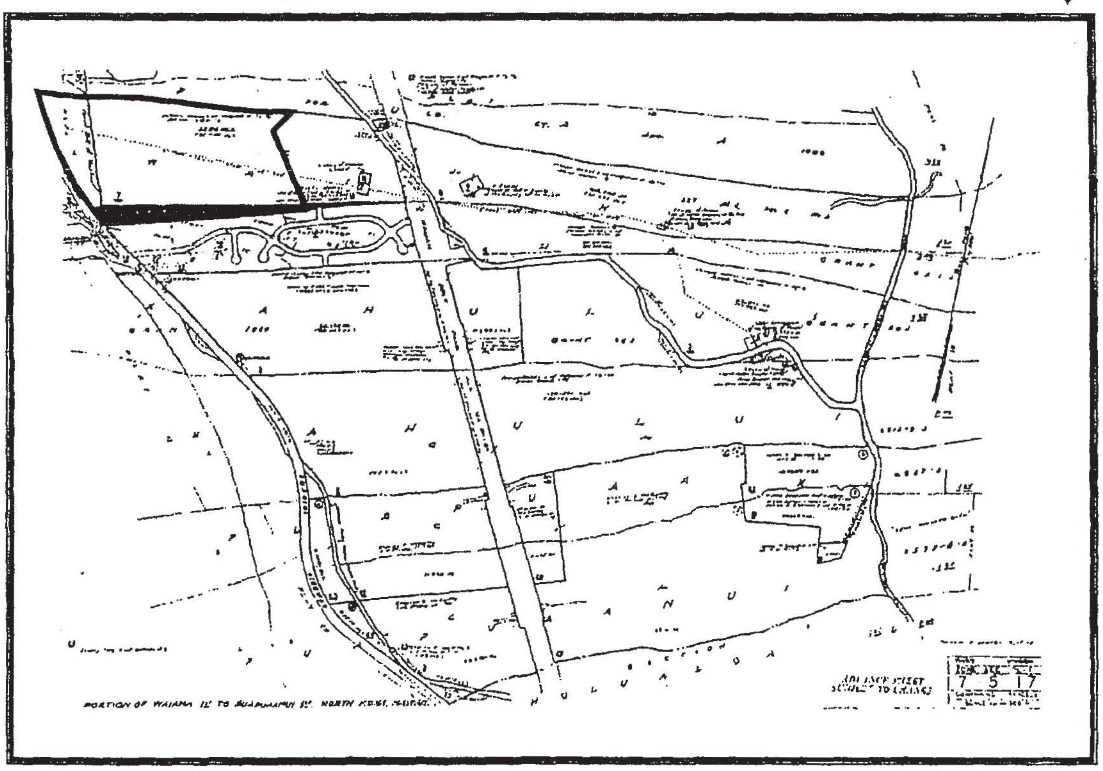


Figure 2. Tax Map Keys: 3-7-5-10 and 17 showing current project area (parcels 85 and 10).

Two historically introduced species, *kiawe* (*Prosopis pallida*) and *koa haole* (*Leucaena glauca*) dominate the vegetation within the project area. A variety of grasses, vines, weeds, and shrubs are also present. Prior impacts within the project area can be described as substantial. Mechanical earth moving is evident as a graded road (no longer in use) corresponding to a waterline easement running *mauka/makai* through the property.

Cultural Contexts

The project area is in the coastal edge of what has been termed the Kona Field System (Cordy 1995, Newman 1970, Schilt 1984). Below we present the current accepted "orthodox" view of this system; however, for a critical analysis of the utility of this construct see discussion beginning page 11. This area extends north at least to Kaū Ahupua'a and south to Honaunau, west from the coastline and east to the forested slopes of Hualālai (Cordy 1995). A large portion of this area is designated in the Hawai'i SIHP (State Inventory of Historic Places) as Site 50-10-37-6601 and has been determined eligible for inclusion in the National Register of Historic Places. The basic characteristics and elevationally delimited zones within this agricultural/residential system as presented in Newman (1970) have been confirmed and elaborated on by ethnohistorical investigations (Kelly 1983).

The current study parcel is in the *kula* zone. This is the area from sea level to 150 meters elevation. Annual rainfall in the *kula* zone is 75 to 125 centimeters. This lower elevation zone is traditionally associated with habitation and the cultivation of sweet potatoes, paper mulberry, and gourds. Agricultural features, such as clearing mounds, planting mounds, planting depressions, modified outcrops, pavements, enclosures, and planting terraces, are common throughout much of this zone (Hammatt and Clark 1980, Hammatt and Folk 1980, Haun et al. 1998, Schilt 1984). Dwellings were scattered throughout the agricultural portion of the *kula*, but they are commonly concentrated along the shoreline (Cordy 1981, Hammatt 1980). The shoreline zone, extending inland approximately 200 meters, was used primarily for permanent habitation and other non-agricultural activities, such as canoe storage, ceremonial and burial practices, recreation, and fishing-related activity. Mao or Nalupo'o Heiau (SIHP 3834) was recorded along the sandy beach shoreline of Wai'aha Ahupua'a (Stokes and Dye 1991).

Royal and high chiefly centers were also situated within the shoreline of the *kula*. These complexes included dwellings for chiefs and their entourage, places of refuge, and other structures. Several large and densely populated royal centers were located along the shoreline between Kailua and Honaunau (Cordy 1995, Tomonari-Tuggle 1993). A variety of non-residential features are present in the *kula* near royal centers, including small agricultural plots, and formal and informal burial features (Cordy 1995, Han et al. 1986, Schilt 1984, Tainter 1973, Tomanari-Tuggle 1993).

Nineteenth century habitation features built on stone platforms were present in the *kula* (Hammatt and Meeker 1979, Schilt 1984). Stone platforms with clearly defined internal divisions are present (O'Hare and Wolforth 1997) and probably reflect a change in residential plans from a complex of multiple, separate, single-function structures (men's sleeping, women's sleeping, cooking) to a single structure with multiple rooms and functions (entire family's quarters and cooking) (Ladefoged 1991). Burial features with historic-era artifacts and architecture (i.e., mortar and corrugated tin) are present in the lower elevations. These are frequently isolated structures, but burial also occurred within residential platforms during the Historic Period (O'Hare and Wolforth 1997).

During the early nineteenth century, following the breaking of the traditional eating *kapu* by Liholiho, Ka'ahumanu, and the Queen mother Keopuolani, which was a symbolic gesture that led to the demise of the entire Hawaiian religious system, the older places of worship (*heiau*) no longer held their significance. Many such places were dismantled, and the stones used for other building projects such as the Kuakini Wall, which bisects the current project area.

The religious, socioeconomic, and demographic changes that took place in the period between 1790 and the 1840s, promoted the establishment of a Euro-American style of land ownership, and the Great *Māhele* was the vehicle for determining ownership of the native land. During this period (1848-1899), the *Māhele* defined the land interests of the King (Kamehameha III), the high-ranking chiefs, and the low-ranking chiefs, the *konohiki*. The chiefs and *konohiki* were required to present their claims to the Land Commission to receive awards for lands provided to them by Kamehameha III. They were also required to provide commutations to the government in order to receive royal patents on their awards. The lands were identified by name only, with the understanding that the ancient boundaries would prevail until the land could be surveyed. This process expedited the work of the Land Commission and speeded the transfers (Chinen 1961:13).

During this process all lands were placed in one of three categories: Crown Lands (for the occupant of the throne), Government Lands, and Konohiki Lands. All three types of land were subject to the rights of the native tenants. Commoners could make claims for land, and if substantiated, they would receive awards referred to as *kuleana*, from the Land Commission. During this period, other land grants were also made to individuals directly from the Kingdom. In 1862, the Commission of Boundaries (Boundary Commission) was established in the Kingdom of Hawai'i to legally set the boundaries of all the *ahupua'a* that had been awarded as a part of the *Māhele*. Subsequently, in 1874, the Commissioners of Boundaries was authorized to certify the boundaries for lands brought before them. The primary informants for the boundary descriptions were old native residents of the lands, many of which had also been claimants for *kuleana* during the *Māhele*. The information was collected primarily between 1873 and 1885. The testimonies were generally given in Hawaiian and simultaneously transcribed in English.

The Missionary William Ellis visited the vicinity of the current project area in 1823 and described the following:

> Leaving Kairua [Kailua], we passed through the villages thickly scattered along the shore to the southward. The country around looked unusually green and cheerful, owing to the frequent rain, which for some months past have fallen on this side of the island. Even the barren lava, over which we traveled, seemed to veil its sterility beneath frequent tufts of tall waving grass, or spreading shrubs and flowers.
>
> The side of the hills, laid out for a considerable extent in gardens and fields, and generally cultivated with potatoes, and other vegetables, were beautiful.
>
> The number of heiaus, and depositories of the dead, which we passed, convinced us that this part of the island must formerly have been populous. The latter were built with fragments of lava, laid up evenly on the outside, generally about eight feet long, from four to six broad, and about four feet high. Some appeared very ancient, other had evidently been standing but a few years. (1963[1823]:72–73).

In 1823 and 1824, Queen Ka'ahumanu granted Rev. Thurston and Rev. Bishop the right to establish missions and schools in Wai'aha. Later, during the *Māhele* the majority Wai'aha 1st was awarded to the American Board of Commissioners for Foreign Missions (LCAw. 387). There were no *kuleana* awards made within the project area. Wai'aha is generally considered to have been a place of high-status residences and ceremonial complexes, and Queen Emma lived in the *ahupua'a* in her later years. Her house and other landmarks are shown on an early (1880s) Hawaii Territory Survey map (Figure 3).

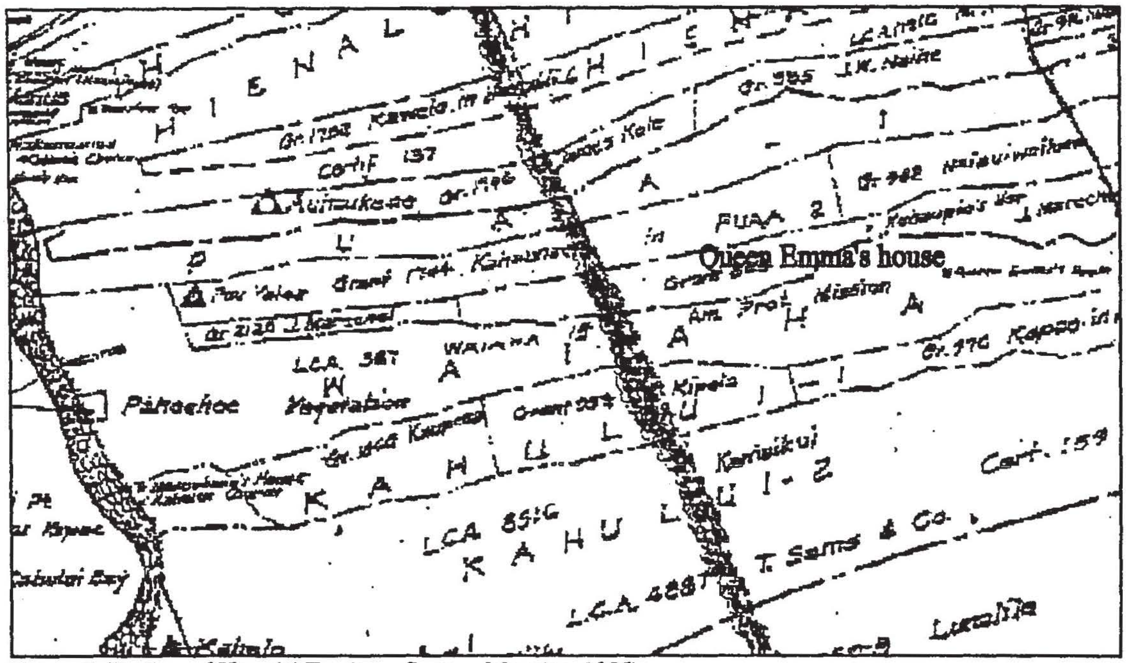


Figure 3. Portion of Hawai'i Territory Survey Map (ca. 1885).

Population declined and settlements became smaller in the Kona area during the Territorial Period (1900–1959). Coastal occupation was concentrated in the small villages of Kailua and Keauhou, with permanent residences with gardens and animal pens scattered along the shoreline. Upland habitation was associated with agricultural and ranching pursuits. More walls were added to the *kula* as cattle pastures expanded into the lower elevations during this period. In 1927, Manuel Gomes acquired the Wai'aha *ahupua'a*, along with the Kahului *ahupua'a*, from the failed Kona Sugar Company (O'Hare and Wolforth 1997). The land became part of the Gomes Ranch and was actively used for cattle grazing and stockading unitl the 1960s. Several of the stone walls seen in the study area today are a legacy of the Gomes Ranch.

Prior Archaeological Studies and Project Expectations

A number of archaeological surveys have been conducted in Wai'aha Ahupua'a, and a significant amount of work has been conducted in adjacent land divisions (see Head et al. 1994 and Haun et al. 1998 for a thorough overview). The findings of the prior investigations allow for a comprehensive portrayal of past land use and settlement patterns for the area. The coastal *kula* areas of greater Kailua-Kona contain numerous late prehistoric and early historic residential sites. Many of these were associated with the more privileged members of Hawaiian society. Also known to exist in this region are *heiau* and burial features. Such sites are known from both historic records and archaeological investigation. In fact, within coastal Wai'aha (*makai* of the current study area) was Ma'o Heiau (Pukui et al. 1974, Thrum 1909), a *heiau kâlua ua* built to control rain. Wai'aha may indeed derive its name ("gathering water") from the association with this *heiau* (Pukui et al. 1974:219). Burial sites both within habitation features and in dedicated burial features are not uncommon in the area (O'Hare and Wolforth 1997, Walker et al. 1996). Also common in this area are small agricultural features, most often associated with the residential sites, but not always. Historic Period sites, frequently related to cattle ranching, also left their mark on the landscape; stone walls and cattle enclosures are found consistently along the area *mauka* of present day Ali'i Drive (former *ala loa*).

One of the most proximate studies to the current project area was an archaeological inventory survey conducted by Rechtman Consulting, LLC on a 19-acre parcel *makai* of Kuakini Highway within Wai'aha 1st Ahupua'a (Rechtman 2000). Small portions of this property had also been previously surveyed (Head et al. 1994) and data recovered (Walker et al. 1996) as part of a sewer easement mitigation project. Of the twenty-nine sites recorded on the 19-acre parcel, twenty-eight were extant at the time of the Rechtman (2000) study. One of these twenty-eight was not considered to be a cultural site (SIHP 15525). Twelve of the remaining twenty-eight sites likely dated to the pre-Contact period; two of these were agricultural sites (SIHP 21992 and 22065), nine were habitation sites (SIHP 15517, 15518, 15521, 15524, 21991, 22067, 22068, 22069, and 22070), and one was a habitation/burial site (SIHP 15507). Three sites (SIHP 21994, 21996, and 22063) seemed to date from the late pre-Contact/early Historic Period, and all may have been associated with one another. All three of these latter sites also seemed to have religious importance, and human remains were discovered at one of them (SIHP 22063). Twelve of the twenty-eight sites dated to the Historic Period. All of these sites were walls or enclosures likely associated with cattle ranching during the early and middle twentieth century.

The current project area had been previously studied as part of a reconnaissance survey (Corbin and Rosendahl 2002) and burial-testing program (Rosendahl 2002) conducted by PHRI (Paul H. Rosendahl Ph.D., Inc.). As a result of the reconnaissance survey Corbin and Rosendahl (2002) recorded 28 archaeological sites encompassing approximately 45 features. One previously identified site (Site 6302), the Kuakini Wall, was also relocated. Other recorded feature types included walls, terraces, mounds, modified outcrops, platforms, enclosures, and lava blister caves. Possible functions suggested for these features included, habitation, ranching, agricultural, and burial. All of the PHRI sites were relocated during the current inventory survey. Subsequent to the reconnaissance survey, PHRI conducted archaeological testing of a sample of possible burial features. Eleven features at eleven different sites were tested for burials (PHRI does not indicate which features were actually tested), all with negative results (Rosendahl 2002). A coral abrader, an adze fragment, and marine shell fragments were noted during the excavations, but apparently not collected.

Based on the previously conducted archaeological studies in the vicinity of the current project area, and the background information presented above, a set of field expectations can be generated. Rechtman (2000) documented the presence of household agricultural sites, permanent and temporary habitation sites (one with a possible household shrine), historic ranching walls, and burial features on a parcel in Wai'aha *makai* of the current study area. All of these fit the pattern for the coastal portions of the Kona. Although Rosendahl (2002) did not identify burials in eleven features contained within the project area, Walker et al. (1996) and other work (O'Hare and Wolforth 1998) in nearby *ahupua'a*, have encountered burials during subsurface testing of features, in both habitation and other contexts. During the current fieldwork it is expected that both temporary and permanent habitation features will be encountered that date from the Precontact and early Historic Periods, and that burials might be present at these sites. The former presence of a coastal *heiau* in Wai'aha may indicate the existence of other such features within the current study area. The project area was part of a failed sugarcane plantation and later became the Gomes Ranch. These Historic Period activities likely resulted in the disturbance of some of the earlier features and the ranching activities should be visible on the landscape in the form of core-filled walls and enclosures.

FIELDWORK AND ANALYSIS

Field work for the current project was carried out between October 29 and December 23, 2002, J. David Nelson, B.A., Dylan S. Amerine, B.A., Gregg A. Harmon, B.A., Kasey A. McCune, B.A., Michael E. Rivera, B.A., Mark J. Winburn, B.A, and Christopher L. Quiseng, B.A., under the direction of Robert B. Rechtman, Ph.D.. Each field worker spent eight hours a day five days a week in the field for the duration of the project, with the exception of one three-day week during Thanksgiving weekend, expending a total of approximately 2,000 man hours for the completion of the inventory survey.

Field and Laboratory Procedures

Fieldwork included a pedestrian survey of the entire study parcel and test excavations at selected features. Survey transects were oriented north/south and the surveyors maintained a 10-meter spacing interval using Garmin 12 handheld GPS technology. Although tall grass covered most of the project area at the time of the inventory survey (making feature identification difficult), it is believed that the vast majority of the archaeological resources on the study parcel were located. It is a possibility that a few isolated small rock mounds or modified outcrops may have been overlooked due to the dense vegetation (but rather unlikely due the tight spacing of the fieldworkers' during transect sweeps). Certainly all the major archaeological resources with the project area were located and recorded. Features identified during the survey were flagged and plotted on a field map. These features were later cleared, recorded in detail, photographed and placed on a large-scale map of the project area (Figure 4).

Twenty-two 1 x 1 meter test units (TUs) were excavated at ten sites. These excavation units were dug following natural strata. Where natural layers could not be determined, excavation followed 10-centimeter arbitrary levels. All excavated material was passed through ¼-inch screening in an attempt to recovered cultural material. Excavation units were dug until bedrock was encountered or until buried human remains were discovered. In the latter case (3 instances) all of the material recovered from the unit was replaced and the featured restored to its pre-excavation condition.

Excavation record forms were maintained for each test unit and photographs were taken (except for the units containing burials). Upon completion of the units, prior to backfilling, stratigraphic information was recorded and profiles drawn. Artifacts recovered from the screening process were cleaned, weighed, counted, and described. Faunal remains were tabulated and identified to the lowest taxonomic level possible. Where applicable, the Number of Identified Specimens (NISP) and the Minimum Number of Individuals (MNI) were determined. Charcoal was recovered from only two units in a quantity sufficient for radiocarbon analysis; these samples were sent to Beta Analytic, Inc. for age determination (Appendix A).

Analytical Methods

This section of the report is intended to elucidate the methodology used in defining sites for the purposes of the current study. The archaeological "site" is the common analytical unit for undertaking comparative analyses. Sites are also the administrative unit for describing and defining archaeological resources, as mandated by DLNR-SHPD. However, sites are not absolute quantifiable entities that are simply waiting to be discovered by archaeologists; rather, sites are defined through the interpretation of features and associations, both spatial and temporal. It is features that are absolute entities waiting to be discovered, described, and measured. It is features that archaeologists encounter in the field, not sites; and it is the associations of features in space and time that facilitate interpretation. Sites are defined once the features are recorded and the associations studied within the context of an entire landscape. Thus, a feature can be said to have formal attributes and a site to be a functional interpretation of formal, spatial, and temporal associations.

Below we describe the formal categories to which features are assigned, the methods used for assigning temporal affiliation, the criteria used for associating features into sites (defining site boundaries), and the process of interpreting site function.

Formal Feature Definitions

Features are the quantifiable forms constructed or modified by human hands that 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 formal features, they are often overgrown with vegetation, collapsed and destroyed (or trampled on by cows), 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. As will be shown in the following sections of this report, similar formal feature types can have very diverse functional and temporal associations.

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 are purposely devoid of function, and present only the common attributes that enabled us to place the diverse formal feature types into easily quantifiable groups. The formal feature types encountered within the project area are mound, modified outcrop, wall, enclosure, terrace, pavement, platform, and lava tube. A definition of each type is presented below and specific examples can be seen in the site inventory section of this text. Also, in addition to the defined feature types, two unique feature types (which have an implicit implied function attached to them) were encountered during the current study. These types include trails (worn alignments or stepping-stone) and game boards *(papamū)*. No definitions are provided for these feature types.

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 (i.e. oval, round, linear, curvilinear, square, crescent, rectangular, or irregular) 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.

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. 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.

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 encountered within the project area take on three general forms; piled (no placement of stones), stacked (stones placed on top of one another), and core-filled (stacked along the edges with a fill of piled stones). Walls may also form adjoining or shaped segments (i.e. L-shaped, T-shaped, U-shaped, etc.).

Terrace

A terrace is a linear or curvilinear stone construction built perpendicular to the natural slope of the terrain. It is generally longer than it is wide and at least two courses high. On the upslope side of the terrace soil is either placed, or more often naturally accumulated, to form a relatively level surface area. The stones of a terrace may be piled or stacked (piled edges are sloped, while stacked edges are generally vertical). Although no such evidence was recorded within the current project area, level soil areas behind shorter terrace walls, which form rectangular areas, have been documented at other locations in Kona to be residential features.

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. Some enclosures completely surround an interior space with no openings.

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.

Platform

A platform is a stone construction with a relatively flat upper surface that is elevated at least two courses above ground surface on all sides. Platforms are usually quadrangular (but may also be rounded or irregular) with neatly stacked edges. The upper surface of a platform often consists of smaller stones than are used to construct the rest of the feature.

Lava tube

This formal feature type is self-explanatory. A lava tube is only considered an archaeological feature if cultural material or modification is present.

Assigning Temporal Affiliation

After the individual features identified in the field are assigned formal type designations, they are examined for indicators of temporal affiliation. To begin this process, features are first categorized into three generic time periods; "Precontact times," the years between the arrival of the first Polynesians in Hawai'i and the European discovery of the islands by Captain Cook in 1778, "Historic times," the years after the arrival of Captain Cook, but before "Modern times," which we define as a fifty year sliding continuum dating back from the present – so beginning roughly in the early 1950's. Modern features are not considered significant archaeological resources, so are not reported on. All other features were grouped into the two remaining time periods using the recorded archaeological data (e.g. proximity and similarity to other features, surface and subsurface artifacts and architecture, topography, and the accumulated knowledge of Hawaiian archaeological forms), and where possible historical documentary research, and oral historical information. However, the two main criteria we used in separating Historic features from Precontact features were types of material remains observed in the archaeological deposits and architectural styles.

The presence of historic artifacts at a feature is a common indicator of Historic Period use. As Cordy et al. write:

> Use of historic period artifacts as a relative dating technique is extremely common in Hawaiian archaeology. Certain artifact types were introduced after European Contact – A.D. 1778, the arrival of Captain Cook. These include objects made from materials such as metal, glass, ceramics, and chert. Common artifact types made from these materials include metal nails and spikes, barrel hoops, cans, knives, and bullets; glass bottles and window panes; ceramic pipes, plates, bowls, cups and beads; and chert gun flints. A less frequently considered artifact is concrete used as a construction material. The presence of

> these objects and materials are indicators of post-A.D. 1778 age. Obviously, historic artifacts were not immediately adopted island-wide by A.D. 1778. Trade objects probably were not numerous until after 1790-1800, so the absence of the items could possibly indicate an early historic period age also. (Cordy et al. 1991: 459)

Of course, a feature containing Historic Period artifacts may not have been used solely during historic times. The feature could have been continually used from Precontact times into Historic times. This would be evidenced by a stratigraphic shift in subsurface artifacts from deeper Precontact items to shallower Historic items. Or, by the presence of artifact types that would have been rapidly replaced early in Historic times by the infusion of European materials (such as bone or shell fishhooks, basalt adzes, and coral or urchin spine abraders) mixed with Historic artifact types. Otherwise, a feature containing predominately historic artifacts, or historic artifacts mixed with less easily replaced Precontact artifacts (such as volcanic glass or cowrie shell octopus lures) probably dates to historic times (Cordy et al. 1991).

Historic walls can sometimes be distinguished from Precontact walls due to varying construction techniques. As Cordy et al. state, "It has long been realized in Hawaiian archaeology that high (1.0+ meter), vertically faced, and core-filled walls are common architectural features of the late 1800s—seen in the form of *kuleana* house lot walls, house walls themselves, and in ranch and *ahupua'a* border walls" (1991: 460). These types of walls are occasionally found in Precontact sites, but were not common and seem to be restricted to certain site types such as *heiau* and canoe houses (Cordy et. al 1991). Often, the materials used to construct the Historic walls were pirated from older Precontact features. Occasionally, the Historic walls even follow the alignments of older walls.

Using the accumulated archaeological data, historical documentary research, oral historical information, along with information contained in the *Māhele* records, the identified historic features were then separated from the Precontact archaeological landscape and grouped into sites (see Defining Site Boundaries below). Archaeological sites are groupings of related features that may span more than one time period. Historic Period sites (not features) can be further separated into relevant time periods. A similar strategy is applied to organize Precontact Period features into sites. Precontact sites can also be further segregated into more specific time periods following any of the established regional culture-historical sequences (i.e., Burtchard 1995; Cordy 2000; Haun et al. 1998; Kirch 1985, Schilt 1984) based on radiocarbon assays and potentially other relative and absolute dating techniques. However, more chronometric data than was obtained during the current study is required to accomplish this goal. The acquisition of such data will be the focus of data recovery efforts within the project area.

Defining Site Boundaries

One of the major issues confronting archaeologists investigating tracks of land within the Kona region is that of defining site boundaries. Kona is not unique in this; in fact, an extensive body of worldwide archaeological literature exists on the subject (c.f Binford 1972 for a discussion). What is unique about Kona is that much of the area has been classified under a single site number (SIHP Site 6601) corresponding to the Kona Field System. However this designation has no analytical utility, unless one is actually studying the entire universe of the Kona Field System. Even then, the concept of a "system" is misleading. A system is an arrangement of things so connected as to form a unity or organic whole. The Kona Field system is no such organic whole. In reality it is a composite of many different individual agricultural systems or fields that are only interrelated in that practitioners of the same culture created them. The agricultural fields of Ki'ilae and Kauleolī (Rechtman et al. 2001) are quite distinct from the fields of Wai'aha, which are in turn different in character than the fields of Kahalu'u *mauka* (Rechtman et al. 2003).

Further, the temporary habitation features within the fields are part of the individual systems, yet standard practice seems to be to assign distinct site numbers to habitation features apart from the agricultural features with which they appear to be associated. It is the position of the writers of this report that the Kona Field System be considered a conceptual cultural landscape upon which many individual agricultural systems were developed and expanded and contracted through time. The current project area, however, is small enough that all of the agricultural features may be related and the number of temporary habitations is great enough that breaking the agricultural features into sites containing habitation features was not possible. Therefore all features of the agricultural landscape (excluding habitations) have been assigned one site number for the purposes of the current study, following standard practice. Subsequent data recovery efforts may help identify more meaningful feature clusters containing habitation features and associated agricultural features.

As for other site definitions used in the current study, unassociated stand-alone Historic Period features (e.g., walls and enclosures) are defined as individual sites; when associations can be confidently made between Historic Period features, these features are described together as belonging to definable site complexes; individual lava blisters are defined as individual sites; Precontact habitation and ceremonial platforms and enclosures are generally assigned individual site numbers unless closely associated with a like feature, and trails are considered individual sites. It is worth mentioning here that even though 26 different sites containing over 300 features are defined, the entire project area should be viewed as a single cultural landscape that records the Precontact diachronic story of an *'ohana holo'oko'a 'āpa'akuma* and their land with a later overlay and intermixing of different cultural practices and a new economic system.

Interpreting Site Function

Interpretation in archaeology is generally a means to an end no matter what ones theoretical orientation or bias happens to be; it is not an end in itself. Interpreting the function of features and organizing features into sites, whose functions are implicit in the features they contain, is an aspect of what has been labeled Middle-Range Theory (Raab and Goodyear 1984). The results of such endeavors can then be used to address more general theoretical research issues such as the development of complexity or the intensification of agriculture, and so on. However, for the purposes of this archaeological inventory survey the goal is to limit the research efforts to the less lofty and more administrative issues of interpreting feature and site function.

Essentially, there are four ways at deriving functional interpretations: Direct Informant Information, in this case a particular resource is identified by an individual who knows what it is and how it functioned; Direct Ethnographic Analogy, here a resource is compared to other resources that are known to have been used by members of the identical culture and the function has been documented; General Analogy, in this situation a resource is compared to a similar looking resource that is used by a related culture and the function of the resource has been documented; and Logical Supposition, in this last instance the researcher makes a conclusion about a resource's function based on a logical argument that usually takes into account prior archaeological interpretation, metrically derived information, archaeological associations, and the results of subsurface testing.

Obviously, each of these techniques has a different confidence level associated with its accuracy, Direct Informant Information potentially having the highest confidence level (however, such information always has to be assessed relative to an individuals faulty or selective memory and any political agendas that might interfere) and Logical Supposition potentially the lowest. All four of these techniques have been employed in varying degrees for making functional interpretations of the archaeological sites recorded during the study. However, before we discuss site function we must first address the possible functions of the formal feature types previously defined. These functional interpretations are specific to the current study. It is recognized that similar formal features found in other parts of North Kona have been interpreted with different functions. For example, burials have been found in modified outcrops, mounds, and platforms during other archaeological projects; but to date no such features within the current study area have yielded human remains. This is not to say that these feature types in the current study area absolutely do not contain burials, rather that we have not discovered any in our, albeit limited, testing. We feel strongly though, that based on the spatial associations, the agricultural features that we recorded are, for the most part, functionally interrelated. If during data recovery investigations burials are discovered in what are currently interpreted as agricultural or habitation features, they will be treated as previously identified and the Hawai'i Island Burial Council will be consulted regarding appropriate treatment.

Mound

This type of feature has a different function depending on its temporal and spatial associations. Mounds can be clearing features, planting features, or landscape markers. The functional distinction between types of mounds is contextual rather than formal. Mounds identified along known boundaries are important point locations are considered to be landscape markers. Mounds found in clusters on barren lava are considered to be planting features. Mounds found in clusters around rock-free areas of plentiful soil are considered to be clearing features. These interpretations are based on both Direct Ethnographic Analogy (Ellis 1963; Fornander 1919; Handy and Handy 1972), and interpretations from prior archaeological studies (Allen 2001; Cordy 2000, Kirch 1985; Rechtman et al. 2001). Testing of mounds during the data recovery phase of this project will address the question of formal variation between presumed planting and clearing features.

Modified outcrop

Bedrock outcrops were modified and functioned as clearing features, planting features, or temporary habitation features. Temporary habitations are defined based on the presence of faunal remains and a level and/or paved surface. Clearing features are defined based on the presence of rocks piled on an outcrop in an area free of stones with ample soil. Planting features are defined based the presence of piled or stacked rocks on an outcrop in areas of no soil.

Wall

The function of a wall is highly dependant on its temporal association. During Precontact times walls functioned primarily as agricultural field boundaries (kuaiwi) (Cordy 2000; Kirch 1985; Soehren and Newman 1968). During Postcontact times walls continued to function as agricultural features, along with defining property boundaries and also were used to control or limit the movement of livestock. *Kuaiwi* are characterized by piled construction with a "humped" profile (Soehren and Newman 1968). Historic Period walls are often of core-filled construction with a rectangular profile (Cordy et al. 1991).

Terrace

The terrace is a specialized feature of an agricultural field. It functioned to trap or retain soil to create a planting area (Kirch 1985; Soehren and Newman 1968). Terrace walls are typically built connecting kuaiwi and are of stacked construction with a rectangular or trapezoidal profile.

Enclosure

An enclosure can be a habitation feature, a planting feature, or used to house or detain animals. Enclosures that function as habitations typically have one opening facing away from the prevailing wind and are constructed by piling and stacking rocks, the interior of the enclosure may or may not contain soil, and habitation debris is usually present. The outline of habitation enclosures is frequently rectangular, C-shaped, or U-shaped (Cordy 1981; Kirch 1985). Planting enclosures (typically with irregular shapes) do not have entrances and are piled or stacked constructions less than one meter in height, with soil in the interior (Ching 1971). Animal enclosures (often square or irregular in outline) usually have no more than one opening with a variable orientation and are core-filled constructions with wall heights greater than one meter (Ching 1971).

Pavement

For the current study, a pavement is hypothesized to be a specialized feature associated with agricultural activity, and used as a produce staging or processing area. This interpretation is based a lack of observed habitation debris at the feature, and the feature's close association with agricultural features (Rechtman et al. 2001). Also, this interpretation is based on personal observations of current day agricultural practices in other parts of the Pacific (particularly in Fiji and Samoa) where similar features are used. There, square or rectangular pavements of rock are built to contain stacked piles of harvested taro, sweet potatoes, and cassava; and also to begin process of preparing paper mulberry prior to pounding.

Platform

Platforms are considered to have functioned as habitation features (house foundations), ceremonial/religious features (*heiau*, altar, shrine), or burials. The characteristics used to distinguish habitation platforms from ceremonial platforms or burials are a suite of traits that include massiveness (the relative volume of rocks used in construction, a function of area multiplied by height)(this trait is discussed by Kolb 1991 relative to labor investment), multi-level (stepped) surface construction (Kirch 1985; Ladefoged et al. 1987), and associations with other features. While it is recognized that ceremonial shrines can be quite small features containing an upright stone for example, no such features were encountered within the current study area (and even if there were such features present, they would not be categorized as platforms). Artifact types found at the platforms can also be used to help determine their function.

Lava Blister

The lava blisters in the study area that were determined to be archaeological features contained evidence of having either been used for habitation or architecturally modified. Habitation tubes contained internal modifications and constructions, and possessed accumulations of marine and terrestrial faunal remains. Many of the lava blisters in the current project area had been recently modified by individuals forced to more marginal living/shelter areas by continued developmental expansion in Kailua.

As discussed above, features are grouped based on functional, spatial, and temporal associations into definable sites. Thus, based on the component features, a site's function is implicit. The following functional site types are defined for use in this study. This list is not intended to be a complete accounting of Hawaiian archaeological site types, but rather those site types we identified based on the features recorded in the current study area.

Habitation

Habitation sites could date to both the Precontact and Historic Periods, but for this study (because no Historic habitations were identified) Habitation Site is defined as a Precontact Period site type. Habitation sites can be a single feature or groupings of platforms, enclosures, or modified outcrops. Lava blister features can also be habitation sites. In the Hawaiian archaeological literature there is a significant amount of attention devoted to qualifying habitation sites into permanent and temporary categories. Cordy (1981, 1995) has developed a model for differentiating permanent and temporary habitation features based on structure size and substantiveness of construction; and permanent and temporary habitation sites based on these criteria plus the number and configuration of features. Generally features less than 20 square meters, those without substantial stonework, and those found in association with other similar features are interpreted as temporary habitations. In the Cordy model permanent habitations have an area greater than 20 square meters, but less than 60 square meters and substantial stonework (i.e., well-faced exteriors, well-made walls, and well-made corners). Temporary and permanent habitations can also be separated by the amount of observed habitation debris located at the feature (Rechtman et al. 2001). However, as Cordy et al. (1991) point out no one attribute should be considered the key variable as exceptions can be found to all of the attributes. Cordy's model has been generally applied to all habitations identified as part of the current study, except when logical supposition or extenuating circumstances superceded the model (exceptions are discussed in the individual site descriptions).

Agricultural

This site type can date from any time period and is an association of mounds, *kuaiwi*, terrace walls, modified outcrops, enclosures, and pavements presumably used for agricultural purposes.

Burial

Given thirty plus years of more or less systematic archaeological research in Kona, the types of sites (or features) that typically contain burials have been documented numerous times (e.g., Cordy et al. 1991; Han et al 1986; Kirch 1979, 1985; Touhy 1965). These include monument burials (Kirch 1985) where skeletal remains are placed in a natural blister or crack in the lava and an above ground stone platform (usually less than one meter tall) is constructed to both conceal the remains and mark the location. Although the surface area (usually less than 10 square meters) and shape (usually rectangular) may vary (Cordy et al. 1991), the construction attributes frequently consist of larger stones forming a facing with small stones filling in the feature, and yet smaller stones as a top dressing or paving. Burials placed in lava cracks and crevasses have also been discovered that do not have platforms erected above them, but rather have simply been concealed by filling in the crack or crevasse with stones, giving the feature a natural appearance. Another typical burial feature in Kona is a stone mound with a collapsed central portion, sometimes referred to as "doughnut-shape" (Cordy et al. 1991:299). Many times the skeletal remains are visible in the center of these features without having to excavate. Otherwise, burials were sometimes placed inside lava tubes on bedrock shelves and occasionally the tube entrances were concealed. It was also a common pattern following the turn of the century up to the 1930s to bury family members within the homestead compound.

A few formal mounds (but no lava tubes) were identified during the current study that approximated the typical burial feature forms and these were tested through hand excavation. None of these contained human skeletal material (or any cultural material), three platforms did however.

Ceremonial/Religious

A site is placed into this classification if it is a platform that has multiple terraced enclosures attached, is relatively massive (large volume of rock used in construction), and/or possesses surface or subsurface branch coral. This site type can date from any period, but typically dates to the Precontact Period.

Trail

Trails are defined by alignments of smooth stones (stepping-stones) across *'a'ā* flows and cleared and worn linear alignments running *mauka/makai* across the landscape.

Ranching

This functional designation is assigned to core-filled walls and enclosures formed by multiple core-filled walls. Within the current project area these sites are associated with the Gomes Ranch and date between 1927-1960.

Landscape Marker

This site type is a wall (usually core-filled) so situated that is appears to correspond with a known land boundary (i.e., property boundary). Such walls were used as landscape markers only during historic times and were often constructed by early cattle ranchers.

Site Descriptions, Test Excavations, and Functional Interpretations

During the current archaeological inventory survey twenty-five previously unrecorded sites and one previously recorded site were discovered. Twenty-two test units were excavated at ten of these sites. Descriptions for each site and the test units excavated at them are presented below. Site discussions are grouped into seven categories: Historic Ranching Related Sites and Boundary Walls, Precontact Habitation Sites, Trails, Ceremonial Sites, Game Boards, Burials, and Agricultural Sites. A complete listing of the sites including their formal feature type, function, and temporal affiliation can be seen in Table 1. The location of each site is shown on Figure 4.

Table 1. Archaeological sites recorded as part of the current inventory survey.

SIHP No.	*Formal Type*	*Functional Type*	*Age*
6302	Wall	Kuakini Wall	Historic
23662	Enclosure	Ranching	Historic
23663	Wall	Ranching	Historic
23664	Wall	Ranching	Historic
23665	Wall	Landscape marker	Historic
23666	Wall	Landscape marker	Historic
23667	Wall	Landscape marker	Historic
23668	Lava blister	Temporary habitation	Precontact
23669	Modified outcrop	Temporary habitation	Precontact
23670	Platform complex	Permanent habitation	Precontact
23671	Platform	Temporary habitation	Precontact
23672	Enclosure complex	Permanent habitation	Precontact
23673	Platform/enclosure	Permanent habitation	Precontact
23674	Platform/enclosure	Temporary habitation	Precontact
23675	Platform	Permanent habitation	Precontact
23676	Platform	Temporary habitation	Precontact
23677	Platform/enclosure	Temporary habitation	Precontact
23678	Enclosure	Temporary habitation	Precontact
23679	Trail	Trail	Precontact
23680	Trail	Trail	Precontact
23681	Platform/enclosure	Ceremonial	Precontact
23682	Game board	Game board	Precontact
23683	Platform	Burial	Precontact
23684	Platform/enclosure	Burial	Precontact
23685	Platform	Burial	Precontact
23686	Complex	Agricultural	Precontact

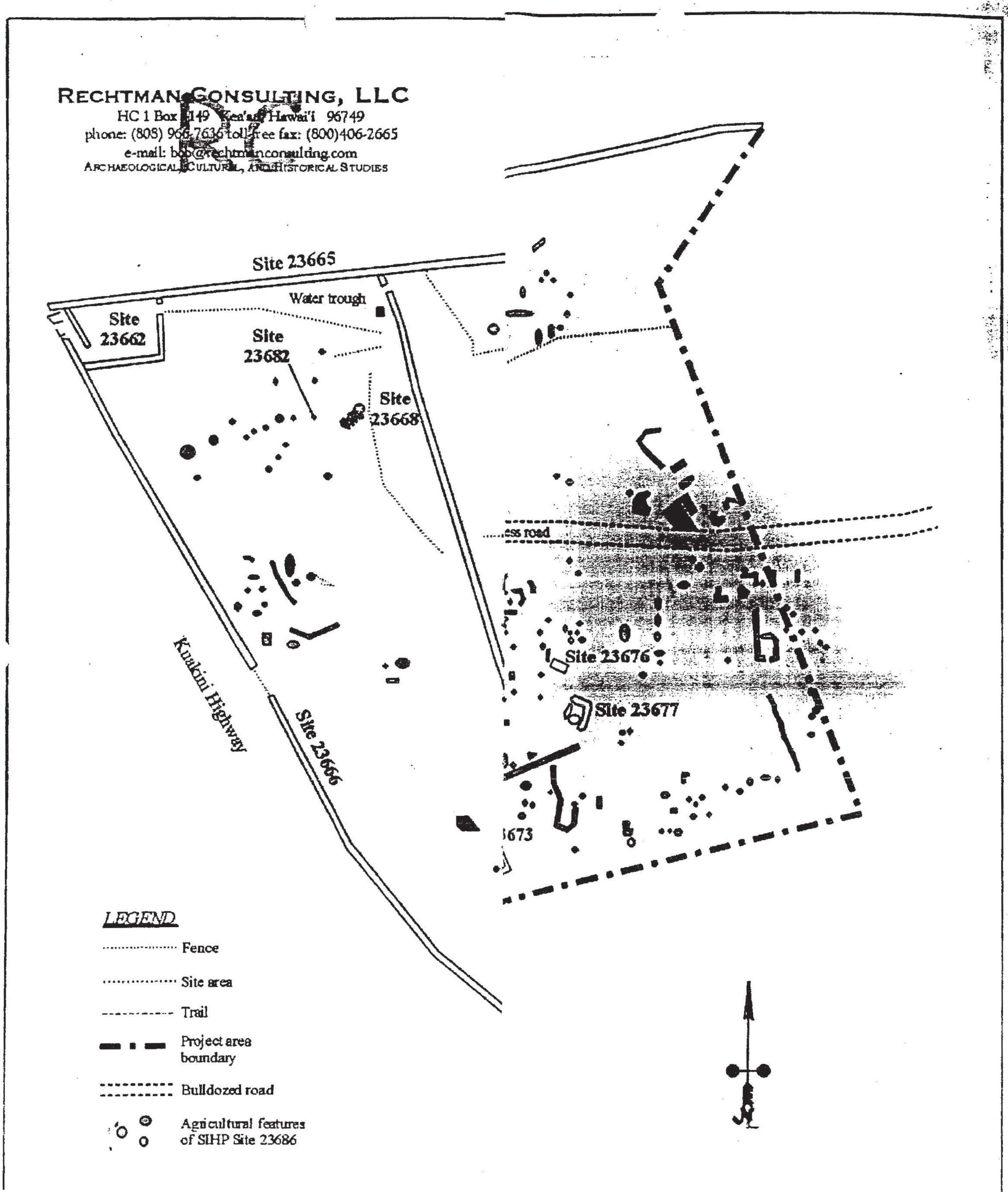


Figure 4. Project area plan view showing site locations.

Historic Ranching Related Sites and Boundary Walls

SIHP Site 6302

Site 6302 is the Statewide Inventory of Historic Places (SIHP) designation for the Kuakini Wall, a portion of which runs through the current project area (see Figure 4). Construction of the Great Wall of Kuakini began in the early 1800s as a response to the growing number of introduced herbivores (i.e. Cattle, goats, and pigs) running rampant in Kona. The wall, which stretches a considerable distance through Kona parallel to the coast, was designed to keep the animals out of coastal residential and agricultural areas. Although no record of Governor Kuakini having ordered the wall built exists, its final configuration was attributed to him (O'Hare and Wolforth 1998).

A 340-meter section of Site 6302 stretches north/south across the current project area. In this section the Kuakini Wall stands up to 1.2 meters high and measures as wide as 1.0 meter. It is of core-filled construction and has two breaks along its length. The first break occurs at its northern end adjacent to Site 23665 and measures 3 meters across. This break was most likely created by the Gomes Ranch (1927-1960s) to help funnel cattle west towards Site 23662. There is a metal water trough located just to the west of the break and a wire fence parallels Site 23665 all the way to Site 23662. The second break occurs at the wall segments south end 20 meters from the southern boundary of the project area at Site 23667. This section of wall was most likely removed to construct Sites 23666 and 23667. A wire fence connects the southern end of the Kuakini wall segment to Site 23666 creating a large paddock between the two walls.

SIHP Site 23662

Site 23662 is a historic/modern cattle enclosure located in the northwest corner of the project area along Kuakini Highway (see Figure 4). The enclosure walls (Figure 5) form a roughly rectangular area measuring 32 meters long (southern wall) by 24 meters wide (eastern wall). The north and west sides of the enclosure (which are actually longer) are formed by Sites 23665 and 23666 respectively. Site 23665 (the north wall of the enclosure), owing to on-going development at the adjoining parcel to the north, has been recently dismantled and reconstructed with stones cemented in place by that property owner. The remaining walls, which are of core-filled construction, attain a maximum height of 1.8 meters above ground surface and measure from 0.5-1.0 meter across their top edges. The interior of the enclosure, accessed through three gates (1 metal and 2 wooden), contains an internal dividing wall, a stone and wood ramp, and two rock piles. The enclosure, most likely constructed by the Gomes Ranch (1927-1960s), appears to have functioned as a holding area designed for loading/unloading cattle trucks at Kuakini Highway.

A small wooden gate (2.0 meters wide), located in the east wall of the enclosure 2.5 meters south of Site 23665, allows access to an eastern paddock area. An internal dividing wall (1.7 meter high by 0.6 meters wide) running southeast from Site 23665 (roughly parallel to the west wall of the enclosure) for 22 meters forms the western edge of the paddock area. The paddock contains several large *kiawe*, tall grasses, and two stone piles, which represent either clearing piles or left over wall building materials. The south end of the internal dividing wall adjoins a four-meter long wooden gate remnant connecting the aforementioned wall to the southern wall of the enclosure. On the west side of this gate a 10-meter wide passage, between the western wall of the enclosure and the internal dividing wall, leads to a ramp and a metal gate facing Kuakini Highway in the enclosure's northwest corner. The 3-meter long metal gate adjoins the southwestern corner of a 3.0 by 3.0 meter stone ramp with a "4 x 4" wooden frame. The ramp rises from ground surface along its eastern edge to 1.1 meters above ground surface along its western face. It is constructed of *pāhoehoe* boulders with smaller cobbles paving its surface. The ramp is fairly dilapidated and covered in dense vegetation. The wall to the north end of the ramp has been recently dismantled.

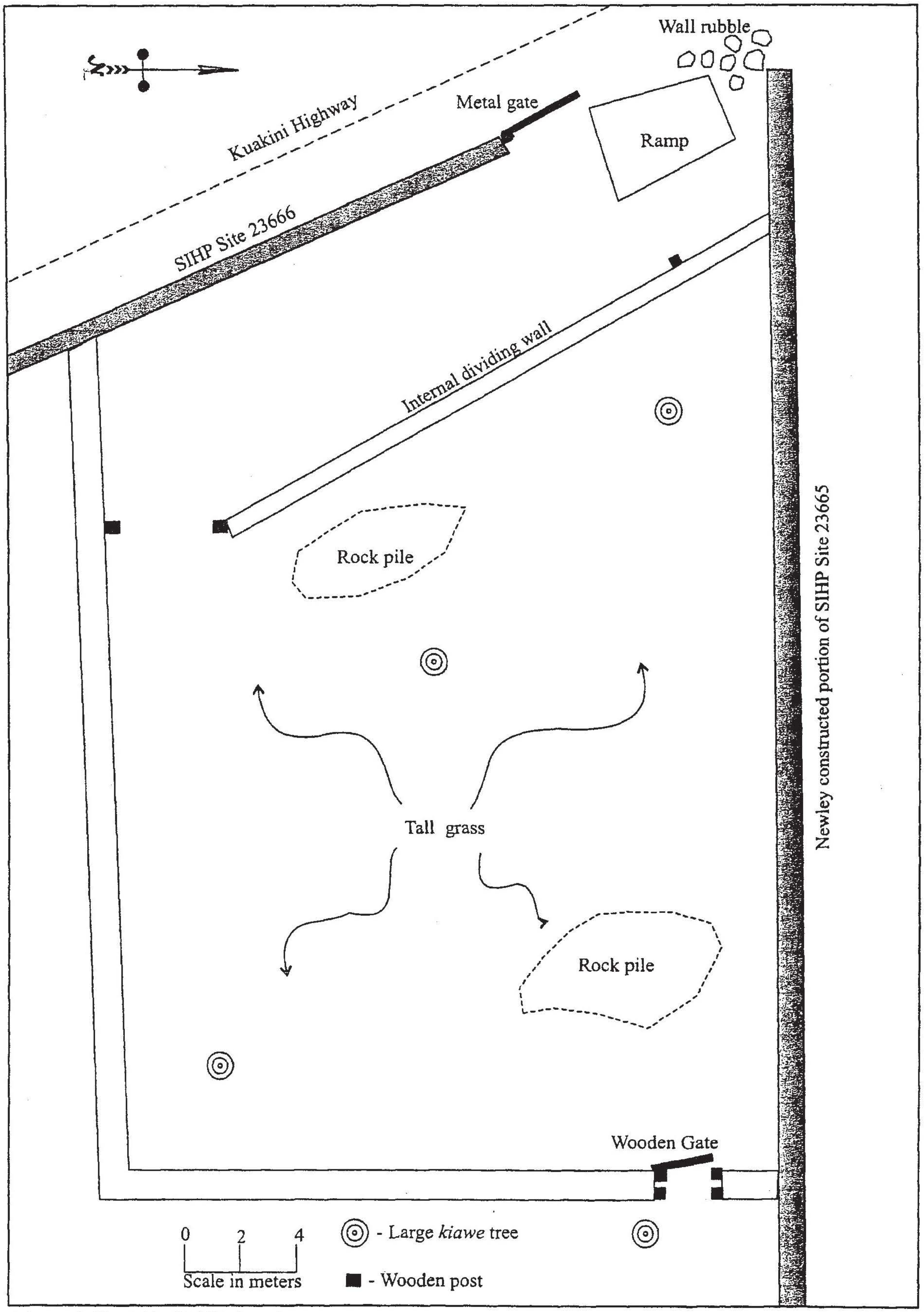


Figure 5. SIHP Site 23662 plan view.

SIHP Site23663

Site 23663 is a historic wall remnant that, together with Site 23665, forms a rough enclosure along the northern boundary of the project area (see Figure 4). The wall is of core-filled construction, but is collapsed in several sections with gaps ranging from 1.0 to 8.0 meters wide. Intact sections of the wall stand up to 0.7 meters above ground surface and measure 40-90 centimeters wide (Figure 6). Starting at its western end (8 meters south of Site 23665) the wall runs for 38.6 meters at 166°, turns and runs a meandering course for 150.0 meters at 80°, then turns once more and runs for 14.3 meters at 380° to its end point (4 meters south of Site 23665). It appears that Site 23663 may have been partially dismantled along its east and west ends during the construction of Site 23665, making it the older of the two walls. Site 23663 was most likely used by the Gomes Ranch (1927-1960s) for livestock control purposes.

Figure 6. SIHP Site 23663 view to east.

SIHP Site 23664

Site 23664 is a historic core-filled wall remnant running east/west roughly parallel to Site 23663 (approximately 10-20 meters to the south) (see Figure 4). The wall stretches for a total distance of 95 meters near the west end of Site 23663. It is in a poor state of preservation standing only 0.6 meters high at its most intact sections and averaging up to 1.2 meters wide. Large portions of the wall may have been pirated to construct Site 23663 or, conversely, the two walls may have acted as a contemporary cattle chute, but over time only Site 23663 was maintained and Site 23664 fell into disuse, or was used for repairs to the other wall. In either case, this wall was most likely constructed by the Gomes Ranch (1927-1960s) for livestock control purposes.

SIHP Site 23665

Site 23665 is a historic core-filled wall running along the northern boundary of the project area (see Figure 4). This wall, most likely built by the Gomes Ranch (1927-1960s), also marks the boundary between Wai'aha 1st Ahupua'a and Pua'a 3rd Ahupua'a. The *makai* most 130 meters of Site 23665 (from the Kuakini Highway to the Kuakini Wall), as a result of on-going development at the neighboring parcel to the north, has been recently dismantled and reconstructed with stones cemented in place. The remaining 470 meters of wall along the northern project area boundary is relatively intact and of historic core-filled construction, although ground surface on the north side of the wall has been significantly raised. Site 23665 is collapsed in several places but in places it stands up to 1.3 meters above project area ground surface and measures as wide as 1.0 meter across the top.

SIHP Site 23666

Site 23666 is a historic core-filled boundary wall running along the *makai* edge of the study area parallel to the Kuakini Highway (see Figure 4). The wall, most likely constructed by the Gomes Ranch (1927-1960s), is in generally good condition, but may have been recently reconstructed in some sections. Site 23666 stretches along the western project area boundary for 440 meters, it stands up to 1.2 meters above ground surface and measures as wide as 0.7 meters across its top edge. The wall used to continue along Kuakini Highway out of the current project area to both the north and the south, but has been destroyed by development on the adjacent parcels. There are two constructed openings in the wall. The first opening, a 3-meter long metal gate located at the northern end of Site 23666, is part of Site 23662. The second opening, located 170 meters south of the walls north end, measures 8.5 meters across and is blocked off with wire fencing.

SIHP Site 23667

Site 23667 is a 140-meter long historic core-filled wall segment running along the southern boundary of the current project area (see Figure 4). This wall is located in Wai'aha 2nd Ahupua'a running along the southern edge of Parcel 6 (TMK:3-7-5-17). Site 23667 is in relatively good condition standing up to 1.0 meter above ground surface and measuring 0.8 meters across its top edge. The wall's western end abuts Site 23666 and the eastern end used to stretch further than it currently does, but has been removed by development on the adjoining parcel to the south.

Precontact Habitation Sites

SIHP Site23668

Site 23668 is an exposed *pāhoehoe* bedrock outcrop (9.0 meters by 7.8 meters) containing a small lava tube and a possibly leveled pavement of *pāhoehoe* cobbles (Figure 7). The site is located in the northwest portion of the project area approximately 20 meters *makai* of Site 6302 (the Kuakini Wall) (see Figure 4). The cobble pavement area (4.0 meters long by 2.5 meters wide), which is located at the southern end of the outcrop (Figure 8), slopes slightly to the north and although the cobbles are arranged in a relatively uniform fashion they may be resting in natural positions. The entrance to the lava tube has been slightly modified suggesting that the site may have been used for temporary habitation purposes. A *Cypraea* shell fragment was found on the ground surface seven meters at 26° from the tube entrance.

Figure 7. SIHP Site 23668 view to south (tube entrance in foreground pavement in background).

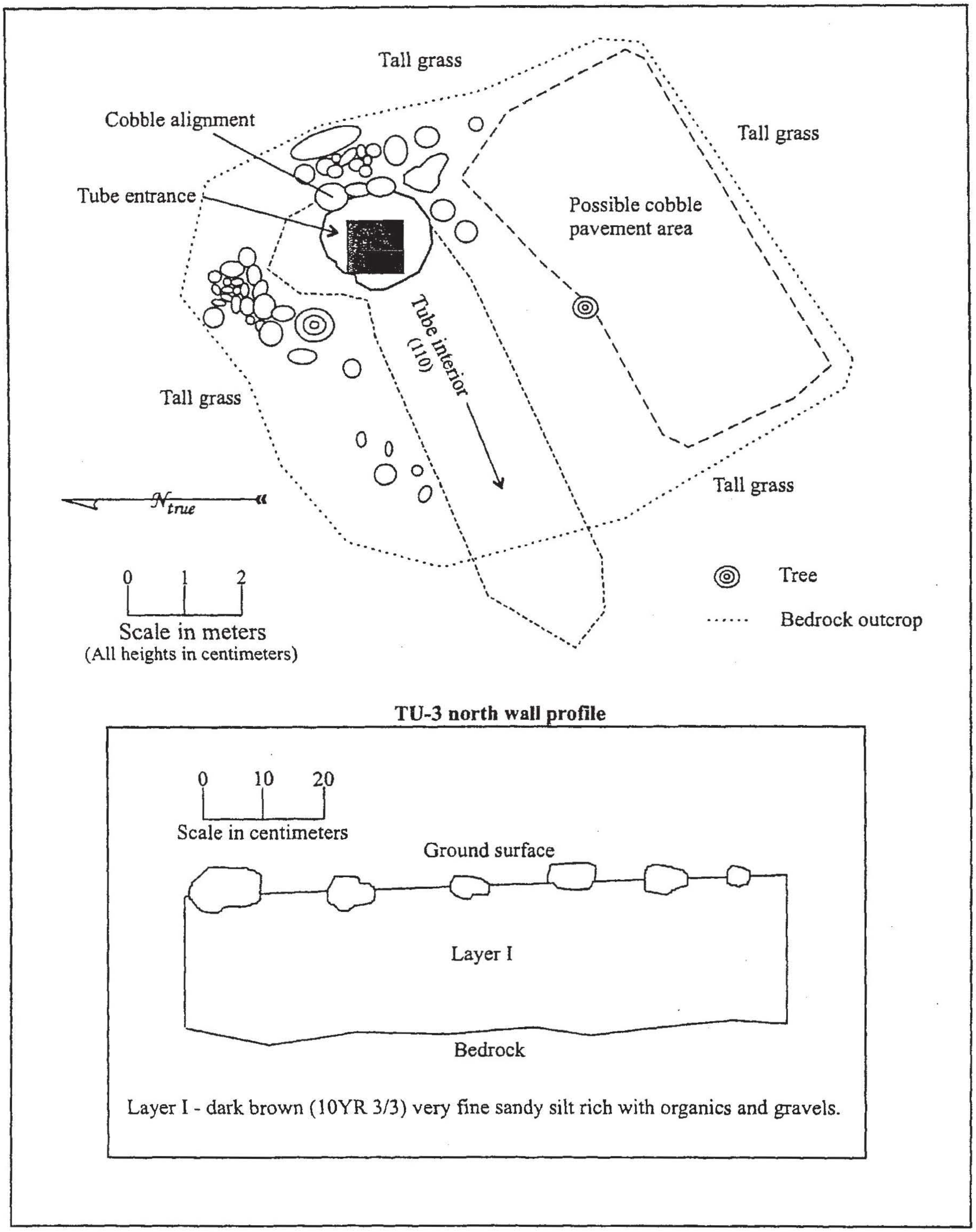


Figure 8. SIHP Site 23668 plan view and TU-3 profile.

The tube entrance measures 1.8 meters by 1.6 meters and drops 1.6 meters to the interior ground surface (Figure 9). A single course of *pāhoehoe* cobbles has been placed along the eastern edge of the entrance filling in a low spot in the bedrock. The interior tube area measures approximately 3.0 meters in diameter at the entrance with a floor to ceiling height if 1.1 meters. A narrow passage, 1.5 meters wide, runs west from the entrance for 6.5 meters before becoming impassable. The floor of the tube consists of soil with a few small cobbles and a house cat skeleton resting on its surface. A 1 x 1 meter test unit (TU-3) was excavated within the central area of the tube entrance (see Figure 8). Excavation of TU-3 revealed a single stratigraphic soil layer (60 centimeters deep) of dark brown (10YR 3/3) very fine sandy silt rich with organics and gravels resting on bedrock. No cultural material was recovered from TU-3 leaving the presumed function of the site somewhat in doubt. The cobble alignment along the eastern edge of the opening may have been placed there by the Gomes Ranch to deter cattle from falling in and injuring themselves.

Figure 9. SIHP Site 23668 tube entrance and location of TU-3 view to north.

SIHP Site 23669

Site 23669 consists of a large *'a'ā* outcrop (27 meters long by 7 meters wide) with several cultural modifications along its length (Features A-F) likely used for temporary habitation purposes with possible agricultural associations (Figure 10). Site 23669 is centrally located within the western half of the project area (see Figure 4) near several agricultural features and a burial (Site 23683). The outcrop stands up to 3 meters above ground surface along its north side and up to 2 meters above ground surface along its south side. The culturally modified areas consist of terraces, stacking, and a modern rock shelter contained within a 20-meter long section on the north side of the outcrop. No habitation debris was observed in the vicinity of the features; however, their formal attributes, small size, and insubstantial construction suggest that they were used for Precontact temporary habitation purposes (Cordy 1985, 1991). Features D and E may have been further modified during modern times.

Feature A is a small cleared and leveled terrace area located at the northeastern end of the outcrop (see Figure 10). The cleared area contains soil and measures 1.4 meters (east/west) by 1.3 meters (north/south) (Figure 11). Its western edge, which consists of stacked cobbles, rises 0.65 meters above ground surface while its southern edge abuts Feature B.

Feature B is cobble terrace (3.0 meters long by 2.0 meters wide) located between Features A and C. The feature consists of stacked cobbles (1.35 meters high) along its north (against Feature A) and west (against Feature C) edges (see Figures 10 and 11), while the two remaining edges are level with the bedrock outcrop. The surface of the feature slopes slightly to the east and lacks any sort of paving. Feature B may represent cobbles cleared and stacked from Features A and C.

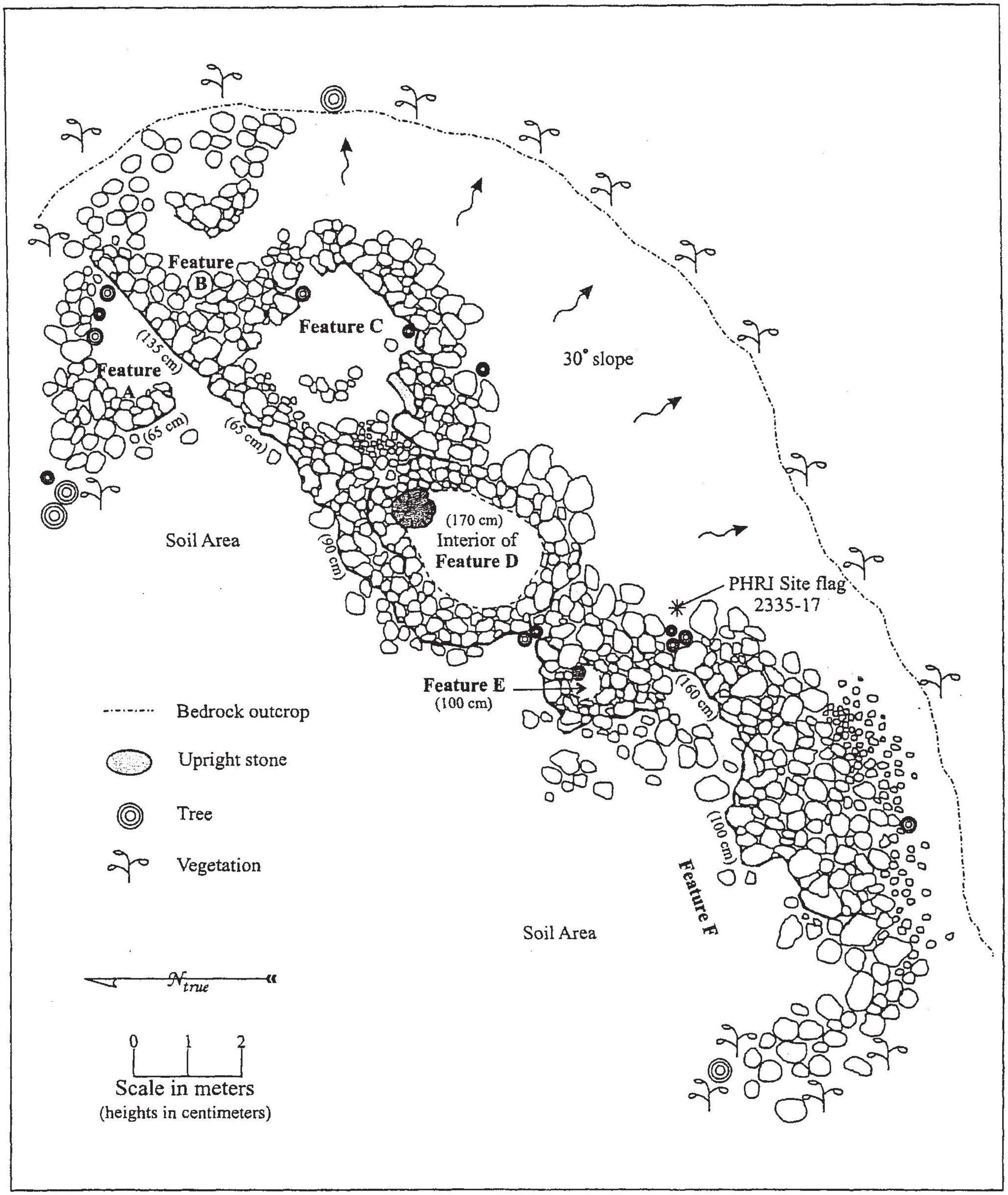


Figure 10. SIHP Site 23669 plan view.

Figure 11. SIHP Site 23669 Features A and B view to east.

Feature C is a cleared and leveled terrace area adjacent to the west side of Feature B (see Figure 10). The cleared area measures 3.0 meters by 2.5 meters and consists of soil (Figure 12). The northern edge of the terrace is stacked and rises 0.65 meters above ground surface. The south and west (Feature B) edges are also stacked and rise 1.35 meters above the terrace's surface. The eastern edge of the soil abuts Feature D.

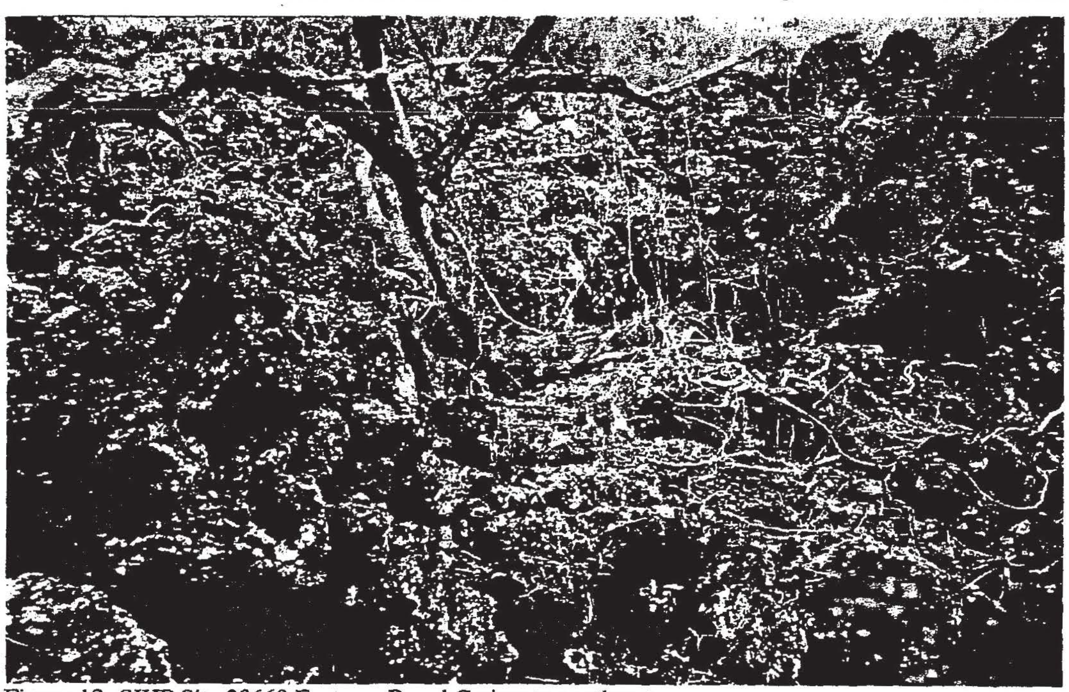


Figure 12. SIHP Site 23669 Features B and C view to southeast.

Feature D is a modern igloo-style domed habitation feature located along the eastern edge of Feature C (see Figure 10). Feature D is built entirely of large *'a'ā* cobbles fitted together with *'a'ā* slab as a roof so as to create an enclosed interior area 2.5 meters long by 1.85 meters wide and 1.8 meters tall. There is a small opening (0.9 meters in diameter) allowing access to the western end of the feature (Figure 13). The interior floor is level, consists of soil, and is littered with modern debris including plastic, beer bottles, Olympia Beer cans, tin cans, and pork chop bones. Feature D appears to have been recently constructed on a former cleared and leveled terrace area.

Feature E is a cupboard located 1.2 meters southwest of Feature D (see Figure 10). The cupboard is constructed with a semicircular alignment of stacked *'a'ā* cobbles (1.0 meter high) to the north and west abutting the bedrock outcrop to the southeast. The interior of the cupboard measures 0.9 meters long by 0.6 meters wide and 0.4 meters deep. Two eroded *'a'ā* cobbles rest across the top of the cupboard creating a roof. A 0.3-meter diameter opening at the west end of the cupboard is its only opening. This feature appears to be related to Feature D and is of modern construction.

Feature F is a meandering alignment of stacked *'a'ā* cobbles and boulders along the southwestern end of the outcrop (see Figure 10). The stacking stands 0.85 vertical meters above ground surface on its north side and behind this slopes southeast at 28° to the top of the outcrop. Feature F may have been created as the soil area to the north of the outcrop was cleared of cobbles, or perhaps as a retaining wall to keep cobbles out of the soil area.

Figure 13. SIHP Site 23669 Feature D (Features E and F in background) view to south.

SIHP Site 23670

Site 23670 is a Precontact permanent habitation site located in the western half of the project area approximately 30 meters north of the eastern end of Site 23667 (see Figure 4). Site 23670 consists of a two-tiered platform (Features A and B) with a second smaller platform (Feature C) located two meters to the east (Figure 14). Both platforms are constructed of *'a'ā* with large cobbles stacked around the outside edges and small cobbles paving the surface. A single *Cypraea* shell fragment was found on ground surface near the south edge of Feature A. Despite the lack of significant habitation debris, the size and construction of the larger platforms (Features A and B) conforms to the specifications generally accepted as permanent habitation (Cordy 1981, 1995), so therefore a function of permanent habitation is tentatively assigned to this site. Subsequent data recovery will help further refine the specific nature of habitation at this site.

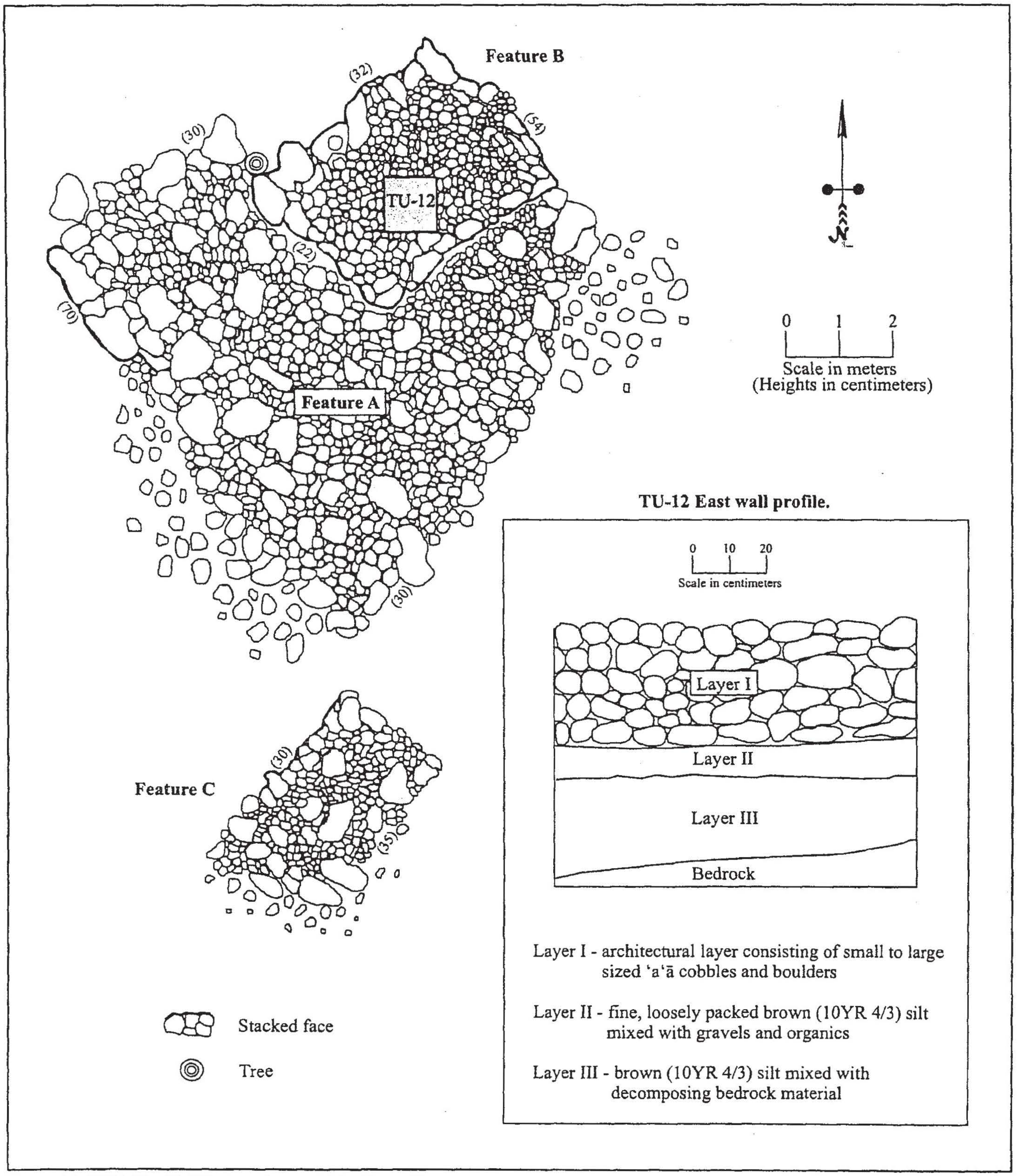


Figure 14. SIHP Site 23670 plan view and TU-12 profile.

Feature A is the lower platform of the two-tiered platform (see Figure 14). This roughly rectangular platform measures 9.0 meters long by 6.2 meters wide (Figure 15). The feature is constructed on bedrock with the outside edges stacked 0.7 meters (two courses) high. The paved surface of Feature A is relatively level and in good condition, although some collapse has occurred along the south and west edges.

Feature B, the upper platform of the two-tiered platform (see Figure 14), is situated on the northeast corner of Feature A (see Figure 15). Feature B is rectangular in shape measuring 3.4 meters long by 3.0 meters wide. Its stacked edges rise as much as 0.3 meters (2 courses) above the surface of Feature A and 0.54 meters above the bedrock ground surface. A single 1 x 1 meter test unit (TU-12) was excavated in the central portion of Feature B.

Figure 15. SIHP Site 23670 Features A and B view to west.

Excavation of TU-12 revealed a simple three-layer stratagraphic profile (see Figure 14). Layer I, the architectural layer, consisted of small to large sized *'a'ā* cobbles and boulders. This layer continued to a depth of 35 centimeters below the unit's surface. Layer I rested on and was incorporated into Layer II, a fine loosely packed brown (10YR 4/3) silt mixed with gravels and organics. Layer II continued for 10 centimeters before transitioning to Layer III at a depth of 45 centimeters below the unit's surface. Layer III consisted of brown silt (10YR 4/3) mixed with decomposing bedrock material, which continued for 25 centimeters below Layer II to a depth of 70 centimeters below the unit's surface. Layer III and the excavation of TU-12 terminated at bedrock. No cultural material was recovered from TU-12.

Feature C is a small rectangular platform located 1.5 meters south of Feature A's southwestern corner (see Figure 14). Feature C measures 3.8 meters long by 3.1 meters wide with stacked sides standing up to 0.35 (1–2 courses) meters above the surrounding bedrock ground surface (Figure 16). Feature C is in relatively good condition, although portions of its southwestern edge have collapsed. No habitation debris was observed in the vicinity of this feature.

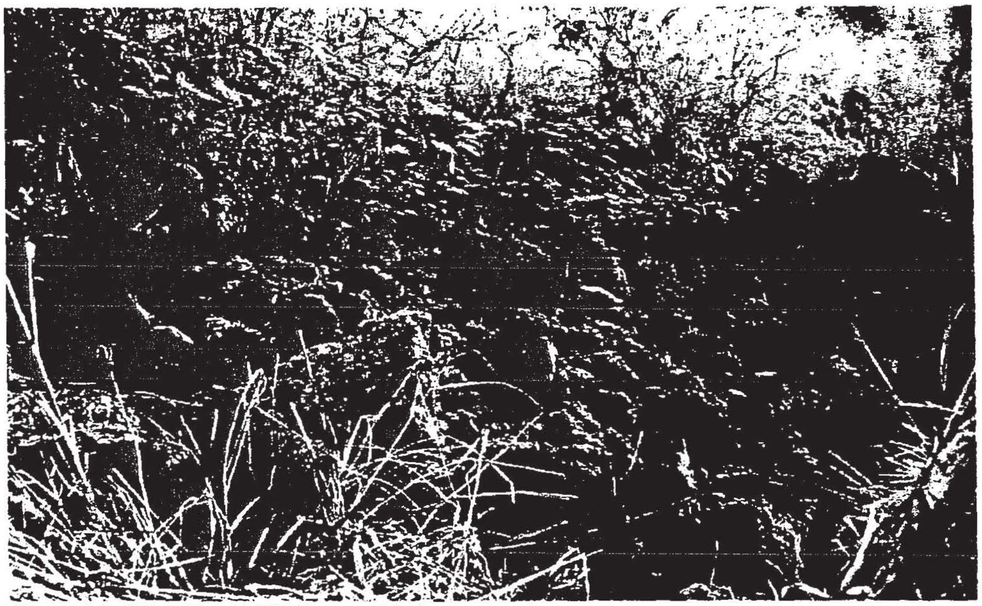


Figure 16. SIHP Site 23670 Feature C view to northeast.

SIHP Site 23671

Site 23671 is a temporary habitation platform remnant located in the central portion of the project area (see Figure 4). The platform (Figure 17), constructed of *'a'ā* cobbles, is largely collapsed although some stacking remains along the western edge. Current platform dimensions are 6.9 meters (north/south) by 3.8 meters (east/west) including the rubble scatter that surrounds the feature. The stacked western edge of the site stands up to 0.9 meters above the surrounding bedrock ground surface. The surface of the platform is relatively level and paved primarily with small *'a'ā* cobbles, although some larger cobbles are present. Site 23671 seems to have been heavily disturbed by ranching activities in the area. No habitation debris was observed on ground surface at this site. No subsurface testing was undertaken at this site as it appeared to lack some context (due to historic ranching impacts) and it generally conformed (with its small size and insubstantial construction) to Cordy's (1981, 1995) model for Precontact temporary habitations. Data recovery efforts will help further determine the specific function of Site 23671.

Figure 17. SIHP Site 23671 view to north.

SIHP Site 23672

Site 23672 is a Precontact permanent habitation site centrally located within the project area (see Figure 4). The site consists of a large rectangular enclosure (Feature A) with a small rounded enclosure (Feature B) located six meters to its south (Figure 18). Bulldozing activity along the old central access road came close to impacting the north edge of Feature A and may have covered a third feature near its northwest corner. Two test units (TU-11 and TU-13), one in each feature, were excavated at Site 23672. Based on the large size of Feature A (Cordy 1981, 1995) and the presence of Precontact habitation debris along with a radiocarbon sample dated 210±70 at Feature B, Site 23672 is thought to have served a Precontact permanent habitation function.

Feature A is a large low-lying enclosure located at the north end of Site 23672. The enclosure (Figure 19), constructed of piled and stacked *'a'ā* cobbles, measures 13.5 meters long by 8.5 meters wide. The interior area of the enclosure (10.1 meters by 6.0 meters) has been cleared of cobbles leaving a leveled soil floor. The cleared cobbles were used to create the enclosure's walls, which stand between 0.6 and 0.9 meters high along the interior edges and gradually transitions into ground surface along the exterior edges.

Figure 19. SIHP Site 23672 Feature A view to southwest.

A single 1 x 1 meter test unit (TU-11) was excavated in the soil floor along the western interior wall of Feature A (see Figure 18). Excavation of TU-11 revealed a two-layer stratigraphic profile (Figure 20). Layer I, the uppermost layer, consisted of a very dark brown (10YR 2/2) thin topsoil four centimeters deep mixed with grass roots and organics. Below this layer was an *'a'ā* cobble layer (Layer II) mixed fairly evenly with a sandy-silt soil. Layer II gradually transitioned from very dark brown (10YR 2/2) to dark yellowish brown (10YR 4/4) and mixed with decomposing bedrock with depth. Excavation of TU-11 concluded at the base of Layer II, 42 centimeters below ground surface at bedrock (Figure 21). Sixteen cow bone fragments were recovered from Layer I and the top of Layer II. These bones showed no sign of human processing and are most likely not related to the feature, but rather to the cow pasture within which the feature resides.

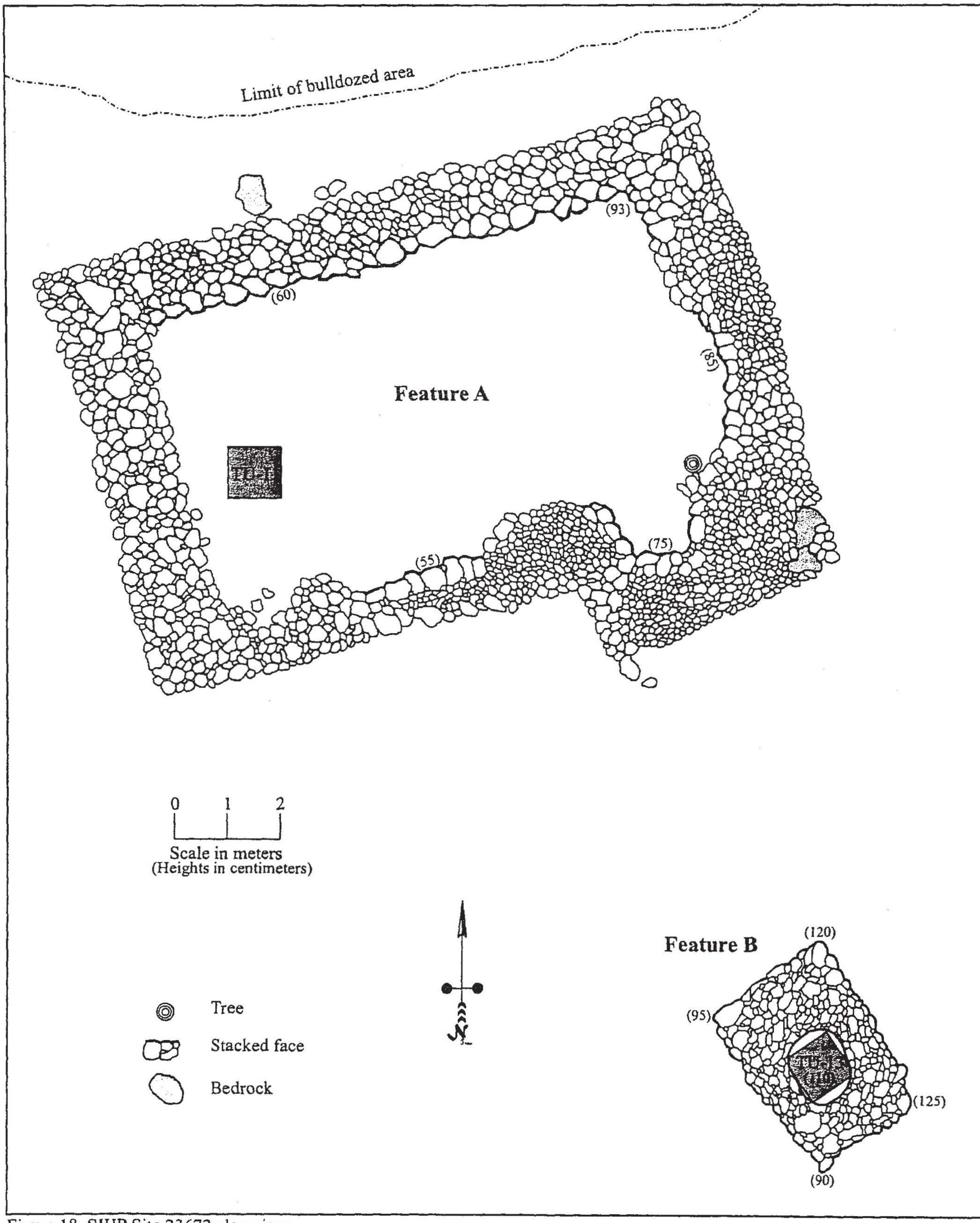
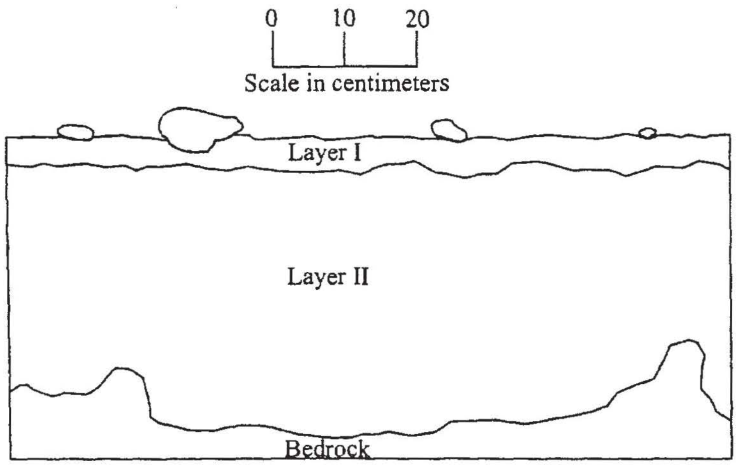


Figure 18. SIHP Site 23672 plan view.



Layer I - very dark brown (10YR 2/2) thin topsoil mixed with grass roots and organics.

Layer II - *'a'ā* cobble layer mixed with sandy-silt soil. Layer gradually transitions from very dark brown (10YR 2/2) to dark yellowish brown (10YR 4/4) and mixed with increasing decomposing bedrock with depth.

Figure 20. SIHP Site 23672 Feature A TU-11 north wall profile.

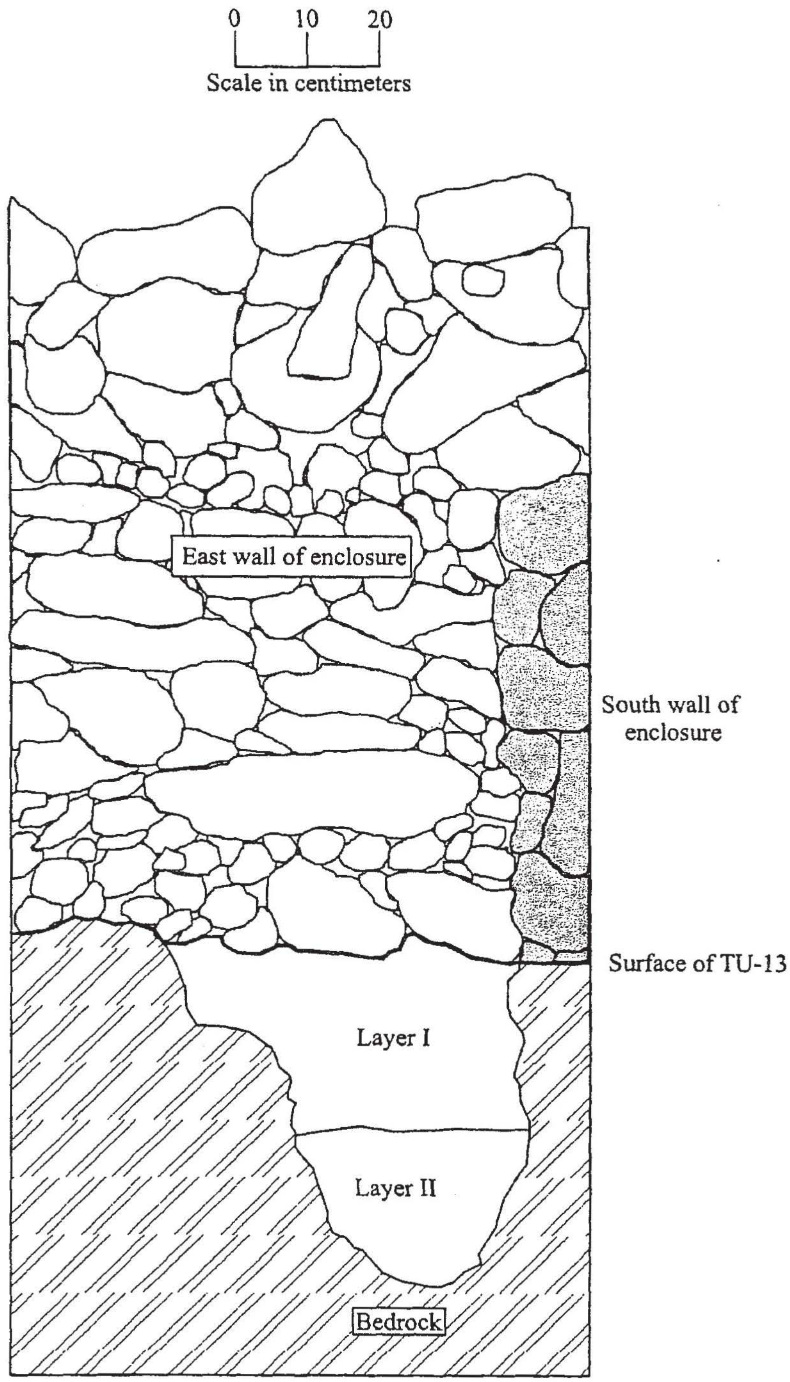
Figure 21. SIHP Site 23672 Feature A TU-11 base of excavation view to north.

Feature B is small roughly rectangular enclosure with rounded corners located six meters south of Feature A (see Figure 18). The enclosure is constructed on an *'a'ā* bedrock outcrop of stacked *'a'ā* cobbles standing 6-8 courses (1.0 –1.3 meters) high (Figure 22). It measures 3.5 meters long by 2.5 meters wide along its exterior edges and has a roughly circular centrally located interior space 1.2 meters in diameter and 1.1 meters deep containing a soil floor. A rubber hose fragment, a modern beer can, decaying organics, and several cobbles were resting on ground surface within the enclosure. Feature B is not large enough to have been used for habitation purposes, and may have been used by the residents of Feature A as a storage area, an agricultural processing area, or perhaps even a trash receptacle.

The entire soil floor of Feature B was removed as a single 1 x 1 meter test unit (TU-13). Excavation of TU-13 revealed two distinct soil horizons resting on bedrock (Figure 23). The uppermost soil layer (Figure 24), Layer I, consisted of very dark grayish brown (10YR 3/2) very fine silt mixed with many small *'a'ā* pebbles, roots and decaying organic material. This layer proceeded to a depth of 22 centimeters below the unit's surface, although bedrock was encountered in the northeastern portion of the unit just below ground surface. Cultural material recovered from Layer I (Table 2) included a large amount of volcanic glass, *kukui* nut fragments, shark's teeth, marine shell fragments, a water worn pebble, and a small amount of charcoal. In portions of the unit a 20-centimeter thick Layer II consisting of dark brown (10YR 3/3) fine silt mixed with decomposing bedrock was encountered. This culturally sterile layer was situated directly on bedrock. Excavation of TU-13 concluded at bedrock.

A carbon sample (1.8 grams) was collected from Layer I during the screening of Level 2, 10-20 centimeters below the surface of TU-13. The carbon sample from this layer was sent to Beta Analytic, Inc. for radiocarbon age determination (Beta-175916; see Appendix A). The sample produced a conventional radiocarbon age of 210±70 years before present, or a 2 sigma calibrated result of A.D. 1510 to 1950 with an intercept of A.D. 1660.

Figure 22. SIHP Site 23672 Feature B exterior view to north.



Layer I - very dark grayish brown (10YR 3/2) very fine silt mixed with many small *'a'a* pebbles, roots and decaying organic material and cultural material.

Layer II - dark brown (10YR 3/3) fine silt mixed with decomposing bedrock.

Figure 23. SIHP Site 23672 Feature B TU-13 east wall profile.

Figure 24. SIHP Site 23672 Feature B interior overview and surface of TU-13.

Table 2. Recovered cultural material from SIHP Site 23672 Feature B, TU-13 Layer I.

ACC #	*Depth (cm)*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
4	0-10	Volcanic glass	Flakes	4	-	1.5
5	0-10	Organic	*Kukui*	2	1	3.0
6	10-20	Basalt	Water worn	1	-	45.1
7	10-20	Volcanic glass	Shatter	44	-	17.5
8	10-20	Bone	Rodent	1	1	0.05
9	10-20	Bone	Shark (teeth)	2	1	0.2
10	10-20	Shell	*Drupa*	1	1	0.1
11	10-20	Shell	*Nerita*	1	1	0.2
12	10-20	Organic	Charcoal	-	-	1.8

SIHP Site 23673

Site 23673 is a permanent habitation site consisting of a platform (Feature A) and an enclosure (Feature B) located in the eastern half of the project area along the southern property boundary (see Figure 4). The permanent habitation interpretation is primarily based on size (Cordy 1991; 1995). The features are constructed of *'a'ā* cobbles and boulders in an area of exposed bedrock and thin soil. Feature A is located 6.7 meters west of Feature B (Figure 25). Modern debris was observed on the surface of the site including a paint can lid and several golf balls. A 1 x 1 meter test unit (TU-17) excavated in the center of Feature A revealed an abundance of habitation debris.

Feature A is a habitation platform measuring 6.8 meters long by 3.9 meters wide (see Figure 25). It is constructed with large cobbles and boulders stacked along the exterior edges (Figure 26) and small cobbles paving the roughly level platform surface. The western edge of the feature rises 0.9 meters above ground surface, while the eastern edge rises 0.4-0.7 meters above ground surface. The exterior edges of Feature A are collapsed in several locations.

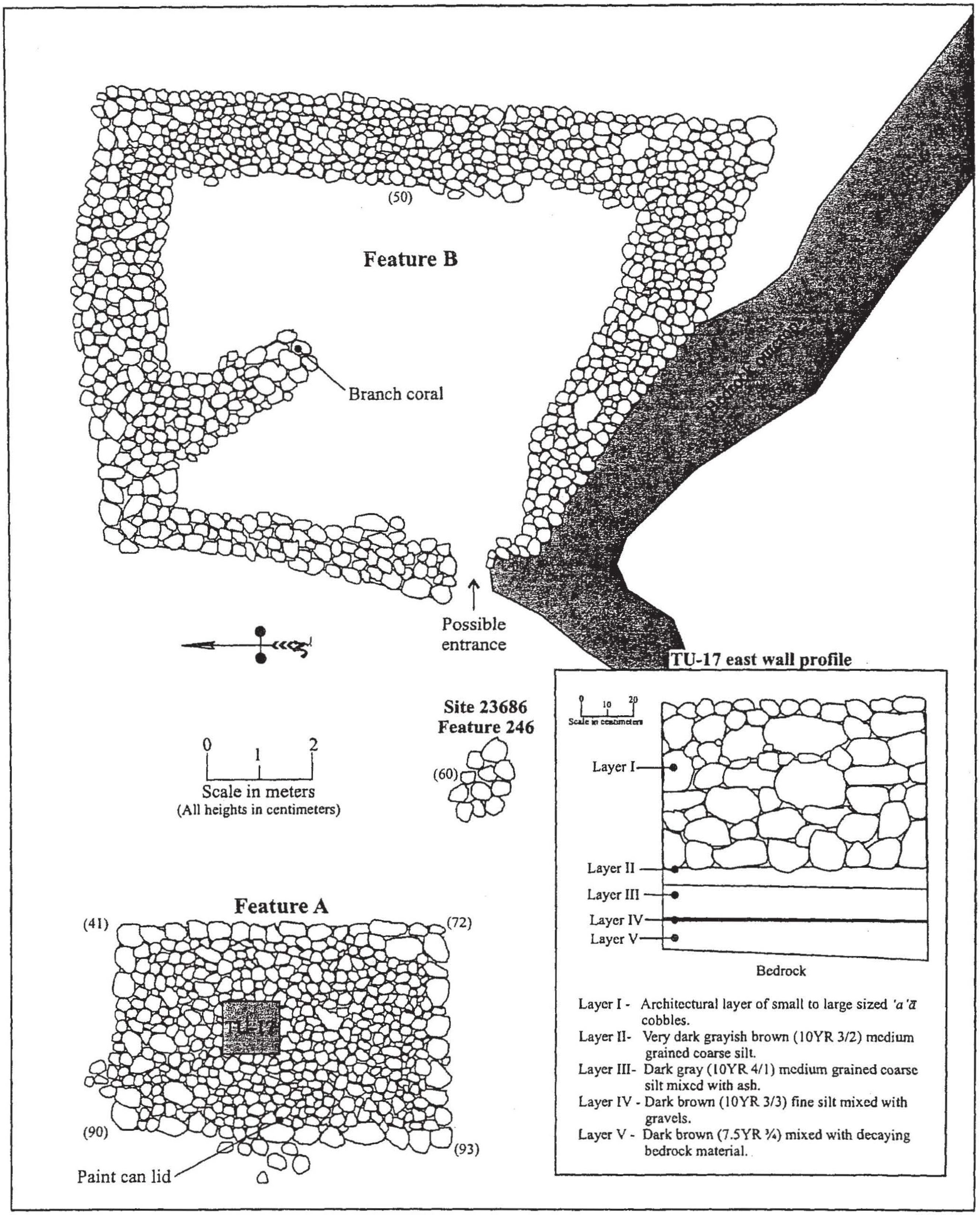


Figure 25. SIHP Site 23673 plan view and TU-17 profile.

Figure 26. SIHP Site 23673 Feature A view to north.

A 1 x 1 meter test unit (TU-17) was excavated in the approximate center of Feature A. Excavation of TU-17 revealed a five-layer stratagraphic soil sequence resting on bedrock (see Figure 25). Layers I, II, III, and IV all contained cultural material consistent with the feature's habitation function (Table 3) including marine shell, coral, bone, *kukui*, and volcanic glass. Layer I, the architectural layer, consisted of small to large sized *'a'ā* cobbles and extended to a depth of 65.0 centimeters below the platform's surface. Layer I rested on and was incorporated into Layer II, a very dark grayish brown (10YR 3/2) medium grained coarse silt rich with organics and habitation debris 8.0 centimeters thick. Layer II gradually transitioned into Layer III, a dark gray (10YR 4/1) medium grained coarse silt mixed with ash and *'a'ā* gravels 13.0 centimeters thick. Layer III rested on the earliest habitation soil at Feature A, Layer IV. Layer IV, which is only 2.0 centimeters thick, consisted of dark brown (10YR 3/3) fine silt mixed with gravels. This layer rested on Layer V, culturally sterile dark brown (7.5YR 3/4) fine silt mixed with decaying bedrock material. Layer V terminated at bedrock marking the base of excavation at TU-17.

Table 3. Recovered cultural material from SIHP Site 23673 Feature A, TU-17.

ACC #	*Layer*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
58	I	Coral	Branch	1	1	28.7
59	I	Organic	*Kukui*	1	1	6.3
60	I	Shell	*Echinoidea*	7	1	0.1
61	I	Shell	*Cypraea*	1	1	2.0
62	I	Bone	Rodent	1	1	0.1
63	II	Coral	Branch	1	1	0.4
64	II	Organic	*Kukui*	6	1	1.6
65	II	Shell	*Echinoidea*	4	1	1.0
66	II	Shell	*Cypraea*	5	2	5.3
67	II	Bone	Fish	1	1	0.6
68	II	Bone	Rodent	1	1	0.1
69	II	Volcanic glass	Flakes	15	-	11.2
70	III	Organic	Seed	1	1	0.1

Table 3 continued on next page.

Table 3. Continued.

ACC #	*Layer*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
71	III	Shell	*Echinoidea*	109	1	9.1
72	III	Shell	*Cypraea*	6	3	6.6
73	III	Shell	*Drupa*	3	1	0.7
74	III	Shell	*Nerita*	2	2	0.4
75	III	Shell	*Cellana*	3	1	0.5
76	III	Organic	*Kukui*	6	1	0.4
77	III	Bone	Fish	4	1	3.6
78	III	Volcanic glass	Flakes	24	-	12.1
81	III	Basalt	Flake	1	-	0.1
82	IV	Shell	*Echinoidea*	13	1	0.8
83	IV	Volcanic glass	Flakes	2	-	0.3
84	IV	Shell	*Cypraea*	4	1	2.7
85	IV	Shell	*Conus*	1	1	2.1
86	IV	Shell	*Drupa*	1	1	0.3

End of Table 3.

Feature B is an enclosure located 6.7 meters east of Feature A (see Figure 25). The enclosure (Figure 27) is roughly square measuring 8.7 meters by 8.6 meters along its exterior edges. The enclosure walls, which are constructed of stacked (but largely collapsed) *'a'ā* cobbles, measure up to 1.2 meters wide and stand 0.5 meters high. The south edge of the feature abuts a raised linear *'a'ā* bedrock outcrop running northwest/southeast. There is a 1.0 meter wide opening (entrance?) accessing the enclosure's southwestern corner. A 3.0-meter long internal dividing wall runs southeast from Feature B's interior north wall. This internal wall, which may have partitioned off separate use areas within the enclosure, stands up to 0.7 meters high and 1.2 meters wide. A branch coral fragment was found on the surface of the wall's south end. No other cultural debris was observed at Feature B. Its habitation function is inferred from its close proximity to Feature A.

Figure 27. SIHP Site 23673 Feature B view to east.

SIHP Site 23674

Site 23674 is a temporary habitation site located in the east-central portion of the project area (see Figure 4). Site 23674 consists of a rough rectangular platform (5.2 meters by 3.3 meters) with a circular enclosure (4.8 meters in diameter) protruding from its south edge (Figure 28). The site is constructed of stacked and piled *'a'ā* cobbles, and the partially leveled surface of the platform is roughly paved with small *'a'ā* cobbles (Figure 29). The platform stands up to 0.66 meters above ground surface along it's stacked southern edge and is slightly terraced to the north standing up to 0.46 meters above ground surface along its northern edge. The enclosure walls measures as wide as 1.9 meters and stand up to 0.66 meters high along their interior edge. The central area of the enclosure consists of leveled soil covered by dense vegetation. No habitation debris was observed at Site 23674; subsequent data recovery investigations will help further refine this site's function.


Figure 28. SIHP Site 23674 view to south.

SIHP Site 23675

Site 23675 is a Precontact permanent habitation platform located in the east-central portion of the project area (see Figure 4). The permanent habitation function assigned to this site is based on its large size (Cordy 1981, 1995) and the presence of habitation debris discovered during subsurface testing (TU-20). The platform is constructed of partially stacked, but now mostly collapsed, small to large sized *'a'a* cobbles (Figure 30). It measures 5.8 meters long by 5.7 meters wide and stands up to 0.8 meters above ground surface (Figure 31). The platform's surface is roughly paved with small sized cobbles. The platform's surface also contains two water worn pebbles and two small circular depressions, one near its southeast corner and the other near the northeast corner. The northern depression measures 1.2 meters in diameter and 0.55 meters deep, while the southern depression measures 1.2 meters in diameter and 0.5 meters deep; both depressions may be the result of vegetation growth at the site.

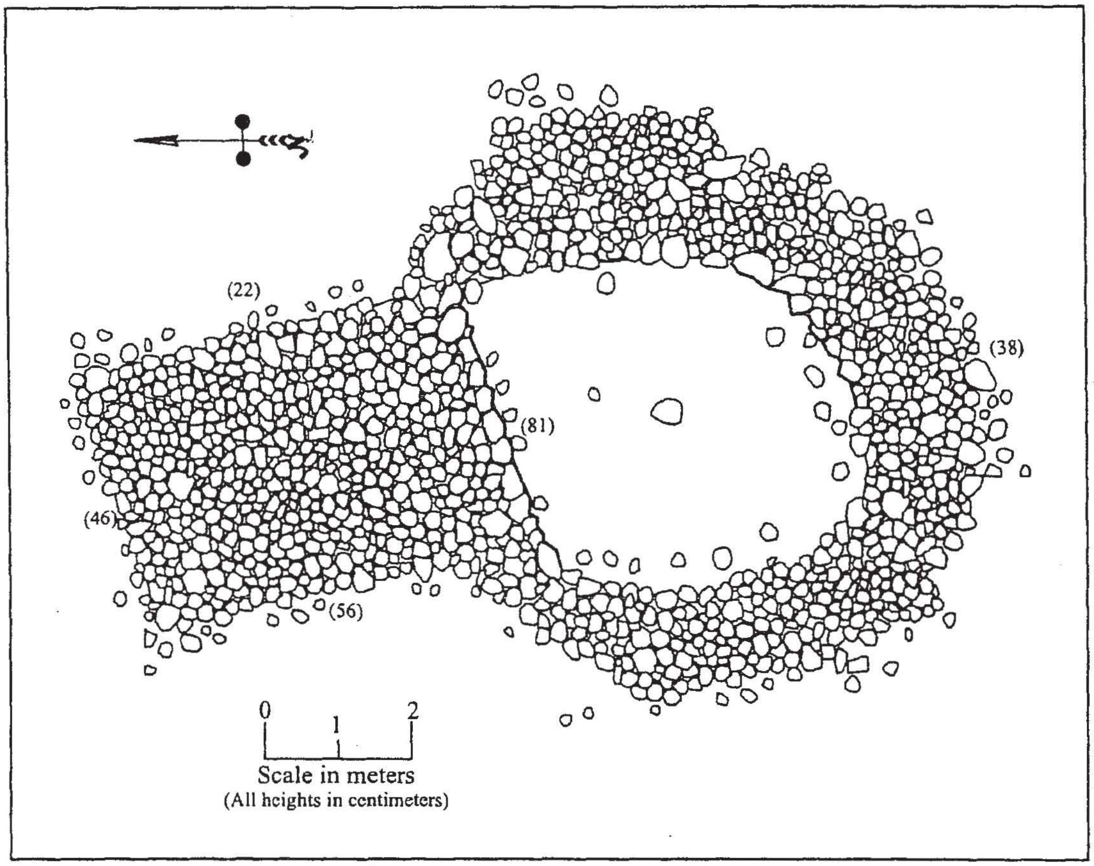


Figure 29. SIHP Site 23674 plan view.

Figure 30. SIHP Site 23675 view to southwest.

A 1 x 1 meter test unit (TU-20) was excavated on top of the northeastern depression (see Figure 31). Excavation of TU-20 revealed a two layer stratigraphic profile resting on bedrock (Figure 32). A small amount of cultural material was recovered from TU-16 (Table 4) including pig (*Sus*) teeth and bone, a marine shell fragment, a water worn pebble, a coral fragment, and a small amount of charcoal. Layer I, a 95-centimeter thick architectural layer, consisted of small to large sized *'a'ā* cobbles mixed with organics. This layer rested on and was incorporated into Layer II, a dark yellowish brown (10YR 4/4) sandy silt mixed with some organics and containing approximately 70 percent gravel content. As the 28-centimeter thick Layer II neared bedrock it gradually transitioned to a dark brown (10YR 3/3) silt containing a high concentration of gravels and decomposing bedrock. Excavation of TU-20 terminated at bedrock 113 centimeters below the platforms surface.

Table 4. Recovered cultural material from SIHP Site 23675, TU-20.

ACC #	*Layer*	*Depth**	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
116	I	0-95	Organic	Charcoal	-	-	0.6
117	II	95-105	Shell	*Cypraea*	1	1	1.3
118	II	95-105	Basalt	Water worn	1	-	71.4
119	II	95-105	Basalt	Groundstone fragment	1	-	116.7
120	II	95-105	Bone	*Sus*	21	1	9.6

***Depth in centimeters below the surface of TU-20.**

SIHP Site 23676

Site 23676 is a Precontact temporary habitation platform located in the east-central portion of the project area (see Figure 4). The platform (5.3 meters long by 3.4 meters wide) is constructed with partially stacked—mostly collapsed—large *'a'ā* cobbles forming its exterior edges (Figure 33). The platform is roughly paved with small *'a'ā* cobbles and pebbles creating a somewhat level living surface (Figure 34). Site 23676 stands up to 0.7 meters above the surrounding ground surface and its southeastern edge dissipates into a bedrock outcrop. A water worn coral fragment was observed on the platform's southern corner. Site 23676 was assigned a temporary habitation function based on its small size and relatively insubstantial construction (Cordy 1981, 1995).

A 1 x 1 meter test unit (TU-18) was excavated into the northwest portion of Site 23676. Excavation of TU-18 revealed a three-layer stratigraphic profile resting on bedrock (see Figure 33). Cultural material consistent with the platform's habitation function was recovered from Layers I and II. Recovered cultural material (Table 5) included marine shell, bone, *kukui,* volcanic glass, a *he'e* (octopus) lure (Figure 35), and a small amount of charcoal. Layer I, the architectural layer, consisted of a 40-centimeter thick layer small to large sized *'a'ā* cobbles mixed with organic debris. Layer I rested on and was incorporated into Layer II, a 31-centemeter thick layer of very dark brown (10YR 2/2) sandy silt with approximately 45 percent *'a'ā* gravel content. Layer II gradually transitioned into Layer III, a dark brown (7.5YR 3/4) fine silt mixed with gravels and decomposing bedrock 6 centimeters thick. Excavation of TU-18 terminated at bedrock 73 centimeters below the platform's surface. The charcoal recovered from TU-18 was too small for standard radiometric analysis, and not deemed a good candidate for AMS dating.

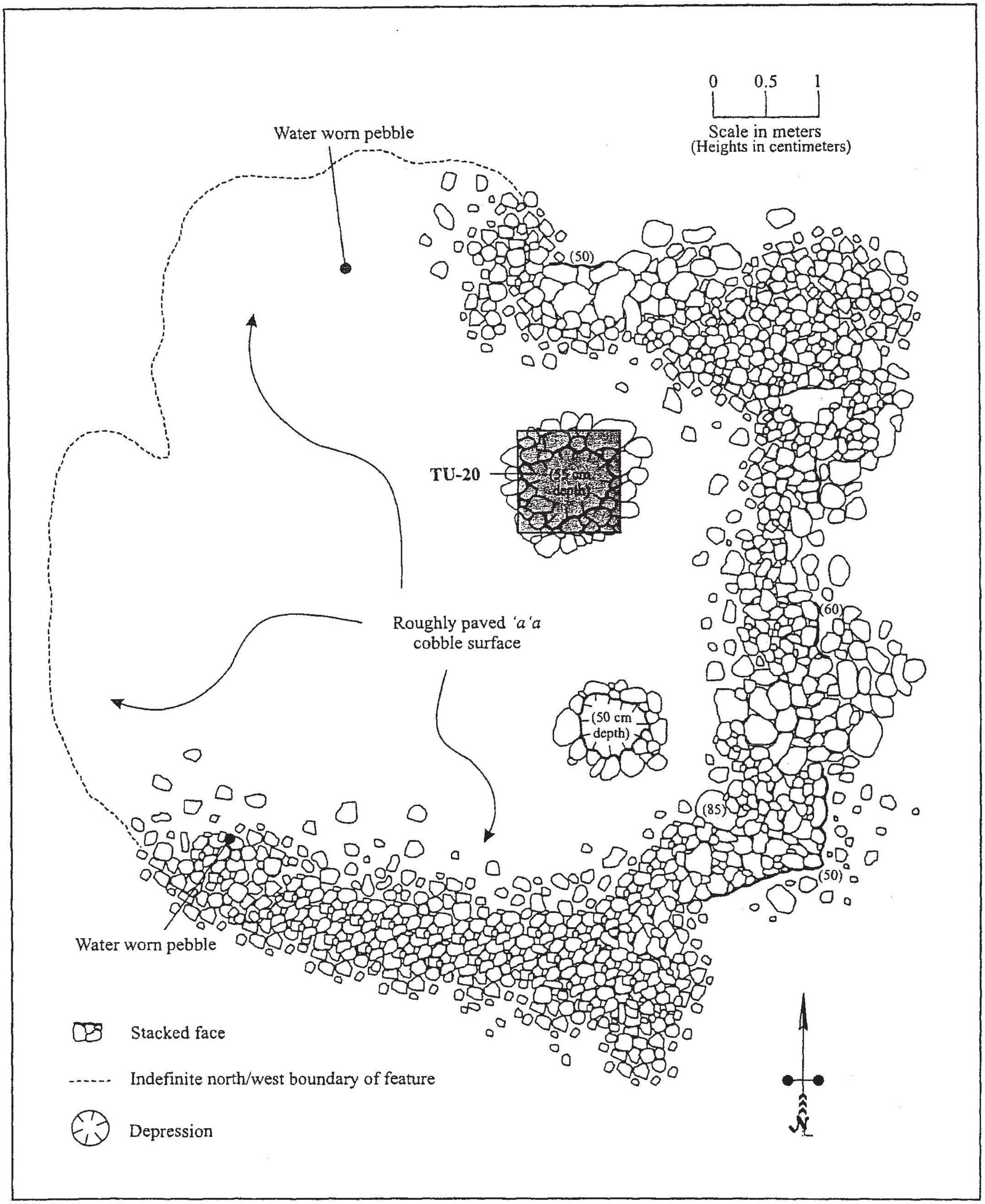
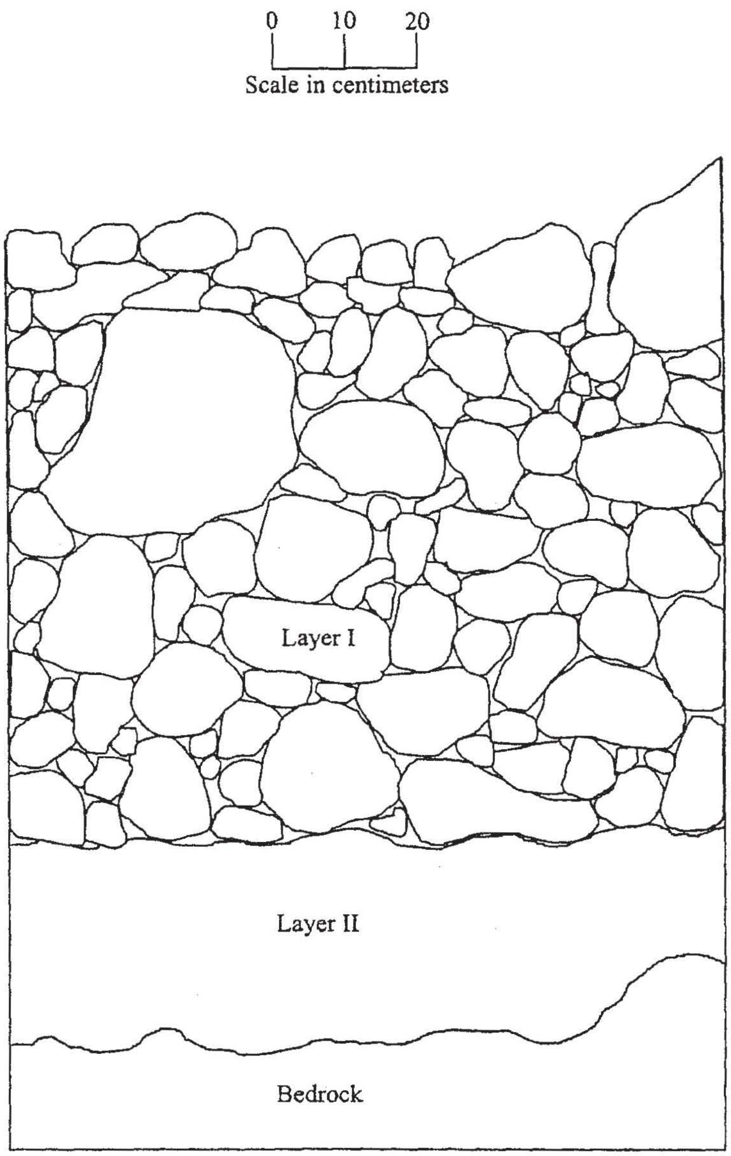


Figure 31. SIHP Site 23675 plan view.



Layer I - architectural layer consisting of small to large sized ʻaʻā cobbles mixed with organics.

Layer II - dark yellowish brown (10YR 4/4) sandy silt mixed with some organics and approximately 70 percent gravel content. As Layer II neared bedrock, it gradually transitioned to a dark brown (10YR 3/3) silt containing a high concentration of gravels and decomposing bedrock.

Figure 32. SIHP Site 23675 TU-20 north wall profile.

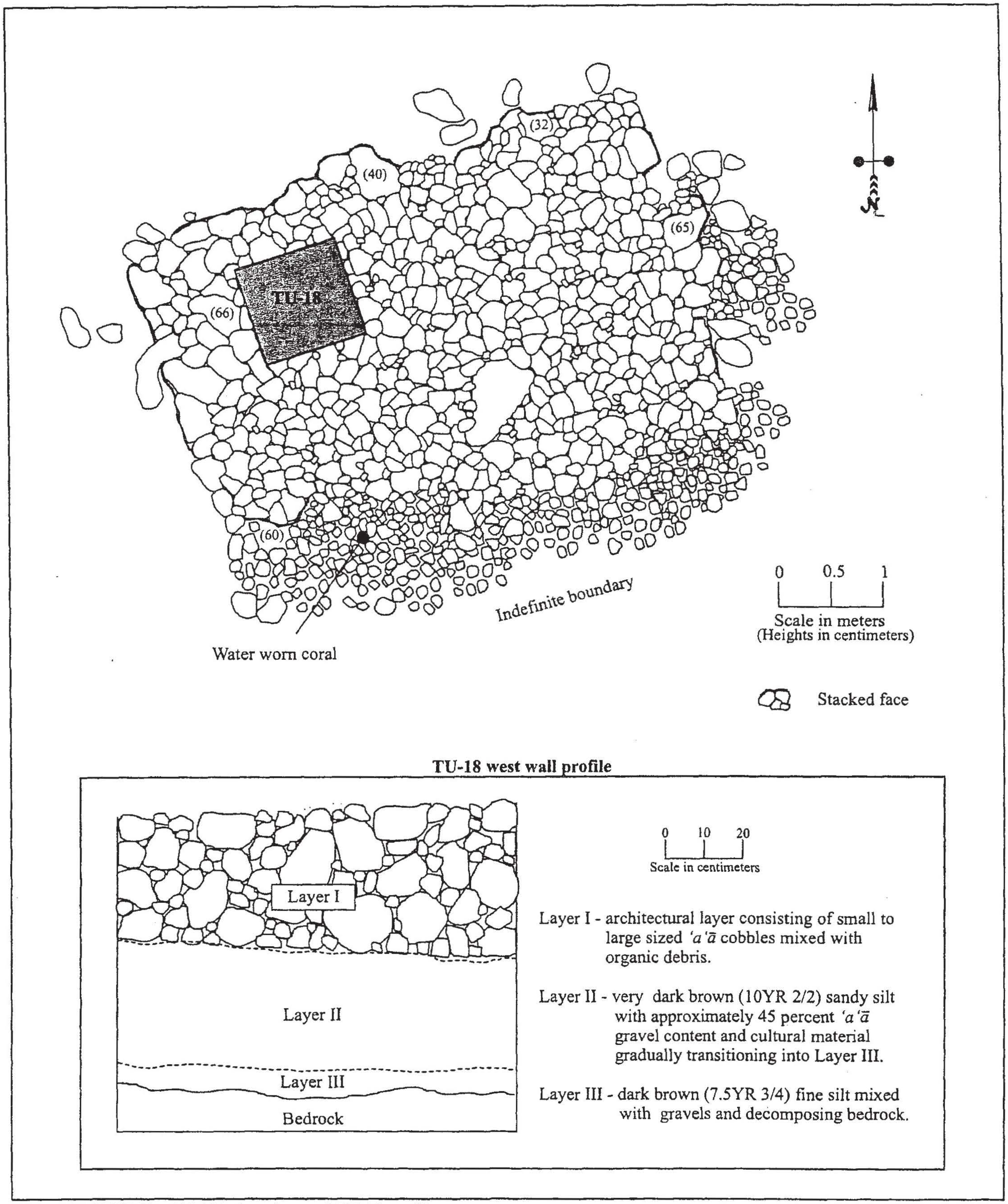


Figure 33. SIHP Site 223676 plan view and TU-18 profile.

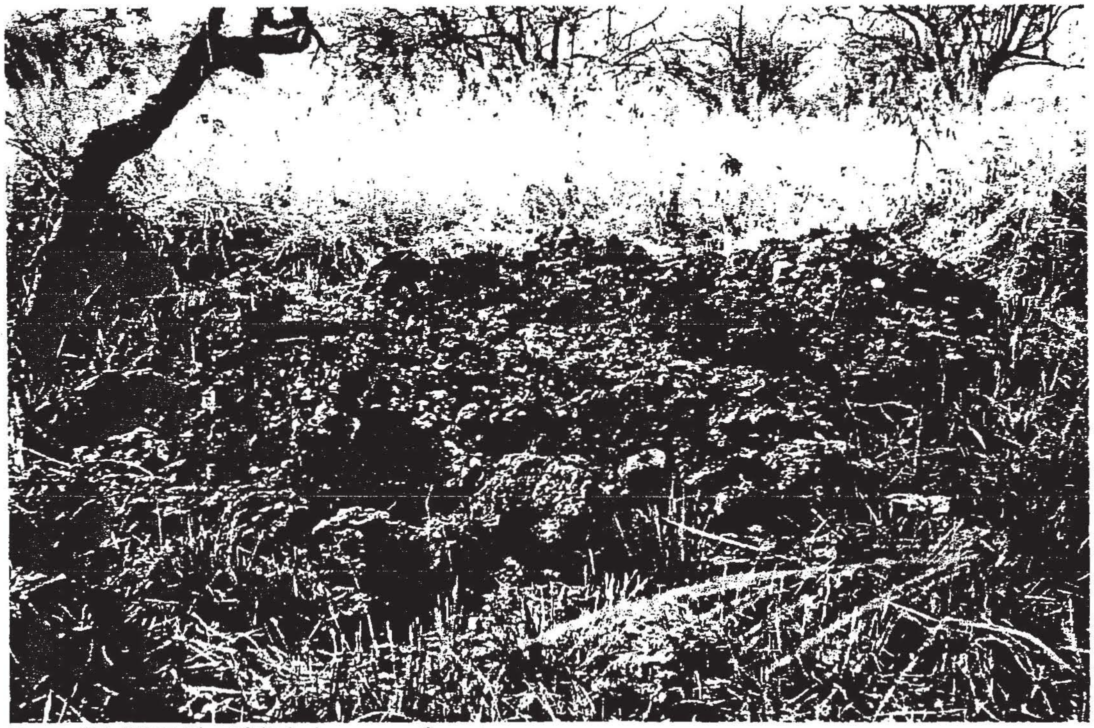


Figure 34. SIHP Site 23676 view to southwest.

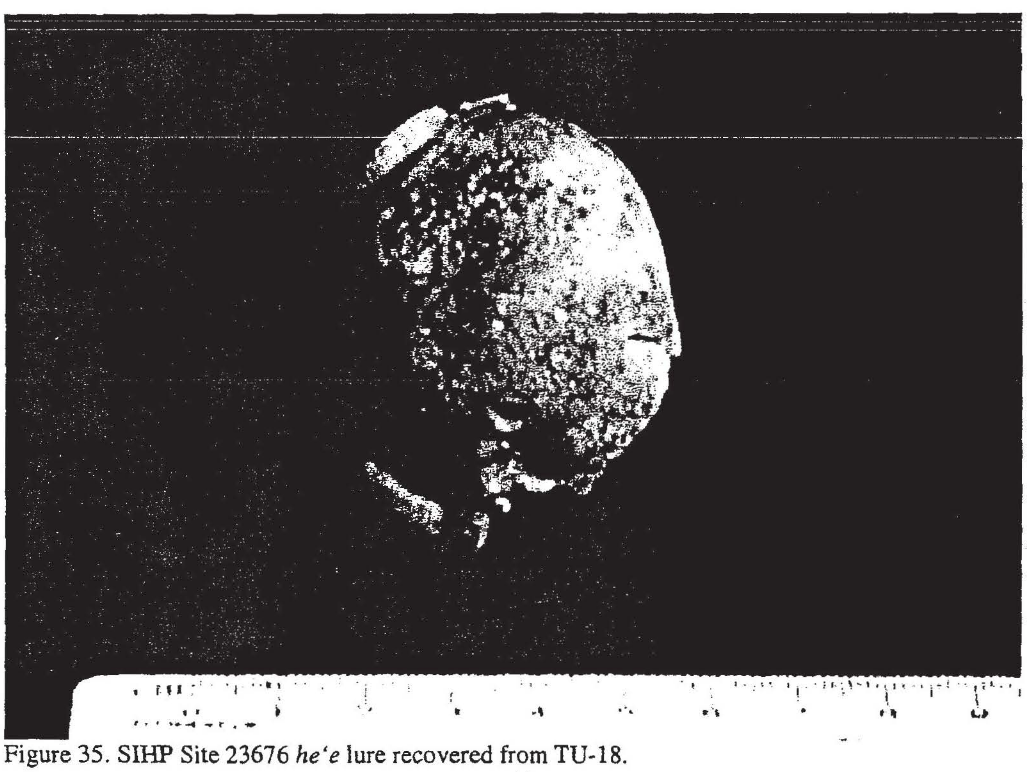


Figure 35. SIHP Site 23676 *he'e* lure recovered from TU-18.

Table 5. Recovered cultural material from SIHP Site 23676, TU-18.

ACC #	*Layer*	*Depth**	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
87	I	0-40	Shell	*Cypraea*	9	3	9.4
88	I	0-40	Shell	*Cellana*	1	1	0.1
89	I	0-40	Shell	Unidentified	1	1	1.0
90	I	0-40	Shell	*He'e* lure	1	1	32.0
91	I	0-40	Organic	*Kukui*	5	-	4.5
92	I	0-40	Bone	Fish	1	1	0.1
93	I	0-40	Bone	*Sus*	1	2	1.4
79	I	0-40	Bone	Rodent	3		0.3
94	I	0-40	Volcanic glass	Flakes	2	-	2.6
95	II	40-50	Organic	Charcoal	-	-	0.5
96	II	40-50	Organic	*Kukui*	10	-	2.3
97	II	40-50	Shell	*Echinoidea*	25	1	1.6
98	II	40-50	Shell	*Conus*	1	1	0.2
99	II	40-50	Shell	*Cypraea*	39	14	22.3
100	II	40-50	Shell	*Drupa*	1	1	0.1
101	II	40-50	Shell	*Nerita*	1	1	0.2
102	II	40-50	Shell	*Cellana*	3	1	0.4
103	II	40-50	Shell	*Strombina*	1	1	0.3
104	II	40-50	Shell	Unidentified	17	-	0.3
105	II	40-50	Bone	Small mammal	4	2	0.8
106	II	40-50	Volcanic glass	Flakes	8	-	6.4
107	II	40-50	Organic	*Kukui*	1	1	0.1
108	II	50-60	Shell	*Echinoidea*	25	1	1.9
109	II	50-60	Shell	*Nerita*	1	1	0.1
110	II	50-60	Organic	Charcoal	-	-	0.2
111	II	50-60	Shell	*Cypraea*	12	3	10.9
112	II	50-60	Volcanic glass	Flakes	2	-	0.9
113	II	60-71	Shell	*Echinoidea*	11	1	0.9
114	II	60-71	Shell	*Cypraea*	6	1	2.1
115	II	60-71	Volcanic glass	Flakes	2	-	1.1

*Depth in centimeters below the surface of TU-18.

SIHP Site23677

Site 23677 is a temporary habitation site located in the east-central portion of the project area (see Figure 4). It consists of a small square platform remnant (Feature A) constructed in the southwest corner of a rough enclosures (Feature B) (Figure 36). The features are constructed of *'a'ā* cobbles and boulders formerly stacked, but now largely collapsed (Figure 37). The interior of the enclosure consists of thin soil covered by dense vegetation. A water worn cobble, a piece of coral, and *Cypraea* shell fragments were observed on ground surface within the site. A 1 x 1 meter test unit (TU-16) was excavated in the center of Feature A.

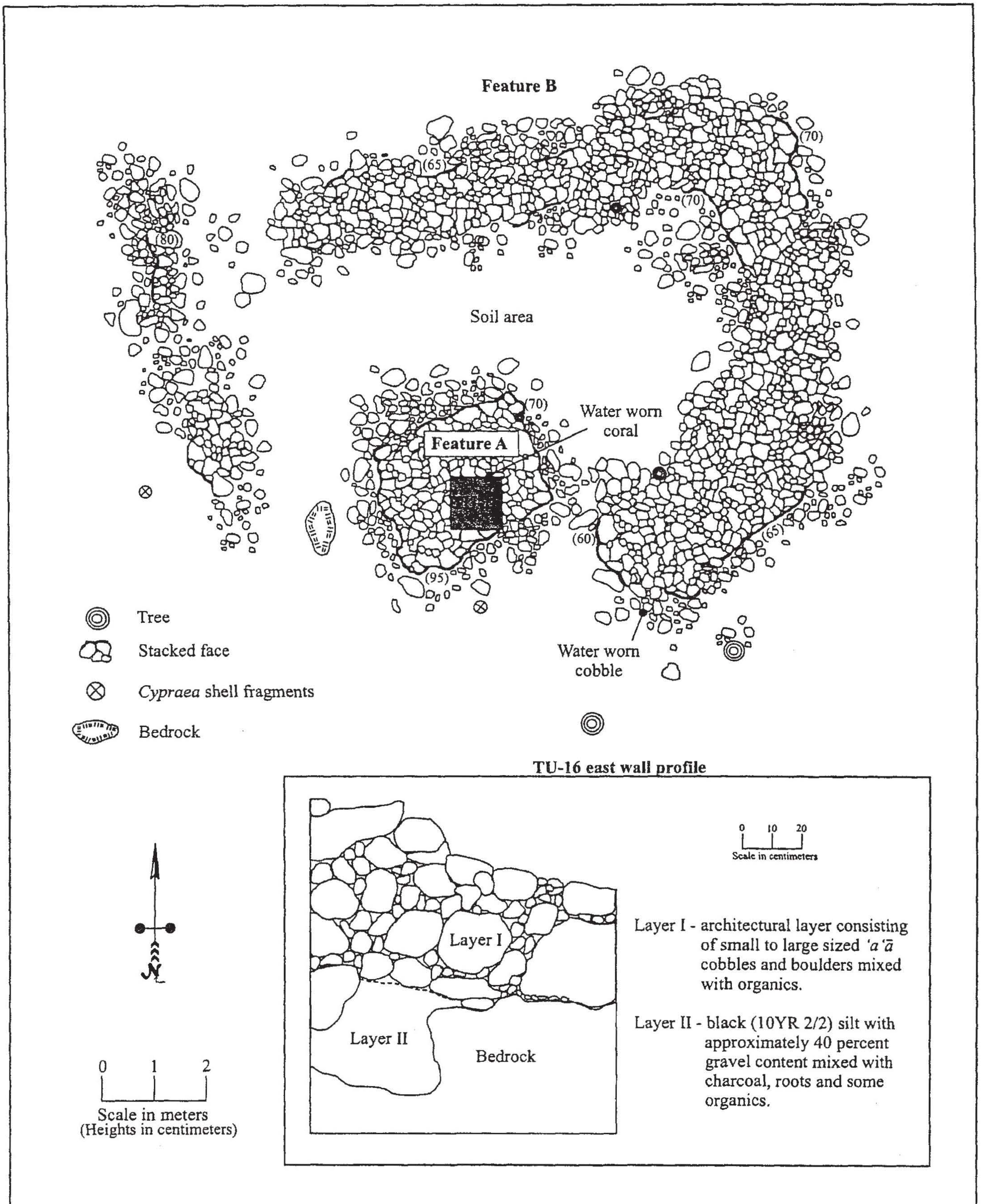


Figure 36. SIHP Site 23677 plan view and TU-16 profile.

Figure 37. SIHP Site 23677 view to southwest.

Feature A is a small platform remnant (2.9 meters long by 2.5 meters wide) located in the northwest corner of the enclosure area (Feature B). The platform is constructed with large *'a'ā* cobbles stacked around the outside edges (0.9 meters high) and small cobbles paving its roughly level surface. Much of Feature A has collapsed leaving a rubble scatter around the entire feature. A piece of water worn coral was found on the platform's surface.

A 1 x 1 meter test unit (TU-16) was excavated in the south-central area of Feature A (see Figure 36). Excavation of TU-16 revealed a two-layer stratigraphic profile and a plethora of cultural material consistent with the sites habitation function. Recovered cultural materials included (Table 6) marine shell, urchin, burned bone, volcanic glass, coral, and a small amount of charcoal. The uppermost layer of TU-16 (Layer I), a 65-centimeter thick architectural layer, consisted of small to large sized *'a'ā* cobbles and boulders mixed with organics. Layer I rested on and was incorporated into Layer II, a 30-centimeter thick layer of black (10YR 2/2) silt with approximately 40 percent gravel content mixed with roots and some organics. The dark color of the soil is most likely the result of charcoal staining. A charcoal sample from this layer was sent to Beta Analytic, Inc. for AMS radiocarbon analysis (Beta Sample No. 175917). The resulting conventional radiocarbon age is 160±40 B.P., with a 2-sigma range of A.D. 1660 to 1950 (Appendix A). Layer II terminated at bedrock 95 centimeters below the platform's surface.

Table 6. Recovered cultural material from SIHP Site 23677, TU-16.

ACC #	*Layer*	*Depth**	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
26	I	0-65	Organic	Charcoal	-	-	0.4
27	I	0-65	Shell	*Echinoidea*	2	1	0.3
28	I	0-65	Shell	*Cypraea*	3	2	5.0
29	I	0-65	Shell	*Conus*	1	1	0.7
30	I	0-65	Shell	*Drupa*	1	1	3.5
31	I	0-65	Shell	*Nerita*	1	1	0.2
32	II	65-75	Organic	Charcoal	-	-	2.2
34	II	65-75	Shell	*Echinoidea*	28	1	3.6
35	II	65-75	Shell	*Nerita*	5	5	1.7
36	II	65-75	Shell	Unidentified	1	1	0.1
37	II	65-75	Coral	Water worn	8	-	4.1
38	II	65-75	Shell	*Drupa*	2	1	0.6
39	II	65-75	Shell	*Cantharus*	1	1	0.1
40	II	65-75	Shell	*Cypraea*	30	4	14.7
41	II	65-75	Shell	*Cellana*	1	1	0.1
42	II	65-75	Shell	*Venus*	1	1	0.1
43	II	65-75	Bone	Fish	1	1	0.2
44	II	65-75	Bone	Small mammal	1	1	2.4
45	II	65-75	Volcanic glass	Flakes	2	-	0.5
46	II	75-85	Organic	Charcoal		-	1.3
47	II	75-85	Shell	*Echinoidea*	16	1	1.6
48	II	75-85	Shell	*Cypraea*	5	1	1.1
49	II	75-85	Shell	*Nerita*	1	1	0.1
50	II	75-85	Shell	*Cellana*	1	1	0.1
51	II	75-85	Bone	Small mammal	1	1	1.0
52	II	75-85	Volcanic glass	Debitage	1	-	0.3
53	II	75-85	Organic	Charcoal	-	-	0. 9
54	II	75-85	Shell	*Echinoidea*	2	1	0.3
55	II	75-85	Shell	*Cypraea*	3	1	2.7
56	II	75-85	Shell	*Nerita*	1	1	0.1
57	II	75-85	Shell	*Venus*	1	1	0.3

*Depth in centimeters below the surface of TU-16.

Feature B is a rough wall partially enclosing Feature A to the north and east. The wall which was formerly stacked, but is now mostly collapsed, measures up to 2.5 meters wide, 0.7 meters high, and encompasses an area approximately 13.2 meters long by 9.5 meters wide. This *'a'ā* cobble wall is absent in the site's southwest corner near Feature A, and only a faint trace of the western wall remains intact. The central area enclosed by the wall consists primarily of thin soil.

SIHP Site 23678

Site 23678 is an oval shaped habitation enclosure located in the north east quadrant of the project area (see Figur 4) constructed within the center of a *kuaiwi* wall remnant (Site 23686 Feature 291) (Figure 38). The enclosure (12.5 meters long by 5.5 meters wide) is constructed of partially stacked (mostly collapsed) *'a'ā* cobbles and boulders (Figure 39). In several locations the tops of the walls, which stand up to 0.6 meters above ground surface and measure 1.0 meter wide, are topped with smooth *pāhoehoe* cobbles. The interior of the enclosure area (7.7 meters long by 2.6 meters wide) consists primarily of thin soil (at least 8 centimeters thick) covered by dense vegetation (Figure x). An engineered opening (1.0 meter wide) located in the center of the north wall allows access to the enclosure. A *Cypraea* shell fragment and a small piece of coral were found on ground surface within Site 23678. Judging by the continuous construction, it appears that the enclosure was built prior to, or at the same time as, the *kuaiwi* wall (Site 23686 Feature 291), which extends in both directions from the enclosure's east and west ends. The rough (insubstantial) construction of the enclosure combined with its relatively small interior space suggests that Site 23678 may have been used for temporary habitation purposes.

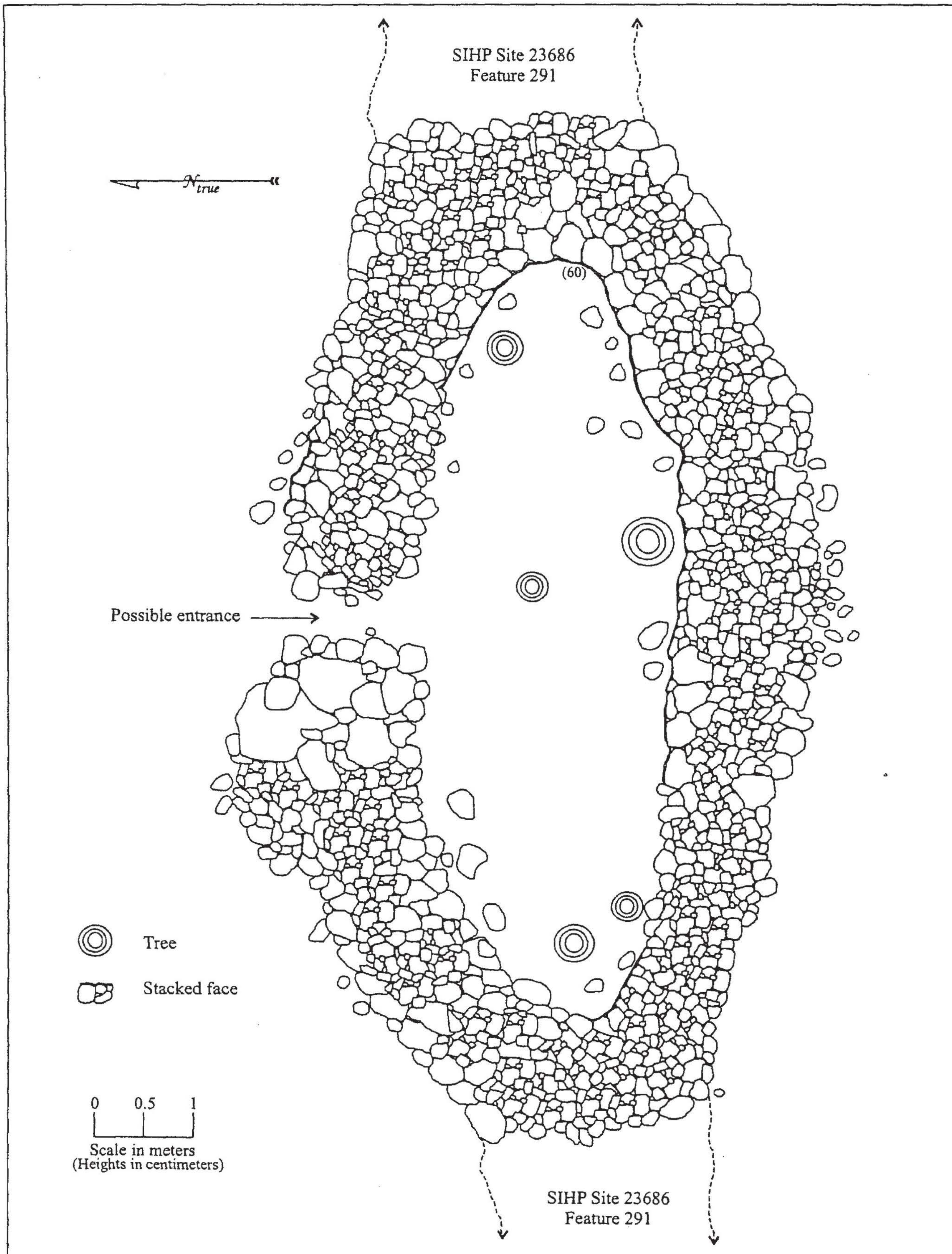


Figure 38. SIHP Site 23678 plan view.

Figure 39. SIHP Site 23678 view to east.

Trails

SIHP Site 23679

Site 23679 is a 20-meter long segment of stepping stone trail running east/west along the south-central portion of the project area (see Figure 4). Site 23679 is constructed of flat *pāhoehoe* and *'a'ā* slabs laid across an exposed *'a'ā* flow (Figure 40). Large cobbles and boulders have been cleared from the trail route and loosely piled along its edges creating a rough kerbing. The west end of the trail segment appears to fork. The north fork runs three meters west before terminating and the south fork travels five meters west before terminating at a wire fence. No further portions of the trail could be located either *mauka* or *makai* of the site.

SIHP Site23680

Site 23680 is a stepping stone trail segment located in the central eastern portion of the project area (see Figure 4). The trail segment runs east/west for 10 meters across an exposed *'a'ā* flow. It is constructed of at least 10 weathered *'a'ā* and smooth *pāhoehoe* slabs laid flat on the natural outcrop (Figure 41). No further portions of the trail could be located either *mauka* or *makai* of the site.

Figure 40. SIHP Site 23679 view to northeast.

Figure 41. SIHP Site 23680 view to west.

Ceremonial Sites

SIHP Site 23681

Site 23681 is interpreted as an agricultural shrine or *heiau* centrally located within the project area (see Figure 4). The site consists of a platform (Feature A) constructed within the northeast corner of a double enclosure area (Feature B) (Figure 42). The platform and enclosure walls are constructed of *'a'ā* cobbles and boulders, while the floor of the enclosure area consists of thin soil covered by dense vegetation. Site 23681 resembles in size and shape other sites described in North Kona as *heiau*:

> Based on the character of their foundations, the heiau would seem to fall into two classes – the platform and the walled enclosure. There were many intermediate forms and combinations of the two. The terraced form was generally an elaboration of the platform type. (Stokes and Dye 1991:21)

Feature A is a large rectangular platform (9.1 meters long by 5.3 meters wide) located in the northeast corner of Site 23681 (see Figure 42). The platform is constructed with large *'a'ā* cobbles and boulders stacked along its outside edges and a surface of small cobbles paving top (Figure 43). The platform rises up to 0.7 meters above the surrounding ground surface and is mostly intact with the exception of some collapse in the southwest corner and along the north edge. The enclosure walls (Feature B) run in a perpendicular direction from the platform's edge starting at its southeast and northwest corners. The walls are not of continuous construction and may have been built subsequent to the completion of the platform. A single piece of water rounded coral and a water worn cobble were found on the surface of the Feature A.

A 1 x 1 meter test unit (TU-14) was excavated in the northeast corner of Feature A (see Figure 42). Excavation of TU-14 revealed a three-layer stratigraphic profile resting on bedrock. Layer I, the 70-centimeter thick architectural layer, consisted of small to large sized *'a'ā* cobbles mixed with organics. Layer I rested on and was incorporated into Layer II, a dark brown (10YR 3/3) sandy silt with approximately 40 percent gravel content 15 centimeters thick. Layer II gradually transitioned into Layer III, a 26-centimeter thick (in places) dark yellowish brown (10YR 4/4) culturally sterile silt mixed with decomposing bedrock. Cultural material collected from Layers I and II included volcanic glass, fire cracked rock, marine shell, urchin, *kukui*, and mammal bone (Table 7). The presence of these remains possibly indicates that multiple activities took place at this site. Excavation of TU-14 ceased at undulating bedrock 106 centimeters below the platform's surface.

Table 7. Recovered cultural material from SIHP Site 23681, TU-14.

ACC #	*Layer*	*Depth**	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
13	I	0-70	Volcanic glass	Flake	1	-	2.7
15	I	0-70	Basalt	Flake	1	-	15.6
16	I	0-70	Bone	Small mammal	2	1	0.3
17	I	0-70	Shell	*Cypraea*	2	2	6.0
18	I	0-70	Shell	*Echinoidea*	9	1	0.7
19	II	70-80	Volcanic glass	Flake	1	-	2.8
20	II	70-80	Bone	Small mammal	2	2	0.1
21	II	70-80	Shell	*Cypraea*	8	2	9.7
22	II	70-80	Shell	*Echinoidea*	6	1	1.2
23	II	70-80	Organic	*Kukui*	1	1	0.2
25	II	80-95	Shell	*Echinoidea*	1	1	0.2

***Depth in centimeters below the surface of TU-14.**

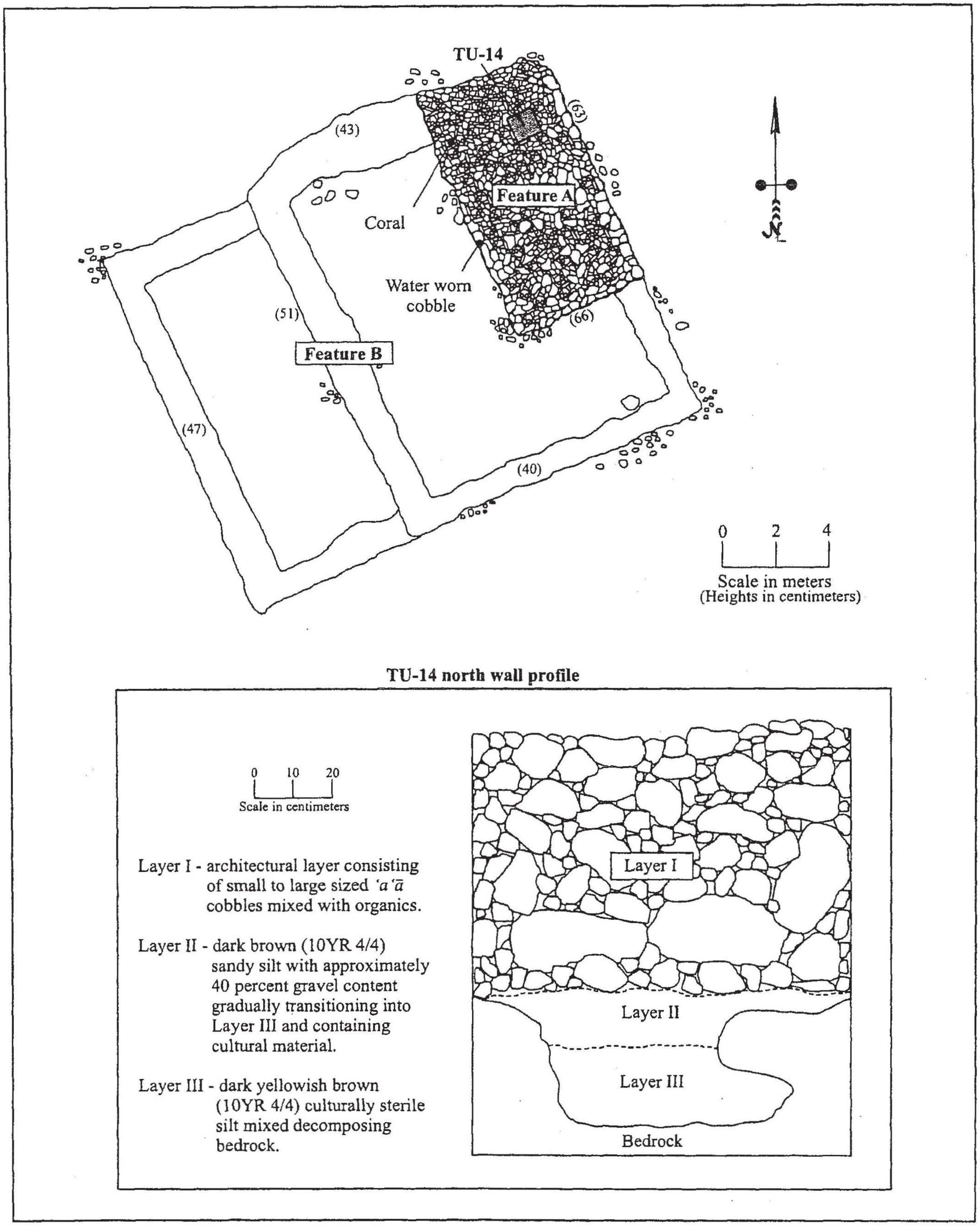


Figure 42. SIHP Site 23681 plan view and TU-14 profile.

Figure 43. SIHP Site 23681 view to northwest (Feature B in foreground and Feature A in background).

Feature B consists of a double enclosure located to the south and west of Feature A (see Figure 42). The enclosure measures 19 meters long by 15 meters wide. A partially terraced central dividing wall creates two enclosure areas within Feature B; the interior of the western area measures 12 meters by 5 meters, and the interior of the eastern area measures 12 meters by 10 meters. The eastern enclosure area is slightly terraced (0.5 meters high) above its western counterpart. The enclosure walls are constructed of *'a'ā* cobbles and boulders (see Figure 43), they were formerly stacked, but are now mostly collapsed. Intact sections of wall stand up to 0.5 meters above ground surface and measure 1.0 meter wide. Ground surface within Feature B consists of thin soil covered by dense vegetation.

Game Boards

SIHP Site23682

Site 23682 is a rough *papamū* located approximately 15 meters west of Site 23668. The roughly square game board (Figure 44), which measures 30 centimeters by 30 centimeters, is pecked into *pāhoehoe* bedrock in an area surrounded by agricultural mounds. It is very weathered making the number of pecked holes and their alignments difficult to discern. It is possible that Site 23682 is located along an old trail route no longer traceable on the *pāhoehoe* bedrock.

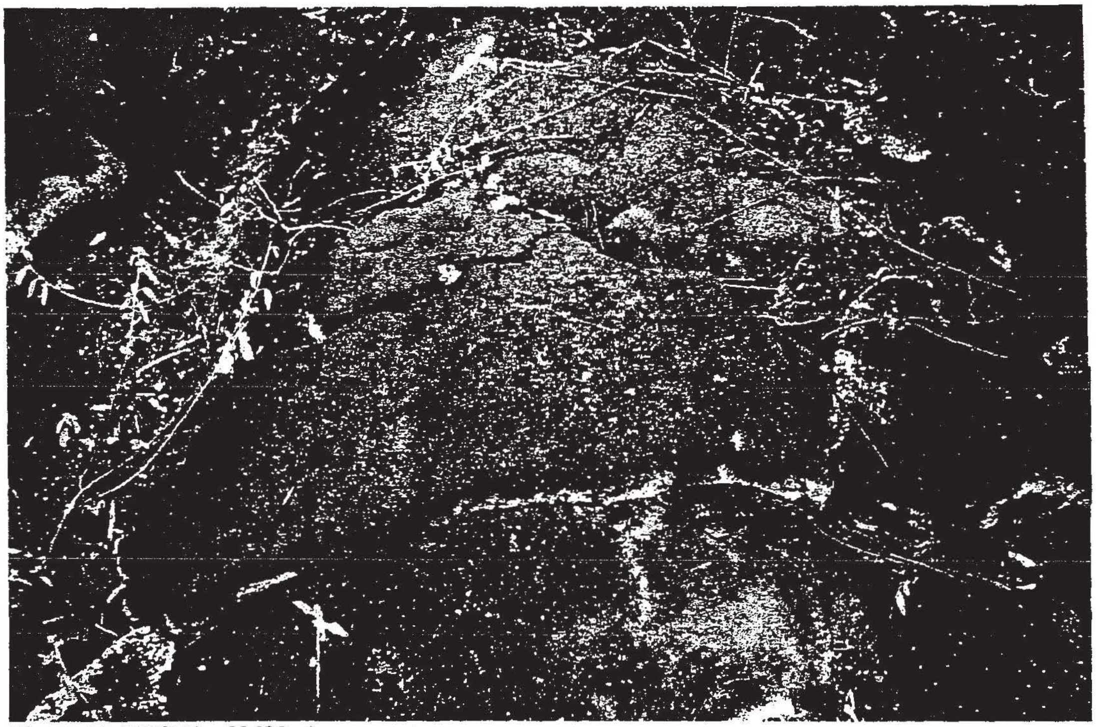


Figure 44. SIHP Site 23682 view to east.

Burials

SIHP Site 23683

Site 23683 is a burial platform located in the west-central portion of the project area (see Figure 4). The platform measures 6.7 meters long by 5.4 meters wide and rises 1.6 meters (3-4 courses) above the surrounding bedrock ground surface at its northeast corner. Site 23683 is constructed with *'a'ā* and *pāhoehoe* boulders and cobbles stacked along its exterior north, south, and east edges. The western edge of the platform abuts a raised bedrock outcrop and the platform's surface is paved with small *'a'ā* and *pāhoehoe* cobbles. Site 23683 is in a decent state of repair, although portions of the exterior walls have collapsed (Figure 45).

A metal site tag with the inscription "PHRI # 17" was found on the platform's surface indicating that this site had been designated as PHRI temporary site 2235-17 (Corbin and Rosendahl 2002). There was further evidence of a previously excavated 1 x 1 meter test unit located near the eastern edge of the platform (Figure 46). A PHRI letter report (Rosendahl 2002) indicated that Site 23683 had indeed been subject to burial testing in June of 2002 with negative results. However, the platform's formal attributes appeared so burial like (i.e. similar to other North Kona burial sites) that it was decided to re-evaluate the presence or absence of a burial within.


Figure 45. SIHP Site 23683 view to south.

A 1 x 1 meter test unit (TU-9) was excavated in the approximate center of the platform adjacent to the western edge of the previously excavated PHRI unit (see Figure 46). Excavation of TU-9 revealed that human skeletal remains were indeed present at Site 23683 (Figure 47). The excavation began with the removal of a 1.1-meter thick architectural layer, Layer I, consisting of small to large sized *'a'ā* and *pāhoehoe* cobbles. A single water worn cobble was observed in the northwest corner of the unit at the base of Layer I, but no other cultural material was present. Layer I rested on a dark brown (10YR 3/2) fine silt mixed with *'a'ā* gravels, Layer II. Approximately 10 centimeters below the surface of Layer II articulated human skeletal remains (oriented north/south) were encountered in the northeast corner of the unit. Upon discovery of the skeletal remains excavation of TU-9 immediately ceased. The remains, which were not moved from their original position, were stabilized and re-buried with the soil excavated from the unit. The architectural layer was then rebuilt on top of the burial, as close to its original specifications as possible, and DLNR-SHPD was notified of the discovery. As no habitation debris or any other cultural material was found at Site 23683 it is suggested that the platform was built solely as a burial monument subsequent to the interment of the deceased individual.

SIHP Site 23684

Site 23684 consists of a burial platform with an attached enclosure located in the southwest corner of the project area (see Figure 4). The rectangular burial platform measures 7.0 meters long by 3.5 meters wide (Figure 48). It is constructed of neatly stacked *'a'ā* cobbles and boulders along its exterior edges (1.1 meters high) with small cobbles paving the roughly level surface (Figure 49). The northwest corner of the platform has collapsed, but otherwise the feature is in fairly stable condition. A single piece of branch coral was found amongst the rubble scatter in the northwest corner. The platform (and enclosure) may have been used for habitation purposes prior to the interment of the deceased individual at the site.

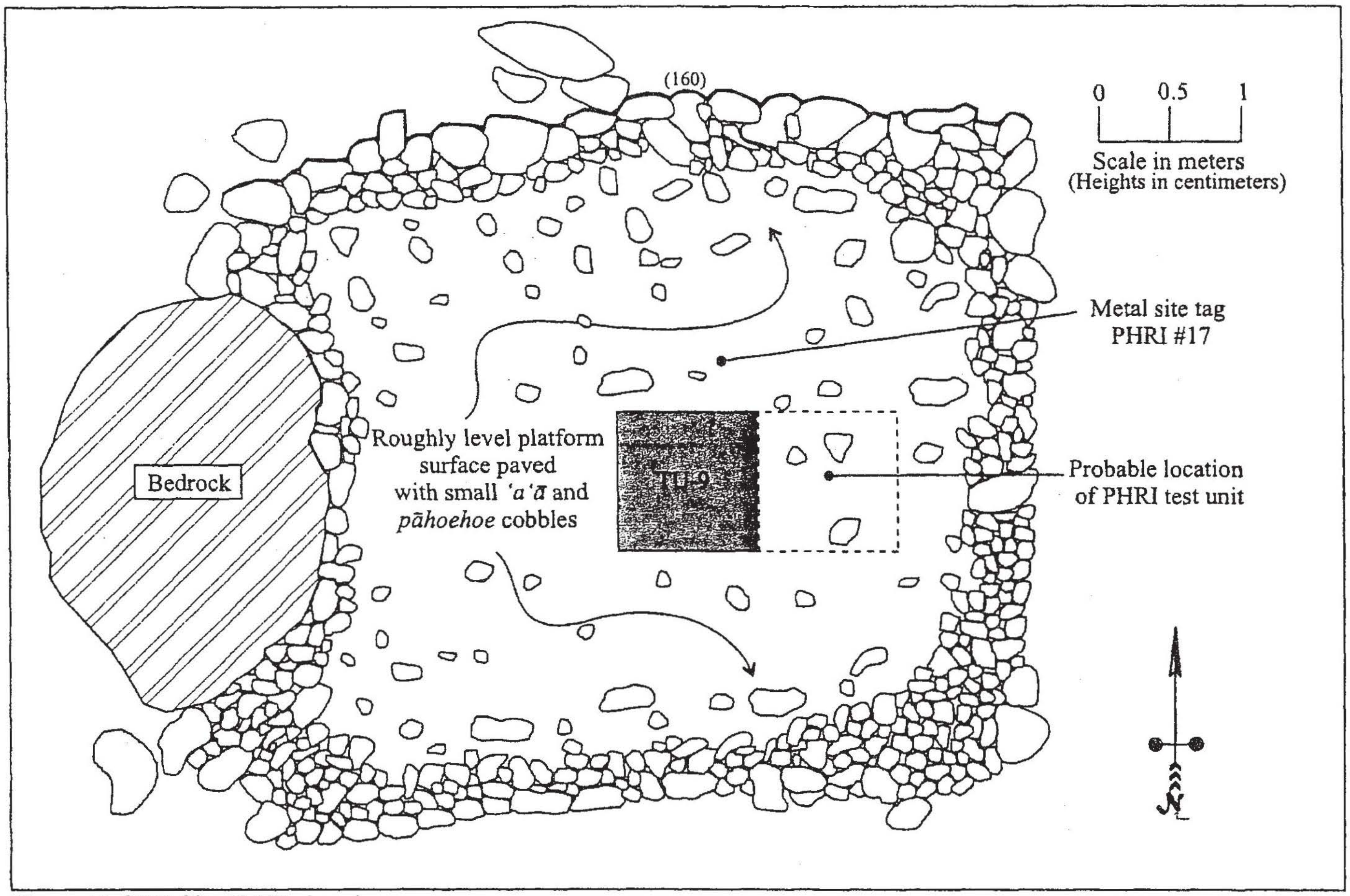


Figure 46. SIHP Site 23683 plan view.

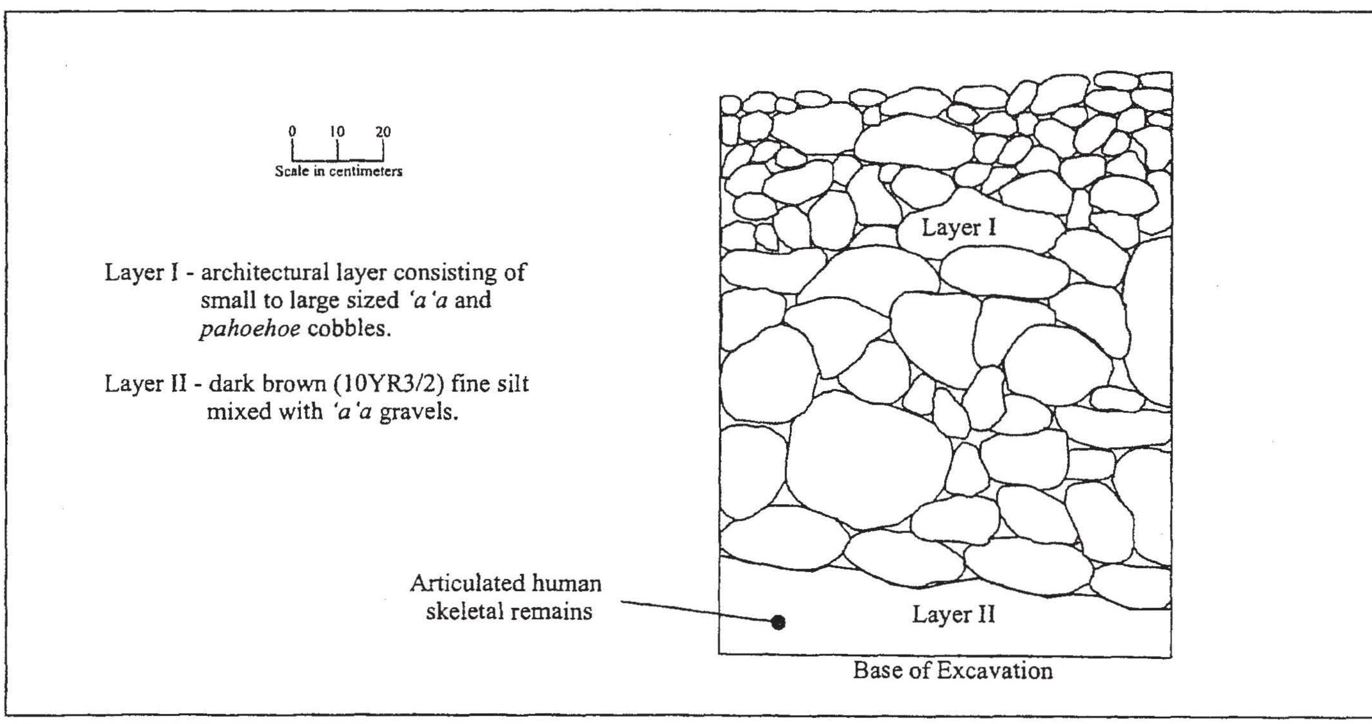


Figure 47. SIHP Site 23683 TU-9 east wall profile.

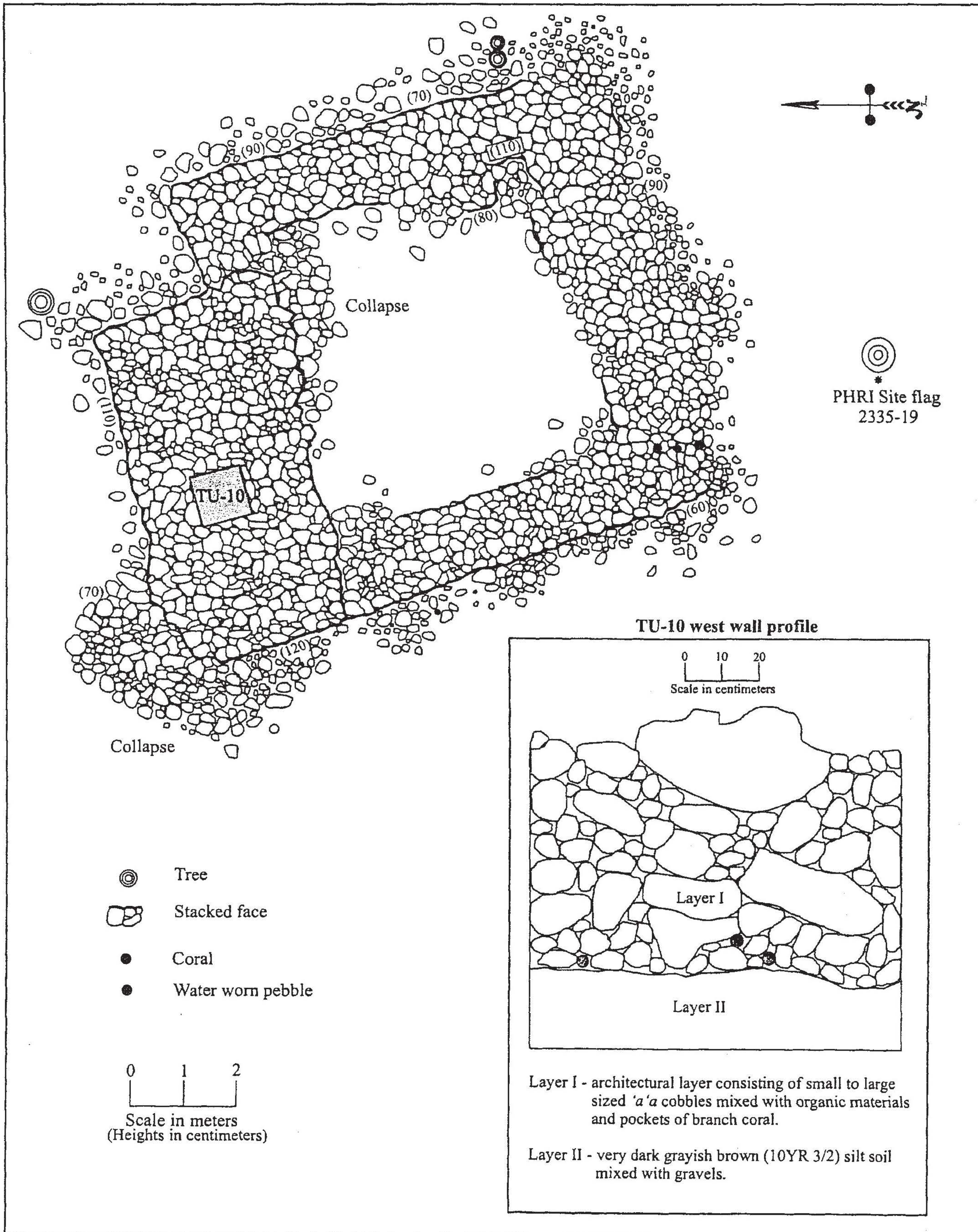


Figure 48. SIHP Site 23684 plan view and TU-10 profile.

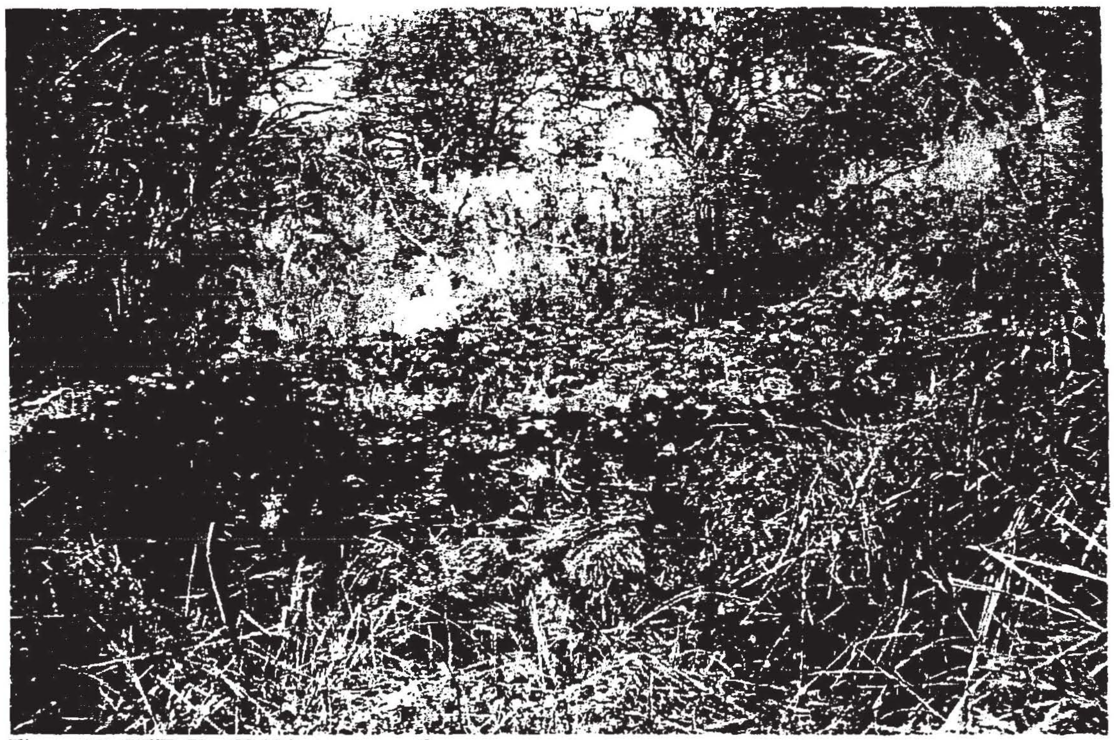


Figure 49. SIHP Site 23684 view to north.

A square enclosure protrudes from the south edge of the platform (see Figure 48). The interior space created by the enclosure walls measures 5.6 meters by 5.6 meters, and consists of soil covered by dense vegetation. The enclosure walls measure approximately 1.5 meters wide and stand up to 1.25 meters high along the interior edge and 0.7 meters high along the exterior edge. They are constructed of stacked *'a'ā* cobbles and boulders and are relatively intact with the exception of some collapse along the exterior southern edge. Two water worn pebbles and a rounded piece of coral were found on top of the wall in the south west corner of the enclosure. Although no test unit was excavated within the interior of the enclosure, it is possible that it contains burials.

A 1 x 1 meter test unit TU-10 was excavated in the central potion of the platform (see Figure 48). Excavation of TU-10 revealed two stratigraphic layers and revealed the presence of human skeletal remains at Site 23684. The excavation began with the removal of a 70-centimeter thick architectural layer, Layer I, consisting of small to large sized *'a'ā* cobbles mixed with organic materials. Pockets of branch coral were also found carefully cached within the architectural layer (Figure 50). Location and placement of the stones and coral were metrically recorded so that they could be returned to their appropriate places upon completion of the unit. Beneath the architectural layer was a very dark grayish brown (10YR 3/2) silt soil mixed with gravels (Layer II). Marine shells, coral and water worn pebbles were also noted in the soil. Five centimeters into the excavation of Layer II articulated human skeletal remains (a cranium) were encountered in the southeast corner of the unit. 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 re-buried with the soil excavated from the unit. All artifacts recovered from the screen were returned to their rightful places. The architectural layer was then rebuilt on top of the burial, as close to its original specifications as possible, and DLNR-SHPD was notified of the discovery.

Figure 50. SIHP Site 23684 TU-10 architectural layer (Layer I) showing branch coral view to west.

SIHP Site 23685

Site 23685 consists of a burial feature located in the north-central portion of the project area (see Figure 4). The feature is a platform (3.8 meters long by 3.0 meters wide) constructed of formerly stacked, but now mostly collapsed *pāhoehoe* cobbles and boulders. It abuts a *pāhoehoe* bedrock outcrop along its northern up slope edge (Figure 51). The platform consists of boulders and cobbles forming a roughly circular monument with a slightly rounded top surface paved with small cobbles (Figure 52). The feature stands 0.95 meters above ground surface along its southern edge and 0.4 meters above the bedrock outcrop along its northern edge. Overall, Site 23685 has a very formal appearance.

A 1 x 1 meter test unit (TU-7) was excavated in the central portion of the feature along an upright *pāhoehoe* slab (see Figure 51). Excavation of TU-7 revealed three stratigraphic layers and confirmed the presence of human skeletal remains at Site 23685. The excavation began with the removal of a 30-centimeter thick architectural layer, Layer I, consisting of small to large sized *pāhoehoe* cobbles mixed with some organics. Layer I rested on and was incorporated into Layer II, a 30-centimeter thick brown (10YR 2/2) fine slightly sandy silt mixed with gravels. In the southeast corner of the unit a black (10YR 2/1) silt soil rich with charcoal (Layer III) was noted 14 centimeters below the base of Layer I, the remains of a possible hearth. Screened soil from this hearth feature yielded a small amount of marine shell, sea urchin, and *kukui*. In the southwest corner of the unit, 18 centimeters below the base of Layer I, articulated human skeletal remains, including a skull, mandible, and scapula were discovered under a large *pāhoehoe* boulder capstone. The burial appeared to be an intrusive pit excavated into the cultural soil, indicating that the individual was interred subsequent to the area being used as a habitation feature. Judging by the accumulated non-cultural soil on top of the hearth feature, the architectural layer may have been added as a monument after the individual was interred.

Upon discovery of the skeletal remains excavation of TU-7 immediately ceased. The remains, which were not moved from their original position, were stabilized and re-buried with the soil excavated from the unit. All artifacts recovered from the screen were returned to their rightful places and the capstone was replaced over the burial. The architectural layer was then rebuilt, as close to its original specifications as possible, and DLNR-SHPD was notified of the discovery.

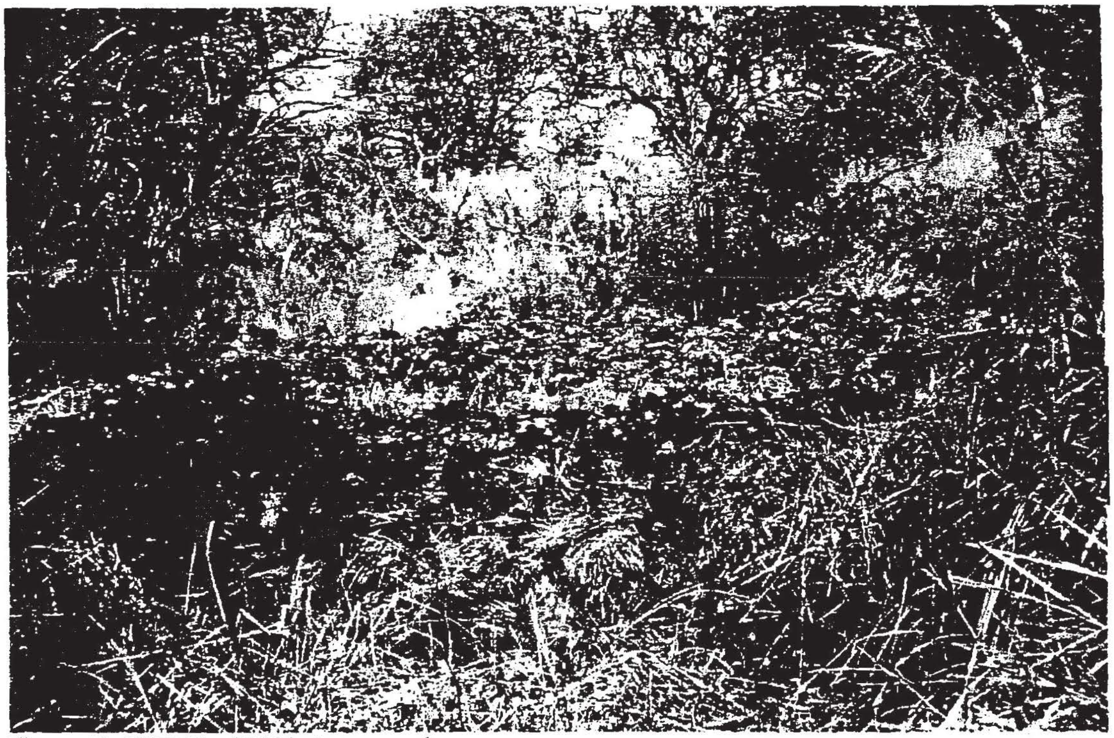


Figure 49. SIHP Site 23684 view to north.

A square enclosure protrudes from the south edge of the platform (see Figure 48). The interior space created by the enclosure walls measures 5.6 meters by 5.6 meters, and consists of soil covered by dense vegetation. The enclosure walls measure approximately 1.5 meters wide and stand up to 1.25 meters high along the interior edge and 0.7 meters high along the exterior edge. They are constructed of stacked *'a'ā* cobbles and boulders and are relatively intact with the exception of some collapse along the exterior southern edge. Two water worn pebbles and a rounded piece of coral were found on top of the wall in the south west corner of the enclosure. Although no test unit was excavated within the interior of the enclosure, it is possible that it contains burials.

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Figure 50. SIHP Site 23684 TU-10 architectural layer (Layer I) showing branch coral view to west.

SIHP Site 23685

Site 23685 consists of a burial feature located in the north-central portion of the project area (see Figure 4). The feature is a platform (3.8 meters long by 3.0 meters wide) constructed of formerly stacked, but now mostly collapsed *pāhoehoe* cobbles and boulders. It abuts a *pāhoehoe* bedrock outcrop along its northern up slope edge (Figure 51). The platform consists of boulders and cobbles forming a roughly circular monument with a slightly rounded top surface paved with small cobbles (Figure 52). The feature stands 0.95 meters above ground surface along its southern edge and 0.4 meters above the bedrock outcrop along its northern edge. Overall, Site 23685 has a very formal appearance.

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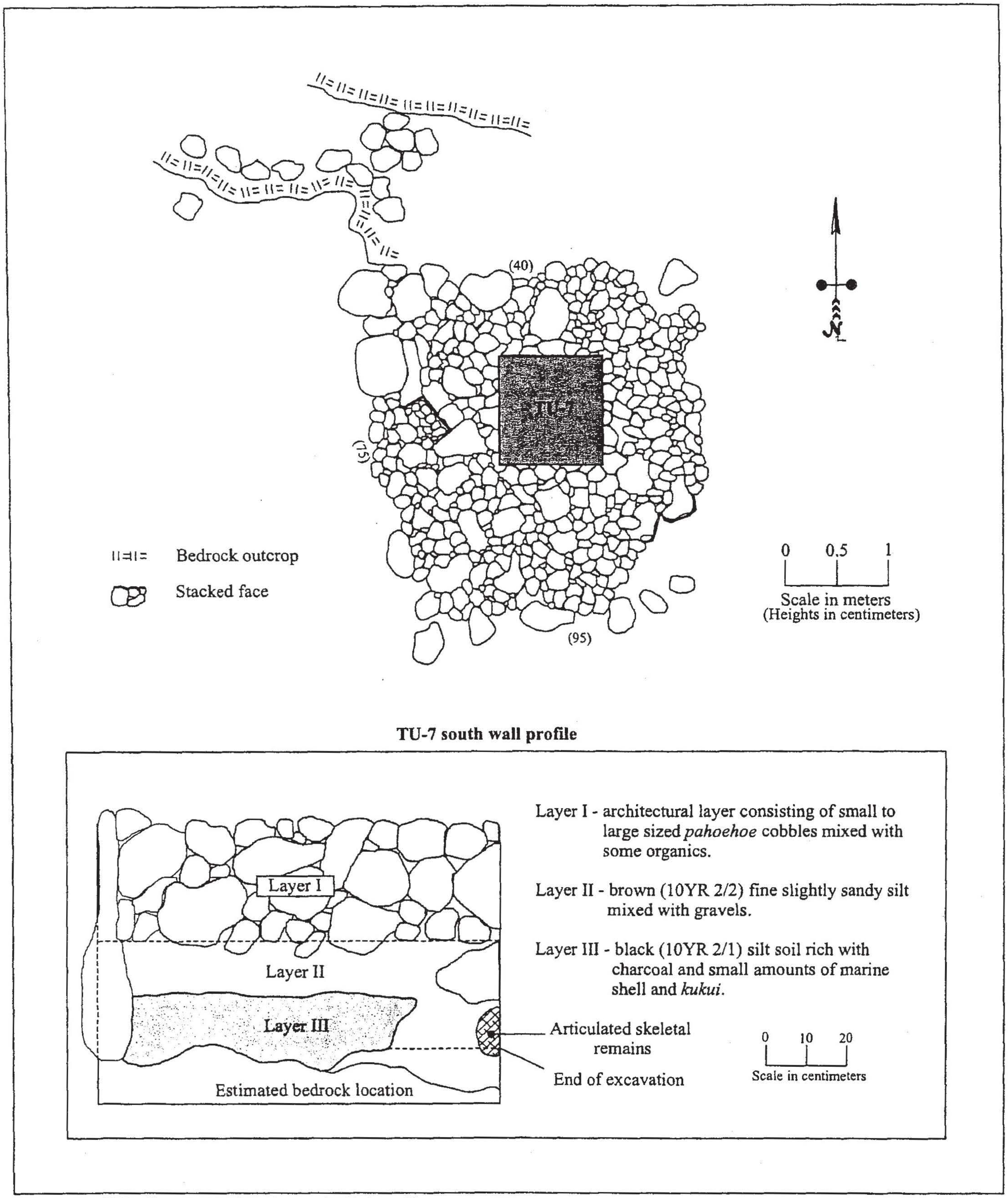


Figure 51. SIHP Site 23685 plan view and TU-7 profile.

Figure 52. SIHP Site 23685 view to east.

Agricultural Sites

SIHP Site 23686

Site 23686 consists of the entire archaeological agricultural landscape contained within the project area. The site encompasses 297 distinct agricultural features including 199 mounds (67.0%), 59 modified outcrops (19.6%), 22 terraces (7.4%), 7 enclosures (2.4%), 7 *kuaiwi* (2.4%), and 3 pavements (1.0%). These features stretch over the entire landscape but, by far, the greatest numbers are concentrated in the southeast quadrant of the project area. This area may have received less historic use, which would point to a higher number of preserved features in this area, rather than increased Precontact use of this portion of the project area. Features in the *makai* third to one half of the project area are constructed primarily of *pāhoehoe* while the *mauka* features are constructed primarily of *'a'ā*, as dictated by the readily available source materials. A complete listing of the features at Site 23686 is shown in Table 8, and the locations of the features are shown on Figure 53.

Ten test units were excavated within a diverse range of features at a variety of elevations within Site 23686. All ten test units had one thing in common, they all yielded no cultural material. A description of the test units, along with a generalized discussion of feature types, using specific examples of the agricultural features, is presented below.

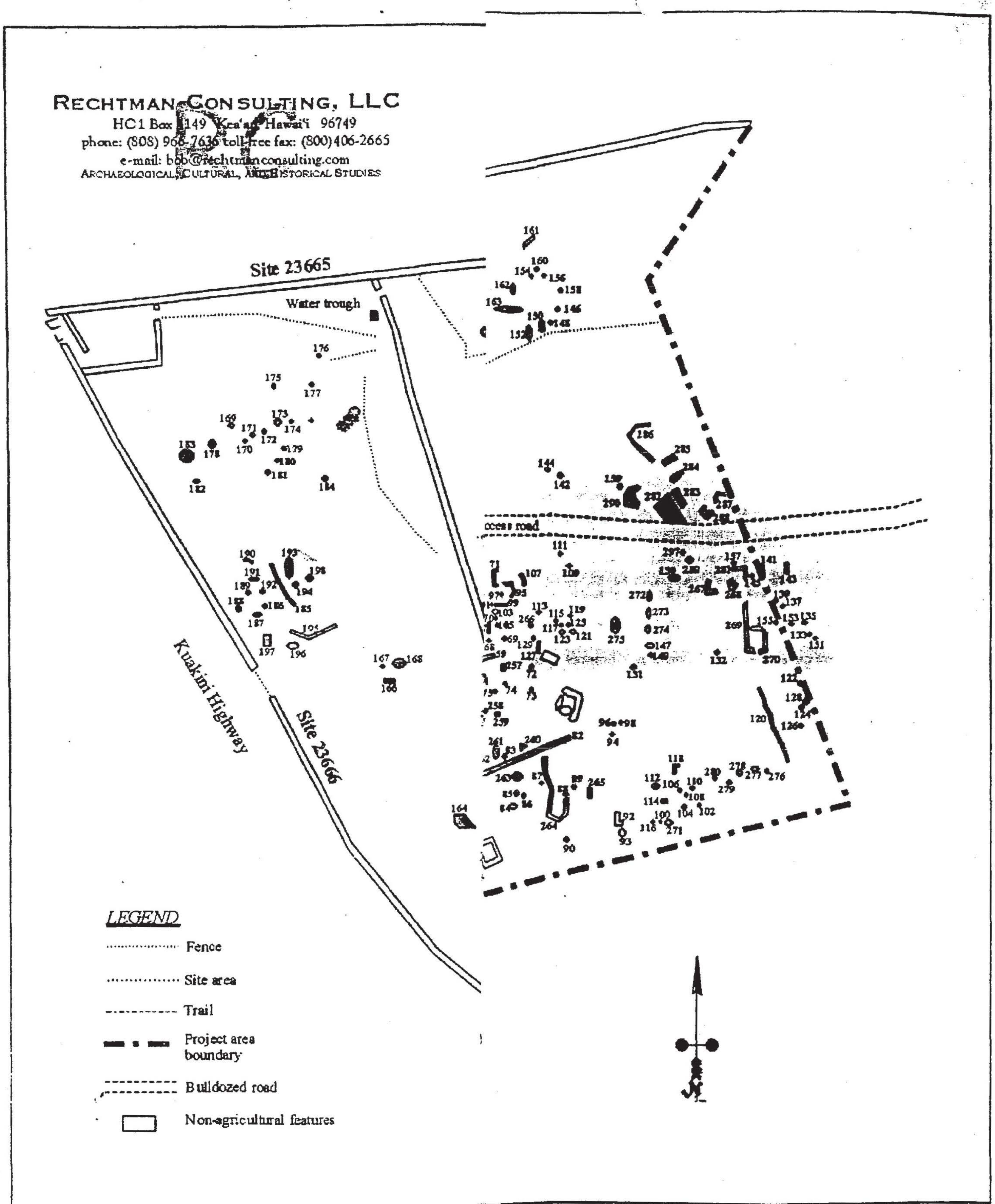


Figure 53. SIHP Site 23686 plan view.

Table 8. SIHP Site 23686 agricultural features.

Feature #	*Feature type*	*Attribute**	*Length (m)*	*Width (m)*	*Height (m)*	*Shape*
1	Mound	S/P	5.2	2.9	0.8	Irregular
2	Mound	S	2.8	2.7	0.8	Oval
3	Modified outcrop	S	4.3	2.2	1.8	Irregular
4	Modified outcrop	P	4.6	2.9	1.1	Linear
5	Modified outcrop	P	5.8	4.2	0.6	Irregular
6	Mound	P	5.0	2.1	0.4	Linear
7	Modified outcrop	P	4.4	3.6	0.6	Triangular
8	Mound	P	2.8	2.8	0.5	Circular
9	Modified outcrop	S	5.2	2.9	0.8	Irregular
10	Mound	P	2.0	1.5	0.5	Oval
11	Mound	P	3.9	1.8	0.8	Linear
12	Mound	P	3.7	2.1	0.7	Linear
13	Mound	P	3.8	2.7	0.9	Linear
14	Mound	P	2.7	2.7	0.7	Circular
15	Mound	P	3.5	3.0	1.0	Oval
16	Mound	P	2.3	2.3	0.8	Circular
17	*Kuaiwi*	P	38.7	2.0	0.8	Linear
18	Mound	P	2.7	2.4	0.7	Circular
19	Mound	P	2.1	0.9	0.9	Linear
20	Mound	P	3.1	1.9	0.9	Oval
21	Mound	P	2.7	1.6	1.0	Irregular
22	Mound	P	3.2	2.9	0.5	Rectangular
23	Mound	P	3.3	0.9	0.9	Linear
24	Mound	P	3.8	3.0	0.9	Irregular
25	Mound	P	3.1	2.5	0.5	Irregular
26	Modified outcrop	P	4.5	3.5	0.7	Irregular
27	Mound	P	2.1	2.1	0.7	Circular
28	Mound	P	3.5	2.0	0.4	Irregular
29	Mound	P	4.1	3.5	0.9	Oval
30	Mound	P	10.7	2.7	0.4	Linear
31	Mound	P/S	2.1	1.9	0.7	Irregular
32	Mound	P	1.8	1.6	0.6	Irregular
33	Mound	P	4.0	3.6	0.8	Oval
34	Mound	P	2.2	2.2	1.0	Circular
35	Enclosure	P	3.0	2.5	0.4	Oval
36	Modified outcrop	P/S	2.1	1.4	1.1	Irregular
37	Terrace	P	4.8	3.1	0.9	Linear
38	Mound	P	2.0	1.7	0.5	Oval
39	Mound	P	1.8	1.4	0.5	Oval
40	Mound	P	2.8	2.1	0.7	Oval
41	Mound	P	1.4	1.4	0.4	Circular
42	Mound	S	2.1	1.8	0.8	Irregular
43	Mound	P	1.9	1.8	0.5	Circular
44	Mound	P	2.3	2.0	0.5	Oval
45	Mound	P	2.3	1.5	0.5	Oval
46	Mound	P	3.2	1.0	0.4	Linear
47	Mound	P	2.5	1.9	0.6	Oval
48	Mound	P	2.6	2.0	0.4	Oval
49	Mound	P	2.3	1.9	0.5	Oval
50	Mound	P	3.2	2.1	0.5	Irregular
51	Mound	P	2.7	1.8	0.5	Irregular
52	Mound	P	1.3	1.3	0.6	Circular

***S=Stacked; P=Piled.**

Table 8 continued on next page.

Table 8. Continued.

Feature #	*Feature type*	*Attribute**	*Length (m)*	*Width (m)*	*Height (m)*	*Shape*
53	Mound	P	4.4	2.9	0.6	Oval
54	Mound	P	1.8	1.3	0.4	Irregular
55	Mound	P	1.9	1.3	0.4	Rectangular
56	Mound	P	2.5	1.7	0.7	Oval
57	Mound	P	2.5	1.6	0.7	Linear
58	Mound	P	4.5	3.2	0.7	Irregular
59	*Kuaiwi*	P	18.6	1.1	0.4	Linear
60	Mound	P	1.4	1.4	0.6	Linear
61	Mound	P	3.3	1.5	0.7	Linear
62	Mound	P	2.1	2.1	0.3	Circular
63	Mound	P	1.7	1.0	0.5	Irregular
64	Mound	P	3.3	1.9	0.3	Oval
65	Mound	P	2.1	1.5	0.2	Oval
66	Mound	P	1.7	2.1	0.3	Circular
67	Mound	P	3.5	0.8	0.4	Linear
68	Mound	P	1.8	1.0	0.5	Circular
69	Mound	P	2.7	2.7	0.6	Circular
70	Mound	P	2.2	1.2	0.4	Oval
71	Mound	P	4.8	3.3	0.4	Irregular
72	Mound	P	1.9	1.5	0.8	Oval
73	Mound	P	1.9	1.9	0.4	Circular
74	Mound	P	1.7	1.7	0.3	Circular
75	Mound	P	2.1	1.4	0.6	Oval
76	Mound	P	1.3	1.3	0.5	Circular
77	Mound	P	1.9	1.2	0.3	Oval
78	Mound	P	1.8	1.1	0.5	Oval
79	Mound	P	1.4	1.4	0.4	Circular
80	Mound	P	3.2	1.4	0.7	Linear
81	Terrace	S	60.0	1.0	0.5	Linear
82	*Kuaiwi*	S	108.0	2.1	0.7	Linear
83	Mound	S	1.8	1.3	0.5	Circular
84	Mound	S	3.4	2.1	0.8	Rectangular
85	Mound	P	3.1	2.2	0.8	Oval
86	Mound	P	3.0	1.7	0.5	Oval
87	Mound	S	1.8	1.1	0.4	Rectangular
88	Mound	P	2.1	1.1	0.4	Oval
89	Mound	P	1.5	1.5	0.5	Circular
90	Mound	P	3.4	1.7	0.6	Linear
91	Mound	P	1.9	1.9	0.6	Circular
92	Mound	P	5.6	2.1	0.7	Linear
93	Mound	P	3.4	1.9	0.4	Rectangular
94	Mound	P	1.9	1.9	0.7	Circular
95	Mound	P	6.4	1.8	1.4	Crescent
96	Mound	P	2.6	1.2	0.7	Irregular
97	Mound	P	1.9	1.4	0.5	Oval
98	Mound	P	2.0	1.2	0.4	Rectangular
99	Mound	P	4.0	1.4	0.4	Linear
100	Mound	P	11.9	1.9	0.5	Circular
101	Mound	P	2.0	2.0	0.5	Circular
102	Mound	P	1.4	1.4	0.4	Circular
103	Mound	P	3.4	1.7	0.5	Irregular
104	Mound	P	1.6	1.1	0.4	Oval

***S=Stacked; P=Piled.**

Table 8 continued on next page.

Table 8. Continued.

Feature #	*Feature type*	*Attribute**	*Length (m)*	*Width (m)*	*Height (m)*	*Shape*
105	Mound	P	2.4	2.4	0.4	Circular
106	Mound	P	1.7	1.7	0.4	Circular
107	Terrace	P	5.2	2.4	0.3	Linear
108	Mound	P	1.7	1.5	0.5	Irregular
109	Mound	P	1.7	1.2	0.5	Oval
110	Mound	P	1.6	1.6	0.5	Circular
111	Mound	P	1.8	1.2	0.5	Oval
112	Modified outcrop	P	3.6	2.3	0.8	Linear
113	Mound	P	2.8	1.8	0.6	Linear
114	Mound	P	2.2	1.5	0.3	Rectangular
115	Mound	P	2.1	2.0	0.5	Irregular
116	Mound	P	2.3	1.4	0.5	Oval
117	Mound	P	2.4	1.2	0.3	Oval
118	Terrace	P	7.0	0.7	0.6	L-shaped
119	Mound	P	2.8	1.9	0.4	Oval
120	Terrace	S	29.0	1.0	0.6	Linear
121	Mound	P	2.7	1.3	0.4	Oval
122	Mound	S	2.8	1.7	0.6	Oval
123	Mound	P	2.3	1.2	0.5	Linear
124	Mound	P	2.3	1.3	0.4	Oval
125	Mound	P	2.0	1.4	0.5	Oval
126	Mound	S	2.6	1.6	0.7	Rectangular
127	Mound	P	5.2	1.2	0.4	Linear
128	Mound	P	3.2	2.2	0.6	Oval
129	Mound	P	3.5	3.2	1.0	Oval
130	Modified outcrop	S	4.7	2.8	0.3	Linear
131	Mound	S	3.4	2.3	0.5	Triangular
132	Mound	P	1.8	1.3	0.8	Oval
133	Modified outcrop	P	2.2	2.0	0.7	Irregular
134	Mound	P	1.9	1.3	0.4	Oval
135	Modified outcrop	P	1.8	1.1	0.6	Irregular
136	Mound	P	2.3	1.9	0.6	Irregular
137	Modified outcrop	P	2.8	2.0	0.8	Rectangular
138	Mound	P	1.3	1.3	0.3	Circular
139	Modified outcrop	P	1.5	1.1	0.7	Oval
140	Mound	S	2.3	1.8	0.7	Irregular
141	Terrace	P	4.7	2.5	1.0	Rectangular
142	Mound	S	1.3	0.9	0.9	Oval
143	Terrace	P	3.6	1.8	0.8	Rectangular
144	Mound	P	2.6	2.1	0.8	Oval
145	Modified outcrop	P	1.8	2.1	0.7	Oval
146	Mound	P	2.6	2.2	0.6	Oval
147	Mound	P	3.7	1.6	0.5	Linear
148	Mound	P	2.3	1.2	0.6	Oval
149	Mound	P	2.0	2.0	0.7	Circular
150	Mound	P	4.4	2.5	0.6	Linear
151	Mound	P	1.4	1.4	0.3	Circular
152	Mound	P	4.9	3.2	0.7	Linear
153	Mound	P	1.4	0.8	0.3	Oval
154	Mound	P	3.6	2.3	0.7	Linear
155	Mound	P	1.5	1.0	0.4	Triangular
156	Mound	P	3.2	2.1	0.6	Oval

***S=Stacked; P=Piled.**

Table 8 continued on next page.

Table 8. Continued.

Feature #	*Feature type*	*Attribute**	*Length (m)*	*Width (m)*	*Height (m)*	*Shape*
157	Mound	P	1.8	1.5	0.5	Circular
158	Mound	S	2.5	1.6	0.7	Oval
159	Mound	P	1.5	1.2	0.7	Oval
160	Mound	S	1.8	1.3	0.6	Irregular
161	Modified outcrop	S/P	6.0	3.0	1.4	Rectangular
162	Mound	P	1.3	1.3	0.6	Circular
163	Modified outcrop	P	12.2	1.1	1.1	Irregular
164	Modified outcrop	P	5.8	4.8	1.9	Rectangular
165	Mound	P	1.8	1.8	0.4	Irregular
166	Mound	P	3.2	1.7	0.8	Linear
167	Mound	P	1.3	1.3	0.4	Circular
168	Mound	S/P	5.7	3.9	0.9	Oval
169	Mound	P	2.2	1.6	0.7	Oval
170	Mound	P	1.3	1.3	0.5	Circular
171	Mound	P	2.2	1.7	0.8	Irregular
172	Mound	P	2.3	1.8	0.5	Oval
173	Mound	P	3.0	2.2	0.9	Oval
174	Mound	P	1.8	1.8	0.3	Circular
175	Modified outcrop	P	2.3	2.1	1.0	Irregular
176	Mound	P	1.1	1.0	0.5	Circular
177	Modified outcrop	P	2.9	2.6	0.6	Crescent
178	Mound	P	2.6	2.1	0.5	Irregular
179	Modified outcrop	P	1.4	2.3	0.4	Irregular
180	Mound	P	1.8	1.8	0.6	Circular
181	Mound	P	2.8	1.7	0.8	Irregular
182	Mound	P	2.2	2.2	0.5	Circular
183	Modified outcrop	S	6.7	5.3	0.8	Irregular
184	Mound	P	2.0	2.0	0.4	Circular
185	Terrace	P	17.0	0.6	0.9	Linear
186	Mound	S/P	2.6	1.4	0.9	Oval
187	Mound	S/P	3.0	1.7	0.8	Rectangular
188	Modified outcrop	P	3.5	2.7	1.0	Irregular
189	Mound	P	2.4	2.2	0.7	Irregular
190	Modified outcrop	S/P	3.9	2.3	0.9	Linear
191	Modified outcrop	P	4.4	2.1	0.8	Linear
192	Modified outcrop	S	2.5	1.8	0.8	Oval
193	Modified outcrop	P	9.2	3.1	1.1	Irregular
194	Mound	P	3.0	2.1	0.6	Oval
195	*Kuaiwi*	S/P	16.0	1.0	0.5	Linear
196	Modified outcrop	P	5.2	2.8	0.8	Linear
197	Mound	S/P	6.0	2.3	1.1	Rectangular
198	Modified outcrop	P	3.1	2.7	0.6	Irregular
199	Modified outcrop	P	6.5	4.8	0.7	L-shaped
200	Terrace	P	7.2	2.1	0.8	Crescent
201	Modified outcrop	S/P	6.2	3.8	0.7	Oval
202	Mound	P	2.1	2.1	0.6	Circular
203	Mound	P	3.4	2.8	0.8	Circular
204	Modified outcrop	S/P	3.4	2.7	0.7	Irregular
205	Modified outcrop	P	3.0	2.3	0.6	Irregular
206	Mound	S	2.3	2.3	0.6	Circular
207	Mound	S	3.2	3.2	0.8	Irregular
208	Modified outcrop	P	2.7	0.9	0.4	Linear

***S=Stacked; P=Piled.**

Table 8 continued on next page.

Table 8. Continued.

Feature #	*Feature type*	*Attribute**	*Length (m)*	*Width (m)*	*Height (m)*	*Shape*
209	Modified outcrop	P	3.7	2.6	0.6	Oval
210	Modified outcrop	P	5.2	3.4	0.9	Irregular
211	Mound	P	3.6	2.8	0.8	Irregular
212	Terrace	P	5.2	1.4	0.5	Linear
213	*Kuaiwi*	P	50.2	1.8	0.7	Linear
214	Mound	S/P	2.6	2.1	0.9	Oval
215	Modified outcrop	S/P	10.3	3.9	1.7	Irregular
216	Mound	P	2.7	2.4	0.2	Circular
217	Modified outcrop	S	1.6	0.4	0.4	Linear
218	Modified outcrop	P	2.0	1.8	0.7	Oval
219	Modified outcrop	P	3.0	1.8	1.0	Irregular
220	Modified outcrop	S	1.8	1.0	1.5	Crescent
221	Mound	S/P	3.5	1.9	1.1	Irregular
222	Mound	P	3.6	2.7	1.0	Rectangular
223	Mound	P	2.5	2.0	0.8	Irregular
224	Mound	S/P	3.3	1.9	0.9	Rectangular
225	Mound	P	1.4	1.4	0.7	Circular
226	Mound	P	2.0	2.0	0.6	Circular
227	Mound	P	4.1	3.7	0.8	Irregular
228	Mound	P	2.3	2.1	1.0	Oval
229	Mound	S/P	4.3	2.0	0.9	Rectangular
230	Modified outcrop	P	3.4	2.3	0.9	Oval
231	Modified outcrop	P	2.3	2.0	0.7	Irregular
232	Modified outcrop	P	1.9	1.7	0.9	Oval
233	Mound	P	2.3	1.7	0.8	Irregular
234	Mound	S/P	2.0	1.7	1.0	Irregular
235	Modified outcrop	S/P	3.9	1.9	1.0	Irregular
236	Modified outcrop	S/P	2.1	1.6	1.1	Irregular
237	Terrace	S/P	6.0	4.0	2.1	Rectangular
238	Modified outcrop	P	3.4	2.8	1.0	L-shaped
239	Modified outcrop	S/P	4.0	2.5	0.7	Rectangular
240	Mound	P	2.5	2.1	0.8	Circular
241	Mound	P	4.4	3.1	1.0	Irregular
242	Modified outcrop	S/P	3.4	2.2	0.8	Irregular
243	Terrace	S/P	11.8	7.9	0.9	Crescent
244	Terrace	S/P	9.0	5.6	0.7	Linear
245	Modified outcrop	S/P	13.9	7.8	1.7	Irregular
246	Mound	S/P	2.2	1.0	0.6	Irregular
247	Terrace	S/P	11.0	2.6	0.9	Linear
248	Modified outcrop	P	3.5	1.9	0.7	Irregular
249	Mound	P	4.1	2.3	0.6	Oval
250	Pavement	P	2.5	1.8	0.5	Rectangular
251	Enclosure	P	12.5	11.5	0.6	Rectangular
252	*Kuaiwi*	P	38.0	2.3	0.8	Linear
253	Terrace	S/P	15.0	2.5	0.7	Linear
254	Terrace	S/P	20.0	2.7	0.8	Linear
255	Mound	P	9.5	2.8	0.8	Linear
256	Mound	P	1.5	1.4	0.5	Circular
257	Mound	S/P	2.9	2.1	0.6	Rectangular
258	Mound	P	1.2	1.0	0.5	Oval
259	Mound	P	2.8	1.2	0.6	Rectangular
260	Mound	S	3.3	2.3	1.2	Triangular

***S=Stacked; P=Piled.**

Table 8 continued on next page.

Table 8. Continued.

Feature #	*Feature type*	*Attribute**	*Length (m)*	*Width (m)*	*Height (m)*	*Shape*
261	Mound	S	5.1	3.0	1.2	Oval
262	Mound	S	3.4	1.7	1.2	Irregular
263	Mound	S/P	4.2	2.2	1.4	Oval
264	Terrace	S/P	36.0	2.1	0.7	Linear
265	Terrace	P	5.2	1.4	0.4	Linear
266	Mound	S	2.4	1.2	0.7	Rectangular
267	Terrace	S/P	5.0	5.0	1.0	L-shaped
268	Modified outcrop	P	3.1	2.1	0.9	Irregular
269	Terrace	S/P	22.5	1.8	0.8	Linear
270	Enclosure	S/P	11.0	9.5	0.9	U-shaped
271	Mound	S	2.9	2.5	0.9	Rectangular
272	Modified outcrop	P	4.6	4.5	0.7	Oval
273	Modified outcrop	P	5.5	3.0	1.1	Irregular
274	Mound	P	4.0	2.5	1.0	Oval
275	Modified outcrop	S/P	5.0	4.5	1.2	Oval
276	Mound	P	2.7	1.4	0.8	Linear
277	Mound	S/P	5.0	2.7	0.9	Oval
278	Mound	P	3.2	2.4	0.9	Oval
279	Enclosure	S/P	3.5	2.6	0.7	Oval
280	Mound	P	2.2	2.2	0.6	Circular
281	Modified outcrop	P	6.4	4.3	1.0	L-shaped
282	Pavement	P	12.5	8.5	0.2	Rectangular
283	Mound	P	7.4	1.7	0.8	Linear
284	Mound	P	4.5	2.9	0.7	Irregular
285	Mound	S/P	5.0	1.3	0.8	Linear
286	Terrace	P	16.0	1.8	0.6	Irregular
287	Modified outcrop	S/P	3.5	1.7	0.9	Irregular
288	Modified outcrop	P	3.0	1.1	0.8	Crescent
289	Pavement	P	9.0	5.5	0.2	Irregular
290	Terrace	S/P	11.0	6.5	0.8	Crescent
291	*Kuaiwi*	P	78.0	3.5	0.3	Linear
292	Modified outcrop	P	5.6	4.7	0.9	Rectangular
293	Enclosure	P	1.9	1.9	0.5	Square
294	Enclosure	P	2.2	2.2	0.6	Square
295	Enclosure	P	5.5	3.4	0.5	U-shaped
296	Mound	P	2.3	1.3	0.7	Oval
297	Modified outcrop	S/P	4.5	4.0	0.7	Oval

***S=Stacked; P=Piled.** **End of Table 8.**

Mounds

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 (i.e. oval, round, linear, curvilinear, square, crescent, rectangular, or irregular) 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.

This type of feature has a different function depending on its temporal and spatial associations. Mounds can be clearing features, planting features, or landscape markers. The functional distinction between types of mounds is contextual rather than formal. Mounds found in clusters on barren lava are considered to be planting features. Mounds found in clusters around rock-free areas of plentiful soil are considered to be clearing features. Testing of mounds during the data recovery phase of this project will address the question of formal variation between presumed planting and clearing features.

Nearly two hundred mounds were recorded within the project area (see Table 8 and Figure 53). The mounds varied immensely in size, shape, and formal attributes. Five mounds (Features 187, 189, 262, 266, 271), ones that appeared to have the most time invested in their construction, underwent subsurface testing in the form of 1 x 1 meter test units. The results are presented below.

Feature 187 is a partially stacked rectangular shaped *pāhoehoe* cobble mound located in the extreme western end of the project area. The mound rests on exposed bedrock. Its edges are mostly stacked, but have collapsed in small sections (Figure 54). Feature 187 measures 3.0 meters long by 1.7 meters wide and 0.8 meters tall. Its surface slopes slightly to the north following the natural bedrock contours.

Figure 54. SIHP Site 23686 Feature 187 view to southeast.

A 1 x 1 meter test unit (TU-1) was excavated into the north-central portion of Feature 187 (Figure 55). Excavation of TU-1 revealed a single architectural layer (Layer I) resting on bedrock. Layer I consisted of small to medium sized *pāhoehoe* cobbles mixed with some organics. This layer rested directly on bedrock and at the base of the layer a single piece of awater rounded coral was discovered. Along the unit's northern edge, a small amount of brown (10YR 4/3) sandy silt (less than 1 centimeter thick) had accumulated subsequent to the feature's construction. No cultural material (with the exception off the coral fragment) was recovered from TU-1 and the excavation terminated at bedrock (Figure 56).

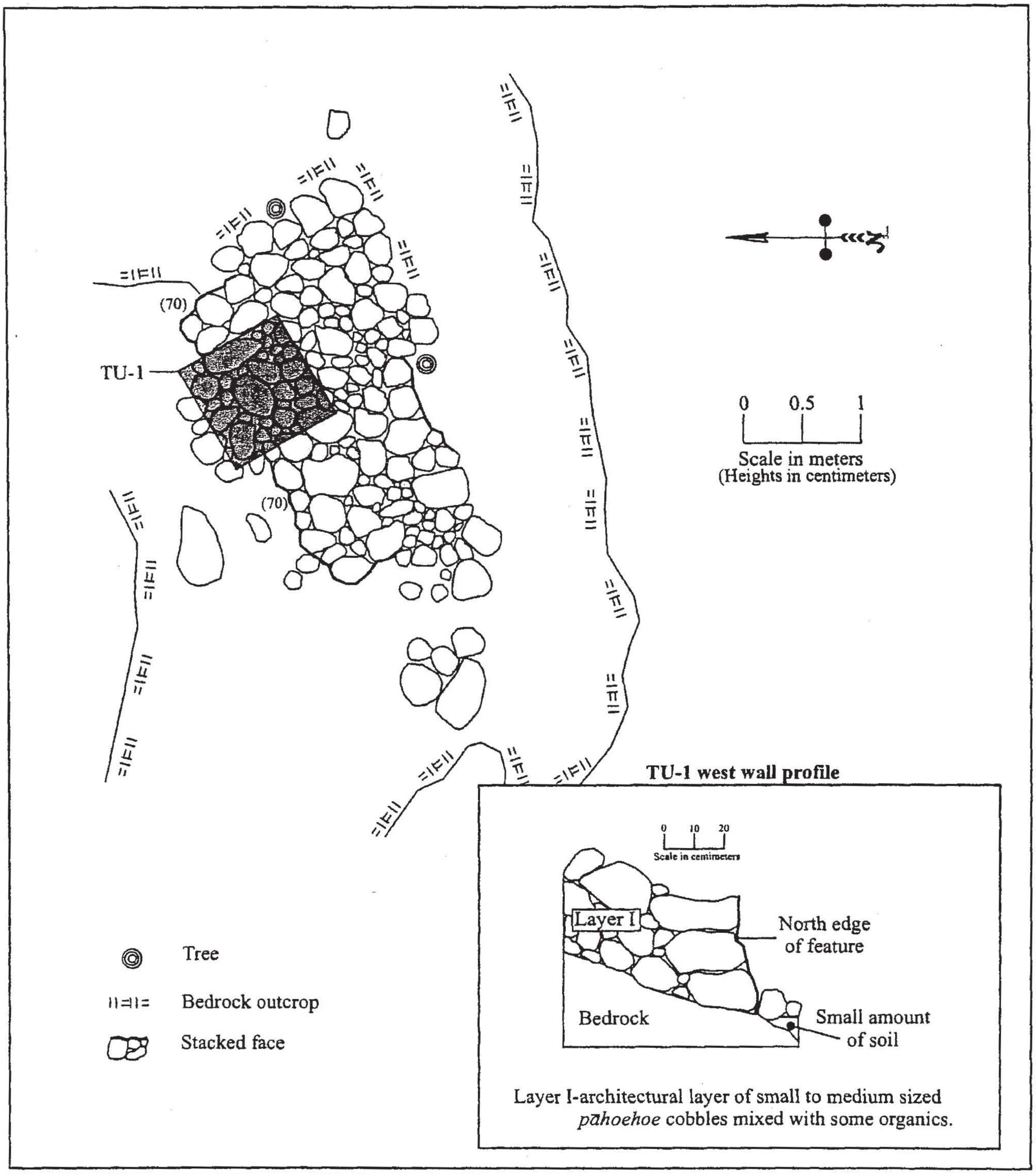


Figure 55. SIHP Site 23686 Feature 187 plan view and TU-1 profile.

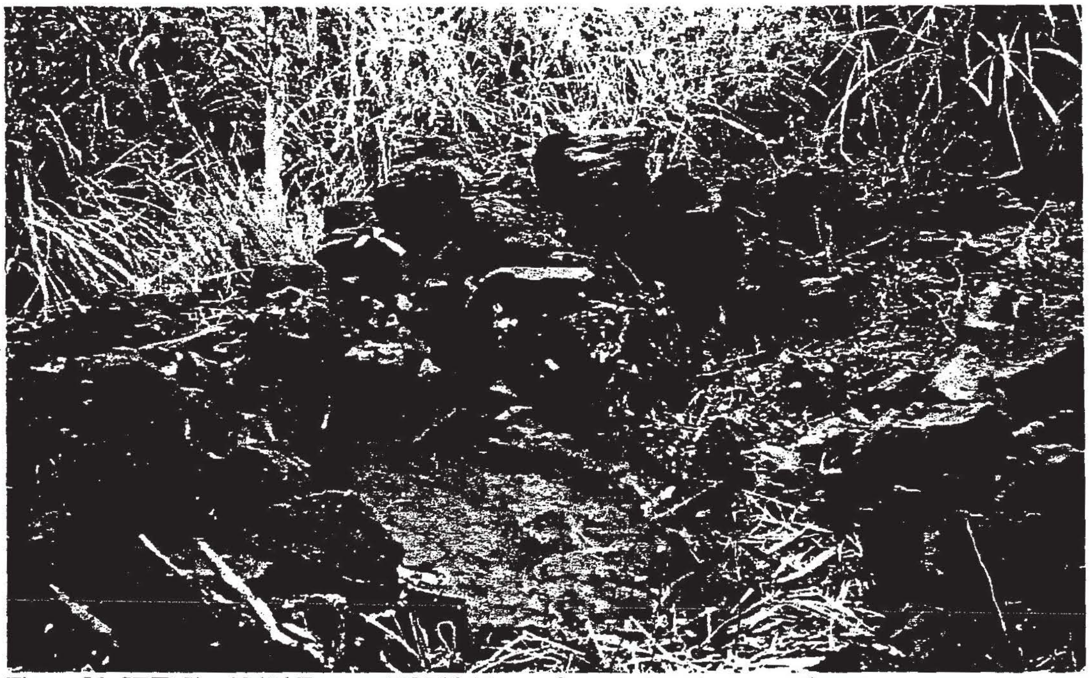


Figure 56. SIHP Site 23686 Feature 187 TU-1 base of excavation view to southwest.

Feature 189 is a piled irregular shaped *pāhoehoe* cobble mound located in the extreme western end of the project area (see Figure 53). The mound rests on exposed bedrock and may have been formerly stacked around its edges, but is now largely collapsed (Figure 57). In its current condition Feature 189 measures 2.4 meters long by 2.2 meters wide and 0.7 meters tall. A small rounded piece of coral was found resting on the feature's southwest corner (Figure 58).

Figure 57. SIHP Site 23686 Feature 189 view to northeast.

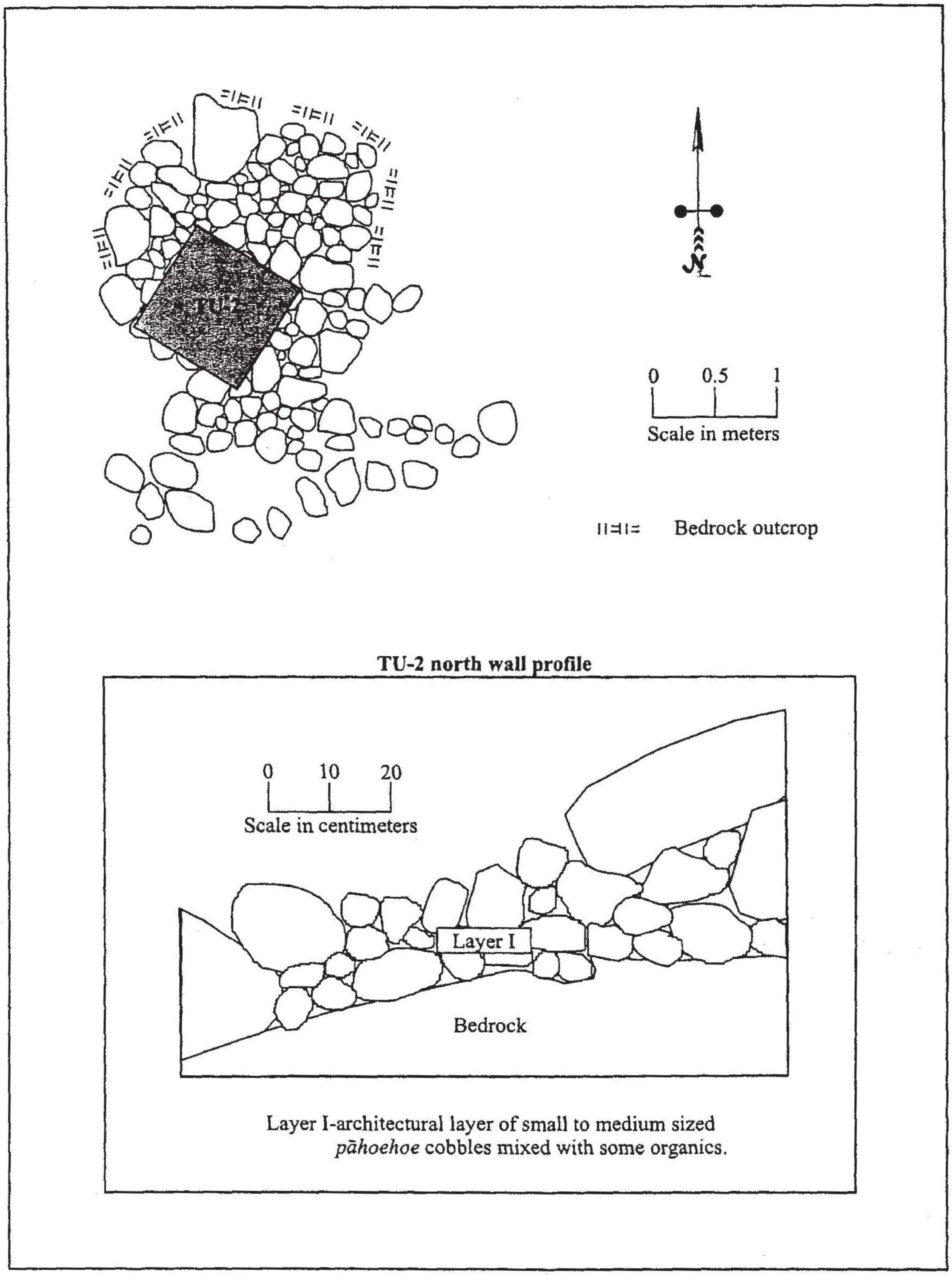


Figure 58. SIHP Site 23686 Feature 189 plan view and TU-2 profile.

A 1 x 1 meter test unit (TU-2) was excavated into the central portion of Feature 189 (see Figure 58). Excavation of TU-2 revealed a single architectural layer (Layer I) resting on bedrock. Layer I consisted of small to medium sized *pāhoehoe* cobbles mixed with some organics. This layer rested directly on bedrock. However, along its southwestern edge, in a bedrock depression (Figure 59), a small amount of brown (7.5YR 3/4) fine silt (less than 1 centimeter thick) had accumulated subsequent to the feature's construction. No cultural material of any kind was recovered from TU-2 and the excavation terminated at bedrock.

Figure 59. SIHP Site 23686 Feature 189 TU-2 base of excavation view to northeast.

Feature 262 is an irregular shaped mound constructed of stacked *'a'ā* cobbles located in the southeast quadrant of the project area along the north side of Feature 82, a *kuaiwi* (see Figure 53). The mound measures 3.4 meter long by 1.7 meters wide and up to 1.25 meters tall (Figure 60). It has a squared north side and a slightly rounded south side with a rounded top surface (Figure 61). Feature 262 rests on a soil ground surface covered by dense vegetation.

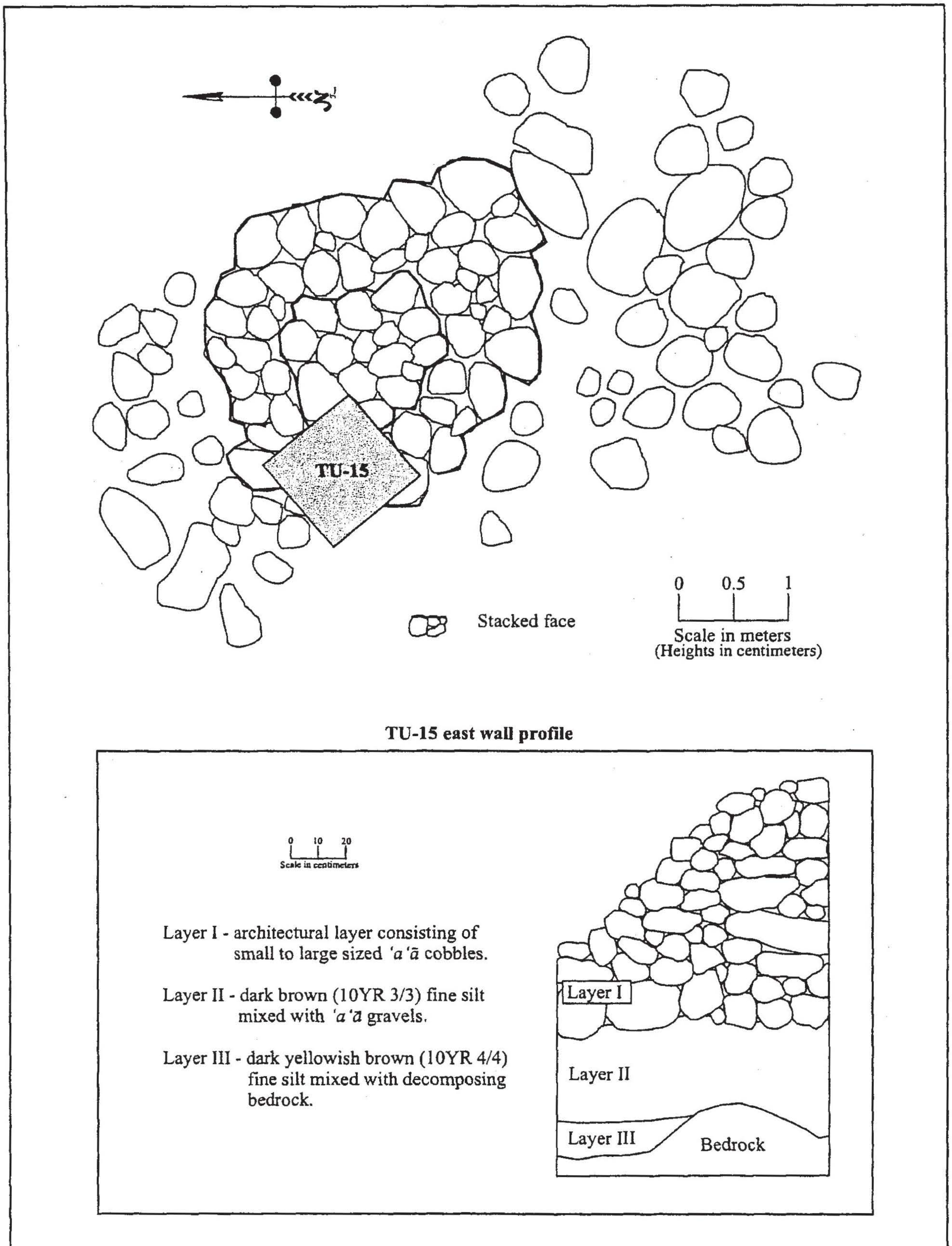


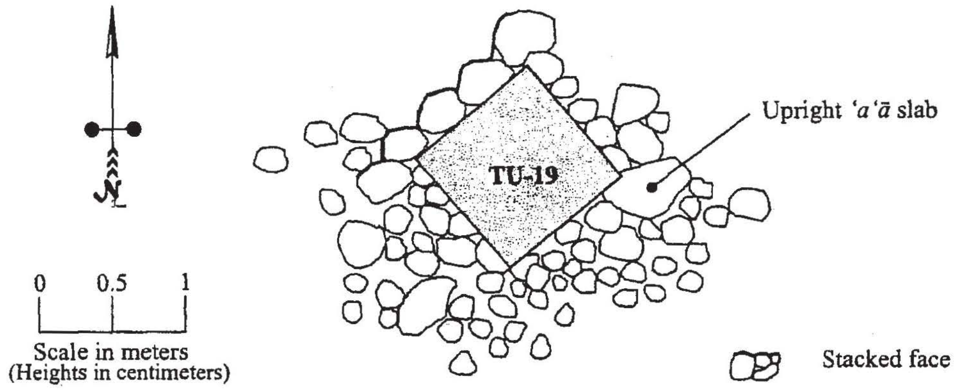
Figure 60. SIHP Site 23686 Feature 262 plan view and TU-15 profile.

Figure 61. SIHP Site 23686 Feature 262 view to east.

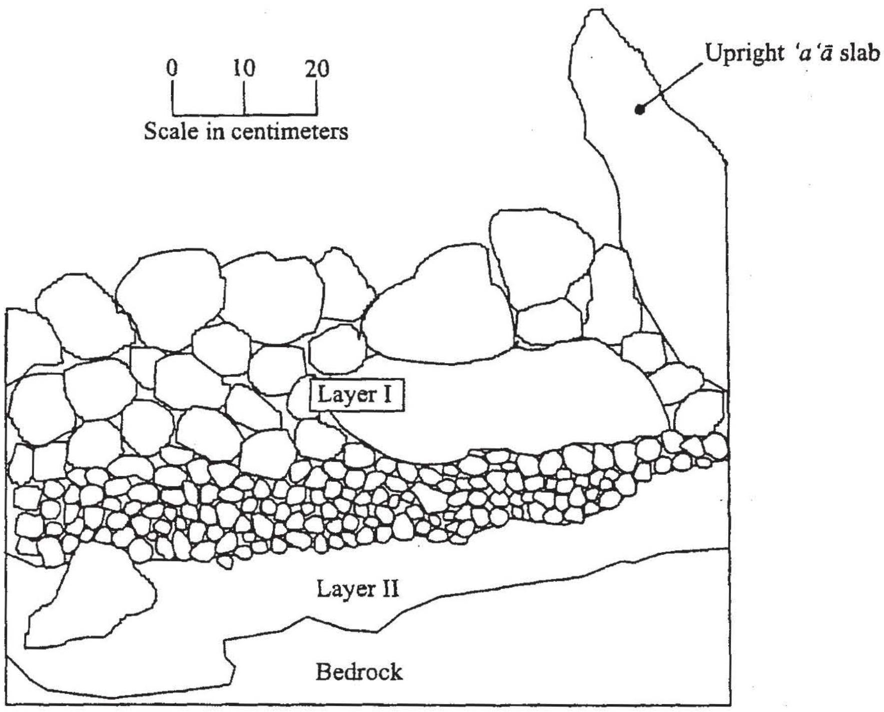
A 1 x 1 meter test unit TU-15 was excavated in the northwest corner of Feature 262 (see Figure 60). Excavation of TU-15 revealed a three-layer stratigraphic profile. Layer I, the 92-centimeter thick architectural layer, consisted of small to large sized *'a'ā* cobbles stacked along the exterior edges of the feature and piled within the interior. Layer I rested on Layer II, a 49-centimeter thick dark brown (10YR 3/3) fine silt mixed with *'a'ā* gravels. Layer II rested on bedrock in the southern portion of TU-15 and Layer III in the northern portion. Layer III consisted of dark yellowish brown (10YR 4/4) fine silt mixed with decomposing bedrock 12 centimeters thick. Excavation of TU-15 terminated at bedrock 147 centimeters below the feature's surface. No cultural material was recovered from TU-15.

Feature 266 is a stacked *'a'ā* cobble mound located in the southeast quadrant of the project area amongst a number of less formal mounds (see Figure 53). This mound, which is roughly rectangular in shape, measures 2.4 meters long by 1.2 meters wide and stands up to 0.7 meters above the surrounding soil ground surface (Figure 62). The west end of the feature is neatly stacked and an *'a'ā* slab (70 centimeters long) had been placed upright at the eastern end of the feature (Figure 63).

A 1 x 1 meter test unit (TU-19) was excavated within the center of Feature 266. Excavation of TU-19 revealed a two-layer stratigraphic profile resting on bedrock. The upper most layer (Layer I), the architectural layer, consisted of small to large sized *'a'ā* cobbles mixed with organics. The 48-centimeter thick Layer I was roughly size sorted with large cobbles on top and smaller cobbles beneath resting on and incorporated into Layer II (Figure 64). Layer II consisted of a dark grayish brown (10YR 3/2) silt containing approximately 50 percent gravel. This 19-centimeter thick layer rested on undulating bedrock. Excavation of TU-19 terminated at bedrock 67 centimeters below the feature's surface. No cultural material was recovered from TU-19.



TU-19 southeast wall profile.



Layer I - architectural layer consisting of small to large sized *'a'ā* cobbles mixed with organics.

Layer II - dark grayish brown (10YR 3/2) silt containing approximately 50% gravel.

Figure 62. SIHP Site 23686 Feature 266 plan view and TU-19 profile.

Figure 63. SIHP Site 23686 Feature 266 view to east.

Figure 64. SIHP Site 23686 Feature 266 TU-19 base of excavation view to northeast.

Feature 271 is a stacked *'a'ā* cobble mound located in the southeast quadrant of the project area along the southern property boundary amongst a number of less formal mounds (see Figure 53). The mound, which is roughly rectangular in shape, measures 2.9 meters long by 2.5 meters wide and stands up to 0.9 meters above the surrounding soil ground surface (Figure 65). An aluminum site tag with the inscription "PHRI Site T2235-10" was found on the surface of the feature and there was evidence that a 1 x 1 meter test unit had been previously excavated at Feature 271. A fragment of water-rounded coral was discovered along the eastern edge of the mound and three coconut husks were resting on its northeast corner.

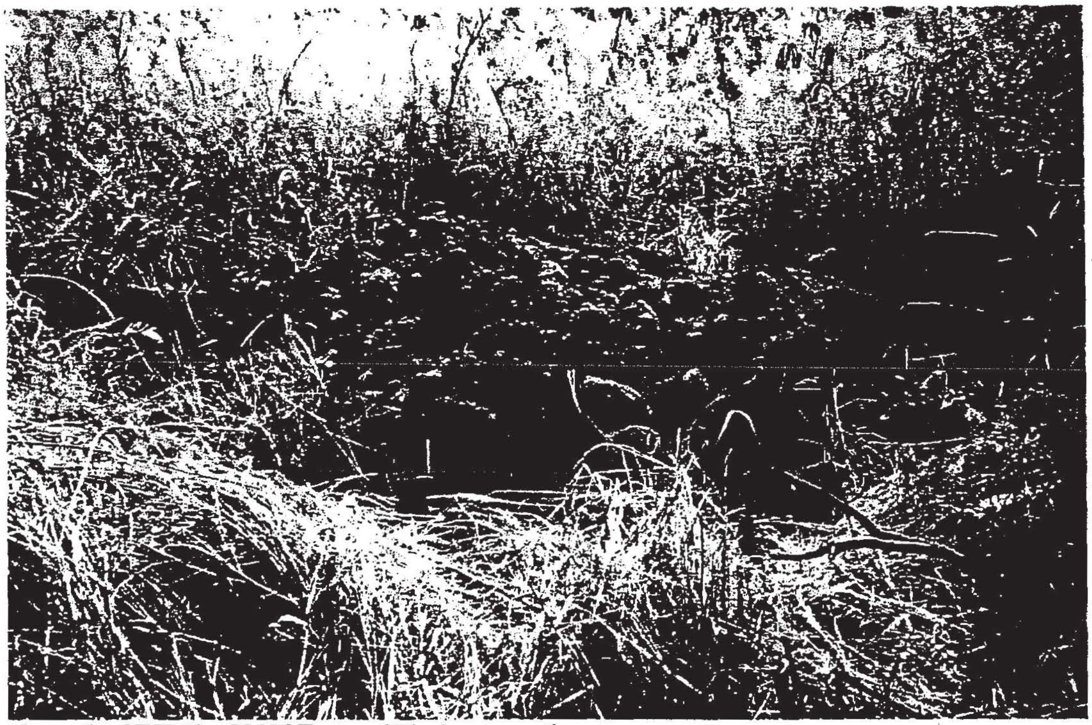


Figure 65. SIHP Site 23686 Feature 271 view to southeast.

A 1 x 1 meter test unit (TU-21) was excavated in the northeast corner of Feature 271 adjacent to the north edge of the previously excavated PHRI test unit (Figure 66). Excavation of TU-21 revealed a single architectural layer (Layer I) resting on bedrock. Layer I consisted of small to large sized *'a'ā* cobbles mixed with organics 61 centimeters thick resting on bedrock. A small amount of soil (approximately 2 centimeters thick) had accumulated in the southwest corner of the unit on top of the bedrock subsequent to the construction of the feature. Excavation of TU-21 terminated at bedrock 61 centimeters below the feature's surface and no cultural material was recovered from Feature 271.

Modified Outcrops

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. 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.

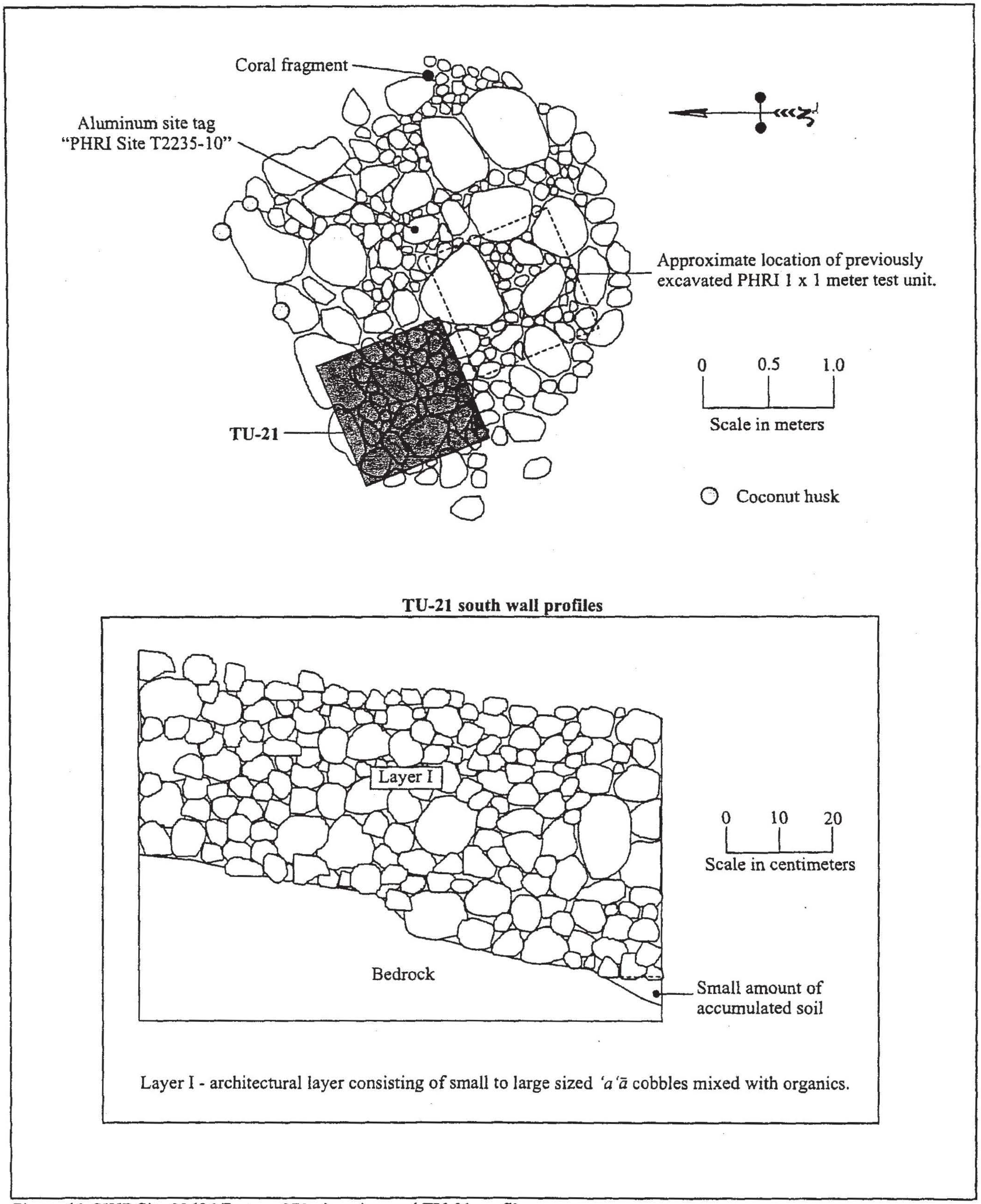


Figure 66. SIHP Site 23686 Feature 271 plan view and TU-21 profile.

Bedrock outcrops, once modified, functioned as clearing features, planting features, or temporary habitation features. Temporary habitations are defined based on the presence of faunal remains and a level and/or paved surface. Clearing features are defined based on the presence of rocks piled on an outcrop in an area free of stones with ample soil. Planting features are defined based the presence of piled or stacked rocks on an outcrop in areas of no soil. The modified outcrops identified as part of this study are considered either planting or clearing features. No modified outcrop temporary habitations were discovered within the project area.

Fifty-nine modified outcrops were recorded within the project area (see Table 8 and Figure 53). The modified outcrops varied immensely in size, shape, and formal attributes. Five modified outcrops (Features 183, 201, 204, 239, and 297), ones that appeared to have the most time invested in their construction, underwent subsurface testing in the form of 1 x 1 meter test units. The results are presented below.

Feature 183 is a modified *pāhoehoe* outcrop located in the extreme northwestern portion of the project area (see Figure 53). The feature measures 6.7 meters long by 5.3 meters wide and stands up to 0.8 meters above the surrounding ground surface. It consists of *pāhoehoe* cobbles and boulders stacked along the south and east edges of an elongated bedrock outcrop stretching to the west (Figure 67). The central portion of the feature, on top of the outcrop, consists of a soil area (2 meters in diameter) cleared of cobbles possibly used for planting. Along the west edge of the soil area is a small blister opening that measures 48 centimeters from floor to ceiling and 60 centimeters deep. No cobble modification was evident around the blister. The feature is most likely constructed from the remains of a larger collapsed blister.

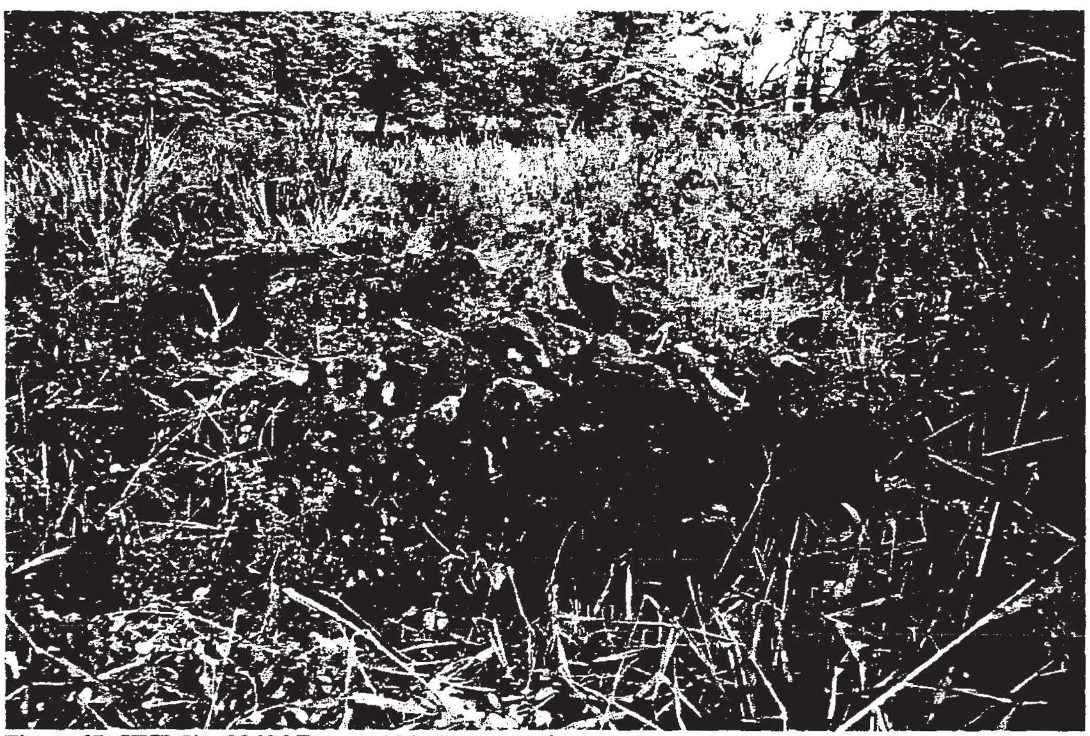


Figure 67. SIHP Site 23686 Feature 183 view to northwest.

A 1 x 1 meter test unit (TU-4) was excavated in the cleared soil area at the center of Feature 183 (Figure 68). Excavation of TU-4 revealed a two-layer stratigraphic soil profile resting on bedrock. Layer I, the uppermost layer, consisted of a 10-centimeter thick very dark grayish brown (10YR 3/2) topsoil mixed with decaying organics and grass roots. This layer rested on Layer II, a dark yellowish brown (10YR 4/3) fine silt mixed with decomposing bedrock at its base. Layer II was 35 centimeters thick and terminated at bedrock 45 centimeters below the surface of TU-4. No cultural material of any kind was recovered Feature 183, but it is suggested that the feature was utilized as a planting area.

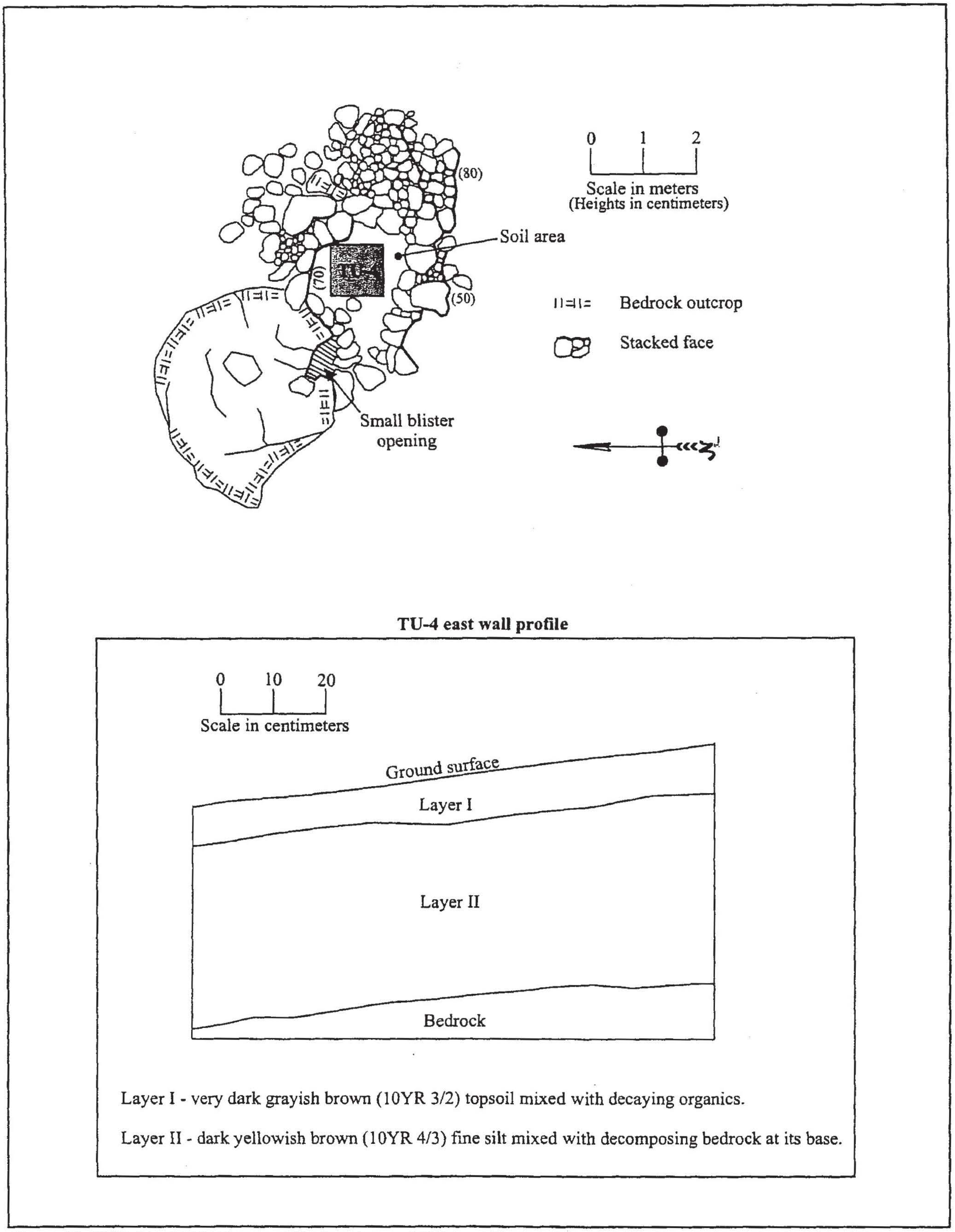


Figure 68. SIHP Site 23686 Feature 183 plan view and TU-4 profile.

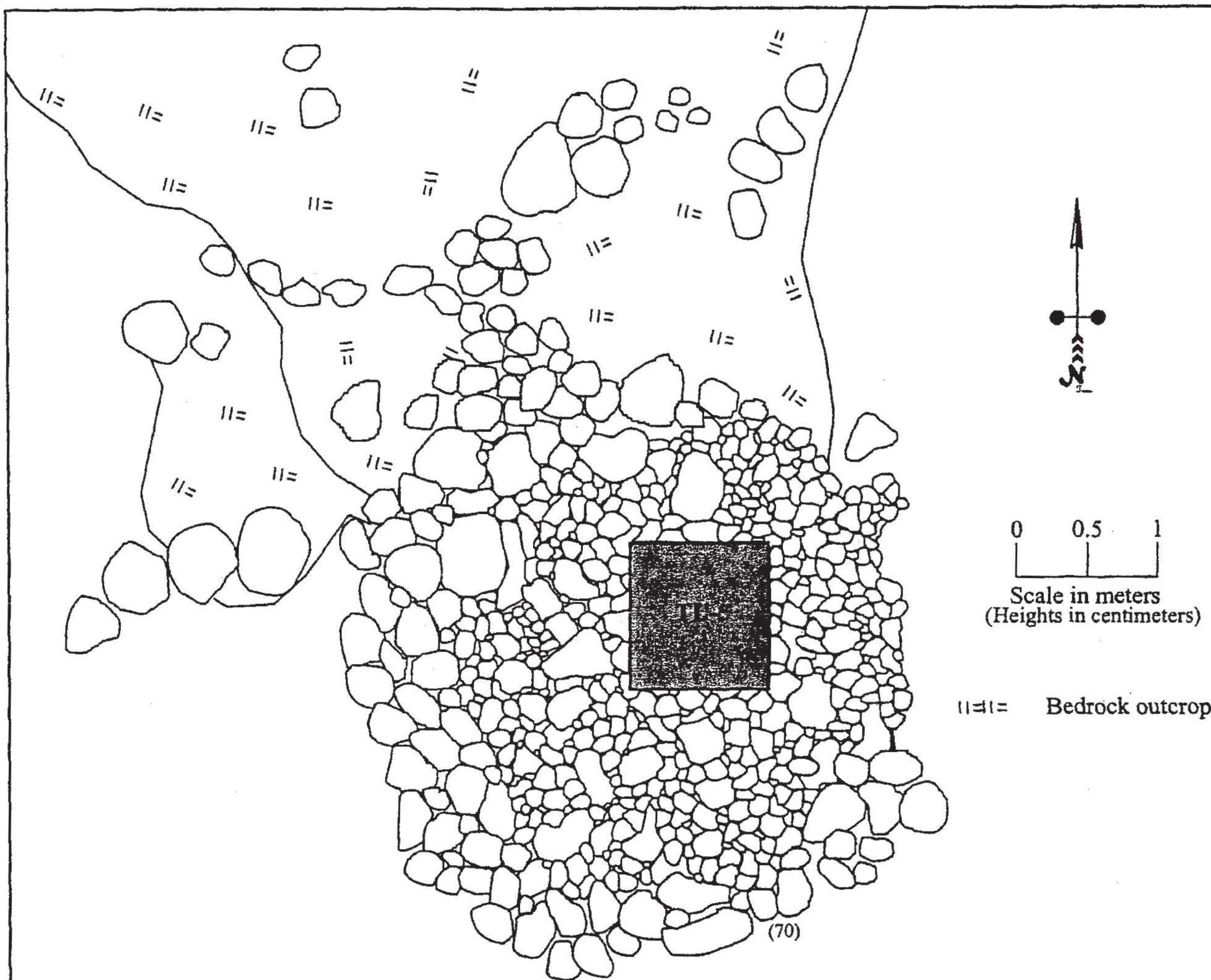
Feature 201 is a modified *pāhoehoe* outcrop located in the northwestern quadrant of the project area along the northern property boundary (see Figure 53). The feature consists of formerly stacked *pāhoehoe* cobbles and boulders, now partially collapsed, supported by a bedrock outcrop to the east (Figure 69). Feature 201 is roughly oval in shape and measures 6.2 long by 3.8 meters wide and stands up to 0.7 meters high along its western edge. The surface of the feature is roughly leveled and paved with small *pāhoehoe* cobbles.


Figure 69. SIHP Site 23686 Feature 201 view to east.

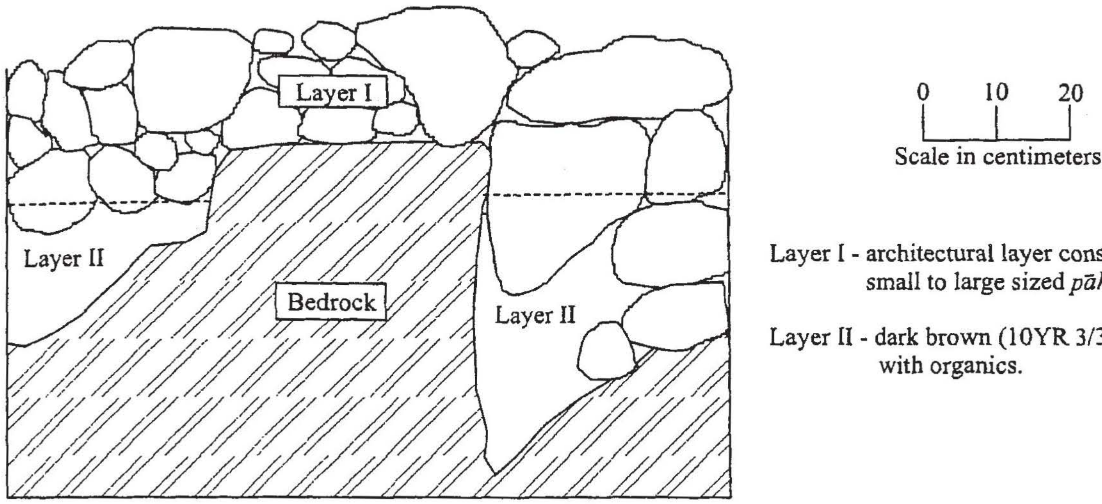
A 1 x 1 meter test unit (TU-5) was excavated in the central portion of Feature 201 (Figure 70). Excavation of TU-5 revealed a two-layer stratigraphic profile resting on undulating bedrock. Layer I, the 25 to 40-centimeter architectural layer, consisted of small to large sized *pāhoehoe* cobbles. This layer rested on and was incorporated into Layer II, a dark brown (10YR 3/3) silt mixed with organics 15 centimeters thick. Layer II most likely accumulated after the construction of the feature as it is only present at low spots within the bedrock. Excavation of TU-5 terminated at bedrock 35 to 50 centimeters below the feature's surface. No cultural material was recovered from Feature 201, and it is suggested that this feature was a by-product of agricultural clearing in the area.

Feature 204 is a modified *pāhoehoe* outcrop located in the northwestern quadrant of the project area (see Figure 53). The feature has an irregular shape and may have been formerly stacked, but is now mostly collapsed (Figure 71). Some remnant *pāhoehoe* cobble stacking still remains along its southwestern edge and the northeastern edge abuts the bedrock outcrop. The surface of the feature, which has evidence of protruding bedrock, is roughly leveled and paved with small *pāhoehoe* cobbles (Figure 72). A water worn cobble was found on the feature's surface adjacent to the bedrock outcrop. Feature 204 measures 3.4 meters long by 2.7 meters wide and stands 0.7 meters high along its western edge.

A 1 x 1 meter test unit (TU-6) was excavated in the west-central portion of Feature 204 (see Figure 71). Excavation of TU-6 revealed a two-layer stratigraphic profile resting on bedrock. Layer I consisted of small to large sized *pāhoehoe* cobbles mixed with organics up to 18 centimeters thick. A small amount of soil (approximately 1 to 5 centimeters thick) had accumulated in low-lying bedrock pockets subsequent to the construction of the feature (Layer II) at the base of Layer I. This soil was a dark brown (10YR 3/3) silt mixed with organics and, like Layer I, rested on bedrock. Excavation of TU-6 terminated at bedrock 25 centimeters below the unit's surface. No cultural material was recovered from Feature 271.



TU-5 west wall profile



Layer I - architectural layer consisting of small to large sized *pāhoehoe* cobbles.

Layer II - dark brown (10YR 3/3) silt mixed with organics.

Figure 70. SIHP Site 23686 Feature 201 plan view and TU-5 profile.

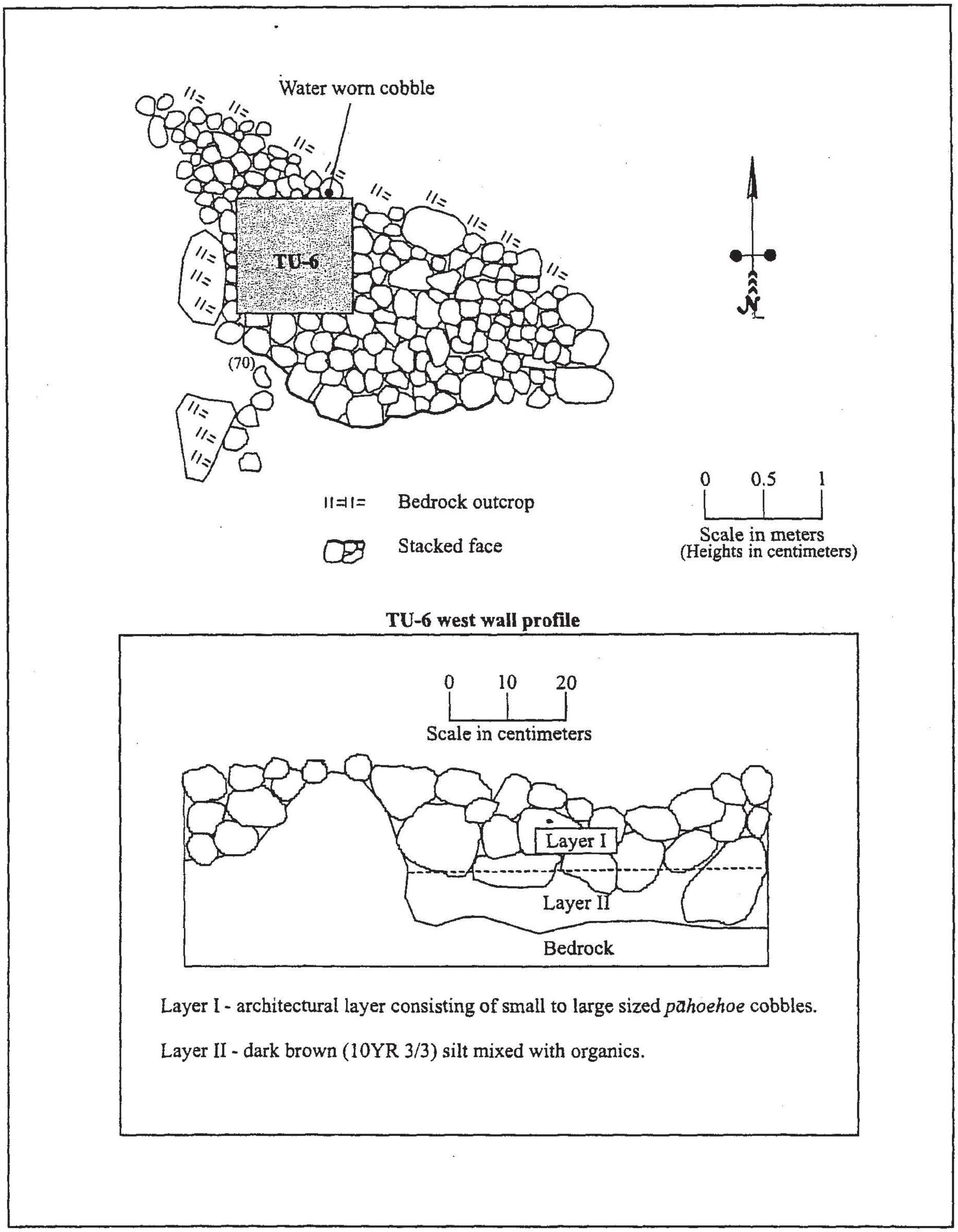


Figure 71. SIHP Site 23686 Feature 204 plan view and TU-6 profile.

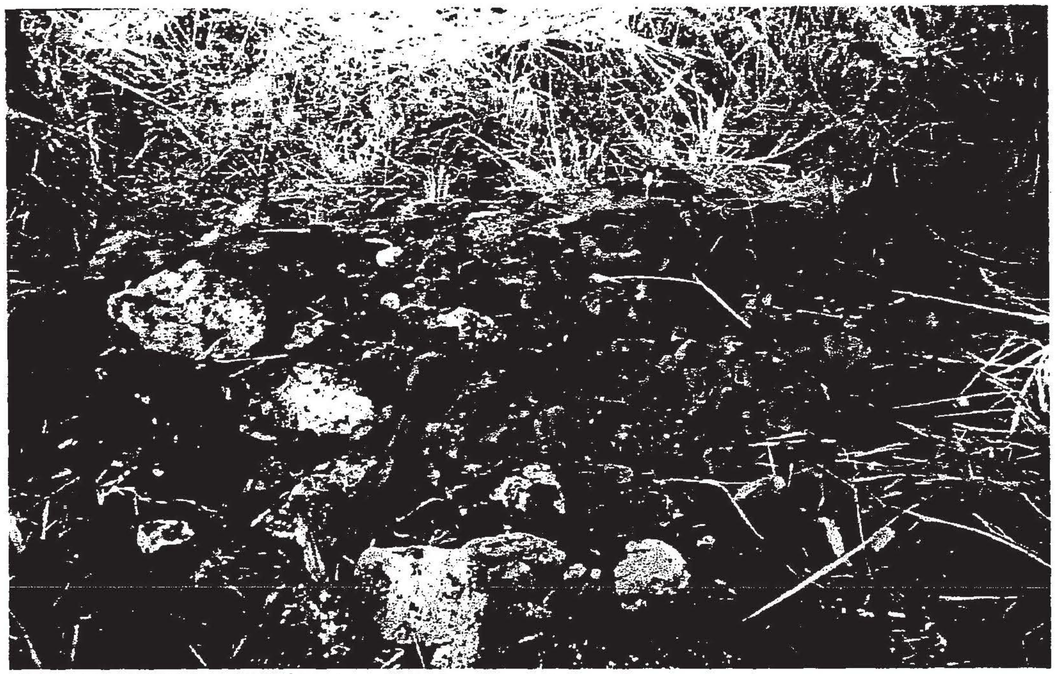


Figure 72. SIHP Site 23686 Feature 204 view to west.

Feature 239 is a modified *'a'ā* outcrop centrally located within the project area amongst a number of other agricultural features (see Figure 53). The feature, which is roughly rectangular, measures 4.0 meters long by 2.5 meters wide and stands up to 0.7 meters high along its southern edge. The southern and western edges consist of stacked *'a'ā* cobbles and boulders (Figure 73). The eastern edge is completely collapsed and the bedrock outcrop supports the northern edge of the feature (Figure 74). The surface of feature 239 is roughly paved and leveled with small *'a'ā* cobbles.

Figure 73. SIHP Site 23686 Feature 239 view to north.

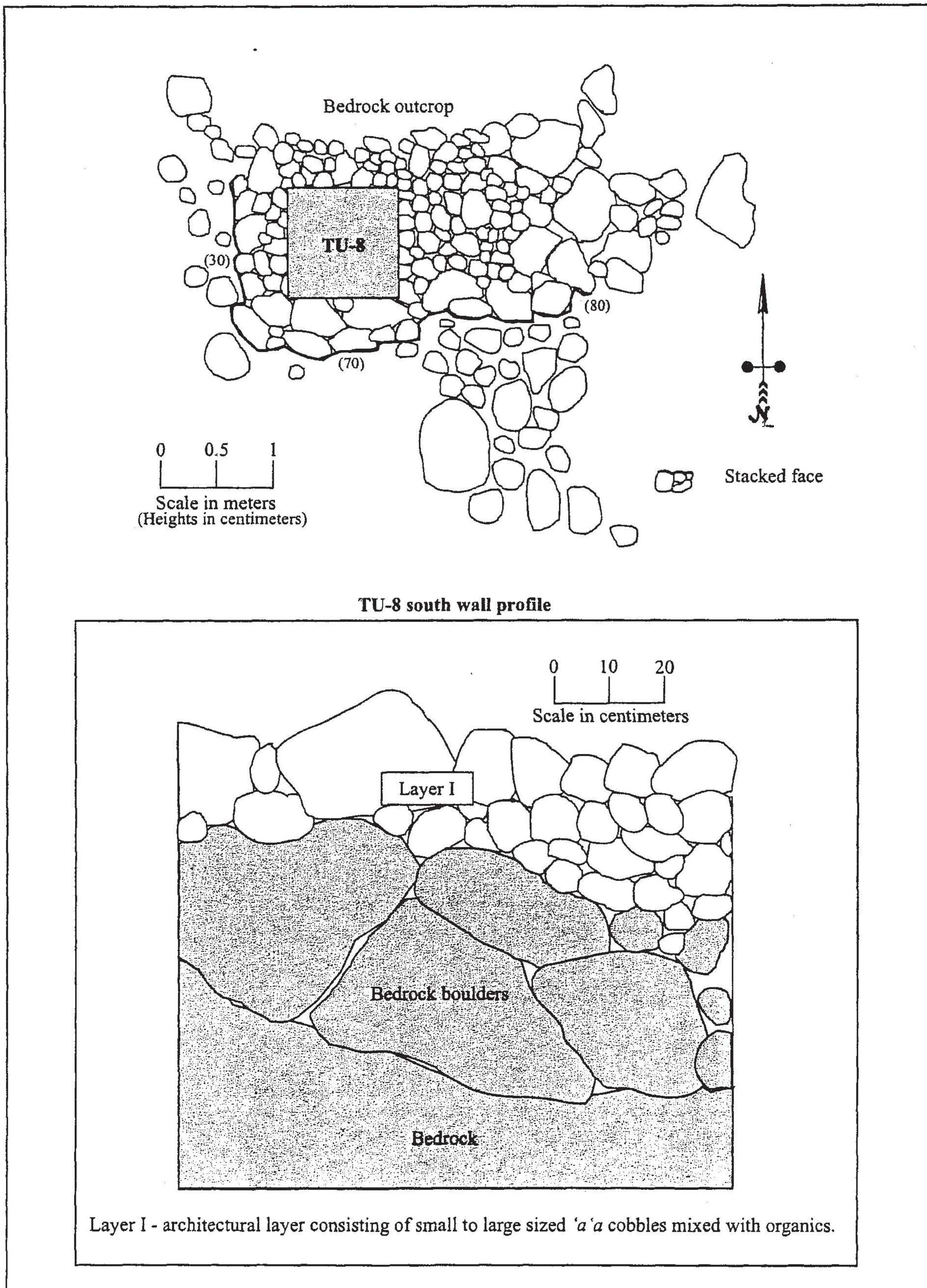


Figure 74. SIHP Site 23686 Feature 239 plan view and TU-8 profile.

A 1 x 1 meter test unit (TU-8) was excavated in the west-central portion of Feature 239 (see Figure 74). Excavation of TU-8 revealed a single architectural layer (Layer I) resting on bedrock. Layer I consisted of small to large sized *'a'ā* cobbles mixed with organics 55 centimeters thick resting on bedrock and mixed with fractured bedrock boulders. A small amount of soil (approximately 1 to 2 centimeters thick) had accumulated at the base of the unit within low-lying bedrock areas subsequent to the construction of the feature. Excavation of TU-8 terminated at bedrock 55 centimeters below the feature's surface (Figure 75). No cultural material was recovered from Feature 239 and it is suggested that this feature may be a by-product of agricultural clearing in the area.


Figure 75. SIHP Site 23686 Feature 239 TU-8 base of excavation view to south.

Feature 297 is a modified *'a'ā* outcrop located at the extreme eastern end of the project area along the southern edge of the old access road (see Figure 53). Feature 297 was formerly constructed of stacked *'a'ā* cobbles, but is now collapsed in several sections. The feature, which is roughly oval in shape, measures 4.5 meters long by 4.0 meters wide and stands up to 0.7 meters above ground surface in its southwestern corner (Figure 76). The southern and northern edges of the feature are stacked (Figure 77). The western edge is nearly completely collapsed and a bedrock outcrop supports the eastern edge of the feature. The surface of Feature 297 is roughly paved and leveled with small sized *'a'ā* cobbles. Overall, the feature has a very formal appearance

A 1 x 1 meter test unit (TU-22) was excavated in the east central portion of Feature 297 (see Figure 76). Excavation of TU-22 revealed a two-layer stratigraphic profile. Layer I, the 33-centimeter thick architectural layer, consisted of small to large sized *'a'ā* cobbles mixed with organics. This layer rested on and was incorporated into Layer II, a dark brown (10YR 3/3) very fine sandy silt 30 centimeters thick. The upper portions of this layer were mixed with decaying organics, while the lower portions gradually transitioned into dark yellowish brown soil (10YR 4/4) mixed with decomposing bedrock. Excavation of TU-22 terminated at bedrock 63 centimeters below the unit's surface. No cultural material off any kind was recovered from TU-22, and it is suggested that Feature 297 may be the by-product of agricultural clearing in area.

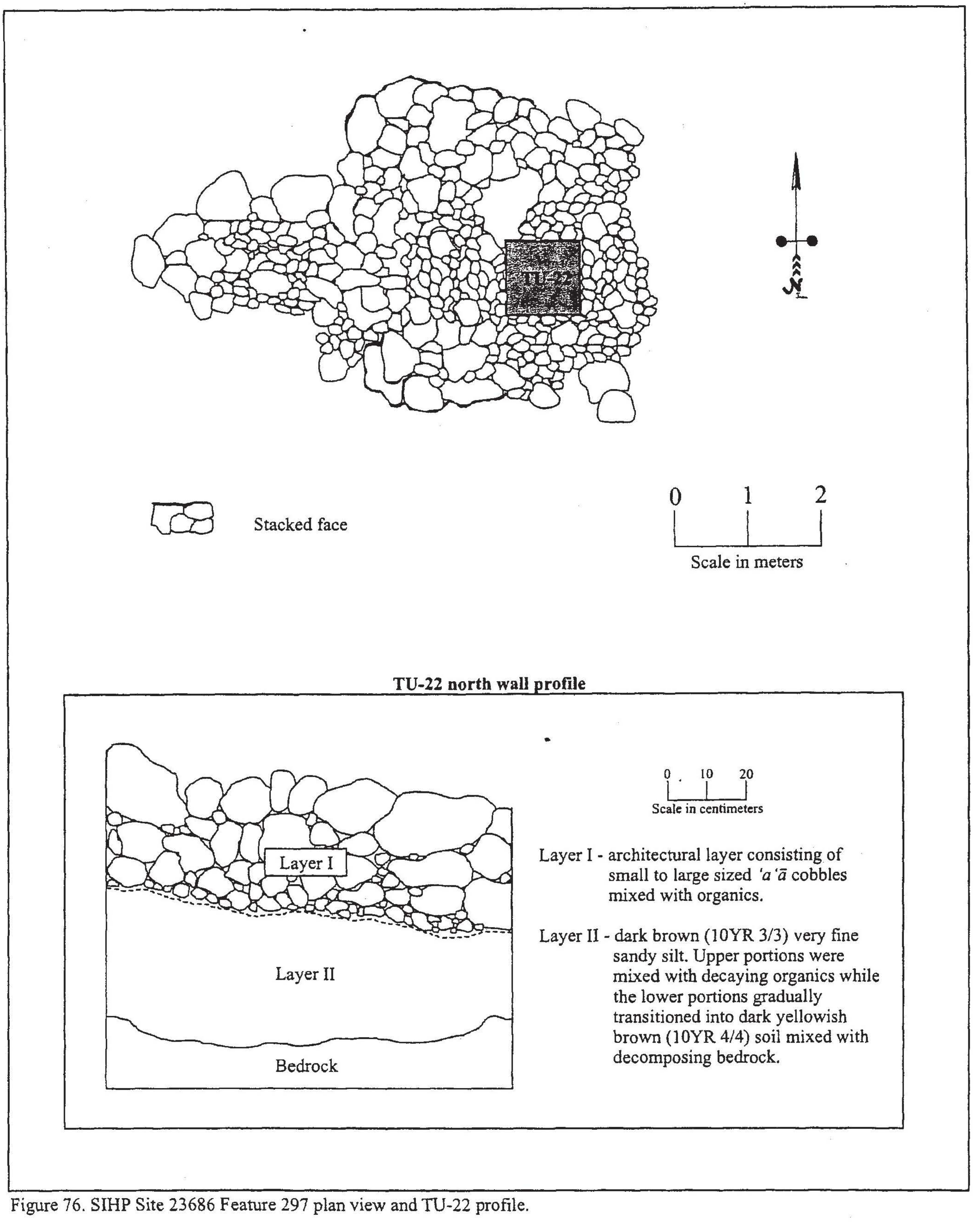


Figure 76. SIHP Site 23686 Feature 297 plan view and TU-22 profile.

Figure 77. SIHP Site 23686 Feature 297 view to north.

Terraces

A terrace is a linear or curvilinear stone construction built perpendicular to the natural slope of the terrain. It is generally longer than it is wide and at least two courses high. On the upslope side of the terrace soil is either placed, or more often naturally accumulated, to form a relatively level surface area. The stones of a terrace may be piled or stacked (piled edges are sloped, while stacked edges are generally vertical). The terrace is a specialized feature of an agricultural field. It functioned to trap or retain soil to create a planting area (Kirch 1985; Soehren and Newman 1968). Terrace walls are typically built connecting kuaiwi and are of stacked construction with a rectangular or trapezoidal profile. Although no such evidence was recorded within the current project area, level soil areas behind shorter terrace walls, which form rectangular areas, have been documented at other locations in Kona to be residential features.

Twenty-two remnant terraces (Figure 78) are present within the study area and are generally orientated perpendicular to the *kuaiwi* (see Figure 53). The downslope sides of the terraces are formed by either piled or stacked walls that range in length from 3.6 to 60 meters and are mostly collapsed because of both erosional forces and cattle grazing impacts. The walls range in height from 0.3 to 1 meter. The terrace areas retained by the walls are a combination of soil and stone and likely functioned as planting areas. Some of the terraces also contain mounds. No terraces were tested as part of the inventory survey.

Enclosures

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 material. 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. Some enclosures completely surround an interior space with no openings.

Figure 78. SIHP Site 23686 Feature 264 typical terrace construction view to northwest.

An enclosure can be a habitation feature, a planting feature, or used to house or detain animals. Planting enclosures (typically with irregular shapes) do not have entrances and are piled or stacked constructions less than one meter in height, with soil in the interior (Ching 1971). Large enclosures with soil interiors could be the by-product of clearing agricultural planting areas in the midst of cobble fields (i.e. the cleared rocks are used to form the enclosure walls). Small enclosures that currently lack soil (or contain only minimal soil) may have at one time been mulched to help create soil and retain moisture (wind and rain could have carried the soil away). Enclosures with higher walls may have also acted as barriers to keep animals out of planting areas. The location of an enclosure is often opportunistic, taking advantage of natural landforms to maximize its usefulness and minimize the amount of effort required for its construction.

Seven agricultural enclosures were recorded within the study area (Features 35, 251, 270, 279, 293, 294, 295) (see Figure 53). One of these is rectangular, two are square, two are oval and two are U-shaped (Figures 79 and 80). All of these features are similar in that they represent cleared areas in an otherwise rocky terrain. The rocks that make up the stacked and piled walls have been cleared from the center of the feature. None of these features is built substantially enough to keep animals inside or to serve as habitations. The walls, however, are tall and wide enough to retain compost and soil and to deter pigs from casually entering the interior enclosed space. No enclosures were tested as part of the current inventory survey, but will be a focus of subsequent data recovery efforts.

Kuaiwi

Kuaiwi are linear or curvilinear alignments of stones (at least two courses high) running *mauka/makai* that are considerably longer than wide. They are constructed using stones of various type and size depending upon the source material. *Kuaiwi* are characterized by piled construction with a "humped" profile (Soehren and Newman 1968). During Precontact times (and into Historic times) *kuaiwi* functioned primarily as agricultural field boundaries (Cordy 2000; Kirch 1985; Soehren and Newman 1968).

Seven remnant *kuaiwi*, orientated generally northeast/southwest, are distributed in a parallel fashion across the study area. They range from relatively short, collapsed segments minimally 16 meters in length to semi-intact segments that extend for as much as 108 meters. Linear *kuaiwi* features (Features 17, 59, 82, 195, 213, 252, 291) can be seen on Figure 53 and appear as broken and segmented wall fragments. It is possible that these field boundary are coincident with *'ili* designations, suggesting the presence of at least five different *'ili* in Wai'aha 1st. No *kuaiwi* were tested as part of the current inventory survey.

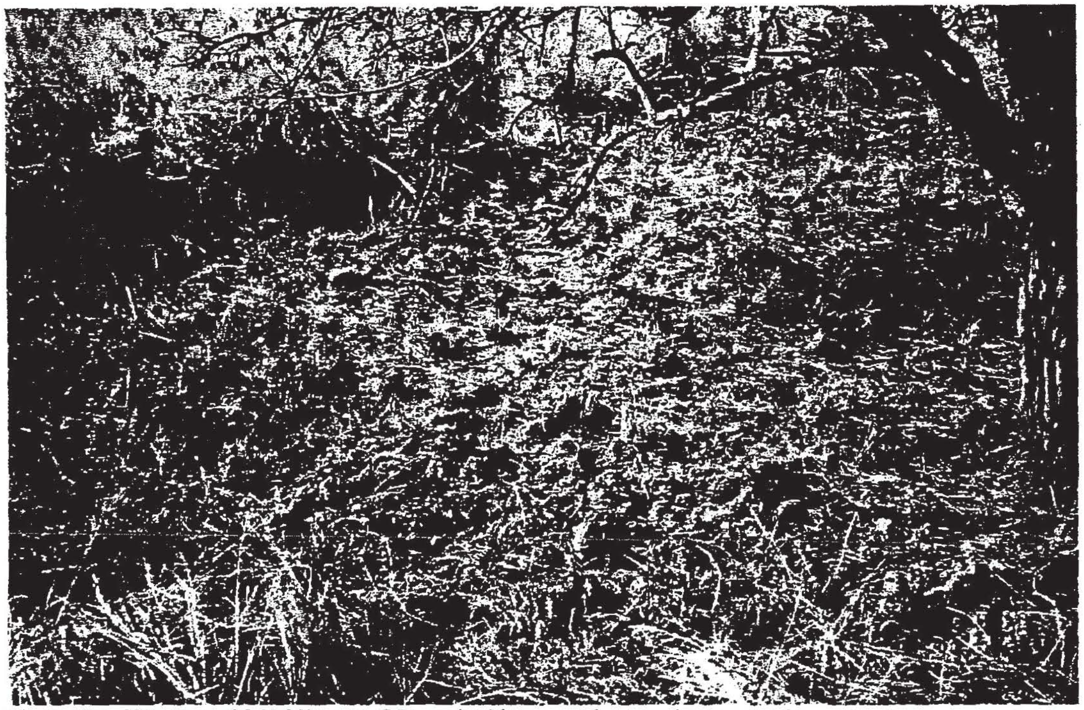


Figure 79. SIHP Site 23686 Feature 251 typical large enclosure view to southwest.

Figure 80. SIHP Site 23686 Feature 294 typical small enclosure view to west.

Pavements

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. One possible explanation for the function of a pavement is that it represents a specialized feature associated with agricultural activity, and was perhaps used as a produce staging or processing area (Rechtman et al. 2001).

Three pavement features (Features 250, 282, 289) were recorded within Site 23686, all within the *mauka* one third of the site (see Figure 53). The respective dimensions of these features are presented in Table 8. Rechtman et al. (2001) formally defined this specialized agricultural feature type based on archaeological survey work within large more or less intact agricultural sites in South Kona. The distribution of the pavements recorded during the current study match what would be expected for centrally located staging and processing areas (it is assumed here that the Precontact agricultural fields once continued more *mauka* than is currently recorded). As none of the pavements were investigated through subsurface testing, this feature type should be a focus of the limited data recovery that is recommended for Site 23686.

SIGNIFICANCE EVALUATION AND TREATMENT RECOMMENDATIONS

All of the sites recorded during the current study are assessed for their significance based on criteria established and promoted by the DLNR–SHPD and contained in the draft Hawaii Administrative Rules 13§13–284–6, dated 1998. 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 treatment for the twenty-six sites are discussed below and presented in Table 9.

Table 9. Site significance and treatment recommendations.

SIHP No.	*Function*	*Temporal Association*	*Significance*	*Recommended Treatment*
6302	Kuakini Wall	Historic	A,C,D	Preservation
23662	Ranching	Historic	D	No further work
23663	Ranching	Historic	D	No further work
23664	Ranching	Historic	D	No further work
23665	Landscape marker	Historic	D	No further work
23666	Landscape marker	Historic	D	No further work
23667	Landscape marker	Historic	D	No further work
23668	Temporary habitation	Precontact	D	No further work
23669	Temporary habitation	Precontact	D	No further work
23670	Permanent habitation	Precontact	D	Data recovery
23671	Temporary habitation	Precontact	D	Data recovery
23672	Permanent habitation	Precontact	D	Data recovery
23673	Permanent habitation	Precontact	D	Data recovery
23674	Temporary habitation	Precontact	D	Data recovery
23675	Permanent habitation	Precontact	D	Data recovery
23676	Temporary habitation	Precontact	D	Data recovery
23677	Temporary habitation	Precontact	D	Data recovery
23678	Temporary habitation	Precontact	D	Data recovery
23679	Trail	Precontact	D	No further work
23680	Trail	Precontact	D	No further work
23681	Ceremonial	Precontact	D,E	Preservation
23682	Game board	Precontact	D	No further work
23683	Burial	Precontact	D,E	Preservation
23684	Burial	Precontact	D,E	Preservation
23685	Burial	Precontact	D,E	Preservation
23686	Agricultural	Precontact	D	Data recovery

Sites Recommended For No Further Work

Upon approval of this report, sites that fall into this category can be dismantled or otherwise destroyed with no further historic preservation consideration.

SIHP 23662

This Historic Period cattle enclosure is significant under Criterion D, and has provided information relative to late nineteenth and early twentieth century use of the property. No further work is recommended.

SIHP 23663

This wall is a significant feature under Criterion D as it relates to early twentieth century ranching practices. The information recorded from this site has sufficiently mitigated any potential impact that may be caused by the development of the parcel.

SIHP 23664

This wall is a significant feature under Criterion D as it relates to early twentieth century ranching practices. The information recorded from this site has sufficiently mitigated any potential impact that may be caused by the development of the parcel.

SIHP 23665

This historic wall is significant under Criterion D and no further work is recommended to mitigate impacts to it. The data collected during the current study sufficiently documented this site.

SIHP 23666

This wall is a significant feature under Criterion D as it relates to early twentieth century ranching practices. The information recorded from this site has sufficiently mitigated any potential impact that may be caused by the development of the parcel.

SIHP 23667

This wall is significant under Criterion D as part of the network of historic ranching/boundary walls on the property. No further work is recommended to mitigate impacts as the data collected during the current study sufficiently documents this site.

SIHP 23668

This lava blister was at most used minimally for temporary habitation purposes and is considered significant under Criterion D. Test excavation conducted as part of this study has resulting in the collection of sufficient information to warrant a no further work recommendation.

SIHP 23669

This site is considered significant under Criterion D as illustrative of the temporary residential use of the *kula* zone. No further work is recommended to mitigate impacts as the data collected during the current study sufficiently documents this very ephemeral temporary habitation site.

SIHP 23679

This short trail segment is significant under Criterion D. It continuance both *mauka* and *makai* could not be discerned. Therefore, the data collected during the current study has been sufficient to mitigate any potential impacts that might be caused by the proposed development; no further work is recommended.

SIHP 23680

This short trail segment is significant under Criterion D. It continuance both *mauka* and *makai* could not be discerned. Therefore, the data collected during the current study has been sufficient to mitigate any potential impacts that might be caused by the proposed development; no further work is recommended.

SIHP 23682

The *papamū* is in a poor state of preservation and has been documented in its entirety; therefore no further work is recommended. However, given the nature of the proposed development (a cultural center), the location of this site could be maintained or memorialized in the development planning and perhaps a similar game board established in the vicinity with appropriate interpretive signage.

Sites Recommended For Data Recovery

Upon approval of this report, sites in this category should be protected until data recovery investigations are completed.

SIHP 23670

This permanent habitation platform complex is considered significant under Criterion D for the potential data it could yield relative to Precontact settlement patterns and land use. Data recovery is recommended.

SIHP 23671

This temporary habitation platform is evaluated as significant under Criterion D, and further data collection is recommended. Excavation of the feature and underlying deposit could provide further data relative to the age of the site and potential association to other sites and features in the vicinity.

SIHP 23672

This permanent habitation enclosure complex is evaluated as significant under Criterion D, and further data collection is recommended. Excavation of portions of both enclosures could provide more specific information relative to both function and temporality.

SIHP 23673

Site 23673 is interpreted as a permanent habitation platform and enclosure and is considered significant under Criterion D. Further investigation of this site will help determine the functional relationship between the two features and establish a more precise temporal association for the site. Data recovery is recommended.

SIHP 23674

This temporary habitation platform and enclosure is evaluated as significant under Criterion D, and further data collection is recommended. Excavation of this site could focus on documenting the quantity and diversity of dietary remains in an effort to make comparisons with Site 23673, interpreted as a permanent habitation platform and enclosure.

SIHP 23675

This permanent habitation platform is considered significant under Criterion D, and further data recovery is recommended to augment the excavation data obtained during the testing. Data recovery excavations could shed further light on site function and age.

SIHP 23676

This site is considered significant under Criteria D as a Precontact temporary habitation platform. As a result of the test excavations, this site yielded a relatively substantial amount remains including marine shell, volcanic glass flakes, and a *he'e* lure. Data recovery is recommended in an effort to further define site function and temporality.

SIHP 23677

This temporary habitation platform and enclosure is evaluated as significant under Criterion D, and further data collection is recommended. Excavation of this site could focus on documenting the quantity and diversity of dietary remains in an effort to make comparisons with Site 23674 (another temporary habitation platform and enclosure) and Site 23673, interpreted as a permanent habitation platform and enclosure.

SIHP 23678

This enclosure is incorporated into a *kuaiwi* (Site 23686 Feature 292) and is unique for the project area. It is interpreted as a temporary habitation and is considered significant under Criterion D. Data recovery is recommended to assess the precise function of the site and to further investigate the relationship between the enclosure and the *kuaiwi*.

SIHP 23686

This site is the complex of agricultural features that form the archaeological backdrop of the study area. A total of 296 features were recorded and this site is considered significant under Criterion D. Limited data recovery is recommended in an effort to collect radiocarbon samples sufficient for age determination analysis. Potentially documenting a when the *kula* zone of Kona was first used for agriculture is an important on-going research goal.

Sites Recommended For Preservation

Upon approval of this report, sites in this category should be protected indefinitely, and perpetual easements established to ensure their long-term preservation.

SIHP 6302

This site has come to be known as the Kuakini Wall and its significance has been evaluated and approved in several projects. This site has been determined significant for its association with broad patterns of lacal history (Criterion A), its characteristic construction style (Criterion C) and its archaeological information (Criterion D). Preservation and interpretation is the recommended general treatment, with the allowance of possible breaches for *mauka/makai* property access. A preservation and interpretation plan should be written in consultation with members of the local community and DLNR–SHPD.

SIHP 23681

This ceremonial site is evaluated as significant under Criteria D, and E; and should be preserved as a stabilized ruin with interpretation. A preservation and interpretation plan should be written in consultation with members of the local community and DLNR–SHPD.

SIHP Sites 23683, 23684 and 23685

These three sites contain buried human remains and are evaluated as significant under Criteria D and E. All of these single feature sites should be preserved as is without interpretation. A search for lineal and cultural descendants should be undertaken and a burial treatment plan written in consultation with any identified descendants and the Hawai'i Island Burial Council.

REFERENCES CITED

Allen, M
2001 *Gardens of Lono Archaeological Investigations at the Amy B. H. Greenwell Ethnobotanical Garden, Kealakekuua, Hawai'i.* Bishop Museum Press, Honolulu Hawai'i.

Binford, L.
1972 *An Archaeological Perspective.* Seminar Press: New York.

Burtchard, G.
1995 Population and Land-use on the Keauhou Coast, the Mauka Lands Inventory Survey, Keauhou, North Kona, Hawaii Island, the Narrative, Part I. International Archaeological Research Institute, Inc. (IARII). Submitted to Belt Collins and Associates and Kamehameha Investment Corporation, Honolulu.

Chinen, J.
1961 *Original Land Titles in Hawaii.* Honolulu: privately published.

Ching, F.
1971 *The Archaeology of South Kohala and North Kona: Surface Survey, Kailua-Kawaihae Road Corridor.* Hawai'i State Archaeological Journal 71-1, Department of Land and Natural resources, State of Hawai'i.

Corbin, A., and P. Rosendahl
2002 Archaeological Assessment Survey U of N BENCORP Development, Lands of Waiaha 1st and 2nd, North Kona District, Island of Hawai'i (TMK:3-7-5-17:6; 3-75-18:73). PHRI Report 2235-041102. Prepared for U of N Bencorp, Kailua-Kona.

Cordy, R.
1981 *A Study of Prehistoric Social Change: The Development of Complex Societies in the Hawaiian Islands.* New York: Academic Press.

1995 Central Kona Archaeological Settlement Patterns. State Historic Preservation Division, DLNR, State of Hawai'i. Prepared for the Planning Department, County of Hawai'i.

2000 *Exalted Sits the Chief. The Ancient History of Hawai'i Island.* Mutual Publishing: Honolulu, Hawai'i.

Cordy, R., Tainter, R. Renger, and R. Hitchcock,
1991 An Ahupua'a Study: The 1971 Archaeological Work at Kaloko Ahupua'a, North Kona, Hawai'i. Western Archaeological and Conservation Center *Publications in Anthropology No. 58.* Prepared for the National Park Service, U.S. Department of the Interior.

Ellis, W.
1963 *Journal of William Ellis, Narrative of a Tour of Hawaii, or Owhyee...* [1823] Honolulu: Advertiser Publishing Co.

Fornander, A.
1919 Fornander Collection of Hawaiian Antiquities and Folklore. (9 vols.) Honolulu: Bishop Museum Press.

Hammatt, H.
1980 Archaeological Surface Survey of a 178 Acre Parcel in Na Ahupua'a, Kaumalumalu, Pahoehoe, Kona, Hawai'i Island. Archaeological Research Center Hawaii, Inc. Report 14-203 II. Prepared for Farms and Ranches, Inc.

Hammatt, H., and S. Clark
1980 Archaeological Testing and Salvage Excavations of a 155 Acre Parcel in Na Ahupua'a Pahoehoe, La'aloa and Kapala'aea, Kona, Hawai'i. Archaeological Research Center Hawaii Report 14-152 III. Prepared for Pacific Basin Resorts, Inc.

Hammatt, H., and W. Folk
1980 Archaeological Survey and Excavations of Coastal Sites, Ouli, Kohala, Hawai'i Island. Archaeological Research Center Hawaii, Inc. Report 14-185 II. Prepared for Mauna Kea Properties, Inc.

Hammatt, H., and V. Meeker
1979 Archaeological Excavations and Heiau Stabilization at Kahalu'u, Kona, Hawaii Island. Archaeological Research Center Hawaii Report 14-172 (II). Prepared for Gerald Park, Urban Planner.

Han, T., S. Collins, S. Clark, and A. Garland
1986 *Moe Kau a Ho'oilo*: Hawaiian Mortuary Practices at Keopu, Kona, Hawai'i. Chapter VII. Artifacts and Manuports from the Keopu Burial Site. *Departmental Report Series* 86–1. Department of Anthropology, B. P. Bishop Museum, Honolulu. Prepared for Hawai'i Department of Transportation.

Handy, E. S. C., and E. G. Handy
1972 Native Planters in Old Hawaii: Their Life, Lore and Environment. *B. P. Bishop Museum Bulletin* 223. Bishop Museum Press, Honolulu. (with M. K. Pukui)

Haun, A., J. Henry, J. Jimenex, M. Kirkendall, K. Maly, and T. Wolforth
1998 *Ali'i Highway Phased Mitigation Program Phase I – Archaeological Intensive Survey, North Kona District, Island of Hawai'i, vol. 1,* Summary. PHRI Report 1320-052798. Submitted to the County of Hawai'i c/o R. M. Towill Corporation.

Head, J., S. Goodfellow, and P. Rosendahl
1994 Archaeological Inventory Survey, Alii Drive Sewer Project, Lands of Puaa 2nd and 3rd, and Waiaha 1st and 2nd, North Kona District, Island of Hawaii (TMK:7-5-18:7,8). PHRI Report 937-070194. Prepared for Mr. Edward Harada, M & E Pacific, Inc.

Hommon, R.
1986 Social Evolution in Ancient Hawai'i. In Kirch, P. V. (ed.), *Island Societies: Archaeological Approaches to Evolution and Transformation*, pp. 55–88. Cambridge: Cambridge University Press.

Kelly, M.
1983 Na Mala O Kona: Gardens of Kona. A History of Land Use in Kona, Hawai'i. *Departmental Report Series* 83-2. Department of Anthropology, B. P. Bishop Museum, Honolulu. Prepared for the Department of Transportation, State of Hawai'i.

Kirch, P.
1979 Marine Exploitation in Prehistoric Hawaii: Archaeological Investigations at Kalahuipua'a, Hawai'i Island. *Pacific Anthropological Records* No. 29. Department of Anthropology, B.P. Bishop Museum, Honolulu.

1985 *Feathered Gods and Fishhooks: An Introduction to Hawaiian Archaeology and Prehistory*. University of Hawai'i Press, Honolulu.

Kolb, M.
1991 Social Power, Chiefly Authority, and Ceremonial Architecture, in an Island Polity, Maui, Hawaii. Dissertation, University of California, Los Angeles. UMI Dissertation Services, Ann Arbor.

Ladefoged, T.
1991 Hawaiian Architectural Transformations during the Early Historic Era. *Asian Perspectives* 30(1):55–70.

Newman, T.
1970 Report on Reconnaissance at Old Kona Airport. Letter. Historic Sites Section, Department of Land and Natural Resources, State of Hawai'i.

O'Hare, C, and T. Wolforth
1997 Archaeological Inventory Survey of the Gomes Property Parcel, Land of Hahalui 1st, Island of Hawaii (TMK: 3-7-5-19:5, 38, 40). PHRI Report 1807-10197. Submitted to Towne Development of Hawai'i, Inc.

Pukui, M. K., S. Elbert, and E. Mookini
1974 *Place Names of Hawaii*. Honolulu: University of Hawai'i Press.

Raab, M., and A. Goodyear
1984 Middle-range Theory in Archaeology: a Critical Review of Origins and Applications. *American Antiquity* 49(2):255-268.

Rechtman, R., M. Clark, and D. Amerine
2003 Archaeological Inventory Survey of a Portion of the Kona Gold Coffee Plantation (TMK:3-7-8-02:6,10), Kahalu'u Ahupua'a, North Kona District, Island of Hawai'i. Report RC-0071. Prepared for Mr. John Perry, Jupiter FL.

Rechtman, R., K. Maly, M. Clark, D. Dougherty, and O. Maly
2001 Archaeological Inventory Survey of the Ki'ilae Estates Development Area (TMK:3-8-5-05:19, 22, 26, 27), Ki'ilae and Kauleolī Ahupua'a, South Kona District, Island of Hawai'i. Report RC-0034. Prepared for Mr. Steven Jiran, Ki'ilae Estates, LLC.

Rosendahl, P.
2002 Interim Report: Testing of Possible Burial Features Archaeological Inventory Survey—Phase 1, U of N BENCORP Development, Lands of Waiaha 1st and 2nd, North Kona District, Island of Hawai'i (TMK:3-7-5-17:6; 3-75-18:73). PHRI Letter Report 2257-070302. Prepared for U of N Bencorp, Kailua-Kona.

Sato, H. H., W. Ikeda, R. Paeth, R. Smythe, and M. Takehiro, Jr.
1973 *Soil Survey of the Island of Hawaii, State of Hawaii*. U.S. Department of Agriculture, Soil Conservation Service and University of Hawai'i Agricultural Experiment Station. Washington, D.C.: Government Printing Office.

Schilt, A.
1984 Subsistence and Conflict in Kona, Hawaii. An Archaeological Study of the Kuakini Highway Realignment Corridor. *Departmental Report Series* 84-1. Department of Anthropology, B.P. Bishop Museum, Honolulu. Prepared for the Department of Transportation, State of Hawai'i.

Soehren, L., and T Newman
1968 Archaeology of Kealakekua Bay. Department of Anthropology, B.P. Bishop Museum, Honolulu, and University of Hawaii-Manoa.

Stokes, J., and T. Dye
1991 *Heiau of the Island of Hawai'i. Bishop Museum Bulletin in Anthropology* 2. Bishop Museum Press, Honolulu.

Tainter, J.
1973 The Social Correlates of Mortuary Patterning at Kaloko, North Kona, Hawaii. *Archaeology and Physical Anthropology in Oceania* 11:91–105.

Thrum, T.
1909 Hawaiian Annual and Almanac for 1909. Honolulu: Thos. G. Thrum.

Tomonari-Tuggle, M.
1993 Draft Report, the Archaeology of the 'Ohi'a Preserve; An Inventory Survey of Surface Structures. International Archaeological Research Institute, Inc. (IARII). Submitted to Kamehameha Investment Corporation, Honolulu.

Tuohy, D.
1965 Salvage Excavations at City of Refuge National Historical Park, Honaunau, Kona, Hawaii. Typescript in Library, BPBM.

Walker, A., P. Rosendahl, with J. Head
1996 Ali'i Drive Sewer Project Mitigation Program – Phase II Archaeological Data Recovery. Lands of Pua'a 2nd and 3rd, and Wai'aha 1st and 2nd, North Kona District, Island of Hawai'i (TMK:7-5-18:7,8). PHRI Report 1556-020796. Prepared for Mr. Harold Sugiyama, Chief, Wastewater Division, Hawai'i County, Department of Public Works.

Wolfe, E. W., and J. Morris
1996 Geological Map of the Island of Hawaii. U.S. Department of the Interior, U.S. Geological Survey.

APPENDIX A – RADIOCARBON RESULTS

Dr. Bob Rechtman — Report Date: 2/17/2003

Rechtman Consulting — Material Received: 2/7/2003

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 175916	180 +/- 60 BP	-23.5 o/oo	210 +/- 70 BP

SAMPLE : RC-0153-12
ANALYSIS : Radiometric-Priority delivery (with extended counting)
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1510 to 1600 (Cal BP 440 to 350) AND Cal AD 1620 to 1950 (Cal BP 330 to 0)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 175917	140 +/- 40 BP	-23.5 o/oo	160 +/- 40 BP

SAMPLE : RC-0153-40
ANALYSIS : AMS-Advance delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1660 to 1950 (Cal BP 290 to 0)

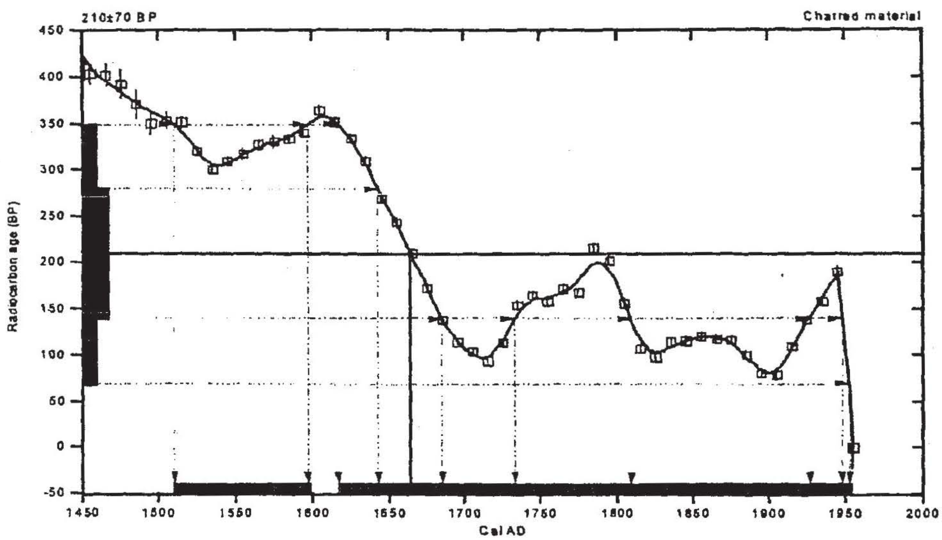
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23.5:lab. mult=1)

Laboratory number:	**Beta-175916**
Conventional radiocarbon age:	**210±70 BP**
2 Sigma calibrated results: (95% probability)	**Cal AD 1510 to 1600 (Cal BP 440 to 350) and Cal AD 1620 to 1950 (Cal BP 330 to 0)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal AD 1660 (Cal BP 290)
1 Sigma calibrated results: (68% probability)	Cal AD 1640 to 1680 (Cal BP 310 to 260) and Cal AD 1730 to 1810 (Cal BP 220 to 140) and Cal AD 1930 to 1950 (Cal BP 20 to 0)



References:

Database used

Calibration Database

Editorial Comment

Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxli-xiii

INTCAL98 Radiocarbon Age Calibration

Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083

Mathematics

A Simplified Approach to Calibrating C14 Dates

Talmo, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Beta Analytic Inc.

4985 SW 74 Court, Miami, Florida 33155 USA • Tel: (305) 667 5167 • Fax: (305) 663 0964 • E-Mail: beta@radiocarbon.com

EXHIBIT "A"

PARCEL FIRST:

LOT A

LAND SITUATED ON THE EASTERLY SIDE OF KUAKINI HIGHWAY, PROJECT FAP NO. S-2291(1) AND ON THE WESTERLY SIDE OF LOT B AND HUALALAI ROAD (KAILUA-KEAUHOU MIDDLE ROAD)

AT WAIAHA 1ST, NORTH KONA, HAWAII, HAWAII

BEING A PORTION OF ROYAL PATENTS 1930 TO ASA THURSTON ON A PORTION OF LAND COMMISSION AWARD 387 PART 4, SECTION 2, NO. 3 TO AMERCAN BOARD OF COMMISSIONERS FOR FOREIGN MISSIONS

Beginning at the Northerly corner of this parcel of land at the Great Wall of Kuakini, being the Southeast corner of Lot 7, TMK: 7-5-018-028, being the existing Northeast corner of TMK: 7-5-018-073 and the existing Northwest corner of TMK: 7-5-017-007, the coordinates of said point of beginning referred to Government Survey Triangulation Station "KAILUA" (North Meridian) being 4,301.12 feet South and 3,245.12 feet East and running by azimuths measured clockwise from true South:

Thence, along Lot A, along Lot 1 of Land Court Application 1666 - Map 1 for the following six (6) courses;

1.	258°	38'	49"	419.30	feet to a point;
2.	265°	41'	49"	603.40	feet to a point;
3.	269°	49'	49"	229.50	feet to a point;
4.	261°	25'	49"	329.20	feet to a point;
5.	258°	35'	49"	269.50	feet to a point;

6.	265°	37'	49"	77.10	feet to a point;

Thence, along Lot B, along a curve to the left having a radius of 500.00 feet. the chord azimuth and distance being;

7.	325°	39'	31"	184.00	feet to a point;
8.	315°	03'	20"	145.67	feet along Lot B to a point;

Thence, along Lot B, along a curve to the right having a radius of 900.00 feet, the chord azimuth and distance being;

9.	322°	59'	20"	248.44	feet to a point;
10.	240°	55'	18"	92.44	feet along Lot B to a point;
11.	179°	04'	30"	10.85	feet along Lot B to a point;
12.	269°	04'	30"	20.28	feet along Lot B to a point;
13.	240°	55'	18"	144.12	feet along Lot B to a point;

Thence, along Lot B, along a curve to the left having a radius of 160.00 feet, the chord azimuth and distance being;

14.	217°	00'	44"	129.69	feet to a point;
15.	193°	06'	10"	33.04	feet to a point;

Thence, along Lot B, along a curve to the right having a radius of 100.00 feet, the chord azimuth and distance being;

16.	215°	47'	40"	77.15	feet to a point;
17.	271°	35'	47"	54.62	feet to a point;

Thence, along the Southwesterly to Westerly side of Hualalai Road (Queen Kaahumanu Highway Extension) Hawaii Belt Road for the following five (5) courses;

18.	304°	42'	24"	138.61	feet to a point;
19.	302°	00'	00"	134.71	feet to a point;
20	311°	15'	00"	21.71	feet to a point;
21.	334°	11'	04"	337.35	feet to a point;
22.	71°	47'	48"	37.57	feet to a point;
23.	76°	50'	39"	150.56	feet along Lots 29 and 26 of Kona Hillcrest Subdivision to a point;
24.	75°	03'	00"	404.68	feet along Lots 26, 24, 23, 21 and 20 of Kona Hillcrest to a point;
25.	78°	26'	08"	2213.85	feet along TMK: 7-5-017-006, along Grant 5327 to Samuel Liftee to a point;
26.	68°	38'	00"	105.50	feet along TMK: 7-5-017-006, along Grant 5327 to Samuel Liftee to a point;
27.	143°	26'	35"	838.99	feet to a point;
28.	151°	59'	00"	321.64	feet along the Easterly side of Kuakini Highway to a point;
29.	265°	01'	00"	424.15	feet along Lot 7, Land Court Application 1659, Map 4 to the point of beginning and containing a gross area of 57.047 acres, more or less, and a net area of 56.597 acres excluding the two (2) Water Tank sites (TMK: 7-5-017-013 and 015), as per survey by Donald C. McIntosh, L.P.L.S. #4968, dated April 4, 2001, revised December 20, 2001.

PARCEL SECOND:

All of that certain parcel of land (being a portion of Land Patent Grant No. 5237 to Samuel Liftee), situate, lying and being at Kahului 1st, District of North Kona, Island and County of Hawaii, State of Hawaii, containing an area of 5.560 acres, more or less, and commonly designated by Tax Map Key (3) 7-5-017-006.

NOTE: First Hawaii Title Corporation recommends that a modern metes and bounds survey be made of the land under search in order that its boundaries may be definitely established and its area accurately computed.

AS TO PARCEL FIRST AND SECOND:

TOGETHER WITH an easement for roadway and utility purposes, as granted by instrument dated November 23, 2001, recorded as Document Nos. 2762460 and 2001-198862 more particularly described as follows:

FIRST:

EASEMENT 79 (50-ft. wide) for roadway and utility purposes, as granted by instrument dated November 23, 2001, recorded as Document Nos. 2762460 and 2001-198862, affecting Lot 1-B as shown on Map filed in the Office of the Assistant Registrar of the Land Court of the State of Hawaii with Land Court Application No. 1066 of the Roman Catholic Church in the State of Hawaii as described in Land Court Order No. 143824.

SECOND:

EASEMENT R-1 (PART 1) 50 FEET WIDE
for Roadway and Utility Purposes

EASEMENT SITUATED ON THE WESTERLY SIDE OF LOT B
ADJOINING THE EASTERLY SIDE OF HUALALAI ROAD

AT PUAA 2ND & 3RD, NORTH KONA, HAWAII, HAWAII

BEING A PORTION OF LOT B, A PORTION OF GRANT 1744
TO KAHUNAELE

Beginning at the Northerly corner of THIS EASEMENT being the Northerly corner of Lot B, also being the Easterly corner of Lot C on the Southwesterly side of Hualalai Road, the coordinates of said point of beginning referred to Government Survey Triangulation Station "North Meridian" being 3,519.30 feet South and 5,165.02 feet East and running by azimuths measured clockwise from true South:

					Thence, along the Southwesterly side of Hualalai Road for the following three (3) courses:
1.	313°	50'	49"	36.33	feet to a point;
2.	314°	26'	49"	110.60	feet to a point;
3.	305°	57'	49"	12.10	feet to a point;
					Thence, along the remainder of Lot B for the following four (4) courses:
4.	35°	57'	49"	20.84	feet to a point;
					Thence, along a curve to the left having a radius of 60.00 feet, the chord azimuth and distance being:
5.	84°	54'	19"	78.82	feet to a point;
					Thence, along a curve to the left having a radius of 275.00 feet, the chord azimuth and distance being:
6.	31°	22'	51"	118.72	feet to a point;
7.	76°	47'	49"	46.25	feet along the remainder of Lot B, the remainder of Easement R-1 and Land Court Application 1666, lot 1-B, Map 15, to a point;
8.	81°	43'	49"	10.67	feet along remainder of Lot B, the remainder of Easement R-1 and Land Court Application 1666, Lot 1-B, Map 15, to a point;
					Thence, along Lot C, along a curve to the right having a radius of 325.00 feet, the chord azimuth and distance being:

9.	208°	46'	48.5"	168.96	to a point;
					Thence, along Lot C, along a curve to the right having a radius of 60.00 feet, the chord azimuth and distance being:
10.	178°	50'	49"	84.85	feet to a point;
11.	223°	50'	49"	19.57	feet along Lot C to the point of beginning and containing an area of 0.342 acres, more or less.

PARCEL THIRD:

ITEM ONE

LOT B
(BEING A CONSOLIDATION OF ITEM ONE, ITEM TWO AND ITEM THREE)
A 4.979 ACRE PARCEL

LAND SITUATED ON THE SOUTHWESTERLY SIDE OF HUALALAI ROAD (KAILUA-HOLUALOA ROAD) ON THE EASTERLY SIDE OF LOT A

AT WAIAHA 1ST, NORTH KONA, HAWAII, HAWAII

BEING A PORTION OF LOT B, A PORTION OF ROYAL PATENT 1930 TO ASA THURSTON ON A PORTION OF LAND COMMISSION AWARD 387, PART 4, SECTION 2, NO. 3 TO AMERICAN BOARD OF COMMISSIONERS

Beginning at the Northeasterly corner of this parcel of land, being the Southeast corner of Land Court Application 1666, Lot 1 on the Southwesterly side of Hualalai Road, the coordinates of said point of beginning referred to Government Survey Triangulation Station "Kailua" (North Meridian" being 4,019.90 feet South and 5,797.91 feet East and running by azimuths measured clockwise from true South:

					Thence, along the Southwesterly side of Hualalai Road for the following three (3) courses;
1.	328°	39'	40"	141.39	feet to a point;
2.	319°	18'	00"	62.91	feet to a point;

3.	304°	42'	24"	11.46	feet to a point;
					Thence, along Lot A, along a curve to the left having a radius of 50.00 feet, the chord azimuth and distance being;
4.	91°	35'	47"	54.62	feet to a point;
					Thence, along Lot A. along a curve to the left having a radius of 100.00 feet, the chord azimuth and distance being;
5.	35°	47'	40"	77.15	feet to a point;
6.	13°	06"	10"	33.04	feet along Lot A to a point;
					Thence, along Lot A, along a curve to the right having a radius of 160.00 feet, the chord azimuth and distance being;
7.	37°	00'	44"	129.69	feet to a point;
8.	60°	55'	18"	144.12	feet along Lot A to a point;
9.	89°	04'	30"	20.28	feet along a Water Tank site (TMK: 7-5-017-015) to a point;
10	359°	04'	30"	10.85	feet along a Water Tank site (TMK: 7-5-017-015) to a point;
11.	60°	55'	18"	92.44	feet along Lot A to a point;
					Thence, along Lot A, along a curve to the left having a radius of 900.00 feet, the chord azimuth and distance being;
12.	142°	59'	20"	248.44	feet to a point;
13.	135°	03'	20"	145.67	feet to a point;

Thence, along Lot A, along a curve to the right having a radius of 500.00 feet, the chord azimuth and distance being;

14.	145°	39'	31"	184.00	feet to a point;
15.	265°	37'	49"	550.70	along the remainder of Lot B, along Land Court Application 1666, Lot 1, Map 1 to a point.
16.	268°	27'	49"	95.35	feet along the remainder of Lot B, along Land Court Application 1666, Lot 1, Map 2 to the point of beginning and containing an area of 4.979 acres, as per survey by Donald C. McIntosh, L.P.L.S. #4968, dated April 4, 2001, revised November 17, 2001.

Being a portion of the land conveyed by the following:

WARRANTY DEED

Grantor:	GOMES FAMILY LIMITED PARTNERSHIP, a Hawaii limited partnership
Grantee:	PACU BENCORP, INC., a Hawaii nonprofit corporation
Dated:	July 31, 2000
Document No.	2000-112926

ITEM TWO

All of that certain parcel of land situate at Puaa 3rd, North Kona, State of Hawaii, described as follows:

Lot 1-B, area 3.985 acres, more or less, as shown on Map 15, filed in the Office of the Assistant Registrar of the Land Court of the State of Hawaii with Land Court Application No. 1666 of Roman Catholic Church;

Being all of the land described in Transfer Certificate(s) of Title No. 596,798.

ITEM THREE:

A 0.702 ACRE PARCEL

LAND SITUATED ON THE SOUTHWESTERLY SIDE
OF HUALALAI ROAD (KAILUA-HOLUALOA ROAD)
ON THE EASTERLY SIDE OF LOT C

AT PUAA 2ND, NORTH KONA, HAWAII, HAWAII

PORTION OF LOT B
PORTIONS OF GRANT 1744
TO KAHUNAELE

Beginning at the Northerly corner of this parcel of land, being the Easterly corner of Lot C on the Southwesterly side of Hualalai Road, the coordinates of said point of beginning referred to Government Survey Triangulation Station "KAILUA" (North Meridian) being 3,519.30 feet South and 5,165.02 feet East and running by azimuths measured clockwise from true South:

Thence along the Southwesterly side of Hualalai Road for the following eight (8) courses;

1.	313°	50'	49"	36.33	feet to a point;
2.	314°	26'	49"	110.60	feet to a point;
3.	305°	57'	49"	57.60	feet to a point;
4.	302°	55'	07"	73.03	feet to a point;
5.	76°	47'	49"	303.75	feet along Lot 1-B, a portion of Lot 1 of Land Court Application No. 1666 to a point;
6.	81°	43'	49"	10.67	feet along Lot 1-B, a portion of Lot 1 of Land Court Application No. 1666 to a point;

Thence, following, along a curve to the right having a radius of 325.00 feet, the chord azimuth and distance being;

7.	208°	46'	48.5"	168.96	feet to a point;
					Thence, along Lot C, along a curve to the left having a radius of 60.00 feet, the chord azimuth and distance being;
8.	178°	50'	49"	84.85	feet to a point;
9.	223°	50'	49"	19.57	feet along Lot C to the point of beginning and containing an area of 0.702 acres.

Being all of the land conveyed by the following:

WARRANTY DEED

Grantor:	UNIVERSITY OF THE NATIONS, INC., a Hawaii nonprofit corporation
Grantee:	U OF N BENCORP, a Hawaii nonprofit corporation
Dated:	October 17, 2001
Document No.	2755105
Document No.	2001-184091

NOTE(S): Parcel Third, Item One, Item Two and Item Three as above described have been consolidated into one parcel of land designated as Lot B on the Revised Final Plat Map approved by the County of Hawaii Planning Department under Final Subdivision Approval No. 7415 on May 21, 2001 and thus cannot be separately conveyed, leased or encumbered.

Appendix J.2

SHPD Acceptance of Archaeological Inventory Survey of TMKs (3) 7-5-10:085 and (3) 7-5-017:06, November, 2003

Rc-0153

LINDA LINGLE
GOVERNOR OF HAWAII

PETER T. YOUNG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

DAN DAVIDSON
DEPUTY DIRECTOR - LAND

ERNEST Y.W. LAU
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
HISTORIC PRESERVATION DIVISION
KAKUHIHEWA BUILDING, ROOM 555
601 KAMOKILA BOULEVARD
KAPOLEI, HAWAII 96707

November 17, 2003

Robert Rechtman, Ph.D.
Rechtman Consultant Services, Inc.
HC1, Box 4149
Kea`au, Hawaii 96749

LOG NO: 2003.2356
DOC NO: 0311PM04

Dear Dr. Rechtman:

SUBJECT: Chapter 6E-42 Historic Preservation Review of a Final Report RC-0153: "An Archaeological Inventory Survey of TMK's: 3-7-5-10:85 and 3-7-5-17:06" (Clark and Rechtman 2003)
Wai'aha, North Kona, Hawaii Island

Thank you for the opportunity to review and comment on the above referenced draft report, which was received in our office August 20, 2003. The report was revised to address the comments in our review letter of May 7, 2003 (Log No. 2003. 0238; Doc. No. 0304PM05).

As indicated in our previous letter, we believe that the archaeological inventory survey of the roughly 62-acre project area was adequate in terms of the identification of significant historic sites. One previously identified site (the Kuakini Wall) and 25 new sites were identified in the survey.

In our review of the first draft report we also concurred with your proposed site significance evaluations and recommended site treatments. All 26 sites in the project area have yielded information important for an understanding of local prehistory or history and are thus significant under Criterion "d." Five sites are significant under multiple criteria. These include the Kuakini Wall site (6302), three burial sites (23683, 23684, and 23685), and one ceremonial site (23681). All five of the sites evaluated as significant under multiple criteria are recommended for preservation. Ten sites are recommended for data recovery. No further work is recommended for the other eleven sites, which include all of the historic ranch walls, the two trail segments, and two of the sites interpreted as temporary habitations.

Your letter notes that you have made all of the revisions to the report we had requested, except for eight specific comments that are discussed in your letter. We will accept your explanations for why you couldn't address these particular comments, but with regard to your comment about previously approved reports, you realize, of course, that approval of a report does not mean that we accept or approve of all of the information or conclusions contained in a report. We still do not agree, for example, with your definition of features and we don't believe that "landscape markers" is a particularly useful umbrella term for such things as cairns and walls, including ranch walls.

Your report meets with our approval. The next step in the historic preservation review process is the preparation and implementation of a data recovery plan, a preservation plan, and a burial treatment plan for sites in the project area.

As a reminder, you need to remember to submit a second copy of all reports, plans, and correspondence to our Kona office. In the future we will not begin a review unless the Kona office has a copy. If you or your client should have any questions about this project please contact our Hawaii Island archaeologist, Patrick McCoy, at 692-8029.

Aloha,

P. Holly McEldowney

P. Holly McEldowney, Acting Administrator
State Historic Preservation Division

c. Chris Yuen, County of Hawaii Planning Department
Kai Emler, County of Hawaii Department of Public Works
Kai Markell, SHPD Burial Sites Program
Mary Lou Kobayashi, Office of Planning
Anthony Ching, Land Use Commission

PM:ak

Appendix J.3

Burial Treatment Plan for Three Sites in the Proposed Hualālai Village Development Area, September, 2003

RC-0175

Burial Treatment Plan for Three Sites in the Proposed Hualālai Village Development Area (TMKs: 3-7-5-10:85 and 3-7-5-17:06)

Wai'aha Ahupua'a
North Kona District
Island of Hawai'i

PREPARED BY:

Robert B. Rechtman, Ph.D.

PREPARED FOR:

U of N BENCORP
75-165 Hualalai Road
Kailua-Kona, HI 96740

September 2003

RECHTMAN CONSULTING
HC 1 Box 4149 • Kea'au, Hawai'i 96749
phone: (808) 966-7636 • (808) 966-6235
toll free fax: (800)406-2665 • e-mail: brechtman@aol.com

Burial Treatment Plan for Three Sites in the Proposed Hualālai Village Development Area (TMKs: 3-7-5-10:85 and 3-7-5-17:06)

Wai‘aha Ahupua‘a
North Kona District
Island of Hawai‘i

RECHTMAN CONSULTING

Contents

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INTRODUCTION

At the request of Mr. Mark Spengler of U of N BENCORP, Rechtman Consulting, LLC has prepared this Burial Treatment Plan (BTP) in conjunction with a proposed three-component development on a roughly 62-acre property (TMKs:3-7-5-10:85 and 3-7-5-17:06) along Kuakini Highway in Wai'aha Ahupua'a, North Kona District, Island of Hawai'i. The development parcels are bounded to the east by Māmalahoa Highway; to the north by a stone wall along the Wai'aha 1st/Pua'a 3rd boundary; to the south by a stone wall in Wai'aha 2nd Ahupua'a just south of the Wai'aha 1st boundary along the edge of TMK: 3-7-5-17:6 and by an existing residential development where the wall no longer stands; and to the west by a stone wall along the *mauka* edge Kuakini Highway (Figures 1 and 2).

The proposed development of the project area includes: the Hualālai Village, a 400-unit condominium complex; the Pacific Islands Cultural Center; and a five-acre educational center, which will be part of the adjacent University of the Nations. The Pacific Islands Cultural Center is intended to serve as a venue that highlights and demonstrates the cultural diversity within the Pacific Rim, with an emphasis on the Hawaiian culture, through the development of programs and demonstrations that provide both educational and entertainment value.

The three burial sites that are addressed in this BTP were identified during an archaeological inventory survey (Clark and Rechtman 2003) of the overall study area. Prior archaeological work on the property included an archaeological reconnaissance survey (Corbin and Rosendahl 2002) and a burial testing project (Rosendahl 2002). No burial sites were identified during the earlier work. Additionally a Cultural Impact Assessment was also prepared for the overall development project (McKeague 2002).

With respect to this BTP, U of N BENCORP is the applicant and the current property owner. U of N BENCORP will development and operate a Pacific Islands Cultural Center on the property that will also include residential condominiums. U of N BENCORP can be contacted at the following address:

Mark Spengler
U of N BENCORP
75-165 Hualālai Road, Second Floor
Kailua-Kona, HI 96740

The purpose of this BTP is to establish procedures for the proper treatment of human skeletal remains that have been identified in two archaeological features within the study area. This BTP follows the process described in the applicable sections of Chapter 6E - Historic Preservation (Hawai'i Revised Statutes; as amended), and in the current administrative rules for the treatment of burial sites and human remains approved and adopted by the State of Hawai'i. The information presented within this BTP, in conjunction with presentation at the appropriate Hawai'i Island Burial Council (HIBC) meeting, is designed to assist the HIBC in making a determination on the preservation of the Native Hawaiian burial sites identified within the project area.

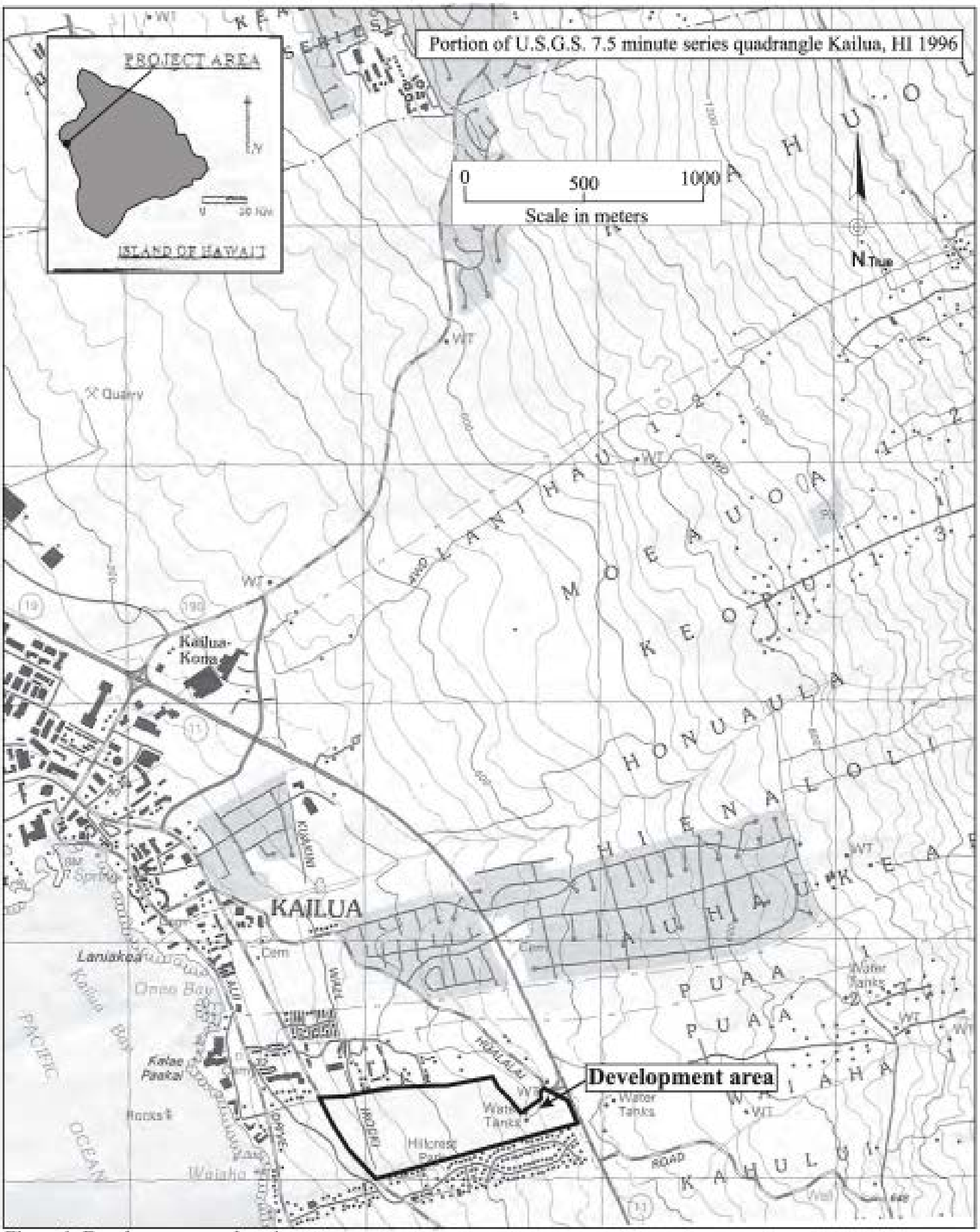
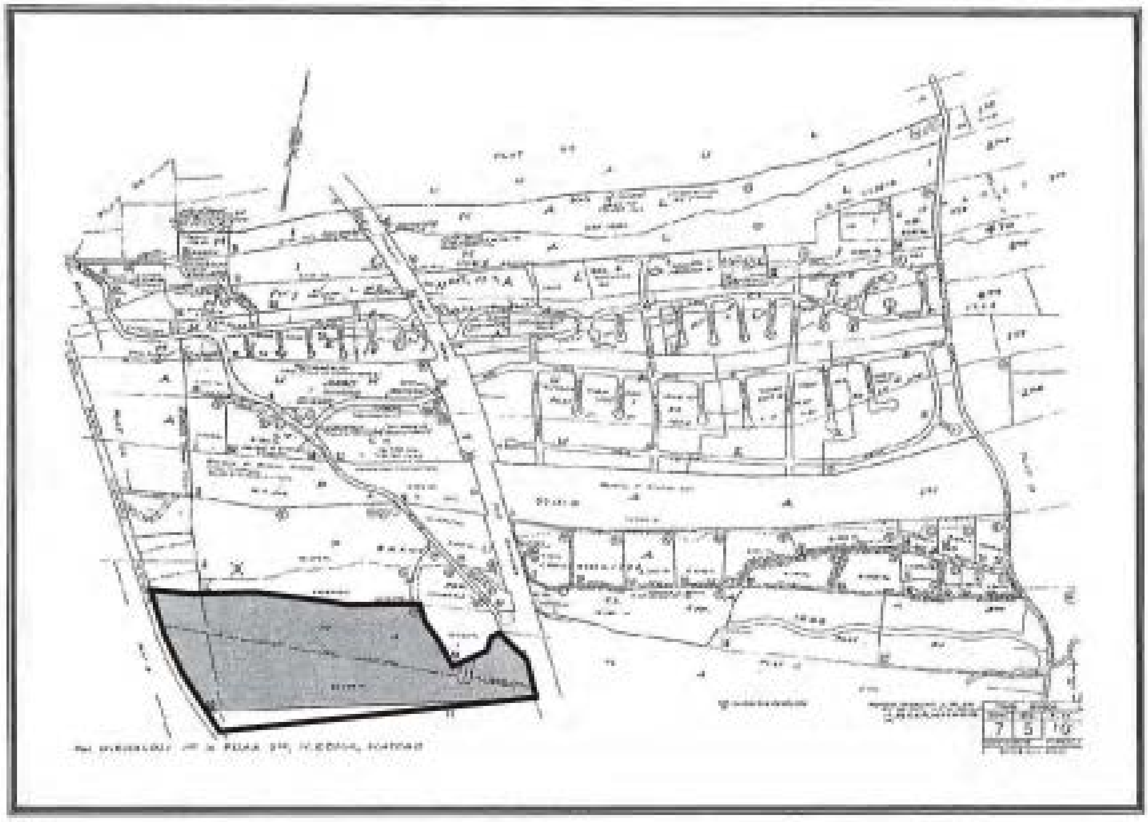


Figure 1. Development area location.



↑TMK:3-7-5-10:85 = Development area = Individual parcel TMK:3-7-5-17:06↓

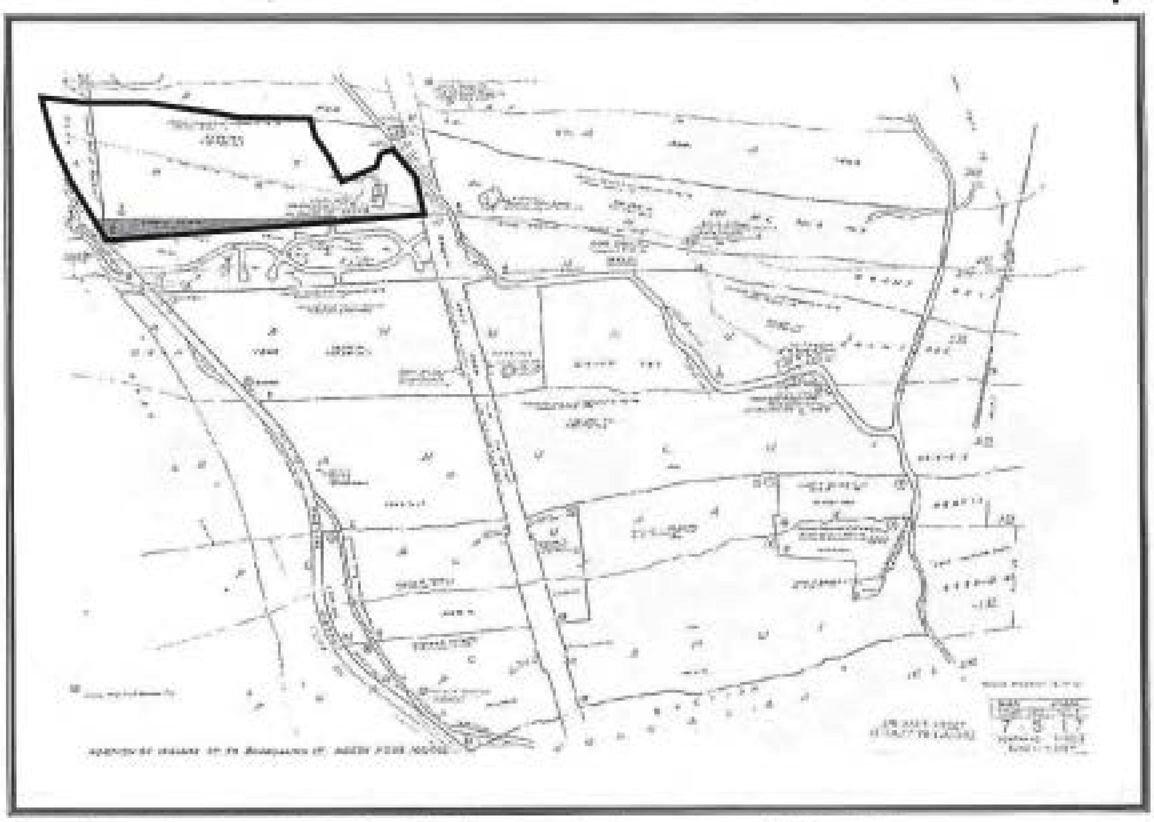


Figure 2. Tax Map Keys: 3-7-5-10 and 17 showing development parcels (85 and 06).

SUMMARY OF IDENTIFIED BURIAL FEATURES

Based on the results of the archaeological inventory survey on the subject property (Clark and Rechtman 2003), three sites (SIHP Site 23683, 23684, and 23685) were identified that contain human skeletal remains (Figure 3).

SIHP Site 23683

Site 23683 is a platform located in the west-central portion of the project area (see Figure 3). The platform measures 6.7 meters long by 5.4 meters wide and rises 1.6 meters (3-4 courses) above the surrounding bedrock ground surface at its northeast corner. Site 23683 is constructed with *'a'ā* and *pāhoehoe* boulders and cobbles stacked along its exterior north, south, and east edges. The western edge of the platform abuts a raised bedrock outcrop and the platform's surface is paved with small *'a'ā* and *pāhoehoe* cobbles. Site 23683 is in a good state of repair, although portions of the exterior walls have collapsed (Figure 4).

A metal site tag with the inscription "PHRI # 17" was found on the platform's surface indicating that this site had been designated as PHRI temporary site 2235-17 (Corbin and Rosendahl 2002). There was further evidence of a previously excavated 1 x 1 meter test unit located near the eastern edge of the platform (Figure 5). A PHRI letter report (Rosendahl 2002) indicated that Site 23683 had indeed been subject to burial testing in June of 2002 with negative results. However, the platform's formal attributes appeared so burial like (i.e. similar to other North Kona burial sites) that it was decided during the inventory survey to re-evaluate the presence or absence of a burial within.

Figure 4. SIHP Site 23683 view to south.

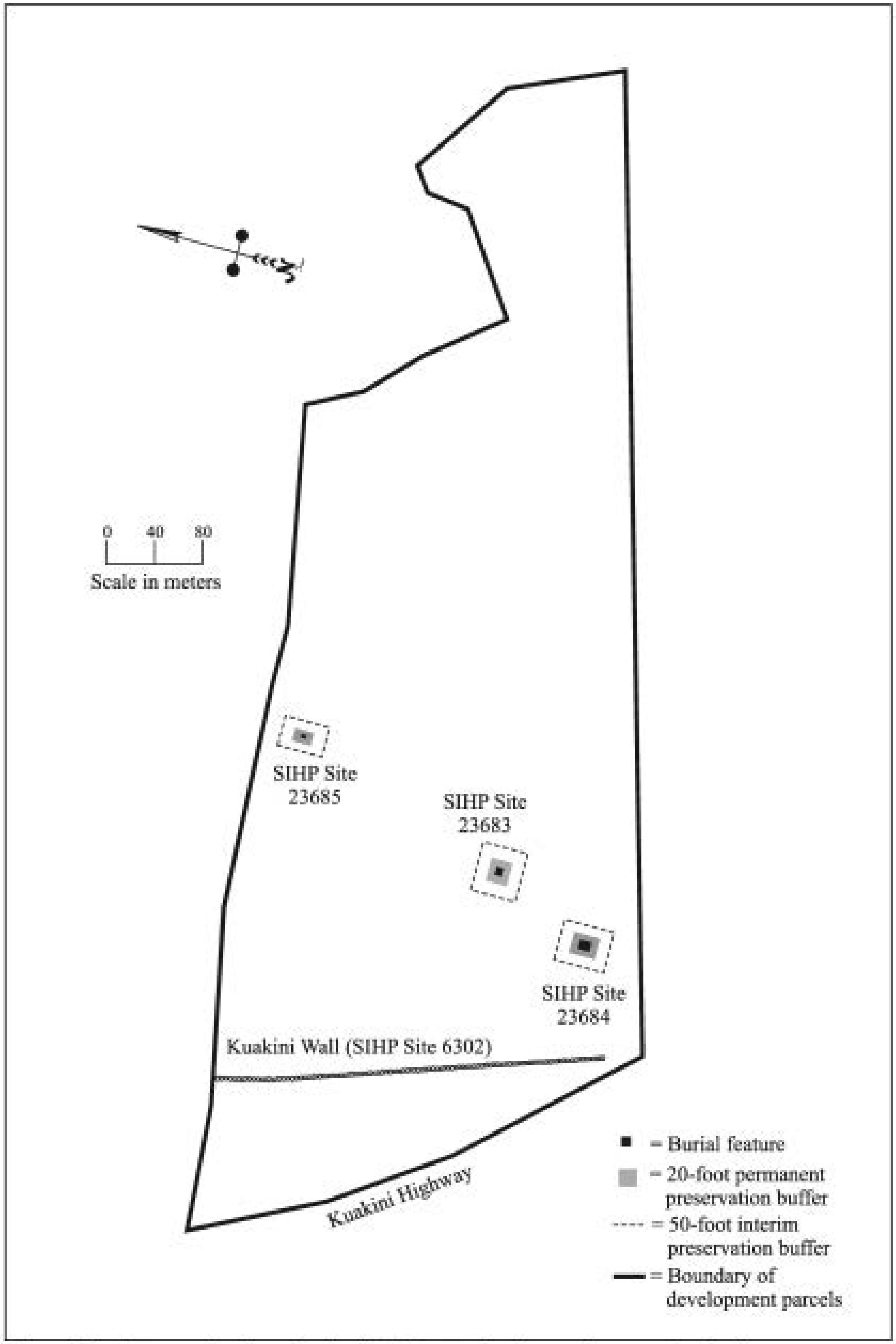


Figure 3. Project area plan view showing burial feature locations and preservation buffers.

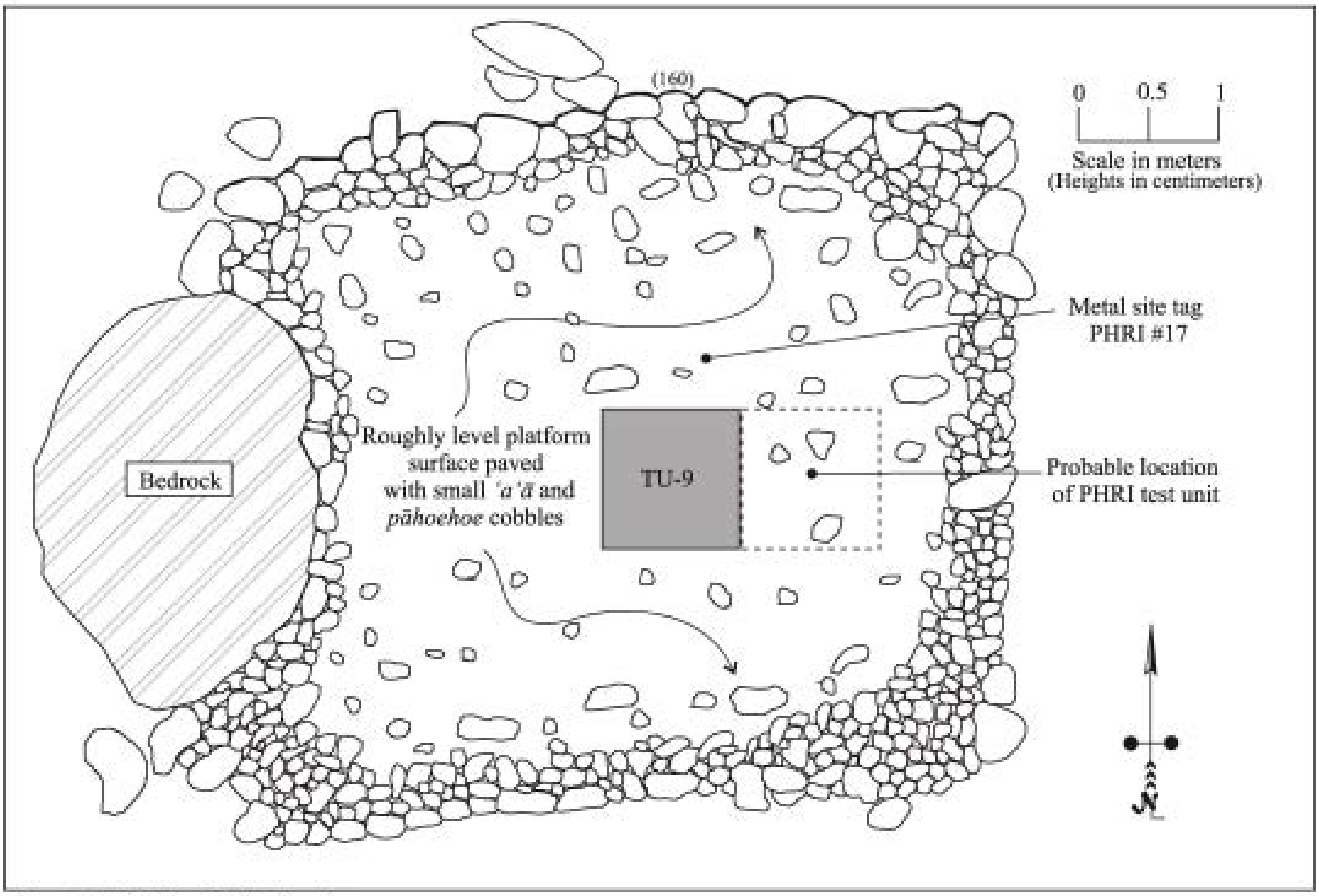


Figure 5. SIHP Site 23683 plan view.

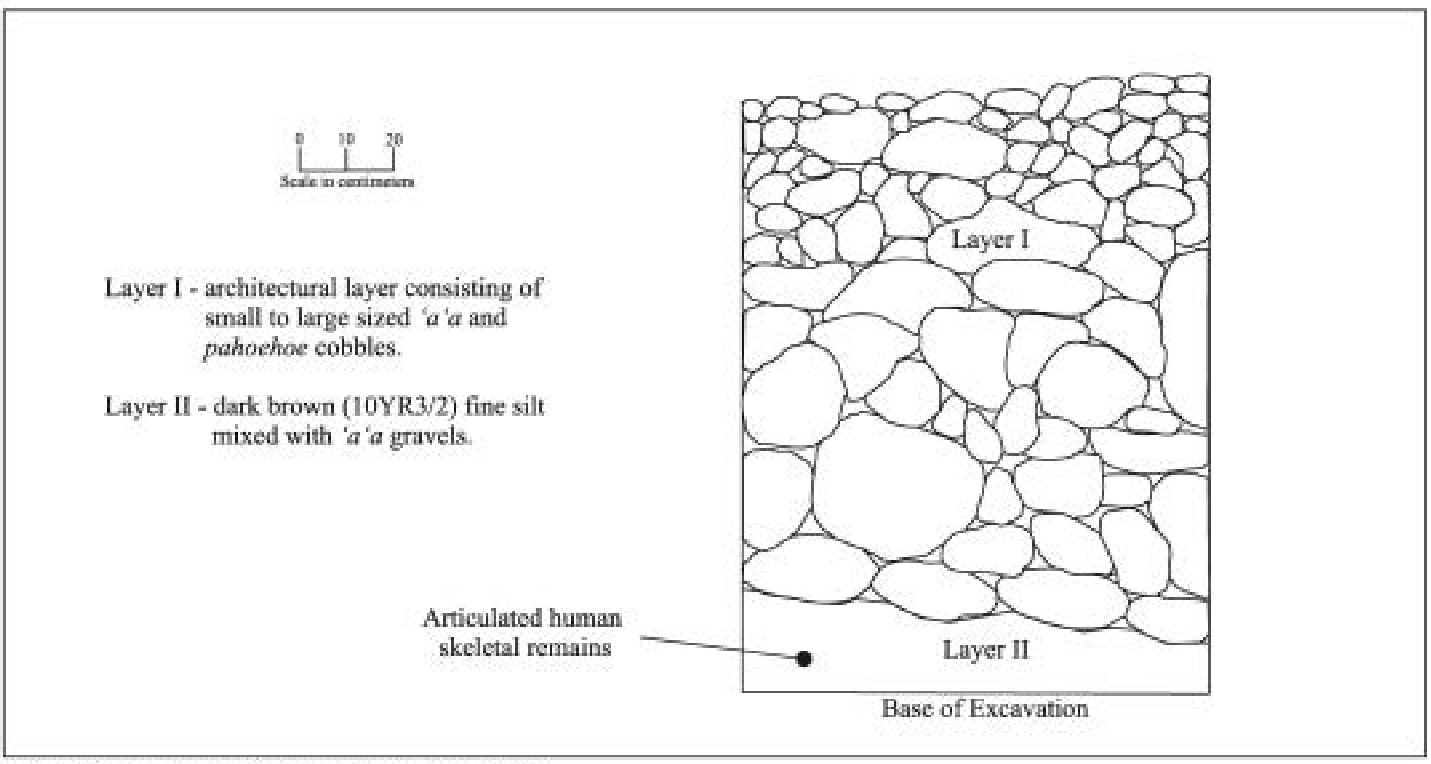


Figure 6. SIHP Site 23683 TU-9 east wall profile.

A 1 x 1 meter test unit (TU-9) was excavated in the approximate center of the platform adjacent to the western edge of the previously excavated PHRI unit (see Figure 5). Excavation of TU-9 revealed that human skeletal remains were indeed present at Site 23683 (Figure 6). The excavation began with the removal of a 1.1-meter thick architectural layer, Layer I, consisting of small to large sized *'a'ā* and *pāhoehoe* cobbles. A single water worn cobble was observed in the northwest corner of the unit at the base of Layer I, but no other cultural material was present. Layer I rested on a dark brown (10YR 3/2) fine silt mixed with *'a'ā* gravels, Layer II. Approximately 10 centimeters below the surface of Layer II articulated human skeletal remains (oriented north/south) were encountered in the northeast corner of the unit. Upon discovery of the skeletal remains excavation of TU-9 immediately ceased. The remains, which were not moved from their original position, were stabilized and re-buried with the soil excavated from the unit. The architectural layer was then rebuilt on top of the burial, as close to its original specifications as possible, and DLNR-SHPD was notified of the discovery. As no habitation debris or any other cultural material was found at Site 23683 it is suggested that the platform was built solely as a burial monument subsequent to the interment of the deceased individual.

SIHP Site 23684

Site 23684 consists of a platform attached to the north side of a square enclosure located in the southwest corner of the project area (see Figure 3). The rectangular platform (Figure 7) measures 7.0 meters long by 3.5 meters wide (Figure 8). It is constructed of neatly stacked *'a'ā* cobbles and boulders along its exterior edges (1.1 meters high) with small cobbles paving the roughly level surface. The northwest corner of the platform has collapsed, but otherwise the feature is in fairly stable condition. A single piece of branch coral was found amongst the rubble scatter in the northwest corner. The platform (and enclosure) may have been used for habitation purposes prior to the interment of the deceased individual at the site.

Figure 7. SIHP Site 23684 view to north.

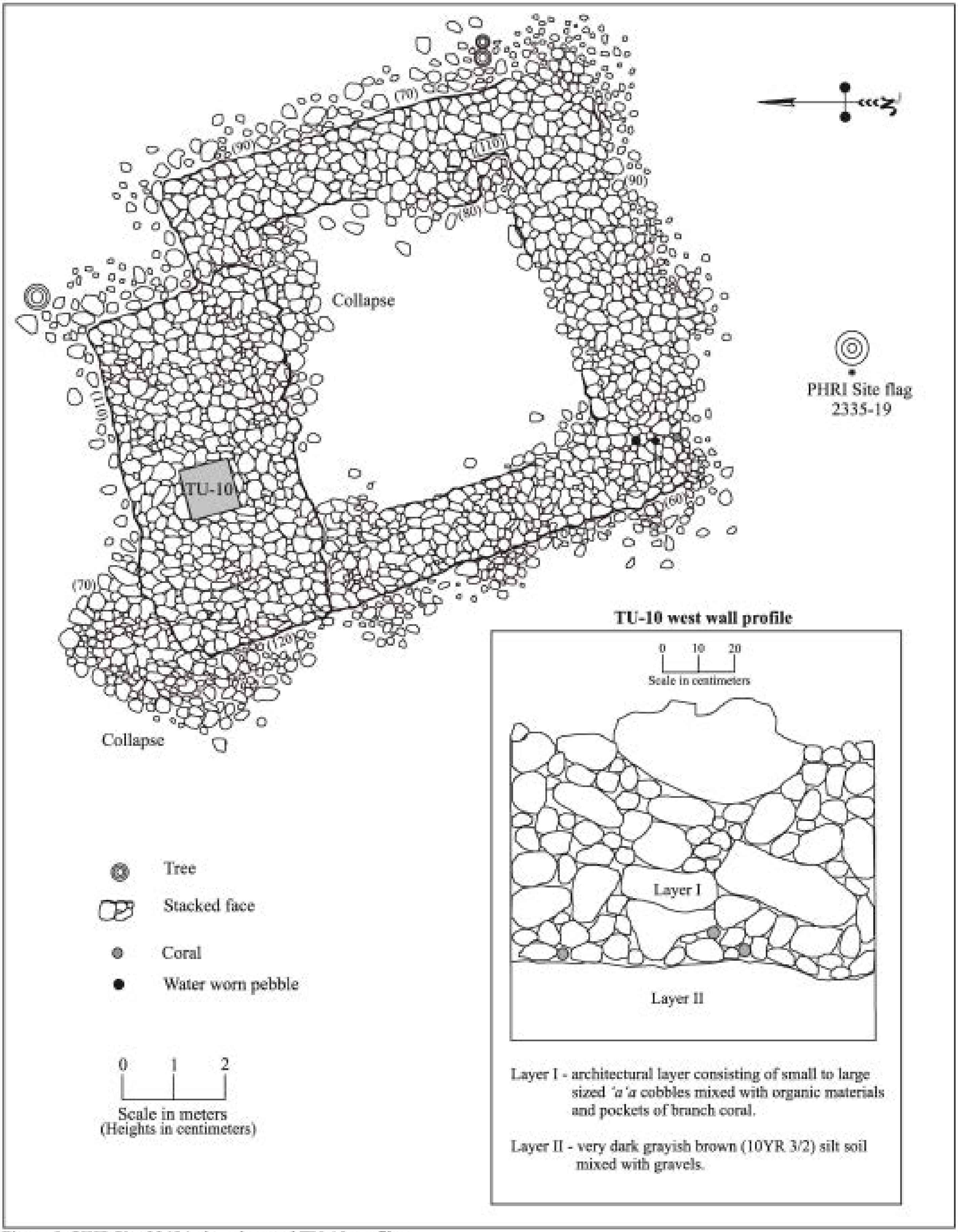


Figure 8. SIHP Site 23684 plan view and TU-10 profile.

A square enclosure protrudes from the south edge of the platform (see Figure 8). The interior space created by the enclosure walls measures 5.6 meters by 5.6 meters, and consists of soil covered by dense vegetation. The enclosure walls measure approximately 1.5 meters wide and stand up to 1.25 meters high along the interior edge and 0.7 meters high along the exterior edge. They are constructed of stacked *'a'ā* cobbles and boulders and are relatively intact with the exception of some collapse along the exterior southern edge. Two water worn pebbles and a rounded piece of coral were found on top of the wall in the south west corner of the enclosure. Although no test unit was excavated within the interior of the enclosure, it is possible that it contains burials.

A 1 x 1 meter test unit TU-10 was excavated in the central potion of the platform (see Figure 8). Excavation of TU-10 revealed two stratigraphic layers and confirmed the presence of human skeletal remains at Site 23684. The excavation began with the removal of a 70-centimeter thick architectural layer, Layer I, consisting of small to large sized *'a'ā* cobbles mixed with organic materials. Pockets of branch coral were also found carefully cached within the architectural layer (Figure 9). Location and placement of the stones and coral were metrically recorded so that they could be returned to their appropriate places upon completion of the unit. Beneath the architectural layer was a very dark grayish brown (10YR 3/2) silt soil mixed with gravels (Layer II). Marine shells, coral and water worn pebbles were also noted in the soil. Five centimeters into the excavation of Layer II articulated human skeletal remains (a cranium) were encountered in the southeast corner of the unit. 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 re-buried with the soil excavated from the unit. All artifacts recovered from the screen were returned to their rightful places. The architectural layer was then rebuilt on top of the burial, as close to its original specifications as possible, and DLNR-SHPD was notified of the discovery.

Figure 9. SIHP Site 23684 TU-10 architectural layer (Layer I) showing branch coral view to west.

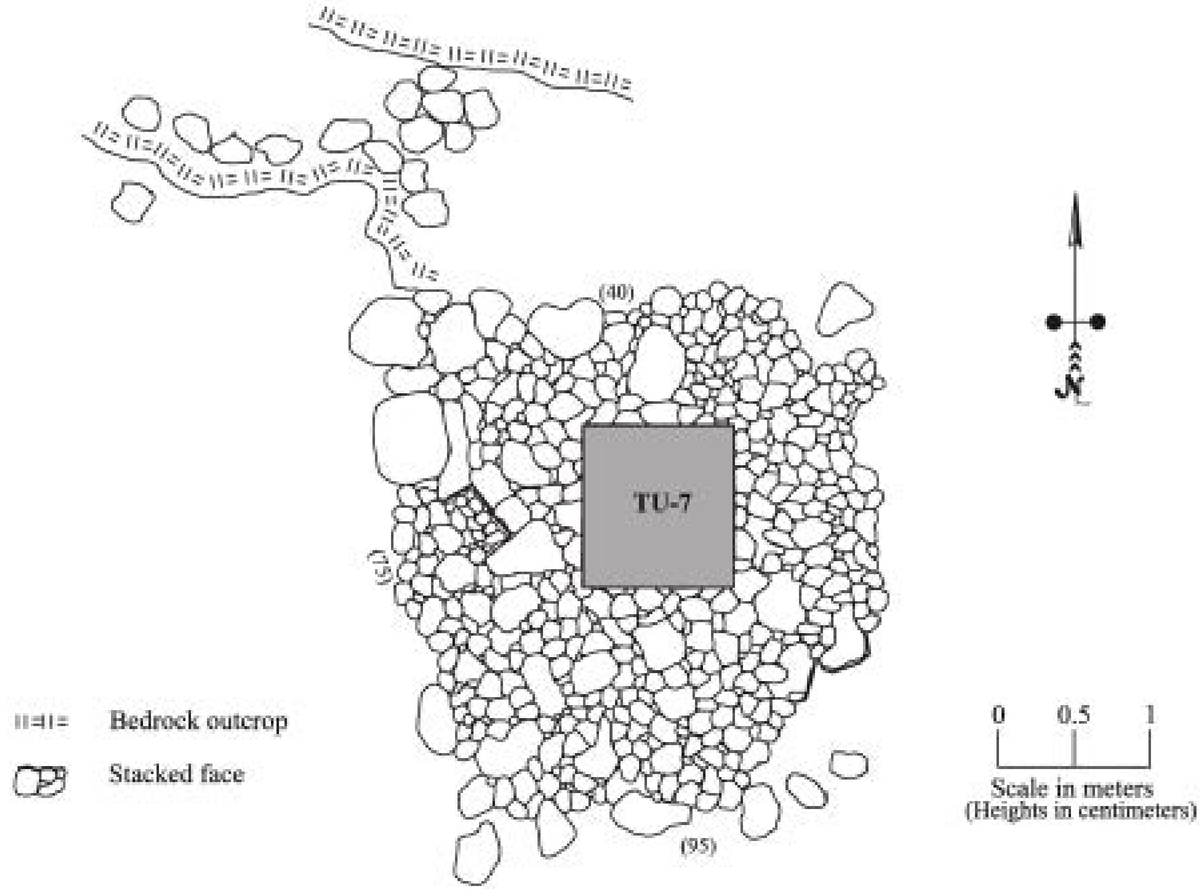
SIHP Site 23685

Site 23685 consists of a platform located in the north-central portion of the project area (see Figure 3). The platform (3.8 meters long by 3.0 meters wide) is constructed of formerly stacked, but now mostly collapsed *pāhoehoe* cobbles and boulders (Figure 10). It abuts a *pāhoehoe* bedrock outcrop along its northern up slope edge (Figure 11). The platform consists of boulders and cobbles forming a roughly circular monument with a slightly rounded top surface paved with small cobbles. The feature stands 0.95 meters above ground surface along its southern edge and 0.4 meters above the bedrock outcrop along its northern edge. Overall, Site 23685 has a very formal appearance.

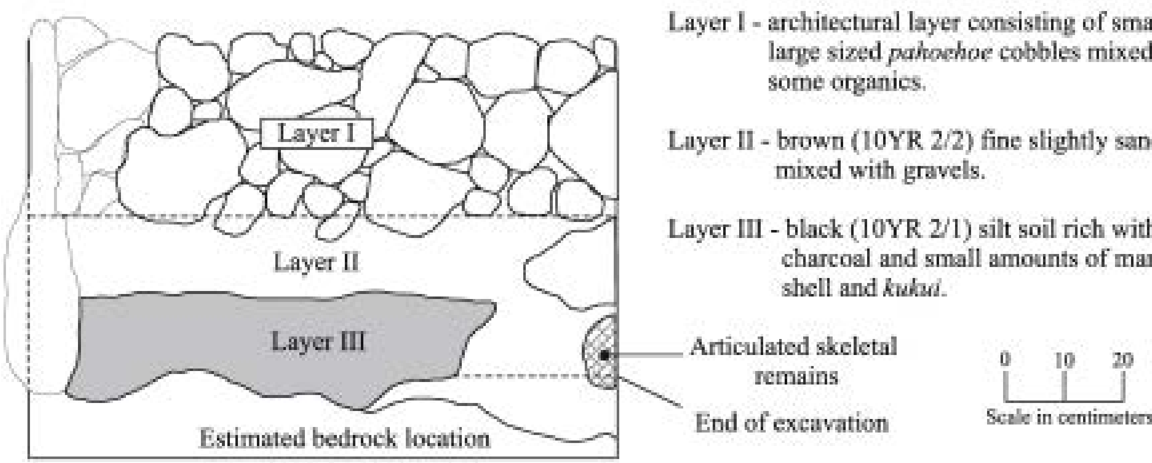
A 1 x 1 meter test unit (TU-7) was excavated in the central portion of the feature along an upright *pāhoehoe* slab (see Figure 51). Excavation of TU-7 revealed three stratigraphic layers and revealed the presence of human skeletal remains at Site 23685. The excavation began with the removal of a 30-centimeter thick architectural layer, Layer I, consisting of small to large sized *pāhoehoe* cobbles mixed with some organics. Layer I rested on and was incorporated into Layer II, a 30-centimeter thick brown (10YR 2/2) fine slightly sandy silt mixed with gravels. In the southeast corner of the unit a black (10YR 2/1) silt soil rich with charcoal (Layer III) was noted 14 centimeters below the base of Layer I, the remains of a possible hearth. Screened soil from this hearth feature yielded a small amount of marine shell, sea urchin, and *kukui*. In the southwest corner of the unit, 18 centimeters below the base of Layer I, articulated human skeletal remains, including a skull, mandible, and scapula were discovered under a large *pāhoehoe* boulder capstone. The burial appeared to be an intrusive pit excavated into the cultural soil, indicating that the individual was interred subsequent to the area being used as a habitation feature. Judging by the accumulated non-cultural soil on top of the hearth feature, the architectural layer may have been added as a monument after the individual was interred.

Upon discovery of the skeletal remains excavation of TU-7 immediately ceased. The remains, which were not moved from their original position, were stabilized and re-buried with the soil excavated from the unit. All artifacts recovered from the screen were returned to their rightful places and the capstone was replaced over the burial. The architectural layer was then rebuilt, as close to its original specifications as possible, and DLNR-SHPD was notified of the discovery.

Figure 10. SIHP Site 23685 view to east.



TU-7 south wall profile



Layer I - architectural layer consisting of small to large sized *pahoehoe* cobbles mixed with some organics.

Layer II - brown (10YR 2/2) fine slightly sandy silt mixed with gravels.

Layer III - black (10YR 2/1) silt soil rich with charcoal and small amounts of marine shell and *kukui*.

Figure 11. SIHP Site 23685 plan view and TU-7 profile.

SEARCH FOR LINEAL AND CULTURAL DESCENDANTS

The required search for lineal and cultural descendants consisted of the following:

1. Review of documentary research relating to the project area and its general vicinity;
2. Publication of appropriate public notices in newspapers of local and statewide distribution; and
3. Consultations with local community representatives, the Hawai`i Island Burial Council (HIBC), the Office of Hawaiian Affairs (OHA), and the State Historic Preservation Division.

Documentary Research

Kāwika McKeague conducted documentary research for the preparation of a Cultural Impact Assessment prepared in conjunction with the current proposed development (McKeague 2002). Among other places, research was conducted at the Department of Land and Natural Resources-State Historic Preservation Division library, in the collections of the University of Hawai`i-Hamilton Library, the Archives of the State of Hawai'i, the State Survey Branch, the Real Property Tax Office, the Bureau of Conveyances, the Archives of the Bishop Museum, and the collections of the Kona Historical Society.

Māhele Claims at Wai'aha

Wai`aha Ahupua`a was divided into two sections, Wai`aha 1st, and Wai`aha 2nd. The development property (and all of the burial sites) is situated primarily in the land division of Wai`aha 1st, with only the small Parcel 6 situated in Wai`aha 2nd. As a result of the *Māhele*, Wai`aha 1st was awarded to American Board of Foreign Missions (LCA 387); and Wai`aha 2nd was designated as crown lands. Nine native tenant (*kuleana*) claims for land in Waiaha were located in the Native Register and Native Testimonies. Four of the claims were for land in Waiaha 1st, and five were for land in Wai`aha 2nd. None of these claims and awarded *kuleana* lots is situated within the current development area. The following list of names is derived from the *kuleana* claims made in both of the Wai`aha *ahupua`a*:

Wai`aha 1st: Kalae, Kalama, Kaulua, Lumaawe
Wai`aha 2nd: Kaanehe, Kanahele, Kaniu, Liawahine, Lono

Public Notices

Appropriate public notices were published in newspapers of local and statewide distribution. The notices contained the project location information, identification of several contact persons, and indication of the landowner/applicant intent for preservation in place of the unmarked graves within the three sites. Copies of each Affidavit of Publication and Public Notice are attached to this plan (Appendix B). Notices were published as follows:

West Hawaii Today—April 2 (Wednesday), April 4 (Friday), and April 6 (Sunday),

Hawaii Tribune Herald— April 2 (Wednesday), April 4 (Friday), and April 6 (Sunday),

Honolulu Advertiser— April 2 (Wednesday), April 4 (Friday), and April 6 (Sunday), and,

Ka Wai Ola o OHA— May 2003

The notices requested that person having any information concerning the unmarked graves within the project area should contact Mr. Kāwika McKeague, Group 70 International; Dr. Robert Rechtman, Rechtman Consulting, LLC; and/or Mr. Kamana'o Mills, Burials Program, State Historic Preservation Division (SHPD). There were no responses to the public notices; however, one individual identified as a potential cultural descendant based on the work associated with the Cultural Impact Assessment (McKeague 2002) was contacted.

Consultation

In August Of 2003 Josephine Kamoku was contacted by Robert B. Rechtman, Ph.D. to discuss the potential of her being a descendant of the *iwi kupuna* located on the proposed development property. She explained that she could not establish any direct ties to the subject property, but as a *kupuna* of the general area, she shared her *mana'o* relative to the treatment of the burial sites in question. Auntie Josephine indicated that she would like to see the burial sites preserved within rock wall enclosures and native plants.

PROPOSED TREATMENT OF BURIAL FEATURES

Preservation in place is the general treatment proposed for the three in situ burials in the project area. In-place preservation would be achieved through the establishment of defined preservation easements, which are described below (see Figure 3). With the exception of appropriate cultural activities and periodic maintenance, no construction, land modification, or other activities of any type would be permitted to occur within the preservation easements.

Interim Preservation Measures

Interim preservations measures will include the establishment of a 50-foot (roughly 15-meter) buffer zones around each burial site, with buffer zone limits marked with brightly colored construction fencing. No activity would be allowed within the designated interim buffer zone until such time as the permanent preservation buffer is constructed. Proper placement of the fence would be checked by a qualified archaeologist and verified in writing to SHPD. The locations of the burial sites and the buffer zones will be plotted on appropriate construction plans. Prior to any construction activities, a qualified archaeologist will meet on-site with construction supervisors to point out the burial features and buffer zone, and to review all preservation requirements needed to assure the protection of the burial sites.

Permanent Preservation Measures

In-place preservation of the burial features will be achieved through the establishment of permanent preservation easements for all three burial sites.

Buffer Zone

The buffer zones will be a minimum of 20 feet (6.1 meters) from the edge of the stone structures that contain the burials to the inside of the boundary wall. There will be an additional 10-foot zone beyond the 20-foot buffer within which no buildings will be erected.

Boundaries

The boundaries of the preservation easements will be defined by stone walls constructed of local basalt boulders and cobbles. The walls would be built so as to be typically traditional Hawaiian in appearance. The walls will have a dry stacked appearance with a hidden concrete core for stability. Wall height will be a minimum of three feet and width will be approximately 2 feet. An inconspicuously situated narrow gated opening will be left through the enclosing walls to allow access for descendants and for maintenance purposes. Appropriate native foliage will be planted along the outside perimeters of the boundary walls.

Landscaping

A formal landscaping plan will be developed and submitted to DLNR-SHPD Burials Program for approval.

Restoration of Structural Features

The structural features marking the identified interments will be cleared of all non-native or non-Polynesian introduced vegetation and the features' stones will be restacked. All work will be done under the supervision of a qualified archaeologist with the assistance of any future-identified descendants.

Signage

A small sign of durable construction would be erected immediately adjacent to the walled preservation easements. The following sign text is suggested:

KULA IWI
This is a culturally sensitive site;
please respect those who came before us
and refrain from entering this area.
This historic site is protected under state law.
Violation could result in a $10,000 fine.
(Chapter 6E-11, Hawai'i Revised Statutes)
DLNR-SHPD (808) 692-0015

Preservation Easements

Based on the parameters outlined above, the approximate size of each of the preservation easements will be roughly 2500 square feet (230 square meters).

Access for Lineal and/or Cultural Descendants

Access to the burial site for appropriate cultural activities would be permitted to any lineal and/or cultural descendant who has been formally recognized by the HIBC in accordance with the administration procedures contained within 13§13-300-35: Recognition of Lineal and Cultural Descendants. The developer in consultation with any recognized lineal and cultural descendants will prepare a formal access agreement.

Ownership and Maintenance

Ownership and maintenance of the burial sites would lie with U of N BENCORP. Long term/permanent in-place preservation would be achieved by means of a perpetual easement that will be incorporated into the deed of the parcel. The perpetual easement will include the appropriate requirements and restrictions relating to physical improvements (boundary walls, landscaping, feature restoration), signage, maintenance, and access by recognized lineal and/or cultural descendants.

IMPLEMENTATION OF THE BURIAL TREATMENT PLAN

Specific BTP measures will be implemented by U of N BENCORP, in accordance with this BTP. Prior to the implementation of the long term/permanent preservation measures contained within this BTP, the short term/interim preservation measure described above will govern the development activities.

REFERENCES CITED

Clark, M., and R. Rechtman
2003 An Archaeological Inventory Survey of TMKs: 3-7-5-10:85 and 3-7-5-17:06 Wai'aha Ahupua'a, North Kona District, Island of Hawai'i. Rechtman Consulting, LLC Report RC-0153. Prepared for U of N BENCORP, Kailua-Kona.

Corbin, A., and P. Rosendahl
2002 Archaeological Assessment Survey U of N BENCORP Development, Lands of Waiaha 1st and 2nd, North Kona District, Island of Hawai'i (TMK:3-7-5-17:6; 3-75-18:73). PHRI Report 2235-041102. Prepared for U of N Bencorp, Kailua-Kona.

McKeague, K.
2002 Cultural Impact Assessment for the Proposed 62-Acre Hualālai Village–Pacific Islands Cultural Center Development. Prepared by Group 70 international, Inc. Prepared for U of N Bencorp, Kailua-Kona..

Rosendahl, P.
2002 Interim Report: Testing of Possible Burial Features Archaeological Inventory Survey—Phase 1, U of N BENCORP Development, Lands of Waiaha 1st and 2nd, North Kona District, Island of Hawai'i (TMK:3-7-5-17:6; 3-75-18:73). PHRI Letter Report 2257-070302. Prepared for U of N Bencorp, Kailua-Kona.

APPENDIX A

Affidavit of Publication and Public Notice: *West Hawaii Today*

Affidavit of Publication and Public Notice: *Hawaii Tribune Herald*

Affidavit of Publication and Public Notice: *Honolulu Advertiser*

Affidavit of Publication and Public Notice: *Ka Wai Ola o OHA*

AFFIDAVIT OF PUBLICATION

State of Hawaii)
) SS:
County of Hawaii)

Lorelei Logan, being first duly sworn, deposes and says:

1. That she is the Advertising Administrative Assistant of WEST HAWAII TODAY, a newspaper published in the City of Kailua Kona, State of Hawaii.

2. That "PUBLIC NOTICE All persons having information concerning unmarked burials on a portion of a roughly 62-acre property" of which a clipping from the newspaper is attached hereto, was published in said newspaper on the following date(s) April 2, 4 and 6, 2003 (etc.)

Lelei Logan

Subscribed and sworn to before me
this 6th day of April , 2003

Lana Taira

Notary Public, Third Circuit,
State of Hawaii

Lana L. Taira

My Commission expires: August 4, 2005

PUBLIC NOTICE

All persons having information concerning unmarked burials on a portion of a roughly 62-acre property (TMK: 3-6-7-10:[illegible]) in Wai'aha 2nd Ahupua'a, North Kona District, Island of Hawai'i are invited to contact Mr. Kawika McKeague, Group 70 International (808) 523-5866, 925 Bethel Street, Fifth Floor, Honolulu, HI 96813; Dr. Bob Rechtman, Rechtman Consulting, LLC (808) 966-7636, HC1 Box 4149, Kea'au, HI 96749; and/or Mr. Kamana'o Mills, Burial Sites Program (808) 587-0010, 555 Kakuhihewa Building, 601 Kamokila Blvd., Kapolei, HI 96707.

The following historical individuals have been identified from Land Commission records as having a connection to the Wai'aha 2nd Ahupua'a: Kaaneke, Kanahele, Kanui, Liawahine, and Lono.

Appropriate treatment of the remains will occur in accordance with HRS, Chapter 6E, respective to unmarked burial sites. The property owner intends to preserve all burials in place, following the preparation of a Burial Treatment Plan in consultation with any identified descendants and with approval of the Hawai'i Island Burial Council. All interested parties should respond within thirty (30) days of this notice and provide information to DLNR-SHPD adequately demonstrating lineal descent from these specific Native Hawaiian remains, or cultural descent from ancestors buried in the same ahupua'a.

(No. 3402-West Hawaii Today: April 2, 4 and 6, 2003)

AFFIDAVIT OF PUBLICATION

State of Hawaii)
) SS:
County of Hawaii)

LEILANI K. R. HIGAKI, being first duly sworn, deposes and says:

1. That she is the BUSINESS MANAGER of HAWAII TRIBUNE HERALD, a newspaper published in the City of HILO, State of Hawaii.

2. That the PUBLIC NOTICE...concerning unmarked burials on... (TMK: 3-5-7-10:85) in Wai'aha 2nd Ahpua'a, North Kona District,...etc., of which a clipping from the newspaper as published is attached hereto, was published in said newspaper on the following date(s) April 2, 4, 6, 2003, (etc.).

#190325

Leilani K R Higaki

Subscribed and sworn to before me this 15th day of April, 2003.

Sharon H. P. Ogata

SHARON H. P. OGATA

Notary Public, Third Circuit, State of Hawaii

My commission expires October 1, 2004

PUBLIC NOTICE

All persons having information concerning unmarked burials on a portion of roughly 62-acre property (TMK: 3-5-7-10:85) in Wai'aha 2nd Ahupua'a, North Kona District, Island of Hawai'i are invited to contact Mr. Keola McKeague, Group 70 International (808) 523-5866, 92 Bethel Street, Fifth Floor, Honolulu, HI 96813; Dr. Bob Rechtman, Rechtman Consulting, LLC (808) 966-7636, HC1 box 4149, Kea'au, HI 96749; and/or Mr. Kamana'o Mills, Burial Sites Program (808) 587-0010, 555 Kakuhihewa Building, 601 Kamokila Blvd., Kapolei, HI 96707.

The following historical individuals have been identified from Land Commission records as having a connection to the Wai'aha 2nd Ahupua'a: Kaaneie, Kanahele, Kanui, Lilowahine, and Lono.

Appropriate treatment of the remains will occur in accordance with HRS, Chapter 6E, respective to unmarked burial sites. The property owner intends to preserve all burials in place, following the preparation of a Burial Treatment Plan in consultation with an identified descendants and with approval of the Hawai'i Island Burial Council. All interested parties should respond within thirty (30) days of this notice and provide information to DLNR-SHPD adequately demonstrating lineal descent from these specific Native Hawaiian remains or cultural descent from ancestors buried in the same ahupua'a.

(190325 Hawaii Tribune-Herald: April 2, 4, 6, 2003)

IN THE MATTER OF

PUBLIC NOTICE

PUBLIC NOTICE

All persons having information concerning unmarked burials on a portion of a roughly 62-acre property (TMK: 3-5-7-11:65) in Wai'aha 2nd Ahupua'a, North Kona District, Island of Hawai'i are invited to contact Mr. Kīwika McKeague, Group 70 International (808) 523-5866, 925 Bethel Street, Fifth Floor, Honolulu, HI 96813, Dr. Bob Rechtman, Rechtman Consulting, LLC (808) 966-7636, HC1 Box 4149, Kea'au, HI 96749, and/or Mr. Kamana'o Mills, Burial Sites Program (808) 587-0010, 555 Kākuhihewa Building, 601 Kamokila Blvd., Kapolei, HI 96707.

The following historical individuals have been identified from Land Commission records as having a connection to the Wai'aha 2nd Ahupua'a: Kaaneke, Kanahele, Kaeau, Liawahine, and Lono.

Appropriate treatment of the remains will occur in accordance with HRS, Chapter 6E, respective to unmarked burial sites. The property owner intends to preserve all burials in place, following the preparation of a Burial Treatment Plan in consultation with any identified descendants and with approval of the Hawai'i Island Burial Council. All interested parties should respond within thirty (30) days of this notice and provide information to DLNR-SHPD adequately demonstrating lineal descent from these specific Native Hawaiian remains, or cultural descent from ancestors buried in the same ahupua'a.

(Hon. Adv.: Apr. 2, 4, 6, 2003) (A-495160)

AFFIDAVIT OF PUBLICATION

STATE OF HAWAII

City and County of Honolulu ss.

Valerie L. Yanagihara *being duly sworn deposes and says that she is a clerk, duly authorized to execute this affidavit of THE HONOLULU ADVERTISER, a division of GANNETT PACIFIC CORPORATION, that said newspaper is a newspaper of general circulation in the State of Hawaii, and that the attached notice is a true notice as was published in the aforerenferenced newspaper as follows:*

The Honolulu Advertiser: *three* *times(s) on*

04/02/2003, 04/04/2003, 04/06/2003

and that affiant is not a party to or in any way interested in the above entitled matter.

Subscribed and sworn to before me this *6th* *day of* *April* *A. D. 20* *03*

ELSIE A. MARUYAMA

Notary Public of the First Judicial Circuit

State of Hawaii

My commission expires March 7, 2004

ELSIE A. MARUYAMA NOTARY PUBLIC STATE OF HAWAII

Ka Wai Ola O OHA

PUBLIC NOTICE: NHPA Section 106

All persons having information concerning unmarked burials on a portion of roughly 62-acre property (TMK: 3-5-7-10:85) in Wai'aha 2nd Ahupua'a, North Kona District, Island of Hawai'i are invited to contact Kawika McKeague, Group 70 International 523-5866, 925 Bethel St., Fifth Flr, Honolulu, HI 96813, Dr. Bob Rechtman, Rechtman Consulting, LLC 808-966-7636, HC1 Box 4149, Kea'au, HI 96749, and/or Kamana'o Mills, Burial Sites Program 587-0010, 555 Kākuhihewa Bldg. 601 Kamokila Blvd., Kapolei, HI 96707.

The following historical individuals have been identified from Land Commission records as having a connection to the Wai'aha 2nd Ahupua'a: Ka'anehe, Kanahele, Kaua, Liawahine, and Lono.

Appropriate treatment of remains will occur in accordance with HRS, Chap. 6E, respective to unmarked burial sites. The property owner intends to preserve all burials in place, following the preparation of a burial treatment plan in consultation with any identified descendants and with approval of the Hawai'i Island Burial Council. All interested parties should respond within 30 days of this notice and provide information to DLNR-SHPD adequately demonstrating lineal descent from these specific Native Hawaiian remains, or cultural descent from ancestors buried in the same ahupua'a. ■

Appendix J.4

SHPD Acceptance of Burial Treatment Plan for Three Sites in the Proposed Hualālai Village Development Area, August 2019

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
FIRST DEPUTY

M. KALEO MANUEL
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
KAKUHIHEWA BUILDING
601 KAMOKILA BLVD, STE 555
KAPOLEI, HAWAII 96707

August 20, 2019

U of N Bencorp
C/O Tom Waddle
75-165 Hualālai Road
Kailua-Kona, HI 96740

LOG NO: 2019.01527
DOC NO: 1908CJO01

Aloha e Mr. Waddle,

SUBJECT: DRAFT Burial Treatment Plan for Three Sites in the Proposed Hualālai Village Development Area Located in Wai'aha Ahupua'a, North Kona District, Island of Hawai'i, TMK: (3) 7-5-010:085 and (3) 7-5-017:006.

We apologize for the delay of this notification. At its monthly meeting on November 20, 2003, the Hawai'i Island Burial Council (HIBC) reached a unanimous decision to **preserve in place** the above burial sites. Additionally, the HIBC recommended that the State Historic Preservation Division (SHPD) accept the DRAFT Burial Treatment Plan.

Following the recommendation of the HIBC, the *DRAFT Burial Treatment Plan for Three Sites in the Proposed Hualālai Village Development Area Located in Wai'aha Ahupua'a, North Kona District, Island of Hawai'i, TMK: (3) 7-5-010:085 and (3) 7-5-017:006* is accepted by the SHPD. Please change the language in the title from "DRAFT Burial Treatment Plan" to "Burial Site Component of a Preservation Plan" and submit hard copies with a copy of this letter and text-searchable PDF CD to both our Kapolei and Hilo offices.

Should you have any additional questions or concerns, please contact our Hawai'i Island Burial Sites Specialist, Chris Omerod at (808) 430-5709 or via email at Christian.Omerod@Hawaii.gov.

Sincerely,

Hinano Rodrigues

Mr. Hinano Rodrigues, B.A., J.D.
History & Culture Branch Chief

CC: Matt Clark, ASM Affiliates, Inc.

Appendix J.5

Archaeological Data Recovery at Ten Sites on TMKs: (3) 7-5-10:085 and (3) 7-5-017:06, October 2007

RC-0223

Archaeological Data Recovery at Ten Sites on TMKs:3-7-5-10:85 and 3-7-5-17:06

Wai'aha Ahupua'a
North Kona District
Island of Hawai'i

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October 2007

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Archaeological Data Recovery at Ten Sites on TMKs:3-7-5-10:85 and and 3-7-5-17:06

Wai‘aha Ahupua‘a
North Kona District
Island of Hawai‘i

Rechtman Consulting

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INTRODUCTION

At the request of Ken Holzhei of U of N BENCORP, Rechtman Consulting, LLC has prepared this data recovery report for ten archaeological sites located on TMKs:3-7-5-10:85 and 3-7-5-17:06 in Waiʻaha Ahupuaʻa, North Kona District, Island of Hawaiʻi (Figure 1). The preparation of this Archaeological Data Recovery Report follows the successful completion of an Archaeological Inventory Survey (Clark and Rechtman 2003) of the property, in which ten sites were recommended for data recovery investigation. This Archaeological Data Recovery Report is based on the strategies set forth in the Data Recovery Plan (Rechtman 2004) for the mitigation of these ten sites from any possible impacts resulting from development of the property.

The current study area is bounded to the east by land (part of the same TMK parcel) that was reportedly (Corbin and Rosendahl 2002) given historic preservation clearance by a DLNR-SHPD representative (Mr. Marc Smith); to the north by a stone wall along the Waiʻaha 1st/Puaʻa 3rd boundary; to the south by a stone wall in Waiʻaha 2nd Ahupuaʻa just south of the Waiʻaha 1st boundary along the edge of TMK: 3-7-5-17:6 and by an existing residential development where the wall no longer stands; and to the west by a stone wall along the *mauka* edge Kuakini Highway (Figure 2). During the *Māhele,* the majority of Waiʻaha 1st was awarded to the American Board of Commissioners for Foreign Missions (LCAw. 387). There were no *kuleana* awards made within the project area. Waiʻaha is generally considered to have been a place of high-status residences and ceremonial complexes, and Queen Emma lived in the *ahupuaʻa* in her later years.

Terrain in the project area is gently undulating and elevation ranges from 100 to 240 feet above sea level. Two soils characterize the project area, Waiʻaha extremely stony silt loam and Punaluʻu extremely rocky peat (Sato et al. 1973). Both are well-drained, thin organic soils over bedrock. The underlying bedrock is *pāhoehoe* within the western third of the project area transitioning to *ʻaʻā* in the eastern two-thirds; the flows date to more than 5,000 years BP (Wolfe and Morris 1996).

Two historically introduced species, *kiawe* (*Prosopis pallida*) and *koa haole* (*Leucaena glauca*) dominate the vegetation within the project area. A variety of grasses, vines, weeds, and shrubs are also present. Prior impacts within the project area can be described as substantial. Mechanical earth moving is evident as a graded road (no longer in use) corresponding to a waterline easement running *mauka/makai* through the property.

A total of twenty-five previously unrecorded sites and one previously recorded site were discovered during the Archaeological Inventory Survey (Clark and Rechtman 2003) (Figure 3). The ten sites recommended for data recovery are listed in Table 1. For descriptions of the other sites see Clark and Rechtman (2003).

Table 1. Data recovery sites on TMK: 3-7-5-10:85.

SIHP No.	*Function*	*Temporal Association*
23670	Permanent habitation	Precontact
23671	Temporary habitation	Precontact
23672	Permanent habitation	Precontact
23673	Permanent habitation	Precontact
23674	Temporary habitation	Precontact
23675	Permanent habitation	Precontact
23676	Temporary habitation	Precontact
23677	Temporary habitation	Precontact
23678	Temporary habitation	Precontact
23686	Agricultural	Precontact

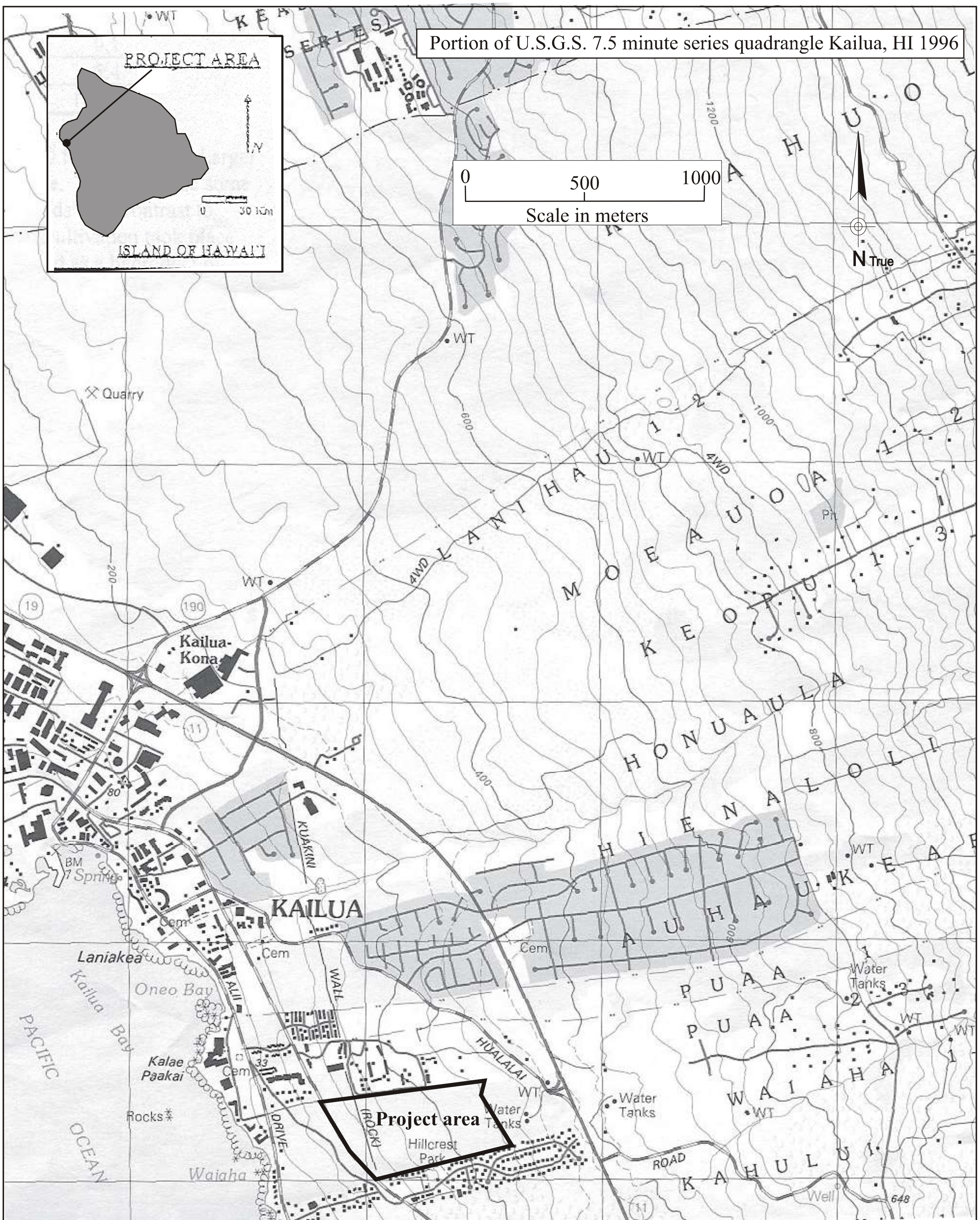
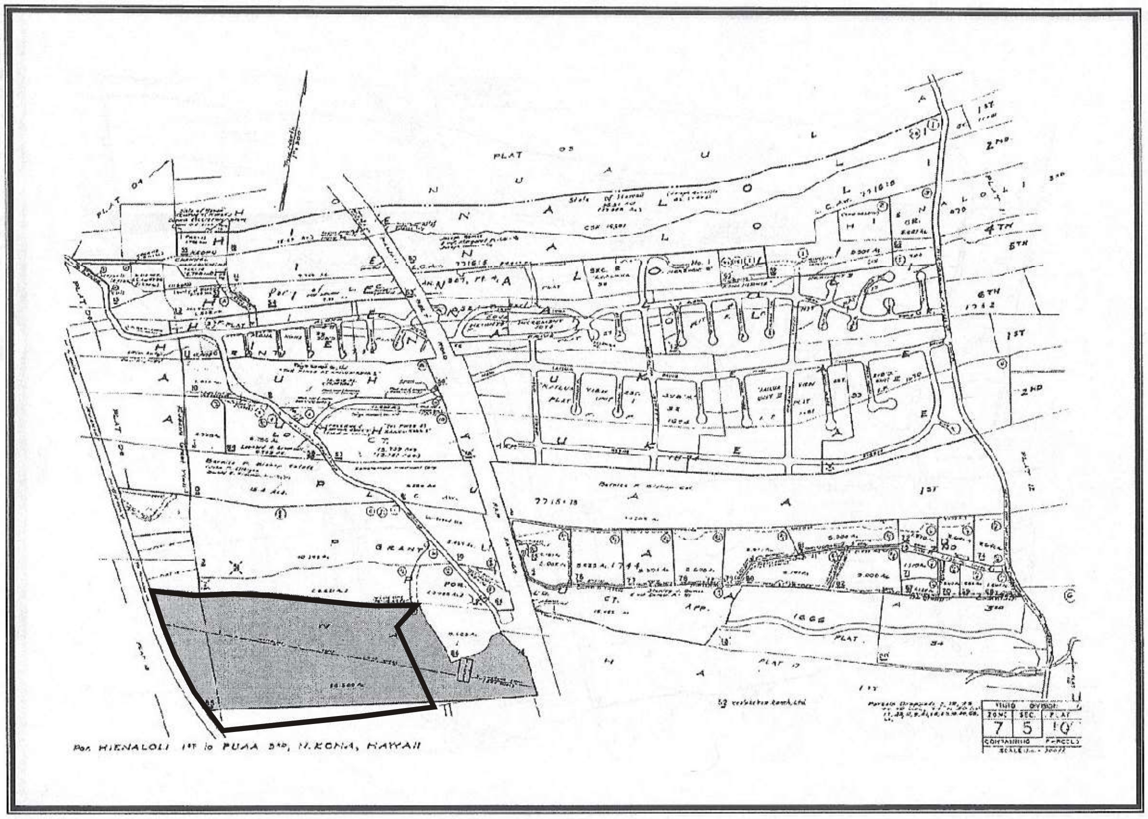


Figure 1. Project area location.



↑ TMK:3-7-5-10:85 = Study area = U of N BENCORP parcels TMK:3-7-5-17:06 ↓

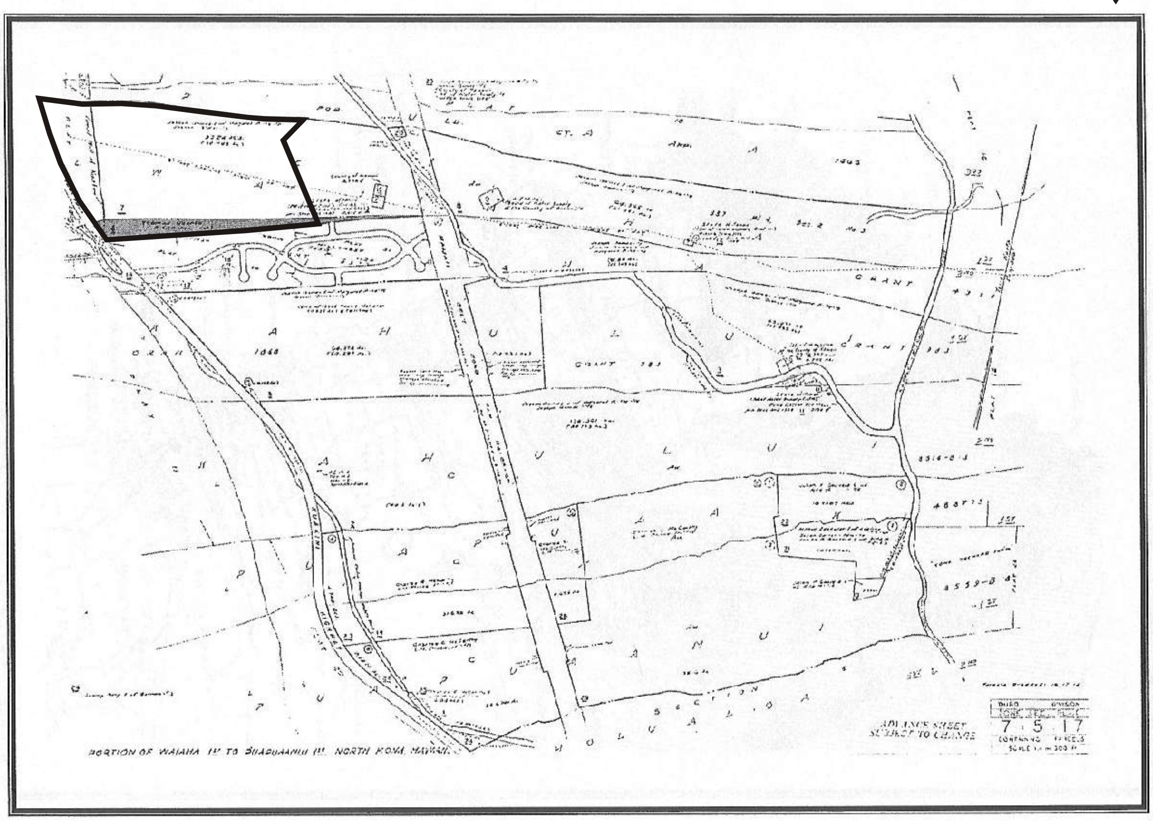


Figure 2. Tax Map Keys:3-7-5-10 and 17 showing current project area (parcels 85 and 06).

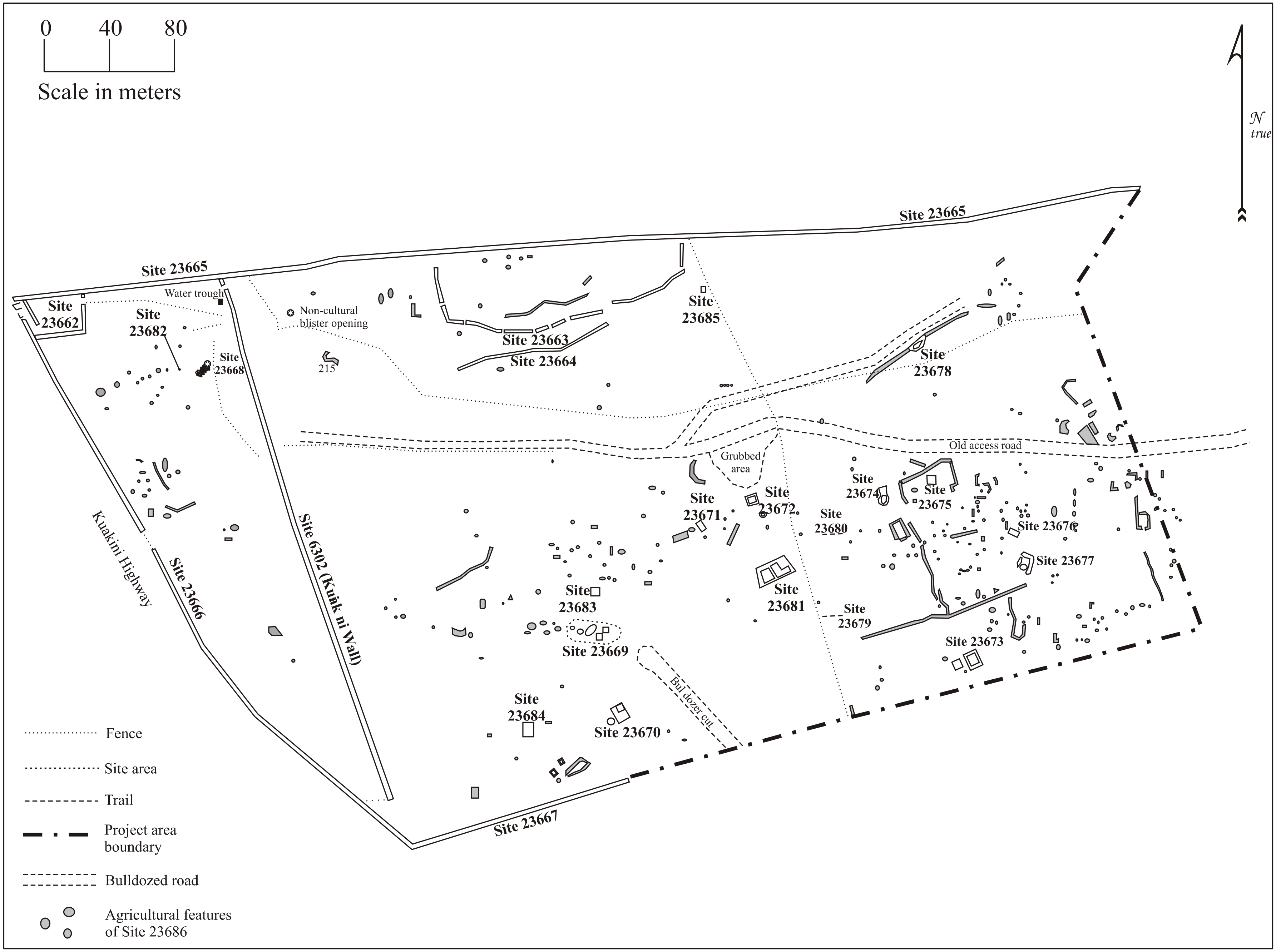


Figure 3. Project area plan view showing site locations.

PHYSICAL AND CULTURAL SETTING

The west-central coast of the island of Hawai‘i includes the western slopes of the dormant Hualālai volcano. The Kona coast is for the most part covered with barren Hualālai lava flows broken only occasionally by fertile patches of land. The successive lava flows contain numerous tubes and blisters. The abundance of volcanic rock provided readily available building material for house platforms, temples, fences, agricultural terraces, and Historic Period stock enclosures. The many crevices and caves created by the numerous lava flows afforded convenient locales for habitation, refuge, storage, refuse disposal, and burial.

Mean annual rainfall in the region ranges between 75 and 125 centimeters. Because it seldom rains on the leeward coast, West Hawai‘i is characterized by a paucity of stream drainages and a tendency to aridity; any surface water is quickly absorbed in the porous bedrock. In the early nineteenth century Ellis (1916:45-46) observed this water shortage, finding on his journey through the area that the populous Kailua was destitute of fresh water, except what was found in pools, or small streams, normally at higher elevations. Native Hawaiian people, however, had no problem drinking from the brackish springs on the coast (Cheever 1851:110).

Remnants of early house platforms that have been found near the Kaloko coast in North Kona radiocarbon dated to between AD 920 and 1290 (Cordy 2000:132). This area is known for its large brackish ponds and flowing drainage around their edges. In Lanihau Ahupua‘a immediately north of the project parcel midden deposits below stone platforms yielded charcoal fragments that were dated to between AD 1055 and 1270. A lava tube shelter to the south of the project parcel, near Kahalu‘u Bay, yielded a roughly contemporary date of AD 1000-1280 (ibid. 132-133). These sites are considered to represent temporary habitations of pioneers utilizing the nearby coastal resources. Charcoal dates from walled upland fields suggest that cultivation of the Kona uplands started between AD 1000 and 1200 (ibid. 133). Considered together, these roughly contemporary dates suggest the small pioneering communities that exploited coastal resources also cultivated the uplands.

Most of the Hawaiians living on the west coast chose to settle in small villages near the shore or clustered around bays where canoes could be launched or landed. Fish and marine resources were nearby and plentiful. The moister uplands could be reached by trails several miles long (Holland 1971:32). Upland forests contained a smaller number of people, in temporary villages, who hunted birds, harvested timber and bark, and logged sandalwood (ibid. 35). The seaward slope eventually became a mixed agricultural zone, with breadfruit planted on the lower slopes and large sweet potato and dry land taro plantations established in the higher elevations that received more rain (ibid. 33). With the decline of the breadfruit plantations, small fields of crops were planted in those areas and enclosed with low stonewalls concealed by sugarcane. Plantains and bananas were sometimes planted in the lower reaches of the rain forest (ibid. 34). Fish and other marine resources from the coast, plus crops and wild plants harvested from the higher slopes, supplied all the food, shelter, and clothing for the people on the west coast of Hawai‘i.

The study parcel is in the *kula* zone, a belt that stretches between sea level and the 150 meter elevation contour. This belt is associated with traditional habitation and the cultivation of sweet potatoes, paper mulberry, and gourds. Agricultural features, notably clearing mounds, planting mounds, planting depressions, modified outcrops, and planting terraces, are common within the *kula* zone (e.g., Hammatt and Clark 1980, Schilt 1984).

Traditional dwellings were concentrated within a roughly 200 meter wide belt along the shoreline, although some were also scattered throughout the agricultural portion of the *kula* zone. In addition to permanent houses, shoreline buildings were constructed for canoe storage, ceremonies and burials, and fishing related activities. A *heiau* related to fishing, known as Hekelinui, was recorded along the shoreline at the union of the two Kahului *ahupua‘a*, not far south of the current study area (Reinecke 1930, Site 62). Bryan (1915:50), among other scholars, observed that *heiau* shrines were usually located near the shore and were particularly dense in the region between Kailua and Kealakekua. A prominent *heiau* near the project area is ‘Ahu‘ena, adjacent to Kamehameha’s royal residence at Kailua.

The west coast's warm, dry climate and fertility made it a favorite residential area of Hawaiʻi's royalty. Important chiefly centers were located within the shoreline portion of the *kula* zone. Several large and densely populated royal centers were located along the shoreline between Kailua and Honaunau (Cordy 1995, Tomonari-Tuggle 1993). A variety of non-residential features are present in the *kula* zone near royal centers, including small agricultural plots, and burials. Wherever the ruling chief had his home, a large group of houses for members of the royal entourage and commoner laborers could also be found.

By the 1400s, dual seats of power existed on the windward and leeward coasts of Hawaiʻi Island. The "Kona" chiefs governed Kohala, Kona, and Kaʻū, while the "I" chiefs controlled Hamakua, Hilo, and Puna (Cordy 2000:205-207). The first chief to permanently unite the island of Hawaiʻi was ʻUmi-a-Liloa, whose father had been an *ad hoc* ruler of the island with his court located in Waipiʻo Valley, Hamakua. ʻUmi subsequently moved the seat of power from the windward to the leeward side of the island at Kona. According to royal genealogies all this most likely took place sometime during the early 1400s to the early 1600s. Royal oral traditions imply that the period from 1500 to the mid-1700s consisted of continual attempts to wrest power from ʻUmi's descendants. These cycles of conquest and re-conquest finally ended with Kamehameha's unification of the Hawaiian Islands in the early Western contact period. The earlier chiefdoms were incorporated into the six districts of Kamehameha's kingdom. Despite the further subdivision of Hilo, Kohala, and Kona into northern and southern portions, the original district boundaries of Hawaiʻi Island still exist today, probably due to their separation according to natural physical barriers.

The town of Kailua, Kona, has long been the residence of Hawaiian chiefs. Kailua is also the site of Kamakahonu, the parcel of land containing King Kamehameha's principal residence and court during the last years of his life. Following Kamehameha's death, his successor Liholiho overthrew the *kapu* system. Following the breaking of the *kapu* system and related traditional Hawaiian beliefs, the older places of worship, such as the *heiau*, lost their former significance. Many such places were dismantled, and the stones were used for other projects, such as the building the Kuakini Wall, which runs through the western third of the project parcel (see Figure 3).

Nineteenth century habitation features built on stone platforms were present in the *kula* zone of the project area (Hammatt and Meeker 1979, Schilt 1984). The Historic Period marked a shift from separate single-function structures (i.e., separate male sleeping quarters, female sleeping quarters, and cooking structures) to single structures with multiple rooms (i.e., male rooms, female rooms, and kitchens under one roof) (Ladefoged 1991). Burials associated with Historic Period structures made from mortar and corrugated tin are present in the lower portions of the *kula* zone. Burials also occurred within residential platforms during the Historic Period (O'Hare and Wolforth 1998).

In 1823 Ellis (1916:47) observed small gardens among the barren rocks of Kailua on which numerous but scattered houses were built "wherever soil could be found sufficient to nourish the sweet potato, the water melon, or even a few plants of tobacco." The project area is actually within the coastal portion of the so-called Kona Field System (Cordy 1995, Newman 1970, Schilt 1984) of North Kona. These fields extend north at least to Kaū Ahupuaʻa and south to Honaunau, west to the coastline and east to the forested slopes of Hualālai (Cordy 1995). A significant portion of the fields is designated in the Hawaiʻi Inventory of Historic Places as SIHP Site 50-10-37-6601 and has been determined eligible for inclusion in the National Register of Historic Places.

Long stone-and-earth field boundaries characterize the Kona Field System. This complex of agricultural fields has never been completely mapped or properly delineated, however. Moreover, Historic Period construction and land-alteration activities have obliterated and obscured large portions of this walled complex. Long walls that mainly run parallel with the slope, called *kuaiwi*, or backbone, typically define former agricultural fields within this field complex. Shorter walls intersect the *kuaiwi* walls in places, giving the field complex an overall grid-like appearance of narrow and elongated rectangles, typically perpendicular to the coast (Soehren and Newman 1968:5). Bearing in mind that the *kuaiwi* walls follow the slope they were very likely not intended to retain soil or water. Instead, they were more likely constructed to delineate plot boundaries and to receive rocks from cleared fields (Kirch 1985:228). Among the *kuaiwi* walls are also preserved stone mounds, terraces, enclosures, and a variety of habitation features (ibid. 230).

Judging from available radiocarbon dates, the most intensive phase of agricultural wall building occurred in the seventeenth to eighteenth centuries.

The emergence of a Euro-American style of land ownership accompanied religious and demographic changes between 1790 and 1840. The Great *Māhele* of 1848 defined the land interests of King Kamehameha III, the high-ranking chiefs, and low-ranking chiefs. The Land Commission awarded land to chiefs given the understanding that the traditional boundaries would prevail until such boundaries could be surveyed. Commoners received land known as *kuleana*.

During the Territorial Period (1900–1959) population declined and settlements diminished along the Kona coast. Coastal populations were concentrated in the small villages of Kailua and Keauhou. These contained residences with gardens and animal pens that were scattered along the shoreline. Upland habitation was associated with cultivation and ranching activities. As cattle pastures expanded into the lower elevations (in the vicinity of the current project area), more walls were built in the *kula* zone.

PREVIOUS WORK AND RESEARCH QUESTIONS

Summary of Previous Work

A total of eleven sites (25 features) were closely investigated during the Archaeological Inventory Survey (Clark and Rechtman 2003) (Table 2). Of the eleven sites (25 features) investigated, nine sites (15 features) were interpreted as habitation and one site (10 features) was interpreted as agricultural. Seven test units were excavated within the habitation features, whereas ten test units were excavated within the agricultural features. Two charcoal samples obtained from habitation features were submitted for radiocarbon assaying. The calibrated dates ranged between the sixteenth and twentieth centuries.

Table 2. Archaeological Inventory Survey sites, features, test units, and dates.

Site #	*Feature letter*	*TU #*	*Form of habitation feature*	*C-14 calibrated date range (AD)*
23670	A	-	Lower two-tiered platform	-
23670	B	12	Upper two-tiered platform	-
23670	C	-	Small platform	-
23671	A	-	Platform	-
23672	A	11	Rectangular enclosure	-
23672	B	13	Rounded enclosure	1510-1950
23673	A	17	Platform	-
23673	B	-	Enclosure	-
23674	A	-	Platform	-
23674	B	-	Circular enclosure	-
23675	A	20	Enclosed platform depression	-
23676	A	18	Platform	-
23677	A	16	Small platform in enclosure	1660-1950
23677	B	-	Rough enclosure	-
23678	A	-	Oval enclosure	-
n=9	n=15	n=7		n=2
Site #	***Feature #***	***TU #***	***Form of agricultural feature***	***C-14 calibrated date range (AD)***
23686	187	1	Mound	-
23686	189	2	Mound	-
23686	262	15	Mound	-
23686	266	19	Mound	-
23686	271	21	Mound	-

Continued on next page

Table 2. Continued.

Site #	*Feature #*	*TU #*	*Form of agricultural feature*	*C-14 calibrated date range (AD)*
23686	183	4	Modified outcrop	-
23686	201	5	Modified outcrop	-
23686	204	6	Modified outcrop	-
23686	239	8	Modified outcrop	-
23686	297	22	Modified outcrop	-
n=1	n=10	n=10		n=0

The following six functional categories have been tentatively assigned to features based on their size and items recovered (Table 3): permanent habitation (n=7), temporary habitation (n=7), unknown agricultural (n=6), agricultural clearing (n=3), planting area (n=1), and storage and/or trash facility (n=1).

Table 3. Archaeological Inventory Survey feature size, inferred function, and items.

Site	*Feature*	*Area m²*	*Function*	*Items recovered*
23670	A	55.8	Permanent habitation	*Cypraea* sp.
23670	B	10.2	Permanent habitation	-
23670	C	11.4	Permanent habitation	-
23671	A	26.2	Temporary habitation	-
23672	A	114.8	Permanent habitation	cow
23672	B	8.8	Storage/trash	shark, shell, *kukui* nutshell, charcoal, rodent, basalt, volcanic glass
23673	A	26.5	Permanent habitation	fish, *Cypraea* sp., coral, Echinoidea, *kukui* nutshell, charcoal, rodent, volcanic glass
23673	B	74.8	Permanent habitation	coral
23674	A	17.2	Temporary habitation	-
23674	B	18.1	Temporary habitation	-
23675	A	33.1	Permanent habitation	*Cypraea* sp., pig, charcoal, basalt
23676	A	18.0	Temporary habitation	fish, *Cypraea* sp. lure, shell, Echinoidea, pig, rodent, *kukui* nutshell, volcanic glass
23677	A	7.3	Temporary habitation	fish, shell, Echinoidea, coral, small mammal, charcoal, volcanic glass
23677	B	6.3	Temporary habitation	-
23678	A	20.0	Temporary habitation	-
23686	187	3.0	?	coral
23686	189	1.5	?	coral
23686	262	5.8	?	-
23686	266	2.9	?	-
23686	271	7.3	?	coral
23686	183	35.5	Planting area	-
23686	201	23.6	Agricultural clearing	-
23686	204	9.2	?	-
23686	239	10.0	Agricultural clearing	-
23686	297	18.0	Agricultural clearing	-

Research Objectives and Analytical Approaches

The primary research objective of this data recovery project is to assess a general hypothesis related to the timing and nature of Precontact land use within the project area, and the concomitant implications for the prehistory within the *kula* zone of Kona. This hypothesis is developed based on general information contained in the large corpus of reports prepared over the past thirty years for the Kona region, as well as the specific results of the inventory survey conducted on the property (Clark and Rechtman 2003).

Secondary research questions, related to the primary hypothesis, are also discussed, along with analytical approaches for assessing all of the research objectives.

Primary Hypothesis and Archaeological Implications

The sequence of Precontact land use within the study area (and the *kula* of Kona in general) is as follows: The first use was for short term habitation and associated opportunistic agriculture, followed by formal agriculture and associated recurrent habitation, then the end of the sequence is marked by more consistent habitation with associated household gardens and animal pens.

The archaeological implications of this hypothesis are many. Those sites that were interpreted as "permanent habitations" in the inventory study (Clark and Rechtman 2003) should postdate the sites interpreted as "temporary habitations," and exhibit the largest investment in construction and contain the widest range of artifact types and the greatest diversity of faunal remains. The temporary habitations should fall into two temporal categories, the earlier being less substantial in construction and contain the fewest artifacts and the least diverse faunal collection, reflective of short term use; the later being more substantial in construction and possessing a wider range of artifacts and a greater diversity of faunal remains, reflective of recurrent use. The recurrent use habitation sites are expected to temporally correlate with the majority of the agricultural features of Site 23686. The permanent habitations should spatially and temporally correlate with enclosure features used either for agriculture or animal husbandry.

A key analytical component for assessing the hypothesis and its implications is comparative analyses of recovered artifact assemblages and faunal collections from the habitation features, and correlating this information with the metric characteristics of the sites. Radiocarbon age determinations are also vital in establishing the contemporaneity of defined recurrent use habitation sites and the formal agricultural features (i.e., *kuaiwi* and terraces). Fifteen charcoal samples from both habitation and agricultural contexts were submitted for radiocarbon analysis. Together with the existing two radiocarbon dates from the test units, the total of radiocarbon assays from the project is seventeen.

An avenue of investigation specific to multi-component habitation sites is an assessment of the functional variability between features. Ethno-historic models suggest that habitation sites (Cordy 1981), and the "planter's homestead" (Handy and Handy 1972:290) contained several functionally different structures (i.e. common house, men's eating house, woman's eating house, sleeping houses, cooking house, etc.). This "idealized" living complex is termed *kauhale*. While this residential pattern may not have been strictly or universally adhered to, the underlying cultural rules are likely to have been practiced in varying degrees at most residential complexes. Therefore, there should be recognizable formal and material content differences between the different types of structures. This can be studied at the sites recorded in the study area. All of the features at these sites will be subject to subsurface investigation. An inter-feature comparative analysis of the recovered material and correlation with the features' formal attributes is used to identify potential functional differences between the site's features. Functional interpretations can then be proposed for the individual features based on the ethno-historic information.

Handy and Handy's (1991:290-300) account of a *kauhale* is based primarily on work that they conducted with Pukui in the district of Ka'ū in southern Hawai'i. For reasons of *kapu*, structures with different uses and/or occupied by people of different gender and/or rank were kept spatially separate. Within most household complexes sleeping was in common but males and females ate and worked separately. The following structures normally occurred within a *kauhale*: common house, men's house, women's *tapa* manufacturing structures, women's menstrual huts, a storage shed for crops and implements, and cooking sheds that were separated along gender lines. Apparently only a few households ever exhibited the full complement of structures, although sleeping and cook houses were probably present within most household complexes. What follows is an overview of the more ubiquitous structures and excavated items that can be expected to be associated with each.

The main structure within the household complex was the common house, or *hale noa*, in which all the family members slept at night. It was normally the largest building within a family compound and the most weatherproof. Its frame consisted of end posts upon which rested the ridgepole. There were also four corner posts with side posts between them. Prior to thatching, the house frame looked like a great cage. In drier areas a low stone wall often formed the outside perimeter support of the thatched rafters. The house sometimes stood on a stone platform of varying size and thickness. This platform at times extended beyond the front of the house to provide a roof-less porch, or *lanai*. A single waist high doorway was usually placed in the center of the front wall. During dedication rituals for a new house, fish were placed under the threshold to keep away evil influences from outside. Hogs, dogs, and chicken were also consumed and discarded during this ritual consecration. Women did not eat pork or dog (e.g., Handy and Handy 1991:292). The sleeping area was normally against the back wall. It was raised slightly and covered with pebbles, dried vines, and leaf mats. It was in the mat-covered space between the sleeping area and the door where women sat weaving mats and where children played on rainy days. Light in the evening was from candles made of the oily *kukui* nuts. Bearing in mind that no food was supposed to be consumed within the *hale noa*, with the exception of the initial house dedication feast, excavated food residues should ideally be a reflection of what was consumed primarily during this feast. Pork and dog bones would be residues left by men, whereas everybody would have consumed shell fish, and *kukui* nutshell fragments most likely would have come from candles or as a delicacy during the dedication feast. Areas covered with mats might appear as voids, whereas food items could expect to accumulate near the wall, particularly in corners, and near the doorway.

In the vicinity of the main sleeping house was the men's house, or *hale mua*. Interestingly, the term *mua* also refers to the fore part, or bow, of a canoe, showing the pervasiveness of a seafaring mindset in Hawaiian culture. At least in historic times the men's house was smaller than the sleeping house. Within the *hale mua* men kept and worked on their tools, including adzes and files for making tools and weapons. No women were allowed within the men's quarters. Against the narrow back wall of the *hale mua* was the shrine of the family ancestor spirits, or *'aumakua*. This shrine often included an altar, or *kuahu*, that comprised a framework of poles supporting a shelf on which was an image of the family ancestor. Shrines could also simply be an upright stone. At the time of the main meal, once a day, the family head placed the slightly narcotic *'awa* liquid on the altar while praying to the family ancestors. On special occasions, such as prior to heavy work or fighting, the men would sleep in the *hale mua*, for intercourse with women was *kapu* at such times. Near the men's house was the oven, or *imu*, where the men cooked their food. Considered overall then, material traces of a *hale mua* would include fragments of basalt adzes, pumice abraders, bone and shell fishing and cultivation gear. Food residues within *hale mua* can be expected to be denser than those from the sleeping house, including pig and dog bones. Upright stones and/or special food residues and coral at one end of the structure could be remnants associated with a shrine.

Cooking areas, as indicated by pits or stone-lined hearths, seemingly occurred on different sides of the house dwelling, or close to the spatially separate activity areas of men and women. Women did their bark cloth, or *tapa*, making in the *hale ku'a*, where strips of bark were processed and stored. These were often raised stone platforms without a roof, the implements being stored inside cupboard-like hollows within the platforms. The structures were apparently somewhat separate from the main house complex as it was *kapu* for men to touch the tools of *tapa* processing. Instruments that are associated with bark cloth processing include wooden beaters that are sometimes preserved within their storage spaces in the drier areas of Hawai'i. The menstrual hut, or *hale pe'a*, was even more remote than the *tapa* processing locales, to ensure that "impure" women during their menses did not come into contact with men. Women who were not menstruating took food to the secluded menstruating women. Remains associated with *kapa* production locales and menstrual huts are expected to be limited and restricted to certain spots, and would include beaters, abraders, and certain shellfish.

Close to the cultivated fields, a farmer would have had a stout storage shed, or *hale papa'a*. This shed served as a storehouse for crops, a place to keep digging sticks, and cuttings of taro, sweet potato, and sugar cane for replanting. Cultivators also used this shed as a shelter during bad weather. Due to the perishable nature of cultivation-related tools and foodstuffs, storage sheds are not expected to contain many items, unless a fire has carbonized and preserved some of the plants and implements from decay.

It is worth noting that according to Handy and Handy, point features on the landscape, such as fresh water sources or protected bays, typically facilitated inter-*kauhale* clustering and intra-*kauhale* nucleation. In the *kula* zone of the project area where such naturally occurring nodes were ostensibly absent, *kauhale* would likely have been dispersed, often with some distance separating neighboring *kauhale* (Handy and Handy 1991:284). Also, a *kauhale* associated with dispersed agricultural activities can be expected to lack the more clearly discernable internal structured relationship between different features found within those *kauhale* that were centered on bays, for example.

Secondary Research Objectives

Refining the nature of habitation sites

Refined assessments of site and feature function have been problematic at best in Hawaiian archaeology. This is particularly so when attempting to assess the nature of presumed habitation features. Nearly thirty years ago a rigid dichotomy of habitation sites types (permanent/temporary) was formally established along with the criteria for distinguishing between temporary versus permanent habitations (Cordy 1978), then later revised (Cordy 1981). The model that resulted is based on a set of co-varying surface observable attributes: form, size; substantiveness of construction; internal features (single versus multiple fire hearths); associated structures; and geographic context. Although criticized (Kirch 1983, 1985) and elaborated on (Clark 1987), the basic elements of Cordy's model have remained in use over years of testing (literally hundreds of studies have used the key variables for interpreting temporary and permanent habitation sites), and codified in the recently signed Administrative Rules (HAR 13§13-275) that govern the historic preservation review process.

Using the criteria of form, size, internal features, and associated structures contained in the Cordy model, three of the sites that are the focus of this data recovery study would be interpreted as permanent habitations; however, the geographic context and substantiveness of construction are not what is expected for a permanent habitation. Further, the qualitatively assessed amount of habitation debris (recovered from testing and seen on the surface) does not seem to be enough for permanent habitation; thus all of these sites are presently interpreted as temporary. It is the criteria for making this interpretation (and thus the utility of the continued use of the orthodox version of the Cordy model) that will be addressed in the data recovery investigation.

One criterion used by Clark (1987) for assessing permanence of habitation sites, which was not a consideration of Cordy's model, was that of abundance and diversity of accumulated habitation debris. Clark did not provide a measurable distinguishing threshold, however, quantity and diversity of habitation debris can be a qualitative measure (an impression). As stated elsewhere (Rechtman 2002), and in the process of being demonstrated (based on data recovery investigations at several sites in both South Kona, and North Kona), that if further developed, some measure of the quantity and diversity of faunal material present within a site can be a powerful tool in assessing permanence of habitation. When a site is excavated, volumetric data can be generated with respect to the quantity of habitation debris. These measures can then be statistically analyzed to identify patterning, which can then be tested against the normative criteria contained in Cordy's model. Likewise, the diversity of species present in the faunal collection can be used as a measure of habitation permanence. This is based on the logical assumption that faunal assemblages from temporary habitations will be less diverse than those from permanent habitations. A diversity index can be generated based on number of species present given a particular volume of excavated sample. Both of these measures might also ultimately prove useful, in conjunction with an examination of other formal feature attributes and recovered artifactual material, in assessing the status of the site residents, through comparisons of inter- and intra-site variability and distribution analyses. It is recognized that environmental conditions and site taphonomy can greatly effect preservation of material remains, and thus their accurate reflection of past behaviors.

Refining the age estimate and functional interpretation of agricultural features

As the subsurface examination of mounds and modified outcrops during the inventory survey (Clark and Rechtman 2003) yielded very little information, the focus of data recovery at SIHP Site 23686 included the other four recorded features types; *kuaiwi*, terraces, enclosures, and pavement.

Cross-sections through three *kuaiwi* (Features 17, 82, and 291) and through the rock facings of six terraces (Features 81, 185, 212, 247, 254, and 286) were excavated by hand in an attempt to document potential successive build episodes, the relationship between the rock feature and the underlying soil, and to recover charcoal samples for radiocarbon analysis.

Three enclosures (Features 251, 293, and 294) were also excavated. As a result of the inventory survey (Clark and Rechtman 2003) these sites were interpreted to be associated with agricultural activities as opposed to having served as animal pens or habitations. This interpretation will be tested through data recovery, as will the identification and characterization of any soil deposits. The stratigraphy of the soil deposits will be recorded and soil and radiocarbon samples collected for laboratory analyses.

Three pavements were recorded during the inventory survey (Clark and Rechtman 2003), all in the *mauka* third of the study area. This feature type represents only about one percent of the feature types recorded at SIHP Site 23686. Rechtman et al. (2001) formally defined this specialized agricultural feature type as 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. In the absence of excavation data, pavements were functionally described as specialized features associated with agricultural activity (possibly for staging and processing agricultural products). It is also possible that pavements served as locations of temporary habitation, or were used simply for sleeping (a use defined here as distinct from habitation).

All three of the recorded pavements (Features 250, 282, and 289) were excavated. The analytical criteria used to interpret the pavements as plant processing activity features was a combination of an abundance of volcanic glass flakes, and a paucity of faunal remains. The characteristics that distinguished the pavement features as loci of habitation were the presence of faunal remains and the identification of a hearth or hearths (hearth features would not be expected to occur within the pavements if they were used for plant processing or drying). If these features were used simply for sleeping then very little or no surface or subsurface cultural material would be present. Based on architectural and artifact similarities with excavated pavements/platforms elsewhere on the island, it could be that some of the more elaborately paved structures represent *heiau*, or shrines.

DATA RECOVERY METHODS

Excavation Units

This section presents a site-by-site accounting (in table form) of the data recovery excavation units and a description the excavation techniques. Table 4 lists the hypothesized habitation sites and the number and configuration of the excavation units. Table 5 lists the excavated features and the unit configuration at the agricultural Site SIHP 23686.

Table 4. Excavation sample size per habitation site and feature.

SIHP No.	*Total m^2*	*Unit Number and Configuration*
23670 Feature A	8	EU-31 (2 x 2m), EU-32 (2 x 2m)
23670 Feature B	2	TU-12 (1 x 1m), EU-34 (1 x 1m)
23670 Feature C	1	EU-33 (1 x 1m)
23671	4	EU-4 (2 x 2m)
23672 Feature A	6	TU-11 (1 x 1m), EU-2 (1 x 1m), EU-3 (2 x 2m)
23672 Feature B	3	TU-13 (1 x 1m), EU-1b (2 x 1m)
23673 Feature A	5	TU-17 (1 x 1m), EU-27 (1 x 2m), EU-28 (1 x 2m)
23673 Feature B	4	EU-29 (2 x 2m), EU-30 (2 x 2m)

Continued on next page

Table 4. Continued.

SIHP No.	*Total m²*	*Unit Number and Configuration*
23674	5	EU-6 (2 x 2m), EU-7 (1 x 1m)
23675	7	TU-20 (1 x 1m), EU-9 (2 x 1m), and EU-10 (2 x 2m)
23676	5	TU-18 (1 x 1 m), EU-21 (2 x 2m)
23677 Feature A	2	TU-16 (1 x 1m), EU-22 (1 x 1m)
23677 Feature B	4	EU-23 (2 x 1m), EU-24 (2 x 1m)
23678	4	EU-14 (2 x 1m), EU-15 (2 x 1m)

Table 5. Features of SIHP Site 23686 subject to data recovery excavation.

Feature Type	*Feature No.*	*Unit Number and Configuration*
Mound	187	TU-1 (1 x 1m)
Mound	189	TU-2 (1 x 1m)
Mound	262	TU-15 (1 x 1m)
Mound	266	TU-19 (1 x 1m)
Mound	271	TU-21 (1 x 1m)
Modified outcrop	183	TU-4 (1 x 1m)
Modified outcrop	201	TU-5 (1 x 1m)
Modified outcrop	204	TU-6 (1 x 1m)
Modified outcrop	239	TU-8 (1 x 1m)
Modified outcrop	297	TU-22 (1 x 1m)
Kuaiwi	17	EU-37 (2 x 1m)
Kuaiwi	82	EU-26 (2 x 1m)
Kuaiwi	291	EU-13 (2 x 1m)
Terrace	81	EU-25 (2 x 1m)
Terrace	185	EU-1a (2 x 1m)
Terrace	212	EU-38 (2 x 1m)
Terrace	247	EU-5 (2 x 1m)
Terrace	254	EU-12 (2 x 1m)
Terrace	286	EU-16 (2 x 1m)
Enclosure	251	EU-8 (2 x 2m)
Enclosure	293	EU-36 (2 x 1m)
Enclosure	294	EU-37 (2 x 1m)
Pavement	250	EU-11 (2 x 2m)
Pavement	282	EU-17 (2 x 1m), EU-18 (2x2m)
Pavement	289	EU-19 (2 x 2m), EU-20 (2 x 2m)

Prior to sub-surface testing, all sites were adequately cleared of vegetation and photographed. Also, scaled plan views were drawn, or updated from the inventory survey (Clark and Rechtman 2003) for each site and feature to show the placement of the excavation units. All excavation units were dug by hand following natural stratigraphic layers divided into 10-centimeter arbitrary levels. The arbitrary levels were measured relative to an elevation datum corresponding to the highest corner of the excavation unit. All excavated matrix were passed through quarter inch mesh screening and cultural material were collected and segregated by level. Level Record Forms were completed for each excavated level. Subsurface features encountered during excavation were fully documented before further excavation of the unit. Excavation was continued down to bedrock. Upon completion of the excavation unit, a Unit Summary Form was completed, photographs were taken, a stratigraphic profile was drawn, and the unit was backfilled.

Cultural Material Analyses

All recovered cultural material was processed in the Rechtman Consulting, LLC laboratory facility. Items were cleaned, weighed, counted, described, and entered into a master project catalog (Appendix A). Where appropriate, artifacts were drawn, photographed, and subjected to further detailed analysis. Faunal remains were tabulated and identified to the lowest taxonomic level possible. Where applicable, the Number of

Identified Specimens (NISP) and the Minimum Number of Individuals (MNI) were determined. Based on evidence from test excavations (Clark and Rechtman 2003) these sites are poor candidates for pollen and flotation (macrobotanical) analyses. Charcoal and other organic samples were prepared for possible radiocarbon analysis.

Radiocarbon Samples

The radiocarbon samples collected during fieldwork were prioritized based on size, provenience, and integrity of association. Priority was given to large single-piece samples recovered in situ from a clear stratigraphic context. All samples were cataloged and initially cleaned and weighed in the Rechtman Consulting, LLC laboratory facility. Following this process, selected samples were sent to Beta Analytic Inc for analysis (Appendix B). Conventional radiocarbon analysis coupled with a calculation of stable isotope ratios (C^{13}/C^{12}) were used for all samples.

Curation of Recovered Archaeological Material

All items recovered during data recovery are temporarily stored at the Rechtman Consulting, LLC curation facility for a period of no more than one year following submission of the final data recovery report, during which time arrangements will be made for permanent curation in consultation with the landowner and DLNR-SHPD. It is the responsibility of the landowner to secure permanent curation in an acceptable facility; included in this responsibility are the costs associated with long-term curation.

DESCRIPTION OF EXCAVATION RESULTS

Introduction

The following description considers together the results from the test units and from the excavation units. The results are presented generally in the sequence of the SIHP Site numbers and feature numbers. The description of the results include site and feature location, size, shape, make-up, stratigraphy, identification and number of recovered items by layer and level, and radiocarbon assays where charcoal samples were analyzed by Beta Analytic. Whereas the items recovered are merely listed in table format within this descriptive section, the identification, weight, distribution, and likely exploitation zones of items are discussed afterwards within the synthesis section.

SIHP Site 23670

Site 23670 is a stone platform complex located in the western half of the project area approximately 30 meters north of the eastern end of Site 23667 (see Figure 3). Site 23670 consists of a two-tiered platform (Features A and B) with a second smaller platform (Feature C) located two meters to the east (Figure 4). Both platforms are constructed of *ʻaʻā* with large cobbles stacked around the outside edges and small cobbles paving the surface. A single *Cypraea* shell fragment was found on ground surface near the south edge of Feature A.

Feature A

Feature A is the lower platform of the two-tiered platform (see Figure 4). This roughly rectangular platform measures 9.0 meters long by 6.2 meters wide. The feature is constructed on bedrock with the outside edges stacked 70 centimeters (two courses) high. The paved surface of Feature A is relatively level and in good condition, although some collapse has occurred along the south and west edges (Figure 5). Two excavation units (EU-31 and EU-32) were placed on the Feature A platform. EU-31 (2 x 2m) was placed near the eastern corner of Feature A, while EU-32 (2 x 2m) was placed near the center of the same feature.

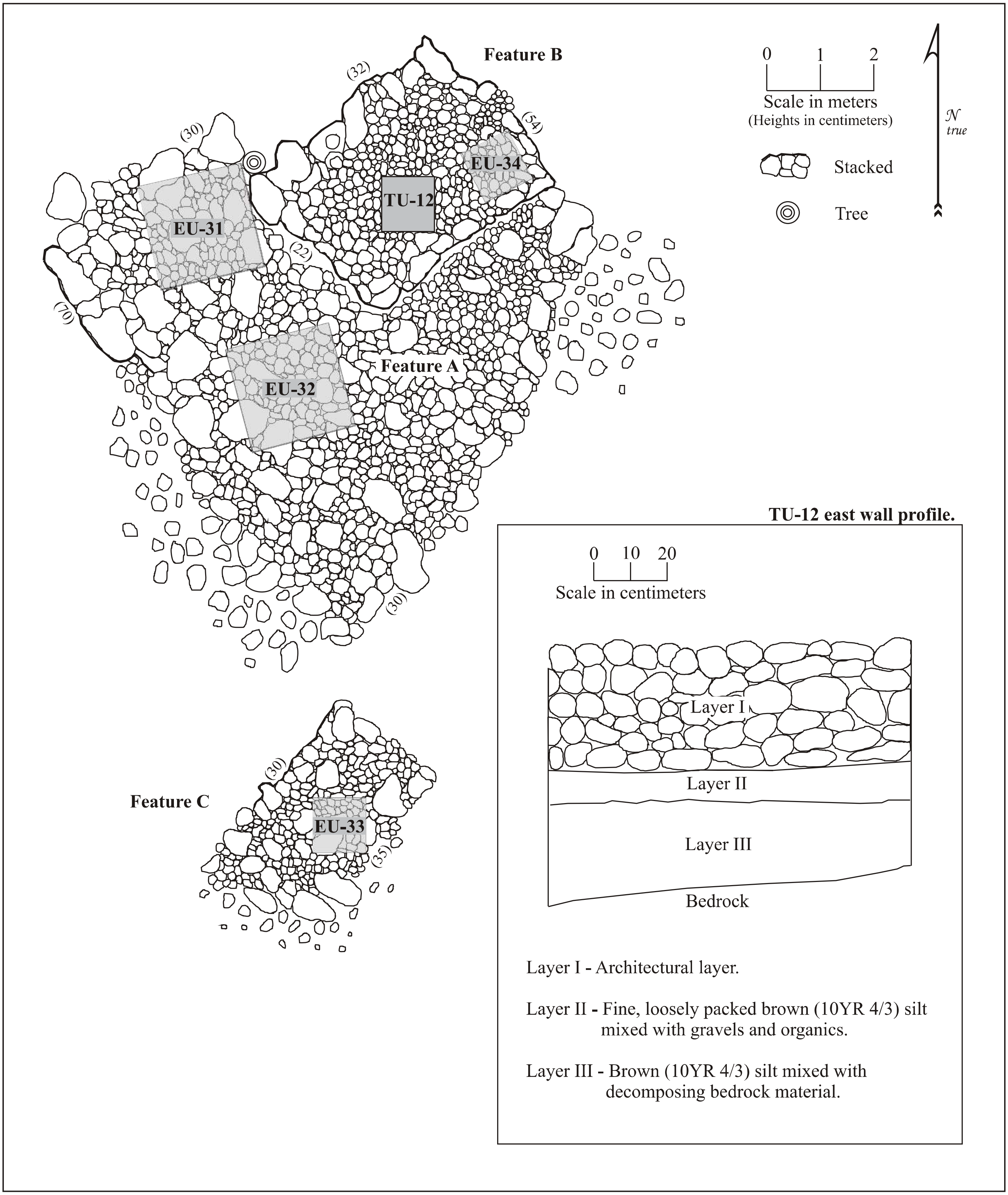


Figure 4. SIHP Site 23670 Features A-C plan view and TU-12 east wall profile.


Figure 5. SIHP Site 23670 Features A and B, view to the west.

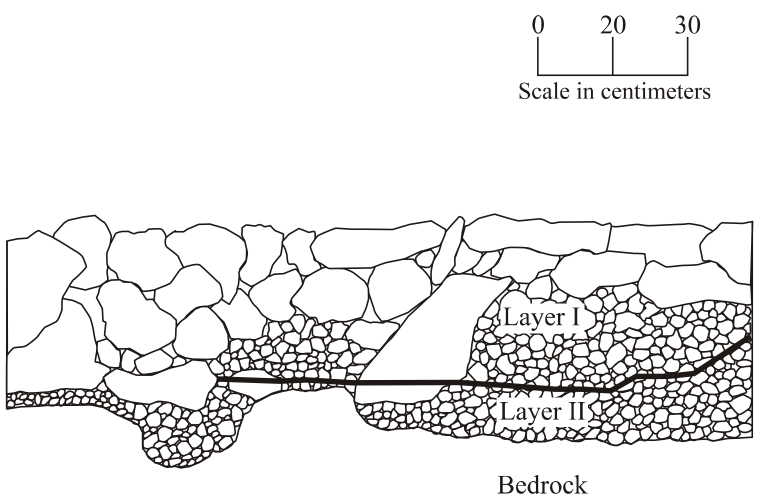
EU-31 revealed the following stratigraphic profile (Figures 6 and 7):

Layer I (0-30cmbs)........... architectural layer with small to large *ʻaʻā* cobbles and boulders.

Layer II (30-50cmbs) .... pebble and cobble layer with dark yellowish brown (10YR 4/4) silt in northeastern corner and very dark grayish brown (10YR 3/2) silt in southeastern corner on undulating bedrock.

Items recovered from EU-31 include *Cypraea* sp., Echinoidea, *kukui* nutshell, and charcoal (Table 6). Historic Period items, all recovered from Layer I, include a glass fragment, iron fragments, and two brass button parts. The brass button parts (Acc# 516 and 517) appear to go together (both came from the same provenience and each weigh 0.8 grams). The size and shape of the buttons differ slightly, however. Brass button part Acc# 516 is a flat round disk with a diameter of 23.5 millimeters and thickness of 0.3 millimeters. Brass button part Acc# 517 (Figure 8) is a slightly convex disk with one hole in the middle and incised with a crown and "warranted fast shank." This brass button is slightly oval (31.3 millimeters long by 20.9 millimeters wide) and is comparatively thick (1.9 millimeters).

Figure 6. SIHP Site 23670 Feature A EU-31 showing Layer I and upright boulders, view to the south.



Layer I - Architectural layer.

Layer II - Predominantly pebble and cobble layer with dark yellowish brown (10YR 4/4) silt in northeastern corner and very dark grayish brown (10YR 3/2) silt in southeastern corner.

Figure 7. SIHP Site 23670 Feature A EU-31 west wall profile.

Figure 8. SIHP Site 23670 brass button part recovered from EU-31 (Acc#. 517).

Table 6. Recovered items from SIHP Site 23670, Feature A, EU-31.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
512	I	1	Marine shell	*Cypraea* sp.	3	1	3.3
515	I	1	Echinoderm	Echinoidea	7	-	0.6
511	I	1	Organic	*Kukui* nutshell	14	-	6.8
510	I	1	Organic	Charcoal	-	-	0.4
513	I	1	Metal	Iron fragments	4	-	0.9
516	I	1	Metal	Brass button part	1	-	0.8
517	I	1	Metal	Brass button inscribed	1	-	0.8
514	I	1	Glass	Brown bottle fragment	1	-	0.4
				Layer I, Level 1 Total:	31	1	14.0
519	II	1	Echinoderm	Echinoidea	2	-	0.1
520	II	1	Organic	*Kukui* nutshell	7	-	2.1
518	II	1	Organic	Charcoal	-	-	0.2
				Layer II, Level 1	9	-	2.4
				EU-31 Total:	40	1	16.4

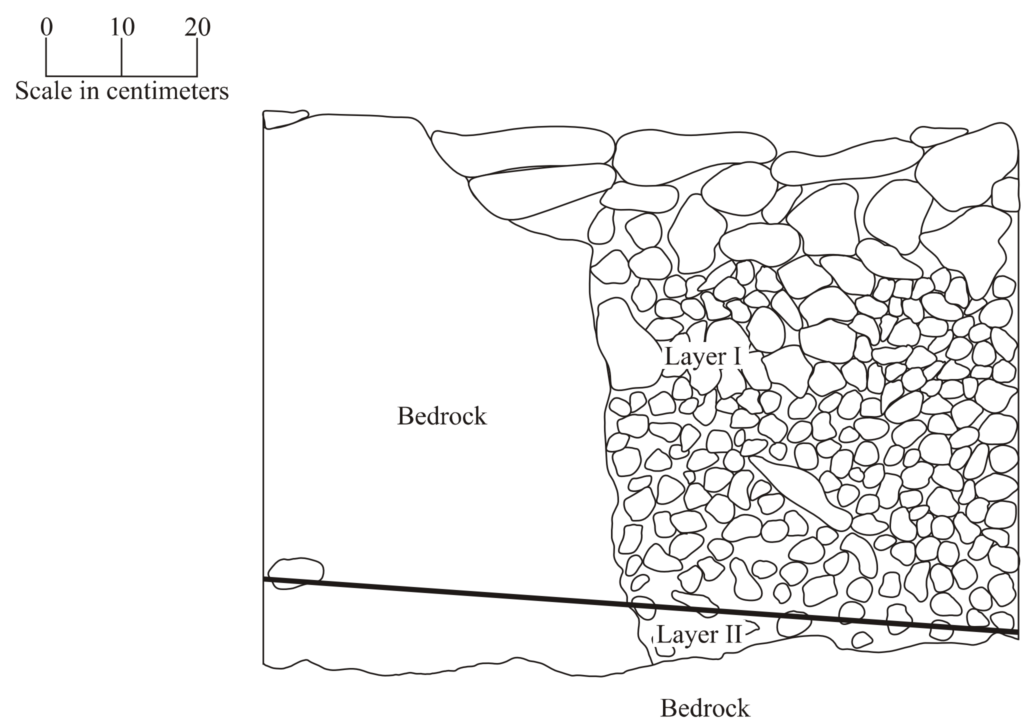
EU-32 contained the following stratigraphic profile (Figures 9 and 10):

Layer I (0-60cmbs)........... architectural layer with *ʻaʻā* cobbles.

Layer II (60-70cmbs) .... pebble and cobble layer with brown (10YR 3/3) silt in southeastern corner.

Items recovered from EU-32 include *kukui* nutshell fragments and brown bottle glass (Table 7).

Figure 9. SIHP Site 23670 Feature A EU-32 base of excavation, view to the west.



Layer I - Architectural layer.

Layer II - Predominantly pebble and cobble layer with brown (10YR 3/3) silt in southeastern corner.

Figure 10. SIHP Site 23670 Feature A EU-32 north wall profile.

Table 7. Recovered items from SIHP Site 3670, Feature A, EU-32.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
522	I	1	Organic	*Kukui* nutshell	2	-	0.5
521	I	1	Glass	Bottle/brown	1	-	0.7
				EU-32 Total:	3	0	1.2

Feature B

Feature B, the upper platform of the two-tiered platform (see Figure 4), is situated on the northeast corner of Feature A. Feature B is rectangular in shape measuring 3.4 meters long by 3.0 meters wide. The stacked edges rise as much as 30 centimeters (2 courses) above the surface of Feature A and 54 centimeters above the bedrock ground surface. Test Unit 12 (TU-12) was excavated near the central portion of Feature B, whereas Excavation Unit 34 (EU-34) was excavated near the eastern corner of Feature B.

Excavation of TU-12 (1 x 1m) revealed the following stratigraphic profile (see Figure 4):

Layer I (0-35cmbs)........... architectural layer with small to large *‘a‘ā* cobbles and boulders.
Layer II (35-45cmbs) .... fine loosely packed brown (10YR 4/3) silt mixed with gravels and organics.
Layer III (45-70cmbs)...... brown (10YR 4/3) silt mixed with decomposing bedrock on bedrock.

No cultural material was recovered from TU-12.

The surface of Feature B on which EU-34 was placed had a pavement of pebbles and cobbles. The surface sloped to the south, probably due to collapsed stacking on this side of Feature B. EU-34 (1 x 1m) revealed the following stratigraphic profile (Figures 11 and 12):

Layer I (0-60cmbs)........... architectural layer with large and small *‘a‘ā* cobbles and pebbles.
Layer II (60-80cmbs) .... loose *‘a‘ā* on uneven bedrock.

The only item recovered within EU-34 is 0.4 grams of charcoal (Acc# 523) in Layer II.

Figure 11. SIHP Site 23670 Feature B EU-34 base of excavation, view to the east.

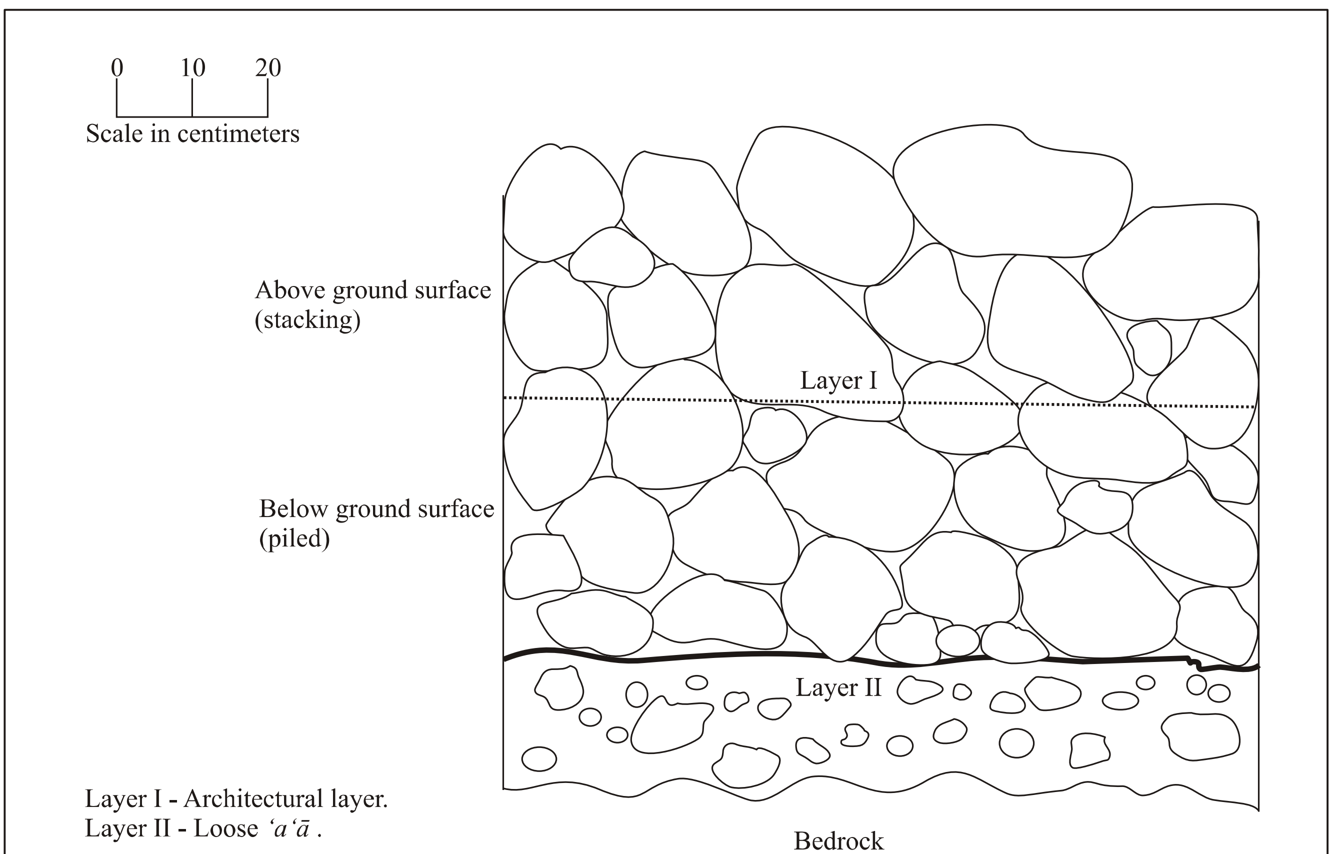


Figure 12. SIHP Site 23670 Feature B EU-34 east wall profile.

Feature C
Feature C is a small rectangular platform located 1.5 meters south of Feature A's southwestern corner (see Figure 4). Feature C measures 3.8 meters long by 2.5 to 3.1 meters wide (including some collapsed cobbles that are scattered along the southeast side of the feature) with stacked sides standing up to 35 centimeters (1 to 2 courses) above the surrounding bedrock ground surface. Feature C is in relatively good condition, although portions of its southwestern edge have collapsed. No habitation debris was observed in the vicinity of this feature. EU-33 was placed on the southeastern side of the rough *ʻaʻā* pavement, within a slight depression.

Excavation of EU-33 (1 x 1m) contained the following stratigraphic profile (Figures 13 and 14):

Layer I (0-50cmbs)........... architectural layer with large and small *ʻaʻā* cobbles and pebbles.
Layer II (50-60cmbs) .... brown (10YR 4/3) silt and clay mixed with organics and decomposing *ʻaʻā* bedrock.

No cultural material was recovered from EU-33.

SIHP Site 23671

Site 23671 is a platform remnant located in the central portion of the project area (see Figure 3). The platform (Figure 15), constructed of *ʻaʻā* cobbles, is largely collapsed although some stacking remained along the western edge. Current platform dimensions are 6.9 meters (north/south) by 3.8 meters (east/west) including the rubble scatter that surrounds the feature. The stacked western edge of the site is 90 centimeters above the surrounding bedrock surface. The surface of the platform is relatively level and paved primarily with small *ʻaʻā* cobbles, although some larger cobbles are present. Site 23671 seems to have been heavily disturbed by ranching activities in the area. No habitation debris was observed on ground surface at this site. During data recovery EU-4 was placed immediately south of the feature's center (Figure 16).

Excavation of EU-4 (2 x 2m) revealed the following stratigraphic profile (Figures 17 and 18):

Layer I, Level 1 (0-40cmbs)............architectural layer with *ʻaʻā* boulders and cobbles.
Layer I, Level 2 (40-65cmbs) *ʻaʻā* cobbles with dark grayish brown (10YR 3/2) silt.
Layer II, Level 1 (65-90cmbs) .... *ʻaʻā* cobbles with brown (10YR 4/3) silt.
Layer II, Level 2 (90-100cmbs) ...... *ʻaʻā* cobbles with brown (10YR 4/3) silt.
Layer II, Level 3 (100-110cmbs) ....exfoliating bedrock with *ʻaʻā* cobbles and dark yellowish brown (10YR 3/4) silt and rootlets.

Figure 13. SIHP Site 23670 Feature C EU-33 base of excavation, view to the south.

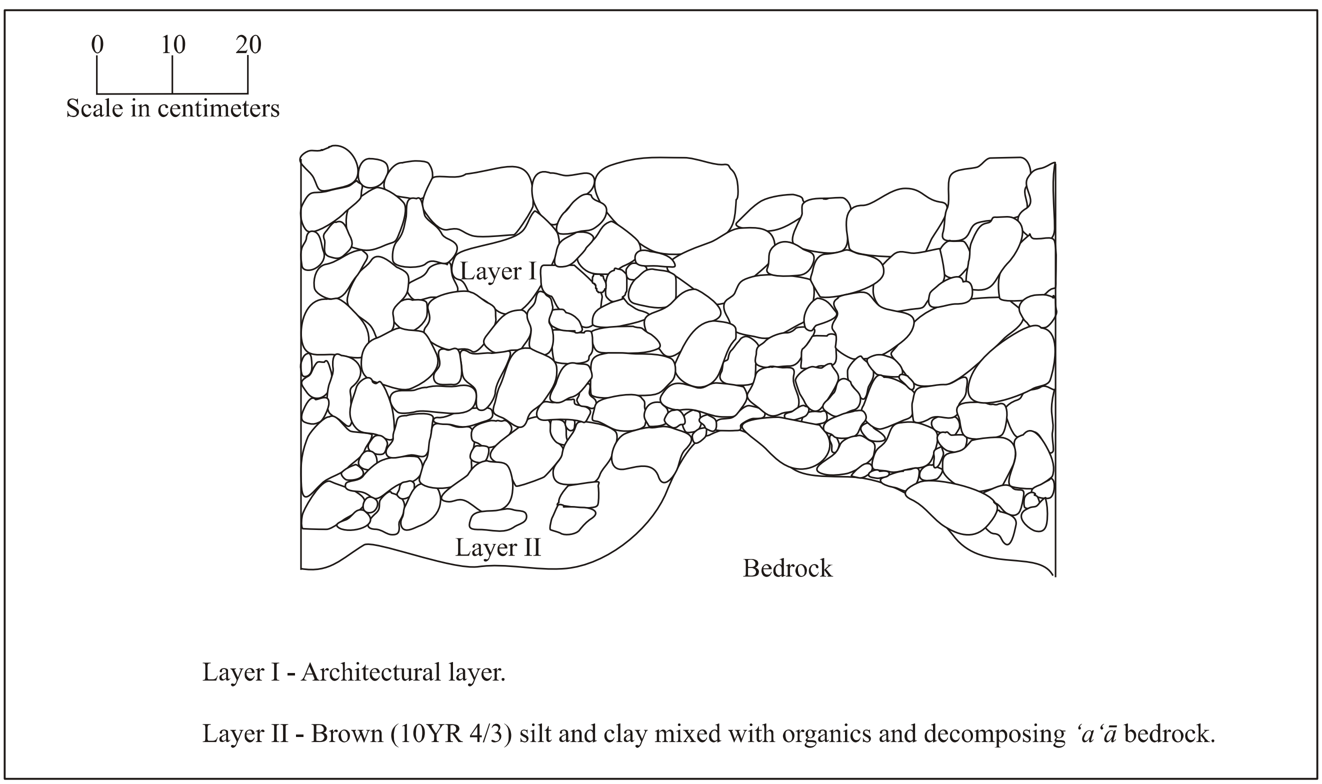


Figure 14. SIHP Site 23670 Feature C EU-33 south wall profile.

Figure 15. SIHP Site 23671, view to the north.

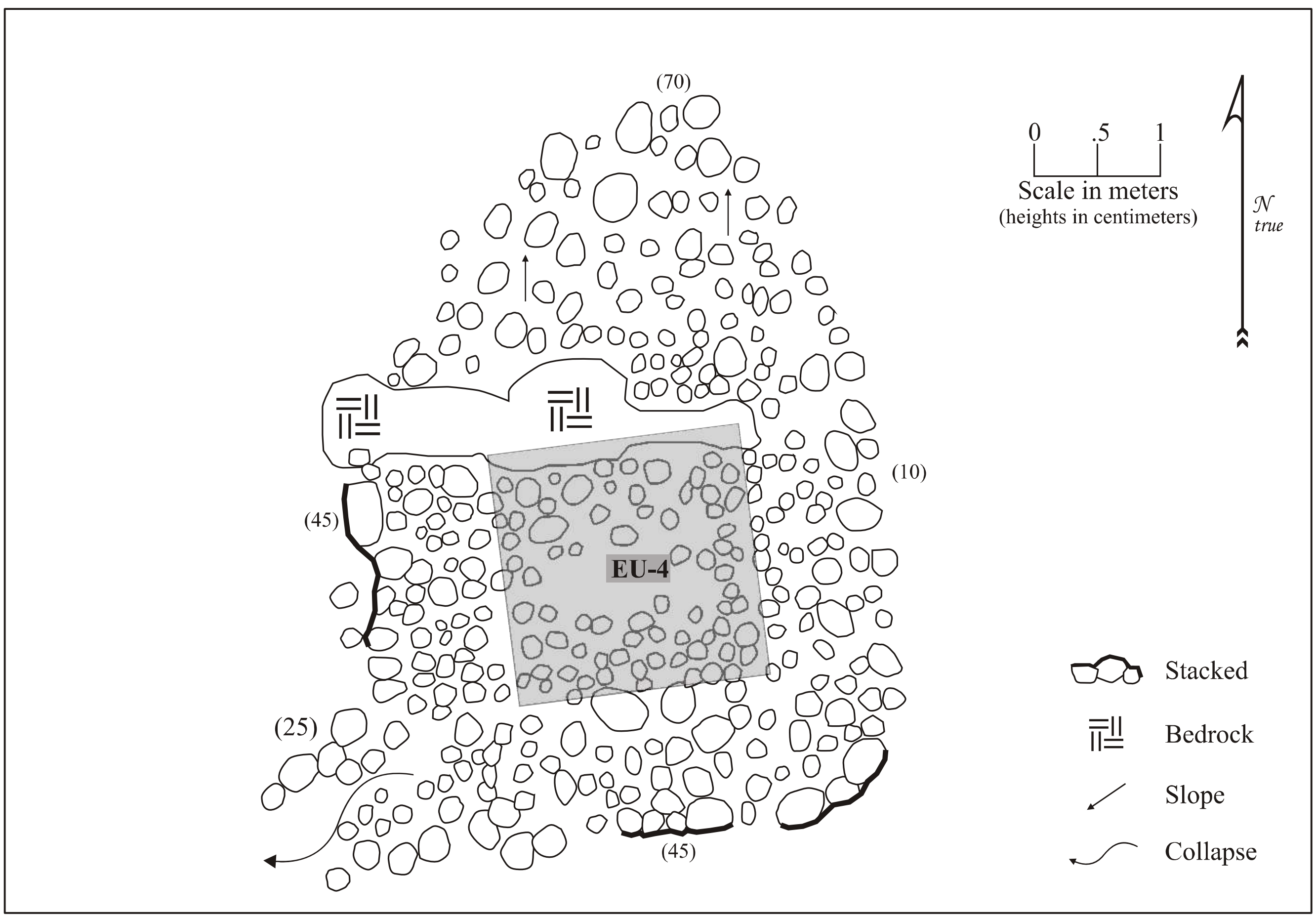
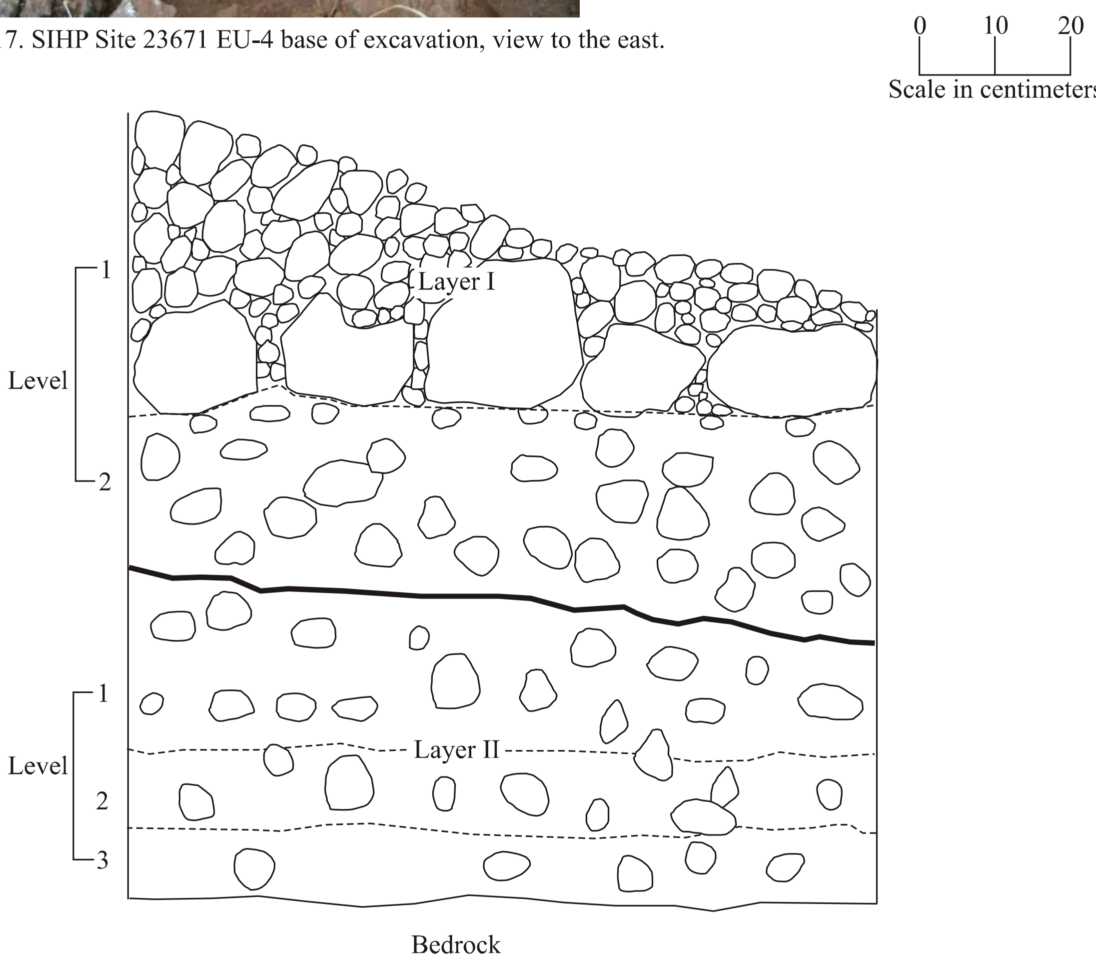


Figure 16. SIHP Site 23671 plan view.

Figure 17. SIHP Site 23671 EU-4 base of excavation, view to the east.



Layer I, Level 1- Architectural layer with *ʻaʻā* boulders and cobbles.

Layer I, Level 2- *ʻAʻā* cobbles with dark grayish brown (10YR 3/2) silt.

Layer II, Level 1- *ʻAʻā* cobbles with brown (10YR 4/3) silt.

Layer II, Level 2- *ʻAʻā* cobbles with brown (10YR 4/3) silt.

Layer II, Level 3- Exfoliating bedrock with *ʻaʻā* cobbles and dark yellowish brown (10YR 3/4) silt.

Figure 18. SIHP Site 23671 EU-4 south wall profile.

Items recovered from EU-4 include *Cypraea* sp. shell, *Drupa* sp., *Morula* sp., *Isognomon* sp., *Nerita* sp., branch coral, Echinoidea, *Turbo* sp., *Brachidontes* sp., *Conus* sp., unidentifiable shell, rodent, charcoal, a basalt flake, and volcanic glass flakes (Table 8). A volcanic glass flake (Acc# 187) that shows signs of working on one edge is 17.9 millimeters long, 14.2 millimeters wide, and 3.3 millimeters thick. No obvious changes or trends in species or artifact types recovered from different layers could be detected.

Table 8. Recovered items from SIHP Site 23671, EU-4.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
7	I	1	Marine shell	*Cypraea* sp.	3	2	6.8
8	I	1	Coral	Waterworn	2	-	3.2
9	I	1	Echinoderm	Echinoidea	1	-	0.4
				Layer I, Level 1 Total:	6	2	10.4
12	I	2	Marine shell	*Cypraea* sp.	17	4	14.6
16	I	2	Marine shell	*Drupa* sp.	1	1	0.7
14	I	2	Marine shell	*Morula* sp.	3	3	2.7
18	I	2	Marine shell	*Isognomon* sp.	14	4	1.6
17	I	2	Marine shell	*Nerita* sp.	1	1	0.4
21	I	2	Marine shell	*Turbo* sp.	1	1	0.5
19	I	2	Marine shell	*Brachiodontes* sp.	50	10	3.4
15	I	2	Marine shell	*Conus* sp.	1	1	1.5
22	I	2	Marine shell	Unidentified	3	-	0.4
20	I	2	Echinoderm	Echinoidea	167	-	13.5
13	I	2	Mammal bone	Unidentified rodent	1	-	0.3
11	I	2	Basalt	Flake	1	-	5.7
10	I	2	Organic	Charcoal	-	-	1.6
				Layer I, Level 2 Total:	260	25	46.9
27	II	1	Marine shell	*Cypraea* sp.	24	4	18.0
25	II	1	Marine shell	*Isognomon* sp.	80	30	4.2
26	II	1	Marine shell	*Brachidontes* sp.	58	14	3.8
187	II	1	Volcanic glass	Flake worked	1	-	1.0
24	II	1	Volcanic glass	Flake	1	-	0.5
23	II	1	Organic	Charcoal	-	-	0.5
				Layer II, Level 1 Total:	164	48	28.0
29	II	2	Marine shell	*Cypraea* sp.	1	1	2.4
32	II	2	Marine shell	*Drupa* sp.	5	2	4.1
31	II	2	Marine shell	*Conus* sp.	1	1	2.2
30	II	2	Coral	Waterworn	1	-	0.6
28	II	2	Echinoderm	Echinoidea	208	-	14.2
				Layer II, Level 2 Total:	216	4	23.5
				EU-4 Total:	646	79	108.8

Charcoal collected from Layer I, Level 2 in EU-4 was submitted for radiocarbon assaying. The sample (Beta-212756) intercepts the tree-ring calibration curve at AD 1490 and has a 2-sigma standard deviation calibrated date range of AD 1440 to 1640.

SIHP SITE 23672

Site 23672 is centrally located within the project area (see Figure 3). The site consists of a large rectangular enclosure (Feature A) with a small rectangular enclosure (Feature B) located six meters to its south (Figure 19). Bulldozing activity along the old central access road came close to impacting the north edge of Feature A and may have covered a third feature near its northwest corner. Two test units (TU-11 and TU-13), one in each feature, were excavated at Site 23672. Two additional excavation units (EU-2 and EU-3) were completed in Feature A.

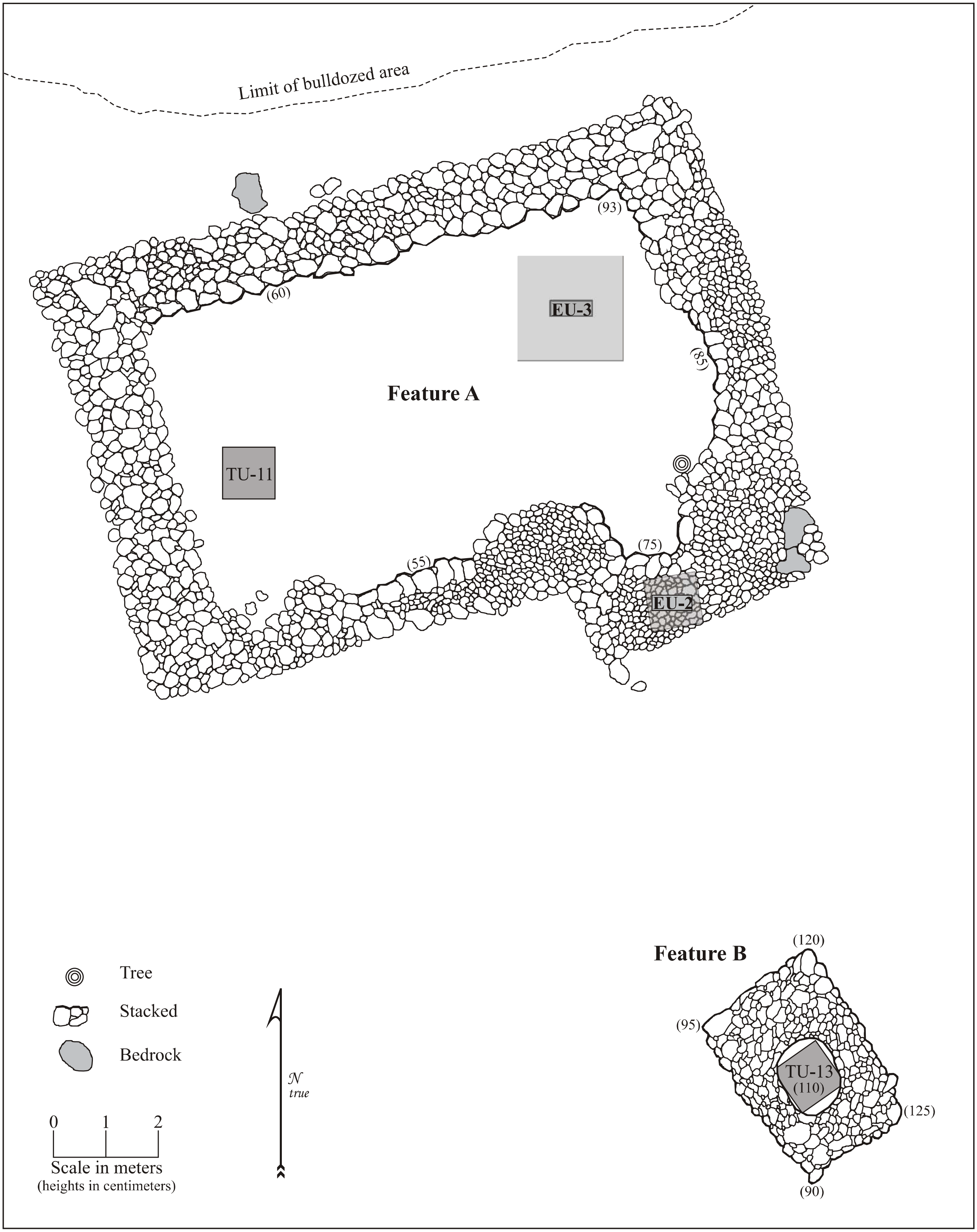


Figure 19. SIHP Site 23672 Features A and B plan view.

Feature A

Feature A is a large low-lying enclosure located at the north end of Site 23672 (see Figure 19). The enclosure (Figure 20), constructed of piled and stacked *ʻaʻā* cobbles, measures 13.5 meters long by 8.5 meters wide. The interior area of the enclosure (10.1 meters by 6.0 meters) has been cleared of cobbles leaving a leveled soil floor. The cleared cobbles were used to create the enclosure's walls, which stand between 60 and 90 centimeters in height along the interior edges and gradually transition into ground surface along the exterior edges.

Figure 20. SIHP Site 23672 Feature A, view to the northeast (location of EU-3).

TU-11 was excavated in the soil floor along the western interior wall of Feature A (see Figure 19). Excavation of TU-11 (1 x 1m) revealed the following stratigraphic profile (Figures 21 and 22):

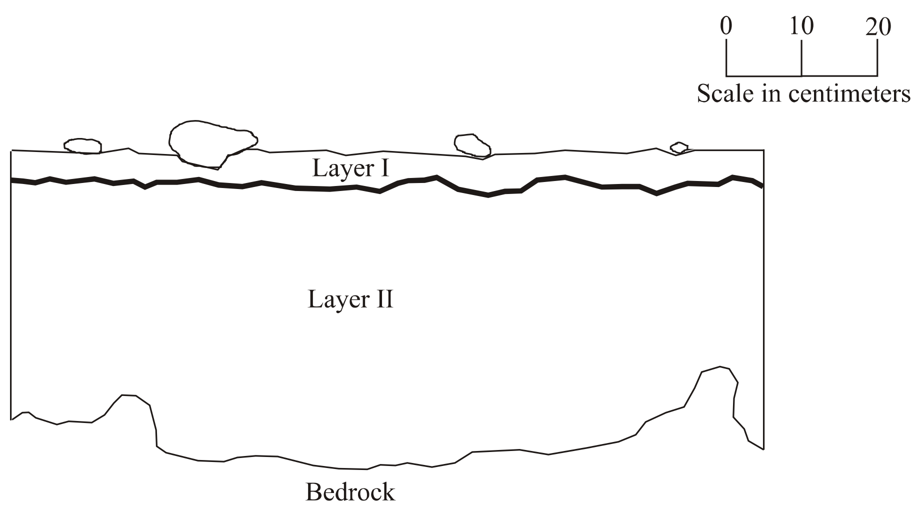
Layer I (0-4cmbs)............. very dark brown (10YR 2/2) thin topsoil mixed with grass roots and organics.

Layer II (4-42cmbs) .... *ʻaʻā* cobbles mixed fairly evenly with a sandy-silt soil gradually transitioning from very dark brown (10YR 2/2) to dark yellowish brown (10YR 4/4) and mixed with decomposing bedrock with increasing depth until bedrock.

Sixteen cow bone fragments were recovered from Layer I and the top of Layer II. These bones showed no sign of human processing and are most likely not related to the feature, but rather to the cow pasture within which the feature resides.

An excavation unit (EU-2) was placed in the southeastern corner of Feature A, within the constructed wall south of the interior. The surface of the unit was fairly level, with medium-sized *ʻaʻā* boulders and cobbles on the northern half and smaller *aʻā* cobbles and pebbles on the southern side. A possible constructed posthole occurred in the southeastern quadrant of EU-2.

Figure 21. SIHP Site 23672 Feature A TU-11 base of excavation, view to the north.



Layer I - Very dark brown (10YR 2/2) thin topsoil.

Layer II - *ʻAʻā* cobble layer mixed with sandy-silt soil. Layer gradually transitions from very dark brown (10YR 2/2) to dark yellowish brown (10YR 4/4).

Figure 22. SIHP Site 23672 Feature A TU-11 north wall profile.

Excavation of EU-2 (1 x 1m) revealed the following stratigraphic profile (Figures 23 and 24):

Layer I (0-10cmbs)........... *a'ā* boulders and cobbles with very dark brown (10YR 2/2) silt.
Layer II (4-42cmbs) .... fewer and smaller *'a'ā* cobbles and pebbles with very dark brown (10YR 2/2) silt on uneven bedrock.

EU-2 yielded a *Cypraea* sp. shell fragment and a volcanic glass flake (Table 9).

Table 9. Recovered items from SIHP Site 3672, Feature A, EU-2.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
1	I	1	Marine shell	*Cypraea* sp.	1	1	1.8
2	II	1	Volcanic glass	Flake	1	-	2.8
				EU-2 Total:	2	1	4.6

EU-3 was placed on the interior surface near the northeastern corner of the Feature A enclosure of Site 23672 (see Figure 19). Excavation of EU-3 (2 x 2m) revealed the following stratigraphic profile (Figures 25 and 26):

Layer I, Level 1 (0-25cmbs) ....very dark brown (10YR 2/2) silt with gravelly inclusions.
Layer I, Level 2 (25-30cmbs) ....very dark yellowish brown (10YR 4/4) silt on *'a'ā* bedrock.

EU-3 yielded waterworn coral fragments, bone fragments of a rodent, volcanic glass flakes, and charcoal fragments (Table 10).

Table 10. Recovered items from SIHP Site 23672, Feature A, EU-3.

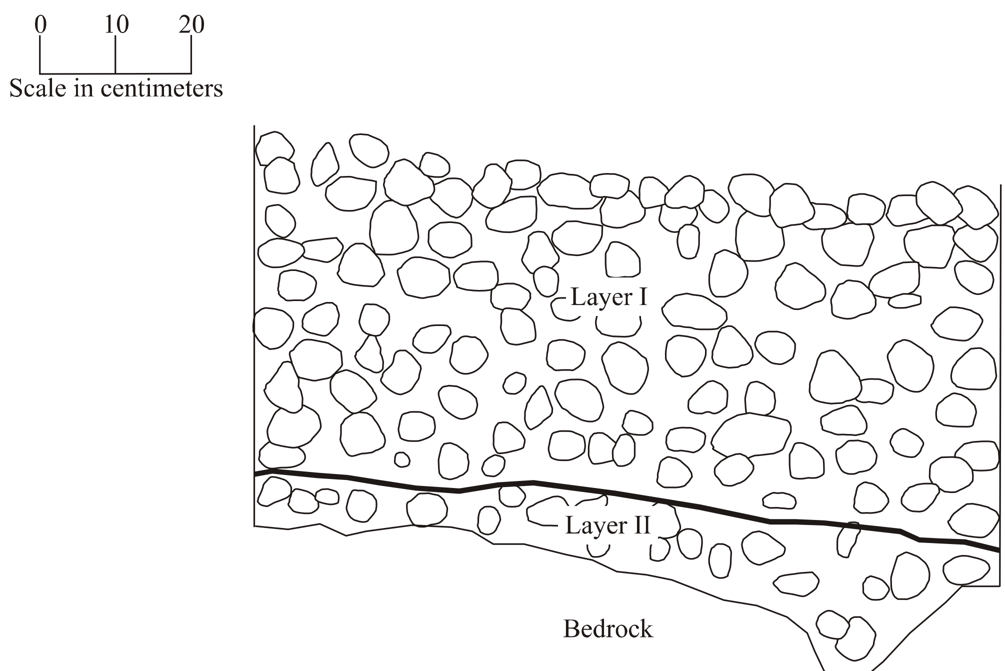
ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
4	I	1	Coral	Waterworn	3	-	2.1
3	I	1	Mammal bone	Unidentified rodent	6	1	2.0
				Layer I, Level 1 Total:	9	1	4.1
5	I	2	Volcanic glass	Flake	2	-	0.6
6	I	2	Organic	Charcoal	-	-	0.4
				Layer I, Level 2 Total:	2	-	1.0
				EU-3 Total:	11	1	5.1

Feature B

Feature B is a small roughly rectangular enclosure with rounded corners located six meters south of Feature A (see Figure 19). The enclosure is constructed on an *'a'ā* bedrock outcrop of stacked *'a'ā* cobbles standing 6 to 8 courses (1.0–1.3 meters) high (Figure 27). It measures 3.5 meters long by 2.5 meters wide along its exterior edges and has a roughly circular centrally located interior space 1.2 meters in diameter and 1.1 meters deep containing a soil floor. A rubber hose fragment, a modern beer can, decaying organics, and several cobbles were resting on ground surface within the enclosure. Feature B is not large enough to have been used for habitation purposes. The entire soil floor of Feature B was removed as a single 1 x 1 meter test unit (TU-13). Excavation of TU-13 revealed the following two distinct soil horizons resting on bedrock (Figure 28):

Layer I (0-22cmbs)........... very dark grayish brown (10YR 3/2) fine silt mixed with many small *'a'ā* pebbles, roots and decaying organic material (bedrock in the northeastern corner just below ground surface)
Layer II (22-42cmbs) .... dark brown (10YR 3/3) fine silt mixed with decomposing bedrock on bedrock.

Figure 23. SIHP Site 23672 Feature A EU-2 base of excavation, view to the south/southeast.



Layer I- *‘A‘ā* boulders and cobbles with very dark brown (10YR 2/2) silt.

Layer II- Small amount of *‘a‘ā* cobbles and pebbles with very dark brown (10YR 2/2) silt.

Figure 24. SIHP Site 23672 Feature A EU-2 south wall profile.

Figure 25. SIHP Site 23672 Feature A EU-3 base of excavation, view to the east.

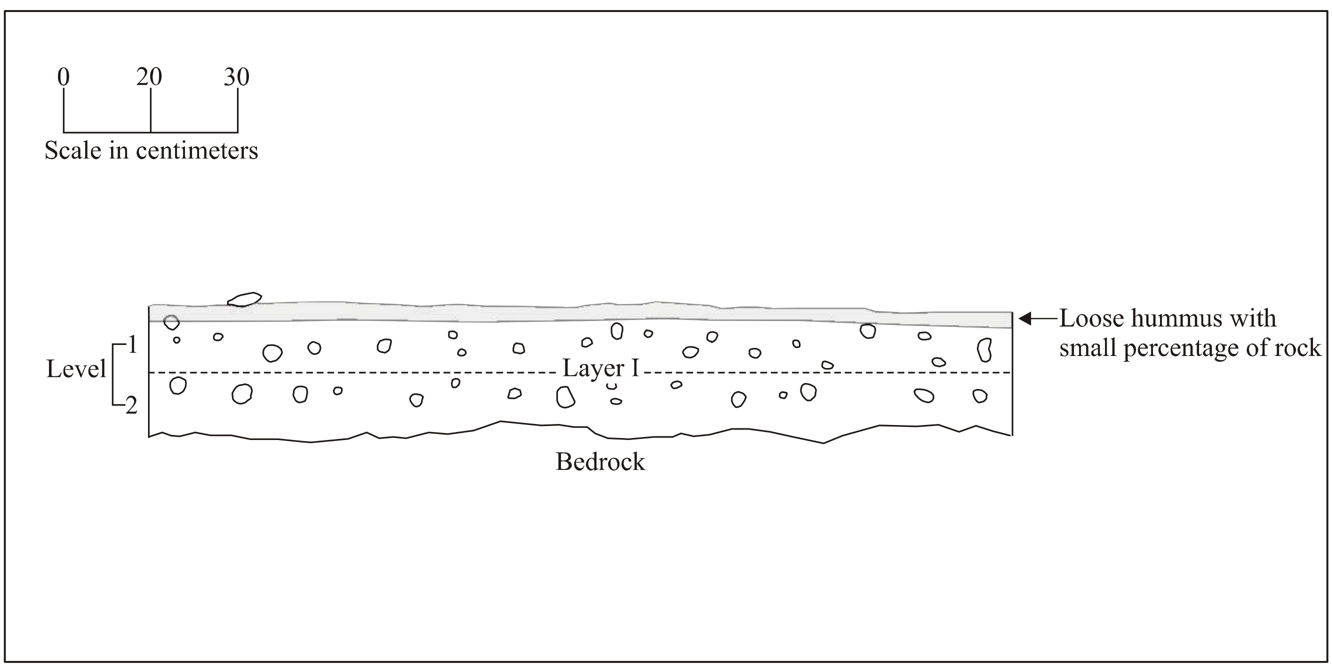


Figure 26. SIHP Site 23672 Feature A EU-3 east wall profile.

TU-13 yielded shark teeth, *Drupa* sp. fragments, *Nerita* sp. fragments, a rodent bone, *kuku*i nutshell fragments, charcoal fragments, volcanic glass flakes and shatter, and waterworn basalt (Table 11). No trends of recovered species or artifact types by increasing depth were apparent, apart from a recovery peak between 10 and 20 centimeters deep.

Table 11. Recovered items from SIHP Site 23672, Feature B, TU-13 Layer I.

ACC #	*Depth (cm)*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
4	0-10	Volcanic glass	Flake	4	-	1.5
5	0-10	Organic	*Kukui* nutshell	2	1	3.0
6	10-20	Basalt	Waterworn	1	-	45.1
7	10-20	Volcanic glass	Shatter	44	-	17.5
8	10-20	Mammal bone	Rodent	1	1	0.1
9	10-20	Fish bone	Shark (teeth)	2	1	0.2
10	10-20	Marine shell	*Drupa* sp.	1	1	0.1
11	10-20	Marine shell	*Nerita* sp.	1	1	0.2
12	10-20	Organic	Charcoal	-	-	1.8
			TU-13 Total:	65	5	69.5

Figure 27. SIHP Site 23672 Feature B exterior, view to the north.

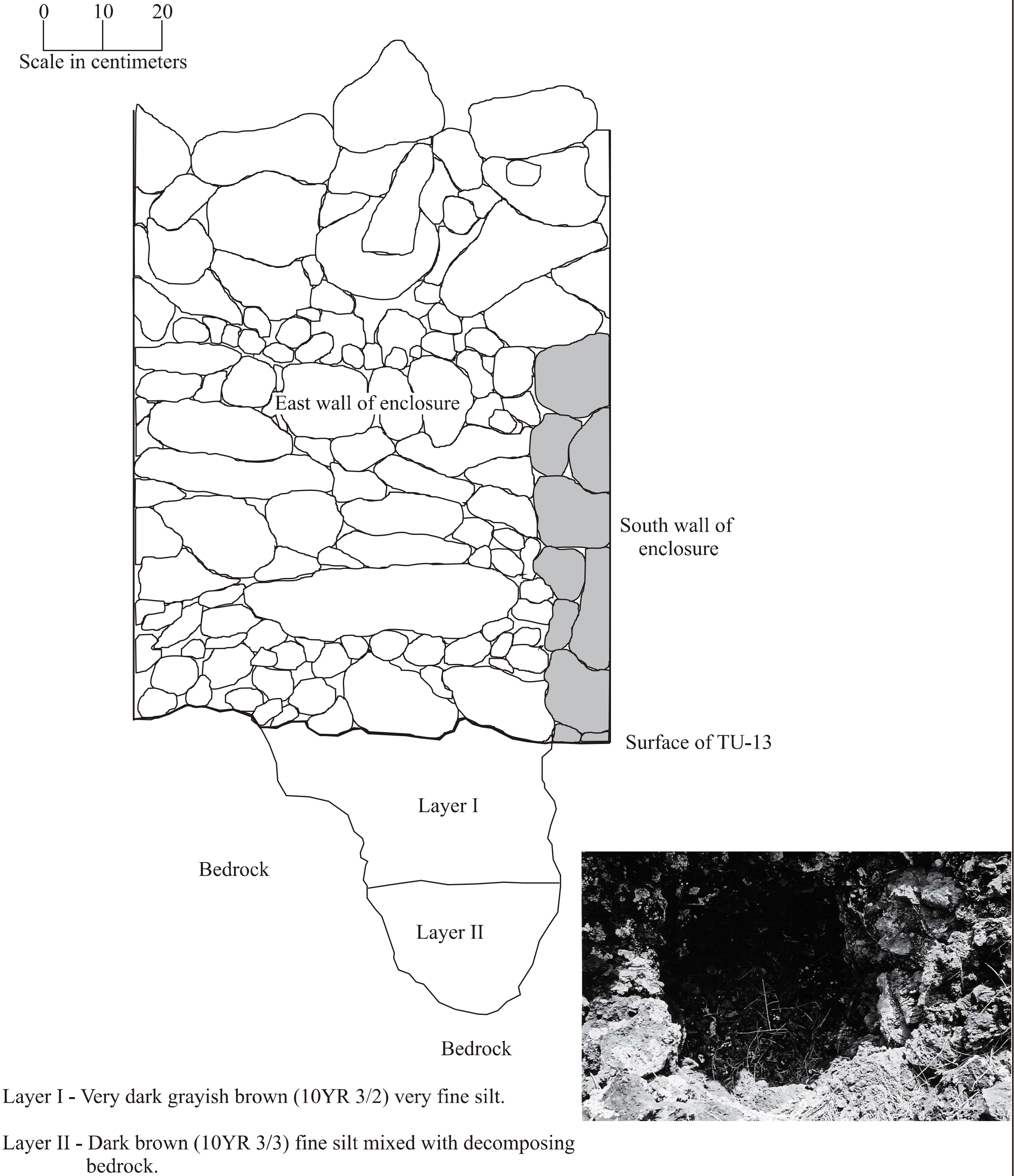


Figure 28. SIHP Site 23672 Feature B TU-13 east wall profile and photograph of base of excavation.

A charcoal sample (1.8 grams) was collected from Layer I during the screening of Level 2, 10-20 centimeters below the surface of TU-13. The carbon sample from this layer was sent to Beta Analytic, Inc. for radiocarbon age determination (Beta-175916). The sample produced a conventional radiocarbon age of 210±70 years before present, or a 2 sigma calibrated range of AD 1510 to 1950 with an intercept of AD 1660 (Clark and Rechtman 2003).

EU-1b was placed in the north section of Feature B, measuring 2 meters from west to east and 1 meter from south to north. Excavation of EU-1b revealed the following stratigraphic profile (Figures 29 and 30):

Layer I (0-80cmbs)........... very dark brown (10YR 3/3) silt mixed with *‘a‘ā* cobbles.
Layer II (80-110cmbs)...... very dark brown (10YR 3/3) fine silt mixed with *‘a‘ā* pebbles on bedrock.

No cultural material was recovered from EU-1b.

SIHP Site 23673

Site 23673 consists of a platform (Feature A) and an enclosure (Feature B) located in the eastern half of the project area along the southern property boundary (see Figure 3). The permanent habitation interpretation is primarily based on size (Cordy 1991; 1995). The features are constructed of *‘a‘ā* cobbles and boulders in an area of exposed bedrock and thin soil. Feature A is located 6.7 meters west of Feature B (Figure 31). Modern debris was observed on the surface of the site including a paint can lid and several golf balls.

Feature A

Feature A is a platform measuring 6.8 meters long by 3.9 meters wide (see Figure 31). It is constructed of large cobbles and boulders stacked along the exterior edges (Figure 32) and small cobbles paving the roughly level platform surface. The western edge of the feature rises 90 centimeters above ground surface, while the eastern edge rises 40 to 70 centimeters above ground surface. The exterior edges of Feature A are collapsed in several locations. The following three excavations were conducted on the Feature A platform surface: TU-17 (1 x 1m); EU-27 (1 x 2m); and EU-28 (1 x 2m).

TU-17 was excavated in the approximate center of Feature A and revealed the following stratigraphic profile (see Figure 31):

Layer I (0-65cmbs)........... architectural layer with small to large sized *‘a‘ā* cobbles.
Layer II (65-73cmbs) .... very dark grayish brown (10YR 3/2) medium grained coarse silt rich with organics.
Layer III (73-86cmbs)...... dark gray (10YR 4/1) medium grained coarse silt mixed with ash and *‘a‘ā* gravels
Layer IV (86-88cmbs)...... dark brown (10YR 3/3) fine silt mixed with gravels.
Layer V (88-90cmbs) .... culturally sterile dark brown (7.5YR 3/4) fine silt mixed with decaying bedrock on bedrock.

Items recovered from TU-17 include fish, *Cypraea* sp., *Drupa* sp., *Cellana* sp., *Nerita* sp., branch coral, Echinoidea, *Conus* sp., rodent, *kukui* nutshell, unidentifiable plant seed, and volcanic glass flakes (Table 12). Apart from a species and artifact type peak in Layer III, no definite trends or change in items could be detected from one layer to the next.

Figure 29. SIHP Site 23672 Feature B EU-1b base of excavation, view to the south.

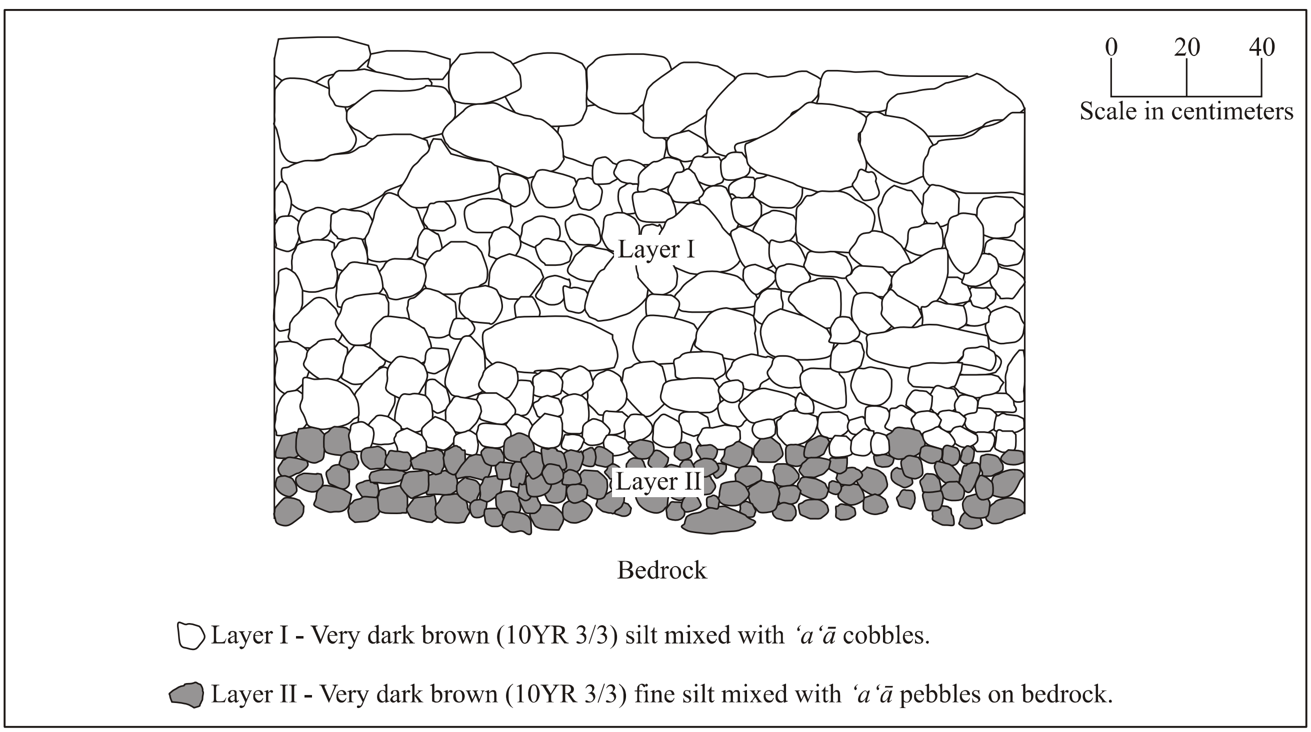


Figure 30. SIHP Site 23672 Feature B EU-1b south wall profile.

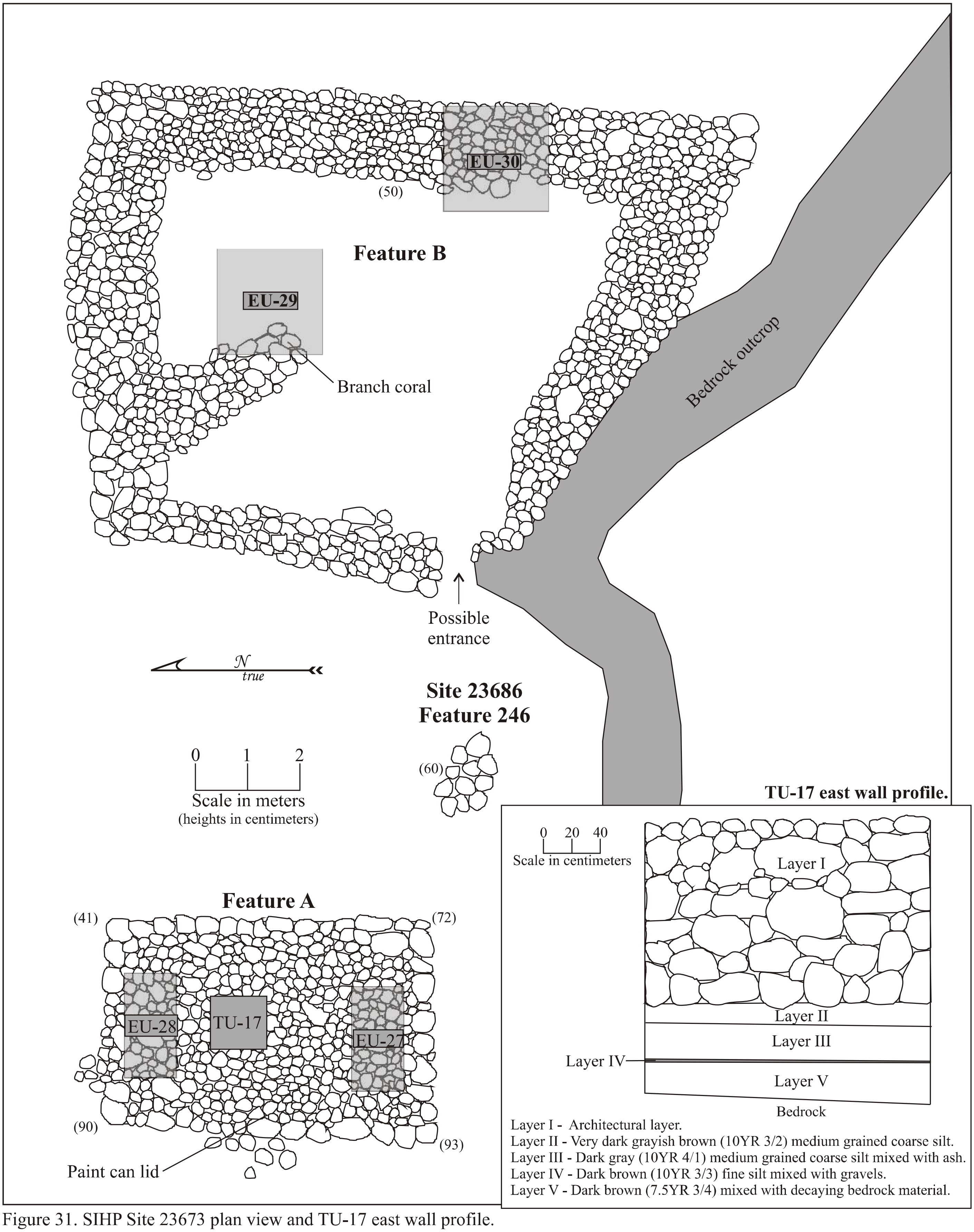


Figure 31. SIHP Site 23673 plan view and TU-17 east wall profile.


Figure 32. SIHP Site 23673 Feature A, view to the north.

Table 12. Recovered items from SIHP Site 23673, Feature A, TU-17.

ACC #	*Layer*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
58	I	Coral	Branch	1	1	28.7
59	I	Organic	*Kukui* nutshell	1	1	6.3
60	I	Echinoderm	Echinoidea	7	1	0.1
61	I	Marine shell	*Cypraea* sp.	1	1	2.0
62	I	Mammal bone	Rodent	1	1	0.1
			Layer I Total:	11	5	37.2
63	II	Coral	Branch	1	1	0.4
64	II	Organic	*Kukui* nutshell	6	1	1.6
65	II	Echinoderm	Echinoidea	4	1	1.0
66	II	Marine shell	*Cypraea* sp.	5	2	5.3
67	II	Fish bone	Unidentified	1	1	0.6
68	II	Mammal bone	Rodent	1	1	0.1
69	II	Volcanic glass	Flakes	15	-	11.2
			Layer II Total:	33	7	20.2
70	III	Organic	Seed	1	1	0.1
71	III	Echinoderm	Echinoidea	109	1	9.1
72	III	Marine shell	*Cypraea* sp.	6	3	6.6
73	III	Marine shell	*Drupa* sp.	3	1	0.7
74	III	Marine shell	*Nerita* sp.	2	2	0.4
75	III	Marine shell	*Cellana* sp.	3	1	0.5
76	III	Organic	*Kukui* nutshell	6	1	0.4
77	III	Fish bone	Unidentified	4	1	3.6
78	III	Volcanic glass	Flake	24	-	12.1

Continued on next page

Table 12. Continued.

ACC #	*Layer*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
81	III	Basalt	Flake	1	-	0.1
			Layer III Total:	159	11	33.6
82	IV	Echinoderm	Echinoidea	13	1	0.8
83	IV	Volcanic glass	Flake	2	-	0.3
84	IV	Marine shell	*Cypraea* sp.	4	1	2.7
85	IV	Marine shell	*Conus* sp.	1	1	2.1
86	IV	Marine shell	*Drupa* sp.	1	1	0.3
			Layer IV Total:	21	4	6.2
			TU-17 Total:	224	27	97.2

EU-27 (aligned east-west) was excavated in the southern third of the Feature A platform and revealed the following stratigraphic profile (see Figures 33 and 34):

Layer I (0-120cmbs)......... architectural layer with small *ʻaʻā* cobbles on the surface transitioning to larger ones with depth.

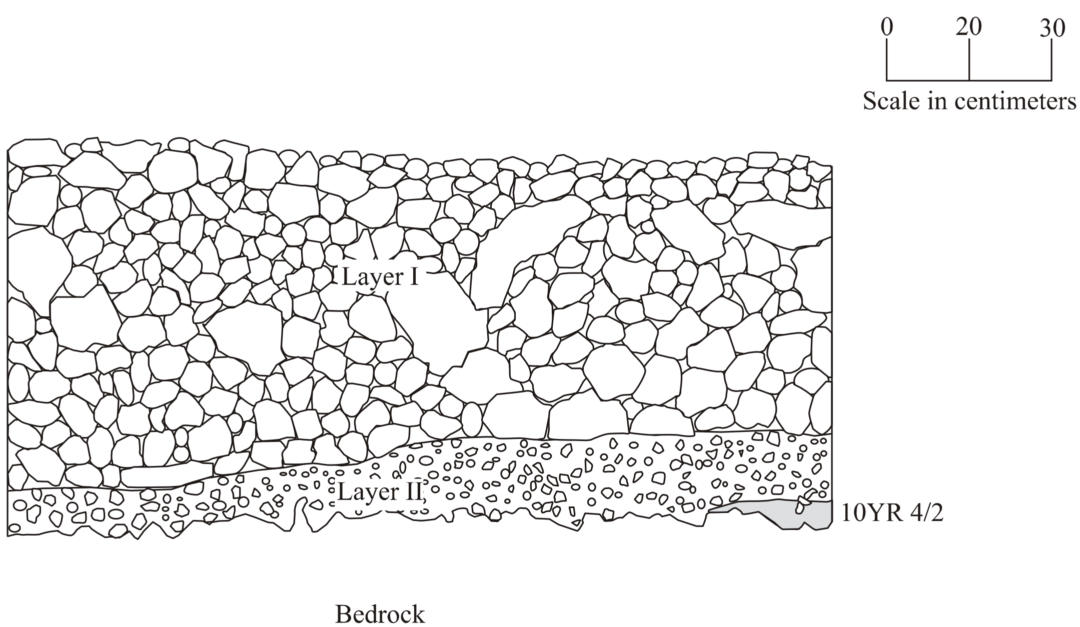
Layer II (120-135cmbs) ... very dark grayish brown (10YR 3/2) medium grained silt with a gray (10YR 4/2) silt pocket in northeastern corner (both on undulating decomposed bedrock).

Items recovered from EU-27 include *Cypraea* sp., *Isognomon* sp., branch coral, Echinoidea, *Fimbria* sp., unidentifiable shell, *kukui* nutshell, charcoal, volcanic glass flakes and shatter, and waterworn basalt (Table 13). No definite stratigraphic trends in recovered items could be detected, except for the Layer II spike.

Table 13. Recovered items from SIHP Site 23673, Feature A, EU-27.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
419	I	1	Marine shell	*Cypraea* sp.	1	1	3.8
420	I	1	Marine shell	*Fimbria* sp.	2	1	2.6
421	I	1	Coral	Branch	4	-	59.0
422	I	1	Coral	Unidentified	-	-	54.2
417	I	1	Basalt	Waterworn pebble	1	-	51.4
416	I	1	Volcanic glass	Flake	1	-	0.7
418	I	1	Organic	*Kukui* nutshell	3	-	5.1
415	I	1	Organic	Charcoal	-	-	0.2
				Layer I, Level 1	12	2	177
425	II	1	Marine shell	*Isognomon* sp.	2	1	0.2
426	II	1	Echinoderm	Echinoidea	2	-	0.1
424	II	1	Volcanic glass	Flake	1	-	0.1
570	II	1	Volcanic glass	Shatter	1	-	13.5
423	II	1	Organic	*Kukui* nutshell/burnt	8	-	1.2
				Layer II, Level 1	14	1	15
430	II	2	Marine shell	Unidentified	3	-	0.7
431	II	2	Coral	Unidentified	1	-	0.1
432	II	2	Echinoderm	Echinoidea	6	-	0.7
429	II	2	Volcanic glass	Flake	9	-	2.6
571	II	2	Volcanic glass	Shatter	7	-	21.5
428	II	2	Organic	*Kukui* nutshell	7	-	0.9
427	II	2	Organic	Charcoal	-	-	0.2
				Layer II, Level 2	33	0	27
434	II	3	Marine shell	*Cypraea* sp.	1	1	0.1
433	II	3	Volcanic glass	Flake	2	-	0.8
				Layer II, Level 3	3	1	0.9
				EU-27 Total:	62	4	220

Figure 33. SIHP Site 23673 Feature A EU-27 base of excavation, view to the north.



Layer I- Architectural layer with small *‘a‘ā* cobbles and boulders.
Layer II- Very dark grayish brown (10YR 3/2) medium grained silt with a gray (10YR 4/2) silt pocket in northeastern corner.

Figure 34. SIHP Site 23673 Feature A EU-27 north wall profile.

EU-28 (aligned east-west) was excavated in the northern third of the Feature A platform and revealed the following stratigraphic profile (see Figures 35 and 36):

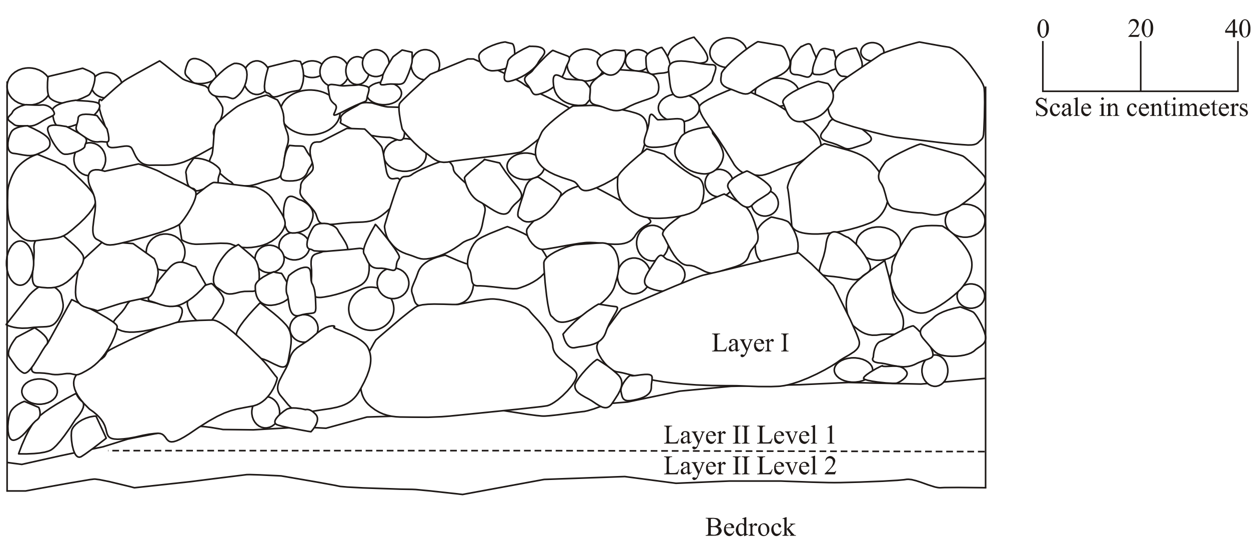
Layer I (0-90cmbs)........... architectural layer with small *'a'ā* cobbles on surface transitioning to larger ones with depth.
Layer II (90-98cmbs) .... thin band (i.e., 2cm thick) of dark brown (10YR 3/3) silt on dark grayish brown (10YR 3/2) loose silt.

Items recovered from EU-28 include fish, *Cypraea* sp., *Drupa* sp., coral, Echinoidea, *Mitra* sp., *Terebra* sp., unidentifiable shell, probable rodent, *kukui* nutshell, charcoal, basalt flake, and volcanic glass flakes and shatter (Table 14). A coral abrader (Acc# 439) from Layer I is cone-shaped with a pointed tip that has six abraded facets (Figure 37). The abrader is 19.15 millimeters long, 18.6 millimeters wide, and 7.9 millimeters thick. A worked coral fragment (Acc# 450) from Level 2 in Layer II has a tabular shape with six flattened surfaces (Figure 38). One of the sides is slanted so that the two edges come to a point. On the opposite side of this beveled edge is a crescent-shaped depression, roughly the size of a small finger. The worked piece of coral is 19.5 millimeters long, 18.6 millimeters wide, and 7.9 millimeters thick. An echinoderm abrader (Acc# 565) from Level 2 in Layer II has one side abraded from its mid-section to its proximal side where it attached to the main body (Figure 39). This abrader is 51.4 millimeters long, 9.6 millimeters wide, and 9.65 millimeters thick.

Table 14. Recovered items from SIHP Site 23673, Feature A, EU-28.

ACC#	***Layer***	***Level***	***Material***	***Species/type***	***Count***	***MNI***	***Weight (g)***
436	I		Marine shell	*Cypraea* sp.	1	1	2.2
437	I		Marine shell	Unidentified	1	-	3.8
439	I		Coral	Abrader	1	-	17.3
438	I		Coral	Unidentified	25	-	88.4
572	I		Basalt	Flake	1	-	6.0
435	I		Volcanic glass	Flake	6	-	6.3
573	I		Volcanic glass	Shatter	1	-	6.6
				Layer I Total:	36	1	131
441	II	1	Fish bone	Unidentified	1	-	1.0
442	II	1	Marine shell	*Cypraea* sp.	2	2	15.9
443	II	1	Marine shell	*Drupa* sp.	1	1	0.9
445	II	1	Coral	Unidentified	5	-	41.2
446	II	1	Coral	Unidentified	1	-	0.6
447	II	1	Echinoderm	Echinoidea	5	-	0.2
440	II	1	Volcanic glass	Flake	7	-	4.8
444	II	1	Organic	*Kukui* nutshell	6	-	0.4
				Layer II, Level 1 Total:	28	3	65
452	II	2	Marine shell	*Cypraea* sp.	1	1	1.4
454	II	2	Marine shell	*Mitra* sp.	1	1	0.1
453	II	2	Marine shell	*Terebra* sp.	1	1	0.1
455	II	2	Marine shell	Unidentified	1	-	0.1
450	II	2	Coral	Worked	1	-	0.5
456	II	2	Coral	Unidentified	3		0.8
457	II	2	Echinoderm	Echinoidea	5	-	0.1
565	II	2	Echinoderm	Echinoidea abrader	1	-	1.6
451	II	2	Small mammal	Jaw and teeth	2	1	0.4
449	II	2	Volcanic glass	Flakes	10	-	6.0
448	II	2	Organic	Charcoal	-	-	0.3
				Layer II, Level 2 Total:	26	4	11
				EU-28 Total:	90	8	207

Figure 35. SIHP Site 23673 Feature A EU-28 base of excavation, view to the west.



Layer I- Architectural layer with small *‘a‘ā* cobbles on surface transitioning to larger ones with depth.

Layer II- Dark brown (10YR 3/3) silt on dark grayish brown (10YR 3/2) loose silt.

Figure 36. SIHP Site 23673 Feature A EU-28 north wall profile.


Figure 37. SIHP Site 23673 coral abrader from EU-28 (Acc#. 439).


Figure 38. SIHP Site 23673 worked coral fragment from EU-28 (Acc#. 450).


Figure 39. SIHP Site 23673 Echinoidea abrader from EU-28 (Acc#. 565).

Generally the same species and artifact types occur in both Layers I and II (Table 14), so no definite evidence exists that different depths represent different components or different activities.

Feature B

Feature B is a walled-enclosure located 6.7 meters east of Feature A (see Figure 31). The enclosure (Figure 40) is roughly square measuring 8.7 meters by 8.6 meters along its exterior edges. The enclosure walls, which are constructed of stacked (but largely collapsed) *ʻaʻā* cobbles, measure up to 1.2 meters wide and stand 50 centimeters high. The south edge of the feature abuts a raised linear *ʻaʻā* bedrock outcrop running northwest/southeast. There is a 1.0 meter wide opening (entrance?) accessing the enclosure's southwestern corner. A 3.0-meter long internal dividing wall runs southeast from Feature B's interior north wall. This internal wall, which may have partitioned off separate use areas within the enclosure, stands up to 70 centimeters high and 1.2 meters wide. A branch coral fragment was found on the surface of the wall's south end. No other cultural debris was observed at Feature B. The following two excavation units were conducted within Feature B: EU-29 (2 x 2m) and EU-30 (2 x 2m).

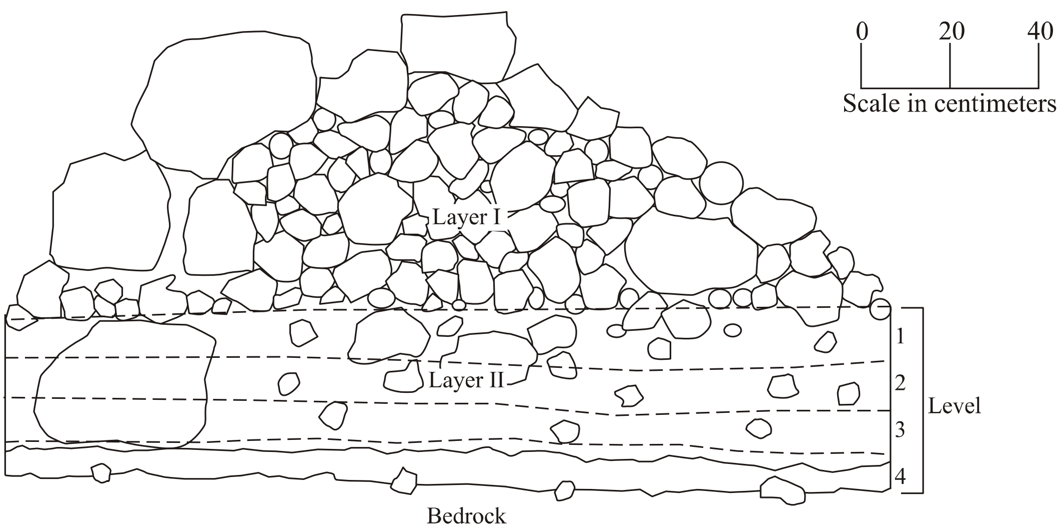
Figure 40. SIHP Site 23673 Feature B, view to the east.

EU-29 was placed in the northeastern portion of the Feature B enclosure, touching the southern tip of an internal partition wall, and revealed the following stratigraphic profile (Figures 41 and 42):

Layer I (0-60cmbs)...................... architectural layer with small to large *ʻaʻā* cobbles, fire cracked rock, and branch coral.
Layer II, Level 1 (60-70cmbs)..... small *ʻaʻā* cobbles with dark brown (10YR 3/3) silt.
Layer II, Level 2 (70-80cmbs)..... small *ʻaʻā* cobbles with very dark gray brown (10YR 3/1) silt.
Layer II, Level 3 (89-90cmbs)..... small *ʻaʻā* cobbles with very dark gray brown (10YR 3/1) silt.
Layer II, Level 4 (90-100cmbs)... small *ʻaʻā* cobbles with very dark brown (7.5YR 2.5/2) silt on weathered *ʻaʻā* bedrock.

Items recovered from EU-29 include *Thunnus thynnus*, unidentifiable fish, *Trochus* sp., *Cypraea* sp., *Drupa* sp., *Isognomon* sp., *Nerita* sp., *Thais* sp., coral, Echinoidea, *Conus* sp., unidentifiable shell, pig, small mammal, charcoal, and volcanic glass flakes (Table 15). A Historic Period .177 caliber lead pellet (Acc# 479) from Level 3 in Layer II testifies to some kind of intrusion into earlier layers. This pellet is 6.6 millimeters long, 5.6 millimeters wide, and 5.75 millimeters thick. An echinoderm abrader fragment (Acc# 482) came from the same provenience as the lead pellet. Only one side of the spine bears signs of abrasion. The spine fragment is 10.8 millimeters long, 6.10 millimeters wide, and 5.9 millimeters thick. Layer I yielded no items. Recovered items peaked in Level 3 of Layer II.

Figure 41. SIHP Site 23673 Feature B EU-29 base of excavation, view to the west.



Layer I- Architectural layer with small to large *ʻaʻā* cobbles.

Layer II, Level 1- Small *ʻaʻā* cobbles with dark brown (10YR 3/3) silt.

Layer II, Level 2- Small *ʻaʻā* cobbles with very dark gray brown (10YR 3/1) silt.

Layer II, Level 3- Small *ʻaʻā* cobbles with very dark gray brown (10YR 3/1) silt.

Layer II, Level 4- Small *ʻaʻā* cobbles with very dark brown (7.5YR 2.5/2) silt on weathered *ʻaʻā* bedrock.

Figure 42. SIHP Site 23673 Feature B EU-29 west wall profile.

Table 15. Recovered items from SIHP Site 23673, Feature B, EU-29.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
460	II	1	Fish bone	*Thunnus thynnus*	2	1	0.8
462	II	1	Marine shell	*Cypraea* sp.	9	2	7.8
463	II	1	Marine shell	*Nerita* sp.	1	1	0.2
464	II	1	Marine shell	Unidentified	2	-	0.4
465	II	1	Coral	Unidentified	1	-	27.4
466	II	1	Coral	Unidentified	2	-	3.1
467	II	1	Echinoderm	Echinoidea	9	-	0.6
461	II	1	Mammal bone	Unidentified	1	-	0.1
459	II	1	Volcanic glass	Flake	1	-	0.2
458	II	1	Organic	Charcoal	-	-	1.1
				Layer II, Level 1 Total:	28	4	42
470	II	2	Marine shell	*Cypraea* sp.	29	2	25.0
471	II	2	Marine shell	*Conus* sp.	2	1	0.6
473	II	2	Coral	Unidentified	3	-	3.6
472	II	2	Echinoderm	Echinoidea	22	-	2.0
469	II	2	Volcanic glass	Flake	4	-	2.0
468	II	2	Organic	Charcoal	-	-	1.2
				Layer II, Level 2 Total:	60	3	34
480	II	3	Fish bone	Unidentified	1	-	0.1
485	II	3	Marine shell	Unidentified	18	-	4.5
475	II	3	Marine shell	*Cypraea* sp.	36	7	36.5
487	II	3	Marine shell	*Drupa* sp.	2	2	0.6
476	II	3	Marine shell	*Isognomon* sp.	6	1	1.2
478	II	3	Marine shell	*Nerita* sp.	1	1	0.1
486	II	3	Marine shell	*Thais* sp.	1	1	0.5
483	II	3	Marine shell	*Conus* sp.	5	2	3.0
484	II	3	Coral	Unidentified	10	-	33.9
482	II	3	Echinoderm	Echinoidea abrader frag	1	-	0.2
488	II	3	Echinoderm	Echinoidea	208	-	25.8
477	II	3	Mammal bone	Unidentified	3	-	0.6
481	II	3	Volcanic glass	Flake	2	-	1.8
474	II	3	Organic	Charcoal	21	-	2.0
479	II	3	Metal	Lead .166 cal Pellet	1	-	0.9
				Layer II, Level 3 Total:	316	14	112
494	II	4	Marine shell	*Trochus* sp.	1	1	0.3
491	II	4	Marine shell	*Cypraea* sp.	12	3	10.2
490	II	4	Echinoderm	Echinoidea	42	-	4.9
492	II	4	Mammal bone	*Sus* sp. vertebrae	1	1	2.2
489	II	4	Organic	Charcoal	47	-	5.5
493	II	4	Organic	Unidentified nut	1	-	0.6
				Layer II, Level 4 Total:	104	5	24
				EU-29 Total:	508	26	211

Charcoal collected from Layer II, Level 3 in EU-29 of Feature B in SIHP Site 23673 was submitted for radiocarbon assaying. The sample (Beta-212769) intercepts the tree-ring calibration curve at AD 1530, 1550, and 1630 and has a 2-sigma standard deviation calibrated date range of AD 1460 to 1660. Charcoal collected from Layer II, Level 4 in EU-29 of Feature B in SIHP Site 23673 was also submitted for radiocarbon assaying. The sample (Beta-212768) intercepts the tree-ring calibration curve at AD 1440 and has a 2-sigma standard deviation calibrated date range of AD 1320 to 1640. A calibrated weighted average of the two "linked" raw assays intercepts the tree-ring calibration curve at AD 1500, with a calibrated standard deviation that ranges between AD 1470 and 1630.

EU-30 was placed on the eastern wall of the Feature B enclosure and revealed the following stratigraphic profile (Figures 43 and 44):

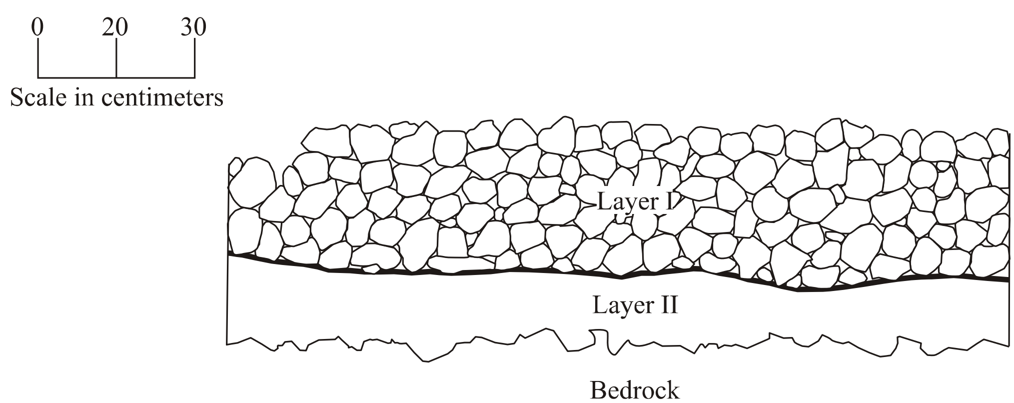
Layer I (0-30cmbs)...................... architectural layer with small to large *ʻaʻā* cobbles.
Layer II Level 1 (30-50cmbs) ..... dark brown (10YR 3/2) silt with *ʻaʻā* cobbles and very dark brown (7.5YR 5/2) silt resting on weathered *ʻaʻā* bedrock.

EU-30 yielded *Thunnus thynnus*, *Drupa* sp., coral, Echinoidea, *Canis* sp., *Rattus* sp., mammal, and *kukui* nutshell remains (Table 16). A machine cut mammal bone rib fragment (Acc# 566) from Level 1 of Layer II suggests some form of post-depositional intrusion. The rib is 118.3 millimeters long, 12.85 millimeters wide, and 11.05 millimeters thick. No trends or changes in species or artifact types could be discerned for the layers within EU-30; species and artifact types are fairly evenly distributed in all excavated layers, except for the comparatively sparse bottom Level 3 of Layer II.

Table 16. Recovered items from SIHP Site 23673, Feature B, EU-30.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
495	I	1	Fish bone	*Thunnus thynnus*	13	1	4.7
496	I	1	Mammal bone	*Canis* sp.	1	1	0.2
				Layer I, Level 1 Total:	14	2	4.9
497	II	1	Fish bone	*Thunnus thynnus*	8	1	4.1
499	II	1	Coral	Unidentified	2	-	7.8
498	II	1	Mammal bone	Unidentified	6	-	4.7
566	II	1	Mammal bone	Machine cut rib	3	-	13.2
500	II	1	Organic	*Kukui* nutshell	2	-	2.1
				Layer II, Level 1 Total:	21	1	31.9
501	II	2	Fish bone	*Thunnus thynnus*	3	1	0.2
503	II	2	Echinoderm	Echinoidea	2	-	0.1
504	II	2	Coral	Unidentified	3	-	0.7
502	II	2	Mammal bone	*Rattus* sp.	1	1	0.1
505	II	2	Organic	*Kukui* nutshell	2	-	0.2
				Layer II, Level 2 Total:	11	2	1.3
506	II	3	Fish bone	*Thunnus thynnus*	2	1	0.1
509	II	3	Shell	*Drupa* sp.	1	1	1.9
508	II	3	Coral	Unidentified	1	-	0.2
507	II	3	Organic	*Kukui* nutshell	1	-	1.9
				Layer II, Level 3 Total:	5	2	4.1
				EU-30 Total:	51	7	42.2

Figure 43. SIHP Site 23673 Feature B EU-30 base of excavation, view to the east.



Layer I - Architectural layer.

Layer II Level 1 - Dark brown (10YR 3/2) silt with *‘a‘ā* cobbles and very dark brown (7.5YR 5/2) silt.

Figure 44. SIHP Site 23673 Feature B EU-30 east wall profile.

SIHP Site 23674

Site 23674 consists of a linked platform and enclosed circle feature that is located in the east-central portion of the project area (see Figure 3). Site 23674 consists of a rough rectangular platform (5.2 meters by 3.3 meters) with a circular enclosure (4.8 meters in diameter) protruding from its south edge (Figures 45 and 46). The site is constructed of stacked and piled *ʻaʻā* cobbles, and the partially leveled surface of the platform is roughly paved with small *ʻaʻā* cobbles (see Figure 45). The platform stands up to 66 centimeters above ground surface along its stacked southern edge and is slightly terraced to the north standing up to 46 centimeters above ground surface along its northern edge. The enclosure walls measures as wide as 1.9 meters and stand up to 66 centimeters high along their interior edge. The central area of the enclosure consists of leveled soil covered by dense vegetation. The following two excavations were conducted at Site 23674: EU-6 (2 x 2m) and EU-7 (1 x 1m).

EU-6 was placed on the central portion of the platform, and revealed the following stratigraphic profile (Figures 47 and 48):

Layer I (0-70cmbs) .... architectural layer with *ʻaʻā* pebble paving on top of small to large cobbles and a few boulders.
Layer II Level 1 (70-90cmbs)......... dark brown (10YR 3/3) silt and *ʻaʻā* gravel.
Layer II Level 2 (90-100cmbs)....... very dark brown (10YR 2/2) and dark yellowish brown (10YR ¾) sandy silt with *ʻaʻā* gravel.
Layer II Level 3 (100-110cmbs)..... dark yellowish brown (10YR ¾) sandy silt and decomposed bedrock on sloping bedrock.

EU-6 yielded fish, *Trochus* sp., *Drupa* sp., *Cellana* sp., *Nerita* sp., coral, Echinoidea, crustacean, *Conus* sp., unidentifiable shell, bird, dog, rodent, mammal, *kukui* nutshell, charcoal, basalt flakes, and volcanic glass flakes and shatter (Table 17). No significant shifts or trends are apparent when the recovered items from different depths are compared. Species and artifact types peak in Layer I, drop off in Levels 1 and 2 of Layer II only to rise slightly again in the bottom Level 3 of Layer II.

Table 17. Recovered items from SIHP Site 23674, EU-6.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
56	I	1	Fish bone	*Scarus* sp. teeth	4	1	0.6
49	I	1	Marine shell	*Cypraea* sp.	59	10	50.4
50	I	1	Marine shell	*Drupa* sp.	11	5	6.4
52	I	1	Marine shell	*Cellana* sp.	1	1	0.8
51	I	1	Marine shell	*Conus* sp.	6	2	0.7
53	I	1	Marine shell	Unidentified	3	-	2.0
61	I	1	Coral	Waterworn	12	-	24.4
55	I	1	Bird bone	Unidentified	5	-	1.0
54	I	1	Mammal bone	*Canis* sp.	2	1	2.0
58	I	1	Basalt	Flake	2	-	2.8
57	I	1	Volcanic glass	Flake	23	-	15.0
564	I	1	Volcanic glass	Shatter	7	-	12.1
60	I	1	Organic	*Kukui* nutshell	1	-	0.4
62	I	1	Organic	Charcoal	-	-	0.2
				Layer I, Level 1 Total:	136	20	118.8

Continued on next page

Table 17. Continued.

ACC#	Layer	Level	Material	Species/type	Count	MNI	eight (g)
69	II	1	Fish Bone	Unidentified jaw	1	-	0.4
63	II	1	Marine shell	*Cypraea* sp.	18	2	10.4
64	II	1	Marine shell	*Drupa* sp.	9	3	2.9
65	II	1	Marine shell	*Conus* sp.	3	2	1.2
66	II	1	Marine shell	Unidentified	3	-	0.6
72	II	1	Coral	Waterworn	1	-	2.9
67	II	1	Echinoderm	Echinoidea	7	-	6.6
68	II	1	Mammal bone	Unidentified	1	-	0.1
70	II	1	Volcanic glass	Flake	73	-	26.1
71	II	1	Organic	*Kukui* nutshell	3	-	0.8
73	II	1	Organic	Charcoal	-	-	0.3
				Layer II, Level 1 Total:	119	5	52.3
80	II	2	Fish bone	Unidentified vertebrae	1	-	0.8
74	II	2	Marine shell	*Cypraea* sp.	16	2	7.6
75	II	2	Marine shell	*Drupa* sp.	7	3	4.5
76	II	2	Marine shell	*Conus* sp.	3	2	5.2
77	II	2	Marine shell	Unidentified	4	-	0.7
78	II	2	Echinoderm	Echinoidea	2	-	0.4
79	II	2	Bird bone	Unidentified	2	-	1.8
81	II	2	Mammal bone	Unidentified rodent	1	-	0.2
82	II	2	Volcanic glass	Flake	30	-	22.8
83	II	2	Organic	*Kukui* nutshell	2	-	0.2
84	II	2	Organic	Charcoal	-	-	0.2
				Layer II, Level 2 Total:	68	7	44.4
85	II	3	Marine shell	*Cypraea* sp.	25	3	10.6
86	II	3	Marine shell	*Drupa* sp	8	1	2.2
88	II	3	Marine shell	*Nerita* sp.	1	1	0.4
87	II	3	Marine shell	*Conus* sp.	6	2	4.0
89	II	3	Marine shell	Unidentified	5	-	1.5
90	II	3	Echinoderm	Echinoidea	6	-	0.5
91	II	3	Crustacean	UID claw fragment	1	-	0.2
92	II	3	Mammal bone	Rodent	10	1	0.5
93	II	3	Volcanic glass	Flake	48	-	14.3
94	II	3	Organic	Charcoal	-	-	0.5
				Layer II, Level 3 Total:	110	8	34.7
				EU-6 Total:	433	40	250.2

EU-7 was placed on the ground surface within the circular enclosure, and revealed the following stratigraphic profile (Figures 49 and 50):

Layer I (0-10cmbs) .... dark brown (10YR 3/3) silt with small *ʻaʻā* pebbles on weathered bedrock.

No cultural material was recovered from EU-7.

Figure 45. SIHP Site 23674, view to the south.

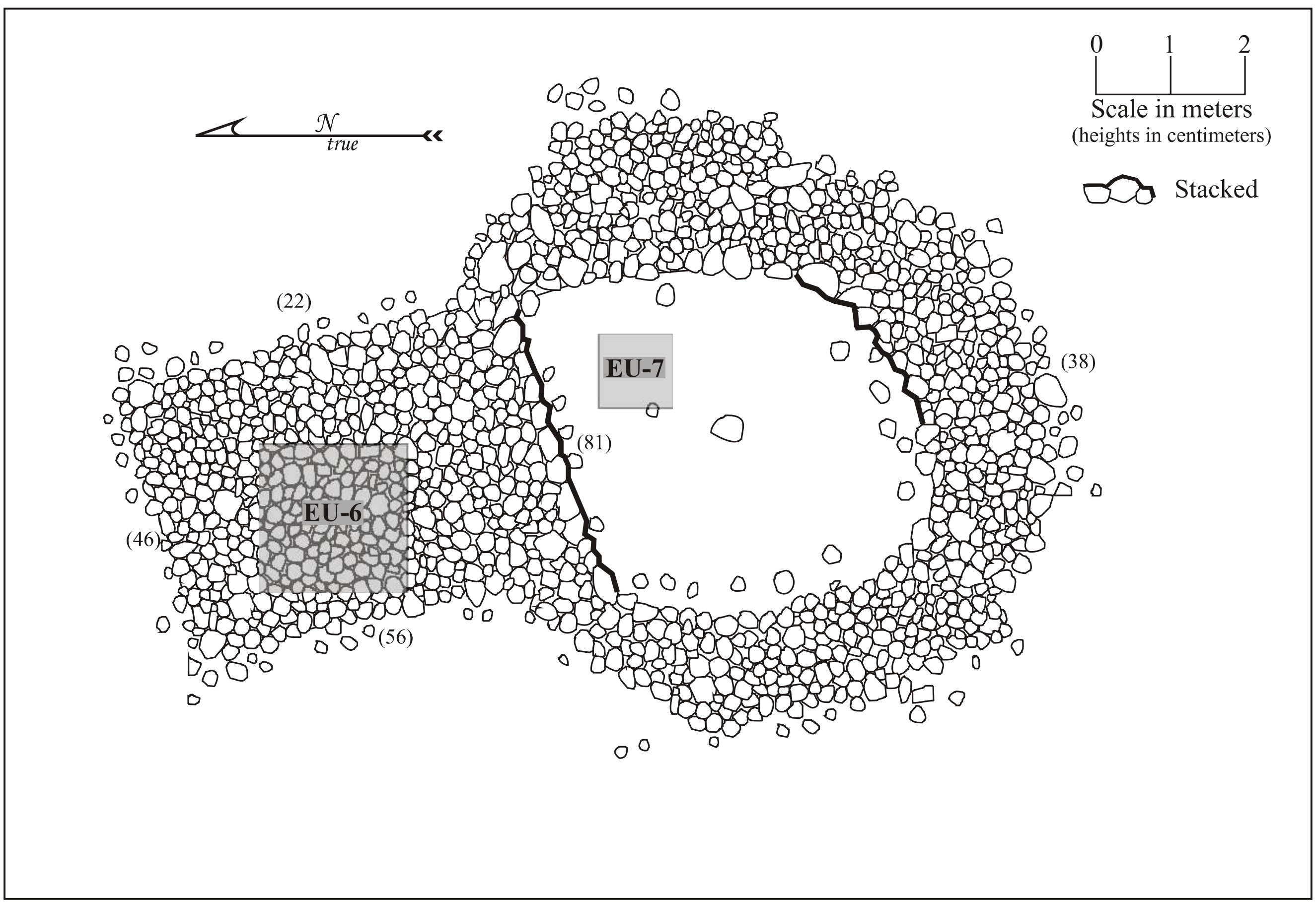
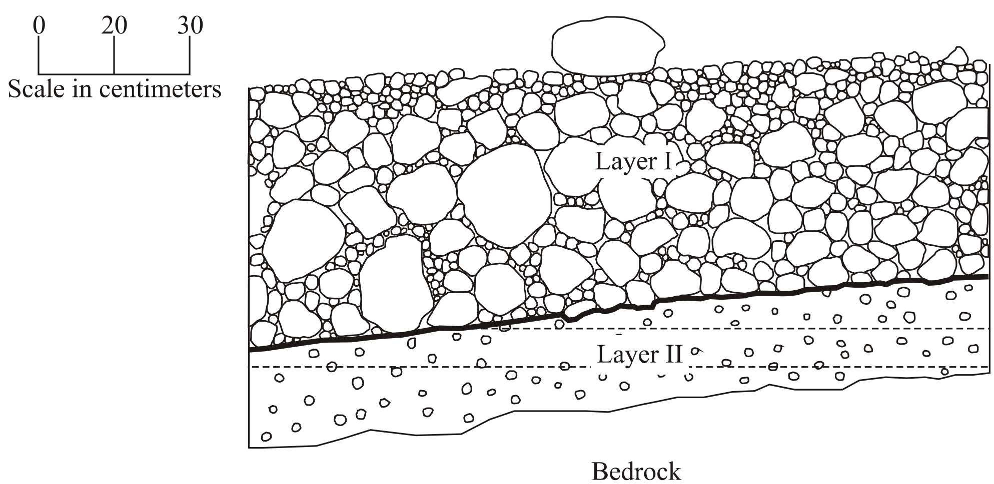


Figure 46. SIHP Site 23674 plan view.

Figure 47. SIHP Site 23674 EU-6 base of excavation, view to the north.



Layer I - Architectural layer.
Layer II Level 1 - Dark brown (10YR 3/3) silt and *ʻaʻā* gravel.
Layer II Level 2 - Very dark brown (10YR 2/2) and dark yellowish brown (10YR 3/4) sandy silt with *ʻaʻā* gravel.
Layer II Level 3 - Dark yellowish brown (10YR 3/4) sandy silt.

Figure 48. SIHP Site 23674 EU-6 north wall profile.

Figure 49. SIHP Site 23674 EU-7 base of excavation, view to the north.

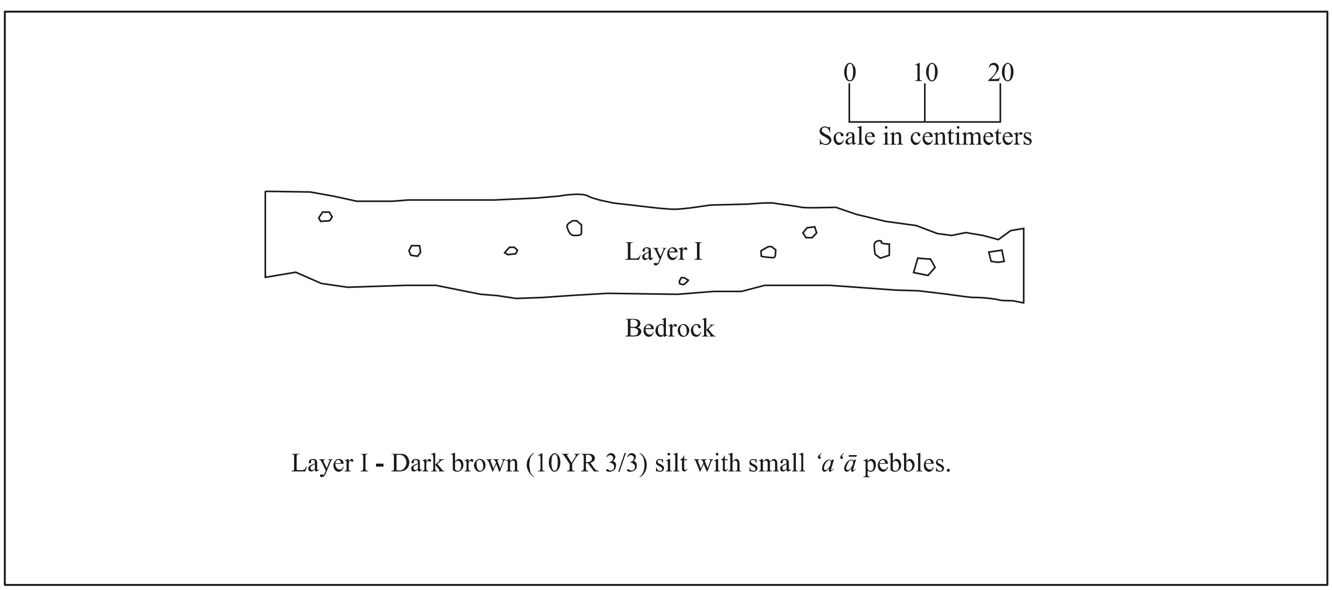


Figure 50. SIHP Site 23674 EU-7 north wall profile.

SIHP SITE 23675

Site 23675 is a partly walled platform located in the east-central portion of the project area (see Figure 3). The platform is constructed of partially stacked, but now mostly collapsed, small to large sized *‘a‘a* cobbles. The southern edge of the platform has no wall. The platform measures 5.8 meters long by 5.7 meters wide and stands up to 80 centimeters above ground surface (Figure 51). The platform’s surface is roughly paved with small sized cobbles. The platform’s surface also contains two waterworn pebbles and two small circular depressions. The western depression measures 1.2 meters in diameter and 55 centimeters deep, while the eastern depression measures 1.2 meters in diameter and 50 centimeters deep; both depressions may be the result of tree-tip-ups at the site. The following three excavations were conducted at Site 23675: TU-20 (1 x 1m), EU-9 (2 x 1m aligned west-east), and EU-10 (2 x 2m).

TU-20 was excavated on top of the eastern depression (see Figure 51) and revealed the following stratigraphic profile (Figure 52):

Layer I (0-95cmbs)........... architectural layer with small to large sized *‘a‘ā* cobbles mixed with organics.

Layer II(95-113cmbs) ...... dark yellowish brown (10YR 4/4) sandy silt mixed with some organics and containing approximately 70% gravel content transitioning to a dark brown (10YR 3/3) silt containing a high concentration of gravels and decomposing bedrock.

TU-20 yielded *Cypraea* sp., *Sus* sp., charcoal, and basalt remains (Table 18). The basalt included a ground stone fragment and a waterworn piece. Layer II clearly yielded more species and types than Layer I.

Table 18. Recovered items from SIHP Site 23675, TU-20.

ACC #	*Layer*	*Depth (cmbs)*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
116	I	0-95	Organic	Charcoal	-	-	0.6
117	II	95-105	Marine shell	*Cypraea* sp.	1	1	1.3
118	II	95-105	Basalt	Waterworn	1	-	71.4
119	II	95-105	Basalt	Groundstone fragment	1	-	116.7
120	II	95-105	Mammal bone	*Sus* sp.	21	1	9.6
				TU-20 Total:	24	2	199.6

EU-9 was excavated on the western depression and revealed the following stratigraphic profile (Figure 53):

Layer I (0-70cmbs) ....architectural layer with loosely stacked *‘a‘ā* cobbles mixed with dark brown (10YR 3/3) silt.

Layer II Level 1 (70-80cmbs)......dark brown (10YR 3/3) silt mixed with *‘a‘ā* cobbles.

Layer II Level 2 (80-90cmbs)......dark brown (10YR 3/3) silt mixed with *‘a‘ā* cobbles and weathered bedrock fragments within a pocket on western side of unit on uneven bedrock.

EU-9 yielded *Cypraea* sp. shell fragments and charcoal (Table 19).

Table 19. Recovered items from SIHP Site 23675, EU-9.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
97	II	1	Marine shell	*Cypraea* sp.	3	2	2.6
96	II	1	Organic	Charcoal	-	-	0.4
				EU-9 Total:	3	2	3.0

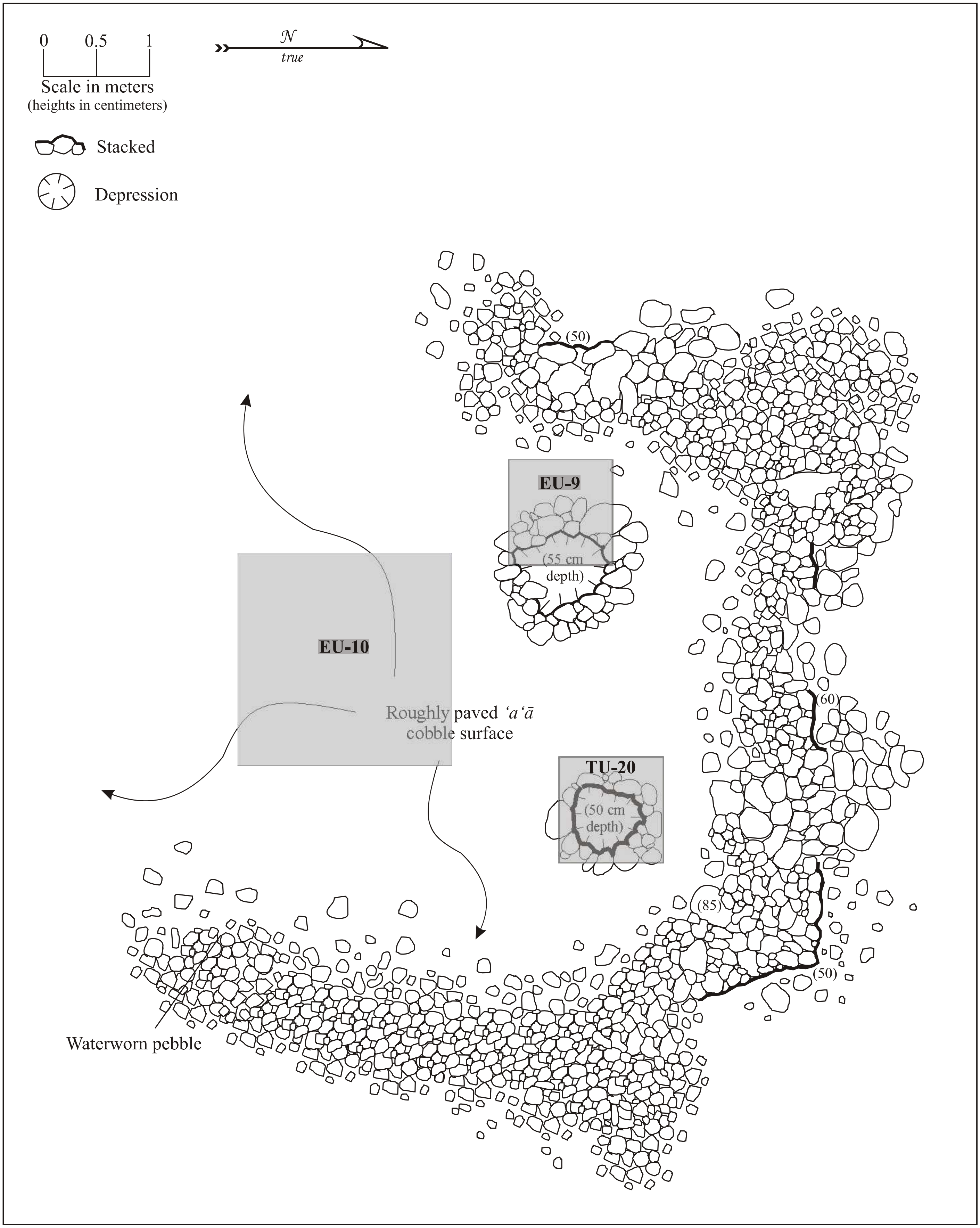
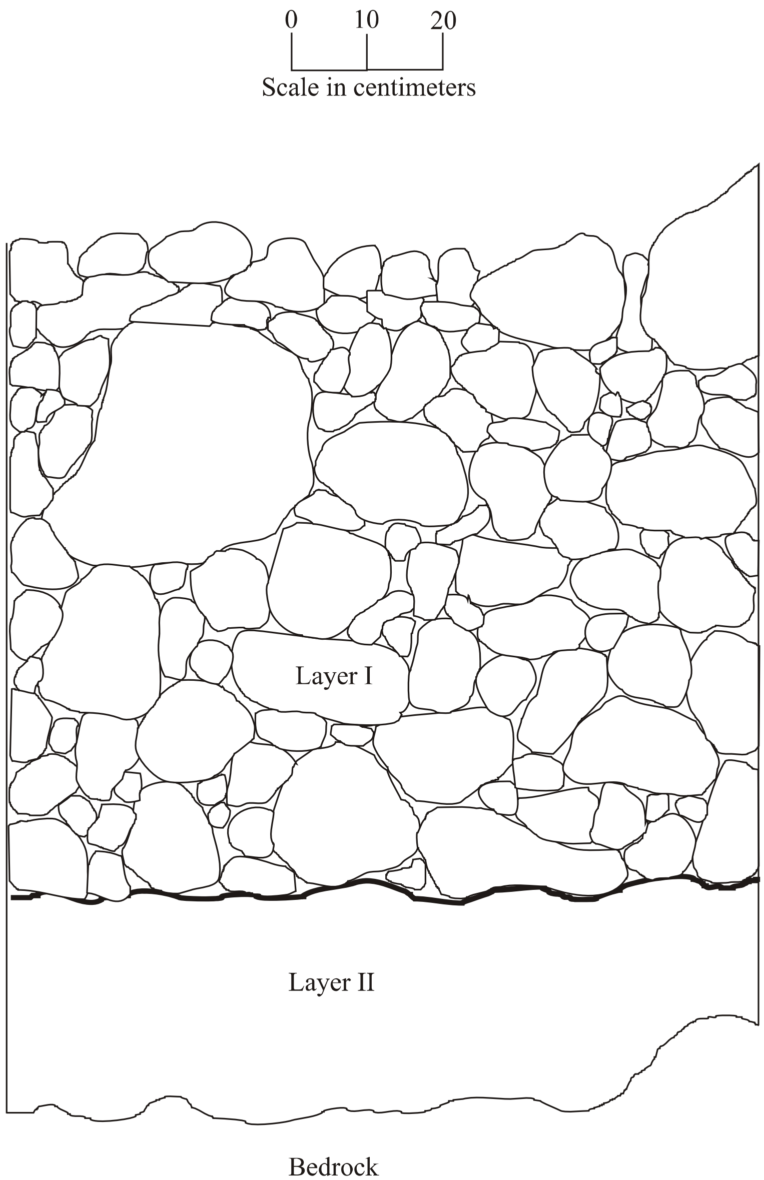


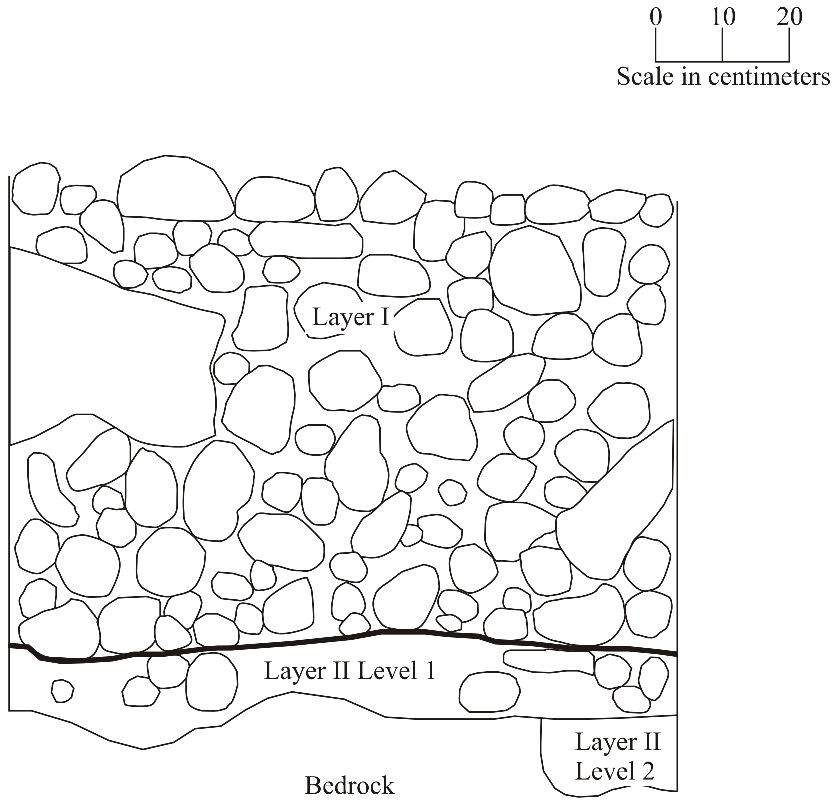
Figure 51. SIHP Site 23675 plan view.



Layer I- Architectural layer consisting of small to large sized *ʻaʻā* cobbles mixed with organics.

Layer II- Dark yellowish brown (10YR 4/4) sandy silt mixed with some organics and approximately 70 percent gravel content.

Figure 52. SIHP Site 23675 TU-20 north wall profile.



Layer I - Architectural layer with loosely stacked *ʻaʻā* cobbles mixed with dark brown (10YR 3/3) silt.

Layer II Level 1 - Dark brown (10YR 3/3) silt mixed with *ʻaʻā* cobbles.

Layer II Level 2 - Dark brown (10YR 3/3) silt mixed with *ʻaʻā* cobbles and weathered bedrock fragments within pocket on western side of unit.

Figure 53. SIHP Site 23675 EU-9 north wall profile.

EU-10 was placed on the south-central portion of the paved surface. The surface of the pavement within the confines of EU-10 slopes slightly to the southwest. The following layers were observed within EU-10 (Figures 54 and 55):

Layer I (0-70cmbs)	architectural layer with small to large *‘a‘ā* cobbles (many of which are waterworn).
Layer II Level 1 (70-80cmbs)......	black (10YR 2/1) and very dark brown (10YR 2/2) mottled silt mixed with *‘a‘ā* cobbles.
Layer II Level 2 (80-90cmbs)......	black (10YR 2/1) and very dark brown (10YR 2/2) mottled silt mixed with *‘a‘ā* cobbles.
Layer II Level 3 (90-100cmbs)	black (10YR 2/1) silt with weathered bedrock on undulating bedrock.

EU-10 yielded fish, *Cypraea* sp., *Drupa* sp., *Cellana* sp., *Nerita* sp., coral, Echinoidea, unidentifiable shell, pig, dog, small mammal, *kukui* nutshell, charcoal, basalt flakes, and volcanic glass flakes (Table 20). A coral abrader (Acc# 109) was recovered from Level 1 of Layer 2 (Figure 56). This irregular-shaped tab has two flat abraded surface, one of which is cut along the abrasion edge. The abrader measures 20.7 millimeters long, 15 millimeters wide, and 7.45 millimeters thick. A worked bone fragment (Acc# 059) was recovered from Level 2 of Layer II within EU-10 (Figure 57). This fragment has three surfaces that appear modified. The fragment is 12.15 millimeters long, 9.25 millimeters wide, and 3.9 millimeters thick. No stratigraphic changes or trends concerning recovered items are apparent within EU-10. The architectural Layer I yielded less species and types than the underlying Layer II, however.

Table 20. Recovered items from SIHP Site 23675, EU-10.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
101	I		Marine shell	*Cypraea* sp.	4	1	6.7
102	I		Marine shell	*Nerita* sp.	1	1	0.8
103	I		Coral	Unidentified	20	-	209.5
104	I		Coral	Waterworn	1	-	6.3
100	I		Mammal bone	*Sus* sp.	1	1	1.5
99	I		Volcanic glass	Flake	1	-	1.5
98	I		Organic	Charcoal in situ	-	-	2.3
				Layer I Total:	28	3	228.6
112	II	1	Marine shell	*Cypraea* sp.	26	5	21.8
114	II	1	Marine shell	*Drupa* sp.	3	1	2.3
110	II	1	Marine shell	*Cellana* sp.	2	1	1.3
115	II	1	Marine shell	*Cellana* sp.	1	1	1.1
111	II	1	Marine shell	*Nerita* sp.	7	6	2.3
116	II	1	Marine shell	Unidentified	2	-	0.4
109	II	1	Coral	Abrader	1	-	1.0
117	II	1	Coral	Unidentified	54	-	69.5
118	II	1	Coral	Waterworn	3	-	16.0
119	II	1	Coral	Unidentified	4	-	4.2
113	II	1	Echinoderm	Echinoidea	5	-	0.5
108	II	1	Mammal bone	*Sus* sp.	2	1	1.1
107	II	1	Volcanic glass	Flake	3	-	4.1
106	II	1	Organic	*Kukui* nutshell	2	-	0.5
105	II	1	Organic	Charcoal	-	-	2.0
				Layer II, Level 1 Total:	115	15	128.1
124	II	2	Fish bone	*Scarus* sp.	2	1	0.7
126	II	2	Marine shell	*Cypraea* sp.	33	6	21.0
127	II	2	Marine shell	*Drupa* sp.	1	1	0.4
123	II	2	Marine shell	*Nerita* sp.	19	16	4.2
128	II	2	Coral	Unidentified	12	-	22.5

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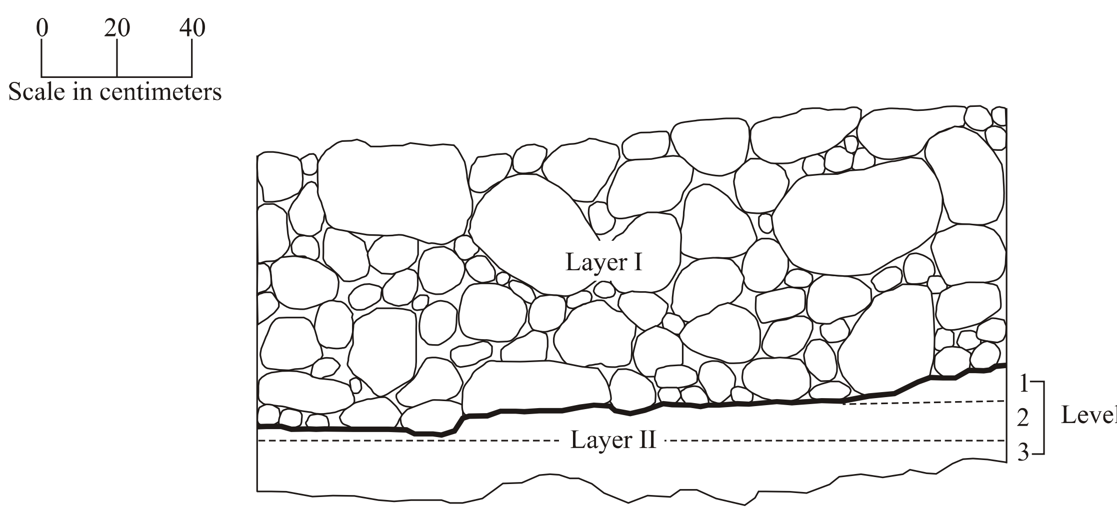
Table 20. Continued.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
129	II	2	Coral	Waterworn	1	-	0.4
125	II	2	Echinoderm	Echinoidea	4	-	0.8
122	II	2	Small mammal	Unidentified	9	-	0.8
59	II	2	Small mammal	Unidentified/worked	1	-	0.2
121	II	2	Volcanic glass	Flake	6	-	9.5
120	II	2	Organic	Charcoal	-	-	2.0
				Layer II, Level 2 Total:	88	24	62.5
135	II	3	Fish bone	Unidentified	1	-	0.1
137	II	3	Marine shell	*Cypraea* sp.	23	2	13.2
141	II	3	Marine shell	*Drupa* sp.	1	1	0.4
136	II	3	Marine shell	*Nerita* sp.	18	15	3.9
138	II	3	Coral	Unidentified	2	-	1.3
139	II	3	Coral	Waterworn	1	-	9.4
140	II	3	Coral	Unidentified	8	-	6.7
133	II	3	Mammal bone	*Sus* sp.	5	1	1.7
134	II	3	Mammal bone	*Canis sp.* tooth	2	1	0.9
131	II	3	Basalt	Flake	6	-	2.2
132	II	3	Volcanic glass	Flake	9	-	5.2
130	II	3	Organic	Charcoal	-	-	4.6
				Layer II, Level 3 Total:	76	20	49.6
				EU-10 Total:	307	62	468.8

In situ charcoal collected from Layer I in EU-10 of SIHP Site 23675 was submitted for radiocarbon assaying. The sample (Beta-212758) intercepts the tree-ring calibration curve at AD 1680, 1740, 1810, 1930, and 1950 and has a 2-sigma standard deviation calibrated date range of AD 1660 to 1950. Charcoal collected from Layer II, Level 3 in EU-10 of SIHP Site 23675 was also submitted for radiocarbon assaying. The sample (Beta-212759) also intercepts the tree-ring calibration curve at AD 1680, 1740, 1810, 1930, and 1950 and has a 2-sigma standard deviation calibrated date range of AD 1660 to 1950. A calibrated weighted average of the two “linked” raw assays intercepts the tree-ring calibration curve at AD 1690, 1740, 1800, 1930, and 1950, with a calibrated standard deviation that ranges between AD 1670 and 1950.

Figure 56. SIHP Site 23675 coral abrader recovered from EU-10 (Acc#. 109).

Figure 54. SIHP Site 23675 EU-10 base of excavation, view to the north.



Layer I - Architectural layer.
Layer II Level 1 - Black (10YR 2/1) and very dark brown (10YR 2/2) mottled silt mixed with *ʻaʻā* cobbles.
Layer II Level 2 - Black (10YR 2/1) and very dark brown (10YR 2/2) mottled silt mixed with *ʻaʻā* cobbles.
Layer II Level 3 - Black (10YR 2/1) silt with weathered bedrock.

Figure 55. SIHP Site 23675 EU-10 north wall profile.


Figure 57. SIHP Site 23675 worked bone fragment from EU-10 (Acc#. 059).

SIHP Site 23676

Site 23676 is a platform located in the east-central portion of the project area (see Figure 3). The platform (5.3 meters long by 3.4 meters wide) is constructed with partially stacked - mostly collapsed - large *'a'ā* cobbles forming its exterior edges (Figures 58 and 59). The platform is roughly paved with small *'a'ā* cobbles and pebbles creating a somewhat level surface. Site 23676 stands up to 70 centimeters above the surrounding ground surface and its southeastern edge dissipates into a bedrock outcrop. A waterworn coral fragment was observed on the platform's southern corner. The following two excavations were conducted on the Site 23878 platform: TU-18 (1 x 1 m) and EU-21 (2 x 2m). TU-18 was excavated into the northwest portion of Site 23676 and revealed the following stratigraphic profile (see Figure 59):

Layer I (0-40cmbs)........... architectural layer with small to large sized *'a'ā* cobbles mixed with organic debris.
Layer II (40-71cmbs) .... very dark brown (10YR 2/2) sandy silt with approximately 45 percent *'a'ā* gravel content.
Layer III (71-73cmbs)...... dark brown (7.5YR 3/4) fine silt mixed with gravels and decomposing bedrock on bedrock.


Figure 58. SIHP Site 23676, view to the southwest.

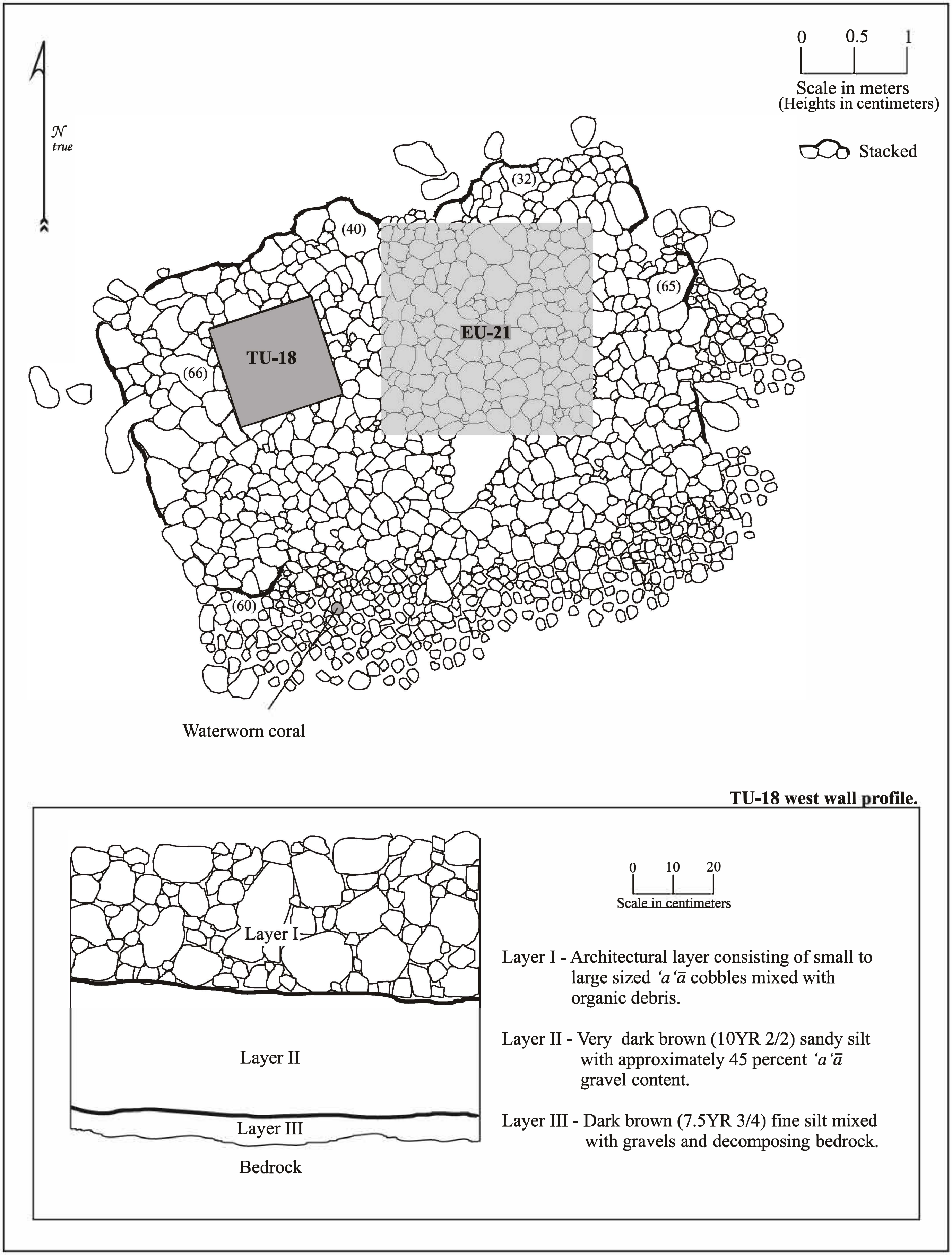


Figure 59. SIHP Site 23676 plan view and TU-18 west wall profile.

TU-18 yielded fish, *Cypraea* sp., a *he'e* lure (Acc# 90 and Figure 60), *Cellana* sp., *Nerita* sp., *Strombina* sp., Echinoidea, *Conus* sp., unidentifiable shell, pig, rodent, unidentifiable small mammal, charcoal, and volcanic glass flakes (Table 21). No stratigraphic changes or trends in species or artifact types are apparent within TU-18, even though the species and types from Layer II clearly outnumber those from Layer I.

Figure 60. SIHP Site 23676 *he'e* lure recovered from TU-18.

Table 21. Recovered items from SIHP Site 23676, TU-18.

ACC #	*Layer*	*Depth (cmbs)*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
87	I	0-40	Marine shell	*Cypraea* sp.	9	3	9.4
88	I	0-40	Marine shell	*Cellana* sp.	1	1	0.1
89	I	0-40	Marine shell	Unidentified	1	1	1.0
90	I	0-40	Marine shell	*He'e* lure	1	1	32.0
91	I	0-40	Organic	*Kukui* nutshell	5	-	4.5
92	I	0-40	Fish bone	Unidentified	1	1	0.1
93	I	0-40	Mammal bone	*Sus* sp.	1	2	1.4
79	I	0-40	Mammal bone	Rodent	3		0.3
94	I	0-40	Volcanic glass	Flake	2	-	2.6
				Layer I Total:	24	9	51.4
95	II	40-50	Organic	Charcoal	-	-	0.5
96	II	40-50	Organic	*Kukui* nutshell	10	-	2.3
97	II	40-50	Echinoderm	Echinoidea	25	1	1.6
98	II	40-50	Marine shell	*Conus* sp.	1	1	0.2
99	II	40-50	Marine shell	*Cypraea* sp.	39	14	22.3
100	II	40-50	Marine shell	*Drupa* sp.	1	1	0.1
101	II	40-50	Marine shell	*Nerita* sp.	1	1	0.2
102	II	40-50	Marine shell	*Cellana* sp.	3	1	0.4
103	II	40-50	Marine shell	*Strombina* sp.	1	1	0.3
104	II	40-50	Marine shell	Unidentified	17	-	0.3

Continued on next page

Table 21. Continued

ACC #	*Layer*	*Depth (cmbs)*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
105	II	40-50	Bone	Small mammal	4	2	0.8
106	II	40-50	Volcanic glass	Flake	8	-	6.4
107	II	40-50	Organic	*Kukui* nutshell	1	1	0.1
108	II	50-60	Echinoderm	Echinoidea	25	1	1.9
109	II	50-60	Marine shell	*Nerita*	1	1	0.1
110	II	50-60	Organic	Charcoal	-	-	0.2
111	II	50-60	Marine shell	*Cypraea*	12	3	10.9
112	II	50-60	Volcanic glass	Flakes	2	-	0.9
113	II	60-71	Echinoderm	Echinoidea	11	1	0.9
114	II	60-71	Marine shell	*Cypraea*	6	1	2.1
115	II	60-71	Volcanic glass	Flakes	2	-	1.1
				Layer II Total:	170	30	53.6
				TU-18 Total:	194	39	105.0

EU-21 was excavated on the northwest portion of Site 23676 and revealed the following stratigraphic profile (Figure 61):

Layer I (0-30cmbs) .... architectural layer with large *ʻaʻā* cobbles on the surface transitioning to smaller cobbles with depth particularly in the southeastern quadrant.

Layer II, Levels 1-4 (30-70cmbs) .... dark brown (10YR 3/3) silt mottled with dark yellowish brown (10YR 3/4) silt and *ʻaʻā* cobbles.

Recovered items from EU-21 include shark, *Serpuloris* sp, *Cypraea* sp., *Drupa* sp., *Morula* sp., *Cellana* sp., *Chama* sp., *Nerita* sp., coral, Echinoidea, *Nassarius* sp., *Fimbria* sp., *Conus* sp., unidentifiable shell, bird, *Sus* sp., *Canis* sp., *Rattus* sp., unidentifiable mammal, *kukui* nutshell, charcoal, and volcanic glass flakes (Table 22). A bone awl fragment (Acc# 337) from Level 2 of Layer II has a chipped point. This awl fragment is 12.4 millimeters long, 8.9 millimeters wide, and 5.4 millimeters thick. A second bone awl (Acc# 352) came from Level 3 in Layer II (Figure 62). This awl is 46.4 millimeters long, 11 millimeters wide, and 7.1 millimeters thick. Items recovered from EU-21 display an unusually high variety and abundance in all the excavated layers. However, no significant change in species or types of items from one layer to the next is apparent within the unit. Species and artifact types peak in Level 1 of Layer II and then increasingly drop off towards bedrock.


Figure 62. SIHP Site 23676 bone awl recovered from EU-21 (Acc# 352).

Table 22. Recovered items from SIHP Site 23676, EU-21.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
310	I		Marine shell	*Serpuloris variabilis*	2	-	2.9
304	I		Marine shell	*Cypraea* sp.	73	4	68.0
302	I		Marine shell	*Drupa* sp.	2	1	6.6
302	I		Marine shell	*Morula* sp.	1	1	0.6
301	I		Marine shell	*Cellana* sp.	2	1	0.8
306	I		Marine shell	*Conus* sp.	2	1	0.2
305	I		Marine shell	Unidentified	44	-	0.2
312	I		Coral	Unidentified	14	-	15.0
313	I		Coral	Unidentified	2	-	9.1
311	I		Echinoderm	Echinoidea	5	-	0.4
309	I		Mammal bone	*Sus* sp.	6	1	2.0
307	I		Mammal bone	*Canis* sp. tooth	1	1	0.4
308	I		Small mammal	*Rattus* sp.	1	1	0.1
300	I		Volcanic glass	Flake	12	-	20.0
299	I		Organic	*Kukui* nutshell	4	-	0.8
298	I		Organic	Charcoal	-	-	3.0
				Layer I Total:	171	11	130.1

Continued on next page

Table 22. Continued.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
318	II	1	Fish	Shark tooth burnt	1	1	0.4
325	II	1	Marine shell	*Serpuloris variabilis*	1	1	0.3
319	II	1	Marine shell	*Cypraea* sp.	81	6	33.7
324	II	1	Marine shell	*Drupa* sp.	5	2	9.9
323	II	1	Marine shell	*Morula* sp.	2	2	1.4
321	II	1	Marine shell	*Cellana* sp.	7	1	3.2
327	II	1	Marine shell	*Chama* sp.	1	1	4.0
320	II	1	Marine shell	*Nerita* sp.	5	4	1.0
326	II	1	Marine shell	*Nassarius* sp.	2	2	1.6
322	II	1	Marine shell	*Conus* sp.	7	2	1.9
328	II	1	Marine shell	Unidentified	26	-	3.2
329	II	1	Coral	Unidentified	1	-	16.9
330	II	1	Coral	Unidentified	22	-	119.2
331	II	1	Echinoderm	Echinoidea	10	-	1.2
317	II	1	Mammal bone	*Sus* sp.	18	1	3.4
316	II	1	Volcanic glass	Flake	17	-	10.8
315	II	1	Organic	*Kukui* nutshell	10	-	4.3
314	II	1	Organic	Charcoal	-	-	2.4
				Layer II, Level 1 Total:	216	23	218.8
343	II	2	Marine shell	*Cypraea* sp.	52	7	29.2
341	II	2	Marine shell	*Drupa* sp.	3	1	3.7
340	II	2	Marine shell	*Morula* sp.	3	3	1.8
338	II	2	Marine shell	*Cellana* sp.	1	1	0.1
342	II	2	Marine shell	*Nassarius* sp.	6	5	2.8
339	II	2	Marine shell	*Conus* sp.	2	1	2.0
344	II	2	Marine shell	Unidentified	22	-	3.2
345	II	2	Coral	Waterworn	1	-	0.6
346	II	2	Coral	Unidentified	10	-	5.9
347	II	2	Echinoderm	Echinoidea	20	-	0.9
337	II	2	Mammal bone	Unidentified/awl	1	-	0.4
336	II	2	Mammal bone	*Sus* sp. burnt	5	1	3.4
335	II	2	Small mammal	*Rattus* sp. jaw	1	1	0.1
334	II	2	Volcanic glass	Flake	11	-	5.4
333	II	2	Organic	*Kukui* nutshell	19	-	3.1
332	II	2	Organic	Charcoal	-	-	3.3
				Layer II, Level 2 Total:	157	20	65.9
358	II	3	Marine shell	*Cypraea* sp.	37	6	23.1
353	II	3	Marine shell	*Drupa* sp.	1	1	4.0
355	II	3	Marine shell	*Nerita* sp.	2	2	0.5
356	II	3	Marine shell	*Nassarius* sp.	3	3	1.4
357	II	3	Marine shell	*Fimbria* sp.	1	1	0.3
354	II	3	Marine shell	*Conus* sp.	1	1	0.3
359	II	3	Marine shell	Unidentified	13	-	1.5
360	II	3	Coral	Unidentified	3	-	0.8
361	II	3	Echinoderm	Echinoidea	15	-	1.5
350	II	3	Mammal bone	*Canis* sp. teeth/burnt	2	1	0.5
352	II	3	Mammal bone	Unidentified/awl	1	-	2.8
351	II	3	Mammal bone	Unidentified/burnt	4	-	1.0
349	II	3	Volcanic glass	Flake	8	-	3.9
348	II	3	Organic	Charcoal	-	-	1.6
				Layer II, Level 3 Total:	91	15	43.2

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Table 22. Continued.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
374	II	4	Fish bone	Shark tooth	1	1	0.1
372	II	4	Marine shell	*Serpuloris variabilis*	1	1	0.9
367	II	4	Marine shell	*Cypraea* sp.	5	2	6.2
369	II	4	Marine shell	*Drupa* sp.	1	1	2.6
368	II	4	Marine shell	*Morula* sp.	1	1	0.5
371	II	4	Marine shell	*Nassarius* sp.	2	2	0.8
370	II	4	Marine shell	*Conus* sp.	2	1	0.5
373	II	4	Marine shell	Unidentified	2	-	0.1
375	II	4	Coral	Unidentified	1	-	0.2
376	II	4	Coral	Unidentified	1	-	0.3
377	II	4	Echinoderm	Echinoidea	3	-	0.2
366	II	4	Bird bone	Unidentified bird	2	-	0.2
365	II	4	Mammal bone	*Canis* sp. tooth	1	1	0.8
364	II	4	Med. mammal	Unidentified/cut	1	-	0.4
363	II	4	Volcanic glass	Flake	2	-	0.5
362	II	4	Organic	Charcoal	-	-	0.1
				Layer II, Level 4 Total:	26	10	14.4
				EU-20 Total:	661	79	472.4

Charcoal collected from Layer II Level 2 in EU-21 of SIHP Site 23676 was submitted for radiocarbon assaying. The sample (Beta-212765) intercepts the tree-ring calibration curve at AD 1520, 1590, and 1620 and has a 2-sigma standard deviation calibrated date range of AD 1440 to 1660. Charcoal collected from Layer I in EU-21 of SIHP Site 23676 was also submitted for radiocarbon assaying. The sample (Beta-212763) intercepts the tree-ring calibration curve at AD 1460 and has a 2-sigma standard deviation calibrated date range of AD 1420 to 1640. Charcoal collected from Layer II Level 1 in EU-21 of SIHP Site 23676 yielded a radiocarbon assay (Beta-212764) that intercepts the tree-ring calibration curve at AD 1460 and has a 2-sigma standard deviation calibrated date range of AD 1410 to 1650. A calibrated weighted average of the three “linked” raw assays intercepts the tree-ring calibration curve at AD 1470, with a calibrated standard deviation that ranges between AD 1450 and 1620.

SIHP Site 23677

Site 23677 is located in the east-central portion of the project area (see Figure 3). It consists of a small square platform remnant (Feature A) constructed in the southwest corner of a rough enclosures (Feature B) (Figures 63 and 64). The features are constructed of *‘a‘ā* cobbles and boulders formerly stacked, but now largely collapsed. The interior of the enclosure consists of thin soil covered by dense vegetation. A waterworn cobble, a piece of coral, and *Cypraea* sp. shell fragments were observed on ground surface within the site. A 1 x 1 meter test unit (TU-16) was excavated in the center of Feature A. A second 1 x 1 meter excavation unit (EU-22) was located immediately northeast of TU-16, near the eastern edge of the Feature B platform. Two abutting excavation units (EU-23 and EU-24) were placed across the southeastern corner of Feature B. Each excavation unit was 2 x 1 meters. Considering that Excavation Units 23 and 24 were abutting, combined these units comprised a trench that was four meters long by one meter wide. This trench covered the entire width of the corner section of the Feature B enclosing wall.

Feature A

Feature A is a small platform remnant (2.9 meters long by 2.5 meters wide) located in the northwest corner of the enclosure area (Feature B). The platform is constructed with large *‘a‘ā* cobbles stacked around the outside edges (90 centimeters high) and small cobbles paving its roughly level surface. Much of Feature A has collapsed leaving a rubble scatter around the entire feature. A piece of waterworn coral was found on the platform’s surface.

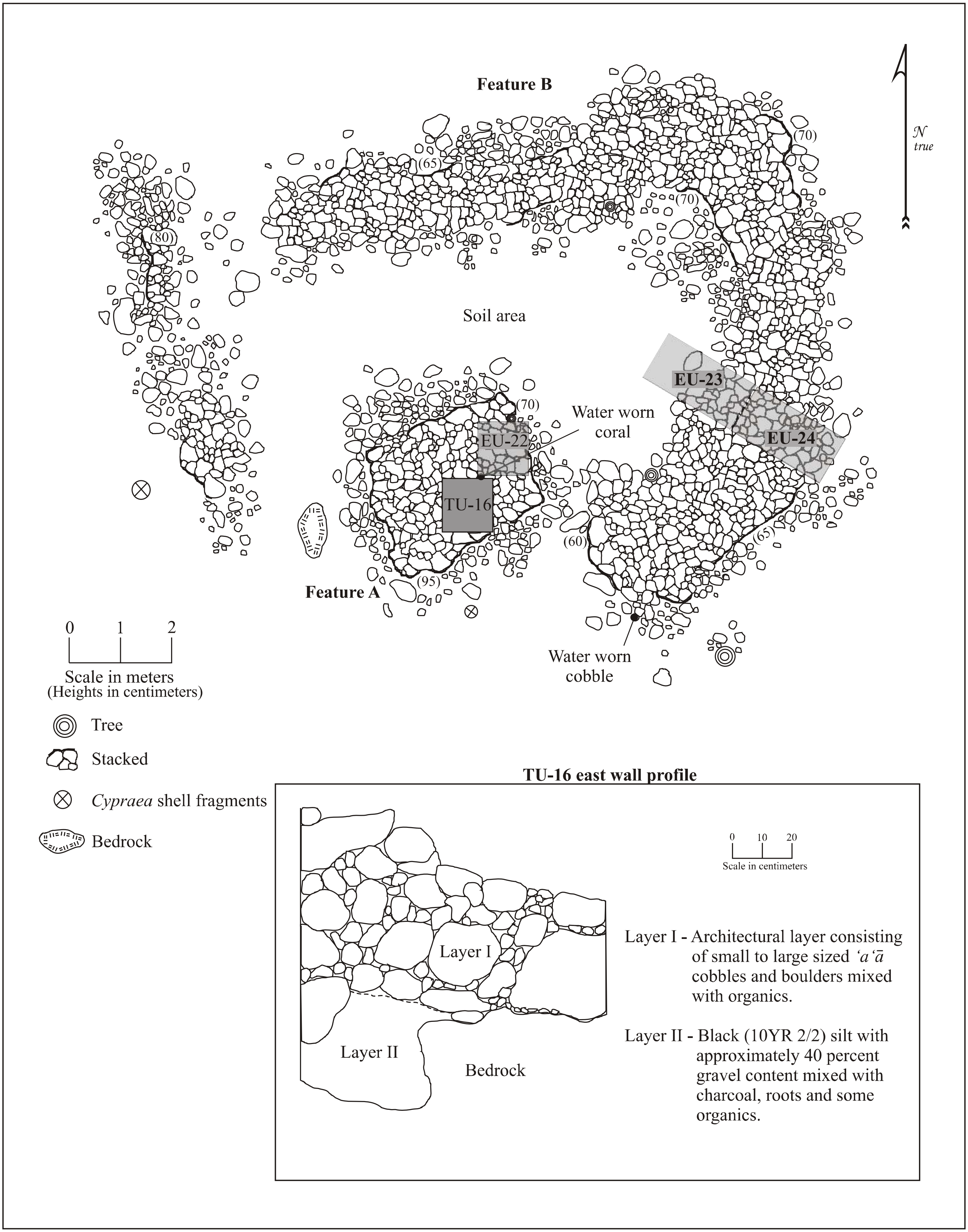

Figure 63. SIHP Site 23677 plan view and TU-16 profile.


Figure 64. SIHP Site 23677, view to the southwest.

TU-16 was excavated in the south-central area of Feature A (see Figure 63) and revealed the following stratigraphic profile:

Layer I (0-65cmbs)........... architectural layer with small to large sized *‘a‘ā* cobbles and boulders mixed with organics.
Layer II (65-95cmbs) .... black (10YR 2/2) silt with approximately 40% gravel content mixed with roots and some organics (charcoal staining?) on bedrock.

Items recovered from TU-16 include fish, *Cypraea* sp., *Drupa* sp., *Cellana* sp., *Nerita* sp., coral, Echinoidea, *Cantharus* sp., *Conus* sp., *Venus* sp., unidentifiable shell, mammal, charcoal, and volcanic glass flakes and shatter (Table 23). Other than Layer II yielding far more and a greater variety of items than Level I, no meaningful changes could be detected between the layers.

Table 23. Recovered items from SIHP Site 23677, Feature A, TU-16.

ACC #	*Layer*	*Depth(cmbs)*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
26	I	0-65	Organic	Charcoal	-	-	0.4
27	I	0-65	Echinoderm	Echinoidea	2	1	0.3
28	I	0-65	Marine shell	*Cypraea* sp.	3	2	5.0
29	I	0-65	Marine shell	*Conus* sp.	1	1	0.7
30	I	0-65	Marine shell	*Drupa* sp.	1	1	3.5
31	I	0-65	Marine shell	*Nerita* sp.	1	1	0.2
				Layer I Total:	8	6	10.1
32	II	65-75	Organic	Charcoal	-	-	2.2
34	II	65-75	Echinoderm	Echinoidea	28	1	3.6
35	II	65-75	Marine shell	*Nerita* sp.	5	5	1.7
36	II	65-75	Marine shell	Unidentified	1	1	0.1
37	II	65-75	Coral	Waterworn	8	-	4.1
38	II	65-75	Marine shell	*Drupa* sp.	2	1	0.6
39	II	65-75	Marine shell	*Cantharus* sp.	1	1	0.1

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Table 23. Continued

ACC #	*Layer*	*Depth(cmbs)*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
40	II	65-75	Marine shell	*Cypraea* sp.	30	4	14.7
41	II	65-75	Marine shell	*Cellana* sp.	1	1	0.1
42	II	65-75	Marine shell	*Venus* sp.	1	1	0.1
43	II	65-75	Fish bone	Unidentified	1	1	0.2
44	II	65-75	Bone	Small mammal	1	1	2.4
45	II	65-75	Volcanic glass	Flakes	2	-	0.5
46	II	75-85	Organic	Charcoal	-	-	1.3
47	II	75-85	Echinoderm	Echinoidea	16	1	1.6
48	II	75-85	Marine shell	*Cypraea* sp.	5	1	1.1
49	II	75-85	Marine shell	*Nerita* sp.	1	1	0.1
50	II	75-85	Marine shell	*Cellana* sp.	1	1	0.1
51	II	75-85	Bone	Small mammal	1	1	1.0
52	II	75-85	Volcanic glass	Debitage	1	-	0.3
53	II	75-85	Organic	Charcoal	-	-	0. 9
54	II	75-85	Echinoderm	Echinoidea	2	1	0.3
55	II	75-85	Marine shell	*Cypraea* sp.	3	1	2.7
56	II	75-85	Marine shell	*Nerita* sp.	1	1	0.1
57	II	75-85	Marine shell	*Venus* sp.	1	1	0.3
				Layer II Total:	113	26	39.3
				TU-16 Total:	121	32	49.4

A charcoal sample from Layer II was sent to Beta Analytic, Inc. for AMS radiocarbon analysis (Beta-175917). The resulting conventional radiocarbon age is 160±40 BP, with a 2-sigma range of AD 1660 to 1950 (Clark and Rechtman 2003).

EU-22 was excavated near the northeast-central edge of Feature A (see Figure 63) and revealed the following stratigraphic profile (Figures 65 and 66):

Layer I (0-20cmbs)..........................architectural layer with angular *‘a‘ā* cobbles.
Layer II, Levels 1-3 (20-80cmbs)....dark brown (10YR 3/3) silt with approximately 70% *‘a‘ā* cobbles.
Layer III, Level 1-3 (80-130cmbs)..black (10YR 2/1) silt with approximately 70% *‘a‘ā* cobbles.

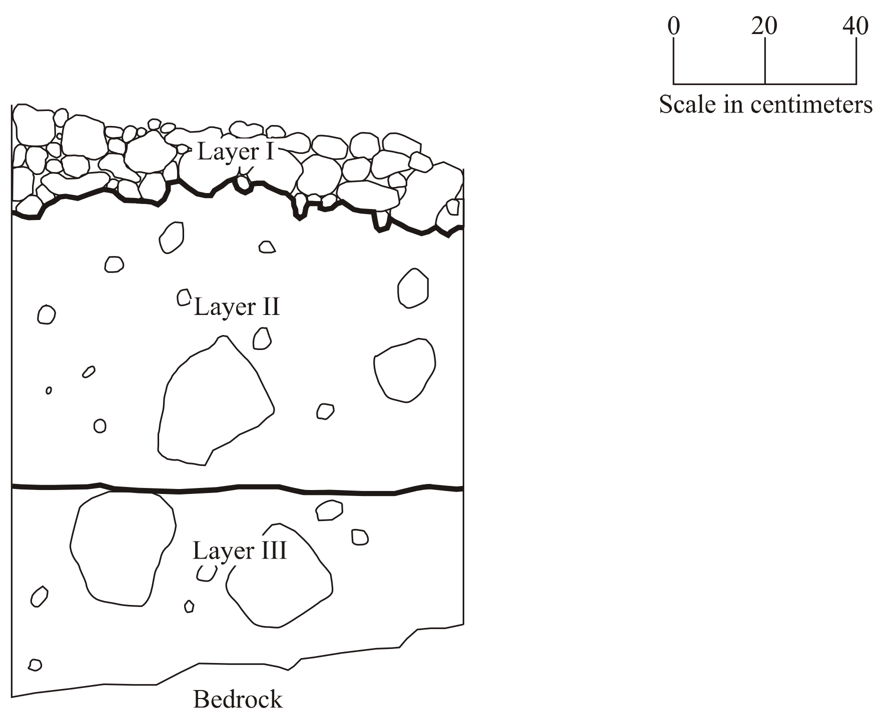
Items recovered from EU-22 include *Cypraea* sp., *Drupa* sp., *Chama* sp., *Nerita* sp., coral, Echinoidea, *Conus* sp., unidentifiable shell, rodent, unidentifiable mammal, *kukui* nutshell, charcoal, and volcanic glass flake (Table 24). No items were recovered in the architectural Layer I, while items peaked in Level 2 of Layer III. Volcanic glass flakes were limited to Layer III. Other than these stratigraphic differences, no significant trends for species by depth are apparent within EU-22.

Charcoal collected from Layer II Level 1 in EU-22, SIHP Site 23677 was submitted for radiocarbon assaying. The sample (Beta-212766) intercepts the tree-ring calibration curve at AD 1950 and has a 2-sigma standard deviation calibrated date range of AD 1680 to 1960. Charcoal collected from Layer III Level 3 in EU-22 was also submitted for radiocarbon assaying. The sample (Beta-212767) intercepts the tree-ring calibration curve at AD 1680/1740/1800/1930/1950 and has a 2-sigma standard deviation calibrated date range of AD 1660 to 1950. Charcoal collected from Layer I in TU-16 of SIHP Site 23677 yielded a radiocarbon assay that intercepts the tree-ring calibration curve at AD 1680/1740/1800/1930/1950 and has a 2-sigma standard deviation calibrated date range of AD 1660 to 1950. A calibrated weighted average of the three “linked” raw assays intercepts the tree-ring calibration curve at AD 1690/1730/1810/1920/1950, with a calibrated standard deviation that ranges between AD 1690 and 1950.

Table 24. Recovered items from SIHP Site 23677, Feature A, EU-22.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
380	II	1	Marine shell	*Cypraea* sp.	2	1	2.8
381	II	1	Coral	Unidentified	15	-	3.1
379	II	1	Small mammal	*Rattus* sp.	1	1	0.2
378	II	1	Organic	Charcoal	-	-	1.0
				Layer II, Level 1 Total:	18	2	7.1
383	II	2	Marine shell	*Cypraea* sp.	1	1	1.2
382	II	2	Marine shell	*Conus* sp.	2	1	0.7
384	II	2	Coral	Unidentified	1	-	5.1
385	II	2	Coral	Unidentified	2	-	3.7
386	II	2	Echinoderm	Echinoidea	1	-	0.1
387	II	3	Marine shell	*Cypraea* sp.	4	3	5.2
388	II	3	Marine shell	*Drupa* sp.	1	1	1.1
389	II	3	Coral	Unidentified	1	-	0.6
				Layer II, Level 2 Total:	13	6	17.7
392	III	1	Marine shell	*Cypraea* sp.	4	1	5.8
394	III	1	Marine shell	*Nerita* sp.	2	2	0.5
393	III	1	Marine shell	*Conus* sp.	3	1	1.1
395	III	1	Coral	Unidentified	1	-	0.1
396	III	1	Echinoderm	Echinoidea	2	-	0.3
391	III	1	Volcanic glass	Flake	1	-	0.4
390	III	1	Organic	Charcoal	-	-	0.2
				Layer III, Level 1 Total:	13	4	8.4
402	III	2	Marine shell	*Cypraea* sp.	35	5	26.4
405	III	2	Marine shell	*Drupa* sp.	1	1	0.1
404	III	2	Marine shell	*Nerita* sp.	7	5	1.4
403	III	2	Marine shell	*Conus* sp.	3	1	1.0
406	III	2	Marine shell	Unidentified	9	-	2.2
407	III	2	Coral	Unidentified	4	-	3.9
408	III	2	Echinoderm	Echinoidea	45	-	4.6
401	III	2	Mammal bone	Unidentified/burnt	2	-	0.9
400	III	2	Volcanic glass	Flake	3	-	2.8
399	III	2	Organic	*Kukui* nutshell	1	-	0.2
397	III	2	Organic	Charcoal	6	-	0.4
398	III	2	Organic	Charcoal in situ	14	-	0.2
				Layer III, Level 2 Total:	130	12	44.1
411	III	3	Marine shell	*Cypraea* sp.	6	1	9.2
413	III	3	Marine shell	*Drupa* sp.	1	1	0.3
414	III	3	Marine shell	*Pseudochama* sp.	2	1	0.3
412	III	3	Marine shell	*Nerita* sp.	1	1	0.4
410	III	3	Volcanic glass	Flake	1	-	1.2
409	III	3	Organic	Charcoal	37	-	1.5
				Layer III, Level 3 Total:	48	4	12.9
				EU-22 Total:	222	28	90.2

Figure 65. SIHP Site 27677 Feature A EU-22 base of excavation, view to the west.



Layer I - Architectural layer with angular *ʻaʻā* cobbles.

Layer II, Levels 1-3 - Dark brown (10YR 3/3) silt with approximately 70% *ʻaʻā* cobbles.

Layer III, Level 1-3 - Black (10YR 2/1) silt with approximately 70% *ʻaʻā* cobbles.

Figure 66. SIHP Site 27677 Feature A EU-22 west wall profile.

Feature B

Feature B is a rough wall partially enclosing Feature A to the north, east, and south. The wall which was formerly stacked, but is now mostly collapsed, measures up to 2.5 meters wide 70 centimeters high, and encompasses an area approximately 13.2 meters long by 9.5 meters wide. This *‘a‘ā* cobble wall is absent in the site’s southwest corner near Feature A, and only a faint trace of the western wall remains intact. The central area enclosed by the wall consists primarily of thin soil.

EU-23 and EU-24 were placed back-on-back across the southeastern corner of the Feature B wall and revealed the following stratigraphic profile (Figures 67, 68, and 69):

Layer I (0-40cmbs)........... architectural layer with small to large sized *‘a‘ā* cobbles and boulders with an upright in the center of the wall.
Layer II (65-95cmbs) .... dark brown (10YR 3/3) loose silt with approximately 90% small *‘a‘ā* cobbles and pebbles on weathered bedrock.

No items were recovered from EU-23, which fell on the northwestern half of the wall. *Cypraea* sp. and cone shell fragments were recovered from Level 2 of Layer II (Table 25).

Table 25. Recovered items from SIHP Site 23677, EU-24.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
562	II	2	Marine shell	*Cypraea* sp.	1	1	5.2
563	II	2	Marine shell	*Conus* sp.	1	1	0.3
				EU-24 Total:	2	2	5.5

SIHP Site 23678

Site 23678 is an enclosure in the northeast quadrant of the project area (see Figure 3) constructed within the center of a *kuaiwi* remnant (Site 23686 Feature 291) (Figure 70). The oval shaped enclosure (12.5 meters long by 5.5 meters wide) is constructed of partially stacked (mostly collapsed) *‘a‘ā* cobbles and boulders (Figure 71). In several locations the tops of the walls, which stand up to 60 centimeters above ground surface and measure 1.0 meter wide, and are topped with smooth *pāhoehoe* cobbles. The interior of the enclosure area (7.7 meters long by 2.6 meters wide) consists primarily of thin soil (at least 8 centimeters thick) covered by dense vegetation. An engineered opening (1.0 meter wide) located in the center of the north wall allows access to the enclosure. A *Cypraea* shell fragment and a small piece of coral were found on ground surface within Site 23678. Judging by the continuous construction, it appears that the enclosure was built prior to, or at the same time as, the *kuaiwi* (Site 23686 Feature 291), which extends in both directions from the enclosure’s east and west ends.

EU-14 (2 x 1m aligned west-east) was placed within the oval-shaped enclosure, east of the possible northern entrance (see Figure 70) and revealed EU-14 revealed the following stratigraphic profile (Figure 72):

Layer I, Levels 1-2 (0-20cmbs)........ dark brown (10YR 3/3) silt with 40% small *a‘ā* cobbles and pebbles.
Layer I, Level 3 (20-30cmbs)........... dark yellowish brown (10YR 3/4) silt on undulating and decomposing bedrock.

EU-14 yielded items that include *Cypraea* sp., *Drupa* sp., *Cellana* sp., *Isognomon* sp., coral, Echinoidea, *Conus* sp., *Venus* sp., unidentifiable shell, charcoal, fire cracked basalt, a basalt adze fragment, basalt flake, waterworn basalt, and volcanic glass flakes and shatter (Table 26). Most of the recovered items came from Levels 1 and 2. The fine-grained basalt adze fragment (Acc# 223) from Level 3 of Layer I has one polished face (Figure 73). This fragment is 13.05 millimeters long, 9.9 millimeters wide, and 1.55 millimeters thick. Other than these differences, no significant change in species or artifact types is apparent.

Figure 67. EU-23 base of excavation, view to the northeast.

Figure 68. EU-24 base of excavation, view to the northeast.

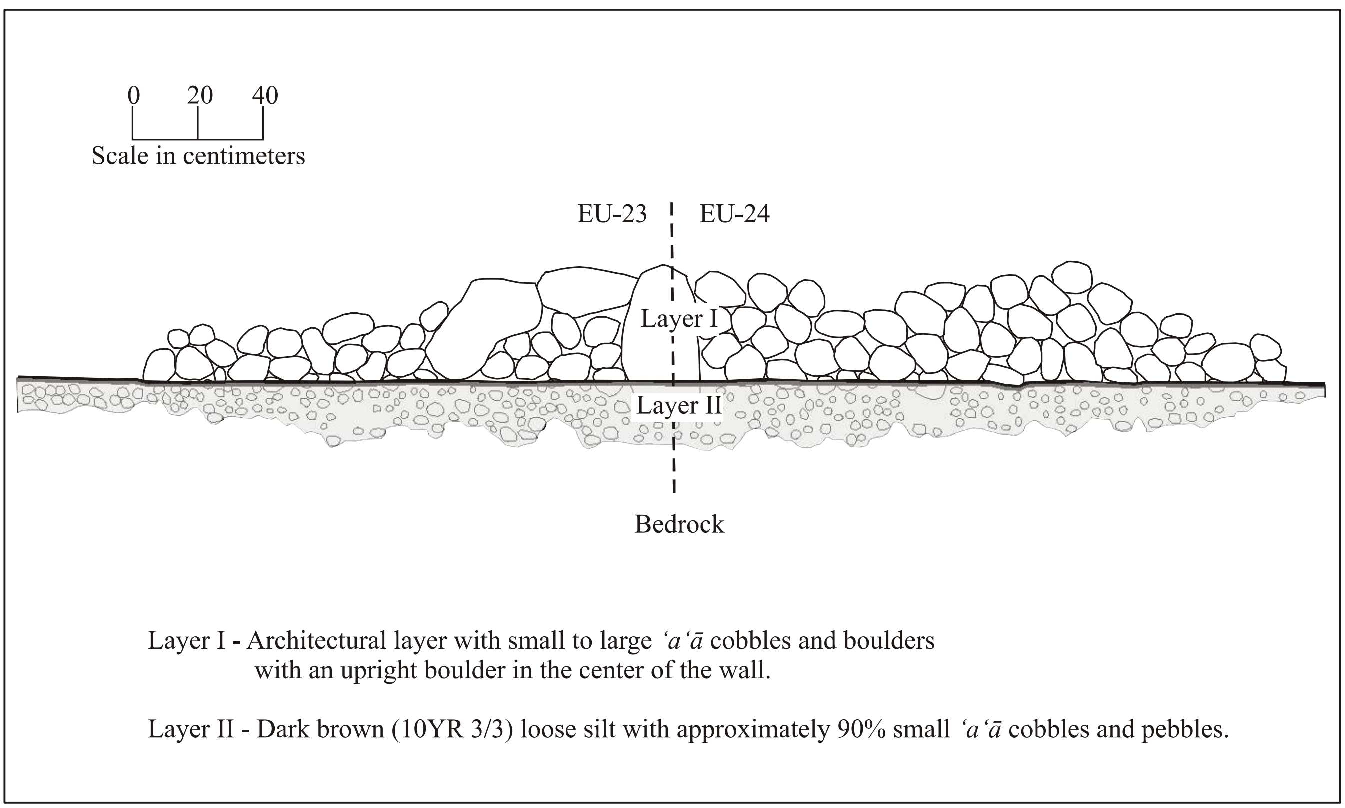


Figure 69. SIHP Site 23677 Feature B EU-23 and 24 northeast wall profile.

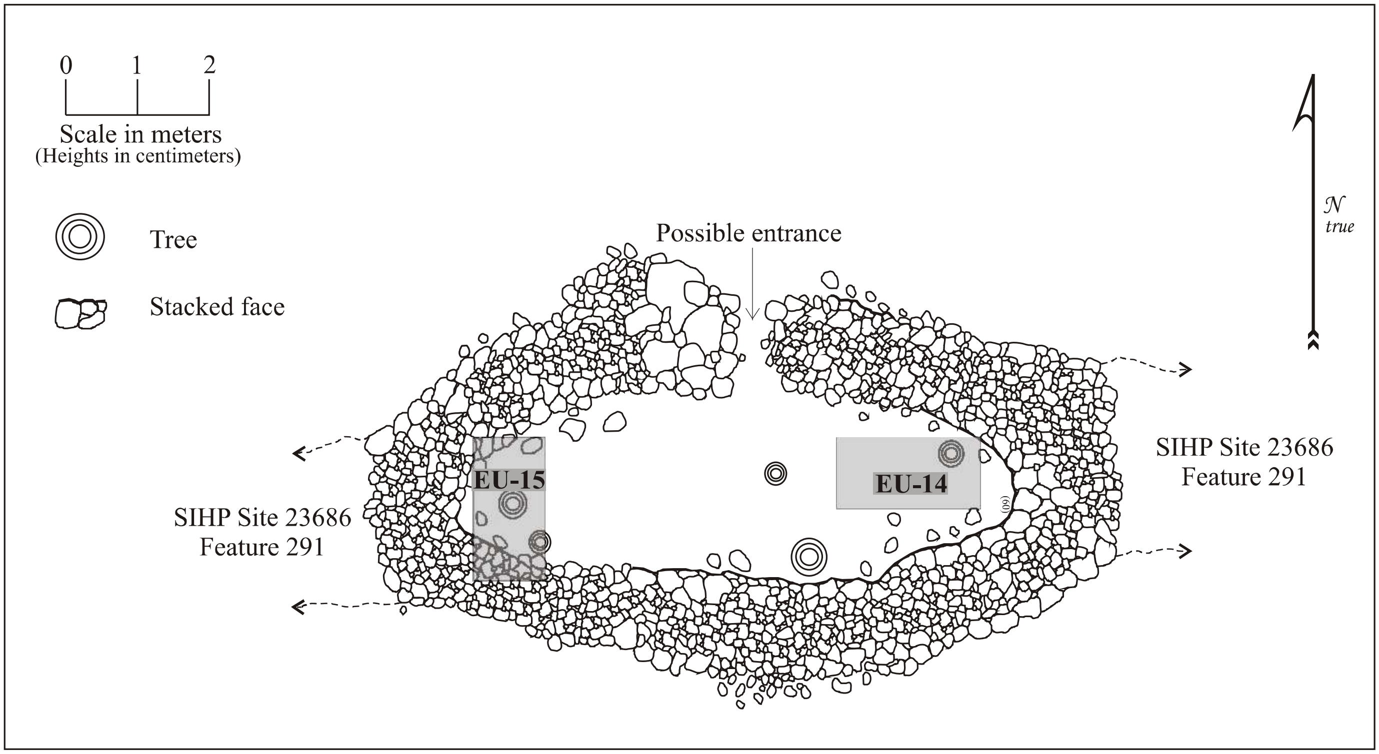
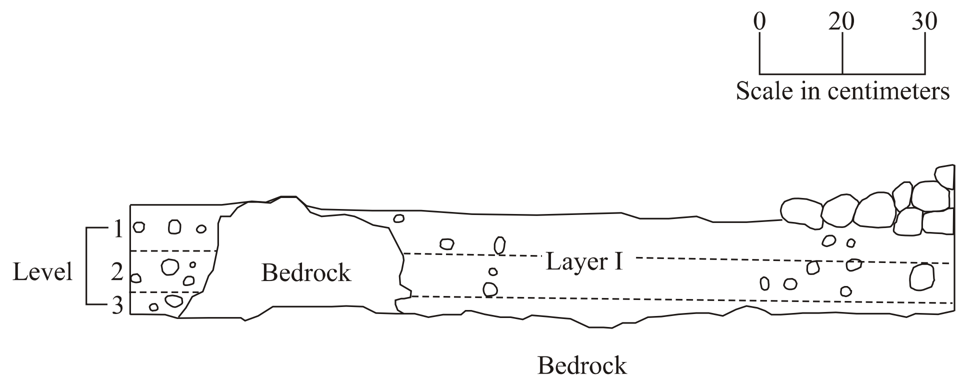


Figure 70. SIHP Site 23678 plan view.

Figure 71. SIHP Site 23678, view to the east .



Layer I, Levels 1-2 - Dark brown (10YR 3/3) silt with 40% small *‘a‘ā* cobbles and pebbles.

Layer I, Level 3 - Dark yellowish brown (10YR 3/4) silt on undulating and decomposing bedrock.

Figure 72. SIHP Site 23678 EU-14 north wall profile.

Figure 73. SIHP Site 23678 EU-14 basalt adze fragment (Acc.# 223).

Table 26. Recovered items from SIHP Site 23678, EU-14.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
204	I	1	Marine shell	*Cypraea* sp.	37	4	29.1
203	I	1	Marine shell	*Cellana* sp.	1	1	0.1
567	I	1	Marine shell	*Cellana* sp.	1	1	0.5
202	I	1	Marine shell	*Conus* sp.	6	-	2.8
568	I	1	Marine shell	*Conus* sp.	1	1	1.0
569	I	1	Marine shell	Unidentified bivalve	3	-	1.9
205	I	1	Marine shell	Unidentified	4	-	0.7
206	I	1	Coral	Unidentified	12	-	12.2
207	I	1	Coral	Unidentified	19	-	22.2
208	I	1	Coral	Waterworn	11	-	6.5
200	I	1	Basalt	Flake	1	-	0.7
199	I	1	Basalt	Fire cracked	1	-	54.2
201	I	1	Volcanic glass	Flake	9	-	4.7
198	I	1	Organic	Charcoal	-	-	0.2
				Layer I, Level 1 Total:	106	7	136.8
217	I	2	Marine shell	*Cypraea* sp.	30	3	17.5
215	I	2	Marine shell	*Drupa* sp	5	-	2.3
216	I	2	Marine shell	*Isognomon* sp.	2	1	0.1
214	I	2	Marine shell	*Conus* sp.	7	3	3.8
219	I	2	Marine shell	Unidentified	20	-	6.0
220	I	2	Coral	Unidentified	22	-	2.0
221	I	2	Coral	Unidentified	30	-	30.5
222	I	2	Coral	Waterworn	3	-	0.6
218	I	2	Echinoderm	Echinoidea	11	-	0.9
213	I	2	Basalt	Waterworn pebble	1	-	0.5
212	I	2	Volcanic glass	Flake	18	-	7.5
211	I	2	Volcanic glass	Shatter	1	-	2.5
209	I	2	Organic	Charcoal	-	-	1.0
210	I	2	Organic	Wood	1	-	0.1
				Layer I, Level 2 Total:	151	7	75.3
224	I	3	Marine shell	*Cypraea* sp.	7	1	4.0
226	I	3	Marine shell	Unidentified	6	-	2.0
227	I	3	Coral	Unidentified	2	-	0.4
228	I	3	Coral	Unidentified	5	-	2.8
225	I	3	Echinoderm	Echinoidea	1	-	0.1
223	I	3	Basalt	Adze fragment	1	-	0.2
				Layer I, Level 3 Total:	22	1	9.5
				EU-14 Total:	279	15	221.6

Charcoal collected from Level 2 in Layer I of EU-14, SIHP Site 23678 was submitted for radiocarbon assaying. The sample (Beta-212762) intercepts the tree-ring calibration curve at AD 1660 and has a 2-sigma standard deviation calibrated date range of AD 1640 to 1950.

EU-15 (2 x 1m aligned south-north) was placed partly within the oval-shaped enclosure and partly on the enclosing wall, southwest of the possible northern entrance (see Figure 70). EU-15 revealed the following stratigraphic profile (Figures 74 and 75):

Layer I (0-30cmbs)..........................architectural layer with small to large sized *ʻaʻā* cobbles and boulders with an upright in the center of the wall.
Layer II, Levels 1-4 (30-60cmbs)....dark brown (10YR 3/3) silt with *ʻaʻā* cobbles and pebbles.
Layer III (60-70cmbs).....................dark yellowish brown (10 YR3/4) silt on weathered and uneven *ʻaʻā* bedrock.

EU-15 yielded fish, *Cypraea* sp., *Drupa* sp., *Morula* sp., *Cellana* sp., *Isognomon* sp., *Nerita* sp., *Strombina* sp., coral, Echinoidea, *Conus* sp., *Venus* sp., unidentifiable shell, bird, charcoal, basalt flakes, waterworn basalt, and volcanic glass flakes and shatter (Table 27). Species and artifact types peak in Level 2 of Layer II and then drops off to bedrock. Other than these shifts in numbers, no meaningful stratigraphic trends for recovered items are apparent. EU-15 is unusual in terms of the density of recovered items.

Table 27. Recovered items from SIHP Site 23678, EU-15.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
229	I	1	Marine shell	*Cypraea* sp.	2	1	2.9
230	I	1	Coral	Branch	2	-	67.0
231	I	1	Coral	Unidentified	3	-	12.2
232	I	1	Coral	Unidentified	15	-	66.4
				Layer I, Level 1 Total:	22	1	148.5
235	II	1	Fish bone	Unidentified	1	-	0.1
238	II	1	Marine shell	*Cypraea* sp.	16	2	12.0
237	II	1	Marine shell	*Drupa* sp.	2	1	0.5
241	II	1	Marine shell	*Drupa* sp.	2	1	0.6
239	II	1	Marine shell	*Morula* sp.	2	2	0.3
236	II	1	Marine shell	*Conus* sp.	7	3	3.5
240	II	1	Marine shell	Unidentified	15	-	4.3
242	II	1	Coral	Unidentified	16	-	12.2
243	II	1	Coral	Unidentified	42	-	43.9
244	II	1	Echinoderm	Echinoidea	5	-	0.3
234	II	1	Basalt	Waterworn pebble	1	-	2.3
233	II	1	Volcanic glass	Flake	1	-	0.8
				Layer II, Level 1 Total:	110	9	80.8
250	II	2	Marine shell	*Cypraea* sp.	58	4	36.5
252	II	2	Marine shell	*Drupa* sp	3	1	0.9
253	II	2	Marine shell	*Morula* sp.	2	1	0.7
255	II	2	Marine shell	*Cellana* sp.	1	1	0.1
254	II	2	Marine shell	*Isognomon* sp.	2	1	0.3
257	II	2	Marine shell	*Strombus* sp.	2	2	0.6
251	II	2	Marine shell	*Conus* sp.	20	3	9.4
256	II	2	Marine shell	Unidentified bivalve	3	-	1.4
258	II	2	Marine shell	Unidentified	59	-	19.7
260	II	2	Coral	Unidentified	32	-	13.2
261	II	2	Coral	Unidentified	72	-	75.3
259	II	2	Echinoderm	Echinoidea	44	-	2.6
249	II	2	Bird bone	Unidentified	1	-	0.1
246	II	2	Basalt	Flake	4	-	2.8
247	II	2	Volcanic glass	Flake	10	-	7.7
248	II	2	Volcanic glass	Shatter	1	-	1.8
245	II	2	Organic	Charcoal	-	-	0.3
				Layer II, Level 2 Total:	314	13	173.4

Continued on next page

Table 27. Continued.

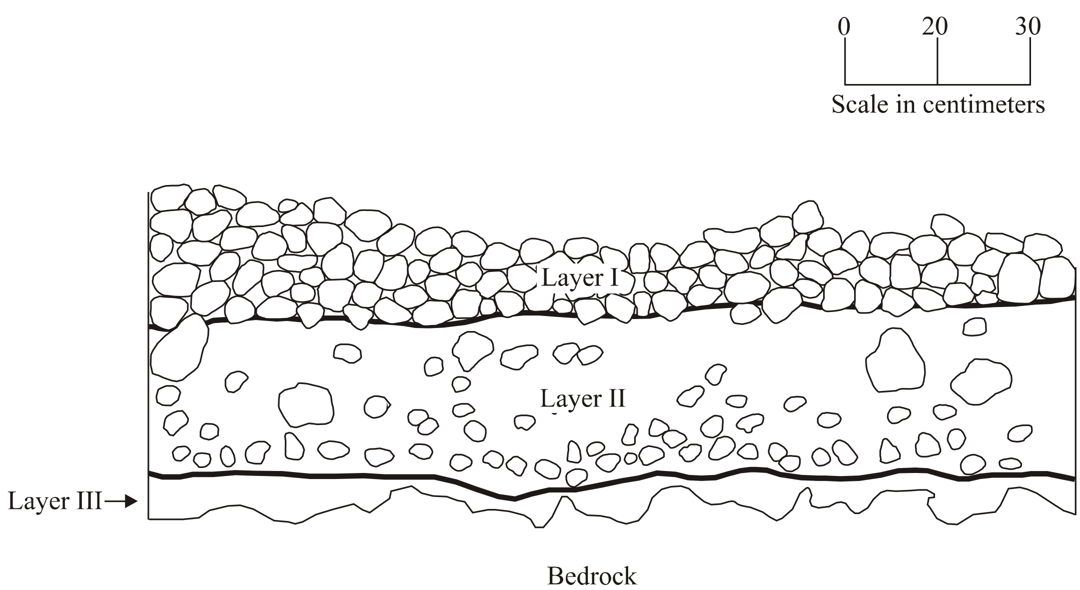
ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
266	II	3	Marine shell	*Cypraea* sp.	16	2	13.5
264	II	3	Marine shell	*Drupa* sp	5	2	2.6
265	II	3	Marine shell	*Nerita* sp.	1	1	0.1
263	II	3	Marine shell	*Conus* sp.	17	3	8.2
267	II	3	Marine shell	Unidentified bivalve	3	-	1.7
268	II	3	Marine shell	Unidentified	18	-	8.0
270	II	3	Coral	Unidentified	12	-	3.7
271	II	3	Coral	Unidentified	30	-	30.0
272	II	3	Coral	Waterworn	3	-	1.2
269	II	3	Echinoderm	Echinoidea	24	-	1.1
262	II	3	Volcanic glass	Flake	1	-	0.8
				Layer II, Level 3 Total:	130	8	70.9
274	II	4	Marine shell	*Cypraea* sp.	4	1	2.8
275	II	4	Marine shell	*Conus* sp.	2	1	1.2
277	II	4	Marine shell	Unidentified bivalve	1	-	0.6
276	II	4	Marine shell	Unidentified	5	-	1.2
279	II	4	Coral	Unidentified	3	-	2.0
280	II	4	Coral	Unidentified	8	-	6.2
281	II	4	Coral	Waterworn pebble	1	-	0.1
278	II	4	Echinoderm	Echinoidea	4	-	0.9
273	II	4	Basalt	Waterworn pebble	1	-	0.5
				Layer II, Level 4 Total:	29	2	15.5
				EU-15 Total:	605	33	489.1

SIHP SITE 23686

Site 23686 consists of the entire archaeological agricultural landscape contained within the project area. The site encompasses 297 distinct agricultural features including 199 mounds (67.0%), 59 modified outcrops (19.6%), 22 terraces (7.4%), 7 enclosures (2.4%), 7 *kuaiwi* (2.4%), and 3 pavements (1.0%). See Clark and Rechtman (2003) for a discussion of feature type definitions. These features stretch over the entire landscape but, by far, the greatest numbers are concentrated in the southeast quadrant of the project area (see Figure 3). This area may have received less Historic Period use, which would point to a higher number of preserved features in this area, rather than increased Precontact use of this portion of the project area. Features in the *makai* third to one half of the project area are constructed primarily of *pāhoehoe* while the *mauka* features are constructed primarily of *ʻaʻā*, as dictated by the readily available source materials. A complete listing of the features at Site 23686 is shown in Table 7, and the locations of the features are shown on Figure 76.

During the Inventory Survey (Clark and Rechtman 2003) ten test units were excavated within five mounds (Features 187, 189, 262, 266, and 271) and five modified outcrops (Features 183, 201, 204, 239, and 297) at various elevations within Site 23686. No cultural material was recovered from any of these test units; and no terraces, enclosures, *kuaiwi*, or pavements were tested during the inventory survey. During data recovery seventeen excavation units were excavated within fifteen features (2 excavation units were placed within each of Features 282 and 289). The fifteen excavated features include two square enclosures (Features 293 and 294), one rectangular enclosure (Feature 251), two rectangular pavements (Features 250 and 282), one irregular pavement (Feature 289), five linear terraces (Features 81, 185, 212, 247 and 254), one irregular terrace (Feature 286), and three linear *kuaiwi* (Features 17, 82, and 291).

Figure 74. SIHP Site 23678 EU-15 base of excavation, view to the north.



Layer I - Architectural layer with small to large sized *ʻaʻā* cobbles and boulders.

Layer II, Levels 1-4 - Dark brown (10YR 3/3) silt with *ʻaʻā* cobbles and pebbles.

Layer III - Dark yellowish brown (10 YR3/4).

Figure 75. SIHP Site 23678 EU-15 west wall profile.

Figure 76. SIHP Site 23686 plan view.

Table 28. SIHP Site 23686 agricultural features.

Feature #	*Feature type*	*Attribute**	*Length (m)*	*Width (m)*	*Height (m)*	*Shape*
1	Mound	S/P	5.2	2.9	0.8	Irregular
2	Mound	S	2.8	2.7	0.8	Oval
3	Modified outcrop	S	4.3	2.2	1.8	Irregular
4	Modified outcrop	P	4.6	2.9	1.1	Linear
5	Modified outcrop	P	5.8	4.2	0.6	Irregular
6	Mound	P	5.0	2.1	0.4	Linear
7	Modified outcrop	P	4.4	3.6	0.6	Triangular
8	Mound	P	2.8	2.8	0.5	Circular
9	Modified outcrop	S	5.2	2.9	0.8	Irregular
10	Mound	P	2.0	1.5	0.5	Oval
11	Mound	P	3.9	1.8	0.8	Linear
12	Mound	P	3.7	2.1	0.7	Linear
13	Mound	P	3.8	2.7	0.9	Linear
14	Mound	P	2.7	2.7	0.7	Circular
15	Mound	P	3.5	3.0	1.0	Oval
16	Mound	P	2.3	2.3	0.8	Circular
17	*Kuaiwi*	P	38.7	2.0	0.8	Linear
18	Mound	P	2.7	2.4	0.7	Circular
19	Mound	P	2.1	0.9	0.9	Linear
20	Mound	P	3.1	1.9	0.9	Oval
21	Mound	P	2.7	1.6	1.0	Irregular
22	Mound	P	3.2	2.9	0.5	Rectangular
23	Mound	P	3.3	0.9	0.9	Linear
24	Mound	P	3.8	3.0	0.9	Irregular
25	Mound	P	3.1	2.5	0.5	Irregular
26	Modified outcrop	P	4.5	3.5	0.7	Irregular
27	Mound	P	2.1	2.1	0.7	Circular
28	Mound	P	3.5	2.0	0.4	Irregular
29	Mound	P	4.1	3.5	0.9	Oval
30	Mound	P	10.7	2.7	0.4	Linear
31	Mound	P/S	2.1	1.9	0.7	Irregular
32	Mound	P	1.8	1.6	0.6	Irregular
33	Mound	P	4.0	3.6	0.8	Oval
34	Mound	P	2.2	2.2	1.0	Circular
35	Enclosure	P	3.0	2.5	0.4	Oval
36	Modified outcrop	P/S	2.1	1.4	1.1	Irregular
37	Terrace	P	4.8	3.1	0.9	Linear
38	Mound	P	2.0	1.7	0.5	Oval
39	Mound	P	1.8	1.4	0.5	Oval
40	Mound	P	2.8	2.1	0.7	Oval
41	Mound	P	1.4	1.4	0.4	Circular
42	Mound	S	2.1	1.8	0.8	Irregular
43	Mound	P	1.9	1.8	0.5	Circular
44	Mound	P	2.3	2.0	0.5	Oval
45	Mound	P	2.3	1.5	0.5	Oval
46	Mound	P	3.2	1.0	0.4	Linear
47	Mound	P	2.5	1.9	0.6	Oval
48	Mound	P	2.6	2.0	0.4	Oval
49	Mound	P	2.3	1.9	0.5	Oval
50	Mound	P	3.2	2.1	0.5	Irregular
51	Mound	P	2.7	1.8	0.5	Irregular
52	Mound	P	1.3	1.3	0.6	Circular

***S=Stacked; P=Piled.**

continued on next page.

Table 28. Continued.

Feature #	*Feature type*	*Attribute**	*Length (m)*	*Width (m)*	*Height (m)*	*Shape*
53	Mound	P	4.4	2.9	0.6	Oval
54	Mound	P	1.8	1.3	0.4	Irregular
55	Mound	P	1.9	1.3	0.4	Rectangular
56	Mound	P	2.5	1.7	0.7	Oval
57	Mound	P	2.5	1.6	0.7	Linear
58	Mound	P	4.5	3.2	0.7	Irregular
59	*Kuaiwi*	P	18.6	1.1	0.4	Linear
60	Mound	P	1.4	1.4	0.6	Linear
61	Mound	P	3.3	1.5	0.7	Linear
62	Mound	P	2.1	2.1	0.3	Circular
63	Mound	P	1.7	1.0	0.5	Irregular
64	Mound	P	3.3	1.9	0.3	Oval
65	Mound	P	2.1	1.5	0.2	Oval
66	Mound	P	1.7	2.1	0.3	Circular
67	Mound	P	3.5	0.8	0.4	Linear
68	Mound	P	1.8	1.0	0.5	Circular
69	Mound	P	2.7	2.7	0.6	Circular
70	Mound	P	2.2	1.2	0.4	Oval
71	Mound	P	4.8	3.3	0.4	Irregular
72	Mound	P	1.9	1.5	0.8	Oval
73	Mound	P	1.9	1.9	0.4	Circular
74	Mound	P	1.7	1.7	0.3	Circular
75	Mound	P	2.1	1.4	0.6	Oval
76	Mound	P	1.3	1.3	0.5	Circular
77	Mound	P	1.9	1.2	0.3	Oval
78	Mound	P	1.8	1.1	0.5	Oval
79	Mound	P	1.4	1.4	0.4	Circular
80	Mound	P	3.2	1.4	0.7	Linear
81	Terrace	S	60.0	1.0	0.5	Linear
82	*Kuaiwi*	S	108.0	2.1	0.7	Linear
83	Mound	S	1.8	1.3	0.5	Circular
84	Mound	S	3.4	2.1	0.8	Rectangular
85	Mound	P	3.1	2.2	0.8	Oval
86	Mound	P	3.0	1.7	0.5	Oval
87	Mound	S	1.8	1.1	0.4	Rectangular
88	Mound	P	2.1	1.1	0.4	Oval
89	Mound	P	1.5	1.5	0.5	Circular
90	Mound	P	3.4	1.7	0.6	Linear
91	Mound	P	1.9	1.9	0.6	Circular
92	Mound	P	5.6	2.1	0.7	Linear
93	Mound	P	3.4	1.9	0.4	Rectangular
94	Mound	P	1.9	1.9	0.7	Circular
95	Mound	P	6.4	1.8	1.4	Crescent
96	Mound	P	2.6	1.2	0.7	Irregular
97	Mound	P	1.9	1.4	0.5	Oval
98	Mound	P	2.0	1.2	0.4	Rectangular
99	Mound	P	4.0	1.4	0.4	Linear
100	Mound	P	11.9	1.9	0.5	Circular
101	Mound	P	2.0	2.0	0.5	Circular
102	Mound	P	1.4	1.4	0.4	Circular
103	Mound	P	3.4	1.7	0.5	Irregular
104	Mound	P	1.6	1.1	0.4	Oval

***S=Stacked; P=Piled.**

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Table 28. Continued.

Feature #	*Feature type*	*Attribute**	*Length (m)*	*Width (m)*	*Height (m)*	*Shape*
105	Mound	P	2.4	2.4	0.4	Circular
106	Mound	P	1.7	1.7	0.4	Circular
107	Terrace	P	5.2	2.4	0.3	Linear
108	Mound	P	1.7	1.5	0.5	Irregular
109	Mound	P	1.7	1.2	0.5	Oval
110	Mound	P	1.6	1.6	0.5	Circular
111	Mound	P	1.8	1.2	0.5	Oval
112	Modified outcrop	P	3.6	2.3	0.8	Linear
113	Mound	P	2.8	1.8	0.6	Linear
114	Mound	P	2.2	1.5	0.3	Rectangular
115	Mound	P	2.1	2.0	0.5	Irregular
116	Mound	P	2.3	1.4	0.5	Oval
117	Mound	P	2.4	1.2	0.3	Oval
118	Terrace	P	7.0	0.7	0.6	L-shaped
119	Mound	P	2.8	1.9	0.4	Oval
120	Terrace	S	29.0	1.0	0.6	Linear
121	Mound	P	2.7	1.3	0.4	Oval
122	Mound	S	2.8	1.7	0.6	Oval
123	Mound	P	2.3	1.2	0.5	Linear
124	Mound	P	2.3	1.3	0.4	Oval
125	Mound	P	2.0	1.4	0.5	Oval
126	Mound	S	2.6	1.6	0.7	Rectangular
127	Mound	P	5.2	1.2	0.4	Linear
128	Mound	P	3.2	2.2	0.6	Oval
129	Mound	P	3.5	3.2	1.0	Oval
130	Modified outcrop	S	4.7	2.8	0.3	Linear
131	Mound	S	3.4	2.3	0.5	Triangular
132	Mound	P	1.8	1.3	0.8	Oval
133	Modified outcrop	P	2.2	2.0	0.7	Irregular
134	Mound	P	1.9	1.3	0.4	Oval
135	Modified outcrop	P	1.8	1.1	0.6	Irregular
136	Mound	P	2.3	1.9	0.6	Irregular
137	Modified outcrop	P	2.8	2.0	0.8	Rectangular
138	Mound	P	1.3	1.3	0.3	Circular
139	Modified outcrop	P	1.5	1.1	0.7	Oval
140	Mound	S	2.3	1.8	0.7	Irregular
141	Terrace	P	4.7	2.5	1.0	Rectangular
142	Mound	S	1.3	0.9	0.9	Oval
143	Terrace	P	3.6	1.8	0.8	Rectangular
144	Mound	P	2.6	2.1	0.8	Oval
145	Modified outcrop	P	1.8	2.1	0.7	Oval
146	Mound	P	2.6	2.2	0.6	Oval
147	Mound	P	3.7	1.6	0.5	Linear
148	Mound	P	2.3	1.2	0.6	Oval
149	Mound	P	2.0	2.0	0.7	Circular
150	Mound	P	4.4	2.5	0.6	Linear
151	Mound	P	1.4	1.4	0.3	Circular
152	Mound	P	4.9	3.2	0.7	Linear
153	Mound	P	1.4	0.8	0.3	Oval
154	Mound	P	3.6	2.3	0.7	Linear
155	Mound	P	1.5	1.0	0.4	Triangular
156	Mound	P	3.2	2.1	0.6	Oval

***S=Stacked; P=Piled.**

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Table 28. Continued.

Feature #	*Feature type*	*Attribute**	*Length (m)*	*Width (m)*	*Height (m)*	*Shape*
157	Mound	P	1.8	1.5	0.5	Circular
158	Mound	S	2.5	1.6	0.7	Oval
159	Mound	P	1.5	1.2	0.7	Oval
160	Mound	S	1.8	1.3	0.6	Irregular
161	Modified outcrop	S/P	6.0	3.0	1.4	Rectangular
162	Mound	P	1.3	1.3	0.6	Circular
163	Modified outcrop	P	12.2	1.1	1.1	Irregular
164	Modified outcrop	P	5.8	4.8	1.9	Rectangular
165	Mound	P	1.8	1.8	0.4	Irregular
166	Mound	P	3.2	1.7	0.8	Linear
167	Mound	P	1.3	1.3	0.4	Circular
168	Mound	S/P	5.7	3.9	0.9	Oval
169	Mound	P	2.2	1.6	0.7	Oval
170	Mound	P	1.3	1.3	0.5	Circular
171	Mound	P	2.2	1.7	0.8	Irregular
172	Mound	P	2.3	1.8	0.5	Oval
173	Mound	P	3.0	2.2	0.9	Oval
174	Mound	P	1.8	1.8	0.3	Circular
175	Modified outcrop	P	2.3	2.1	1.0	Irregular
176	Mound	P	1.1	1.0	0.5	Circular
177	Modified outcrop	P	2.9	2.6	0.6	Crescent
178	Mound	P	2.6	2.1	0.5	Irregular
179	Modified outcrop	P	1.4	2.3	0.4	Irregular
180	Mound	P	1.8	1.8	0.6	Circular
181	Mound	P	2.8	1.7	0.8	Irregular
182	Mound	P	2.2	2.2	0.5	Circular
183	Modified outcrop	S	6.7	5.3	0.8	Irregular
184	Mound	P	2.0	2.0	0.4	Circular
185	Terrace	P	17.0	0.6	0.9	Linear
186	Mound	S/P	2.6	1.4	0.9	Oval
187	Mound	S/P	3.0	1.7	0.8	Rectangular
188	Modified outcrop	P	3.5	2.7	1.0	Irregular
189	Mound	P	2.4	2.2	0.7	Irregular
190	Modified outcrop	S/P	3.9	2.3	0.9	Linear
191	Modified outcrop	P	4.4	2.1	0.8	Linear
192	Modified outcrop	S	2.5	1.8	0.8	Oval
193	Modified outcrop	P	9.2	3.1	1.1	Irregular
194	Mound	P	3.0	2.1	0.6	Oval
195	*Kuaiwi*	S/P	16.0	1.0	0.5	Linear
196	Modified outcrop	P	5.2	2.8	0.8	Linear
197	Mound	S/P	6.0	2.3	1.1	Rectangular
198	Modified outcrop	P	3.1	2.7	0.6	Irregular
199	Modified outcrop	P	6.5	4.8	0.7	L-shaped
200	Terrace	P	7.2	2.1	0.8	Crescent
201	Modified outcrop	S/P	6.2	3.8	0.7	Oval
202	Mound	P	2.1	2.1	0.6	Circular
203	Mound	P	3.4	2.8	0.8	Circular
204	Modified outcrop	S/P	3.4	2.7	0.7	Irregular
205	Modified outcrop	P	3.0	2.3	0.6	Irregular
206	Mound	S	2.3	2.3	0.6	Circular
207	Mound	S	3.2	3.2	0.8	Irregular
208	Modified outcrop	P	2.7	0.9	0.4	Linear

***S=Stacked; P=Piled.**

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Table 28. Continued.

Feature #	*Feature type*	*Attribute**	*Length (m)*	*Width (m)*	*Height (m)*	*Shape*
209	Modified outcrop	P	3.7	2.6	0.6	Oval
210	Modified outcrop	P	5.2	3.4	0.9	Irregular
211	Mound	P	3.6	2.8	0.8	Irregular
212	Terrace	P	5.2	1.4	0.5	Linear
213	*Kuaiwi*	P	50.2	1.8	0.7	Linear
214	Mound	S/P	2.6	2.1	0.9	Oval
215	Modified outcrop	S/P	10.3	3.9	1.7	Irregular
216	Mound	P	2.7	2.4	0.2	Circular
217	Modified outcrop	S	1.6	0.4	0.4	Linear
218	Modified outcrop	P	2.0	1.8	0.7	Oval
219	Modified outcrop	P	3.0	1.8	1.0	Irregular
220	Modified outcrop	S	1.8	1.0	1.5	Crescent
221	Mound	S/P	3.5	1.9	1.1	Irregular
222	Mound	P	3.6	2.7	1.0	Rectangular
223	Mound	P	2.5	2.0	0.8	Irregular
224	Mound	S/P	3.3	1.9	0.9	Rectangular
225	Mound	P	1.4	1.4	0.7	Circular
226	Mound	P	2.0	2.0	0.6	Circular
227	Mound	P	4.1	3.7	0.8	Irregular
228	Mound	P	2.3	2.1	1.0	Oval
229	Mound	S/P	4.3	2.0	0.9	Rectangular
230	Modified outcrop	P	3.4	2.3	0.9	Oval
231	Modified outcrop	P	2.3	2.0	0.7	Irregular
232	Modified outcrop	P	1.9	1.7	0.9	Oval
233	Mound	P	2.3	1.7	0.8	Irregular
234	Mound	S/P	2.0	1.7	1.0	Irregular
235	Modified outcrop	S/P	3.9	1.9	1.0	Irregular
236	Modified outcrop	S/P	2.1	1.6	1.1	Irregular
237	Terrace	S/P	6.0	4.0	2.1	Rectangular
238	Modified outcrop	P	3.4	2.8	1.0	L-shaped
239	Modified outcrop	S/P	4.0	2.5	0.7	Rectangular
240	Mound	P	2.5	2.1	0.8	Circular
241	Mound	P	4.4	3.1	1.0	Irregular
242	Modified outcrop	S/P	3.4	2.2	0.8	Irregular
243	Terrace	S/P	11.8	7.9	0.9	Crescent
244	Terrace	S/P	9.0	5.6	0.7	Linear
245	Modified outcrop	S/P	13.9	7.8	1.7	Irregular
246	Mound	S/P	2.2	1.0	0.6	Irregular
247	Terrace	S/P	11.0	2.6	0.9	Linear
248	Modified outcrop	P	3.5	1.9	0.7	Irregular
249	Mound	P	4.1	2.3	0.6	Oval
250	Pavement	P	2.5	1.8	0.5	Rectangular
251	Enclosure	P	12.5	11.5	0.6	Rectangular
252	*Kuaiwi*	P	38.0	2.3	0.8	Linear
253	Terrace	S/P	15.0	2.5	0.7	Linear
254	Terrace	S/P	20.0	2.7	0.8	Linear
255	Mound	P	9.5	2.8	0.8	Linear
256	Mound	P	1.5	1.4	0.5	Circular
257	Mound	S/P	2.9	2.1	0.6	Rectangular
258	Mound	P	1.2	1.0	0.5	Oval
259	Mound	P	2.8	1.2	0.6	Rectangular
260	Mound	S	3.3	2.3	1.2	Triangular

***S=Stacked; P=Piled.**

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Table 28. Continued.

Feature #	*Feature type*	*Attribute**	*Length (m)*	*Width (m)*	*Height (m)*	*Shape*
261	Mound	S	5.1	3.0	1.2	Oval
262	Mound	S	3.4	1.7	1.2	Irregular
263	Mound	S/P	4.2	2.2	1.4	Oval
264	Terrace	S/P	36.0	2.1	0.7	Linear
265	Terrace	P	5.2	1.4	0.4	Linear
266	Mound	S	2.4	1.2	0.7	Rectangular
267	Terrace	S/P	5.0	5.0	1.0	L-shaped
268	Modified outcrop	P	3.1	2.1	0.9	Irregular
269	Terrace	S/P	22.5	1.8	0.8	Linear
270	Enclosure	S/P	11.0	9.5	0.9	U-shaped
271	Mound	S	2.4	1.2	0.7	Rectangular
272	Modified outcrop	P	4.6	4.5	0.7	Oval
273	Modified outcrop	P	5.5	3.0	1.1	Irregular
274	Mound	P	4.0	2.5	1.0	Oval
275	Modified outcrop	S/P	5.0	4.5	1.2	Oval
276	Mound	P	2.7	1.4	0.8	Linear
277	Mound	S/P	5.0	2.7	0.9	Oval
278	Mound	P	3.2	2.4	0.9	Oval
279	Enclosure	S/P	3.5	2.6	0.7	Oval
280	Mound	P	2.2	2.2	0.6	Circular
281	Modified outcrop	P	6.4	4.3	1.0	L-shaped
282	Pavement	P	12.5	8.5	0.2	Rectangular
283	Mound	P	7.4	1.7	0.8	Linear
284	Mound	P	4.5	2.9	0.7	Irregular
285	Mound	S/P	5.0	1.3	0.8	Linear
286	Terrace	P	16.0	1.8	0.6	Irregular
287	Modified outcrop	S/P	3.5	1.7	0.9	Irregular
288	Modified outcrop	P	3.0	1.1	0.8	Crescent
289	Pavement	P	9.0	5.5	0.2	Irregular
290	Terrace	S/P	11.0	6.5	0.8	Crescent
291	*Kuaiwi*	P	78.0	3.5	0.3	Linear
292	Modified outcrop	P	5.6	4.7	0.9	Rectangular
293	Enclosure	P	1.9	1.9	0.5	Square
294	Enclosure	P	2.2	2.2	0.6	Square
295	Enclosure	P	5.5	3.4	0.5	U-shaped
296	Mound	P	2.3	1.3	0.7	Oval
297	Modified outcrop	S/P	4.5	4.0	0.7	Oval

***S=Stacked; P=Piled.**

Five mounds (Features 187, 189, 262, 266, 271), ones that appeared to have the most time invested in their construction, underwent subsurface testing in the form of 1 x 1 meter test units.

Feature 187

Feature 187 is a partially stacked rectangular shaped *pāhoehoe* cobble mound located in the extreme western end of Site 23686 (see Figure 76). The mound rests on exposed bedrock. Its edges are mostly stacked, but have collapsed in small sections (Figure 77). Feature 187 measures 3.0 meters long by 1.7 meters wide and 80 centimeters tall. Its surface slopes slightly to the north following the natural bedrock contours.

Figure 77. SIHP Site 23686 Feature 187, view to the southeast.

A 1 x 1 meter test unit (TU-1) was excavated into the north-central portion of Feature 187 (Figure 78) and revealed a single architectural layer (Layer I) resting on bedrock. Layer I consisted of small to medium sized *pāhoehoe* cobbles mixed with some organics. This layer rested directly on bedrock and at the base of the layer a single piece of water rounded coral was discovered. Along the unit's northern edge, a small amount of brown (10YR 4/3) sandy silt (less than 1 centimeter thick) had accumulated subsequent to the feature's construction. No cultural material (with the exception of the coral fragment) was recovered from TU-1 and the excavation terminated at bedrock (Figure 79).

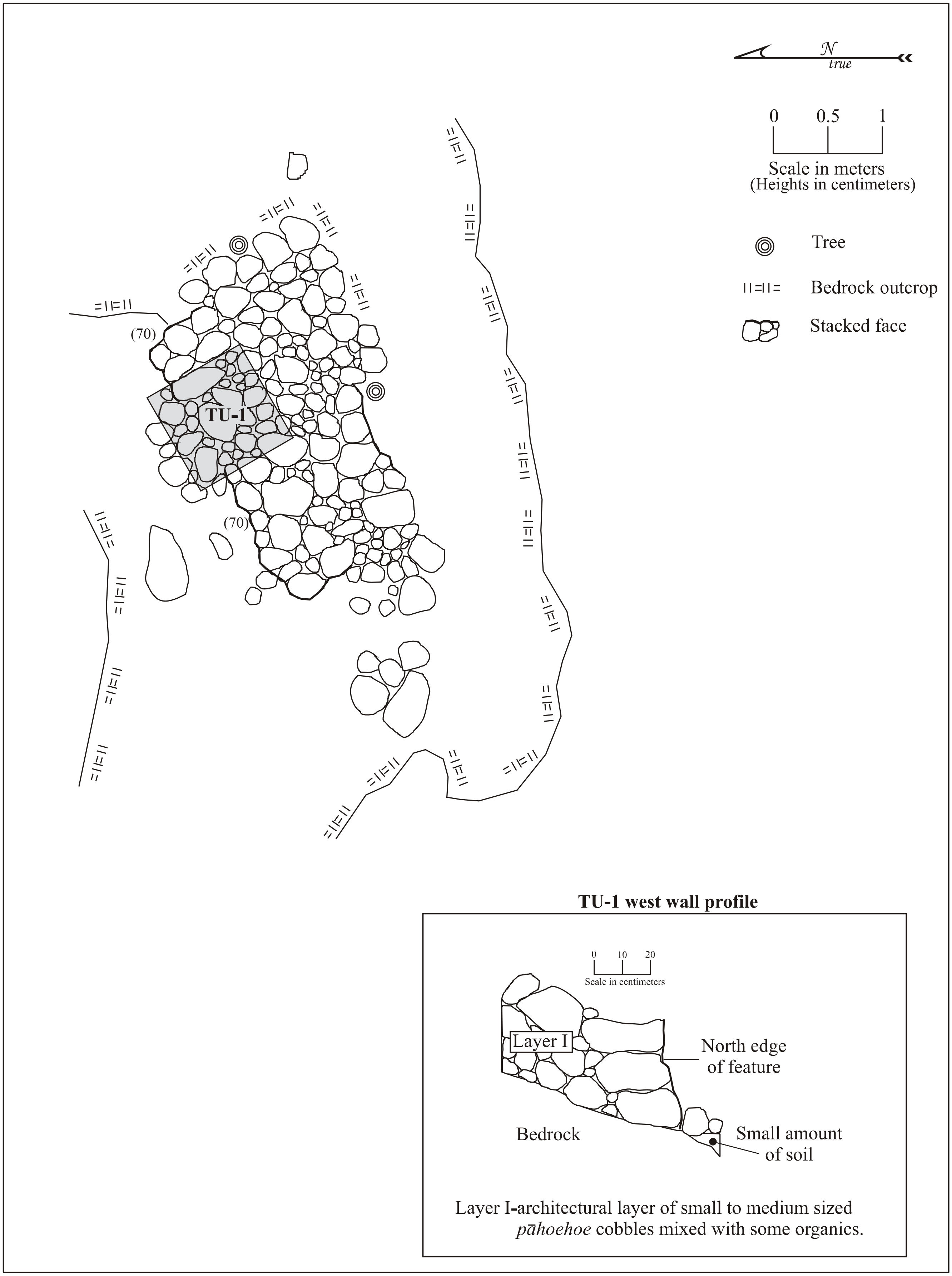


Figure 78. SIHP Site 23686 Feature 187 plan view and TU-1 profile.

Figure 79. SIHP Site 23686 Feature 187 TU-1 base of excavation, view to the southwest.

Feature 189

Feature 189 is a piled irregular shaped *pāhoehoe* cobble mound located in the extreme western end of the project area (see Figure 76). The mound rests on exposed bedrock and may have been formerly stacked around its edges, but is now largely collapsed (Figures 80 and 81). In its current condition Feature 189 measures 2.4 meters long by 2.2 meters wide and 70 centimeters tall. A small rounded piece of coral was found resting on the feature's southwest corner.

Figure 80. SIHP Site 23686 Feature 189, view to the northeast.

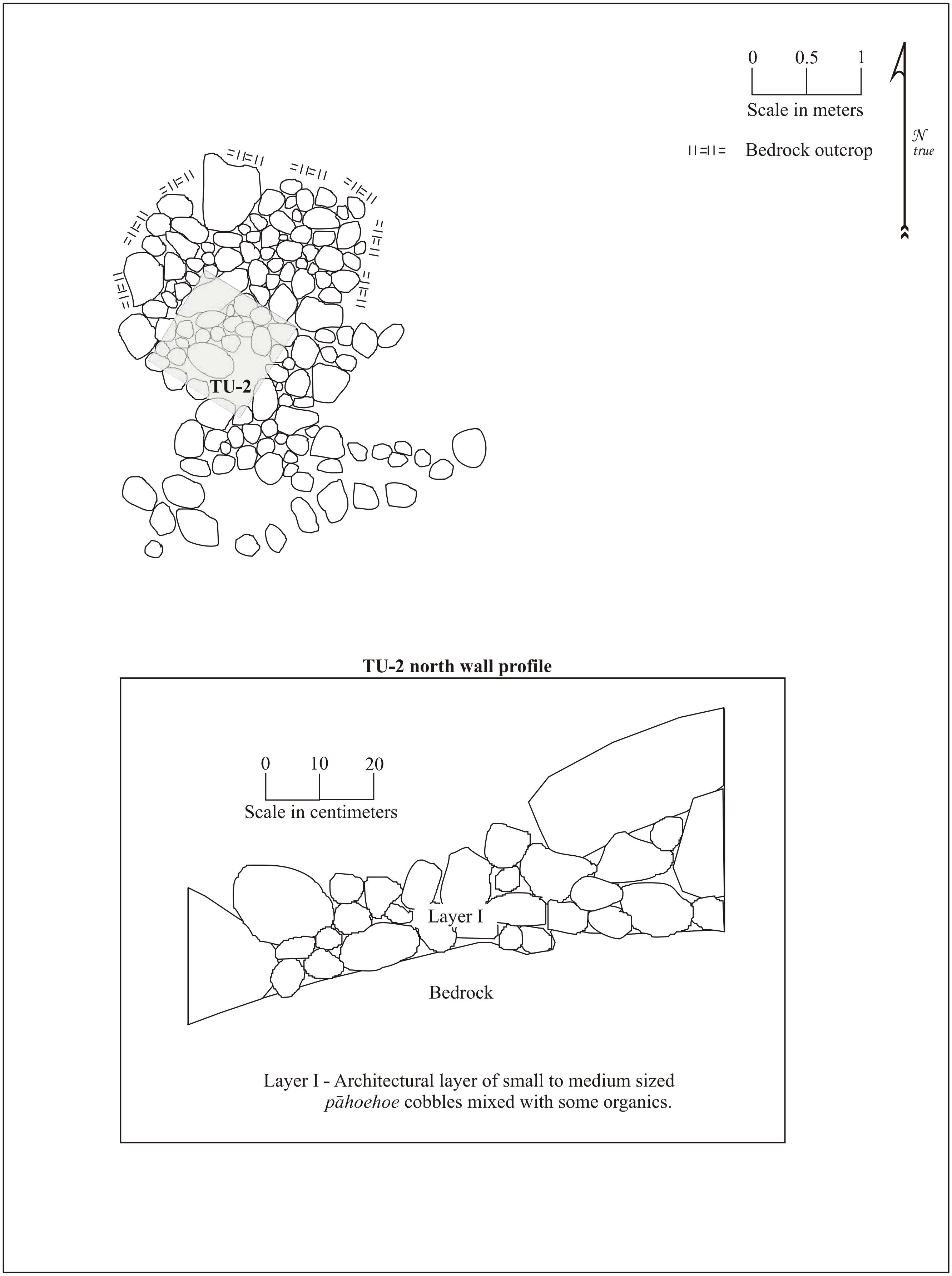


Figure 81. SIHP Site 23686 Feature 189 plan view and TU-2 profile.

A 1 x 1 meter test unit (TU-2) was excavated into the central portion of Feature 189 (see Figure 81). Excavation of TU-2 revealed a single architectural layer (Layer I) resting on bedrock. Layer I consisted of small to medium sized *pāhoehoe* cobbles mixed with some organics. This layer rested directly on bedrock. However, along its southwestern edge, in a bedrock depression, a small amount of brown (7.5YR 3/4) fine silt (less than 1 centimeter thick) had accumulated subsequent to the feature's construction. No cultural material of any kind was recovered from TU-2 and the excavation terminated at bedrock (Figure 82).

Figure 82. SIHP Site 23686 Feature 189 TU-2 base of excavation, view to the northeast.

Feature 262

Feature 262 is an irregular shaped mound constructed of stacked *'a'ā* cobbles located in the southeast quadrant of the project area along the north side of Feature 82, a *kuaiwi* (see Figure 76). The mound measures 3.4 meter long by 1.7 meters wide and up to 1.25 meters tall (Figure 83). It has a squared north side and a slightly rounded south side with a rounded top surface (Figure 84). Feature 262 rests on a soil ground surface covered by dense vegetation.

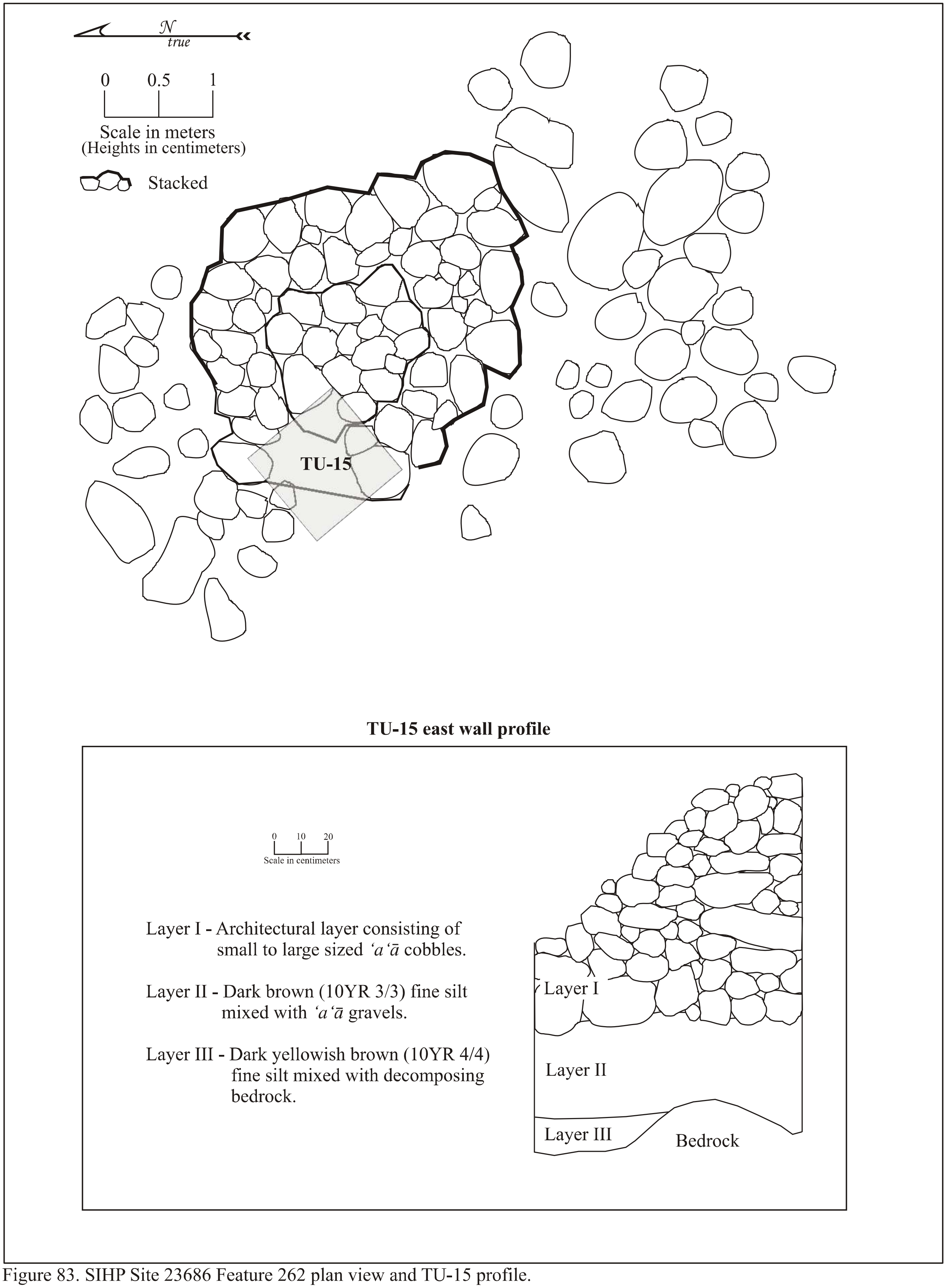


Figure 83. SIHP Site 23686 Feature 262 plan view and TU-15 profile.

Figure 84. SIHP Site 23686 Feature 262, view to the east.

A 1 x 1 meter Test Unit (TU-15) was excavated in the northwest corner of Feature 262 (see Figure 83) and revealed the following stratigraphic profile (which contained no cultural items):

Layer I (0-92cmbs)........... architectural layer with small to large sized *'a'ā* cobbles stacked along the exterior edges of the feature and piled within the interior.
Layer II (92-141cmbs) ..... dark brown (10YR 3/3) fine silt mixed with *'a'ā* gravels on bedrock in the southern portion of TU-15.
Layer III (141-147cmbs) .. dark yellowish brown (10YR 4/4) fine silt mixed with decomposing bedrock on bedrock.

Feature 266

Feature 266 is a stacked *'a'ā* cobble mound located in the southeast quadrant of the project area amongst a number of less formal mounds (see Figure 76). This mound, which is roughly rectangular in shape, measures 2.4 meters long by 1.2 meters wide and stands up to 70 centimeters above the surrounding soil ground surface (Figures 85 and 86). The west end of the feature is neatly stacked and an upright *'a'ā* slab (70 centimeters long) is located at the eastern end of the feature.

A 1 x 1 meter test unit (TU-19) was excavated within the center of Feature 266 (see Figure 85 and 87) and revealed the following stratigraphic profile (which contained no cultural items):

Layer I (0-48cmbs)........... architectural layer with large sized *'a'ā* cobbles on top and smaller ones beneath mixed with organics (Figure 41).
Layer II (48-67cmbs) .... dark grayish brown (10YR 3/2) silt with approximately 50% gravel on undulating bedrock.

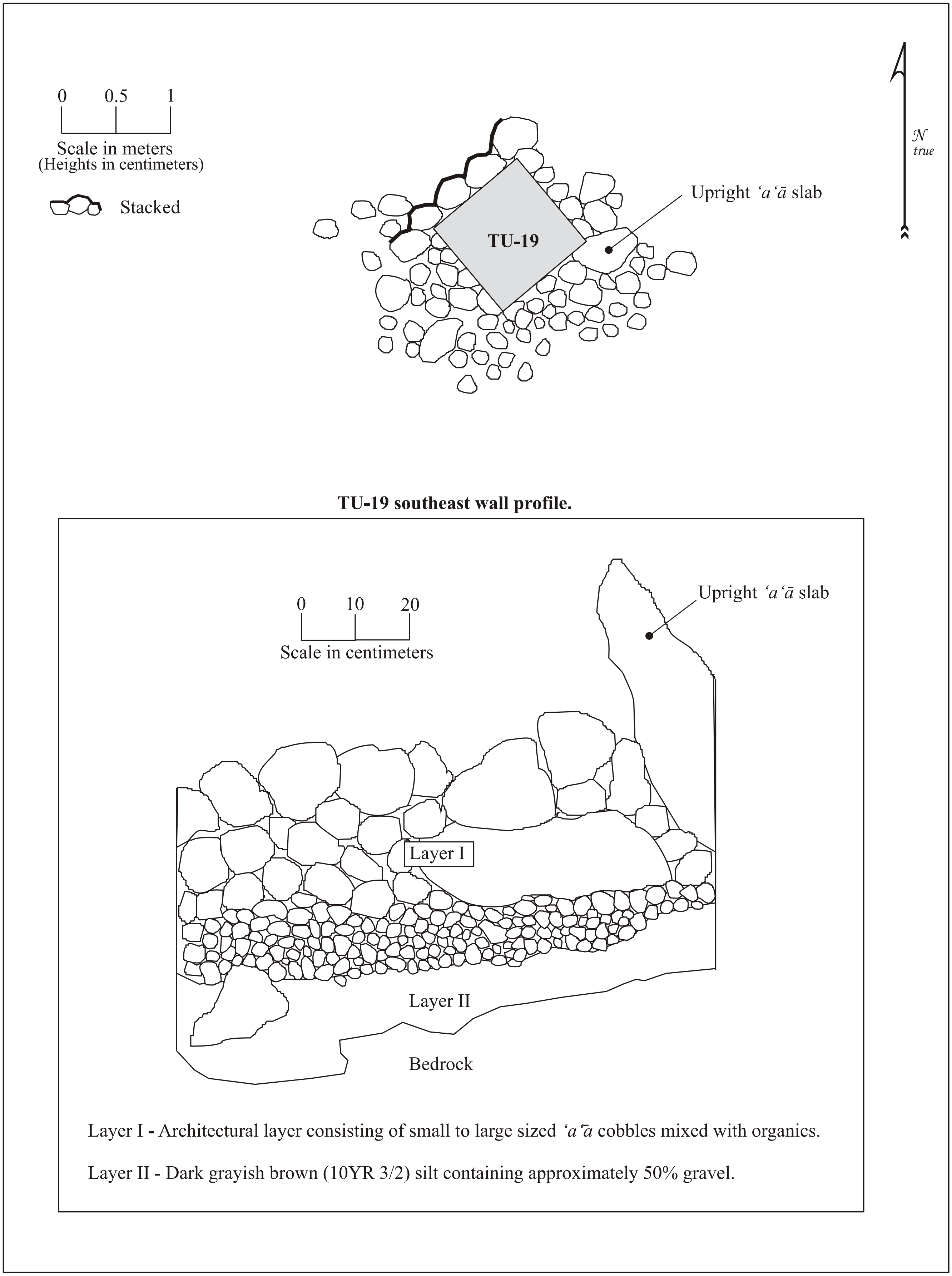


Figure 85. SIHP Site 23686 Feature 266 plan view and TU-19 profile.

Figure 86. SIHP Site 23686 Feature 266, view to the east.

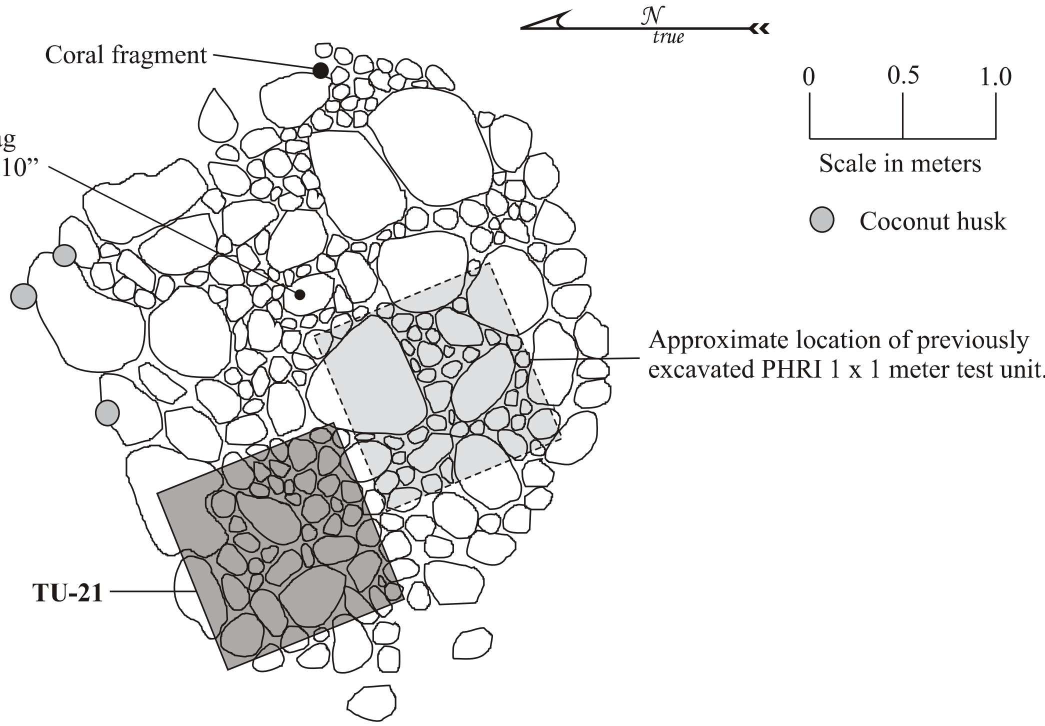
Figure 87. SIHP Site 23686 Feature 266 TU-19 base of excavation, view to the northeast.

Feature 271

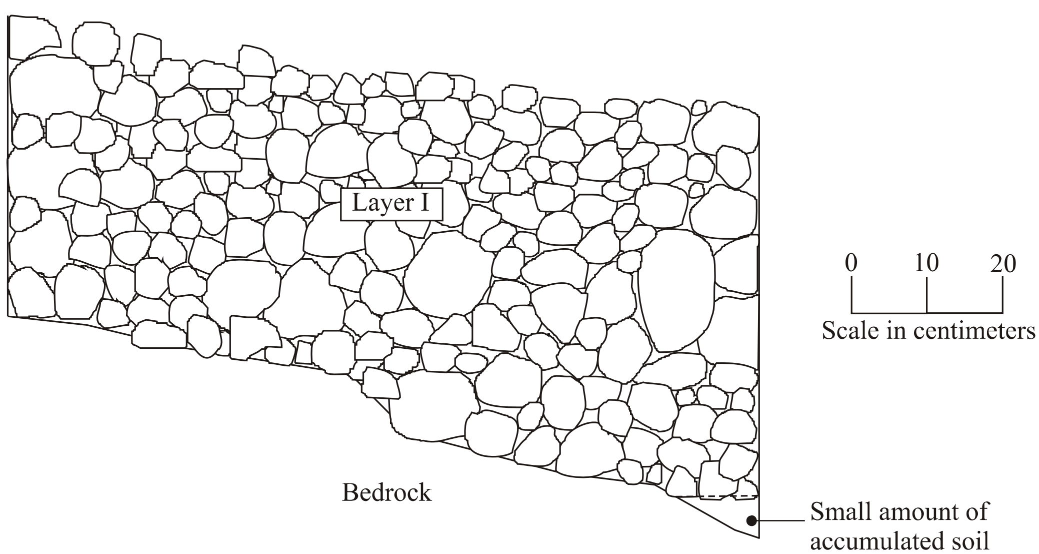
Feature 271 is a stacked *ʻaʻā* cobble mound located in the southeast quadrant of the project area along the southern property boundary amongst a number of less formal mounds (see Figure 76). The mound, which is roughly rectangular in shape, measures 2.9 meters long by 2.5 meters wide and stands up to 90 centimeters above the surrounding soil ground surface (Figures 88 and 89). An aluminum site tag with the inscription "PHRI Site T2235-10" was found on the surface of the feature and there was evidence that a 1 meter by 1 meter test unit had been previously excavated at Feature 271. A fragment of water-rounded coral was discovered along the eastern edge of the mound and three coconut husks were resting on its northeast corner.

Figure 89. SIHP Site 23686 Feature 271, view to the southeast.

A 1 x 1 meter test unit (TU-21) was excavated in the northeast corner of Feature 271 adjacent to the north edge of the previously excavated PHRI test unit (Figure 88). Excavation of TU-21 revealed a single architectural layer (Layer I) resting on bedrock. Layer I consisted of small to large sized *'a'ā* cobbles mixed with organics 61 centimeters thick resting on bedrock. A small amount of soil (approximately 2 centimeters thick) had accumulated in the southwest corner of the unit on top of the bedrock subsequent to the construction of the feature. Excavation of TU-21 terminated at bedrock 61 centimeters below the feature's surface and no cultural material was recovered from Feature 271.



TU-21 south wall profiles



Layer I - Architectural layer consisting of small to large sized *'a'ā* cobbles mixed with organics.

Figure 88. SIHP Site 23686 Feature 271 plan view and TU-21 profile.

Five modified outcrops (Features 183, 201, 204, 239, and 297), ones that appeared to have the most time invested in their construction, underwent subsurface testing in the form of 1 meter by 1 meter test units. The results are presented below.

Feature 183

Feature 183 is a modified *pāhoehoe* outcrop located in the extreme northwestern portion of the project area (see Figure 76). The feature measures 6.7 meters long by 5.3 meters wide and stands up to 80 centimeters above the surrounding ground surface (Figure 90). It consists of *pāhoehoe* cobbles and boulders stacked along the southeast edge of a bedrock outcrop stretching to the west (Figure 91). The central portion of the feature, on top of the outcrop, consists of a soil area (2 meters in diameter) cleared of cobbles possibly used for planting. Along the west edge of the soil area is a small blister opening that measures 48 centimeters from floor to ceiling and 60 centimeters deep. No cobble modification was evident around the blister. The feature is most likely constructed from the remains of a larger collapsed blister.

Figure 90. SIHP Site 23686 Feature 183, view to the northwest.

A 1 x 1 meter test unit (TU-4) was excavated in the cleared soil area at the center of Feature 183 (see Figure 91) and revealed the following stratigraphic profile (which contained no cultural items, but could have been used as a planting area (Clark and Rechtman 2003)):

Layer I (0-10cmbs)........... very dark grayish brown (10YR 3/2) topsoil mixed with decaying organics and grass roots.

Layer II (10-45cmbs) .... dark yellowish brown (10YR 4/3) fine silt mixed with decomposing bedrock at the base of the layer.

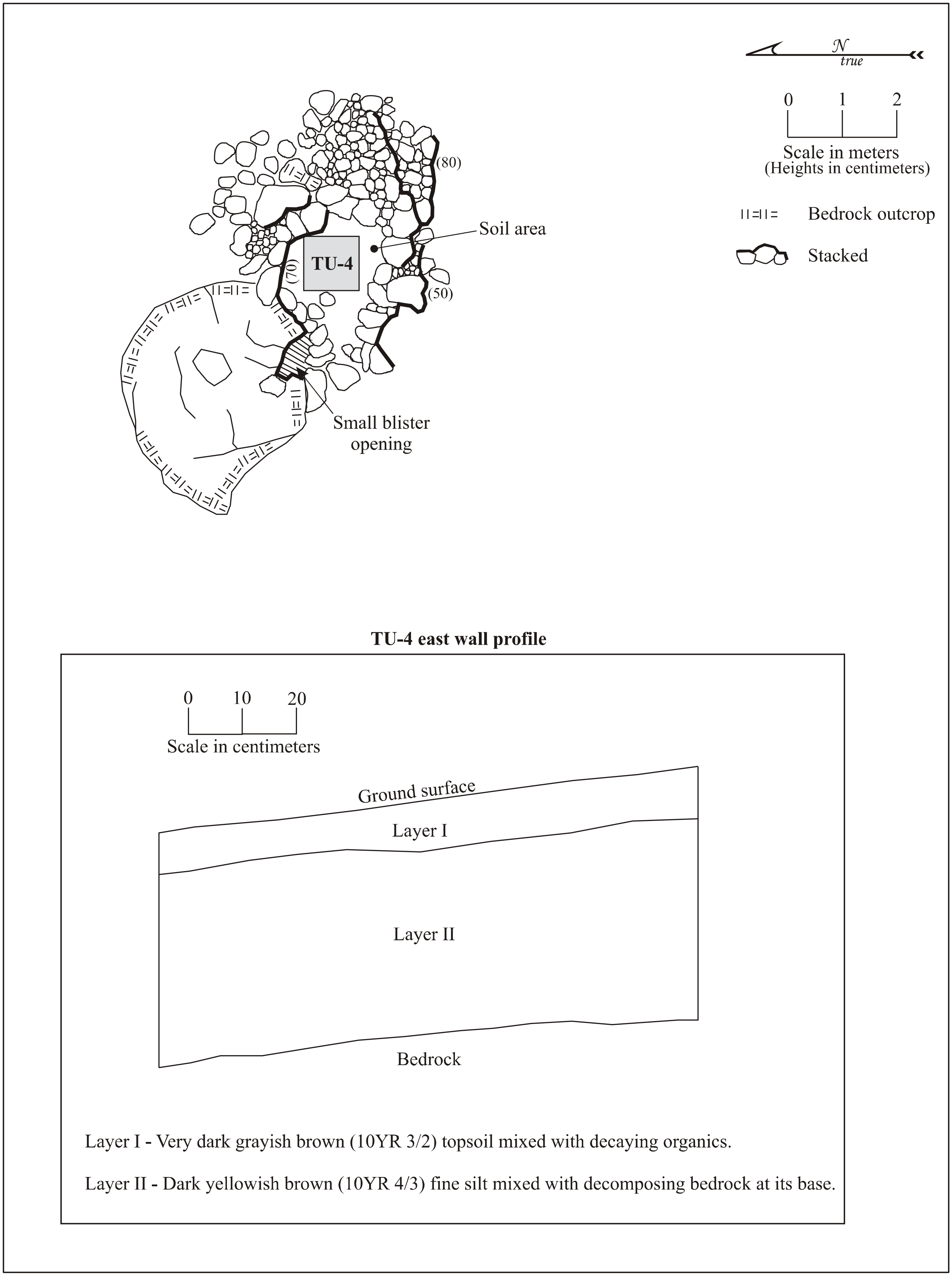


Figure 91. SIHP Site 23686 Feature 183 plan view and TU-4 profile.

Feature 201

Feature 201 is a modified *pāhoehoe* outcrop located in the northwestern quadrant of the project area along the northern property boundary (see Figure 76). The feature consists of formerly stacked *pāhoehoe* cobbles and boulders, now partially collapsed, supported by a bedrock outcrop to the east (Figure 92). Feature 201 is roughly oval in shape and measures 6.2 meters long by 3.8 meters wide and stands up to 70 centimeters high along its western edge (Figure 93). The surface of the feature is roughly leveled and paved with small *pāhoehoe* cobbles.

Figure 92. SIHP Site 23686 Feature 201, view to the east.

A 1 x 1 meter test unit (TU-5) was excavated in the central portion of Feature 201 (see Figure 93) and revealed the following stratigraphic profile (which contained no cultural items, but could have been a by-product of agricultural clearing nearby (Clark and Rechtman 2003):

Layer I (0-25/40cmbs) .... architectural layer with small to large sized *pāhoehoe* cobbles.

Layer II (25/40-35/50cmbs)..... dark brown (10YR 3/3) silt mixed with organics only within bedrock low spots.

Feature 204

Feature 204 is a modified *pāhoehoe* outcrop located in the northwestern quadrant of the project area (see Figure 76). The feature has an irregular shape and may have been formerly stacked, but is now mostly collapsed (Figures 94 and 95). Some remnant *pāhoehoe* cobble stacking still remains along its southwestern edge and the northeastern edge abuts the bedrock outcrop. The surface of the feature, which has evidence of protruding bedrock, is roughly leveled and paved with small *pāhoehoe* cobbles (see Figure 95). A waterworn cobble was found on the feature's surface adjacent to the bedrock outcrop. Feature 204 measures 3.4 meters long by 2.7 meters wide and stands 70 centimeters high along its western edge.

A 1 x 1 meter test unit (TU-6) was excavated in the west-central portion of Feature 204 (see Figure 94) and revealed the following two layers (which contained no cultural items):

Layer I (0-18cmbs)........... small to large sized *pāhoehoe* cobbles mixed with organics on bedrock and bedrock pockets.

Layer II (18-25cmbs) .... low-lying bedrock pockets with dark brown (10YR 3/3) silt mixed with organics on bedrock.

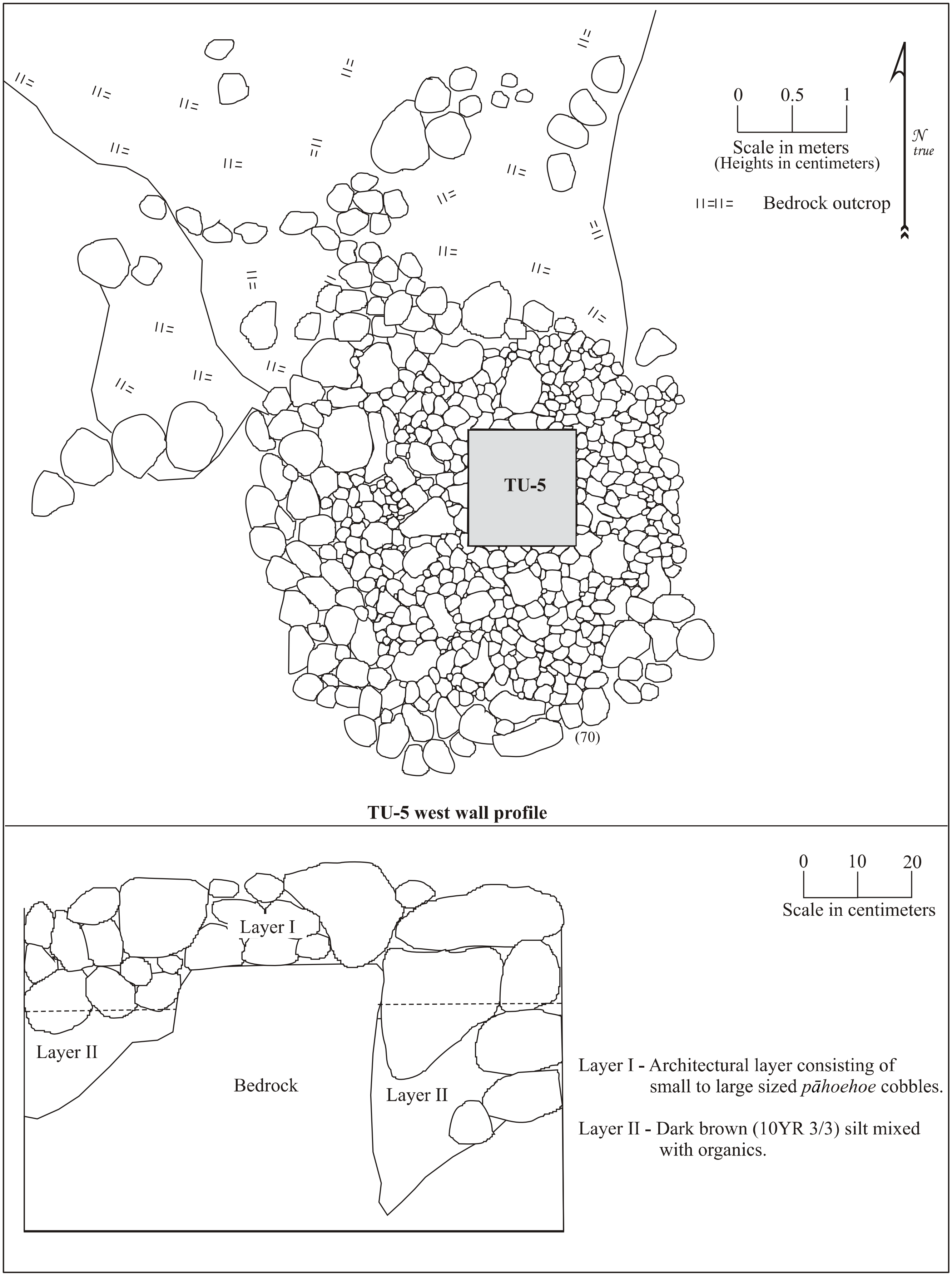
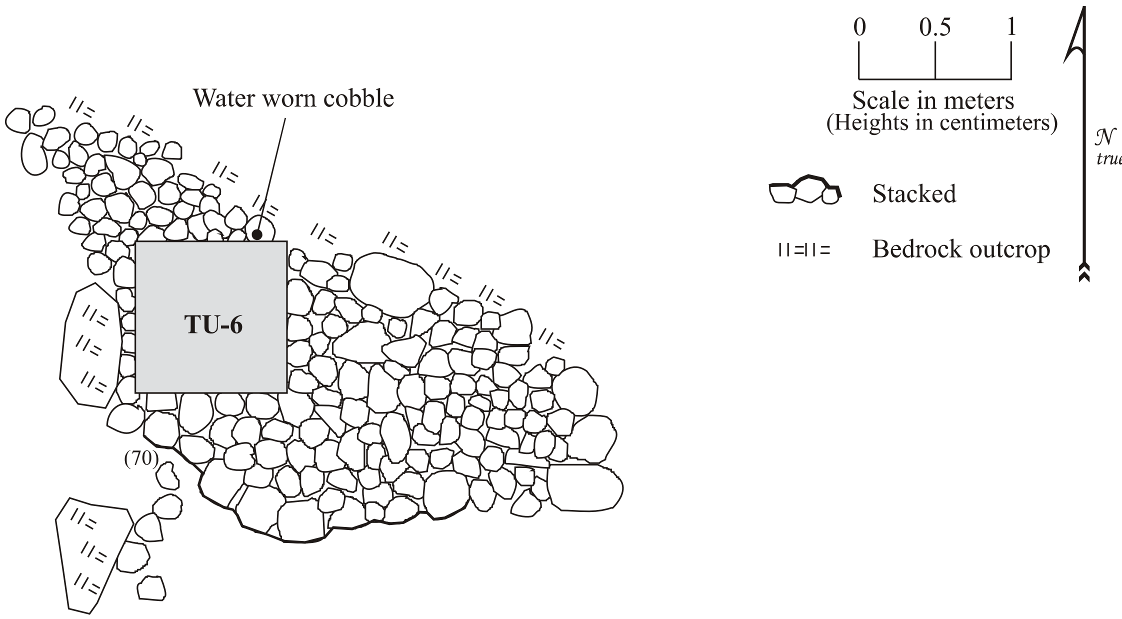
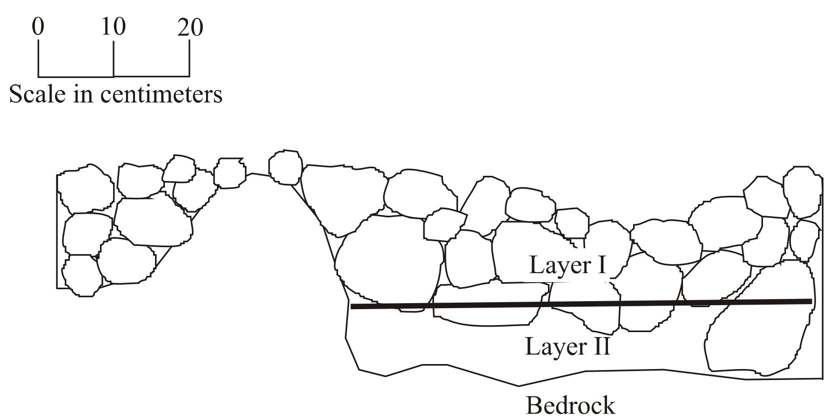


Figure 93. SIHP Site 23686 Feature 201 plan view and TU-5 profile.



TU-6 west wall profile



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

Layer II - Dark brown (10YR 3/3) silt mixed with organics.

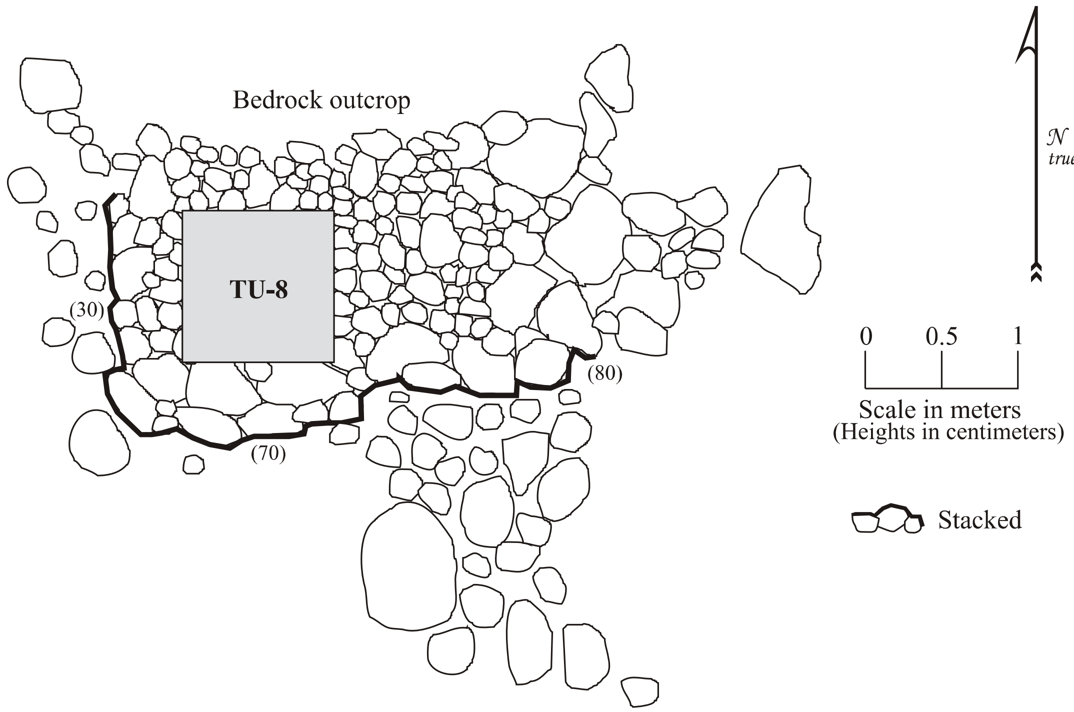
Figure 94. SIHP Site 23686 Feature 204 plan view and TU-6 profile.

Figure 95. SIHP Site 23686 Feature 204, view to the west.

Feature 239

Feature 239 is a modified *'a'ā* outcrop centrally located within the project area amongst a number of other agricultural features (see Figure 76). The feature, which is roughly rectangular, measures 4.0 meters long by 2.5 meters wide and stands up to 70 centimeters high along its southern edge (Figure 96). The southern and western edges consist of stacked *'a'ā* cobbles and boulders (Figure 97). The eastern edge is completely collapsed and the bedrock outcrop supports the northern edge of the feature. The surface of Feature 239 is roughly paved and leveled with small *'a'ā* cobbles.

Figure 96. SIHP Site 23686 Feature 239, view to the north.



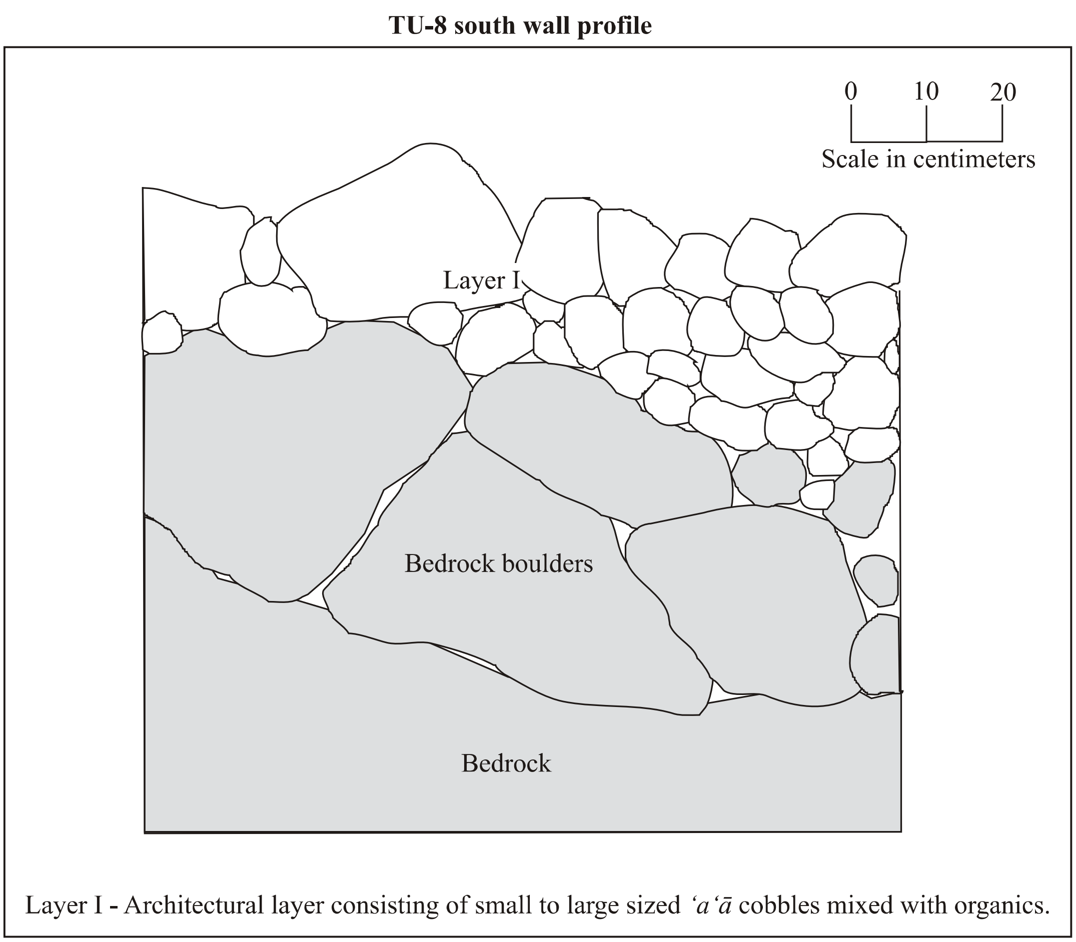


Figure 97. SIHP Site 23686 Feature 239 plan view and TU-8 profile.

A 1 x 1 meter test unit (TU-8) was excavated in the west-central portion of Feature 239 (see Figure 97). Excavation of TU-8 revealed a single architectural layer (Layer I) resting on bedrock. Layer I consisted of small to large sized *ʻaʻā* cobbles mixed with organics 55 centimeters thick resting on bedrock and mixed with fractured bedrock boulders. A small amount of soil (approximately 1 to 2 centimeters thick) had accumulated at the base of the unit within low-lying bedrock areas subsequent to the construction of the feature. Excavation of TU-8 terminated at bedrock 55 centimeters below the feature's surface (Figure 98). No cultural material was recovered from Feature 239, and Clark and Rechtman (2003) suggested that this feature may be a by-product of agricultural clearing in the area.


Figure 98. SIHP Site 23686 Feature 239 TU-8 base of excavation, view to the south.

Feature 297

Feature 297 is a modified *ʻaʻā* outcrop located at the extreme eastern end of the project area along the southern edge of the old access road (see Figure 76). Feature 297 was formerly constructed of stacked *ʻaʻā* cobbles, but is now collapsed in several sections (Figures 99 and 100). The feature, which is roughly oval in shape, measures 4.5 meters long by 4.0 meters wide and stands up to 70 centimeters above ground surface in its southwestern corner. The southern and northern edges of the feature are stacked. The western edge is nearly completely collapsed and a bedrock outcrop supports the eastern edge of the feature. The surface of Feature 297 is roughly paved and leveled with small sized *ʻaʻā* cobbles. Overall, the feature has a very formal appearance.

A 1 x 1 meter test unit (TU-22) was excavated in the east central portion of Feature 297 (see Figure 99) and revealed the following stratigraphic profile:

Layer I (0-33cmbs)........... architectural layer with small to large sized *ʻaʻā* cobbles mixed with organics

Layer II (33-63cmbs) .... dark brown (10YR 3/3) very fine sandy silt mixed with decaying organics, the lower portions grading into dark yellowish brown soil (10YR 4/4) mixed with decomposing bedrock on bedrock.

No cultural material of any kind was recovered from TU-22, and Clark and Rechtman (2003) suggested that Feature 297 may be the by-product of agricultural clearing in the area.

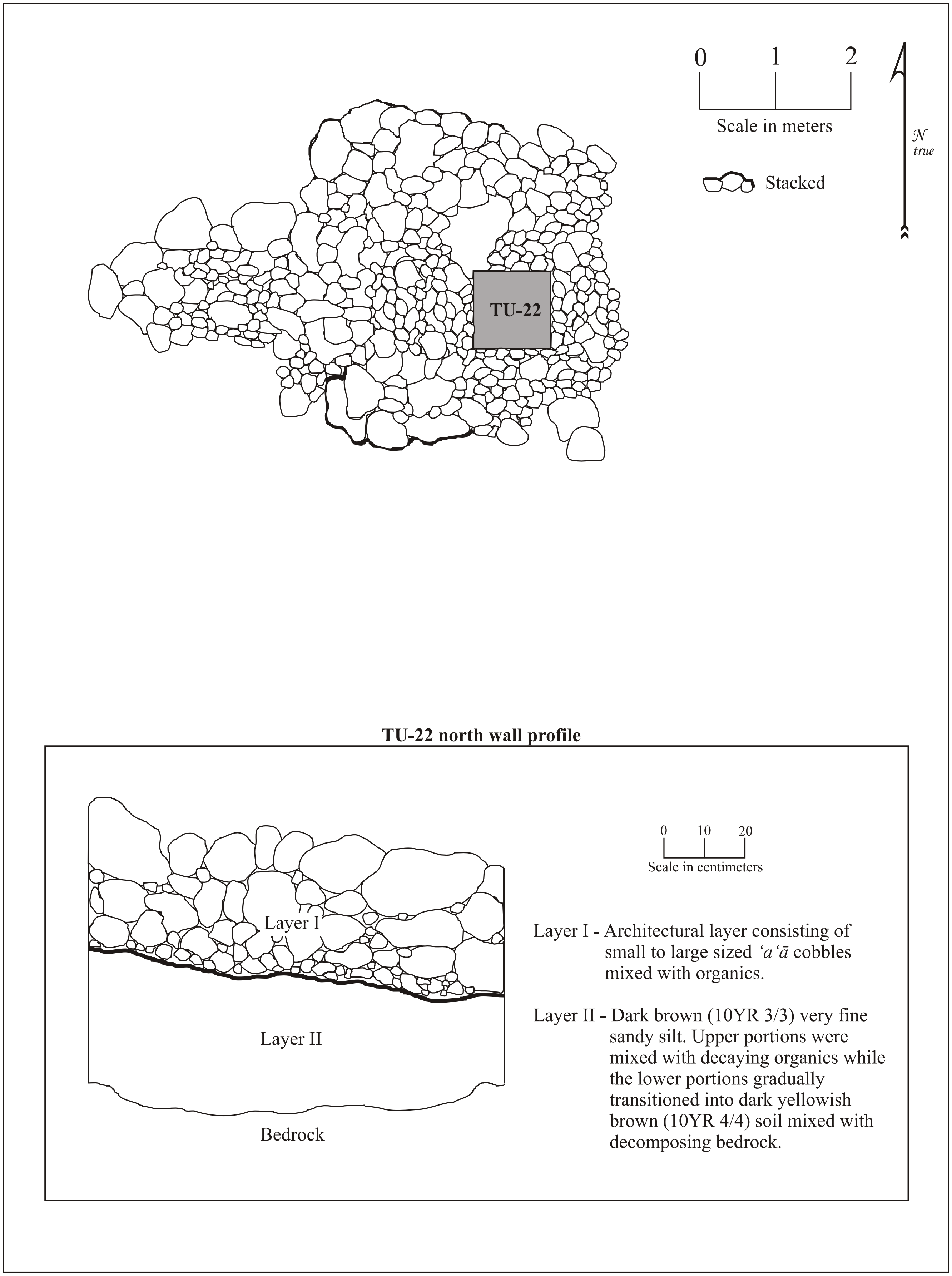


Figure 99. SIHP Site 23686 Feature 297 plan view and TU-22 profile.


Figure 100. SIHP Site 23686 Feature 297, view to the north.

Feature 185

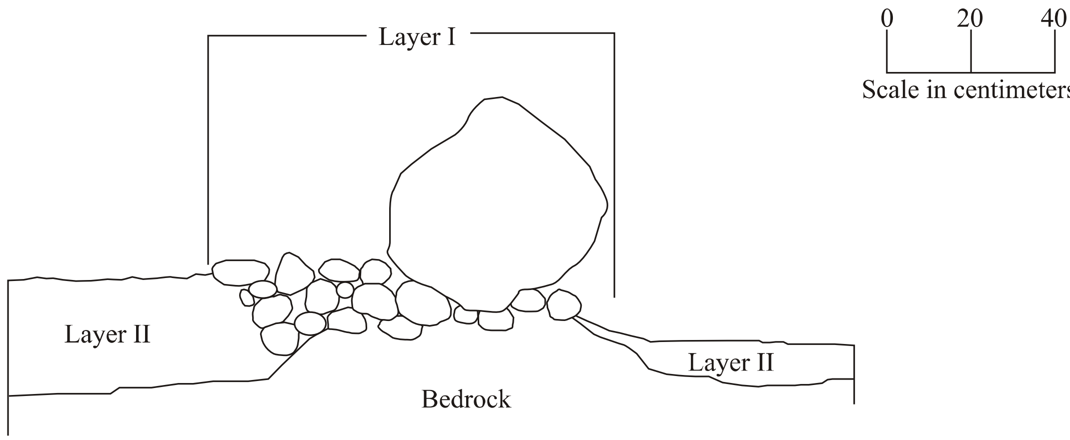
Feature 185 is a linear terrace constructed of piled *pāhoehoe* near the western end of the project area not far from the Kuakini Highway (see Figure 76). The southeast to northwest aligned feature is 17 meters long, 60 centimeters wide, and 90 centimeters high. Small to medium boulders align the *makai* edge of the wall whereas small cobbles make-up the *mauka* side of the wall. Soil accumulation occurred after construction of the wall, particularly on the northeastern side. The wall rested directly on *pāhoehoe* bedrock.

A 2 x 1 meter excavation unit (EU-1a), aligned southwest-northeast, was placed two meters from the northern edge of the terrace wall and revealed the following stratigraphic profile (Figure 101). No cultural items were recovered:

Layer I with boulders on wall (0-50cmbs) .... architectural layer with medium to small *pāhoehoe* boulders and cobbles on *pāhoehoe* bedrock.

Layer II northeast/*mauka* of wall (0-40cmbs) ...... very dark brown (7.5YR 2.5/3) silt mixed with 10 percent rock.

Layer II northeast/*makai* of wall (0-20cmbs) .... very dark brown (7.5YR 2.5/3) silt mixed with 10 percent rock.



Layer I - Architectural layer consisting of medium to small *pāhoehoe* boulders and cobbles on bedrock.

Layer II (northeast/*mauka* of wall) - Very dark brown (7.5YR 2.5/3) silt mixed with 10% rock.

Layer II (northeast/*makai* of wall) - Very dark brown (7.5YR 2.5/3) silt mixed with 10% rock.

Figure 101. SIHP Site 23686 Feature 185 EU-1a south wall profile.

Feature 247

Feature 247 is a linear terrace constructed of small *ʻaʻā* cobbles near the center of the project area (see Figure 76). The southwest to northeast aligned feature is 11 meters long, 2.6 meters wide, and 90 centimeters high. The wall consists of piled stone with an outer stacked edge.

A 2 x 1 meter excavation unit (EU-5) aligned west to east, was placed within the wall *mauka* of the *makai* stacked wall edge. EU-5 revealed the following stratigraphic profile (Figures 102 and 103):

Layer I (0-40cmbs)........... architectural layer with piled *ʻaʻā* cobbles and stacked *ʻaʻā* cobble facing on the west.

Layer II (40-80cmbs) .... very dark grayish brown (10YR 3/2) fine silt grading into reddish brown (5YR 4/4) silt immediately above weathered and undulating *ʻaʻā* bedrock (95cm deep pocket within *ʻaʻā* bedrock in northwest corner).

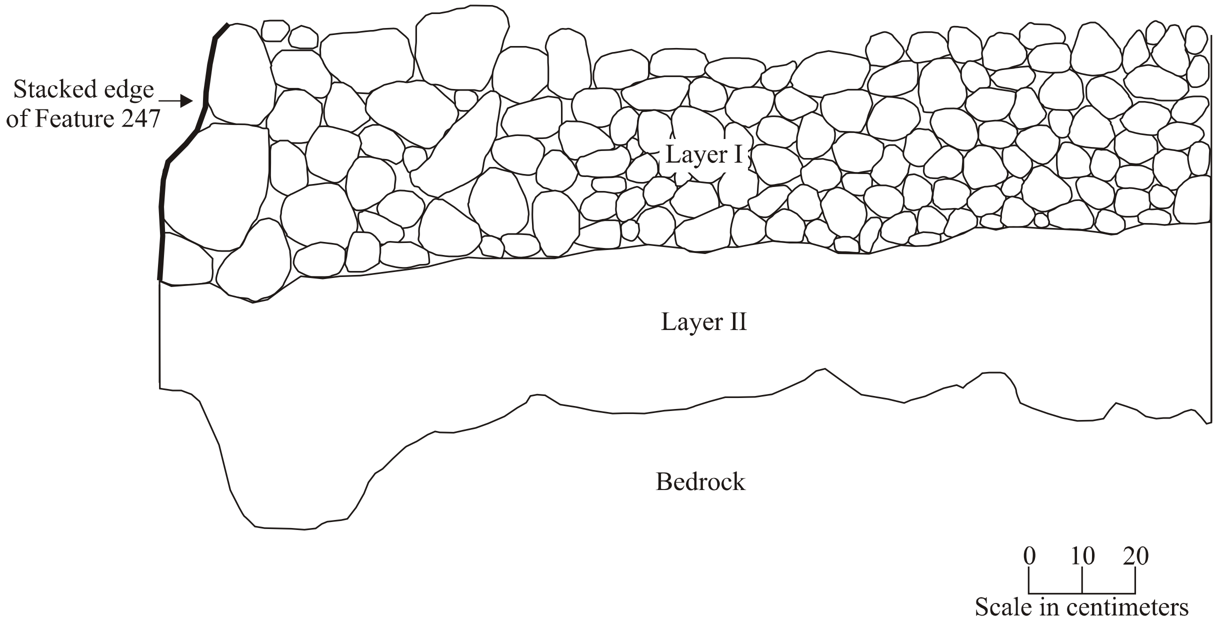
Recovered items from EU-5 include *Cypraea* sp., *Drupa* sp., *Cellana* sp., coral, *kukui* nutshell, charcoal, basalt flakes, and a volcanic glass flake (Table 29). A corroded iron horseshoe nail (Acc# 034) from Level 1 of Layer I is probably intrusive. This nail is 36 millimeters long, 7.4 millimeters wide and 3 millimeters thick. Other than the nail the vertical distribution of species and artifact types appears fairly constant within the unit.

Table 29. Recovered items from SIHP Site 23686, Feature 247, EU-5.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
33	Surface		Marine shell	*Cypraea* sp.	1	1	23.4
36	I	1	Marine shell	*Cypraea* sp.	3	1	4.3
38	I	1	Marine shell	*Cellana* sp.	1	1	0.7
35	I	1	Coral	Unidentified	10	-	9.7
37	I	1	Organic	*Kukui* nutshell	4	-	2.6
34	I	1	Metal	Iron horseshoe nail	1	-	2.1
				Layer I, Level 1 Total:	19	2	19.4
42	II	1	Marine shell	*Cypraea* sp.	2	1	1.1
41	II	1	Coral	Unidentified	3	-	1.2
40	II	1	Volcanic glass	Flake	1	-	1.4
39	II	1	Organic	*Kukui* nutshell	5	-	2.2
				Layer II, Level 1 Total:	11	1	5.9
45	II	2	Marine shell	*Cypraea* sp.	7	2	9.0
47	II	2	Marine shell	*Drupa* sp.	1	1	2.8
44	II	2	Basalt	Flake	1	-	4.2
48	II	2	Basalt	Flake	8	-	6.7
46	II	2	Organic	*Kukui* nutshell	7	-	2.2
43	II	2	Organic	Charcoal	-	-	3.3
				Layer II, Level 2 Total:	24	3	28.2
				EU-5 Total:	55	7	76.9

Charcoal collected from Layer II Level 2 of EU-5, Feature 247, was submitted for radiocarbon assaying. The sample (Beta-212757) intercepts the tree-ring calibration curve at AD 1530, 1560, and 1630 and has a 2-sigma standard deviation calibrated date range of AD 1460 to 1660.

Figure 102. SIHP Site 23686 Feature 247 EU-5 base of excavation.



Layer I - Architectural layer composed of cobbles.

Layer II - Very dark grayish brown (10YR 3/2) fine silt grading into reddish brown (5YR 4/4) silt.

Figure 103. SIHP Site 23686 Feature 247 EU-5 north wall profile.

Feature 251

Feature 251 is a rectangular enclosure constructed of *ʻaʻā* cobbles within the southeastern quadrant of the project area (see Figure 76). The southeast to northwest aligned walled-enclosure is 12.5 meters long by 11.5 meters wide, and the wall is 60 centimeters high.

A 2 x 2 meter excavation unit (EU-8) was placed within the enclosure, two meters east of the western wall and four meters south of the northern wall, and revealed the following stratigraphic profile (Figures 104 and 105):

Layer I (0-25cmbs)........... 20cm thick dark brown (10YR 3/3) sandy silt with 25% cobbles on 5cm thick dark yellowish brown (10YR 3/4) silt mixed with decomposing *ʻaʻā* bedrock.

Seventeen fragments, or 34.5 grams, of bovine bone and teeth fragments came from Layer I Level 1 of EU-8 (Acc# 95). The fragments probably represent the remains of a single cow.

Feature 250

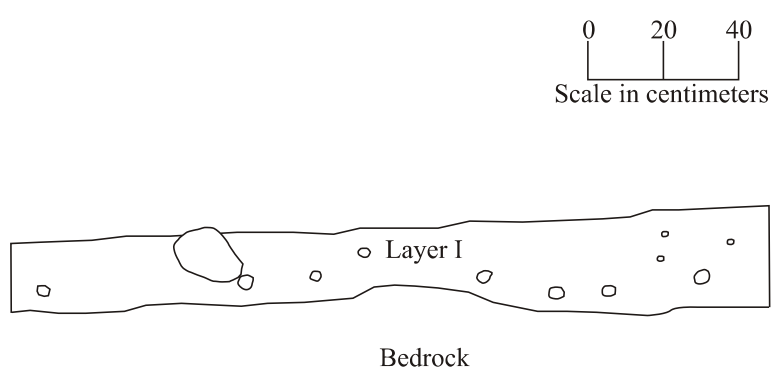
Feature 250 is a rectangular pavement constructed of *ʻaʻā* cobbles within the southeastern quadrant of the project area (see Figure 76). The east to west aligned platform is 2.5 meters long, 1.8 meters wide, and 50 centimeters high.

A 2 x 2 meter excavation unit (EU-11) was placed on the central portion of the platform surface, and revealed the following stratigraphy (Figure 106):

Layer I Level 1 (0-65cmbs)...........architectural layer with piled *ʻaʻā* cobbles, diminishing in size with increasing depth.
Layer II Level 1 (65-90cmbs)........dark brown (10YR 3/3) silt with 85% cobbles.
Layer II, Level 2 (90-100cmbs).....dark brown (10YR 3/3) silt with 85% cobbles on weathered bedrock.

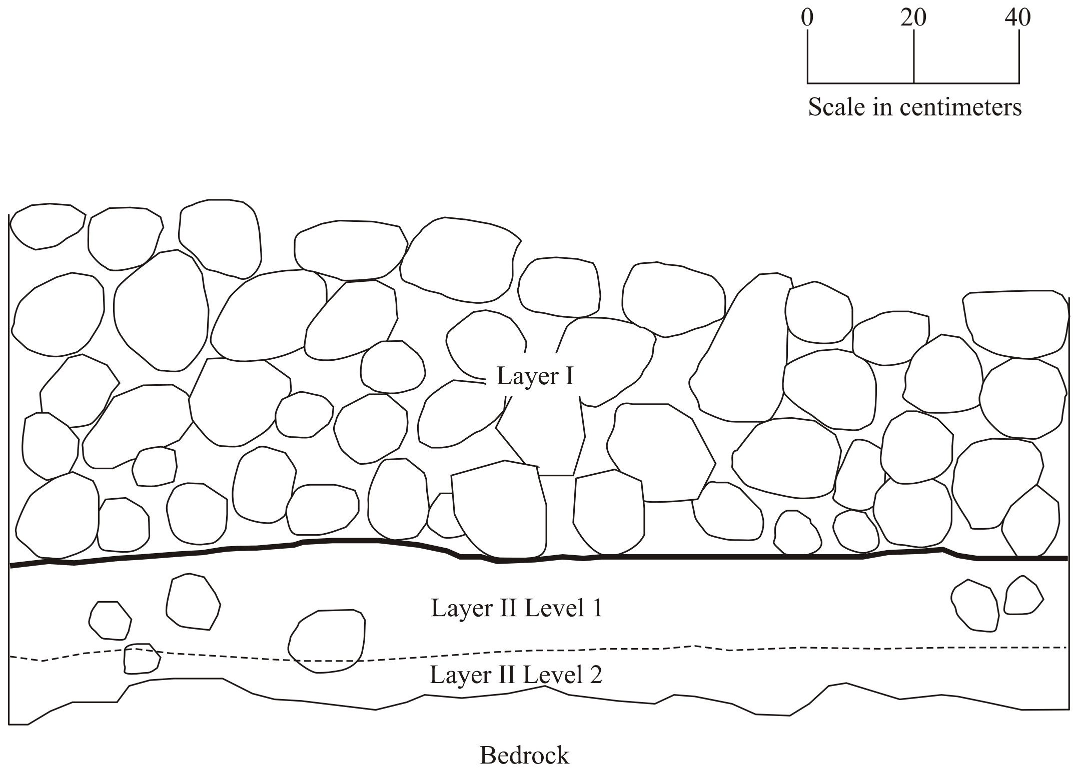
Recovered items from EU-11 include fish, *Cypraea* sp., *Drupa* sp., *Cellana* sp., coral, *Sus* sp., *kukui* nutshell, charcoal, and volcanic glass flakes (Table 30). Overall species and artifact type density increases with increasing depth within EU-11. Apart from this stratigraphic trend there is no evidence for shifting diet or activities between the different layers.

Figure 104. SIHP Site 23686 Feature 251 EU-8 base of excavation, view to the west/southwest.



Layer I - Dark brown (10YR 3/3) sandy silt with 25% cobbles on 5cm thick dark yellowish brown (10YR 3/4) silt.

Figure 105. SIHP Site 23686 Feature 251 EU-8 north wall profile.



Layer I Level 1 - Architectural layer with piled *ʻaʻā* cobbles, diminishing in size with increasing depth.

Layer II Level 1 - Dark brown (10YR 3/3) silt with 85% cobbles.

Figure 106. SIHP Site 23686 Feature 250 EU-11 north wall profile.

Table 30. Recovered items from SIHP Site 23686, Feature 250, EU-11.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
142	I	1	Marine shell	*Drupa* sp	1	1	20.5
143	I	1	Marine shell	*Cellana* sp.	1	1	59.1
				Layer 1, Level 1 Total:	2	2	79.6
147	II	1	Fish bone	*Scarus* sp. pharyngeal plate	1	1	0.6
148	II	1	Marine shell	*Drupa* sp.	1	1	2.2
149	II	1	Coral	Unidentified	1	-	0.4
146	II	1	Mammal	*Canis* sp. tooth	1	1	1.0
145	II	1	Volcanic glass	Flake	2	-	1.8
144	II	1	Organic	*Kukui* nutshell	3	-	1.0
				Layer II, Level 1 Total:	9	3	7.0
153	II	2	Fish bone	Unidentified	1	-	0.1
154	II	2	Marine shell	*Cypraea* sp.	4	1	1.3
155	II	2	Marine shell	*Drupa* sp.	3	1	3.5
156	II	2	Coral	Unidentified	10	-	7.2
157	II	2	Coral	Unidentified	1	-	0.3
152	II	2	Volcanic glass	Flake	5	-	3.2
151	II	2	Organic	*Kukui* nutshell	2	-	0.9
150	II	2	Organic	Charcoal	-	-	0.5
				Layer II, Level 2 Total:	26	2	17.0
				EU-11 Total:	37	7	103.6

Charcoal collected from Layer II Level 2 of EU-11, Feature 250, was submitted for radiocarbon assaying. The sample (Beta-212760) intercepts the tree-ring calibration curve at AD 1650 and has a 2-sigma standard deviation calibrated date range of AD 1520 to 1950.

Feature 254

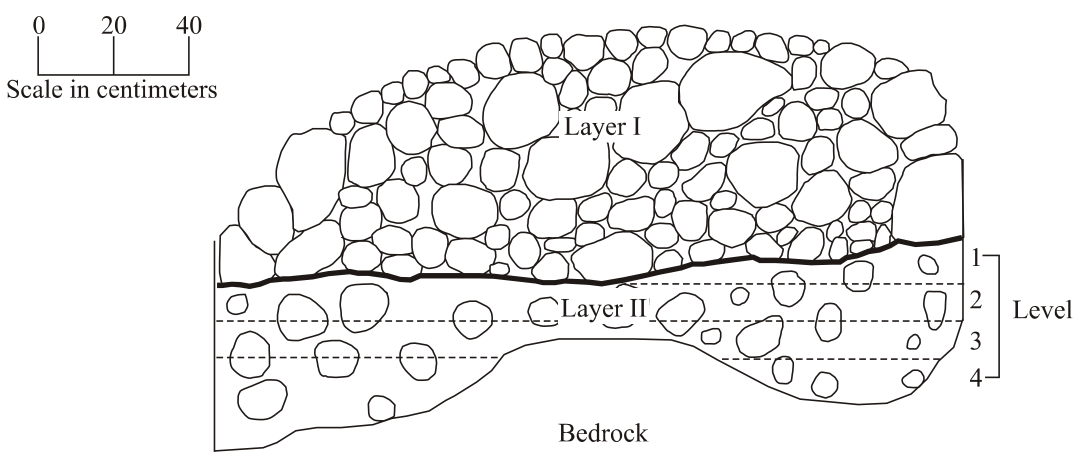
Feature 254 is a linear terrace wall constructed of *ʻaʻā* cobbles within the southeastern quadrant of the project area (see Figure 71). The southeast to northwest aligned wall is 20 meters long, 2.7 meters wide, and 80 centimeters high. The wall is loosely stacked along its edges with a slightly mounded interior surface of piled cobbles.

A 2 x 1 meter excavation unit (EU-12) was placed perpendicularly across the terrace wall in a northeastern alignment and revealed the following stratigraphic profile (Figures 107 and 108):

Layer I, Level 1 (0-60cmbs)..........architectural layer with small piled *ʻaʻā* cobbles and larger stacked *ʻaʻā* cobbles along outer edges.
Layer II, Level 1 (60-70cmbs).......dark yellowish brown (10YR 3/4) silt with cobbles.
Layer II, Level 2 (70-80cmbs).......dark yellowish brown (10YR 3/4) and dark brown (10YR 3/3) mottled silt with medium-sized cobbles.
Layer II, Level 3 (80-90cmbs).......very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) mottled silt with cobbles.
Layer II, Level 4 (90-100cmbs).....dark brown (10YR 3/3) silt with less cobbles on undulating *ʻaʻā* bedrock.

Recovered items from EU-12 included *Cypraea* sp., coral, unidentifiable shell, *Sus* sp., and charcoal (Table 31). All the recovered items came from Layer II; the architectural layer and the bottom-most silt layer being sterile.

Figure 107. SIHP Site 23686 Feature 254 EU-12 base of excavation, view to the southeast.



Layer I, Level 1 - Architectural layer with small piled *ʻaʻā* cobbles and larger stacked *ʻaʻā* cobbles along outer edges.

Layer II, Level 1 - Dark yellowish brown (10YR 3/4) silt with cobbles.

Layer II, Level 2 - Dark yellowish brown (10YR 3/4) and dark brown (10YR 3/3) mottled silt with medium-sized cobbles.

Layer II, Level 3 - Very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) mottled silt with cobbles.

Layer II, Level 4 - Dark brown (10YR 3/3) silt with a small amount of cobbles.

Figure 108. SIHP Site 23686 Feature 254 EU-12 northwest wall profile.

Table 31. Recovered items from SIHP Site 23686, Feature 254, EU-12.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
159	II	1	Marine shell	*Cypraea* sp.	1	1	0.7
158	II	1	Organic	Charcoal	-	-	0.2
				Layer II, Level 1 Total:	1	1	0.9
163	II	2	Marine shell	Unidentified	1	-	0.2
162	II	2	Coral	Unidentified	4	-	1.5
161	II	2	Mammal bone	*Sus* sp. vertebrae	1	1	1.1
160	II	2	Organic	Charcoal	-	-	0.5
				Layer II, Level 2 Total:	6	1	3.3
164	II	3	Organic	Charcoal	-	-	0.3
				Layer II, Level 3 Total:	0	0	0.3
				EU-12 Total:	7	2	4.5

Charcoal collected from Layer II Level 2 of EU-12, Feature 254, was submitted for radiocarbon assaying. The sample (Beta-212761) intercepts the tree-ring calibration curve at AD 1650 and has a 2-sigma standard deviation calibrated date range of AD 1520 to 1950.

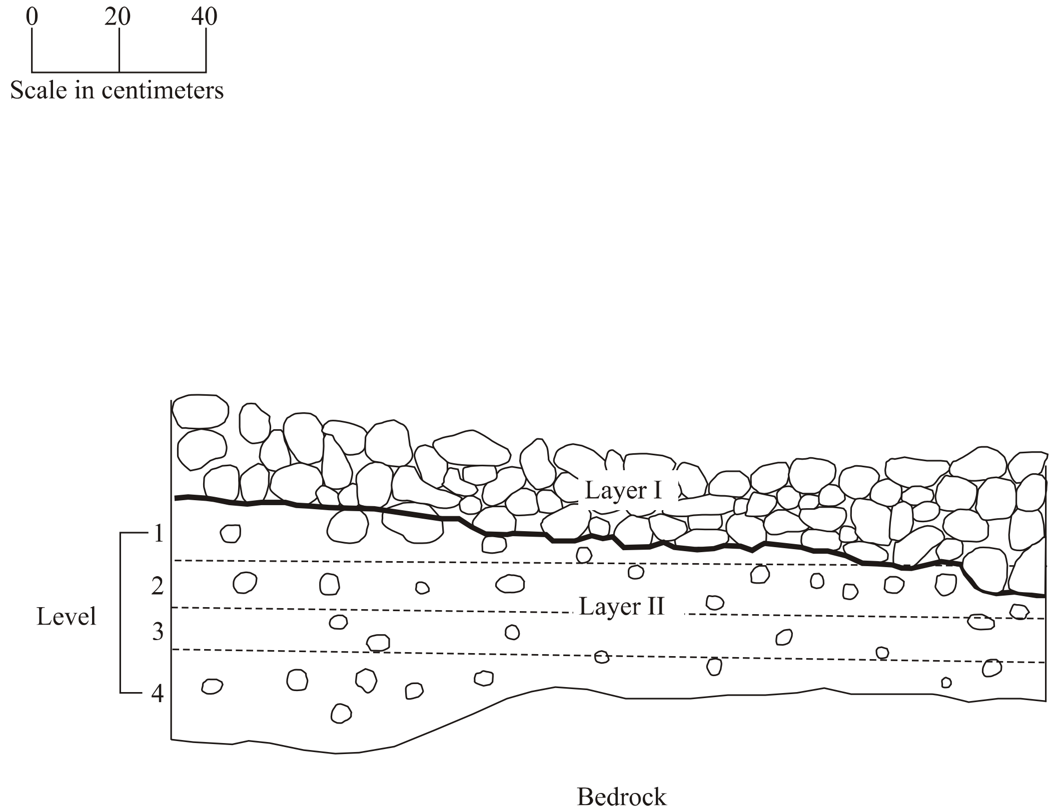
Feature 291

Feature 291 is a linear *kuaiwi* constructed of *ʻaʻā* cobbles within the northeastern quadrant of the project area (see Figure 76). The southwest to northeast aligned wall is 78 meters long, 3.5 meters wide, and 30 centimeters high. The wall is comprised of loosely piled small to medium cobbles.

A 2 x 1 meter excavation unit (EU-13) was placed from north to south across the wall near its northeastern tip and revealed the following profile (Figure 109):

Layer I (0-30cmbs) ....architectural layer with small to medium piled *ʻaʻā* cobbles.
Layer II, Level 1 (30-40cmbs).......dark brown (10YR 3/3) silt with cobbles.
Layer II, Level 2 (40-50cmbs).......brown (10YR 4/3) silt with 40% cobbles.
Layer II, Level 3 (50-60cmbs).......brown (10YR 4/3) silt with smaller cobbles.
Layer II, Level 4 (60-80cmbs).......brown (10YR 4/3) silt with 80% smaller cobbles on undulating *ʻaʻā* bedrock.

Items recovered from EU-13 include *Cypraea* sp., *Drupa* sp., *Morula* sp., *Isognomon* sp., coral, Echinoidea, *Conus* sp., unidentifiable shell, volcanic glass flake, and waterworn basalt pebbles (Table 32). Layer II yielded more items than the architectural Layer I. However, no dietary or activity shifts are evident.



Layer I - Architectural layer with small to medium piled *ʻaʻā* cobbles.

Layer II, Level 1 - Dark brown (10YR 3/3) silt with cobbles.

Layer II, Level 2 - Brown (10YR 4/3) silt with 40% cobbles.

Layer II, Level 3 - Brown (10YR 4/3) silt with smaller cobbles.

Layer II, Level 4 - Brown (10YR 4/3) silt with 80% small cobbles.

Figure 109. SIHP Site 23678 EU-13 west wall profile.

Table 32. Recovered items from SIHP Site 23686, Feature 291, EU-13.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
165	I	1	Marine shell	*Cypraea* sp.	7	2	15.3
166	I	1	Marine shell	*Drupa* sp	1	1	1.2
167	I	1	Marine shell	*Conus* sp.	1	1	2.1
170	I	1	Marine shell	*Conus* sp.	1	1	0.0
168	I	1	Coral	Unidentified	1	-	2.8
169	I	1	Coral	Unidentified	12	-	67.5
				Layer I, Level 1 Total:	23	5	88.9
172	II	1	Marine shell	*Cypraea* sp.	7	1	5.3
173	II	1	Marine shell	*Drupa* sp.	3	1	1.1
174	II	1	Marine shell	*Conus* sp.	6	2	2.4
175	II	1	Marine shell	Unidentified	1	-	0.2
176	II	1	Coral	Unidentified	20	-	7.7
177	II	1	Coral	Unidentified	1	-	1.5
178	II	1	Coral	Waterworn	2	-	1.1
171	II	1	Basalt	Waterworn pebble	2	-	3.7
				Layer II, Level 1 Total:	42	4	23.0
180	II	2	Marine shell	*Cypraea* sp.	11	1	5.2
184	II	2	Marine shell	*Drupa* sp	1	1	1.5
185	II	2	Marine shell	*Morula* sp.	1	1	1.0
183	II	2	Marine shell	*Isognomon* sp.	1	1	0.1
182	II	2	Marine shell	*Conus* sp.	4	1	1.5
186	II	2	Marine shell	Unidentified	5	-	1.6
188	II	2	Coral	Unidentified	2	-	1.5
189	II	2	Coral	Waterworn	2	-	0.4
190	II	2	Coral	Unidentified	5	-	3.3
181	II	2	Echinoderm	Echinoidea	1	-	0.3
179	II	2	Volcanic glass	Flake	1	-	0.9
				Layer II, Level 2 Total:	34	5	17.2
191	II	3	Marine shell	*Cypraea* sp.	10	2	6.1
194	II	3	Marine shell	*Drupa* sp.	1	1	0.4
192	II	3	Marine shell	*Conus* sp.	8	2	3.9
195	II	3	Marine shell	Unidentified	12	-	1.1
196	II	3	Coral	Unidentified	5	-	1.7
197	II	3	Coral	Waterworn	6	-	2.5
193	II	3	Echinoderm	Echinoidea	3	-	0.5
				Layer II, Level 3 Total:	45	5	16.2
				EU-13 Total:	144	19	145.3

Feature 286

Feature 286 is an irregularly shaped terrace wall constructed of *ʻaʻā* cobbles within the east-central portion of the project area (see Figure 76). The roughly L-shaped wall extends for approximately ten meters from the southeast to the northwest where it turns into a generally northeasterly facing arc-shape for another six meters. The average width of the wall is 1.8 meters and its height is 60 centimeters. The wall consists of piled large cobbles and small boulders.

A 2 x 1 meter excavation unit (EU-16) was placed from east to west across the wall near its eastward turn and revealed the following stratigraphic profile (the deposits yielded no cultural items) (Figure 110):

Layer I (0-50cmbs)........... architectural layer with piled large to small *ʻaʻā* cobbles and a few boulders.
Layer II (50-80cmbs) .... dark brown (10YR 3/3) silt grading into dark yellowish brown (10YR 3/4) silt immediately above weathered and undulating *ʻaʻā* bedrock.

Feature 282

Feature 282 is a rectangular pavement constructed of *ʻaʻā* cobbles within the east-central portion of the project area (see Figure 76). The southeast to northwest aligned platform is 12.5 meters long, 8.5 meters wide, and 20 centimeters above ground surface. Two excavation units (i.e., EU-17 and EU-18) were placed on the Feature 282 pavement.

A 2 x 1 meter excavation unit (EU-17) was placed in the northwestern portion of the pavement and revealed the following stratigraphic profile (the deposits yielded no cultural items) (Figures 111 and 112):

Layer I (0-25cmbs)........... architectural layer with piled small to large *ʻaʻā* cobbles (smaller pebbles formed a 10cm thick pavement).
Layer II (25-50cmbs) .... brown (10YR 4/3) silt with 80% rock above weathered *ʻaʻā* bedrock.

A 2 x 2 meter excavation unit (EU-18) was placed near the northwestern corner of the pavement and revealed the following stratigraphic profile (the deposits yielded no cultural items) (Figures 113 and 114):

Layer I (0-25cmbs)........... architectural layer with piled small to large *ʻaʻā* cobbles.
Layer II (25-45cmbs) .... brown (10YR 4/3) silt with 80% rock above weathered *ʻaʻā* bedrock.

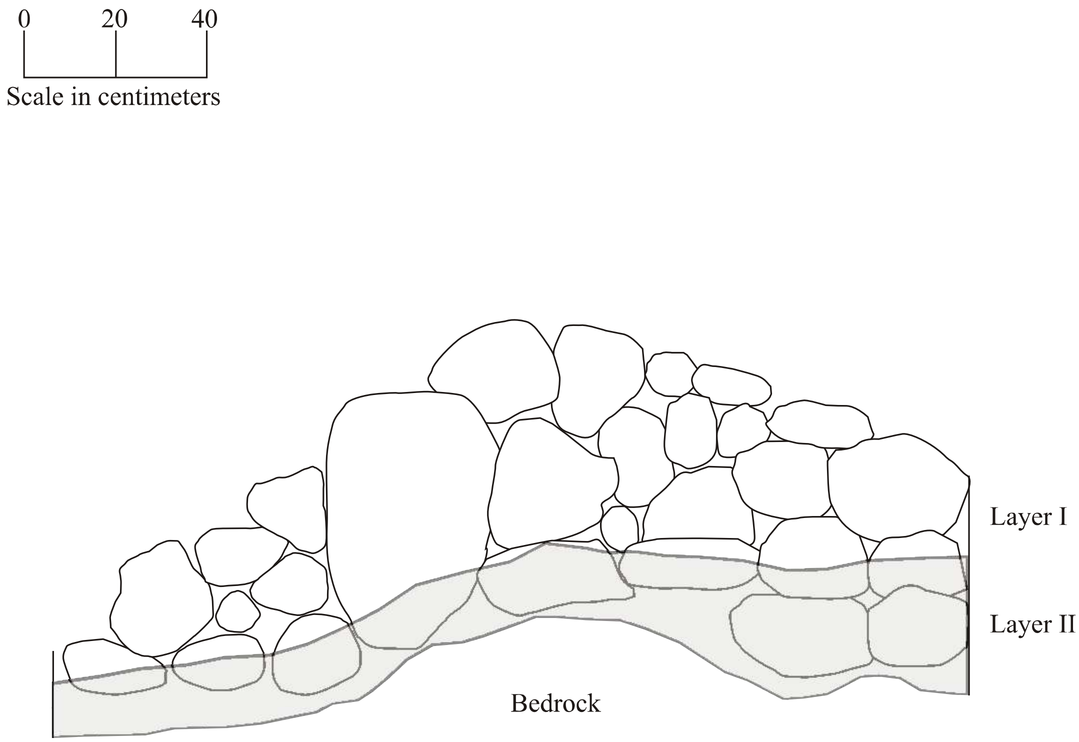
Feature 289

Feature 289 is an irregularly-shaped pavement constructed of *ʻaʻā* cobbles within the east-central portion of the project area (see Figure 76). The west to east aligned platform is nine meters long, 5.5 meters wide, and 20 centimeters above the surrounding ground surface. Two excavation units (i.e., EU-19 and EU-20) were placed on the Feature 289 pavement.

A 2 x 2 meter excavation unit (EU-19) was placed near the southwestern portion of the pavement and revealed the following stratigraphic profile (Figure 115):

Layer I (0-45cmbs)..........................architectural layer with piled small to large *ʻaʻā* cobbles and a few small boulders.
Layer II, Level 1 (45-55cmbs).........dark brown (10YR 3/3) silt with *ʻaʻā* cobbles from architectural layer.
Layer II, Level 2 (55-65cmbs).........dark brown (10YR 3/3) silt with 20% *ʻaʻā* gravels.
Layer II, Level 3 (65-80cmbs).........dark brown (10YR 3/3) silt with crumbly *ʻaʻā* cobble fragments from underlying undulating bedrock.

Items recovered from EU-19 include *Cypraea* sp., *Morula* sp., *Isognonom* sp., coral, and *Conus* sp. (Table 33). All the items came from Layer II below the architectural layer.

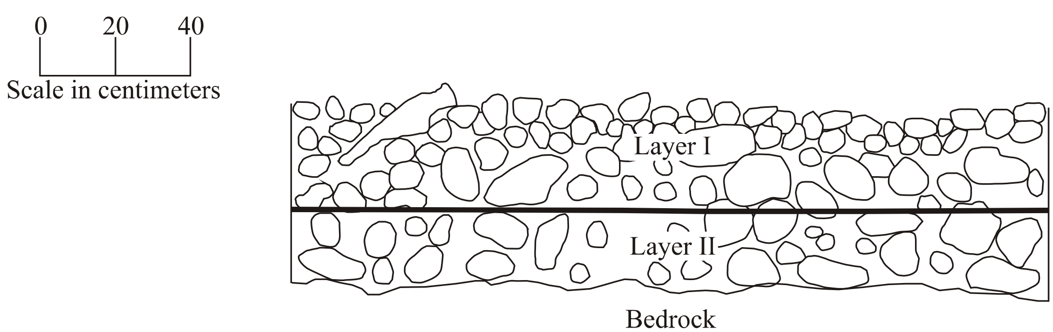


Layer I - Architectural layer with piled large to small *‘a‘ā* cobbles and a few boulders.

Layer II - Dark brown (10YR 3/3) silt grading into dark yellowish brown (10YR 3/4) silt.

Figure 110. SIHP Site 23686 Feature 286 EU-16 north wall profile.

Figure 111. SIHP Site 23686 Feature 282 EU-17 base of excavation, view to the east.



Layer I - Architectural layer with piled small to large *‘a‘ā* cobbles (smaller pebbles formed a 10cm thick pavement).

Layer II - Brown (10YR 4/3) silt with 80% rock above.

Figure 112. SIHP Site 23686 Feature 282 EU-17 east wall profile.

Figure 113. SIHP Site 23686 Feature 282 EU-18 base of excavation, view to the east.

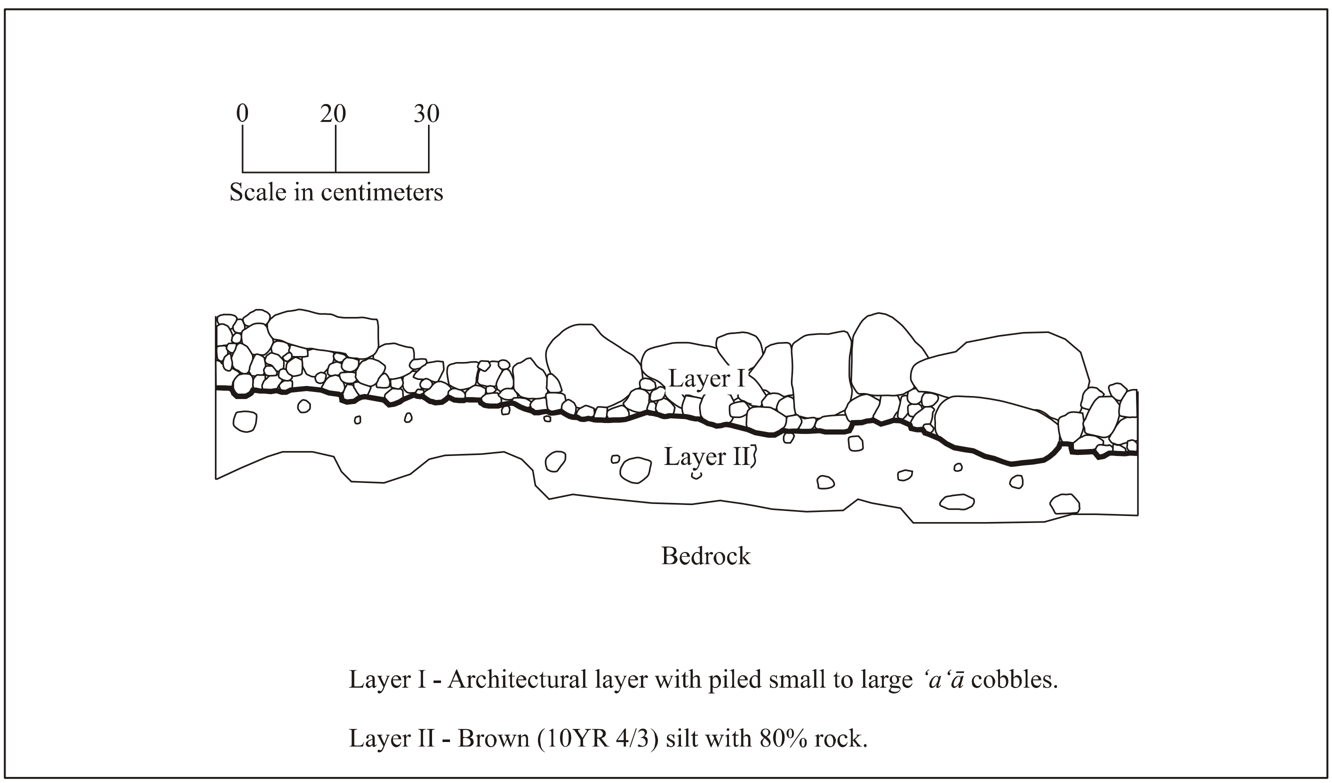
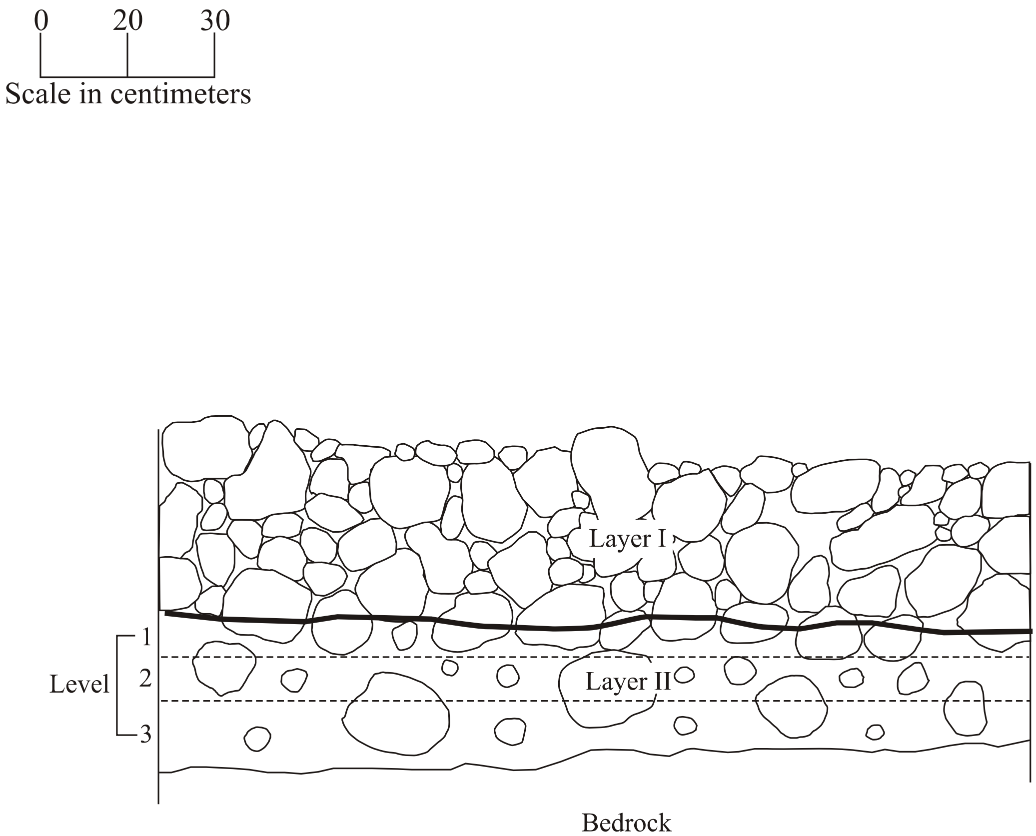


Figure 114. SIHP Site 23686 Feature 282 EU-18 east wall profile.



Layer I - Architectural layer with piled small to large *‘a‘ā* cobbles and a few small boulders
.
Layer II, Level 1 - Dark brown (10YR 3/3) silt with *‘a‘ā* cobbles from architectural layer.

Layer II, Level 2 - Dark brown (10YR 3/3) silt with 20% *‘a‘ā* gravels.

Layer II, Level 3 - Dark brown (10YR 3/3) silt with crumbly *‘a‘ā* cobble fragments.

Figure 115. SIHP Site 23686 Feature 289 EU-19 north wall profile.

Table 33. Recovered items from SIHP Site 23686, Feature 289, EU-19.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
282	II	1	Marine shell	*Cypraea* sp.	10	2	7.6
284	II	1	Marine shell	*Isognomon* sp.	2	1	0.4
283	II	1	Marine shell	*Conus* sp.	1	1	0.2
285	II	1	Coral	Unidentified	1	-	0.3
				Layer II, Level 1 Total:	14	4	8.5
286	II	2	Marine shell	*Cypraea* sp.	1	1	0.7
				Layer II, Level 2 Total:	1	1	0.7
287	II	3	Marine shell	*Cypraea* sp.	3	1	1.0
288	II	3	Marine shell	*Morula* sp.	1	1	0.7
				Layer II Level 3Total:	4	2	1.7
				EU-19 Total:	19	7	10.9

A 2 x 2 meter excavation unit (EU-20) was placed near the central portion of the pavement (immediately east of and abutting EU-19) and revealed the following stratigraphic profile (Figures 116 and 117):

Layer I (0-30cmbs)..........................architectural layer with piled small to large *ʻaʻā* cobbles and a few small boulders.
Layer II, Level 1 (30-40cmbs).........brown (10YR 4/3) silt with 60% *ʻaʻā* cobbles from architectural layer.
Layer II, Level 2 (40-50cmbs).........brown (10YR 4/3) silt with 60% *ʻaʻā* gravels.
Layer II, Level 3 (50-60cmbs).........brown (10YR 4/3) silt with crumbly *ʻaʻā* cobble fragments from underlying bedrock.

Items recovered from EU-20 include *Cypraea* sp., *Cymatium* sp., *Conus* sp., coral, and a volcanic glass flake (Table 34). The architectural layer yielded more remains than the underlying Layer II.

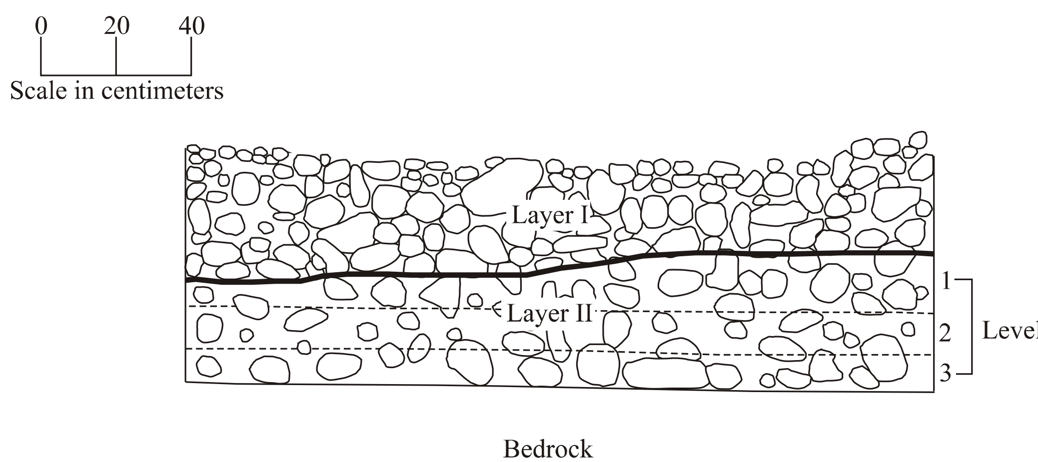
Table 34. Recovered items from SIHP Site 23686, Feature 289, EU-20.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
289	I	1	Marine shell	*Cypraea* sp.	2	1	5.6
292	I	1	Marine shell	*Cypraea* sp.	14	2	7.8
294	I	1	Marine shell	*Cymatium* sp.	1	1	3.1
293	I	1	Marine shell	*Conus* sp.	2	1	2.9
290	I	1	Coral	Unidentified	1	-	17.2
291	I	1	Volcanic glass	Flake	1	-	0.5
				Layer I, Level 1 Total:	21	5	37.1
295	II	2	Marine shell	*Cypraea* sp.	4	1	1.6
296	II	2	Marine shell	*Conus* sp.	2	1	1.5
297	II	2	Coral	Unidentified	1	-	2.5
				Layer II, Level 2 Total:	7	2	5.6
				EU-20 Total:	28	7	42.7

Feature 81

Feature 81 is a linear terrace constructed of *ʻaʻā* cobbles within the southeastern quadrant of the project area (see Figure 76). The southeast to northwest aligned wall is 60 meters long, one meter wide, and 50 centimeters above the surrounding ground surface.

Figure 116. SIHP Site 23686 Feature 289 EU-20 base of excavation, view to the east.



Layer I - Architectural layer with piled small to large *ʻaʻā* cobbles and a few small boulders.
Layer II, Level 1 - Brown (10YR 4/3) silt with 60% *ʻaʻā* cobbles from architectural layer.
Layer II, Level 2 - Brown (10YR 4/3) silt with 60% *ʻaʻā* gravels.
Layer II, Level 3 - Brown (10YR 4/3) silt with crumbly *ʻaʻā* cobble fragments from underlying bedrock.

Figure 117. SIHP Site 23686 Feature 289 EU-20 south wall profile.

A 2 x 1 m excavation unit (EU-25), aligned southeast-northwest, was placed in the *makai* portion of the terrace wall. EU-25 revealed the following stratigraphic profile (the deposits yielded no cultural items) (Figures 118 and 119):

Layer I (0-30cmbs).........................architectural layer with piled small to large *ʻaʻā* cobbles.
Layer II, Level 1 (30-40cmbs).........dark brown (10YR 3/3) silt with 60% *ʻaʻā* cobbles.
Layer II, Level 2 (40-50cmbs).........brown (10YR 4/3) silt with 80% *ʻaʻā* gravels on bedrock.

Feature 82

Feature 82 is a linear *kuaiwi* constructed of *ʻaʻā* cobbles within the southeastern quadrant of the project area (see Figure 76). The southwest to northeast aligned wall is 108 meters long, 2.1 meters wide, and 70 centimeters high. The wall is composed of loosely piled small to medium cobbles and exhibits a considerable degree of post-constructional disturbance.

A 2 x 1 meter excavation unit (EU-26) was placed from east to west across the wall near its right-angled intersection with the Feature 81 wall and revealed the following stratigraphic profile (the deposits yielded no cultural items) (Figures 120 and 121):

Layer I (0-15cmbs)........... architectural layer with small to large piled *ʻaʻā* cobbles.
Layer II (15-28cmbs) .... dark brown (10YR 3/3) and dark yellowish brown (10YR 3/4) mottled silt with small cobbles on crumbly *ʻaʻā* bedrock.

Feature 17

Feature 17 is a linear *kuaiwi* constructed of *ʻaʻā* cobbles close to the southwestern quadrant of the project area (see Figure 76). The southwest to northeast aligned wall is 38.7 meters long, two meters wide, and 80 centimeters high. The wall consists of loosely piled small to medium cobbles.

A 2 x 1 meter excavation unit (EU-35) was placed from southeast to northwest across the wall and revealed the following stratigraphic profile (the deposits yielded no cultural items) (Figures 122 and 123):

Layer I (0-60cmbs)........... architectural layer with small to large piled *ʻaʻā* cobbles.
Layer II (60-65cmbs) .... dark yellowish brown (10YR 3/4) silt with organic debris on uneven *ʻaʻā* bedrock.

Feature 293

Feature 293 is a square enclosure constructed of *ʻaʻā* cobbles towards the southwestern portion of the project area (see Figure 76). The enclosure wall is 1.9 meters long by 1.9 meters thick and 50 centimeters above ground surface. Extensive modern-day activities in and around the feature have impacted the configuration and height of the enclosure wall as well as introduced recent items to the deposits, such as glass, plastic and metal containers, automobile parts, clothing, and fish remains.

A 2 x 1 meter excavation unit (EU-36) aligned south to north, was placed in the central portion of the enclosed space covered by inwardly collapsed wall remnants. EU-36 revealed the following stratigraphic profile with evidence of disturbance (Figures 124 and 125):

Layer I (0-40cmbs).........................architectural layer with piled small to large *ʻaʻā* cobbles, *ʻiliʻili* pebbles, coral, and marine shell.
Layer II Level 1 (40-60cmbs) ....dark brown (10YR 3/3) silt with 30% *ʻaʻā* gravel.
Layer II Level 2 (60-80cmbs) ....dark brown (10YR 3/3) and brown (10YR 4/3) mottled silt on undulating *ʻaʻā* bedrock.

Figure 118. SIHP Site 23686 Feature 81 EU-25 base of excavation, view to the northwest.

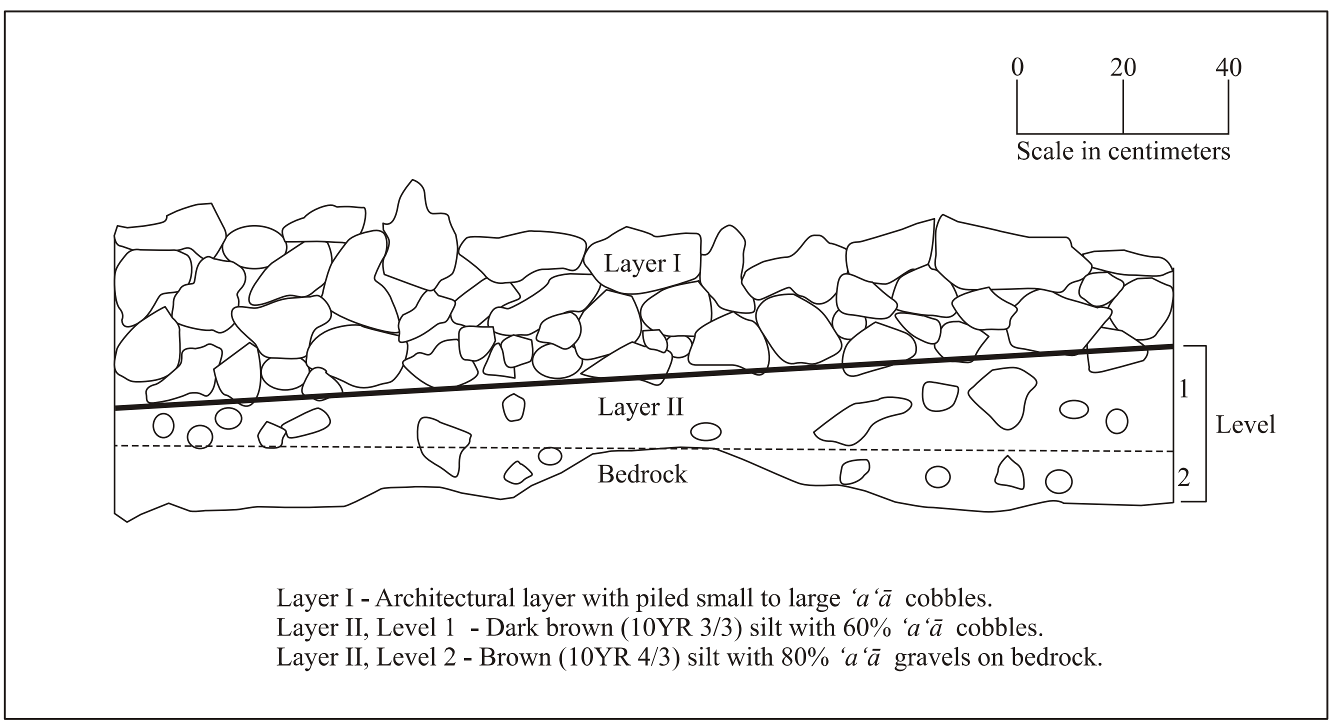


Figure 119. SIHP Site 23686 Feature 81 EU-25 northeast wall profile.

Figure 120. SIHP Site 23686 Feature 82 EU-26 base of excavation, view to the north.

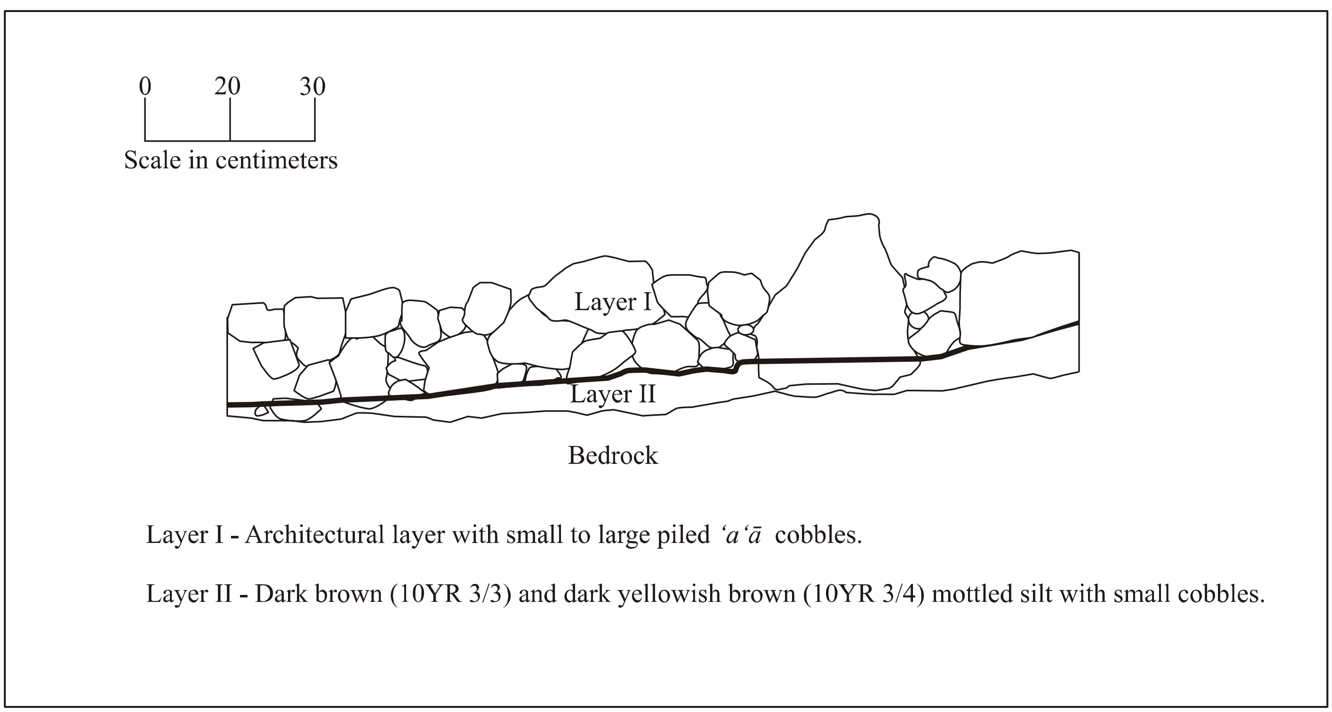


Figure 121. SIHP Site 23686 Feature 82 EU-26 north wall profile.

Figure 122. SIHP Site 23686 Feature 17 EU-35 base of excavation, view to the east.

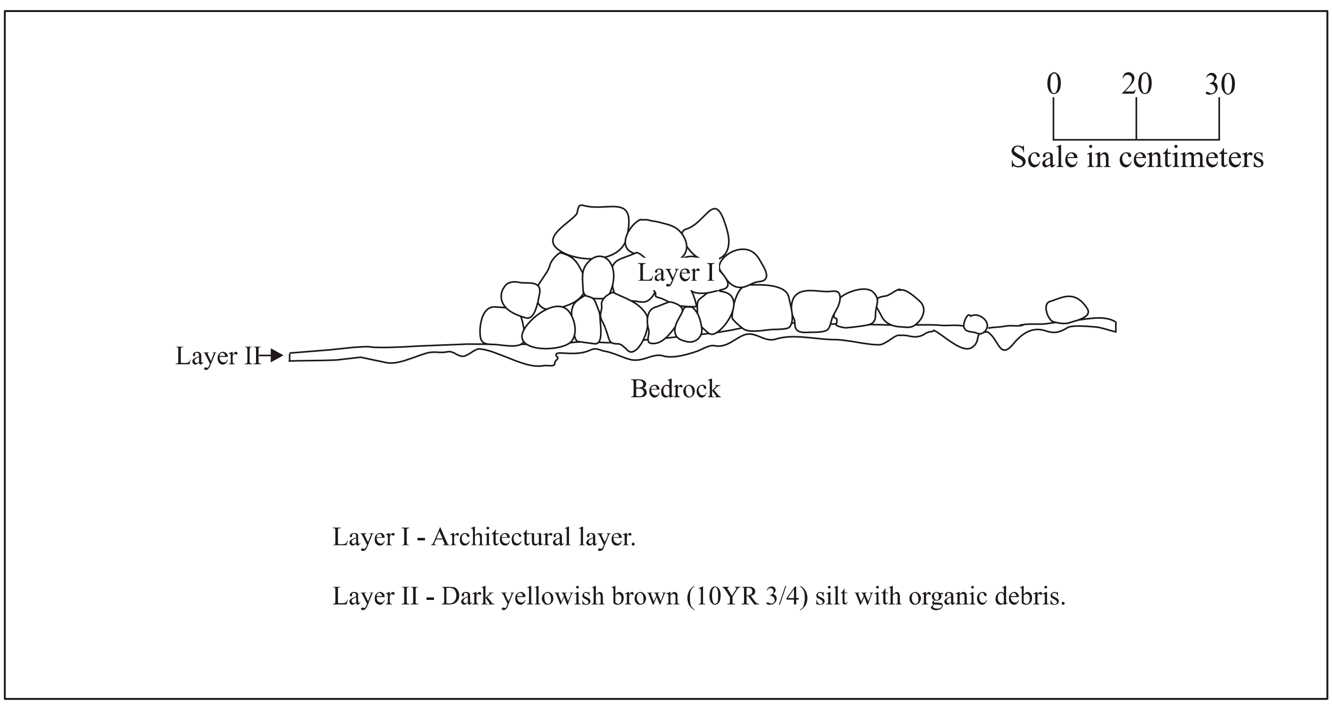
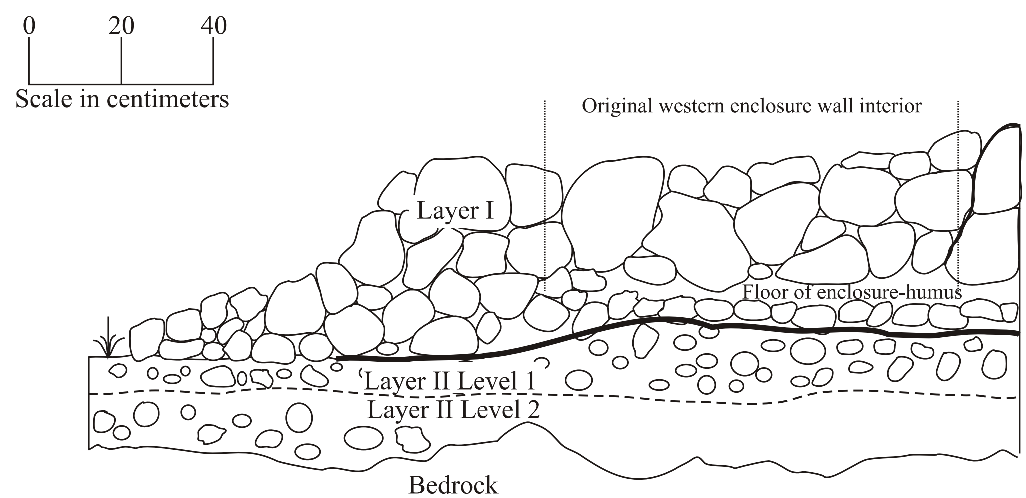


Figure 123. SIHP Site 23686 Feature 17 EU-35 northeast wall profile.

Figure 124. SIHP Site 23686 Feature 293 EU-36 base of excavation, view to the west.



Layer I - Architectural layer.

Layer II Level 1 - Dark brown (10YR 3/3) silt with 30 percent *‘a‘ā* gravel.

Layer II Level 2 - Dark brown (10YR 3/3) and brown (10YR 4/3) mottled silt near bedrock.

Figure 125. SIHP Site 23686 Feature 293 EU-36 west wall profile.

Items recovered from EU-36 include fish, *Cypraea* sp., coral, Echinoidea, *Sus* sp., *Rattus* sp., *kukui* nutshell, charcoal, a volcanic glass flake, and waterworn basalt (Table 35). Historic Period items include steel nuts, screws, nails, bottle glass, and a plastic container. A steel common nail (Acc # 530) from Level 1 in Layer II appears modern. It is 38.5 millimeters long, 6.3 millimeters wide, and 2.85 millimeters thick. A steel finish nail (Acc# 546) from Level 2 in Layer II also appears modern. This nail is 51 millimeters long, 4 millimeters wide, and 2.9 millimeters thick. And finally, a hexagonal steel nut (Acc# 532) from Level 1 in Layer II also appears modern. This nut is sheared and corroded on the inside. It is 13.7 millimeters long, 12.5 millimeters wide, and 8.9 millimeters thick. The recovery of Historic Period materials from the deepest levels within EU-36 indicate post-depositional disturbance.

Table 35. Recovered items from SIHP Site 23686, Feature 293, EU-36.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
526	I	1	Marine shell	*Cypraea* sp.	1	1	8.3
525	I	1	Coral	Unidentified	3	-	16.1
524	I	1	Basalt	Waterworn	1	-	5.5
				Layer I, Level 1 Total:	5	1	30
533	II	1	Fish bone	Unidentified	2	-	0.3
527	II	1	Basalt	Waterworn	22	-	47.1
535	II	1	Organic	*Kukui* nutshell	1	1	0.9
528	II	1	Organic	Charcoal	-	-	1.8
530	II	1	Metal	Steel nail	1	-	1.5
531	II	1	Metal	Iron fragments rusted	43	-	15.6
532	II	1	Metal	Steel nut	1	-	6.1
534	II	1	Glass	Brown bottle	3	-	4.8
536	II	1	Glass	Clear thin fragments	4	-	3.3
537	II	1	Glass	Clear thick fragments	2	-	0.7
538	II	1	Glass	Light green bottle	2	-	0.7
539	II	1	Glass	Clear fragments	2	-	1.1
529	II	1	Synthetic	Plastic container	9	-	4.9
				Layer II, Level 1 Total:	92	1	89
552	II	2	Fish bone	Unidentified vertebrae	1	-	1.8
553	II	2	Fish bone	Unidentified	1	-	0.2
545	II	2	Marine shell	*Cypraea* sp.	1	1	3.0
544	II	2	Coral	Unidentified	4	-	1.7
556	II	2	Echinoderm	Echinoidea	1	-	>0.1
541	II	2	Mammal bone	*Sus* sp. rib	2	1	6.4
551	II	2	Mammal bone	*Rattus* sp. jaw	1	1	0.1
542	II	2	Basalt	Waterworn	13	-	24.1
550	II	2	Volcanic glass	Flake	1	-	0.5
543	II	2	Organic	*Kukui* nutshell	1	-	0.9
561	II	2	Organic	Charcoal	4	-	0.2
540	II	2	Metal	Iron fragments rusted	57	-	33.4
546	II	2	Metal	Steel finish nails	3	-	5.6
555	II	2	Metal	Steel screw	1	-	3.8
547	II	2	Glass	Clear bottle fragments	8	-	10.5
548	II	2	Glass	Light green bottle	3	-	5.8
549	II	2	Glass	Brown bottle	6	-	2.5
554	II	2	Glass	Clear fragments	5	-	4.2
557	II	2	Glass	Clear fragment	1	-	2.7
558	II	2	Glass	Clear fragment	1	-	0.3
559	II	2	Synthetic	Plastic	4	-	0.9
560	II	2	Synthetic	Plastic	9	-	0.8
				Layer II, Level 2 Total:	128	3	109
				EU-36 Total:	225	5	228

Charcoal collected from Layer II Level 1 of EU-36, Feature 293, was submitted for radiocarbon assaying. The sample (Beta-212770) intercepts the tree-ring calibration curve at AD 1410 and has a 2-sigma standard deviation calibrated date range of AD 1290 to 1480.

Feature 294

Feature 294 is a square enclosure constructed of loosely piled *ʻaʻā* cobbles. The feature is located towards the southwestern portion of the project area (see Figure 76). The enclosure wall is two meters long by two meters thick and 60 centimeters above ground surface. Extensive modern-day activities in and around the feature have impacted the configuration and height of the enclosure wall as well as introduced recent items to the architectural layer, such as glass, plastic and metal containers, and automobile parts.

A 2 x 1 meter excavation unit (EU-37), aligned west to east, was placed across Feature 294, including the enclosed space and the surrounding wall. EU-37 revealed the following stratigraphic profile (apart from the modern items, the deposits yielded no cultural items) (Figures 126 and 127):

Layer I (0-40cmbs)..........................architectural layer with piled small to large *ʻaʻā* cobbles and a few small boulders.
Layer II (40-42cmbs) ....dark brown (10YR 3/3) silt on uneven *ʻaʻā* bedrock.

Feature 212

Feature 212 is a linear terrace constructed of very loosely piled *pāhoehoe* cobbles. The feature is located in the north-central portion of the project area (see Figure 76). The terrace wall is 5.2 meters long by 1.4 meters thick and 50 centimeters high. The orientation of the wall is southwest to northeast.

A 2 x 1 meter excavation unit (EU-38), aligned southeast to northwest, was placed perpendicularly across Feature 212. EU-38 revealed the following stratigraphic profile (the deposits yielded no cultural items) (Figures 128 and 129):

Layer I (0-10cmbs)..........................architectural layer with loosely piled *pāhoehoe* cobbles.
Layer II (10-20cmbs) ....dark brown (10YR 3/3) silt on uneven *pāhoehoe* bedrock.

Figure 126. SIHP Site 23686 Feature 294 EU-37 base of excavation, view to the south.

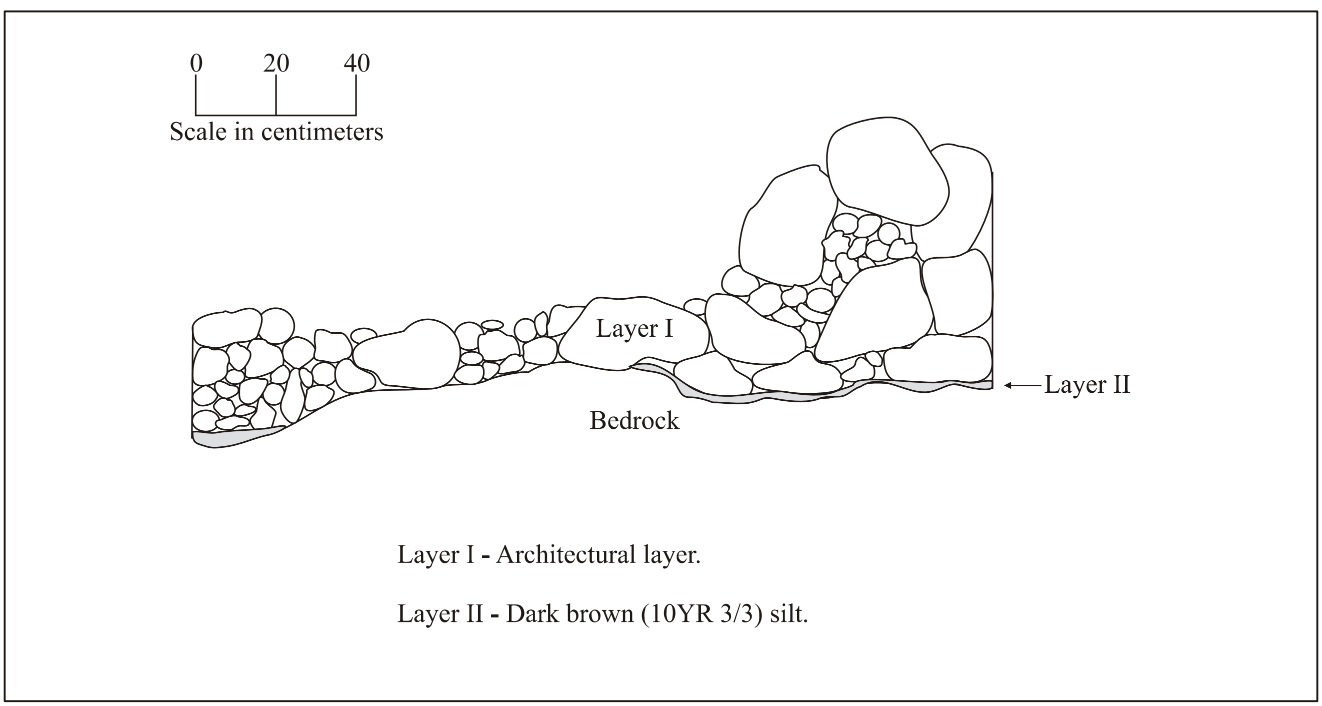


Figure 127. SIHP Site 23686 Feature 294 EU-37 south wall profile.

Figure 128. SIHP Site23686 Feature 212 EU-38 base of excavation, view to the southwest.

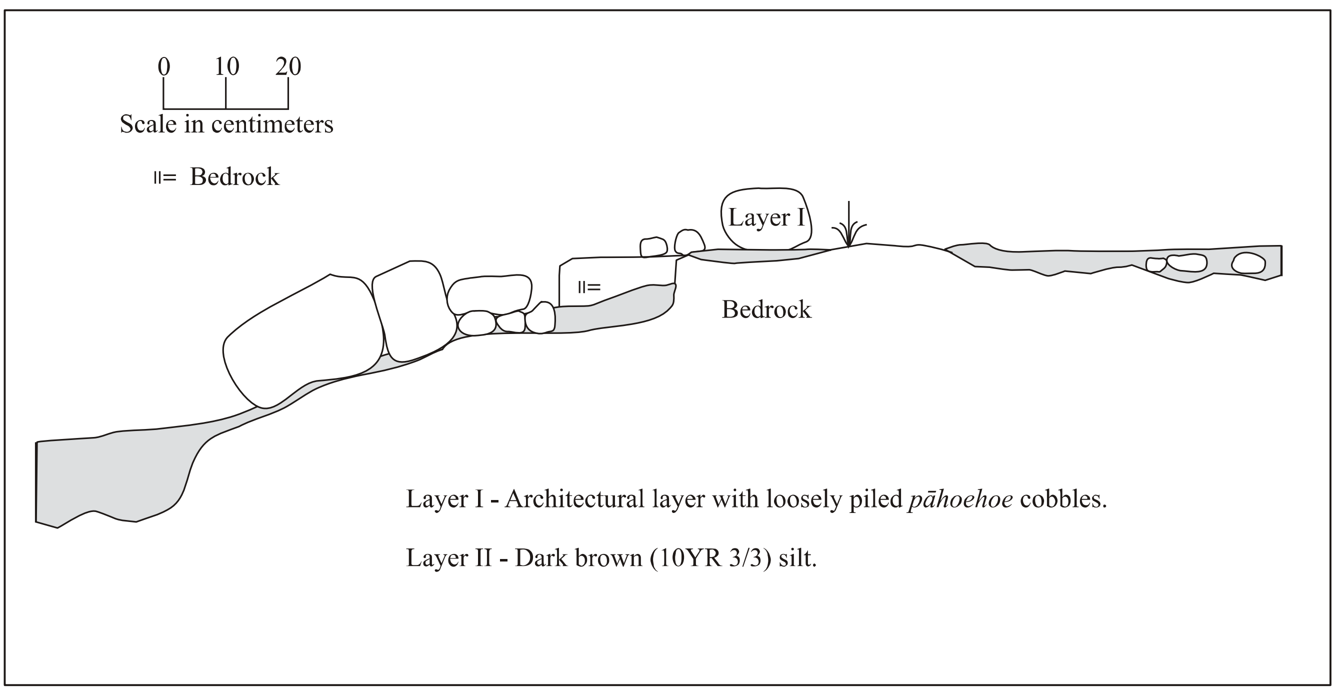


Figure 129. SIHP Site23686 Feature 212 EU-38 southwest wall profile.

SYNTHESIS OF EXCAVATION RESULTS

Introduction

The following synthesis considers together the results from the inventory survey and from the data recovery work. The synthesis is presented to evaluate the hypotheses outlined in the research objective. First, as afar as radiocarbon assays and cross-dating evidence allow, habitation and agricultural sites and features are ordered within a chronological framework. Secondly, the identity and function of roughly contemporaneous habitation and agricultural sites and features are interpreted in terms of architectural criteria and associated items. Once roughly contemporary sets of habitation and agricultural sites and features and associated items are compared and contrasted with sets from different periods, it would be possible to evaluate the primary hypothesis. The primary research question was to determine if short term habitation and associated opportunistic agriculture was indeed followed by recurrent habitation and associated formal agriculture and finally by more consistent habitation with associated household gardens and animal pens. Changes in resource exploitation through time are also considered as is an assessment of tentatively identified permanent and temporary habitation features, and agricultural features.

Site and Feature Chronology

Altogether, seventeen charcoal samples were submitted for radiocarbon assaying (Table 36). Of these, two were previously submitted samples from Test Units 13 and 16. Of the remaining fifteen, eleven came from suspected habitation features and four came from suspected agricultural features.

Table 36. Charcoal samples submitted for radiocarbon assaying, by laboratory number.

Beta-	RC-	Site	Feature	EU	Layer	Level	Measured BP	Standard Deviation	13C/12C	Conventional BP
175916	-	23672	B	TU-13	I	-	-	-	-	210
175917	-	23677	A	TU-16	I	-	-	40	-	160
212756	0223-10	23671	-	4	I	2	340	40	-23.1‰	370
212757	0223-43	23686	247	5	II	2	350	40	-26.9‰	320
212758	0223-98	23675	-	10	I	in situ	100	40	-21.7‰	150
212759	0223-130	23675	-	10	II	3	190	80	-26.2‰	170
212760	0223-150	23686	250	11	II	2	300	40	-27.4‰	260
212761	0223-160	23686	254	12	II	2	250	40	-24.4‰	260
212762	0223-209	23678	-	14	I	2	200	40	-24.1‰	210
212763	0223-298	23676	-	21	I	-	390	60	-23.4‰	410
212764	0223-314	23676	-	21	II	1	410	70	-25.4‰	410
212765	0223-332	23676	-	21	II	2	340	60	-25.1‰	340
212766	0223-378	23677	A	22	II	1	60	40	-24.1‰	70
212767	0223-409	23677	A	22	III	3	120	40	-22.6‰	160
212768	0223-474	23673	B	29	II	3	400	80	-22.5‰	440
212769	0223-498	23673	B	29	II	4	300	50	-24.4‰	310
212770	0223-528	23686	293	36	II	1	520	80	-23.5‰	540

Table 37 presents the calibrated dates sequentially, starting with the most recent ones and moving back in time. The two calibrated dates from EU-22 (i.e., Feature A of Site 23677) appear to match the stratigraphy in terms of chronological succession; charcoal from Layer II Level 1 is slightly younger than charcoal from Layer III Level 3. The two calibrated dates from EU-10 (i.e., Site 23675) are similarly compatible with stratigraphic depth; charcoal from Layer I is younger than charcoal from Layer II Level 3. However, the three radiocarbon dates from EU-21 (i.e., Site 23676) appear to be jumbled when viewed in their stratigraphic contexts; Layer II Level 1 is sandwiched between Layer I and Layer II Level 2 has yielded the earliest charcoal, whereas the charcoal from the deepest the three proveniences (i.e., Layer II Level 2) is the most recent. Two charcoal dates from EU-29 (i.e., Feature B of Site 23673) are also inverted; Layer II Level 3 contained older charcoal than the underlying Level 4. The calibrated standard deviation ranges of the dates from each of these four excavation units (i.e., EU-10, EU-21, EU-22, and EU-29) overlap within the same unit, suggesting that the dates represent different estimates of a site's occupation. Of the four sites, the dates from Site 23676 and Site 23677 appear to have the tightest range (Figure 130). The ostensibly "inverted" dates could actually be the result of fluctuations in counting radioactive carbon instead of stratigraphic disturbance or post-depositional movement of charcoal. Indeed, "split dates" of the same charcoal sample are known to produce slightly different results, not unlike the overlapping but tight range of variation as exhibited by the three dates from EU-21 in Site 23676.

Table 37. Calibrated radiocarbon dates by increasing age.

Beta-	Site	Feature	EU	Layer	Level	Conventional AD	AD intercept(s)	2-σ calibration
212766	23677	A	22	II	1	1880	1950	1680-1960
212767	23677	A	22	III	3	1790	1680/1740/1800/1930/1950	1660-1950
175917	23677	A	TU-16	I		1790	1680/1740/1800/1930/1950	1660-1950
212762	23678	-	14	I	2	1740	1660	1640-1950
212758	23675	-	10	I	in situ	1800	1680/1740/1810/1930/1950	1660-1950
212759	23675	-	10	II	3	1780	1680/1770/1800/1940/1950	1520-1960
212760	23686	250	11	II	2	1690	1650	1520-1950
212761	23686	254	12	II	2	1690	1650	1520-1950
175916	23672	B	TU-13	I		1740	1660	1510-1950
212756	23671	-	4	I	2	1580	1490	1440-1640
212765	23676	-	21	II	2	1610	1520/1590/1620	1440-1660
212763	23676	-	21	I	-	1540	1460	1420-1640
212764	23676	-	21	II	1	1540	1460	1410-1650
212769	23673	B	29	II	4	1640	1530/1550/1630	1460-1660
212768	23673	B	29	II	3	1510	1440	1320-1640
212757	23686	247	5	II	2	1630	1530/1560/1630	1460-1660
212770	23686	293	36	II	1	1410	1410	1290-1480

A "best estimate" age of different radiocarbon dates from the same unit or the same feature can be derived from calculating a weighted average of the dates and then calibrate the weighted average against the tree-ring calibration curve (Table 38, Figure 131). Judging from roughly contemporary calibration intercepts (which, by the way, do not necessarily represent the most probable date) and from similarities in the calibrated standard deviation ranges, four phases, labeled A to D, appear to be represented. The breaks between the phases are somewhat arbitrary, especially considering overlaps in standard deviation ranges. Nonetheless, for comparative purposes and for the detection of possible habitation and agricultural trends through time, grouping together roughly contemporary sites and features can be useful.

Table 38. Single and weighted average calibrated radiocarbon dates by increasing age.

Site	Feature	Unit (x dates per unit)	Layer	Level	AD multiple date weighted average and single date calibration intercept(s)	AD calibrated 2-σ range	Phase
23677	A	EU-22 (x2) and TU-16	I-III	1-3	1690/1730/1810/1920/1950	1690-1950	D
23678	-	EU-14	I	2	1660	1640-1950	D
23675	-	EU-10 (x2)	I-II	3	1690/1740/1800/1930/1950	1670-1950	D
23686	250	EU-11	II	2	1650	1520-1950	C
23686	254	EU-12	II	2	1660	1510-1950	C
23672	B	TU-13	I		1660	1510-1950	C
23686	247	EU-5	II	2	1530/1560/1630	1460-1660	B
23671	-	EU-4	I	2	1490	1440-1640	B
23676	-	EU-21 (x3)	I-II	1-2	1470	1450-1620	B
23673	B	EU-29 (x2)	II	3-4	1500	1470-1630	B
23686	293	EU 36	II	1	1410	1290-1480	A

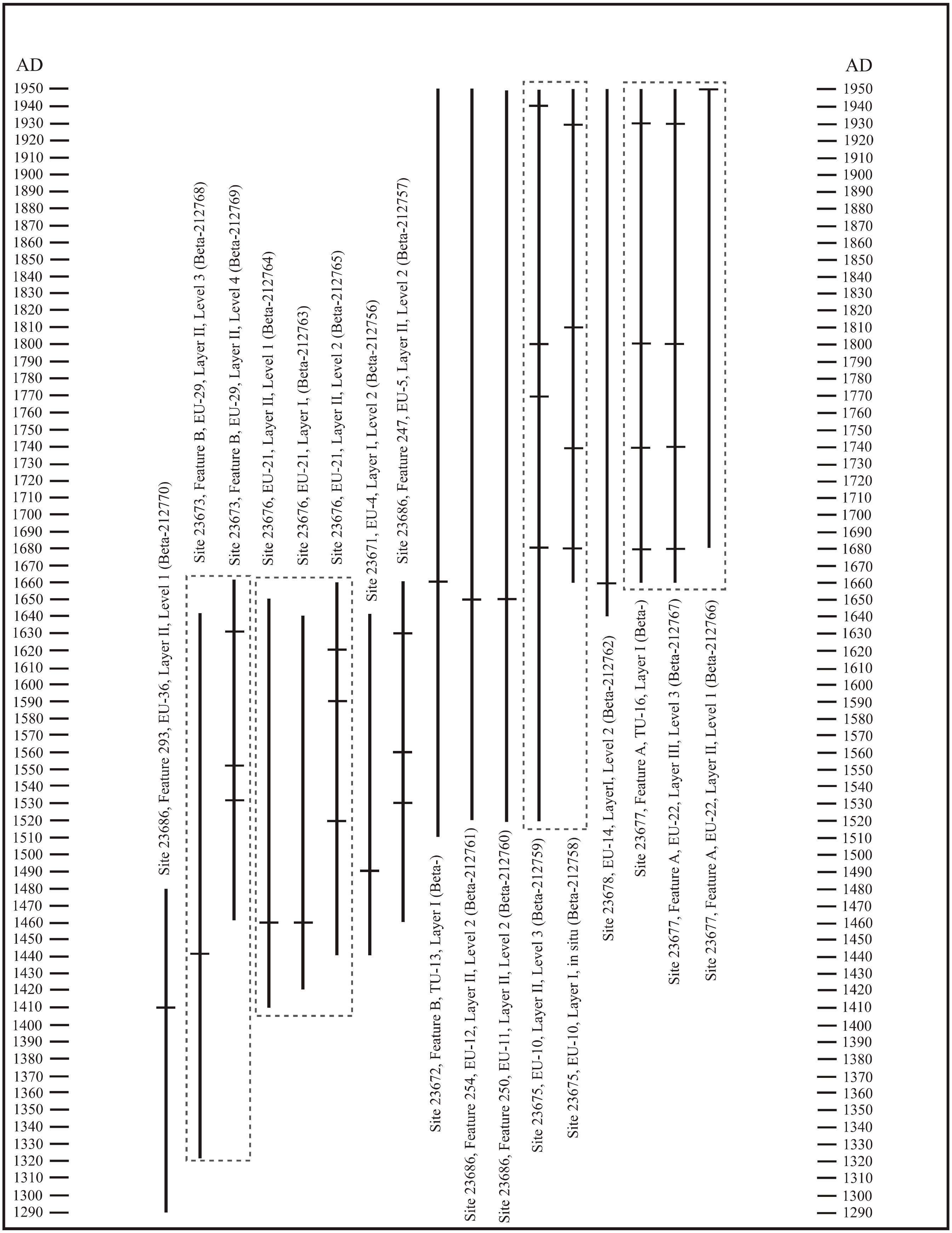


Figure 130. Diagrammatic representation of calibrated radiocarbon dates.

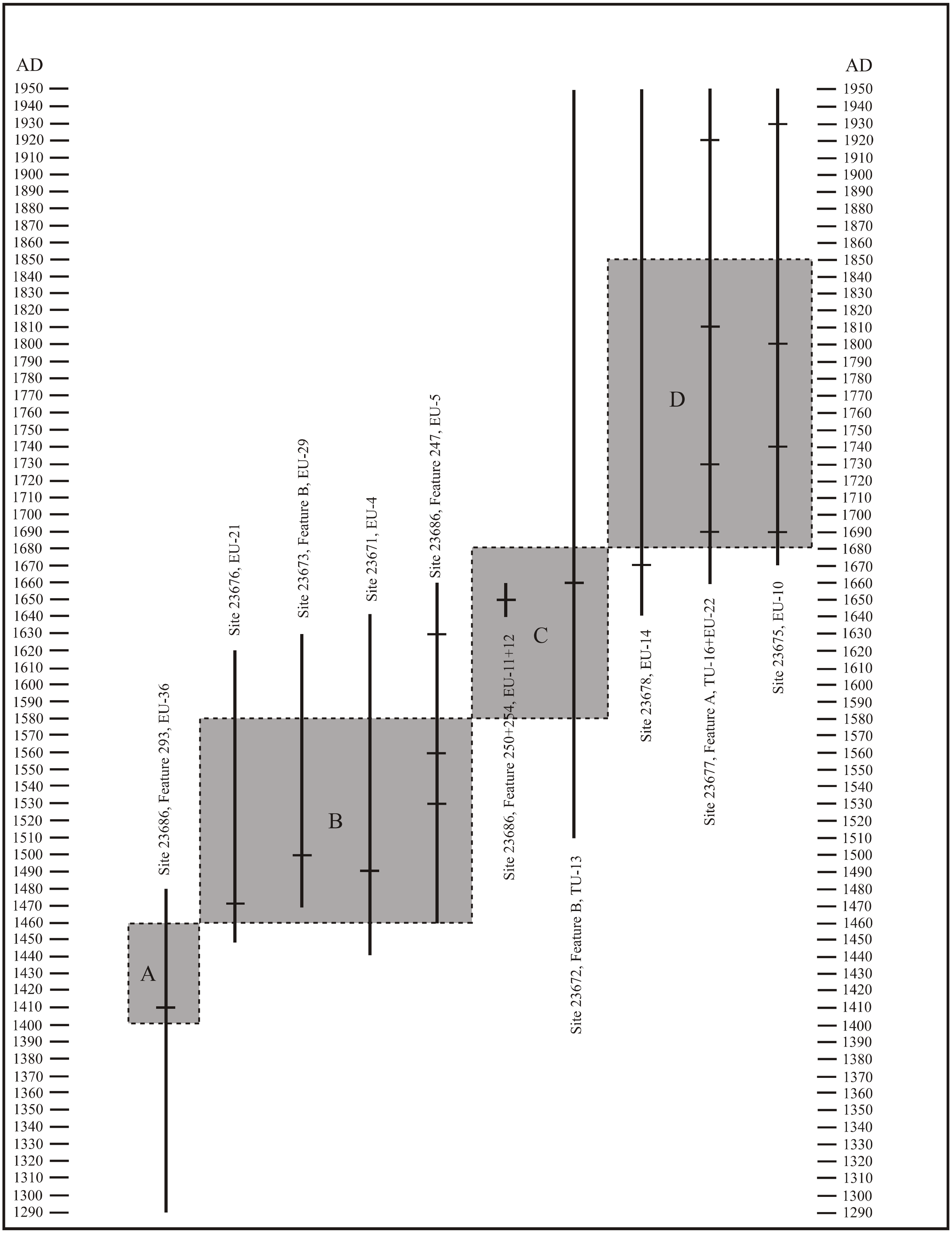


Figure 131. Diagrammatic representation of calibrated weighted averages with proposed phases.

Based on the information in Table 38 and Figure 129, the suggested phases probably span the following four somewhat arbitrary time periods: Phase A from AD 1400 to AD 1460, Phase B from AD 1460 to AD 1580, Phase C from AD 1580 to AD 1680, and Phase D from AD 1680 to AD 1850. The AD 1850 cut-off date is based on the probable AD 1830 to AD 1850 time range for the inscribed brass button from EU-31 in Feature A of Site 23670. Albeit overlapping and probably representing a gradual development, the phases are used as heuristic devices to help detect similarities and differences of site use and recovered items through time.

SITE AND FEATURE FUNCTION

Now that the time periods have been established in broad outline, roughly contemporary sites and features can be grouped by phase and then compared to sites and features from different phases. Doing this would help determine if the primary hypothesis is valid or if it needs modification. To re-iterate, this hypothesis states that: The first use was for short term habitation and associated opportunistic agriculture, followed by formal agriculture and associated recurrent habitation, then the end of the sequence is marked by more consistent habitation with associated household gardens and animal pens.

Starting with the earliest dated feature in the project area and then progressively moving towards the Historic Period, the following discussion synthesizes the field and laboratory results, first on a intra-site feature-by-feature basis and then on a inter-site settlement level. Undated features and sites are lumped with dated features and structures whenever possible, using criteria such as spatial proximity (i.e., closely juxtaposed sites are likely to be contemporary), architectural connectedness (e.g., a wall surrounding a platform), similarity and/or relatedness of recovered items, and related feature types as suggested in the ethnographic record (cf. primarily Handy and Handy 1972).

Phase A (ca. AD 1400-1460)

Two features associated with the earliest dated evidence of occupation within the project area are Feature 293 and the nearby Feature 294 of Site 23686. Both features, which are located near the southwestern corner of the project area (Figure 132), have been preliminary identified as being related to agricultural activities. Almost five meters of empty ground separate the features, both of which are square enclosures of roughly equal size (i.e., approximately 4 m^2). Both features also have been disturbed somewhat by modern-day activities and are covered in recent refuse, such as glass, plastic and metal containers, and automobile parts. The features also have a similar architectural layer comprised of *‘a‘ā* cobbles and small boulders, roughly 40 centimeters thick. Considering the generally similar size, shape, architectural attributes, and deposits from Features 293 and 294, it is proposed that the two are roughly contemporary (i.e., the charcoal date from Feature 293 is plausibly an indicator of Feature 294’s antiquity).

In spite of these similarities between the two features some differences are also apparent. First, the thirty-centimeter thick dark brown (10YR3/3) silt layer within Feature 293 far exceeds the two-centimeter thick silt layer within Feature 294. Secondly, Feature 293 showed signs of once having had a pavement of *‘ili‘ili* pebbles, coral, and marine shell, which was absent within Feature 294. And finally, Feature 293 yielded ten different kinds of items, mostly from the silt layer, whereas Feature 294 yielded no items (Table 39). Overall then, Feature 293 appears to have been more elaborate and used more extensively than the nearby Feature 294. Whether these differences translate into significant chronological differences is not certain, although it is proposed here that the differences probably have more to do with different functions, intensity of use, and/or persistence of use than with time differences.

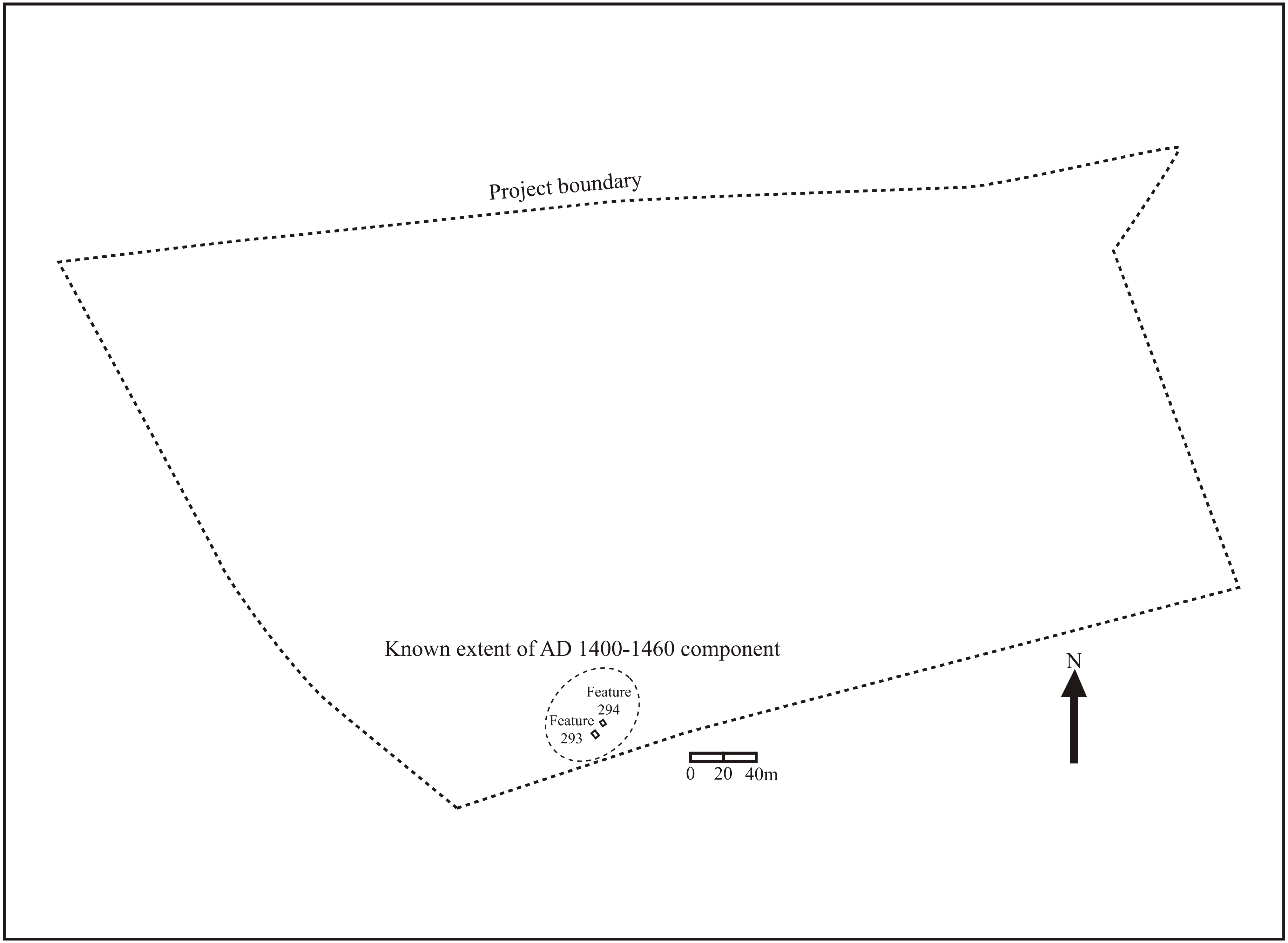


Figure 132. Probable extent of known Phase A features.

As can be seen in Table 39, items recovered from Feature 293 include fish, *Cypraea* sp., coral, Echinoidea, pig, rodent, *kukui* nutshell, wood charcoal, volcanic glass flakes, and waterworn basalt. These items indicate that resources from the ocean, rocky coast line, local area, and interior were utilized (no beach shells were recovered). The presence of pig remains suggests the possibility that males used the structure. Based on its small size and the comparatively low combined weight of recovered items per square meter (i.e., 58.2 g), the structure was most likely used on an intermittent or temporary basis. Being isolated in the *kula* zone during this relatively early period, suggests that Feature 293 was probably used by men cultivating fields away from the main habitation area. The nearby Feature 294 was probably used for a shorter period or as temporary sleeping quarters. Whatever the case might have been, the available radiocarbon and site functional evidence suggests that the initial fifteenth century AD occupation of the project area was restricted and temporary.

Table 39. Weight (grams) of recovered items from Phase A features.

Site	*Feature*	*Unit*	*Fish UID*	*Cypraea*	*Branch coral*	*Echinoidea*	*Pig*	*Rodent*	*Kukui* **nuthsell**	*Charcoal*	*Volcanic glass flake*	*Basalt waterworn*	*Total*
23686	293	E36	2.3	8.6	17.8	0.1	6.4	0.1	1.8	2	0.5	76.7	116.3
23686	294	E37	-	-	-	-	-	-	-	-	-	-	-

Phase B (ca. AD 1460-1580)

The five features that can be associated with the second oldest period of occupation within the project area are the following: (1.) the Site 23676 platform, (2.) the Feature B enclosure of Site 23673; (3.) the Feature A platform of Site 23673; (4.) the Site 23671 platform, and (5.) the Feature 247 terrace within Site 23686. Considering that Features B and A of are part of one Site 23673 and that Site 23671 and Feature 247 are neighbors (an approximately 15 m gap separates 23671 and 247) with virtually identical radiocarbon dates, the following three separate sites can be said to be presented during Phase B: (1.) Site 23676; (2.) Site 23673, and (3.) Site 23671/Feature 247. Viewed together, these three sites extend from the southeast to the northwest, more-or-less within the southeastern portion of the project area (Figure 133).

Based on the kinds and weight of items recovered, plus considerations of feature shape and size, the function of each feature can be inferred. First, the presence of certain animal species and artifacts are indicative of the highly gendered dietary and activity “preferences” in Hawaiian culture. Shark, tuna, chicken, pig, and dog remains particularly indicate male consumption, activities, and rituals. According to Malo (1951), prior to 1819 shark meat was *kapu* for Hawaiian women. The recovery of a burnt shark tooth from Site 23676 could be the remains of a meal or a discarded tool (see Table 40). Malo (1951) notes that tuna, or *‘ahi*, was particularly favored by men of high status. The concentration of tuna remains within the Feature B enclosure of Site 23673 is suggestive that the feature was used by high status males. The recovery of pig and dog remains from the same Feature B underscores its male association. The recovery of pig, dog, and bird (chicken?) remains from Site 23676 (Table 40) is also significant in this regard; all three animal species were consumed as food by men or used as offerings to the family ancestor spirits in the *hale mua* (Handy and Handy 1972:24, 252, 256, 387). Even after the early nineteenth century abolition of the *kapu* against women eating pig and dog, these animals were still considered a favorite among men (ibid. 245). Moreover, according to Handy and Handy (1972:301) fishing and the making of fishing gear were essentially male activities. The *Cypraea* sp. shell lure from Site 23676 is an example of a composite fishing tool that took some time and skill to manufacture. The entire composite tool was lowered on a line from a canoe to the ocean floor, where the cowry lure attracted octopus (Kirch 1997:203-204). The recovery of fishing gear, albeit minimal, suggests that at least some of the men who cultivated the *kula* zone also fished in the ocean. Bone awls recovered from Sites 23676 and 23673 further suggest male-related activities in these two locales.

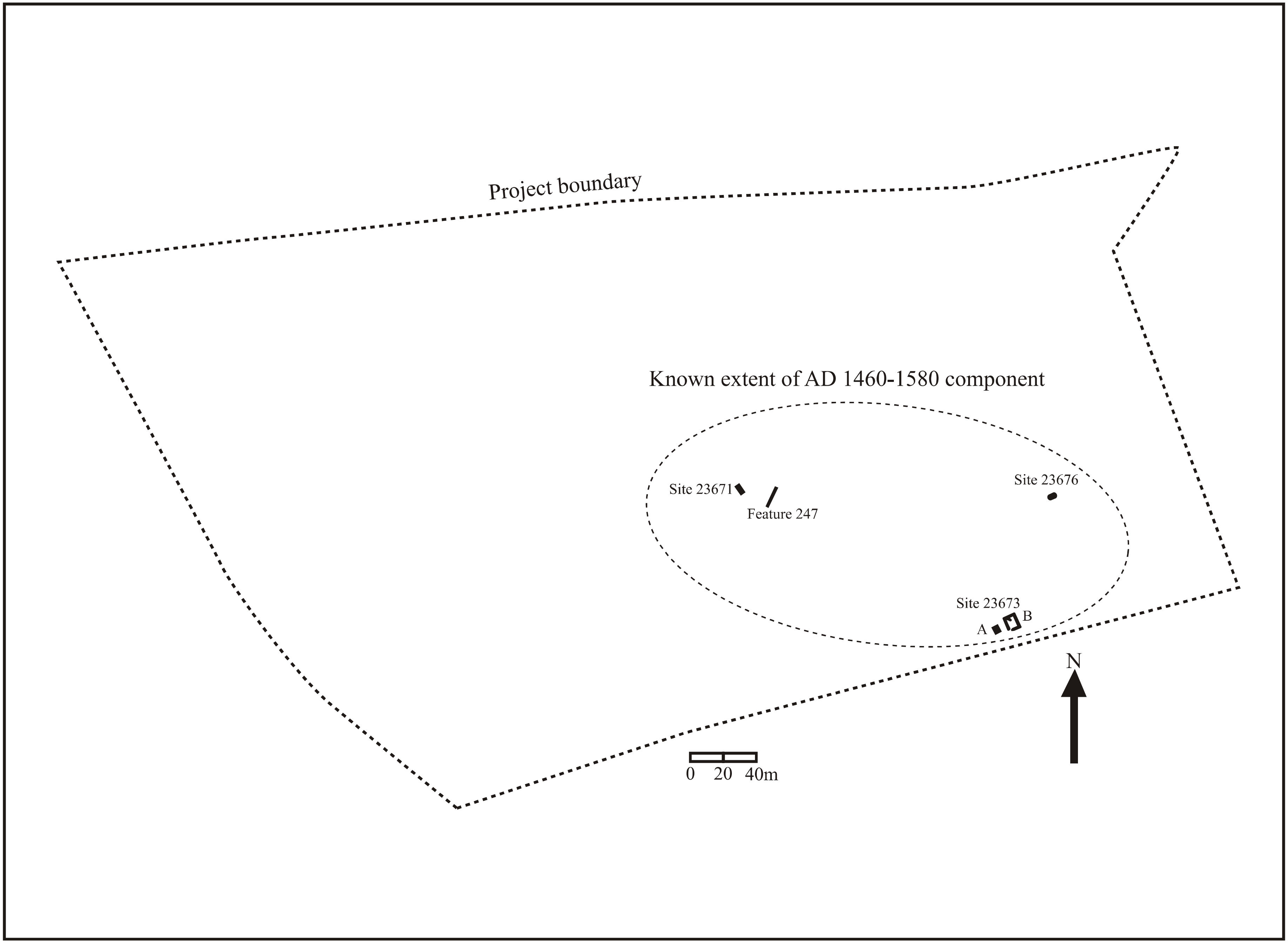


Figure 133. Probable extent of known Phase B sites and features.

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Table 40. Weight (grams) of recovered fish, fishing gear, and land animals from Phase B features.*

Site	*Feature*	*Unit*	*Tuna*	*Shark*	*Fish Scaridae*	*Fish UID*	*He'e lure*	*Avian bone*	*Pig*	*Dog*	*Rodent*	*Mammal bone*	*Medium mammal bone cut*	*Small mammal*	*Small mammal bone awl*	*Small mammal worked bone*
23676	-	E21	-	0.5	-	-	-	0.2	8.8	1.7	0.2	1	0.4	-	3.2	-
23676	-	T18	-	-	0.1	-	32.0	-	1.4	-	0.3	-	-	0.8	-	-
23673	B	E29	0.8	-	-	0.1	-	-	2.2	-	-	-	-	-	0.7	-
23673	B	E30	9.1	-	-	-	-	-	-	0.2	0.1	-	-	4.7	-	13
23673	A	E27	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23673	A	E28	-	-	-	1	-	-	-	-	0.4	-	-	-	-	-
23673	A	T17	-	-	4.2	-	-	-	-	-	0.2	-	-	-	-	-
23671	-	E04	-	-	-	-	-	-	-	-	0.3	-	-	-	-	-
23686	247	E05	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*male related items are shaded

Of note is the absence of male-related remains from Site 23671 and from the contemporary Feature 247 (Table 40), suggesting some other function for these two features which will be discussed below. Although the Feature A platform at Site 23673 also lacks male-related items, its proximity to the Feature B enclosure suggests that the platform and enclosure are related. Indeed, the high combined average weight of recovered items per square meter (i.e., 104 g) from the three Feature A units is higher than that for the average per square meter weight from the nearby two Feature B units (i.e., 40.2 g). The average mass of recovered items from the Feature A platform, however, is less than that from the Site 23676 platform (i.e., 115 g). The deposits within both platforms are dark in color, suggesting some kind of cooking residue. But perhaps more importantly, the Feature A and Site 23676 platforms have similar rectangular shapes, even though Feature A (i.e., 26.5 m^2) is somewhat bigger than Site 23676 (i.e., 18 m^2). Based on the similar architecture and deposits of the platforms at Feature A and Site 23676, it is suggested that they could have functioned primarily as cooking areas for male consumption, whereas Feature B of Site 23673 was actually a *hale mua* structure in which males consumed and discarded their food. The partition wall within this Feature B, together with a branch coral on the wall and tuna remains, suggests that it was a comparatively important structure in the project area, perhaps with a shrine-like area behind the partition. The absence of pig and dog remains at Feature A could be that these prestige animals were all taken to the nearby Feature B for consumption, whereas the more isolated location Site 23676 meant that the pigs and dogs cooked on site were also consumed and discarded on site. Sites 23676 and 23673 are contemporary in terms of the radiocarbon time-scale, so it is likely that they existed on the landscape at roughly the same time, perhaps serving different sections of the work force. Alternatively, Site 23676 could be slightly earlier than the more elaborate Site 23673. If this was indeed the scenario, then the addition of an enclosure next-to the platform at Site 22673 could signify the beginning of settling down in the project area.

The more-or-less simultaneous appearance of the Site 23671 platform and Feature 247 terrace wall roughly 180 meters northwest of Site 23673 is an additional sign of filling-in of the landscape. Albeit disturbed, the intact portions of the Site 23671 platform exhibits a level surface paved with small *ʻaʻā* cobbles. Although the size of this platform (i.e., 26.2 m^2) is somewhat small for a *hale noa* sleeping hut, it could indeed have served as the foundation of a somewhat temporary hut. The brown (10YR 4/3) deposits within the platform were slightly lighter than the very dark gray brown (10YR 3/2) silt within the *hale mua* features discussed above, suggesting less cooking activities inside the platform. But perhaps more importantly, the excavation unit within Site 23671 only yielded a total of 27.2 grams of items per square meter. The nearby contemporary terrace wall midden yielded 37.4 grams. This comparatively low mass of items recovered suggests far less food preparation, consumption, and discard at this proposed *hale noa* locale than the *hale mua* area to the southeast and east.

Nonetheless, as can be seen in Tables 41 to 43, the shell and lithic items recovered from the proposed *hale noa* and associated wall midden broadly match those from the contemporary *hale mua*. A variety of shells from a rocky coastline, corals, Echinoidea, beach shells, *kukui* nutshell, wood charcoal fragments, volcanic glass flakes, and waterworn basalt came from all the features dating to Period B. These items indicate that resources from the ocean, rocky coastline, beach, local area, and interior were utilized.

Table 41. Weight (grams) of recovered rocky shore shell from Phase B features.

Site	*Feature*	*Unit*	*Serpulorbis* **sp.**	*Trochus* **sp.**	*Cypraea* **sp.**	*Drupa* **sp.**	*Morula* **sp.**	*Cellana* **sp.**	*Isognomon* **sp.**	*Chama* **sp.**	*Nerita* **sp.**	*Strombina* **sp.**	*Thais* **sp.**	
23676	-	E21	4.1	-	160.2	26.8	4.3	4.1	-	4.0	0.6	-	-	*hale mua* kitchen
23676	-	T18	-	-	44.7	0.1	-	0.5	-	-	0.3	0.3	-	
23673	B	E29	-	0.3	151.2	0.6	-	-	1.2	-	0.3	-	0.5	*hale mua*
23673	B	E30	-	-	-	1.9	-	-	-	-	-	-	-	
23673	-	E27	-	-	3.9		-	-	0.2	-	-	-	-	*hale mua* kitchen
23673	A	E28	-	-	19.5	0.9	-	-	-	-	-	-	-	
23673	A	T17	-	-	16.6	1.0	-	0.5	-	-	0.4	-	-	
23671	-	E04	-	-	41.8	4.8	2.7	-	5.8	-	0.4	-	-	*hale noa*
23686	247	E05	-	-	37.8	2.8	-	0.7	-	-	-	-	-	*hale noa* boundary

Table 42. Weight (grams) of recovered coral, Echinoidea, and beach shell from Phase B features.

Site	*Feature*	*Unit*	*Coral abrader*	*Branch coral*	*Echinoidea*	*Turbo*	*Nassarius*	*Brachidontes*	*Fimbria* **sp.**	*Conus*	*Mitra* **sp.**	*Terebra* **sp.**	*Shell UID*	
23676	-	E21	-	168.0	4.2	-	6.6	-	0.3	4.9	-	-	8.2	*hale mua* kitchen
23676	-	T18	-	-	4.4	-	-	-	-	0.2	-	-	1.3	
23673	B	E29	-	68	33.5	-	-	-	-	0.9	-	-	4.9	*hale mua*
23673	B	E30	-	8.7	0.1	-	-	-	-	-	-	-	-	
23673	A	E27	-	113.3	0.8	-	-	-	2.6	-	-	-	0.7	*hale mua* kitchen
23673	A	E28	17.8	131	1.9	-	-	-	-	-	0.1	0.05	3.9	
23673	A	T17	-	29.1	11.0	-	-	-	-	2.1	-	-	-	
23671	-	E04	-	3.8	28.1	0.5	-	7.2	-	3.7	-	-	0.4	*hale noa*
23686	247	E05	-	10.9	-	-	-	-	-	-	-	-	-	*hale noa* boundary

Table 43. Weight (grams) of recovered plants and lithics from Phase B features.

Site	***Feature***	***Unit***	**Kukui nutshell**	***Charcoal***	***Basalt flake***	***Volcanic glass flake***	***Volcanic shatter***	***Basalt waterworn***	
23676		E21	8.2	10.4	-	40.6	-	-	*hale mua* kitchen
23676		T18	6.9	0.7	-	11.0	-	-	
23673	B	E29	-	10.4	-	4	-	-	*hale mua*
23673	B	E30	4.2	-	-	-	-	-	
23673	A	E27	7.2	0.4	-	4.2	35	51.4	*hale mua* kitchen
23673	A	E28	0.4	0.3	5.7	1.5	12.6	-	
23673	A	T17	6.3	-	-	23.7	-	-	
23671		E04	-	2.1	7.2	-	-	-	*hale noa*
23686	247	E05	7	3.3	10.9	1.4	-	-	*hale noa* boundary

Based on the evidence then, the following two main categories of features were used during Phase B: (1.) *hale mua* male eating house (Feature B walled structure of Site 23673) and *hale mua* kitchen (Feature A platform of Site 23673 and platform at Site 23676); and (2.) *hale noa* sleeping house (platform at Site 23671) and the possibly related *hale noa* midden that accumulated within the nearby agricultural terrace (Feature 247 of Site 23686). Furthermore, the appearance of a terrace wall, albeit diagonal to later *kuaiwi* walls, shows that by the late fifteenth to early sixteenth centuries, agricultural land started to have short partitions, in this case seemingly some kind of a boundary wall between the *hale noa makai* and *hale mua mauka*.

Phase C (ca. AD 1580-1680)

The seven features that can be associated with the third phase of occupation within the project area are the following: (1.) the Feature 250 pavement within Site 23686; (2.) the Feature 254 terrace within Site 23686; (3.) possibly the Site 23674 articulated platform and circular enclosure; (4.) the Feature A enclosure of Site 23672; (5.) the smaller Feature B enclosure of Site 23672; (5.) possibly the Feature 289 pavement within Site 23686; and (6.) possibly the large Feature 282 pavement within Site 23686. Although Site 23674 has not been dated, its placement between the contemporary Features 250/254 *mauka* and Site 23672 *makai* suggests that Site 23674 belongs to the same period. The observation that Features 282 and 289 fall on the *mauka* end of the same line tentatively suggests that they too date to Phase C, although this is less certain.

Considering that 20 meters separates Features 250 and 254 that have virtually identical radiocarbon dates, these two features are treated as part of one site, labeled Feature 250/254. Also considering that six meters separate Features A and B of Site 237672, this site too is treated as one entity. The following five sites can then be said to be present during Phase C: (1.) Feature 250/254; (2.) Site 23674; (3.) Site 23672; (4.) Feature 289; and (5.) Feature 282. Viewed together, these five sites form a long line that stretches west to east along the east-central portion of the project area (Figure 134).

Based on the kinds and weight of items recovered and on considerations of feature shape and size, the function of each Phase C feature is interpreted. The recovery of pig and dog from Features 250/254 (Table 44) suggests that males cooked, consumed, and discarded food in these structures. However, the average weight per square meter of all the items recovered from Features 250/254 is comparatively light (i.e., 18 g). This suggests that the fairly small Feature 250 platform (i.e., 4.5 m^2) was only a temporary or short-term cooking and/or eating house, perhaps catering for men laboring in the fields. The contemporary south to north aligned Feature 254 terrace wall probably marked a boundary *mauka* of this small platform (reminiscent of the earlier Feature 247 terrace wall *mauka* of the Site 23671 *hale noa*).

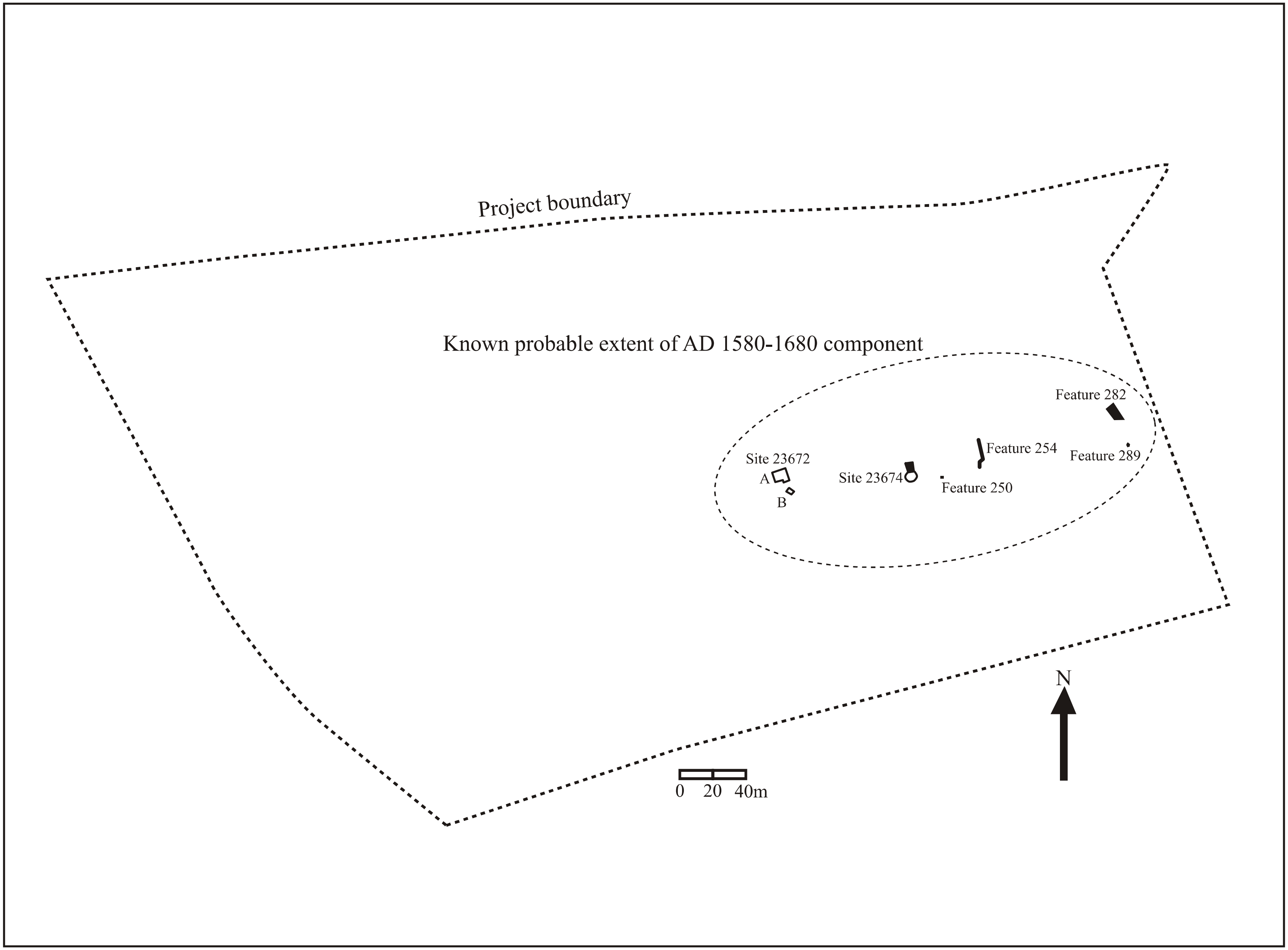

Figure 134. Probable extent of known and possible Phase C sites and features.

Roughly 15 meters *makai* from Feature 250 platform is the more substantial Site 23674 platform. The recovery of bird (chicken?) and dog from Site 23674 suggests that it too is associated with male eating. Judging from the size, weight, and variety of items, the Site 23674 platform seems to be a more substantial and permanent *hale mua* than Feature 250. The Site 23674 platform, which covers 17.2 m^2, has a wider variety of items than Feature 250 (i.e., 20 versus 10 different kinds of items). The items recovered from Site 23674 also weigh more (i.e., 62.3 g per square meter) and came from comparatively dark 10 YR3/2 grayish brown silt compared to the lighter 10 YR3/3 dark brown of Feature 250. The circular enclosure that is attached to the Site 23674 was sterile with lighter and thinner soil, however, suggesting that this space was kept clean.

The two shark teeth from Feature B of Site 23672 (Table 44) could also have been associated with male-related activities. It should be noted that once a day men cooked meals for women and children of their family in a temporary shed, called *hale ʻaina*, near the common sleeping house, or *hale noa*. At times a substantial oven would have been built into the surface of the *hale ʻaina* cooking shed (e.g., Handy and Handy 1972:302). It could indeed be that Feature B of Site 23672 with its 69.5 grams of items and very dark grayish brown (10YR 3/2) fine silt was such a cooking locale. The shark teeth found within could have been introduced while men were preparing food.

The nearby Feature A walled enclosure of Site 23672 is probably a *hale noa* where everybody slept. This identification is supported by the comparatively big size of the walled enclosure (i.e., 114.8 m^2), bearing in mind that a *hale noa* was normally the largest building around (Handy and Handy 1972:291). Also, the absence of male-related items, the low average weight of items recovered (i.e., 1.94 g per square meter), and the low variety of items identified (i.e., 5 different kinds of items) fit the specifications of a typical *hale noa*.

The likely functions of Features 282 and 289 near the extreme eastern boundary of the project area are less certain. The mere size and even surface of the rectangular Feature 282 platform (i.e., 106.3 m^2) suggests that it could have been a *heiau* platform. Together with its big size, rectangular shape, the paucity of associated items are attributes of *heiau* elsewhere in Hawai ʻi (e.g., Loubser and Rechtman 2007). A wide variety of *heiau* existed in Hawaiʻi, both in terms of architectural layout and function. *Heiau* vary from seemingly insignificant natural rock outcrops to elaborately constructed platforms. Moreover, like *hale mua*, *heiau* were placed at the approach toward a settlement, such as in front of a household cluster (Valeri 1985:174) or agricultural plots; people had to pass through these "gateways" to reach destinations beyond. It is worth noting that in relation to the *hale noa* dating to Phases B and C, the *hale mua* and proposed *heiau* were all on the *mauka* side. If these identifications are indeed correct, then the agricultural settlement within the project area was approached from the *mauka* side. The south to north orientation of the terrace walls dating to Phases B and C could also be significant in this regard, providing a "front" fence as people approached the nearby *hale noa* (i.e., the Feature 247 wall and Site 23671) and *hale mua* (i.e., Feature 254 and Site 23674) from the interior.

Feature 289 yielded a more restricted range of items than the other features with the exception of the nearby Feature 282 that yielded nothing (see Tables 44 and 45). Only shell and a volcanic glass flake were recovered from the small (i.e., 49.5 m^2) platform; the feature could have been a convenient stopping and snacking point on the way to agricultural plots.

Fish, shell, coral, urchin, crab, bird, mammal, terrestrial plants, and volcanic glass and basalt were found at most of the excavated Phase C locales (Tables 44 and 45). Shell from beach-like settings only came from the Site 23674 *hale mua* and Feature 289 platform. The recovered items indicate that resources from the ocean, rocky coast line, beach (at two locales), local area, and interior were utilized.

Table 44. Weight (grams) of recovered shark, land animals, plants, and lithics from Phase C features.*

Site	*Feature*	*Unit*	*Shark*	*Avian bone*	*Pig*	*Dog*	*Rodent*	*Small mammal*	*Kukui* nutshell	*Charcoal*	*Basalt flake*	*Volcanic glass flake*	*Volcanic shatter*	*Basalt waterworn*	
23686	250	E11	-	-	-	1.0	-	-	1.9	0.5	-	5.0	-	-	*hale mua*
23686	254	E12	-	-	1.1	-	-	-	-	1.0	-	-	-	-	*hale mua* boundary
23674	-	E06	-	1.9	-	2.0	0.7	0.1	1.4	1.2	2.8	78.2	12.1	-	*hale mua*
23674	-	E07	-	-	-	-	-	-	-	-	-	-	-	-	
23672	A	E03	-	-	-	-	2.0	-	-	0.4	-	0.6	-	-	*hale noa*
23672	A	E02	-	-	-	-	-	-	-	-	-	2.8	-	-	
23672	A	T11	-	-	-	-	-	-	-	-	-	-	-	-	
23672	B	T13	0.2	-	-	-	0.05	-	3.00	1.80	-	1.50	17.50	45.10	*hale noa* kitchen
23672	B	E1b	-	-	-	-	-	-	-	-	-	-	-	-	
23686	289	E19	-	-	-	-	-	-	-	-	-	-	-	-	agricultural platform
23686	289	E20	-	-	-	-	-	-	-	-	-	0.5	-	-	
23686	282	E17	-	-	-	-	-	-	-	-	-	-	-	-	*heiau*?
23686	282	E18	-	-	-	-	-	-	-	-	-	-	-	-	

*male related items are shaded

Table 45. Weight (grams) of recovered fish and shell from Phase C features.

Site	*Feature*	*Unit*	*Fish Scaridae*	*Fish UID*	*Cypraea* sp.	*Drupa* sp.	*Morula* sp.	*Cellana* sp.	*Isognomon* sp.	*Cymatium* sp.	*Nerita* sp.	*Branch coral*	*Echinoidea*	*Crustacean*	*Brachidontes* sp.	*Conus* sp.	*Shell UID*
23686	250	E11	0.6	0.1	1.3	26.2	-	59.1	-	-	-	7.9	-	-	-	-	-
23686	254	E12	-	-	0.7	-	-	-	-	-	-	1.5	-	-	-	-	0.2
23674	-	E06	0.6	1.2	79.0	16	-	0.8	-	-	0.4	27.3	7.5	0.2	-	11	4.8
23674	-	E07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23672	A	E03	-	-	-	-	-	-	-	-	-	2.1	-	-	-	-	-
23672	A	E02	-	-	1.8	-	-	-	-	-	-	-	-	-	-	-	-
23672	A	T11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23672	B	T13	-	-	-	0.10	-	-	-	-	0.20	-	-	-	-	-	-
23672	B	E1b	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23686	289	E19	-	-	9.3	-	0.7	-	0.4	-	-	0.3	-	-	-	0.2	-
23686	289	E20	-	-	15.0	-	-	-	-	3.1	-	19.7	-	-	4.4	-	-
23686	282	E17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23686	282	E18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Based on the evidence then, the following four main categories of features were used during Phase C: (1.) *hale mua* male eating houses (Site 23674 and Feature 250 of Site 23686) and an associated terrace wall (Feature 254 of Site 23686); (2.) a *hale noa* sleeping house (Feature A of Site 23672) and the possibly associated *hale noa* kitchen (Feature B of Site 23672); (3.) an agricultural platform (Feature 289); and (4.) a possible *heiau* platform. The Feature 254 terrace wall could be a partition between the *hale mua makai* and *heiau mauka*. The increase in the different kinds of features on the late sixteenth to mid- seventeenth century landscape suggests a settling in and increasingly permanent use of the area. However, as will be discussed below, Phase C represents an overall drop in the mass and variety of resources exploited when compared to the earlier Phase B. Phase D, nonetheless, shows a dramatic increase over Phase C.

Phase D (ca. AD 1680-1850)

The nine excavated features that can be associated with the fourth phase of occupation within the project area are the following: (1.) the Site 23675 enclosed platform; (2.) the Site 23670A lower tier platform; (3.) the Site 23670B upper tier platform; (4.) the Site 23670C platform; the Site 23678 oval enclosure; (5.) the Site 23677A enclosure; (6.) the Site 23677B platform; (7.) (8.) the Feature 251 enclosure within Site 23686; and (9.) the Feature 23686 *kuaiwi*. Although the *kuaiwi* has not been dated directly, its age can be inferred from it being an extension of the late-seventeenth century Site 23678 oval enclosure.

Considering that Features A and B are two platforms arranged at different levels within the same "stepped" platform structure of Site 23670, they are really part of one feature. Moreover, considering that Feature C is a small rectangular platform some 1.5 meters south of Feature A, it too is an integral part of Site 23670. Knowing that the Feature A platform at Site 23677 is partly enclosed by the Feature B wall, these features are treated as part of the same occupation. Accordingly, the following six sites are present during Phase D: (1.) Site 23675; (2.) Site 23670; (3.) Site 23678; (4.) Site 23677; (5.) Feature 251; and (6.) Feature 291. Viewed together, these six sites stretch from south to north in the eastern half of the project area. Site 23670 appears as an outlier *makai* from this settlement line (Figure 135).

The function of each Phase D feature is interpreted based on the kinds and weight of items recovered and on considerations of feature shape and size. The recovery of pig and dog from Site 23675 (Table 46) suggests that males cooked, consumed, and discarded food in this structure. The average weight per square meter of all items recovered from Site 23675 is comparatively heavy (i.e., 112 g). This suggests that the comparatively big Site 23675 enclosure (i.e., 33.1 m^2) was a permanent eating house. Two depressions and a C-shaped rock alignment visible on the paved surface could be remnants of hearths. Also, black (10YR 2/1) silt from EU-10 suggests organic refuse generated by cooking. The comparatively robust Site 23675 being in the vicinity of the earlier but smaller male cooking structures at Feature 250 and Site 23674 suggests that the *hale mua* was a more permanent fixture on the landscape.

The tiered Site 23670A and B platform structure probably functioned as a *heiau*. The overall size (approximately 56 m^2) of Site 23670, its roughly rectangular shape, its fairly level but stepped surface, and general paucity of associated items are attributes of *heiau* elsewhere in Hawai'i (e.g., Loubser and Rechtman 2007). The nearby Feature C is aligned in a similar direction as Features A and B. This suggests that the small Feature C platform, albeit sterile, was somehow related to the Features A and B platform. In this regard then one can perhaps refer to Site 23670 as a complex.

Unlike the location of the proposed *heiau* from the earlier Phases B and C on the *mauka* end of the occupation, the Phase D *heiau* complex appears to be *makai* from the main settlement. If the identification of the Phase D *heiau* is correct, then the settlement would probably have been approached from the *makai* side. This suggests that the main approach to the agricultural settlement changed 180° during Phase D times.

The southwest to northeast aligned Feature 291 wall runs more-or-less perpendicular to the coast line. In this regard the wall is roughly parallel to nearby but longer *kuaiwi* in the project area. The appearance of a wall that runs perpendicular instead of parallel to the coast by the mid- to late seventeenth century suggests that new kinds of divisions emerged on the agricultural landscape of the project area; up slope-down slope boundary walls appeared alongside earlier terraced walls.

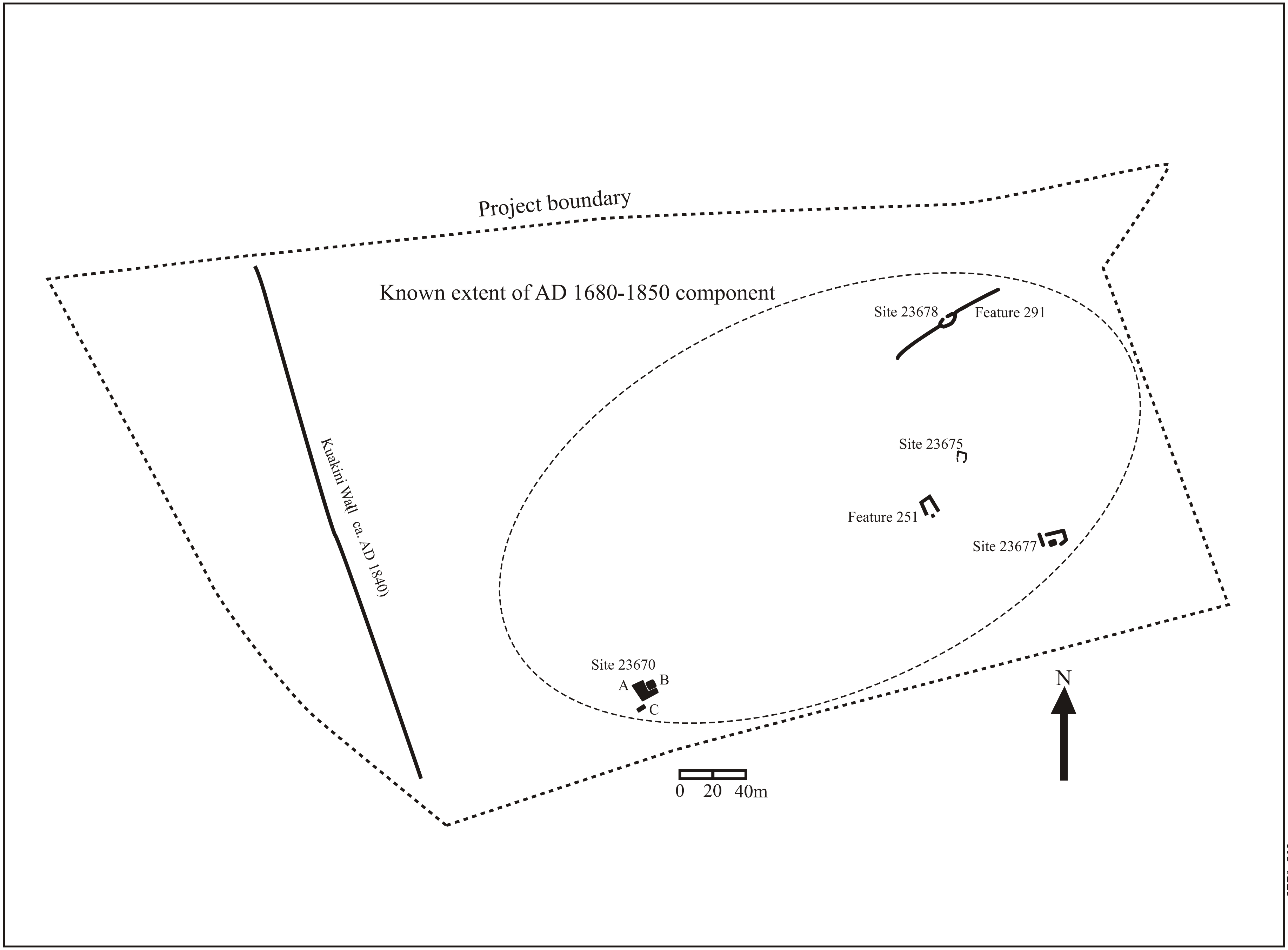

Figure 135. Probable extent of known Phase D sites and features.

Built within the Feature 291 wall is the oval-shaped Site 23678 (judging from how their walls abut, the undated Feature 291 is either contemporary or slightly later that the dated Site 23678). Judging from the medium-sized structure (55 m^2) and the absence of male-related items (Table 46), Site 23678 might very well have been a common sleeping house, or *hale noa*. However, the unusually high average weight of items recovered (i.e., 178 g per square meter) and high variety of items identified (i.e., 21 different kinds of items) exceed the specifications of a typical *hale noa*. Nonetheless, instead of suggesting a different function, an increase in the mass and variety of items deposited within could simply be the result of increased and more intensive use of the structure. A fragment of a basalt adze found within the Feature 23678 is the only one recovered from the project area. The recovery of fire cracked rock and dark brown (10YR 3/3) silt from Site 23678 suggests that cooking occurred within, an activity that typically generate an above average amount of refuse. Excess trash was also probably disposed within the nearby wall, roughly two meters to the northeast of the proposed *hale noa*. Whatever the function of Site 23678 might have been, the weight and variety of items from within and from nearby deposits strongly suggests increased and more intensified occupation.

On the opposite side of the Phase D occupation within the project area, at Site 23677 Features A and B, are the remains of what could be a second *hale noa*, As already mentioned, the Feature A platform being partly enclosed by the Feature B wall shows that these two features are part of the same structure. Whereas the wall yielded only a few shell remains and nothing else, the platform yielded 19 different kinds of items and an average weight of 69.2 grams per square meter of items. Recovered remains from the platform include fish, rocky shore shell, beach shell, mammals and plants from around the settlement, and volcanic glass from the interior. Together with these items, the presence of 10YR 2/1 black ashy silt within the platform suggests that cooking occurred on this platform. If so, then as in the case of Site 23678, Site 23677 had a cooking area within. The cooking areas being part of the proposed *hale noa* structures at Sites 23677 and 23678 of Phase D contrast with the earlier Phase C Site 23672 proposed *hale noa* where the cooking area was a spatially separate structure. The incorporation of the cooking areas within structures during the eighteenth century, whatever the function of the structures might have been, is a topic worth pursuing in future data recovery projects.

Fish, shell, coral, Echinoidea, bird, mammals, terrestrial plants, and volcanic glass and basalt were found at most of the excavated Phase D locales (Tables 46 and 49). The recovered items indicate that resources from the ocean, rocky coast line, beach, local area, and interior were utilized.

Not shown in Table 46 are the cattle bones recovered from within the rectangular Feature 251 enclosure. The size (143.8 m^2) of this enclosure, together with the absence of items apart from the cow carcass, strongly suggests that the enclosure served as a cattle pen. Cattle were first introduced to Hawaiʻi in 1793 and by 1810 big herds roamed across the island. By 1812 the *kapu* against capturing feral cattle was lifted, marking the beginning of fully fledged ranching activities. Captured animals were taken to stone-walled paddocks where they were given food and water. By the 1830s, ranching was an important part of the Hawaiian economy and by the late 1800s cattle ranches had grown up in the Kona District (e.g., Kelly 1980). The presence of cattle bones within Feature 251 suggests that it could have been used as a paddock, most likely some time between 1812 and the 1850s. In this regard the Feature 251 probable stock pen probably post-dates the radiocarbon dated structures.

Table 46. Weight (grams) of recovered bone and plant from Phase D features.*

Site	*Feature*	*Unit*	*Avian bone*	*Pig*	*Dog*	*Rodent*	*Small mammal*	*Mammal bone*	*Small mammal worked bone*	*Kukui* nutshell	*Charcoal*	
23675	-	E10	-	4.3	0.9	-	0.8	-	0.2	0.5	10.9	*Hale mua*
23675	-	T20	-	9.6	-	-	-	-	-	-	0.6	*Hale mua*
23675	-	E09	-	-	-	-	-	-	-	-	0.4	*Hale mua*
23670	A	E31	-	-	-	-	-	-	-	8.9	0.6	*Heiau* platforms
23670	A	E32	-	-	-	-	-	-	-	0.5	-	*Heiau* platforms
23670	B	E34	-	-	-	-	-	-	-	-	-	*Heiau* platforms
23670	B	T12	-	-	-	-	-	-	-	-	-	*Heiau* platforms
23670	C	E33	-	-	-	-	-	-	-	-	-	*Heiau* platforms
23678	-	E14	-	-	-	-	-	-	-	-	1.3	*Hale noa*
23678	-	E15	0.1	-	-	-	-	-	-	-	0.3	*Hale noa*
23677	B	E24	-	-	-	-	-	-	-	-	-	*Hale noa*
23677	B	E23	-	-	-	-	-	-	-	-	-	*Hale noa*
23677	A	E22	-	-	-	0.2	-	0.9	-	0.2	3.3	*Hale noa* kitchen
23677	A	T16	-	-	-	-	3.4	-	-	-	3.9	*Hale noa* kitchen
23686	251	E08	-	-	-	-	-	-	-	-	-	Cattle enclosure
23686	291	E13	-	-	-	-	-	-	-	-	-	*Kuaiwi* wall

*male related items are shaded

Table 47. Weight (grams) of recovered fish and shell from Phase D features.

Site	*Feature*	*Unit*	*Fish Scaridae*	*Fish UID*	*Cypraea* sp.	*Drupa* sp.	*Morula* sp.	*Cellana* sp.	*Isognomon* sp.	*Chama* sp.	*Nerita* sp.	
23675	-	E10	0.7	0.05	62.7	3.1	-	2.4	-	-	11.2	*Hale mua*
23675	-	T20	-	-	1.3	-	-	-	-	-	-	*Hale mua*
23675	-	E09	-	-	2.6	-	-	-	-	-	-	*Hale mua*
23670	A	E31	-	-	3.3	-	-	-	-	-	-	*Heiau* platforms
23670	A	E32	-	-	-	-	-	-	-	-	-	*Heiau* platforms
23670	B	E34	-	-	-	-	-	-	-	-	-	*Heiau* platforms
23670	B	T12	-	-	-	-	-	-	-	-	-	*Heiau* platforms
23670	C	E33	-	-	-	-	-	-	-	-	-	*Heiau* platforms
23678	-	E14	-	-	50.6	2.3	-	0.6	0.1	-	-	*Hale noa*
23678	-	E15	-	0.05	67.7	4.6	1	0.1	0.3	-	0.1	*Hale noa*
23677	B	E24	-	-	5.2	-	-	-	-	-	-	*Hale noa*
23677	B	E23	-	-	-	-	-	-	-	-	-	*Hale noa*
23677	A	E22	-	-	50.6	1.5	-	-	-	0.3	2.3	*Hale noa* kitchen
23677	A	T16	0.2	-	23.5	4.1	-	0.2	-	-	2.1	*Hale noa* kitchen
23686	251	E08	-	-	-	-	-	-	-	-	-	Cattle enclosure
23686	291	E13	-	-	31.9	4.2	1	-	0.05	-	-	*Kuaiwi* wall

Table 48. Weight (grams) of recovered shell, coral, and Echinoidea from Phase D features.

Site	*Feature*	*Unit*	*Strombina* sp.	*Coral abrader*	*Branch coral*	*Echinoidea*	*Cantharus* sp.	*Conus* sp.	*Venus* sp.	*Shell UID*	
23675	-	E10	-	1	345.8	1.3	-	-	-	0.4	*Hale mua*
23675	-	T20	-	-	-	-	-	-	-	-	
23675	-	E09	-	-	-	-	-	-	-	-	
23670	A	E31	-	-	-	0.7	-	-	-	-	*Heiau* platforms
23670	A	E32	-	-	-	-	-	-	-	-	
23670	B	E34	-	-	-	-	-	-	-	-	
23670	B	T12	-	-	-	-	-	-	-	-	
23670	C	E33	-	-	-	-	-	-	-	-	
23678	-	E14	-	-	77.2	0.95	-	7.6	1.9	8.7	*Hale noa*
23678	-	E15	0.6	-	333.4	4.9	-	22.3	3.7	33.2	
23677	B	E24	-	-	-	-	-	0.3	-	-	*Hale noa*
23677	B	E23	-	-	-	-	-	-	-	-	
23677	A	E22	-	-	16.5	5	-	1.9	-	2.2	*Hale noa* kitchen
23677	A	T16	-	-	4.1	5.8	0.1	0.7	0.1	0.1	
23686	251	E08	-	-	-	-	-	-	-	-	Cattle enclosure
23686	291	E13	-	-	90	0.75	-	9.93	-	2.9	*Kuaiwi* wall

Table 49. Weight (grams) of recovered lithics from Phase D features.

Site	*Feature*	*Unit*	*Basalt fire cracked rock*	*Basalt adze fragment*	*Basalt flake*	*Volcanic glass flake*	*Volcanic shatter*	*Basalt grinder*	*Basalt waterworn*	
23675	-	E10	-	-	2.2	20.3	-	-	-	*Hale mua*
23675	-	T20	-	-	-	-	-	116.7	71.4	
23675	-	E09	-	-	-	-	-	-	-	
23670	A	E31	-	-	-	-	-	-	-	*Heiau* platforms
23670	A	E32	-	-	-	-	-	-	-	
23670	B	E34	-	-	-	-	-	-	-	
23670	B	T12	-	-	-	-	-	-	-	
23670	C	E33	-	-	-	-	-	-	-	
23678	-	E14	54.2	0.2	0.7	12.2	2.5	-	0.5	*Hale noa*
23678	-	E15	-	-	2.8	9.3	1.8	-	2.8	
23677	B	E24	-	-	-	-	-	-	-	*Hale noa*
23677	B	E23	-	-	-	-	-	-	-	
23677	A	E22	-	-	-	4.4	-	-	-	*Hale noa* kitchen
23677	A	T16	-	-	-	0.5	0.3	-	-	
23686	251	E08	-	-	-	-	-	-	-	Cattle enclosure
23686	291	E13	-	-	-	0.9	-	-	3.7	*Kuaiwi* wall

Based on the available evidence, the following five main categories of features were used during Phase D: (1.) a *hale mua* male eating house (Site 23675); (2.) two *hale noa* sleeping houses containing kitchens within (Sites 23678 and 23677); (3.) a *kuaiwi* (Feature 291) associated with the Site 23678 *hale noa*; (4.) a possible *heiau* platform complex (Site 23670, Features A-C); and (5.) a likely cattle enclosure (Feature 251). Except for the *heiau* platform complex *makai* of the main site concentration, all the Phase D features were sandwiched between the Feature 291 *kuaiwi* to the north and the Feature 82 *kuaiwi* wall to the south. Considering that these *kuaiwi* walls followed the slope they were not soil retention or water-holding devices (e.g., Kirch 1985:228). Rather, these walls were intended to define boundaries between plots and/or homestead units, or *kauhale*. Generally speaking, the presence of *kuaiwi* walls on the landscape suggests that a permanent cropping system replaced a shifting system of rotating cultivation by the eighteenth century.

The probable post- AD 1680 date for the *kuaiwi* within the project area supports evidence from Ka‘awaloa that the formal walled fields (*kuaiwi*) immediately above Kealakekua Bay were established after AD 1670 (Clark and Rechtman 2002), during what has been termed the Competition Period (Burtchard 1995).

It could be that the land sandwiched between the *kuaiwi* represented an *‘ili*, or land division. An *‘ili* was typically a long and narrow strip of land running lengthwise along an *ahupua‘a,* or tax unit. An *‘ili* could be discontinuous and represented portions of *ahupua‘a* land allotted to the families who lived on them and cultivated them. The right to continue to use and cultivate these small strips of land stayed with the *‘ohana* (extended families) living on them regardless of any transfer of title to the *ahupua‘a* (Kelly 1980:22-25). Division chiefs of any particular *ahupua‘a* could construct an agricultural shrine, or *heiau*, where increase ceremonies could be attended by those who worked the land.

The Kuakini Wall (SIHP 50-10-28-6302/-7276), that falls in the *makai* third of the project area, was probably constructed during Governor Kuakini’s administration (AD 1820-1844). The most likely date of this wall’s construction falls within the latter portion of Phase D and so the wall is probably roughly contemporary with the Feature 251 proposed cattle enclosure. Indeed, one likely function of the Kuakini Wall was to keep cattle away from settlements along the coast.

Data recovery results have for the most part upheld the primary hypothesis given above under research objectives. As can be inferred from summary information in Table 50, the first use (ca. AD 1400-1460, or Phase A) was for short term habitation and associated opportunistic agriculture (i.e., only one probable cooking and eating facility of a temporary nature and an associated structure of uncertain function), followed by formal agriculture and associated recurrent habitation (ca. AD 1460-1680, or Phases B and C) (i.e., *hale noa* sleeping quarters appearing not far from fairly permanent-looking *hale mua* eating houses as well as the eventual appearance of *heiau*-looking platforms and terrace walls), then the end of the sequence (ca. AD 1680-1850, or Phase D) is marked by more consistent habitation (i.e., more than two *hale noa* common houses and *kuaiwi*) with associated animal pens. The dates of associated household gardens are not certain due to the lack of charcoal from these contexts (but see discussion below).

Table 50. Summary of site and feature function types through time.

Phase	*Date range (AD)*	*Sites/ Features (n)*	*hale mua (n)*	*hale noa (n)*	*terrace wall (n)*	*heiau (n)*	*unknown agricultural (n)*	*Kuaiwi (n)*	*cattle enclosure (n)*
A	1400-1460	2	1	-	-	-	1	-	-
B	1460-1580	5	3	1	1	-	-	-	-
C	1580-1680	7	2	2	1	1	1	-	-
D	1680-1850	9	1	3	-	3	-	1	1

Material traces that survived on the landscape suggest changing trends in gender presence and activities. The two temporary Phase A structures probably represent temporary male eating and sleeping quarters. The drastic increase of Phase B structures, particularly the prominent Site 23673 proposed *hale mua*, suggests that some time after AD 1460 men slept and ate in the fields on a more permanent basis. However, the fairly rudimentary Site 23671 probable *hale noa* suggests that common sleeping structures for the entire family was still temporary. This situation seemed to have changed by the late sixteenth and early seventeenth centuries, for by then the prominent Site 23672 probable *hale noa* appears on the landscape with an associated cooking area. This is also the time period that a possible *heiau* platform makes its appearance. By the late seventeenth century a prominent *hale mua* (i.e., Site 23675) occurs in the roughly the same locale of where an earlier but smaller *hale mua* structures (i.e., Site 23674 and Feature 250) stood previously. The late seventeenth to early eighteenth centuries also witnessed the construction of two prominent probable *hale noa*, one at Site 23678 and the other at Site 23677. Both of these latter two sites yielded considerable amounts of items, suggesting that by that time families were more-or-less permanently settled in the *kula* zone of the project area. The stepped platform probable *heiau* at Site 23670 and Feature 291 *kuaiwi* wall support this evidence for increasingly permanent occupation of the area.

It is perhaps of tangential interest that through time recognizable concentrations of sites and features shifted *makai* (southwest) to *mauka* (northeast): the two Phase A features are in the southwestern portion of the project area; the five Phase B features are in the center to the southeastern portion of the project area; the seven Phase C features are in the east-central portion of the project area; whereas the Phase D occupation expanded to the north of the previous three (compare Figures 132, 133, 134, and 135).

Assuming that agricultural features, such as field-clearing piles and modified outcrops, were not far from the dated features, certain tentative inferences can be made about the intensity of agricultural activities based on the number of agricultural features near dated features. As six agricultural features (i.e., Features 19-24) occur near Features 293 and 294 of Phase A, it can be assumed that these features probably date to the earlier known phase of agricultural activity in the project area (see Figure 76). Site 23673 of Phase B is the only dated structure near twenty seven agricultural features (i.e., Features 34-37, Features 84-93, Features 102-104, Feature 106, Feature 112, Feature 118, Feature 260, Feature 263, and Features 276-279) in the southeastern portion of the project area. Bearing in mind that the eastern portion of Phase D overlaps Phase C, it is not clear to what component the agricultural features in the eastern third of the project area belong. However, the forty two agricultural features *makai* of the westernmost known Phase C structure, Site 23672, seem to best fit the spatial spread of Phase D sites and features. These are Features 1 to 17 and Features 218 to 242. An addition eleven agricultural features (i.e., Features 146, 148, 150, 152, 154, 156, 158, 160-163) *mauka* of the Phase D Feature 291 *kuaiwi* most likely are associated with the Site 23678 proposed *hale noa* structure. Judging from these spatial associations then, the latest occupation, Phase D, witnessed the culmination of agricultural activity within the project area. Due to its spatial overlap with Phase D, the agricultural activity during Phase C is uncertain, although a fair number of agricultural features occur in the vicinity of Sites 23672 and Features 250 and 254. Undated and ostensibly sterile agricultural features in the far western and far northern portions of the project area probably date to the latest phase of Hawaiian occupation.

From the evidence presented thus far it would appear that each phase is more extensive than the preceding one. Most notably, Phase A is represented by two habitation features and six agricultural features, Phase B by five substantial features and at least twenty seven associated features, Phase C by seven substantial features and an unknown number of associated features, and Phase D by nine substantial features and at least fifty three associated features. However, it is proposed that these ostensible increases in site and feature numbers and their spatial expansion across the landscape are not echoed by the mass, kinds, and varieties of resources extracted during the different time periods. Once the weights of recovered items and variety of items from the different phases are compared it would become apparent that resource exploitation did not necessarily increase linearly with time.

Changes in Resource Exploitation through Time

Albeit not directly addressed in the research objectives, a potentially interesting trend apparent in the results is variation in the weight and variety of items used through time. When recovered items from only the twelve radiocarbon dated proveniences are considered (taking into consideration that EU-10 yielded 2 dates, EU-21 yielded 3 dates, EU-22 yielded 2 dates, and EU-29 yielded 2 dates, so the number of dated proveniences (n=12) are less than the total of radiocarbon dates (n=17)), temporal associations are more tight and reliable. The following dated proveniences are included in this assessment: Feature 293 of Site 23686 (Phase A); Site 23676 (Phase B); Feature B of Site 23673 (Phase B); Site 23671 (Phase B); Feature 247 of Site 23686 (Phase B); Feature 250 of Site 23686 (Phase C); Feature 254 of Site 23686 (Phase C);

Feature B of Site 23672 (Phase C); Site 23675 (Phase D); Site 23678 (Phase D); Feature A of Site 23677 (Phase D); Feature A of Site 23677 (Phase D).

From the radiocarbon evidence we can see that one provenience dates to Phase A, four proveniences date to Phase B, three proveniences date to Phase C, and four proveniences date to Phase D. The number of dates alone suggests that there is an ostensible drop in intensity (as opposed to extensiveness) of occupation during Phase C (i.e., the period roughly dating to between AD 1580 and AD 1680). Fluctuations in the total weight of charcoal recovered from the different phases indeed suggest that wood was not equally available or exploited with the same intensity through time. This can be seen when the following total weights of charcoal recovered from the different dated proveniences are compared: 2 grams from Phase A; 26.2 grams from Phase B; 3.3 grams from Phase C; and 19.4 grams from Phase D. According to these numbers then most wood was burned during Phase B and then picking up again in Phase D after a drop in Phase C.

This fluctuation in the amount of recovered charcoal is mirrored by other items recovered from the different phases (Table 51). As can be seen in Table 51, Phase B (i.e., the period dating to roughly between AD 1460 and 1580) has a greater average weight and variety of items than the other three phases. Phase C represents a drop in weight and variety of items recovered, whereas Phase D represents an increase. The Phase D increase is perhaps not that substantial, however, considering that it lasted roughly two centuries (i.e., from approximately AD 1680 to AD 1850) as opposed to the shorter century-long duration of each other phase.

Table 51. Weight and variety of items recovered by Phase.

Phase	*Number of Dated Proveniences*	*Total weight of recovered items (g)*	*Corrected weight per square meter (g)*	*Different kinds of items recovered*
A	1	116	58	10
B	4	935	63	32
C	3	118	32	17
D	4	829	91	29

The same fluctuation trend is apparent when the presence/absence of recovered items is considered; Phase B represents a rapid increase in variety of items recovered over Phase A. This increase contrasts with a drop during Phase C and a rise in Phase D (Table 52). Specifically, beach shell (i.e., *Turbo* sp., *Nassarius* sp., *Cantharus* sp., *Brachidontes* sp., *Fimbria* sp., *Conus* sp.. *Mitra* sp., *Terebra* sp., and *Venus* sp.) and basalt tools/flakes are absent from directly dated Phase A and Phase C proveniences. Moreover, comparatively rare items, such as tuna, octopus lure, and bird (chicken?) remains were only recovered from Phase B deposits. Considered overall then, Phase B, dating to roughly between AD 1460 and AD 1580, represents both an expansion and an intensification of activities over the previous Phase A. Even though Phase C might have been associated with more sites and features than the earlier Phase B, individually dated Phase C sites and features yielded a smaller mass of items and a smaller variety of items than their Phase B predecessors. The drop-off in weight and variety of items during the period dating roughly to between AD 1580 and AD 1680 is worth additional investigation in neighboring areas. Depending on results from neighboring areas, it can be determined if the drop-off is of local or regional extent, for instance.

Table 52. Presence/absence and percentage ubiquity of recovered items by Phase.

	Ocean fish	***Rocky shell***	***Beach shell***	***UID shell***	***Bird***	***Pig***	***Dog***	***Rat***	***UID bone***	***Kukui*** nutshell	***Charcoal***	***Basalt adze***	***Basalt flake***	***Volcanic flake***	***Volcanic shatter***	***Basalt utilized***	***Total presence***
Phase A presence	1	3	-	-	-	1	-	1	-	1	1	-	-	1	-	1	10
Phase A ubiquity %	10	30	-	-	-	10	-	10	-	10	10	-	-	10	-	10	100
Phase B presence	3	26	7	3	1	2	1	2	4	2	4	-	2	3	-	-	60
Phase B ubiquity %	5	43	12	5	2	3	2	3	7	3	7	-	3	5	-	-	100
Phase C presence	3	8	-	1	-	1	1	1	-	2	3	-	-	2	1	1	24
Phase C ubiquity %	13	33	-	4	-	4	4	4	-	8	13	-	-	8	4	4	100
Phase D presence	3	25	5	4	-	1	1	1	4	2	4	1	2	4	2	2	61
Phase D ubiquity %	5	41	8	7	-	2	2	2	7	3	7	2	3	7	3	3	100

Assessing Permanent, Temporary, and Agricultural Features

The above discussed features were identified not only through the nature and variety of items recovered, but also in terms of their shapes, sizes, and the deposits they contain. Ultimately, the functions of the excavated sites and features could be inferred via certain similarities with ethnographically recorded instances. However, due to variations in human behavior, even within one cultural group living during the same time period, residues left at sites and their shapes and sizes are bound to vary somewhat. Idiosyncrasies, especially between families, are bound to result in some variation between sites with similar functions. For instance, one *hale mua* can be expected to differ somewhat in architecture from the next, depending on preferences and wealth of a particular family. The nature and time of site abandonment or even possible re-use are also factors to consider. For example, were sites abandoned in a "clean" or "messy" state and were they left in a hurry or gradually? It is for reasons such as these then that rigidly quantifiable categories or threshold values might not be realistic ways to categorize sites.

With these caveats in mind the following discussion uses the results from the excavated sites and features to assess Cordy's (1981) model that uses surface attributes to differentiate permanent from temporary occupations (also included are features identified as agricultural in terms of surface criteria). Related to Clark's (1987) use of abundance and diversity of accumulated habitation debris to assess permanence of habitation, the following assessment considers total average weight and variety of recovered items per square meter. Basically, if assessments based on surface features alone are valid, then permanent habitations will have a greater weight and variety of items than temporary habitations or agricultural features. In other words, there would be a clear rank ordering of permanent habitations, temporary habitations, and agricultural features in terms of descending weight and variety of items recovered. That this is clearly not the case within the project area is shown in Table 53; proposed temporary habitations are interspersed with permanent habitations and agricultural features. Of particular note are the oval structure of Site 23678 and the platform of Site 23676 that were both thought to be temporary but turned out to be at the top of the list in terms of weight and variety of items recovered. On the opposite side of the spectrum is the paucity of items from the proposed permanent platform complex at Site 23670. If anything, Table 53 shows that the relationship between feature shape, size, and associated items is a complicated one.

Table 53. Sites and features by descending weight and variety of items recovered.

Site	*Feature*	*Unit*	*Form*	*Function*	*Tentative assignment*	*Area (sq. m)*	*Total weight of items (g)*	*Weight per sq.m (g)*	*Variety of items*
23678		E15	Oval enclosure	*Hale noa*	Temporary habitation	55.0	489	245	19
23675		T20	Enclosed platform depression	*Hale mua*	Permanent habitation	33.1	200	200	5
23676		E21	Platform	*Hale mua* kitchen	Temporary habitation	18.0	472	118	24
23675		E10	Enclosed platform depression	*Hale mua*	Permanent habitation	33.1	469	117	18
23678		E14	Oval enclosure	*Hale noa*	Temporary habitation	55.0	222	111	16
23673	A	E27	Platform	*Hale mua* kitchen	Permanent habitation	26.5	220	110	11
23676		T18	Platform	*Hale mua* kitchen	Temporary habitation	18.0	105	105	16
23673	A	E28	Platform	*Hale mua* kitchen	Permanent habitation	26.5	207	103	14
23673	A	T17	Platform	*Hale mua* kitchen	Permanent habitation	26.5	95	95	12
23677	A	E22	Small platform in enclosure	*Hale noa* kitchen	Temporary habitation	7.3	89	89	13
23686	291	E13	Linear wall	*Kuaiwi*	Agricultural	273.0	145	73	10
23673	B	E29	Enclosure	*Hale mua*	Permanent habitation	74.8	280	70	16
23672	B	T13	Enclosure	*Hale noa* kitchen	Permanent habitation	8.8	69	69	9
23674		E06	Platform	*Hale mua*	Temporary habitation	17.2	249	62	20
23686	293	E36	Enclosure	*Hale mua*	Agricultural	3.6	116	58	10
23677	A	T16	Small platform in enclosure	*Hale noa* kitchen	Temporary habitation	7.3	49	49	15
23686	247	E05	Terrace	Wall w/midden	Agricultural	28.6	75	37	8
23671		E04	Platform	*Hale noa*	Temporary habitation	26.2	109	27	14
23686	250	E11	Pavement	*Hale mua*	Agricultural	4.5	104	26	10
23686	289	E20	Pavement	Platform	Agricultural	49.5	43	11	5
23673	B	E30	Enclosure	*Hale mua*	Permanent habitation	74.8	42	11	9
23686	289	E19	Pavement	Platform	Agricultural	49.5	11	5.5	5
23672	A	E02	Enclosure	*Hale noa*	Permanent habitation	114.8	4.6	4.6	2
23670	A	E31	Lower two-tiered platform	*Heiau*	Permanent habitation	10.2	14	3.4	4
23675		E09	Enclosed platform depression	*Hale mua*	Permanent habitation	33.1	3	3	2
23677	B	E24	Enclosure	*Hale noa*	Temporary habitation	125.4	5.5	2.8	2
23686	254	E12	Terrace	Terrace wall	Agricultural	54.0	4.5	2.3	5
23672	A	E03	Enclosure	*Hale noa*	Permanent habitation	114.8	5.1	1.3	4
23670	A	E32	Lower two-tiered platform	*Heiau*	Permanent habitation	55.8	0.5	0.1	1
23677	B	E23	Enclosure	*Hale noa*	Temporary habitation	125.4	0	0	0
23672	A	T11	Enclosure	*Hale noa*	Permanent habitation	114.8	0	0	0
23674		E07	Circular enclosure	*Hale mua* yard	Temporary habitation	18.0	0	0	0
23670	B	E34	Upper two-tiered platform	*Heiau*	Permanent habitation	10.2	0	0	0
23670	B	T12	Upper two-tiered platform	*Heiau*	Permanent habitation	10.2	0	0	0
23670	C	E33	Platform	*Heiau*	Permanent habitation	9.5	0	0	0
23672	B	E1b	Enclosure	*Hale noa* kitchen	Permanent habitation	8.8	0	0	0

Perhaps it can be argued that the permanent versus temporary dichotomy is problematic due to the terms used. Substantial and carefully constructed structures, such as the residences of royalty, can be labeled as temporary if they are occupied for a brief period only, whereas a seemingly insignificant agricultural shed can be re-occupied over a long period and so become a permanent fixture. One potentially effective way of distinguishing permanent from temporary structures might be to compare thickness of stratigraphic build-up between structures and/or temporal spread of different radiocarbon dates from the same structure. Arguably the most important finding that emerges from this assessment is the need for excavation, bearing in mind that interpretations based on surface inspections alone can be misleading.

CONCLUDING REMARKS

This data recovery effort satisfactorily mitigated the adverse effects to Ten Sites on TMKs: 3-7-5-10:85 and 3-7-5-17:06 that resulted from development of the area. The research objectives were addressed concerning the determination of both dates and possible duration of occupation as well as site function assessment. The information collected from this data recovery project will hopefully contribute to the growing corpus of knowledge concerning Pre-contact use of Kona's *kula* zone, and is available for use into future regional syntheses. It is hoped that the interpretations of feature use and site layout proposed in the concluding section would prove to be of heuristic value, especially if the interpretations help generate opposing interpretations and encourage looking at the archaeological record in innovative and revealing ways.

REFERENCES CITED

Burtchard, G.
1995 Population and Land-Use on the Keauhou Coast, the Mauka Lands Inventory Survey, Keauhou, North Kona, Hawaii Island, (the Narrative Part I). IARII Report. Submitted to Belt Collins Inc. and Kamehameha Investment Corporation, Honolulu.

Bryan, W.
1915 *Natural History of Hawaii*. Hawaiian Gazette Co., Honolulu.

Cheever, H. T.
1851 *The Island World of the Pacific*. Harper and Brothers, New York.

Clark, J.
1987 Waimea-Kawaihae, A Leeward Hawaii Settlement Pattern. Unpublished Ph.D. dissertation, Department of Anthropology, University of Illinois at Urbana-Champaign.

Clark, M. and R. Rechtman
2002 Data Recovery Investigations at SIHP Sites 13658 and 13669, Ka‘awaloa Ahupua‘a, South Kona, Island of Hawai‘i. Rechtman Consulting Report RC-0025. Prepared for Pali-K Ranch, Captain Cook, Hawai‘i.

2003 An Archaeological Inventory Survey of TMK:3-7-5-10:85 and 3-7-5-17:06. Wai‘aha Ahupua‘a, North Kona District, Island of Hawai‘i. Rechtman Consulting report RC-0153. Prepared for U of N Bencorp, Kailua-Kona, Hawai‘i.

Corbin, A., and P. Rosendahl
2002 Archaeological Assessment Survey U of N BENCORP Development, Lands of Waiaha 1st and 2nd, North Kona District, Island of Hawai‘i (TMK:3-7-5-17:6; 3-75-18:73). PHRI Report 2235-041102. Prepared for U of N Bencorp, Kailua-Kona.

Cordy, R.
1995 Central Kona Archaeological Settlement Patterns. State Historic Preservation Division, DLNR, State of Hawai‘i. Prepared for the Planning Department, County of Hawai‘i.

1978 A Study of Prehistoric Social Change: The Development of Complex Societies in the Hawaiian Islands. Unpublished Ph.D. dissertation, Department of Anthropology, University of Hawaii at Manoa.

1981 *A Study of Prehistoric Social Change: The Development of Complex Societies in the Hawaiian Islands*. New York: Academic Press.

1995 Central Kona Archaeological Settlement Patterns. State Historic Preservation Division, DLNR, State of Hawai‘i. Prepared for the Planning Department, County of Hawai‘i.

2000 *Exalted Sits the Chief: The Ancient History of Hawai‘i Island*. Mutual Publishing, Honolulu.

Cordy, R., J. Tainter, R. Renger, and R. Hitchcock,
1991 An Ahupua‘a Study: The 1971 Archaeological Work at Kaloko Ahupua‘a, North Kona, Hawai‘i. Western Archaeological and Conservation Center *Publications in Anthropology No. 58*. Prepared for the National Park Service, U.S. Department of the Interior.

Ellis, W.
1916 Journal of William Ellis: A Narrative of a Tour Through Hawaii in 1823. Hawaiian Gazette Co., Honolulu.

Hammatt, H., and S. Clark
1980 Archaeological Testing and Salvage Excavations of a 155 Acre Parcel in Na Ahupua‘a Pahoehoe, La‘aloa and Kapala‘aea, Kona, Hawai‘i. Archaeological Research Center Hawaii Report 14-152 III. Prepared for Pacific Basin Resorts, Inc.

Hammatt, H. and V. Meeker
1979 Archaeological Excavations and Heiau Stabilization at Kahalu‘u, Kona, Hawaii Island. Archaeological Research Center Hawaii Report 14-172 (II). Prepared for Gerald Park, Urban Planner.

Handy, E. S. C. and E. G. Handy
1972 Native Planters in Old Hawaii: Their Life, Lore and Environment. *B. P. Bishop Museum Bulletin* 223. Bishop Museum Press, Honolulu. (with M. K. Pukui)

Holland, J. J.
1971 Land and Livelihood: The Kona Coast About 1825. MA Thesis, The University of Hawai‘i, Honolulu.

Kelly, M.
1980 Land Tenure in Hawaii. *Amerasia Journal* 7(2):57-73..

Kirch, P.
1983 The Hawaiian Case, Review of Cordy 1981. “A Study of Prehistoric Social Change: The Development of Complex Societies in the Hawaiian Islands.” Review in *Anthropology* 10:17-28.

1985 *Feathered Gods and Fishhooks: An Introduction to Hawaiian Archaeology and Prehistory*. University of Hawai‘i Press, Honolulu.

Ladefoged, T.
1991 Hawaiian Architectural Transformations during the Early Historic Era. *Asian Perspectives* 30(1):55–70.

Loubser, J. H. N. and B. Rechtman
2006 Archaeological Data Recovery Investigations at SIHP Sites 7827, 7829, and 7830 (TMK: 3-7-8-010:093) Kahalu‘u *ahupua*‘a North Kona District, Hawai‘i. Rechtman Consulting Report RC-0038. Prepared for Keauhou Lot 14C, LLC.

Malo, D.
1951 *Hawaiian Antiquities*. Bishop Museum Press, Honolulu.

Newman, T.
1970 Report on Reconnaissance at Old Kona Airport. Letter. Historic Sites Section, Department of Land and Natural Resources, State of Hawai‘i.

O’Hare, C., and T. Wolforth
1998 Archaeological Inventory Survey of the Gomes Property Parcel, Land of Kahului 1st, Island of Hawaii (TMK: 3-7-5-19:5, 38, 40). PHRI Report 1807-090998. Submitted to Towne Development of Hawai‘i, Inc.

Rechtman, R.

2002 Archaeological Mitigation Plan for Fourteen Sites in the Kiʻilae Estates Development Area (TMK:3-8-5-05:19,22). Kiʻilae and Kauleolī Ahupuaʻa, South Kona District, Island of Hawaiʻi. Rechtman Consulting report RC-0138. Prepared for Mr. Steven A. Jiran, Kiʻilae Estates, Makawao, Hawaiʻi.

2004 An Archaeological Data Recovery Plan for Ten Sites on TMKs:3-7-5-17:06. Waiʻaha Ahupuaʻa, North Kona District, Island of Hawaiʻi. Rechtman Consulting report RC-0223. Prepared for U of N Bencorp, Hawaiʻi.

Rechtman, R., K. Maly, M. Clark, D. Dougherty, and O. Maly

2001 Archaeological Inventory Survey of the Kiʻilae Estates Development Area (TMK:3-8-5-05:19, 22, 26, 27), Kiʻilae and Kauleolī Ahupuaʻa, South Kona District, Island of Hawaiʻi. Report RC-0034. Prepared for Mr. Steven Jiran, Kiʻilae Estates, LLC.

Reinecke, J.

1930 Survey of Hawaiian Sites, 1929-1930. Manuscript. Department of Anthropology, B.P. Bishop Museum, Honolulu.

Sato, H. H., W. Ikeda, R. Paeth, R. Smythe, and M. Takehiro, Jr.

1973 *Soil Survey of the Island of Hawaii, State of Hawaii.* U.S. Department of Agriculture, Soil Conservation Service and University of Hawaiʻi Agricultural Experiment Station. Washington, D.C.: Government Printing Office.

Schilt, A.

1983 *Subsistence and Conflict in Kona, Hawaii. An Archaeological Study of the Kuakini Highway Realignment Corridor*. Departmental Report Series 84-1. Department of Anthropology, B.P. Bishop Museum, Honolulu. Prepared for the Department of Transportation, State of Hawaiʻi.

Soehren, L. J. and T. S. Newman.

1968 *The Archaeology of Kealakekua*. Department of Anthropology, B.P. Bishop Museum, University of Hawaiʻi, Honolulu.

Tomonari-Tuggle, M.

1993 Draft Report, the Archaeology of the ʻOhiʻa Preserve; An Inventory Survey of Surface Structures. International Archaeological Research Institute, Inc. (IARII). Submitted to Kamehameha Investment Corporation, Honolulu.

Valeri, V.

1985 Kingship and Sacrifice: Ritual and Society in Ancient Hawaiʻi. The University of Chicago Press, Chicago.

Wolfe E. and J. Morris.

1996 *Geologic Map of the Island of Hawaiʻi.* Geologic Investigations Series Map 1-2524-A. U.S. Department of the Interior, U.S. Geological Survey.

APPENDIX—A—Master Catalog

SIHP Site 23672 Feature A EU-2.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
1	I	1	Marine shell	*Cypraea* sp.	1	1	1.8
2	II	1	Volcanic glass	Flake	1	-	2.8

SIHP Site 23672 Feature A EU-3.

ACC#	Layer	Level	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
3	I	1	Mammal bone	Unidentified rodent	6	-	2.0
4	I	1	Coral	Waterworn	3	-	2.1
5	I	2	Volcanic glass	Flake	2	-	0.6
6	I	2	Organic	Charcoal	-	-	0.4

SIHP Site 23671 EU-4.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
7	I	1	Marine shell	*Cypraea* sp.	3	2	6.8
8	I	1	Coral	Waterworn	2	-	3.2
9	I	1	Echinoderm	Echinoidea	1	-	0.4
10	I	2	Organic	Charcoal	-	-	1.6
11	I	2	Basalt	Flake	1	-	5.7
12	I	2	Marine shell	*Cypraea* sp.	17	4	14.6
13	I	2	Mammal bone	Unidentified rodent	1	-	0.3
14	I	2	Marine shell	*Morula* sp.	3	3	2.7
15	I	2	Marine shell	*Conus* sp.	1	1	1.5
16	I	2	Marine shell	*Drupa* sp.	1	1	0.7
17	I	2	Marine shell	*Nerita* sp.	1	1	0.4
18	I	2	Marine shell	*Isognomon* sp.	14	4	1.6
19	I	2	Marine shell	*Brachiodontes* sp.	50	10	3.4
20	I	2	Echinoderm	Echinoidea	167	-	13.5
21	I	2	Marine shell	*Turbo* sp.	1	1	0.5
22	I	2	Marine shell	Unidentified	3	-	0.4
23	II	1	Organic	Charcoal	-	-	0.5
24	II	1	Volcanic glass	Flake	1	-	0.5
187	II	1	Volcanic glass	Utilized flake	1	-	1.0
25	II	1	Marine shell	*Isognomon* sp.	80	30	4.2
26	II	1	Marine shell	*Brachidontes* sp.	58	14	3.8
27	II	1	Marine shell	*Cypraea* sp.	24	4	18.0
28	II	2	Echinoderm	Echinoidea	208	-	14.2
29	II	2	Marine shell	*Cypraea* sp.	1	1	2.4
30	II	2	Coral	Waterworn	1	-	0.6
31	II	2	Marine shell	*Conus* sp.	1	1	2.2
32	II	2	Marine shell	*Drupa* sp.	5	2	4.1

SIHP Site 23686 Feature 247 EU-5.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
33	Surface	-	Marine shell	*Cypraea* sp.	1	1	23.4
34	I	1	Metal	Iron horseshoe nail	1	-	2.1
35	I	1	Coral	Unidentified	10	-	9.7
36	I	1	Marine shell	*Cypraea* sp.	3	1	4.3
37	I	1	Organic	*Kukui* nutshell	4	-	2.6
38	I	1	Marine shell	*Cellana* sp.	1	1	0.7
39	II	1	Organic	*Kukui* nutshell	5	-	2.2
40	II	1	Volcanic glass	Flake	1	-	1.4
41	II	1	Coral	Unidentified	3	-	1.2
42	II	1	Marine shell	*Cypraea* sp.	2	1	1.1
43	II	2	Organic	Charcoal	-	-	3.3
44	II	2	Basalt	Flake	1	-	4.2
45	II	2	Marine shell	*Cypraea* sp.	7	2	9.0
46	II	2	Organic	*Kukui* nutshell	7	-	2.2
47	II	2	Marine shell	*Drupa* sp.	1	1	2.8
48	II	2	Basalt	Flake	8	-	6.7

SIHP Site 23674 EU-6.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
49	I	1	Marine shell	*Cypraea* sp.	59	10	50.4
50	I	1	Marine shell	*Drupa* sp.	11	5	6.4
51	I	1	Marine shell	*Conus* sp.	6	2	0.7
52	I	1	Marine shell	*Cellana* sp.	1	1	0.8
53	I	1	Marine shell	Unidentified	3	-	2.0
54	I	1	Mammal bone	*Canis* sp.	2	1	2.0
55	I	1	Bird bone	Unidentified	5	-	1.0
56	I	1	Fish bone	*Scarus* sp. teeth	4	1	0.6
57	I	1	Volcanic glass	Flake	23	-	15.0
564	I	1	Volcanic glass	Shatter	7	-	12.1
58	I	1	Basalt	Flake	2	-	2.8
60	I	1	Organic	*Kukui* nutshell	1	-	0.4
61	I	1	Coral	Waterworn	12	-	24.4
62	I	1	Organic	Charcoal	-	-	0.2
63	II	1	Marine shell	*Cypraea* sp.	18	2	10.4
64	II	1	Marine shell	*Drupa* sp.	9	3	2.9
65	II	1	Marine shell	*Conus* sp.	3	2	1.2
66	II	1	Marine shell	Unidentified	3	-	0.6
67	II	1	Echinoderm	Echinoidea	7	-	6.6
68	II	1	Mammal bone	Unidentified	1	-	0.1
69	II	1	Fish Bone	Unidentified jaw	1	-	0.4
70	II	1	Volcanic glass	Flake	73	-	26.1
71	II	1	Organic	*Kukui* nutshell	3	-	0.8
72	II	1	Coral	Waterworn	1	-	2.9
73	II	1	Organic	Charcoal	-	-	0.3
74	II	2	Marine shell	*Cypraea* sp.	16	2	7.6
75	II	2	Marine shell	*Drupa* sp.	7	3	4.5
76	II	2	Marine shell	*Conus* sp.	3	2	5.2
77	II	2	Marine shell	Unidentified	4	-	0.7
78	II	2	Echinoderm	Echinoidea	2	-	0.4
79	II	2	Bird bone	Unidentified	2	-	1.8
80	II	2	Fish bone	Unidentified vertebrae	1	-	0.8
81	II	2	Mammal bone	Unidentified rodent	1	-	0.2
82	II	2	Volcanic glass	Flake	30	-	22.8

83	II	2	Organic	*Kukui* nutshell	2	-	0.2
84	II	2	Organic	Charcoal	-	-	0.2
85	II	3	Marine shell	*Cypraea* sp.	25	3	10.6
86	II	3	Marine shell	*Drupa* sp	8	1	2.2
87	II	3	Marine shell	*Conus* sp.	6	2	4.0
88	II	3	Marine shell	*Nerita* sp.	1	1	0.4
89	II	3	Marine shell	Unidentified	5	-	1.5
90	II	3	Echinoderm	Echinoidea	6	-	0.5
91	II	3	Crustacean	Unidentified claw fragment	1	-	0.2
92	II	3	Mammal bone	Unidentified rodent	10	-	0.5
93	II	3	Volcanic glass	Flake	48	-	14.3
94	II	3	Organic	Charcoal	-	-	0.5

SIHP Site 23686 Feature 251 EU-8.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
95	I	1	Mammal bone	Bovine bone and teeth fragments	17	1	34.5

SIHP Site 23675 EU-9.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
96	II	1	Organic	Charcoal	-	-	0.4
97	II	1	Marine shell	*Cypraea* sp.	3	2	2.6

SIHP Site 23675 EU-10.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
98	I	-	Organic	Charcoal in situ	-	-	2.3
99	I	-	Volcanic glass	Flake	1	-	1.5
100	I	-	Mammal bone	*Sus* sp.	1	1	1.5
101	I	-	Marine shell	*Cypraea* sp.	4	1	6.7
102	I	-	Marine shell	*Nerita* sp.	1	1	0.8
103	I	-	Coral	Unidentified	20	-	209.5
104	I	-	Coral	Waterworn	1	-	6.3
105	II	1	Organic	Charcoal	-	-	2.0
106	II	1	Organic	*Kukui* nutshell	2	-	0.5
107	II	1	Volcanic glass	Flake	3	-	4.1
108	II	1	Mammal bone	*Sus* sp.	2	1	1.1
109	II	1	Coral	Abrader	1	-	1.0
110	II	1	Marine shell	*Cellana* sp.	2	1	1.3
111	II	1	Marine shell	*Nerita* sp.	7	6	2.3
112	II	1	Marine shell	*Cypraea* sp.	26	5	21.8
113	II	1	Echinoderm	Echinoidea	5	-	0.5
114	II	1	Marine shell	*Drupa* sp.	3	1	2.3
115	II	1	Marine shell	*Cellana* sp.	1	1	1.1
116	II	1	Marine shell	Unidentified	2	-	0.4
117	II	1	Coral	Unidentified	54	-	69.5
118	II	1	Coral	Waterworn	3	-	16.0
119	II	1	Coral	Unidentified	4	-	4.2
120	II	2	Organic	Charcoal	-	-	2.0
121	II	2	Volcanic glass	Flake	6	-	9.5
122	II	2	Small mammal bone	Unidentified	9	-	0.8
059	II	2	Small mammal bone	Unidentified/worked	1	-	0.2
123	II	2	Marine shell	*Nerita* sp.	19	16	4.2
124	II	2	Fish bone	*Scarus* sp.	2	1	0.7
125	II	2	Echinoderm	Echinoidea	4	-	0.8

126	II	2	Marine shell	*Cypraea* sp.	33	6	21.0
127	II	2	Marine shell	*Drupa* sp.	1	1	0.4
128	II	2	Coral	Unidentified	12	-	22.5
129	II	2	Coral	Waterworn	1	-	0.4
130	II	3	Organic	Charcoal	-	-	4.6
131	II	3	Basalt	Flake	6	-	2.2
132	II	3	Volcanic glass	Flake	9	-	5.2
133	II	3	Mammal bone	*Sus* sp.	5	1	1.7
134	II	3	Mammal bone	*Canis sp.* tooth	2	1	0.9
135	II	3	Fish bone	Unidentified	1	-	0.05
136	II	3	Marine shell	*Nerita* sp.	18	15	3.9
137	II	3	Marine shell	*Cypraea* sp.	23	2	13.2
138	II	3	Coral	Unidentified	2	-	1.3
139	II	3	Coral	Waterworn	1	-	9.4
140	II	3	Coral	Unidentified	8	-	6.7
141	II	3	Marine shell	*Drupa* sp.	1	1	0.4

SIHP Site 23686 Feature 250 EU-11.

ACC#	***Layer***	***Level***	***Material***	***Species/type***	***Count***	***MNI***	***Weight (g)***
142	I	1	Marine shell	*Drupa* sp	1	1	20.5
143	I	1	Marine shell	*Cellana* sp.	1	1	59.1
144	II	1	Organic	*Kukui* nutshell	3	-	1.0
145	II	1	Volcanic glass	Flake	2	-	1.8
146	II	1	Mammal bone	*Canis* sp. tooth	1	1	1.0
147	II	1	Fish bone	*Scarus* sp. pharyngeal plate	1	1	0.6
148	II	1	Marine shell	*Drupa* sp.	1	1	2.2
149	II	1	Coral	Unidentified	1	-	0.4
150	II	2	Organic	Charcoal	-	-	0.5
151	II	2	Organic	*Kukui* nutshell	2	-	0.9
152	II	2	Volcanic glass	Flake	5	-	3.2
153	II	2	Fish bone	Unidentified	1	-	0.1
154	II	2	Marine shell	*Cypraea* sp.	4	1	1.3
155	II	2	Marine shell	*Drupa* sp.	3	1	3.5
156	II	2	Coral	Unidentified	10	-	7.2
157	II	2	Coral	Unidentified	1	-	0.3

SIHP Site 23686 Feature 254 EU 12.

ACC#	***Layer***	***Level***	***Material***	***Species/type***	***Count***	***MNI***	***Weight (g)***
158	II	1	Organic	Charcoal	-	-	0.2
159	II	1	Marine shell	*Cypraea* sp.	1	1	0.7
160	II	2	Organic	Charcoal	-	-	0.5
161	II	2	Mammal bone	*Sus* sp. vertebrae	1	1	1.1
162	II	2	Coral	Unidentified	4	-	1.5
163	II	2	Marine shell	Unidentified	1	-	0.2
164	II	3	Organic	Charcoal	-	-	0.3

SIHP Site 23686 Feature 291 EU-13.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
165	I	1	Marine shell	*Cypraea* sp.	7	2	15.3
166	I	1	Marine shell	*Drupa* sp	1	1	1.2
167	I	1	Marine shell	*Conus* sp.	1	1	2.1
168	I	1	Coral	Unidentified	1	-	2.8
169	I	1	Coral	Unidentified	12	-	67.5
170	I	1	Marine shell	*Conus* sp.	1	1	0.25
171	II	1	Basalt	Waterworn pebble	2	-	3.7
172	II	1	Marine shell	*Cypraea* sp.	7	1	5.3
173	II	1	Marine shell	*Drupa* sp.	3	1	1.1
174	II	1	Marine shell	*Conus* sp.	6	2	2.4
175	II	1	Marine shell	Unidentified	1	-	0.2
176	II	1	Coral	Unidentified	20	-	7.7
177	II	1	Coral	Unidentified	1	-	1.5
178	II	1	Coral	Waterworn	2	-	1.1
179	II	2	Volcanic glass	Flake	1	-	0.9
180	II	2	Marine shell	*Cypraea* sp.	11	1	5.2
181	II	2	Echinoderm	Echinoidea	1	-	0.25
182	II	2	Marine shell	*Conus* sp.	4	1	1.5
183	II	2	Marine shell	*Isognomon* sp.	1	1	0.05
184	II	2	Marine shell	*Drupa* sp	1	1	1.5
185	II	2	Marine shell	*Morula* sp.	1	1	1.0
186	II	2	Marine shell	Unidentified	5	-	1.6
188	II	2	Coral	Unidentified	2	-	1.5
189	II	2	Coral	Waterworn	2	-	0.4
190	II	2	Coral	Unidentified	5	-	3.3
191	II	3	Marine shell	*Cypraea* sp.	10	2	6.1
192	II	3	Marine shell	*Conus* sp.	8	2	3.9
193	II	3	Echinoderm	Echinoidea	3	-	0.5
194	II	3	Marine shell	*Drupa* sp.	1	1	0.4
195	II	3	Marine shell	Unidentified	12	-	1.1
196	II	3	Coral	Unidentified	5	-	1.7
197	II	3	Coral	Waterworn	6	-	2.5

SIHP Site 23678 EU-14.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
198	I	1	Organic	Charcoal	-	-	0.2
199	I	1	Basalt	Fire cracked	1	-	54.2
200	I	1	Basalt	Flake	1	-	0.7
201	I	1	Volcanic glass	Flake	9	-	4.7
202	I	1	Marine shell	*Conus* sp.	6	-	2.8
203	I	1	Marine shell	*Cellana* sp.	1	1	0.1
204	I	1	Marine shell	*Cypraea* sp.	37	4	29.1
205	I	1	Marine shell	Unidentified	4	-	0.7
567	I	1	Marine shell	*Cellana* sp.	1	1	0.5
568	I	1	Marine shell	*Conus* sp.	1	1	1.0
569	I	1	Marine shell	Unidentified Bivalve	3	-	1.9
206	I	1	Coral	Unidentified	12	-	12.2
207	I	1	Coral	Unidentified	19	-	22.2
208	I	1	Coral	Waterworn	11	-	6.5
209	I	2	Organic	Charcoal	-	-	1.0
210	I	2	Organic	Unidentified Wood	1	-	0.1
211	I	2	Volcanic glass	Shatter	1	-	2.5
212	I	2	Volcanic glass	Flake	18	-	7.5

213	I	2	Basalt	Waterworn pebble	1	-	0.5
214	I	2	Marine shell	*Conus* sp.	7	3	3.8
215	I	2	Marine shell	*Drupa* sp	5	-	2.3
216	I	2	Marine shell	*Isognomon* sp.	2	1	0.1
217	I	2	Marine shell	*Cypraea* sp.	30	3	17.5
218	I	2	Echinoderm	Echinoidea	11		0.9
219	I	2	Marine shell	Unidentified	20	-	6.0
220	I	2	Coral	Unidentified	22	-	2.0
221	I	2	Coral	Unidentified	30	-	30.5
222	I	2	Coral	Waterworn	3	-	0.6
223	I	3	Basalt	Adze fragment	1	-	0.2
224	I	3	Marine shell	*Cypraea* sp.	7	1	4.0
225	I	3	Echinoderm	Echinoidea	1	-	0.05
226	I	3	Marine shell	Unidentified	6	-	2.0
227	I	3	Coral	Unidentified	2	-	0.4
228	I	3	Coral	Unidentified	5	-	2.8

SIHP Site 23768 EU-15.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
229	I	1	Marine shell	*Cypraea* sp.	2	1	2.9
230	I	1	Coral	Branch	2	-	67.0
231	I	1	Coral	Unidentified	3	-	12.2
232	I	1	Coral	Unidentified	15	-	66.4
233	II	1	Volcanic glass	Flake	1	-	0.8
234	II	1	Basalt	Waterworn pebble	1	-	2.3
235	II	1	Fish bone	Unidentified	1	-	0.05
236	II	1	Marine shell	*Conus* sp.	7	3	3.5
237	II	1	Marine shell	*Drupa* sp.	2	1	0.5
238	II	1	Marine shell	*Cypraea* sp.	16	2	12.0
239	II	1	Marine shell	*Morula* sp.	2	2	0.3
240	II	1	Marine shell	Unidentified	15	-	4.3
241	II	1	Marine shell	*Drupa* sp.	2	1	0.6
242	II	1	Coral	Unidentified	16	-	12.2
243	II	1	Coral	Unidentified	42	-	43.9
244	II	1	Echinoderm	Echinoidea	5	-	0.3
245	II	2	Organic	Charcoal	-	-	0.3
246	II	2	Basalt	Flake	4	-	2.8
247	II	2	Volcanic glass	Flake	10	-	7.7
248	II	2	Volcanic glass	Shatter	1	-	1.8
249	II	2	Bird bone	Unidentified	1	-	0.1
250	II	2	Marine shell	*Cypraea* sp.	58	4	36.5
251	II	2	Marine shell	*Conus* sp.	20	3	9.4
252	II	2	Marine shell	*Drupa* sp	3	1	0.9
253	II	2	Marine shell	*Morula* sp.	2	1	0.7
254	II	2	Marine shell	*Isognomon* sp.	2	1	0.3
255	II	2	Marine shell	*Cellana* sp.	1	1	0.1
256	II	2	Marine shell	Unidentified bivalve	3	-	1.4
257	II	2	Marine shell	*Strombus* sp.	2	2	0.6
258	II	2	Marine shell	Unidentified	59	-	19.7
259	II	2	Echinoderm	Echinoidea	44	-	2.6
260	II	2	Coral	Unidentified	32	-	13.2
261	II	2	Coral	Unidentified	72	-	75.3
262	II	3	Volcanic glass	Flake	1	-	0.8
263	II	3	Marine shell	*Conus* sp.	17	3	8.2
264	II	3	Marine shell	*Drupa* sp	5	2	2.6

265	II	3	Marine shell	*Nerita* sp.	1	1	0.1
266	II	3	Marine shell	*Cypraea* sp.	16	2	13.5
267	II	3	Marine shell	Unidentified bivalve	3	-	1.7
268	II	3	Marine shell	Unidentified	18	-	8.0
269	II	3	Echinoderm	Echinoidea	24	-	1.1
270	II	3	Coral	Unidentified	12	-	3.7
271	II	3	Coral	Unidentified	30	-	30.0
272	II	3	Coral	Waterworn	3	-	1.2
273	II	4	Basalt	Waterworn pebble	1	-	0.5
274	II	4	Marine shell	*Cypraea* sp.	4	1	2.8
275	II	4	Marine shell	*Conus* sp.	2	1	1.2
276	II	4	Marine shell	Unidentified	5	-	1.2
277	II	4	Marine shell	Unidentified bivalve	1	-	0.6
278	II	4	Echinoderm	Echinoidea	4	-	0.9
279	II	4	Coral	Unidentified	3	-	2.0
280	II	4	Coral	Unidentified	8	-	6.2
281	II	4	Coral	Waterworn pebble	1	-	0.1

SIHP Site 23686 Feature 289 EU-19.

ACC#	***Layer***	***Level***	***Material***	***Species/type***	***Count***	***MNI***	***Weight (g)***
282	II	1	Marine shell	*Cypraea* sp.	10	2	7.6
283	II	1	Marine shell	*Conus* sp.	1	1	0.2
284	II	1	Marine shell	*Isognomon* sp.	2	1	0.4
285	II	1	Coral	Unidentified	1	-	0.3
286	II	3	Marine shell	*Cypraea* sp.	1	1	0.7
287	II	4	Marine shell	*Cypraea* sp.	3	1	1.0
288	II	4	Marine shell	*Morula* sp.	1	1	0.7

SIHP Site 23686 Feature 289 EU-20.

ACC#	***Layer***	***Level***	***Material***	***Species/type***	***Count***	***MNI***	***Weight (g)***
289	I	1	Marine shell	*Cypraea* sp.	2	1	5.6
290	I	1	Coral	Unidentified	1	-	17.2
291	I	1	Volcanic glass	Flake	1	-	0.5
292	I	1	Marine shell	*Cypraea* sp.	14	2	7.8
293	I	1	Marine shell	*Conus* sp.	2	1	2.9
294	I	1	Marine shell	*Cymatium* sp.	1	1	3.1
295	II	2	Marine shell	*Cypraea* sp.	4	1	1.6
296	II	2	Marine shell	*Conus* sp.	2	1	1.5
297	II	2	Coral	Unidentified	1	-	2.5

SIHP Site 23676 EU-21.

ACC#	***Layer***	***Level***	***Material***	***Species/type***	***Count***	***MNI***	***Weight (g)***
298	I	-	Organic	Charcoal	-	-	3.0
299	I	-	Organic	*Kukui* nutshell	4	-	0.8
300	I	-	Volcanic glass	Flake	12	-	20.0
301	I	-	Marine shell	*Cellana* sp.	2	1	0.8
302	I	-	Marine shell	*Morula* sp.	1	1	0.6
302	I	-	Marine shell	*Drupa* sp.	2	1	6.6
304	I	-	Marine shell	*Cypraea* sp.	73	4	68.0
305	I	-	Marine shell	Unidentified	44	-	0.2
306	I	-	Marine shell	*Conus* sp.	2	1	0.2
307	I	-	Mammal bone	*Canis* sp. tooth	1	1	0.4
308	I	-	Mammal bone	*Rattus* sp.	1	1	0.1
309	I	-	Mammal bone	*Sus* sp.	6	1	2.0

310	I	-	Marine shell	*Serpuloris variabilis*	2	-	2.9
311	I	-	Echinoderm	Echinoidea	5	-	0.4
312	I	-	Coral	Unidentified	14	-	15.0
313	I	-	Coral	Unidentified	2	-	9.1
314	II	1	Organic	Charcoal	-	-	2.4
315	II	1	Organic	*Kukui* nutshell	10	-	4.3
316	II	1	Volcanic glass	Flake	17	-	10.8
317	II	1	Mammal bone	*Sus* sp.	18	1	3.4
318	II	1	Fish bone	Shark tooth burnt	1	1	0.4
319	II	1	Marine shell	*Cypraea* sp.	81	6	33.7
320	II	1	Marine shell	*Nerita* sp.	5	4	1.0
321	II	1	Marine shell	*Cellana* sp.	7	1	3.2
322	II	1	Marine shell	*Conus* sp.	7	2	1.9
323	II	1	Marine shell	*Morula* sp.	2	2	1.4
324	II	1	Marine shell	*Drupa* sp.	5	2	9.9
325	II	1	Marine shell	*Serpuloris variabilis*	1	1	0.3
326	II	1	Marine shell	*Nassarius* sp.	2	2	1.6
327	II	1	Marine shell	*Chama* sp.	1	1	4.0
328	II	1	Marine shell	Unidentified	26	-	3.2
329	II	1	Coral	Unidentified	1	-	16.9
330	II	1	Coral	Unidentified	22	-	119.2
331	II	1	Echinoderm	Echinoidea	10	-	1.2
332	II	2	Organic	Charcoal	-	-	3.3
333	II	2	Organic	*Kukui* nutshell	19	-	3.1
334	II	2	Volcanic glass	Flake	11	-	5.4
335	II	2	Mammal bone	*Rattus* sp. jaw	1	1	0.1
336	II	2	Mammal bone	*Sus* sp. /burnt	5	1	3.4
337	II	2	Mammal bone	Unidentified/awl	1	-	0.4
338	II	2	Marine shell	*Cellana* sp.	1	1	0.1
339	II	2	Marine shell	*Conus* sp.	2	1	2.0
340	II	2	Marine shell	*Morula* sp.	3	3	1.8
341	II	2	Marine shell	*Drupa* sp.	3	1	3.7
342	II	2	Marine shell	*Nassarius* sp.	6	5	2.8
343	II	2	Marine shell	*Cypraea* sp.	52	7	29.2
344	II	2	Marine shell	Unidentified	22	-	3.2
345	II	2	Coral	Waterworn	1	-	0.6
346	II	2	Coral	Unidentified	10	-	5.9
347	II	2	Echinoderm	Echinoidea	20	-	0.9
348	II	3	Organic	Charcoal	-	-	1.6
349	II	3	Volcanic glass	Flake	8	-	3.9
350	II	3	Mammal bone	*Canis* sp. teeth/burnt	2	1	0.5
351	II	3	Mammal bone	Unidentified/burnt	4	-	1.0
352	II	3	Mammal bone	Unidentified/awl	1	-	2.8
353	II	3	Marine shell	*Drupa* sp.	1	1	4.0
354	II	3	Marine shell	*Conus* sp.	1	1	0.3
355	II	3	Marine shell	*Nerita* sp.	2	2	0.5
356	II	3	Marine shell	*Nassarius* sp.	3	3	1.4
357	II	3	Marine shell	*Fimbria* sp.	1	1	0.3
358	II	3	Marine shell	*Cypraea* sp.	37	6	23.1
359	II	3	Marine shell	Unidentified	13	-	1.5
360	II	3	Coral	Unidentified	3	-	0.8
361	II	3	Echinoderm	Echinoidea	15	-	1.5
362	II	4	Organic	Charcoal	-	-	0.1
363	II	4	Volcanic glass	Flake	2	-	0.5
364	II	4	Medium mammal bone	Unidentified/cut	1	-	0.4
365	II	4	Mammal bone	*Canis* sp. tooth	1	1	0.8

366	II	4	Bird bone	Unidentified	2	-	0.2
367	II	4	Marine shell	*Cypraea* sp.	5	2	6.2
368	II	4	Marine shell	*Morula* sp.	1	1	0.5
369	II	4	Marine shell	*Drupa* sp.	1	1	2.6
370	II	4	Marine shell	*Conus* sp.	2	1	0.5
371	II	4	Marine shell	*Nassarius* sp.	2	2	0.8
372	II	4	Marine shell	*Serpuloris variabilis*	1	1	0.9
373	II	4	Marine shell	Unidentified	2	-	0.1
374	II	4	Fish bone	Shark tooth	1	1	0.1
375	II	4	Coral	Unidentified	1	-	0.2
376	II	4	Coral	Unidentified	1	-	0.3
377	II	4	Echinoderm	Echinoidea	3	-	0.2

SIHP Site 23677 Feature A EU-22.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
378	II	1	Organic	Charcoal	-	-	1.0
379	II	1	Small mammal bone	*Rattus* sp.	1	1	0.2
380	II	1	Marine shell	*Cypraea* sp.	2	1	2.8
381	II	1	Coral	Unidentified	15	-	3.1
382	II	2	Marine shell	*Conus* sp.	2	1	0.7
383	II	2	Marine shell	*Cypraea* sp.	1	1	1.2
384	II	2	Coral	Unidentified	1	-	5.1
385	II	2	Coral	Unidentified	2	-	3.7
386	II	2	Echinoderm	Echinoidea	1	-	0.1
387	II	3	Marine shell	*Cypraea* sp.	4	3	5.2
388	II	3	Marine shell	*Drupa* sp.	1	1	1.1
389	II	3	Coral	Unidentified	1	-	0.6
390	III	1	Organic	Charcoal	-	-	0.2
391	III	1	Volcanic glass	Flake	1	-	0.4
392	III	1	Marine shell	*Cypraea* sp.	4	1	5.8
393	III	1	Marine shell	*Conus* sp.	3	1	1.1
394	III	1	Marine shell	*Nerita* sp.	2	2	0.5
395	III	1	Coral	Unidentified	1	-	0.1
396	III	1	Echinoderm	Echinoidea	2	-	0.3
397	III	2	Organic	Charcoal	6	-	0.4
398	III	2	Organic	Charcoal in situ	14	-	0.2
399	III	2	Organic	*Kukui* nutshell	1	-	0.2
400	III	2	Volcanic glass	Flake	3	-	2.8
401	III	2	Mammal bone	Unidentified/burnt	2	1	0.9
402	III	2	Marine shell	*Cypraea* sp.	35	5	26.4
403	III	2	Marine shell	*Conus* sp.	3	1	1.0
404	III	2	Marine shell	*Nerita* sp.	7	5	1.4
405	III	2	Marine shell	*Drupa* sp.	1	1	0.1
406	III	2	Marine shell	Unidentified	9	-	2.2
407	III	2	Coral	Unidentified	4	-	3.9
408	III	2	Echinoderm	Echinoidea	45	-	4.6
409	III	3	Organic	Charcoal	37	-	1.5
410	III	3	Volcanic glass	Flake	1	-	1.2
411	III	3	Marine shell	*Cypraea* sp.	6	1	9.2
412	III	3	Marine shell	*Nerita* sp.	1	1	0.4
413	III	3	Marine shell	*Drupa* sp.	1	1	0.3
414	III	3	Marine shell	*Pseudochama* sp.	2	1	0.3

SIHP Site 23677 Feature B EU-24

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
562	II	2	Marine shell	*Cypraea* sp.	1	1	5.2
563	II	2	Marine shell	*Conus* sp.	1	1	0.3

SIHP Site 23673 Feature A EU-27.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
415	I	1	Organic	Charcoal	-	-	0.2
416	I	1	Volcanic glass	Flake	1	-	0.7
417	I	1	Basalt	Waterworn pebble	1	-	51.4
418	I	1	Organic	*Kukui* nutshell	3	-	5.1
419	I	1	Marine shell	*Cypraea* sp.	1	1	3.8
420	I	1	Marine shell	*Fimbria* sp.	2	1	2.6
421	I	1	Coral	Branch	4	-	59.0
422	I	1	Coral	Unidentified	-	-	54.2
423	II	1	Organic	*Kukui* nutshell/burnt	8	-	1.2
424	II	1	Volcanic glass	Flake	1	-	0.1
570	II	1	Volcanic glass	Shatter	1	-	13.5
425	II	1	Shell	*Isognomon* sp.	2	1	0.2
426	II	1	Echinoderm	Echinoidea	2	-	0.1
427	II	2	Organic	Charcoal	-	-	0.2
428	II	2	Organic	*Kukui* nutshell	7	-	0.9
429	II	2	Volcanic glass	Flake	9	-	2.6
571	II	2	Volcanic glass	Shatter	7	-	21.5
430	II	2	Marine shell	Unidentified	3	-	0.7
431	II	2	Coral	Unidentified	1	-	0.1
432	II	2	Echinoderm	Echinoidea	6	-	0.7
433	II	3	Volcanic glass	Flake	2	-	0.8
434	II	3	Marine shell	*Cypraea* sp.	1	1	0.05

SIHP Site 23673 Feature A EU-28.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
435	I	-	Volcanic glass	Flake	6	-	6.3
572	I	-	Basalt	Flake	1	-	6.0
573	I	-	Volcanic glass	Shatter	1	-	6.6
436	I	-	Marine shell	*Cypraea* sp.	1	1	2.2
437	I	-	Marine shell	Unidentified	1	-	3.8
438	I	-	Coral	Unidentified	25	-	88.4
439	I	-	Coral	Abrader	1	-	17.3
440	II	1	Volcanic glass	Flake	7	-	4.8
441	II	1	Fish bone	Unidentified	1	-	1.0
442	II	1	Marine shell	*Cypraea* sp.	2	2	15.9
443	II	1	Marine shell	*Drupa* sp.	1	1	0.9
444	II	1	Organic	*Kukui* nutshell	6	-	0.4
445	II	1	Coral	Unidentified	5	-	41.2
446	II	1	Coral	Unidentified	1	-	0.6
447	II	1	Echinoderm	Echinoidea	5	-	0.2
448	II	2	Organic	Charcoal	-	-	0.3
449	II	2	Volcanic glass	Volcanic glass	10	-	6.0
450	II	2	Coral	Worked	1	-	0.5
451	II	2	Small mammal bone	Unidentified jaw and teeth	2	-	0.4
452	II	2	Marine shell	*Cypraea* sp.	1	-	1.4
453	II	2	Marine shell	*Terebra* sp.	1	1	0.05
454	II	2	Marine shell	*Mitra* sp.	1	1	0.1

455	II	2	Marine shell	Unidentified	1	-	0.1
456	II	2	Coral	Unidentified	3		0.8
457	II	2	Echinoderm	Echinoidea	5	-	0.1
565	II	2	Echinoderm	Echinoidea abrader	1	-	1.6

SIHP Site 23673 Feature B EU-29.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
458	II	1	Organic	Charcoal	-	-	1.1
459	II	1	Volcanic glass	Flake	1	-	0.2
460	II	1	Fish bone	*Thynnus thynnus*, from 3ft. specimen	2	1	0.8
461	II	1	Mammal bone	Unidentified	1		0.1
462	II	1	Marine shell	*Cypraea* sp.	9	2	7.8
463	II	1	Marine shell	*Nerita* sp.	1	1	0.15
464	II	1	Marine shell	Unidentified	2	-	0.4
465	II	1	Coral	Unidentified	1	-	27.4
466	II	1	Coral	Unidentified	2	-	3.1
467	II	1	Echinoderm	Echinoidea	9	-	0.6
468	II	2	Organic	Charcoal	-	-	1.2
469	II	2	Volcanic glass	Flake	4	-	2.0
470	II	2	Marine shell	*Cypraea* sp.	29	2	25.0
471	II	2	Marine shell	*Conus* sp.	2	1	0.6
472	II	2	Echinoderm	Echinoidea	22	-	2.0
473	II	2	Coral	Unidentified	3	-	3.6
474	II	3	Organic	Charcoal	21	-	2.0
475	II	3	Marine shell	*Cypraea* sp.	36	7	36.5
476	II	3	Marine shell	*Isognomon* sp.	6	1	1.2
477	II	3	Mammal Bone	Unidentified	3	-	0.6
478	II	3	Marine shell	*Nerita* sp.	1	1	0.1
479	II	3	Metal	Lead .177 cal Pellet	1	-	0.9
480	II	3	Fish bone	Unidentified	1		<0.1
481	II	3	Volcanic glass	Flake	2	-	1.8
482	II	3	Echinoderm	Echinoidea abrader fragment	1	-	0.2
483	II	3	Marine shell	*Conus* sp.	5	2	3.0
484	II	3	Coral	Unidentified	10	-	33.9
485	II	3	Marine shell	Unidentified	18	-	4.5
486	II	3	Marine shell	*Thais* sp.	1	1	0.5
487	II	3	Marine shell	*Drupa* sp.	2	2	0.6
488	II	3	Echinoderm	Echinoidea	208	-	25.8
489	II	4	Organic	Charcoal	47	-	5.5
490	II	4	Echinoderm	Echinoidea	42	-	4.9
491	II	4	Marine shell	*Cypraea* sp.	12	3	10.2
492	II	4	Mammal bone	*Sus* sp. vertebrae	1	1	2.2
493	II	4	Organic	Unidentified nut	1	-	0.6
494	II	4	Marine shell	*Trochus* sp.	1	1	0.3

SIHP Site 23673 Feature B EU-30.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
495	I	1	Fish bone	*Thynnus thynnus*	13	1	4.7
496	I	1	Mammal bone	*Canis* sp.	1	1	0.2
497	II	1	Fish bone	*Thynnus thynnus*	8	1	4.1
498	II	1	Mammal bone	Unidentified	6	-	4.7
566	II	1	Mammal bone	Unidentified/cut	3	-	13.2
499	II	1	Coral	Unidentified	2	-	7.8
500	II	1	Organic	*Kukui* nutshell	2	-	2.1
501	II	2	Fish bone	*Thynnus thynnus*	3	1	0.2
502	II	2	Mammal bone	*Rattus* sp.	1	1	<0.1
503	II	2	Echinoderm	Echinoidea	2	-	0.1
504	II	2	Coral	Unidentified	3	-	0.7
505	II	2	Organic	*Kukui* nutshell	2	-	0.2
506	II	3	Fish bone	*Thynnus thynnus*	2	1	<0.1
507	II	3	Organic	*Kukui* nutshell	1	-	1.9
508	II	3	Coral	Unidentified	1	-	0.2
509	II	3	Marine shell	*Drupa* sp.	1	1	1.9

SIHP Site 23670 Feature A EU-31.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
510	I	1	Organic	Charcoal	-	-	0.4
511	I	1	Organic	*Kukui* nutshell	14	-	6.8
512	I	1	Marine shell	*Cypraea* sp.	3	1	3.3
513	I	1	Metal	Iron fragments	4	-	0.9
514	I	1	Glass	Brown bottle fragment	1	-	0.4
515	I	1	Echinoderm	Echinoidea	7	-	0.6
516	I	1	Metal	Brass button part	1	-	0.8
517	I	1	Metal	Brass button part inscribed	1	-	0.8
518	II	1	Organic	Charcoal	-	-	0.2
519	II	1	Echinoderm	Echinoidea	2	-	0.1
520	II	1	Organic	*Kukui* nutshell	7	-	2.1

SIHP Site 23670 Feature A EU-32.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
521	I	1	Glass	Brown bottle fragment	1	-	0.7
522	I	1	Organic	*Kukui* nutshell	2	-	0.5

SIHP Site 23670 Feature B EU-34.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
523	II	1	Organic	Charcoal	-	-	0.4

SIHP Site 23686 Feature 293 EU-36.

ACC#	*Layer*	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
524	I	1	Basalt	Waterworn	1	-	5.5
525	I	1	Coral	Unidentified	3	-	16.1
526	I	1	Marine shell	*Cypraea* sp.	1	1	8.3
527	II	1	Basalt	Waterworn	22	-	47.1
528	II	1	Organic	Charcoal	-	-	1.8
529	II	1	Synthetic	Plastic container	9	-	4.9
530	II	1	Metal	Steel nail	1	-	1.5
531	II	1	Metal	Iron fragments rusted	43	-	15.6
532	II	1	Metal	Steel nut	1	-	6.1
533	II	1	Fish bone	Unidentified	2	-	0.3
534	II	1	Glass	Brown bottle fragments	3	-	4.8
535	II	1	Organic	*Kukui* nutshell	1	-	0.9
536	II	1	Glass	Clear thin fragments	4	-	3.3
537	II	1	Glass	Clear thick fragments	2	-	0.7
538	II	1	Glass	Light green bottle fragments	2	-	0.7
539	II	1	Glass	Clear fragments	2	-	1.1
540	II	2	Metal	Iron fragments rusted	57	-	33.4
541	II	2	Mammal bone	*Sus* sp. rib	2	1	6.4
542	II	2	Basalt	Waterworn	13	-	24.1
543	II	2	Organic	*Kukui* nutshell	1	-	0.9
544	II	2	Coral	Unidentified	4	-	1.7
545	II	2	Marine shell	*Cypraea* sp.	1	1	3.0
546	II	2	Metal	Steel finish nails	3	-	5.6
547	II	2	Glass	Clear bottle fragments	8	-	10.5
548	II	2	Glass	Light green bottle fragments	3	-	5.8
549	II	2	Glass	Brown bottle fragments	6	-	2.5
550	II	2	Volcanic glass	Flake	1	-	0.5
551	II	2	Mammal bone	*Rattus* sp. jaw	1	1	0.1
552	II	2	Fish bone	Unidentified vertebrae	1		1.8
553	II	2	Fish bone	Unidentified	1		0.2
554	II	2	Glass	Clear fragments	5		4.2
555	II	2	Metal	Steel screw	1		3.8
556	II	2	Echinoderm	Echinoidea	1	-	<0.1
557	II	2	Glass	Clear fragment	1	-	2.7
558	II	2	Glass	Clear fragment	1	-	0.3
559	II	2	Synthetic	Plastic	4	-	0.9
560	II	2	Synthetic	Plastic	9	-	0.8
561	II	2	Organic	Charcoal	-	-	0.2

APPENDIX—B—Radiocarbon Results

BETA

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REPORT OF RADIOCARBON DATING ANALYSES

Dr. Bob Rechtman — Report Date: 2/14/2006

Rechtman Consulting, LLC — Material Received: 1/3/2006

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 212756	340 +/- 40 BP	-23.1 o/oo	370 +/- 40 BP

SAMPLE : RC-0223-10
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1440 to 1640 (Cal BP 510 to 310)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 212757	350 +/- 40 BP	-26.9 o/oo	320 +/- 40 BP

SAMPLE : RC-0223-43
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1460 to 1660 (Cal BP 490 to 290)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 212758	100 +/- 40 BP	-21.7 o/oo	150 +/- 40 BP

SAMPLE : RC-0223-98
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1660 to 1950 (Cal BP 290 to 0)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 212759	190 +/- 80 BP	-26.2 o/oo	170 +/- 80 BP

SAMPLE : RC-0223-130
ANALYSIS : Radiometric-Standard delivery (with extended counting)
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1520 to 1580 (Cal BP 430 to 380) AND Cal AD 1630 to 1960 (Cal BP 320 to 0)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 212760	300 +/- 40 BP	-27.4 o/oo	260 +/- 40 BP

SAMPLE : RC-0223-150
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1520 to 1590 (Cal BP 430 to 360) AND Cal AD 1620 to 1670 (Cal BP 330 to 280)
Cal AD 1770 to 1800 (Cal BP 180 to 150) AND Cal AD 1940 to 1950 (Cal BP 10 to 0)

Dates are reported as RCYBP (radiocarbon years before present, "present" = 1950A.D.). By International convention, the modern reference standard was 95% of the C14 content of the National Bureau of Standards' Oxalic Acid & calculated using the Libby C14 half life (5568 years). Quoted errors represent 1 standard deviation statistics (68% probability) & are based on combined measurements of the sample, background, and modern reference standards.

Measured C13/C12 ratios were calculated relative to the PDB-1 international standard and the RCYBP ages were normalized to -25 per mil. If the ratio and age are accompanied by an (*), then the C13/C12 value was estimated, based on values typical of the material type. The quoted results are NOT calibrated to calendar years. Calibration to calendar years should be calculated using the Conventional C14 age.

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Dr. Bob Rechtman

Report Date: 2/14/2006

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 212761	250 +/- 40 BP	-24.4 o/oo	260 +/- 40 BP

SAMPLE : RC-0223-160
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1520 to 1590 (Cal BP 430 to 360) AND Cal AD 1620 to 1670 (Cal BP 330 to 280)
Cal AD 1770 to 1800 (Cal BP 180 to 150) AND Cal AD 1940 to 1950 (Cal BP 10 to 0)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 212762	200 +/- 40 BP	-24.1 o/oo	210 +/- 40 BP

SAMPLE : RC-0223-209
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1640 to 1690 (Cal BP 310 to 260) AND Cal AD 1730 to 1810 (Cal BP 220 to 140)
Cal AD 1920 to 1950 (Cal BP 30 to 0)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 212763	390 +/- 60 BP	-23.4 o/oo	410 +/- 60 BP

SAMPLE : RC-0223-298
ANALYSIS : Radiometric-Standard delivery (with extended counting)
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1420 to 1640 (Cal BP 540 to 310)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 212764	410 +/- 70 BP	-25.4 o/oo	410 +/- 70 BP

SAMPLE : RC-0223-314
ANALYSIS : Radiometric-Standard delivery (with extended counting)
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1410 to 1650 (Cal BP 540 to 300)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 212765	340 +/- 60 BP	-25.1 o/oo	340 +/- 60 BP

SAMPLE : RC-0223-332
ANALYSIS : Radiometric-Standard delivery (with extended counting)
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1440 to 1660 (Cal BP 510 to 290)

Dates are reported as RCYBP (radiocarbon years before present, "present" = 1950A.D.). By International convention, the modern reference standard was 95% of the C14 content of the National Bureau of Standards' Oxalic Acid & calculated using the Libby C14 half life (5568 years). Quoted errors represent 1 standard deviation statistics (68% probability) & are based on combined measurements of the sample, background, and modern reference standards.

Measured C13/C12 ratios were calculated relative to the PDB-1 international standard and the RCYBP ages were normalized to -25 per mil. If the ratio and age are accompanied by an (*), then the C13/C12 value was estimated, based on values typical of the material type. The quoted results are NOT calibrated to calendar years. Calibration to calendar years should be calculated using the Conventional C14 age.

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REPORT OF RADIOCARBON DATING ANALYSES

Dr. Bob Rechtman

Report Date: 2/14/2006

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 212766	60 +/- 40 BP	-24.1 o/oo	70 +/- 40 BP

SAMPLE : RC-0223-378
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1680 to 1740 (Cal BP 270 to 210) AND Cal AD 1810 to 1930 (Cal BP 140 to 20)
Cal AD 1950 to beyond 1960 (Cal BP 0 to 0)

Beta - 212767	120 +/- 40 BP	-22.6 o/oo	160 +/- 40 BP

SAMPLE : RC-0223-409
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1660 to 1950 (Cal BP 290 to 0)

Beta - 212768	400 +/- 80 BP	-22.5 o/oo	440 +/- 80 BP

SAMPLE : RC-0223-474
ANALYSIS : Radiometric-Standard delivery (with extended counting)
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1320 to 1340 (Cal BP 630 to 600) AND Cal AD 1390 to 1640 (Cal BP 560 to 310)

Beta - 212769	300 +/- 50 BP	-24.4 o/oo	310 +/- 50 BP

SAMPLE : RC-0223-489
ANALYSIS : Radiometric-Standard delivery (with extended counting)
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1460 to 1660 (Cal BP 490 to 290)

Beta - 212770	520 +/- 80 BP	-23.5 o/oo	540 +/- 80 BP

SAMPLE : RC-0223-528
ANALYSIS : Radiometric-Standard delivery (with extended counting)
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1290 to 1480 (Cal BP 660 to 470)

Dates are reported as RCYBP (radiocarbon years before present, "present" = 1950A.D.). By International convention, the modern reference standard was 95% of the C14 content of the National Bureau of Standards' Oxalic Acid & calculated using the Libby C14 half life (5568 years). Quoted errors represent 1 standard deviation statistics (68% probability) & are based on combined measurements of the sample, background, and modern reference standards.

Measured C13/C12 ratios were calculated relative to the PDB-1 international standard and the RCYBP ages were normalized to -25 per mil. If the ratio and age are accompanied by an (*), then the C13/C12 value was estimated, based on values typical of the material type. The quoted results are NOT calibrated to calendar years. Calibration to calendar years should be calculated using the Conventional C14 age.

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23.1:lab. mult=1)

Laboratory number: **Beta-212756**

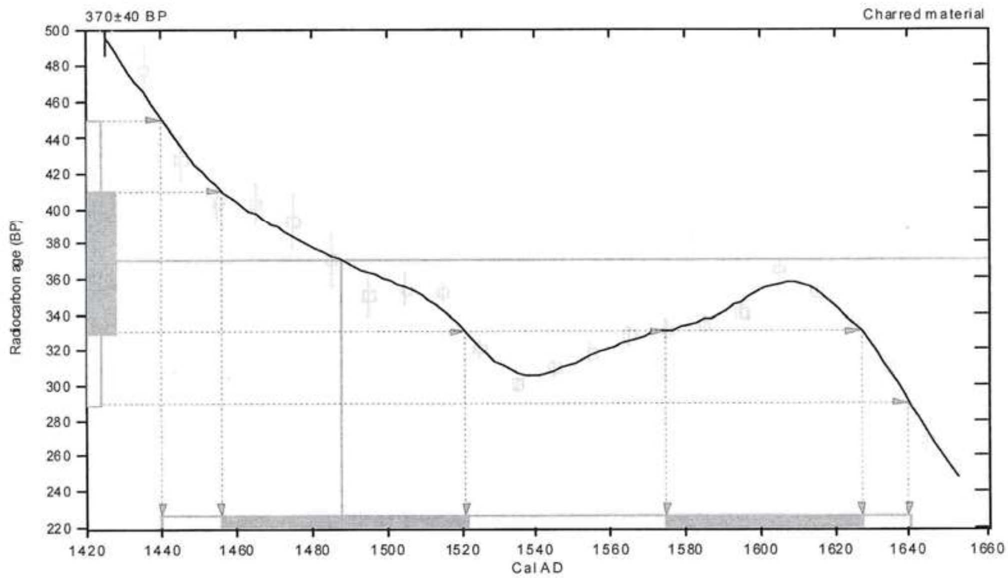
Conventional radiocarbon age: **370±40 BP**

2 Sigma calibrated result: (95% probability) **Cal AD 1440 to 1640 (Cal BP 510 to 310)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 1490 (Cal BP 460)

1 Sigma calibrated results: (68% probability) Cal AD 1460 to 1520 (Cal BP 490 to 430) and Cal AD 1580 to 1630 (Cal BP 380 to 320)



References:

Database used
INTCAL98
Calibration Database
Editorial Comment
Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii
INTCAL98 Radiocarbon Age Calibration
Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083
Mathematics
A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-26.9:lab. mult=1)

Laboratory number: **Beta-212757**

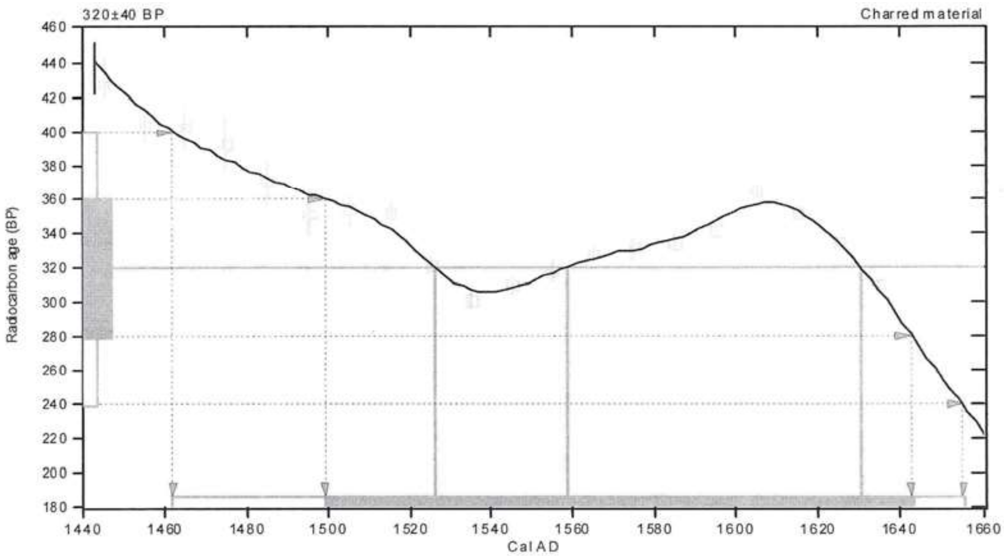
Conventional radiocarbon age: **320±40 BP**

2 Sigma calibrated result: (95% probability) **Cal AD 1460 to 1660 (Cal BP 490 to 290)**

Intercept data

Intercepts of radiocarbon age with calibration curve: Cal AD 1530 (Cal BP 420) and
Cal AD 1560 (Cal BP 390) and
Cal AD 1630 (Cal BP 320)

1 Sigma calibrated result: (68% probability) Cal AD 1500 to 1640 (Cal BP 450 to 310)



References:

Database used
INTCAL98
Calibration Database
Editorial Comment
Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii
INTCAL98 Radiocarbon Age Calibration
Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083
Mathematics
A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-21.7:lab. mult=1)

Laboratory number: **Beta-212758**

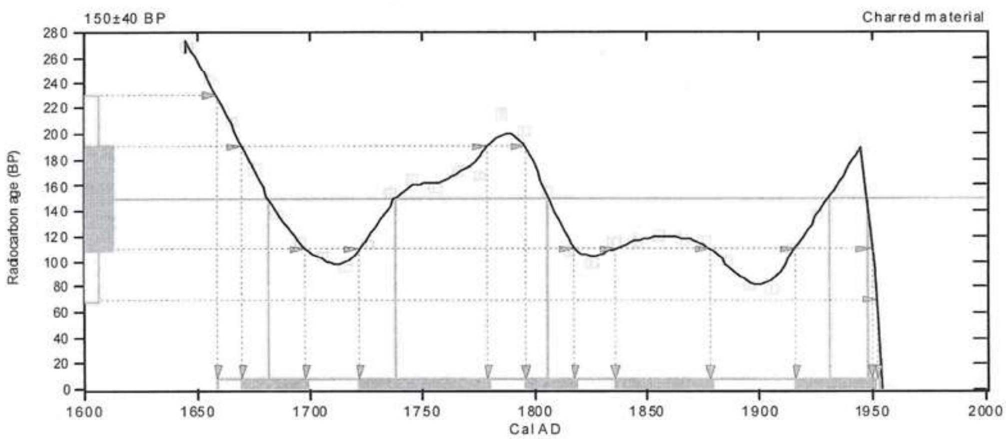
Conventional radiocarbon age: **150±40 BP**

2 Sigma calibrated result: (95% probability) **Cal AD 1660 to 1950 (Cal BP 290 to 0)**

Intercept data

Intercepts of radiocarbon age with calibration curve:
Cal AD 1680 (Cal BP 270) and
Cal AD 1740 (Cal BP 210) and
Cal AD 1810 (Cal BP 140) and
Cal AD 1930 (Cal BP 20) and
Cal AD 1950 (Cal BP 0)

1 Sigma calibrated results: (68% probability)
Cal AD 1670 to 1700 (Cal BP 280 to 250) and
Cal AD 1720 to 1780 (Cal BP 230 to 170) and
Cal AD 1800 to 1820 (Cal BP 150 to 130) and
Cal AD 1840 to 1880 (Cal BP 110 to 70) and
Cal AD 1920 to 1950 (Cal BP 30 to 0)



References:
Database used
INTCAL98
Calibration Database
Editorial Comment
Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii
INTCAL98 Radiocarbon Age Calibration
Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083
Mathematics
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-26.2:lab. mult=1)

Laboratory number: **Beta-212759**

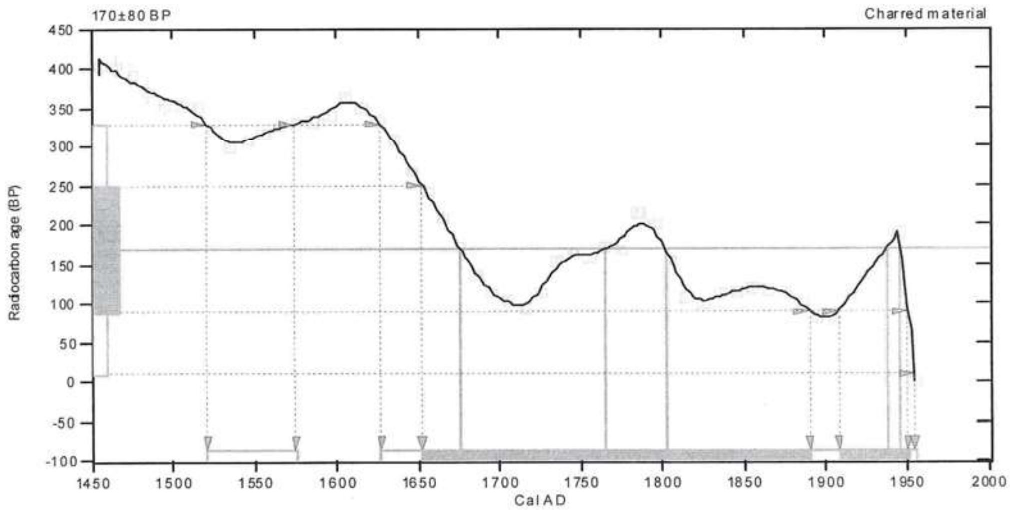
Conventional radiocarbon age: **170±80 BP**

2 Sigma calibrated results: **Cal AD 1520 to 1580 (Cal BP 430 to 380) and**
(95% probability) **Cal AD 1630 to 1960 (Cal BP 320 to 0)**

Intercept data

Intercepts of radiocarbon age with calibration curve: Cal AD 1680 (Cal BP 270) and
Cal AD 1770 (Cal BP 180) and
Cal AD 1800 (Cal BP 150) and
Cal AD 1940 (Cal BP 10) and
Cal AD 1950 (Cal BP 0)

1 Sigma calibrated results: Cal AD 1650 to 1890 (Cal BP 300 to 60) and
(68% probability) Cal AD 1910 to 1950 (Cal BP 40 to 0)



References:
Database used
INTCAL98
Calibration Database
Editorial Comment
Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii
INTCAL98 Radiocarbon Age Calibration
Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083
Mathematics
A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-27.4:lab. mult=1)

Laboratory number: **Beta-212760**

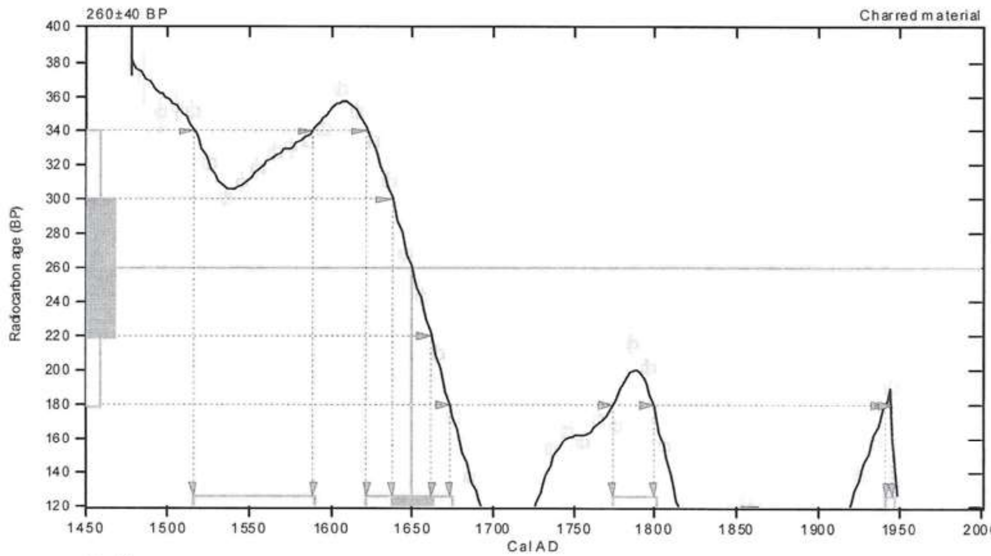
Conventional radiocarbon age: **260±40 BP**

2 Sigma calibrated results: (95% probability) **Cal AD 1520 to 1590 (Cal BP 430 to 360) and Cal AD 1620 to 1670 (Cal BP 330 to 280) and Cal AD 1770 to 1800 (Cal BP 180 to 150) and Cal AD 1940 to 1950 (Cal BP 10 to 0)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 1650 (Cal BP 300)

1 Sigma calibrated result: (68% probability) Cal AD 1640 to 1660 (Cal BP 310 to 290)



References:

Database used
INTCAL 98
Calibration Database
Editorial Comment
Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii
INTCAL98 Radiocarbon Age Calibration
Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083
Mathematics
A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.4:lab. mult=1)

Laboratory number: **Beta-212761**

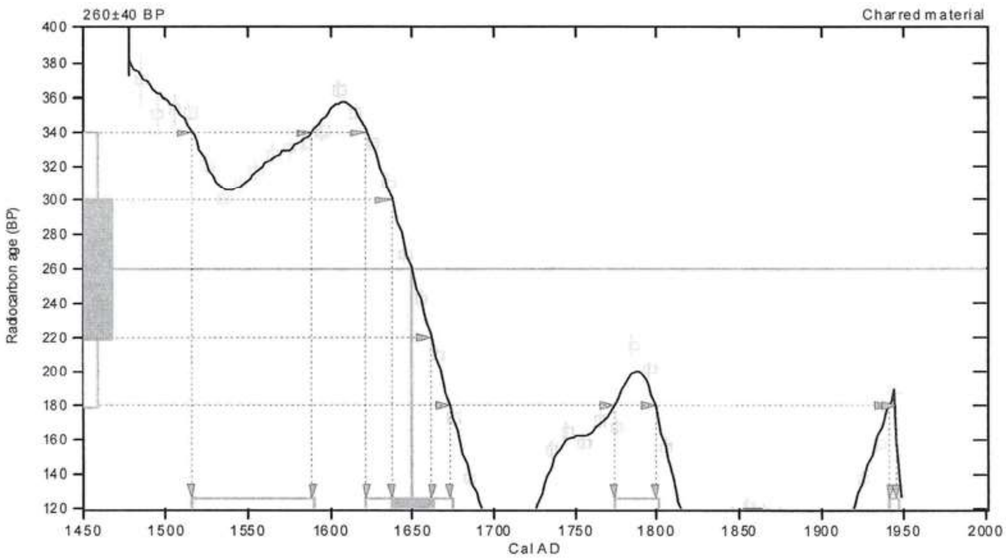
Conventional radiocarbon age: **260±40 BP**

2 Sigma calibrated results: (95% probability) **Cal AD 1520 to 1590 (Cal BP 430 to 360) and Cal AD 1620 to 1670 (Cal BP 330 to 280) and Cal AD 1770 to 1800 (Cal BP 180 to 150) and Cal AD 1940 to 1950 (Cal BP 10 to 0)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 1650 (Cal BP 300)

1 Sigma calibrated result: (68% probability) Cal AD 1640 to 1660 (Cal BP 310 to 290)



References:

Database used
INTCAL98
Calibration Database
Editorial Comment
Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii
INTCAL98 Radiocarbon Age Calibration
Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083
Mathematics
A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.1:lab. mult=1)

Laboratory number: **Beta-212762**

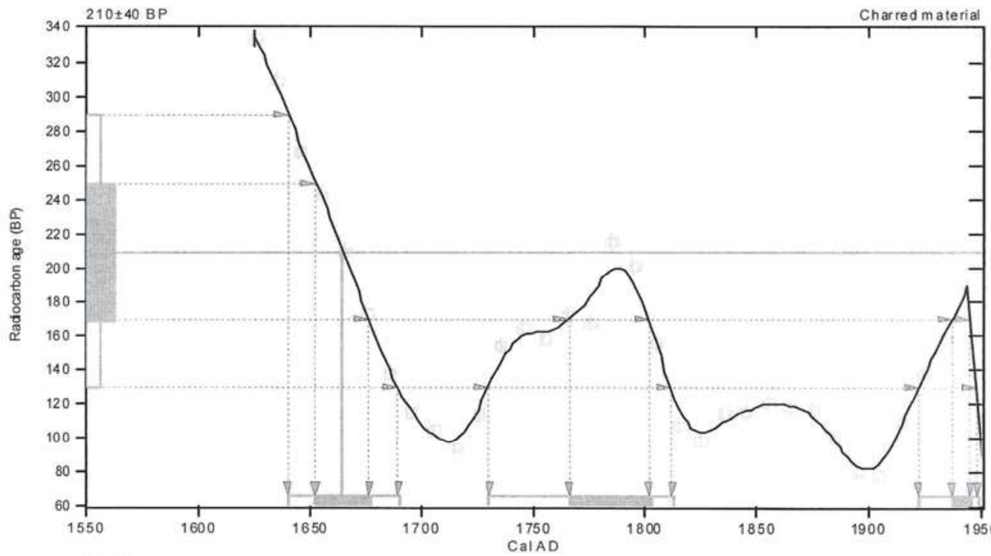
Conventional radiocarbon age: **210±40 BP**

2 Sigma calibrated results: **Cal AD 1640 to 1690 (Cal BP 310 to 260) and**
(95% probability) **Cal AD 1730 to 1810 (Cal BP 220 to 140) and**
Cal AD 1920 to 1950 (Cal BP 30 to 0)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 1660 (Cal BP 290)

1 Sigma calibrated results: Cal AD 1650 to 1680 (Cal BP 300 to 270) and
(68% probability) Cal AD 1770 to 1800 (Cal BP 180 to 150) and
Cal AD 1940 to 1950 (Cal BP 10 to 0)



References:

Database used
INTCAL 98

Calibration Database

Editorial Comment
Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii

INTCAL98 Radiocarbon Age Calibration
Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083

Mathematics

A Simplified Approach to Calibrating C14 Dates
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23.4:lab. mult=1)

Laboratory number: **Beta-212763**

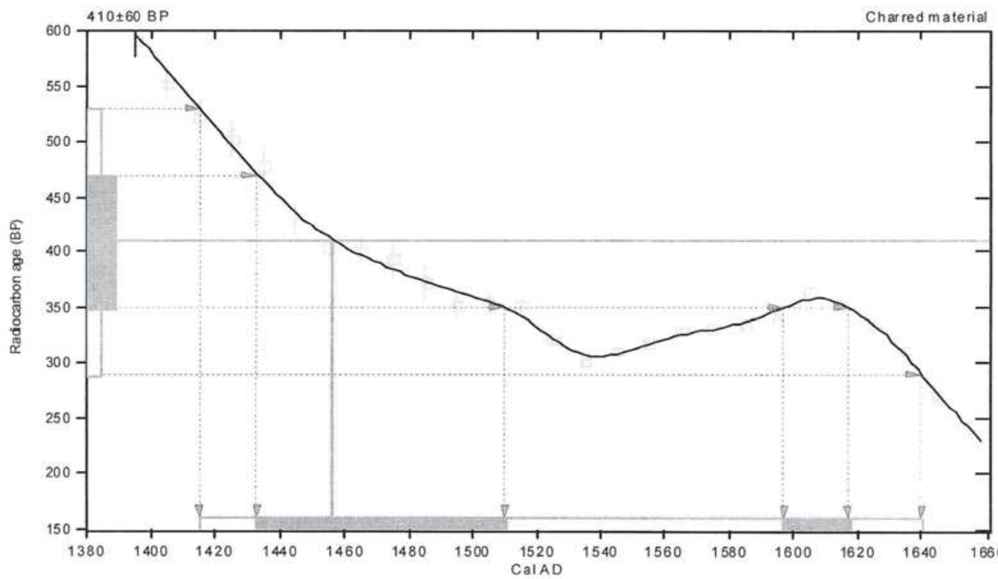
Conventional radiocarbon age: **410±60 BP**

2 Sigma calibrated result: (95% probability) **Cal AD 1420 to 1640 (Cal BP 540 to 310)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 1460 (Cal BP 490)

1 Sigma calibrated results: (68% probability) Cal AD 1430 to 1510 (Cal BP 520 to 440) and Cal AD 1600 to 1620 (Cal BP 350 to 330)



References:

Database used
INTCAL 98
Calibration Database
Editorial Comment
Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii
INTCAL98 Radiocarbon Age Calibration
Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083
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A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.4:lab. mult=1)

Laboratory number: **Beta-212764**

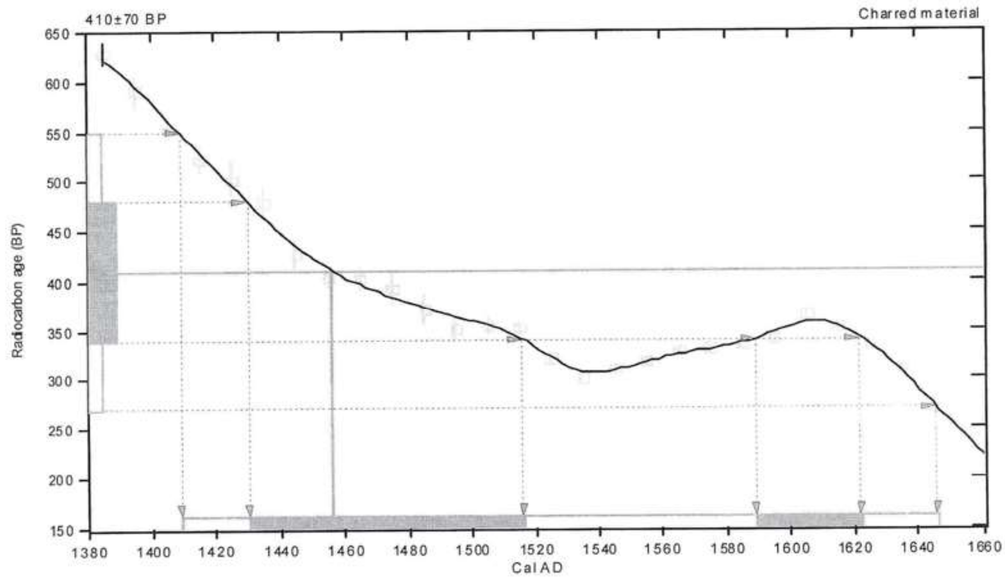
Conventional radiocarbon age: **410±70 BP**

2 Sigma calibrated result: **Cal AD 1410 to 1650 (Cal BP 540 to 300)**
(95% probability)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 1460 (Cal BP 490)

1 Sigma calibrated results: Cal AD 1430 to 1520 (Cal BP 520 to 430) and
(68% probability) Cal AD 1590 to 1620 (Cal BP 360 to 330)



References:
Database used
INTCAL98
Calibration Database
Editorial Comment
Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii
INTCAL98 Radiocarbon Age Calibration
Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.1:lab. mult=1)

Laboratory number: **Beta-212765**

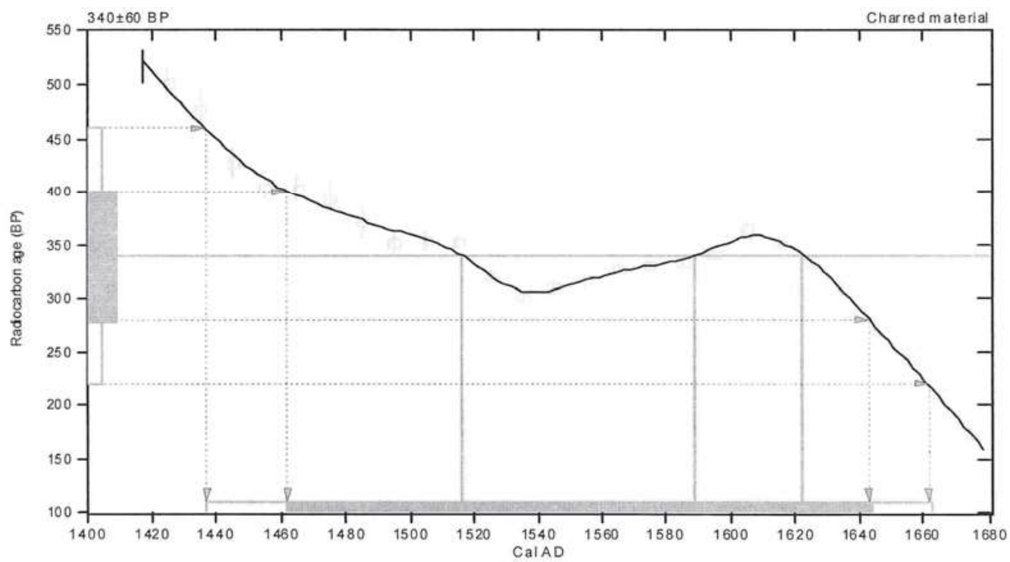
Conventional radiocarbon age: **340±60 BP**

2 Sigma calibrated result: **Cal AD 1440 to 1660 (Cal BP 510 to 290)**
(95% probability)

Intercept data

Intercepts of radiocarbon age
with calibration curve: Cal AD 1520 (Cal BP 430) and
Cal AD 1590 (Cal BP 360) and
Cal AD 1620 (Cal BP 330)

1 Sigma calibrated result: Cal AD 1460 to 1640 (Cal BP 490 to 310)
(68% probability)



References:

Database used
INTCAL98
Calibration Database
Editorial Comment
Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii
INTCAL98 Radiocarbon Age Calibration
Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.1:lab. mult=1)

Laboratory number: **Beta-212766**

Conventional radiocarbon age: **70±40 BP**

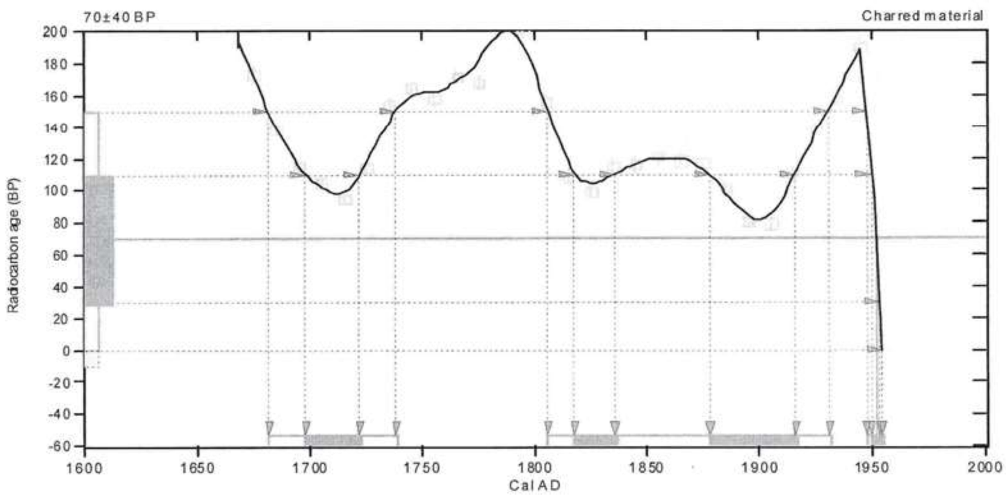
2 Sigma calibrated results[2]: (95% probability) **Cal AD 1680 to 1740 (Cal BP 270 to 210) and Cal AD 1810 to 1930 (Cal BP 140 to 20) and Cal AD 1950 to beyond 1960 (Cal BP 0 to 0)**

[2] 2 Sigma range being quoted is the maximum antiquity based on the minus 2 Sigma range

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 1950 (Cal BP 0)

1 Sigma calibrated results: (68% probability) Cal AD 1700 to 1720 (Cal BP 250 to 230) and Cal AD 1820 to 1840 (Cal BP 130 to 110) and Cal AD 1880 to 1920 (Cal BP 70 to 30) and Cal AD 1950 to 1950 (Cal BP 0 to 0)



References:

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INTCAL98
Calibration Database
Editorial Comment
Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii
INTCAL98 Radiocarbon Age Calibration
Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083
Mathematics
A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-22.6:lab. mult=1)

Laboratory number: **Beta-212767**

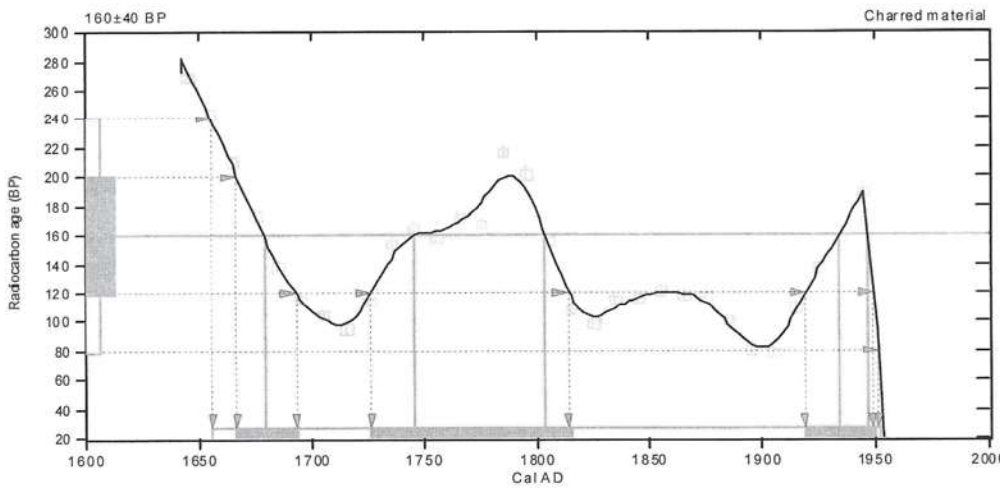
Conventional radiocarbon age: **160±40 BP**

2 Sigma calibrated result: (95% probability) **Cal AD 1660 to 1950 (Cal BP 290 to 0)**

Intercept data

Intercepts of radiocarbon age with calibration curve: Cal AD 1680 (Cal BP 270) and
Cal AD 1740 (Cal BP 200) and
Cal AD 1800 (Cal BP 150) and
Cal AD 1930 (Cal BP 20) and
Cal AD 1950 (Cal BP 0)

1 Sigma calibrated results: (68% probability) Cal AD 1670 to 1690 (Cal BP 280 to 260) and
Cal AD 1730 to 1810 (Cal BP 220 to 140) and
Cal AD 1920 to 1950 (Cal BP 30 to 0)



References:
Database used
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Editorial Comment
Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii
INTCAL98 Radiocarbon Age Calibration
Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083
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Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-22.5:lab. mult=1)

Laboratory number: **Beta-212768**

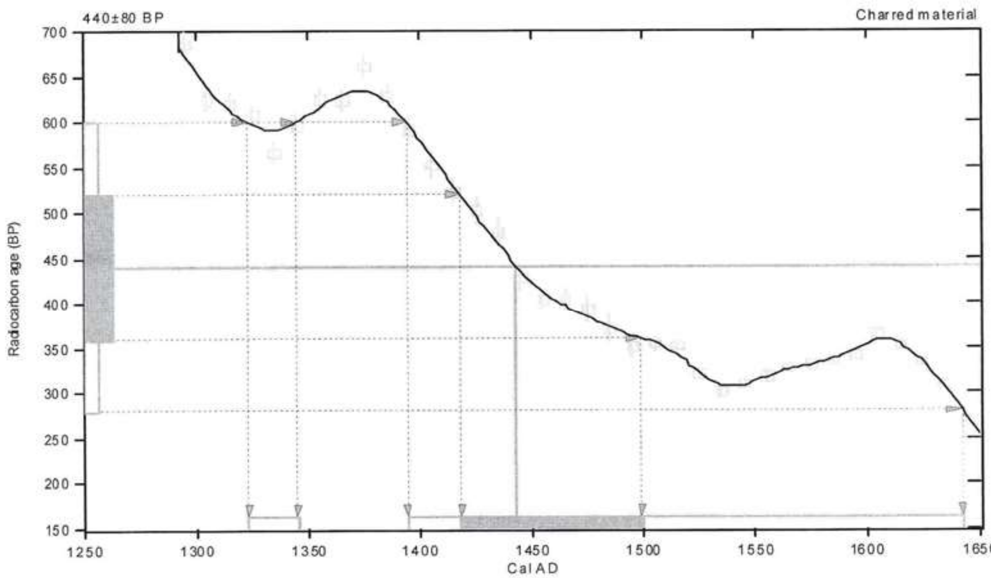
Conventional radiocarbon age: **440±80 BP**

2 Sigma calibrated results: **Cal AD 1320 to 1340 (Cal BP 630 to 600) and**
(95% probability) **Cal AD 1390 to 1640 (Cal BP 560 to 310)**

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal AD 1440 (Cal BP 510)

1 Sigma calibrated result: Cal AD 1420 to 1500 (Cal BP 530 to 450)
(68% probability)



References:

Database used
INTCAL98
Calibration Database
Editorial Comment
Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii
INTCAL98 Radiocarbon Age Calibration
Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083
Mathematics
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.4:lab. mult=1)

Laboratory number: **Beta-212769**

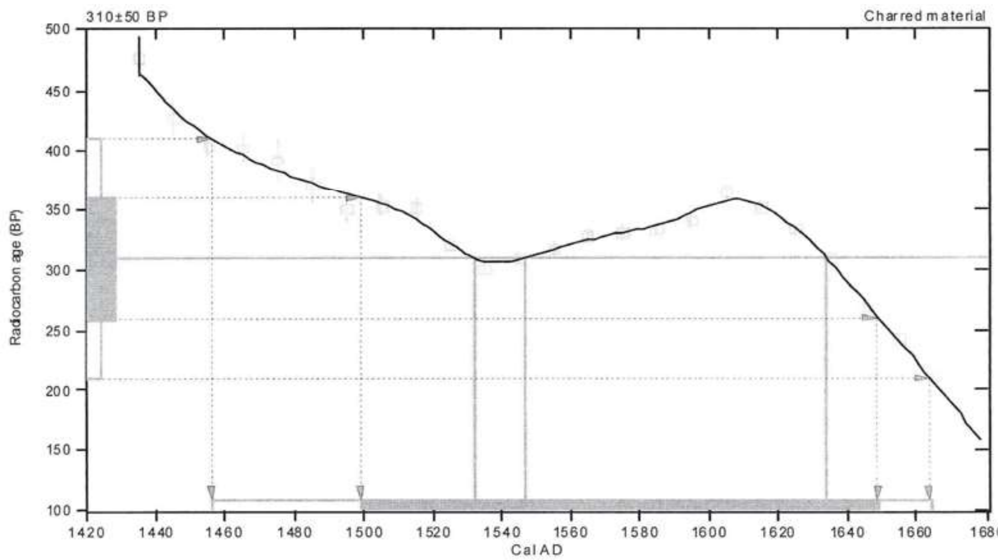
Conventional radiocarbon age: **310±50 BP**

2 Sigma calibrated result: **Cal AD 1460 to 1660 (Cal BP 490 to 290)**
(95% probability)

Intercept data

Intercepts of radiocarbon age with calibration curve: Cal AD 1530 (Cal BP 420) and
Cal AD 1550 (Cal BP 400) and
Cal AD 1630 (Cal BP 320)

1 Sigma calibrated result: Cal AD 1500 to 1650 (Cal BP 450 to 300)
(68% probability)



References:
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Editorial Comment
Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii
INTCAL98 Radiocarbon Age Calibration
Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083
Mathematics
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23.5:lab. mult=1)

Laboratory number: **Beta-212770**

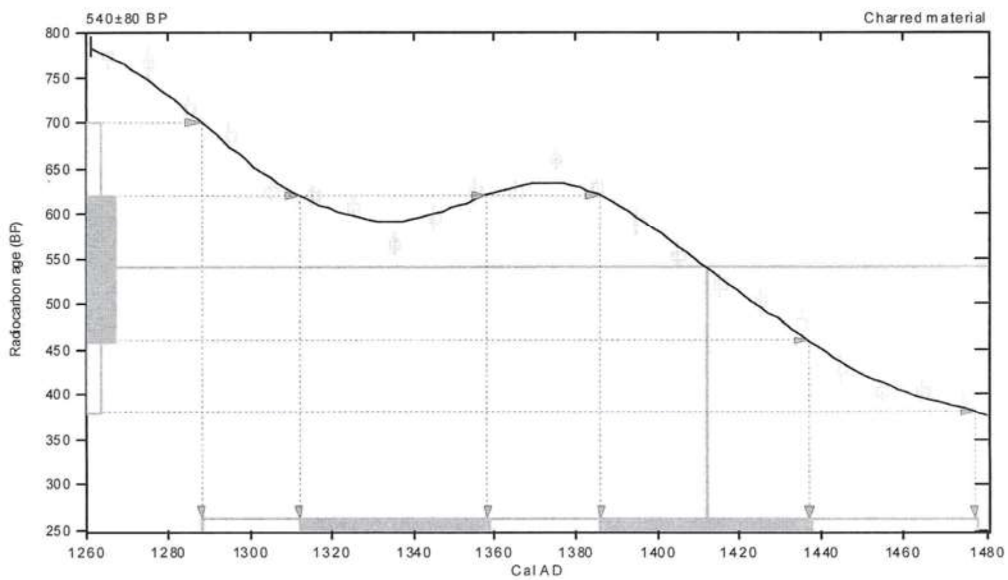
Conventional radiocarbon age: **540±80 BP**

2 Sigma calibrated result: (95% probability) **Cal AD 1290 to 1480 (Cal BP 660 to 470)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 1410 (Cal BP 540)

1 Sigma calibrated results: (68% probability) Cal AD 1310 to 1360 (Cal BP 640 to 590) and Cal AD 1390 to 1440 (Cal BP 560 to 510)



References:

Database used

INTCAL 98

Calibration Database

Editorial Comment

Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii

INTCAL98 Radiocarbon Age Calibration

Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083

Mathematics

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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Appendix J.6

Preservation Plan for SIHP Site 6032 and Site 23681, October 2013

RC-0783

Preservation Plan for SIHP Site 6032 and Site 23681

(TMKs: 3-7-5-10:085
and 3-7-5-17:006)

Wai‘aha 1st Ahupua‘a
North Kona District
Island of Hawai‘i

FINAL VERSION

PREPARED BY:

Robert B. Rechtman, Ph.D.

PREPARED FOR:

U of N BENCORP
75-165 Hualalai Road
Kailua-Kona, HI 96740

October 2013

RECHTMAN CONSULTING, LLC
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ARCHAEOLOGICAL, CULTURAL, AND HISTORICAL STUDIES

Preservation Plan for SIHP Site 6032 and Site 23681

(TMKs: 3-7-5-10:085 and 3-7-5-17:006)

Wai‘aha 1st Ahupua‘a
North Kona District
Island of Hawai‘i

RECHTMAN CONSULTING

CONTENTS

FIGURES

INTRODUCTION

At the request of Mr. Jeffrey Dobbins of U of N BENCORP (landowner), Rechtman Consulting, LLC has prepared this Preservation Plan for SIHP Sites 6302 and 23681 located within a roughly 62-acre project area (TMK: 3-7-5-10:085 and 3-7-5-17:006) adjacent to Kuakini Highway in Waiʻaha 1st Ahupuaʻa, North Kona District, Island of Hawaiʻi (Figures 1 and 2) . As a result of an earlier Archaeological Inventory Survey (Clark and Rechtman 2003) of the project area, twenty-six sites were recorded (Figure 3), eleven of which warranted no further work, ten (SIHP Sites 23670-23678 and 23686) were subject to data recovery (Rechtman and Loubser 2007), three (SIHP Sites 23683, 23684, and 23685) were preserved under a Burial Treatment Plan (Rechtman 2003), and two (SIHP Sites 6302 and 23681) are to be preserved under this current Preservation Plan. SIHP Site 6302 was determined to be significant under Criteria A, C, and D, and the site has been determined eligible for listing (but is not formally listed) in the National Register of Historic Places. DLNR-SHPD also concurred with the determination that SIHP Site 23681 (interpreted to be an agricultural *heiau*) was significant under Criteria D and E (Clark and Rechtman 2003). The current plan, prepared in accordance with HAR 13§13-277 provides both short-term protection and long-term preservation measures for Site 23681 and the portion of the Site 6302 that exists within the current project area.

DESCRIPTION OF THE PROJECT AREA AND DEVELOPMENT PLANS

The current project area is located roughly one mile southeast of Kailua-Kona Town, immediately adjacent to Kuakini Highway, within Waiʻaha 1st Ahupuaʻa, North Kona District, Island of Hawaiʻi (see Figure 1). The boundaries of the current project area are defined to the north by the existing University of the Nations campus and a stone wall along the Waiʻaha 1st/Puaʻa 3rd *ahupuaʻa* boundary, to the east by Hualālai Road, to the south by Kona Hillcrest residential subdivision, and to the west by a stone wall along the *mauka* edge of Kuakini Highway (see Figure 2).

Terrain in the project area is gently undulating and elevation ranges from 40 to 60 feet above sea level. Two soils characterize the project area: Waiʻaha extremely stony silt loam and Punaluʻu extremely rocky peat (Sato et al. 1973). Both are well-drained, thin organic soils over bedrock. The underlying bedrock is *pāhoehoe* within the western third of the project area switching to *ʻaʻā* bedrock underlying the eastern two-thirds and dating to more than 5,000 years B.P. (Wolfe and Morris 1996).

Despite the seemingly consistent semi-arid condition of this area, seasonality is evident. Throughout the Hawaiian Islands, the warmer and drier summer months, traditionally referenced as *kau*, extend from May to September, and the wetter, cooler months (*hoʻoilo*) extend from October to April (Handy and Handy 1972). The temperatures in the Kona area are generally consistent with this seasonal pattern, ranging between 62-80 degrees in winter and 68–86 degrees during the summer months (Schilt 1984). However, the typical rainfall pattern differs considerably from that seen elsewhere; in all elevations along the Kona coast, rainfall during *kau* is typically greater than that during *hoʻoilo* (Schilt 1984).

Two historically introduced species–*kiawe* (*Prosopis pallida*) and *koa haole* (*Leucaena leucocephala*)–dominate the vegetation within the project area. A variety of grasses, vines, weeds, and shrubs are also present. Prior impacts within the project area can be described as substantial. Bulldozing activity in the project area is evidenced by an old access road (no longer in use) corresponding to a waterline easement that extends *mauka/makai* through the property, terminating roughly 10 meters east of Site 6302; and several grubbed areas along the old access road and in the southern portion of the property (see Figure 3). Modern fence lines intersect across the property, extending north/south near the east edge of Site 23681, and wire fencing at the north and south extents of Site 6302 transformed the wall to form the east boundary of a cattle paddock, which likely occurred during utilization of the project area by the Gomes Ranch (1927-1960s). The landowner plans to expand their campus to the south incorporating the current project area. Their current proposed development plan for the property is shown on Figure 4.

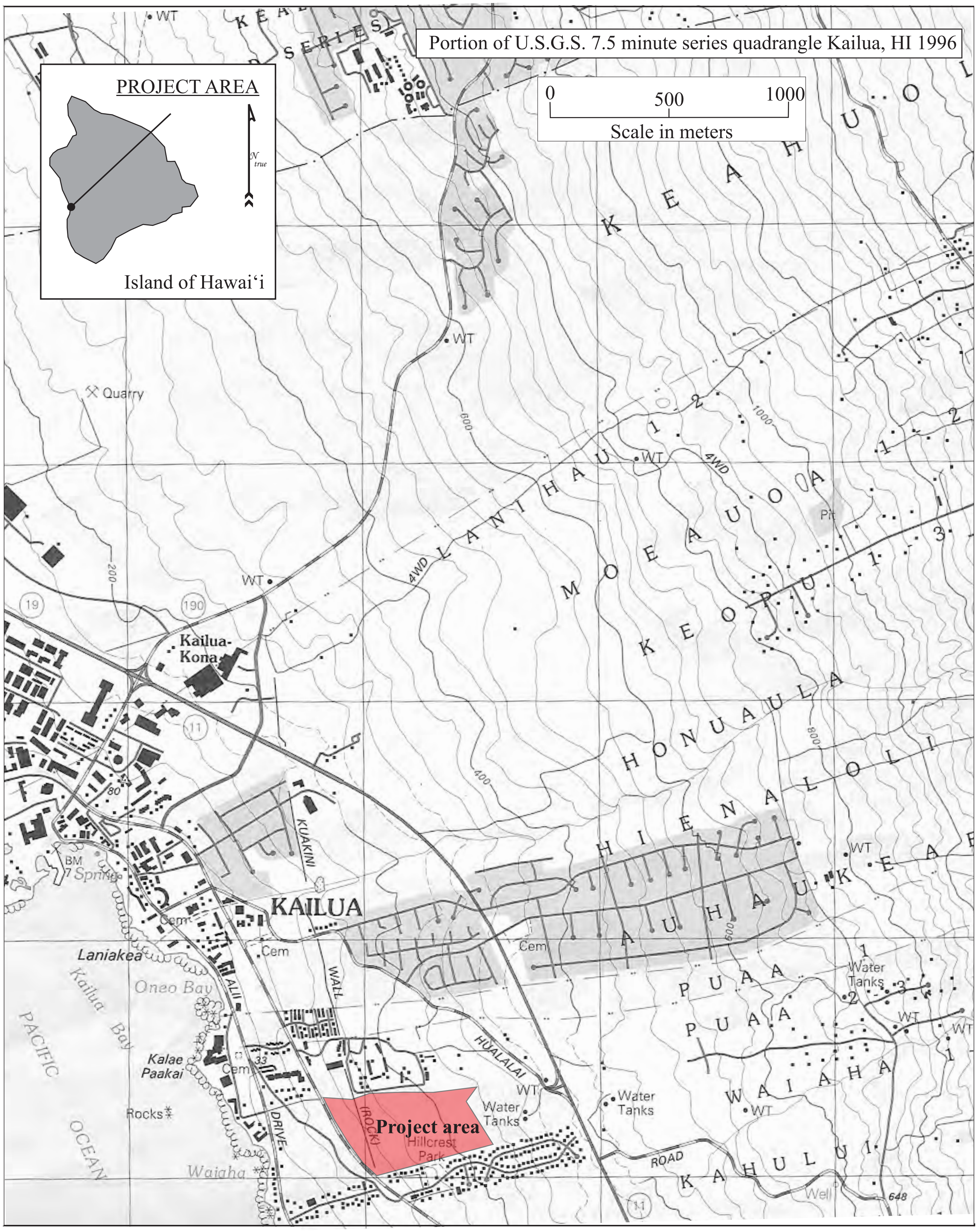

Figure 1. Project area location.

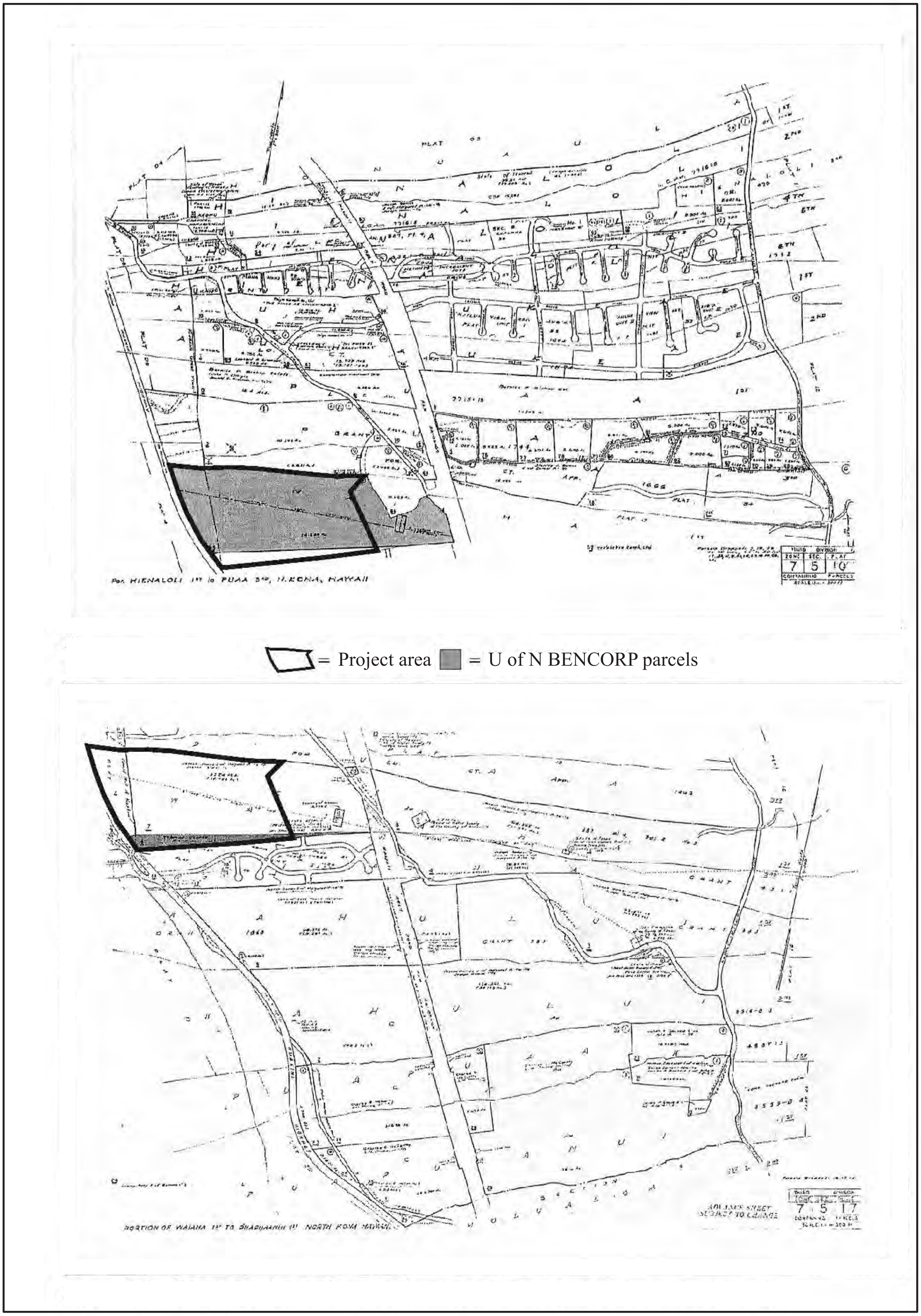

Figure 2. Tax Map Keys: 3-7-5-10 and 17 showing current project area, parcels 85 and 10 (shaded).

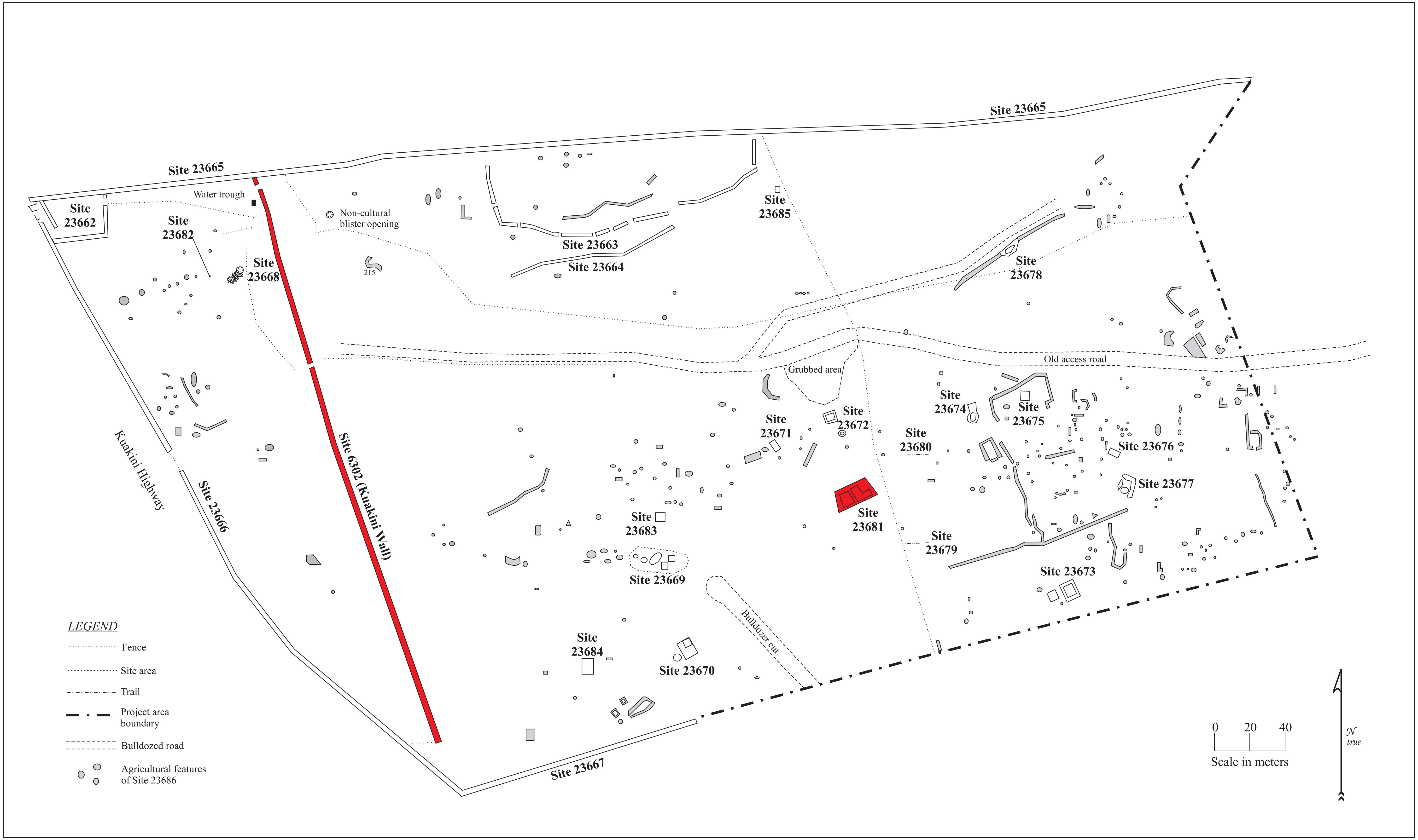

Figure 3. Project area plan view showing archaeological site locations on TMK: 3-7-5-10 and 17 parcels 85 and 06 (SIHP Sites 6302 and 23681 highlighted in red) (Clark and Rechtman 2003).

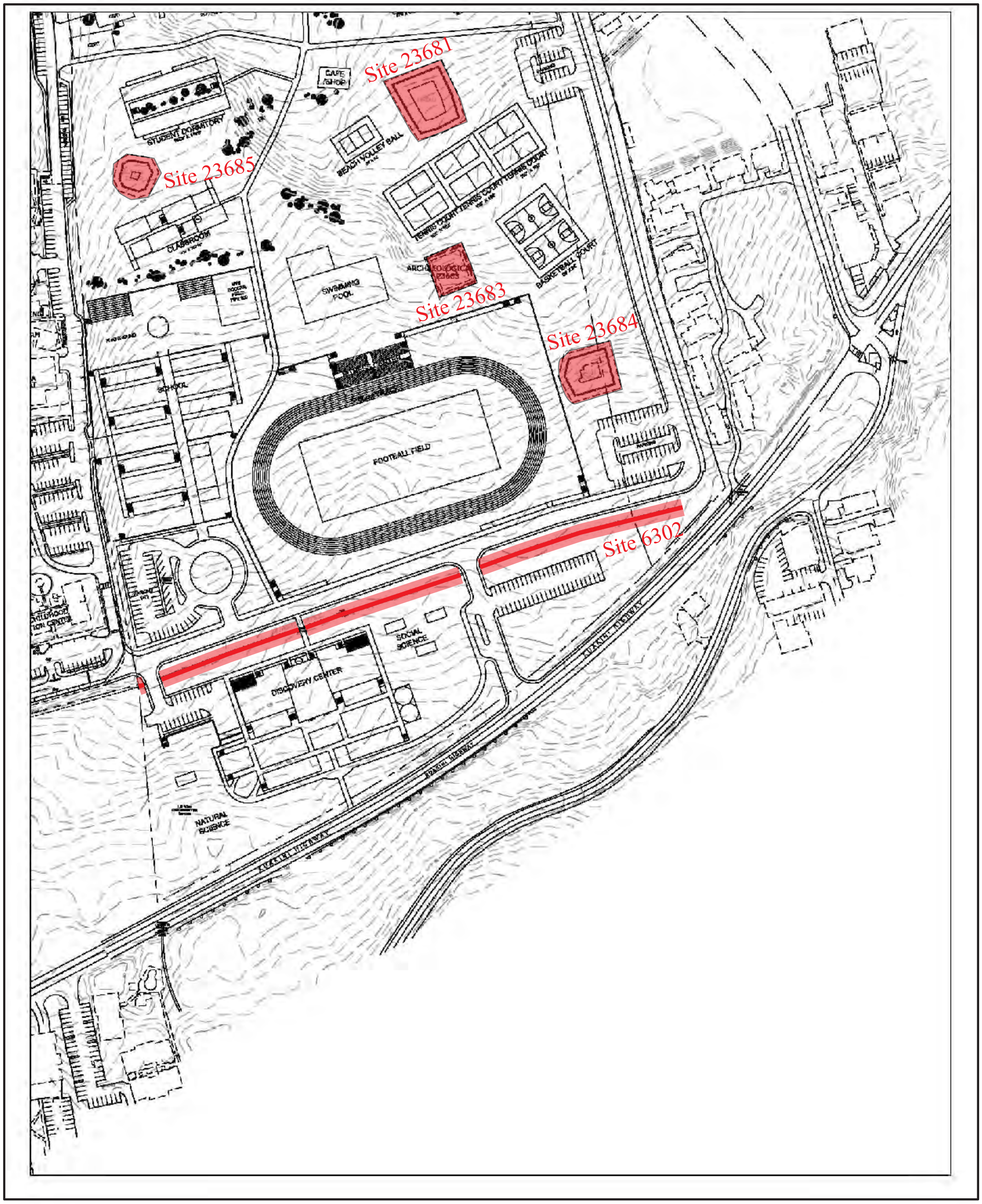

Figure 4. Proposed development showing archaeological and burial preserves.

DESCRIPTION OF THE PRESERVATION SITES

SIHP SITE 6302

Site 6302 is the Statewide Inventory of Historic Places (SIHP) designation for the Kuakini Wall, which extends through the western portion of the current project area. It is generally cited in the archaeological literature (e.g., O'Hare and Wolforth 1998) that the construction of the Great Wall of Kuakini began in the early 1800s as a response to the growing number of feral animals (e.g. cattle, goats, and pigs) running rampant in Kona. Although no record exists of Governor Kuakini having ordered the wall built, its final configuration is attributed to him. John Adams Kuakini was governor of Hawai'i Island between 1820 and 1844. According to Kelly (1983), prior to 1855 this wall was simply known as the Great Wall or the Great Stone Wall. It is perhaps a result of the Reverend Albert Baker's 1915 account of the wall that it has commonly become known as the Kuakini Wall:

> Just a little above [the stone church at Kahalu'u], and continuing all the way to Kailua, is a huge stone wall built in Kuakini's time to keep pigs from the cultivated lands above. (Baker 1915:83)

Other early references to this wall are contained in *Māhele* records for *kuleana* parcels awarded bordering the wall. Typical of these is a *ca*. 1850 map (Figure 5) that accompanied the Land Commission Award to the ABCFM. The wall is documented in the vicinity of the current project area on a *ca*. 1880 map of Kailua town (Figure 6) prepared by J. S. Emerson and S. M. Kanakanui.

Archival research helps shed some light on the timing of the construction of the Great Wall (Rechtman et al. 2005). In Lucy Thurston's writings (Thurston 1882), she states that a stone wall was built in 1825 that completely surrounded the 5-acre property that was given to them; presumably the Great Wall had not yet been built. It was also recorded that the portion of the Great Wall extended north from the northeast corner of the Thurston's property was constructed against the pre-existing Thurston residential compound wall. These facts indicate that the Kuakini Wall was not built as a single construction but rather likely incorporated many preexisting property boundary walls along its course. It is clear from historical records that construction of the wall did not begin until after 1825 and that significant portions of the wall were completed by 1850. It is also interesting to note that the wall's originally cited function—to protect the cultivated fields *mauka* of the wall from feral animals—has been inverted over the years with the purpose becoming the protection of the coastal settlement areas *makai* of the wall. Perhaps the function of the wall changed through time.

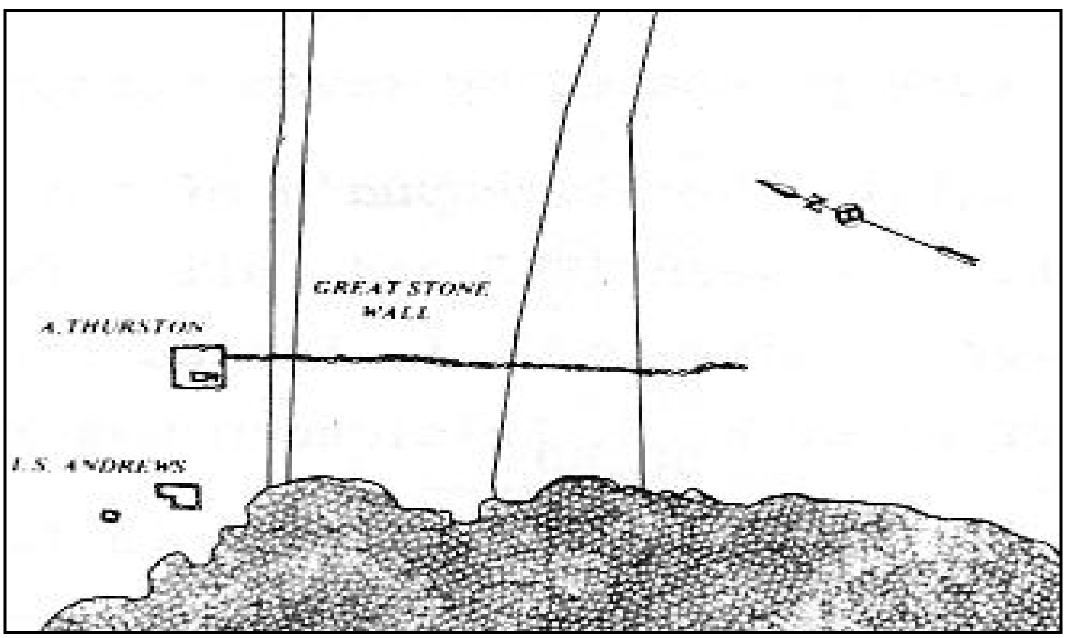

Figure 5. Portion of 1850 map that accompanied LCAw. 387 (from Kelly 1983:41).

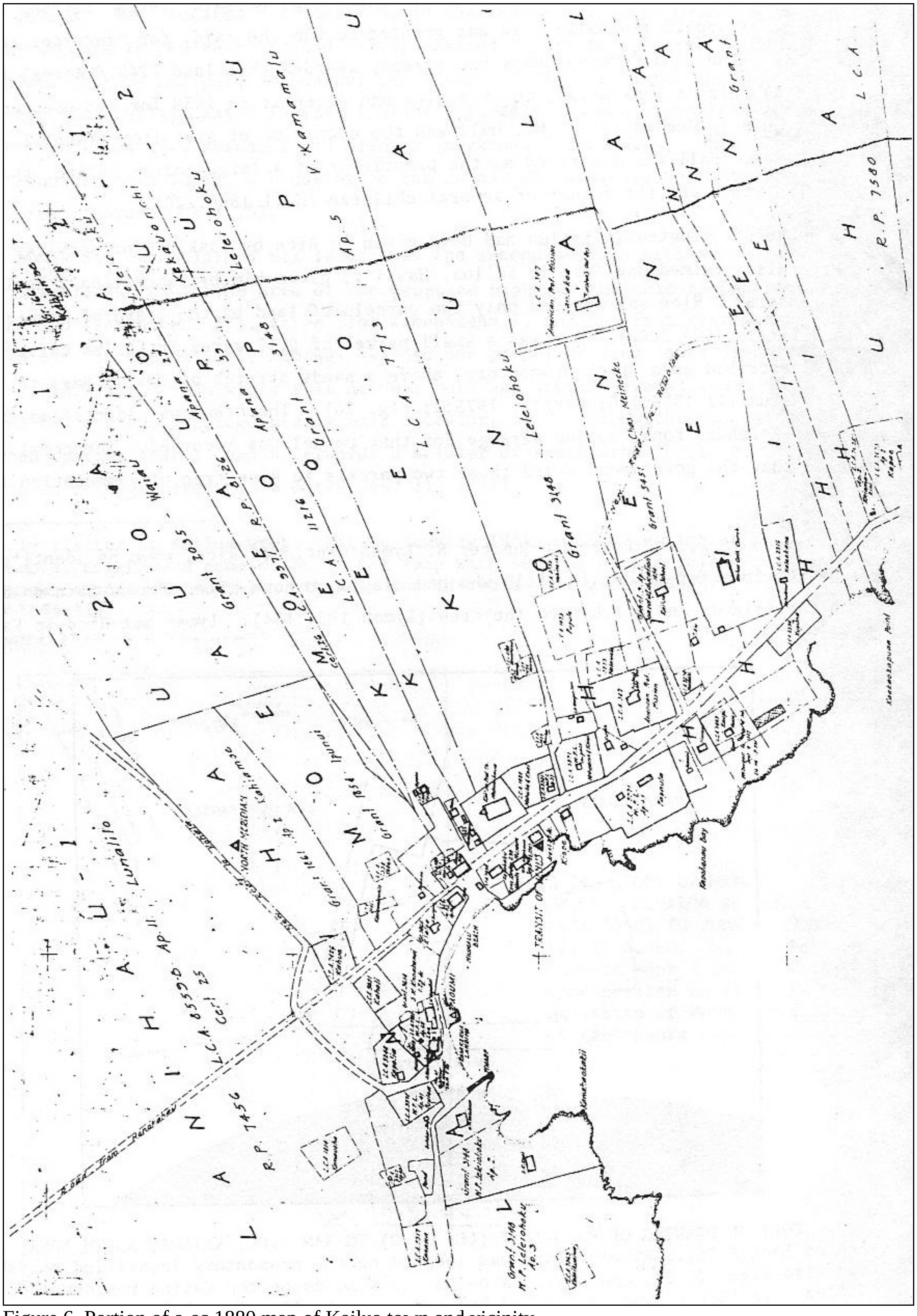

Figure 6. Portion of a *ca.*1880 map of Kailua town and vicinity.

The portion of Site 6302 within the current project area consists of a 340-meter section of wall that extends in a north/south direction in the western portion of the property, terminating to the south near the boundary between the two Tax Map parcels that comprise the project area (see Figure 3). This section of the Kuakini Wall stands up to 1.2 meters high with a maximum width of 1 meter, and is constructed in a core-filled method. Three gaps are present along this section of the wall (see Figure 3). The first gap occurs along its northern end and is 3 meters wide; and the second gap occurs 110 meters south of the northern end and is also 3 meters wide. These gaps was most likely created by the Gomes Ranch (1927-1960s) to help funnel cattle west towards Site 23662, and pasture areas, respectively. At the northern most gap there is a metal water trough located just to the west of the gap and a wire fence parallels Site 23665 all the way to Site 23662. At the second gap there are stub walls and a set of gates. The third gap occurs at the wall's south end 20 meters from the southern boundary of the project area. This section of wall was most likely removed to construct Sites 23666 and 23667. A wire fence connects the southern end of the Kuakini Wall segment to Site 23666 creating a large paddock between the two walls (Clark and Rechtman 2003).

SIHP Site 23681

Site 23681 is interpreted as an agricultural *heiau*, or shrine, located within the south central portion of the project area (see Figure 3). It was originally recorded during fieldwork conducted by Clark and Rechtman (2003). The following description is reproduced here from the Archaeological Inventory Survey report prepared as a result of that fieldwork.

> The site consists of a platform (Feature A) constructed within the northeast corner of a double enclosure (Feature B) [Figure 7]. The platform and enclosure walls are constructed of *'a'ā* cobbles and boulders, while the floor of the enclosure area consists of thin soil covered by dense vegetation. Site 23681 resembles in size and shape other sites described in North Kona as *heiau* (Stokes and Dye 1991).
>
> Feature A is a large rectangular platform (9.1 meters long by 5.3 meters wide) located in the northeast corner of Site 23681. The platform is constructed with large *'a'ā* cobbles and boulders stacked along its outside edges and a surface of small cobbles paving top [see Figure 7]. The platform rises up to 0.7 meters above the surrounding ground surface and is mostly intact with the exception of some collapse in the southwest corner and along the north edge. The enclosure walls (Feature B) run in a perpendicular direction from the platform's edge starting at its southeast and northwest corners. The walls are not of continuous construction and may have been built subsequent to the completion of the platform. A single piece of water rounded coral and a water work cobble were found on the surface of the Feature A.
>
> A 1 X 1 meter test unit (TU-14) was excavated in the northeast corner of Feature A [see Figure 7]. Excavation of TU-14 revealed a three-layer stratigraphic soil profile resting on bedrock. Cultural material collected from TU-14 included volcanic glass, fire cracked rock, marine shell, urchin, *kukui*, and mammal bone.
>
> Feature B consists of a double enclosure located to the south and west of Feature A [see Figure 7]. The enclosure measures 19 meters long by 15 meters wide. A partially terraced central dividing wall creates two enclosure areas within Feature B; the interior of the western area measures 12 meters by 5 meters, and the interior of the eastern area measures 12 meters by 10 meters. The eastern enclosure area is slightly terraced (0.5 meters high) above it western counterpart. The enclosure walls are constructed of *'a'ā* cobbles and boulders, they were formerly stacked, but are now mostly collapsed. Intact sections of wall stand up to 0.5 meters above the ground surface and measure 1.0 meter wide. Ground surface within Feature consist of thin soil covered by dense vegetation. (Clark and Rechtman 2003:52-54).

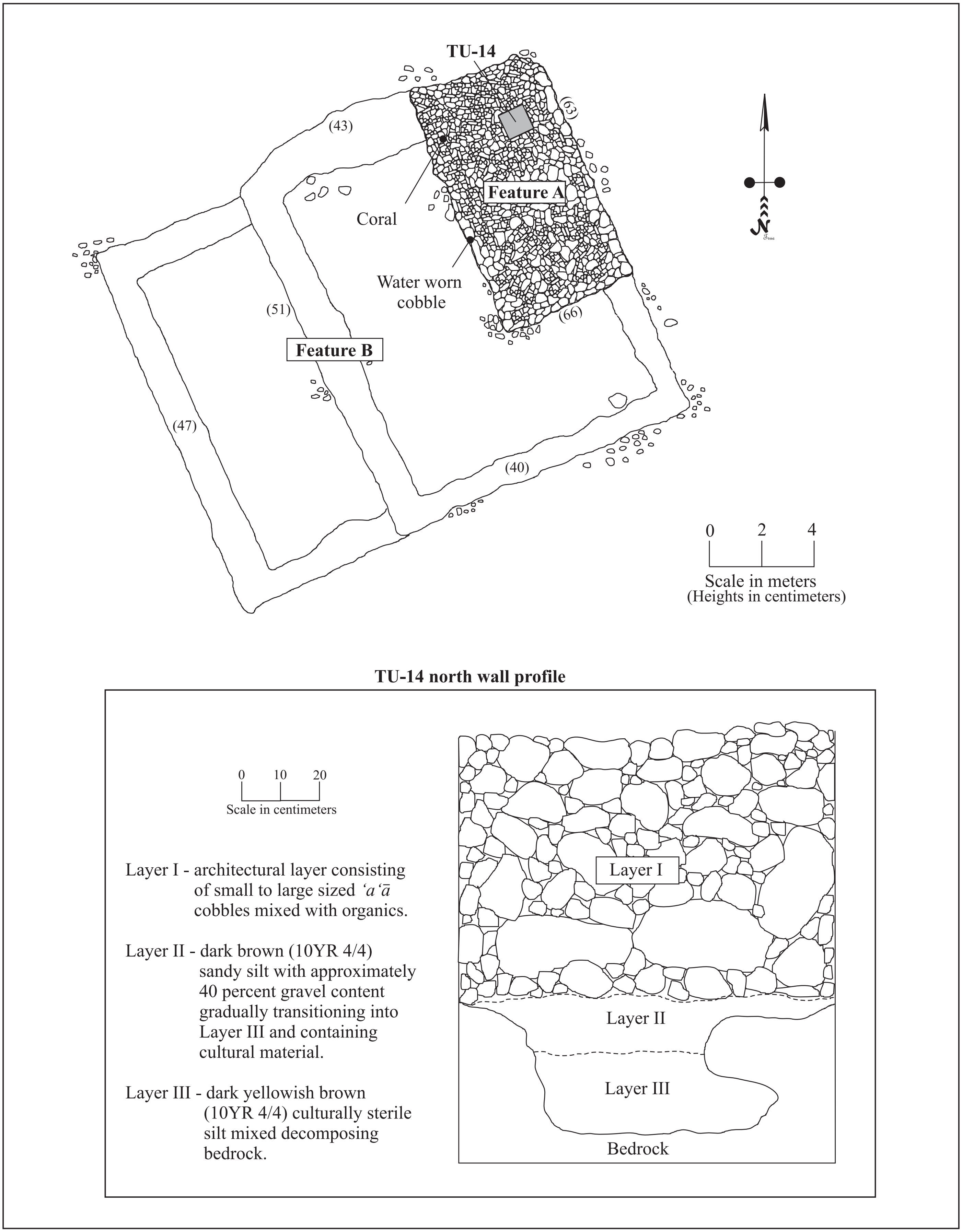

Figure 7. SIHP Site 23681 plan view and TU-14 profile (Clark and Rechtman 2003:53).

PROPOSED PRESERVATION TREATMENTS

SIHP Site 6302

A multi-modal preservation approach is the treatment proposed for the portion of Kuakini Wall within the current project area (Figure 8). The stable intact portions of the wall will be conserved through avoidance and protection, collapsed portions of the wall will be restored and stabilized, the missing southern portion of the wall will be reconstructed to the extent possible given availability of appropriate stones, and the site will be interpreted for the public. An allowance for widening one of the three existing breaches and the creation of a new 40 foot wide breach is also proposed. The overall preservation will be achieved through the establishment of a defined preservation easement, which is described below. No construction, land modification, or other unauthorized activities would be permitted to occur within the preservation easement.

As a primary access to the proposed development area, a roadway will be established extending *mauka* from Kuakini Highway in the south-central portion of the property (see Figure 4). This roadway will require the creation of a new 40 foot wide gap in Site 6302 to accommodate a roadway wide enough for emergency vehicles, curb and gutter, sidewalks, and landscaping. Also, at the northern end of the Kuakini Wall within the proposed development area an existing gap in the wall will be used for the placement of a sewer line and driveway (see Figure 4). It will be necessary to widen this existing gap to facilitate the placement of the infrastructure. Such widening in this area will be limited to no more than 15 feet (roughly 5 meters) of the wall. A third, centrally located gap will be used for pedestrian ingress and egress across the property; the wall terminations at this breach have been previously stabilized during Gomes Ranch use of the land.

All rocks taken from the existing gaps and during the creation of the new breach will be removed by hand and used to repair existing collapsed sections of the wall within the project area, and to restore the missing portion of the wall beginning at its current southern termination and extending southward. The dismantling process will be monitored by an archaeologist and cross-section profile drawings will be prepared and photographs will be taken documenting the walls construction techniques. The new wall terminations will be stabilized consistent with the recent treatment of this site in the vicinity of Palani Road (Rechtman and Nelson 2012). All sections of the wall that will require stabilization/restoration will be documented prior to any such work. A dismantling/restoration plan will be submitted to DLNR-SHPD for approval prior to the implementation of any of the above proposed work. This plan will describe the locations of all dismantling/stabilization/restoration work and contain plan view maps and photographs. The plan will also discuss the provision for preparing a documentation report to be submitted to DLNR-SHPD upon completion of the dismantling/stabilization/restoration work.

The below described preservation measures are consistent with approved preservations plans for this same site on other similar Kailua-Kona properties (e.g., Rechtman 2005; Tulchin and McDermott 2009).

Long-Term/Permanent Preservation Measures

Long-term preservation will be achieved through the establishment of a permanent preservation easement that will be recorded with the Bureau of Conveyances and will be attached to the property deed. The buffer zone will be delineated by a vegetation transition.

Buffer

A twenty-foot buffer zone on either side of the wall, measured from the *mauka* and *makai* faces of the wall, will be established. No construction will be allowed within this buffer zone.

Landscaping and Stabilization

Invasive vegetation will be removed by hand from within the preservation buffer and collapsed portions of the wall will be restacked using immediately available stones (those from the collapses) and any stones removed form the potential gap widening areas. If any vegetation is introduced into the buffer zone it will consist of shallow rooted native and Polynesian-introduced species.

Interpretation

Several small interpretive/cautionary signs will be established along the preservation buffer zone boundary. The proposed language for the signs reads as follows:

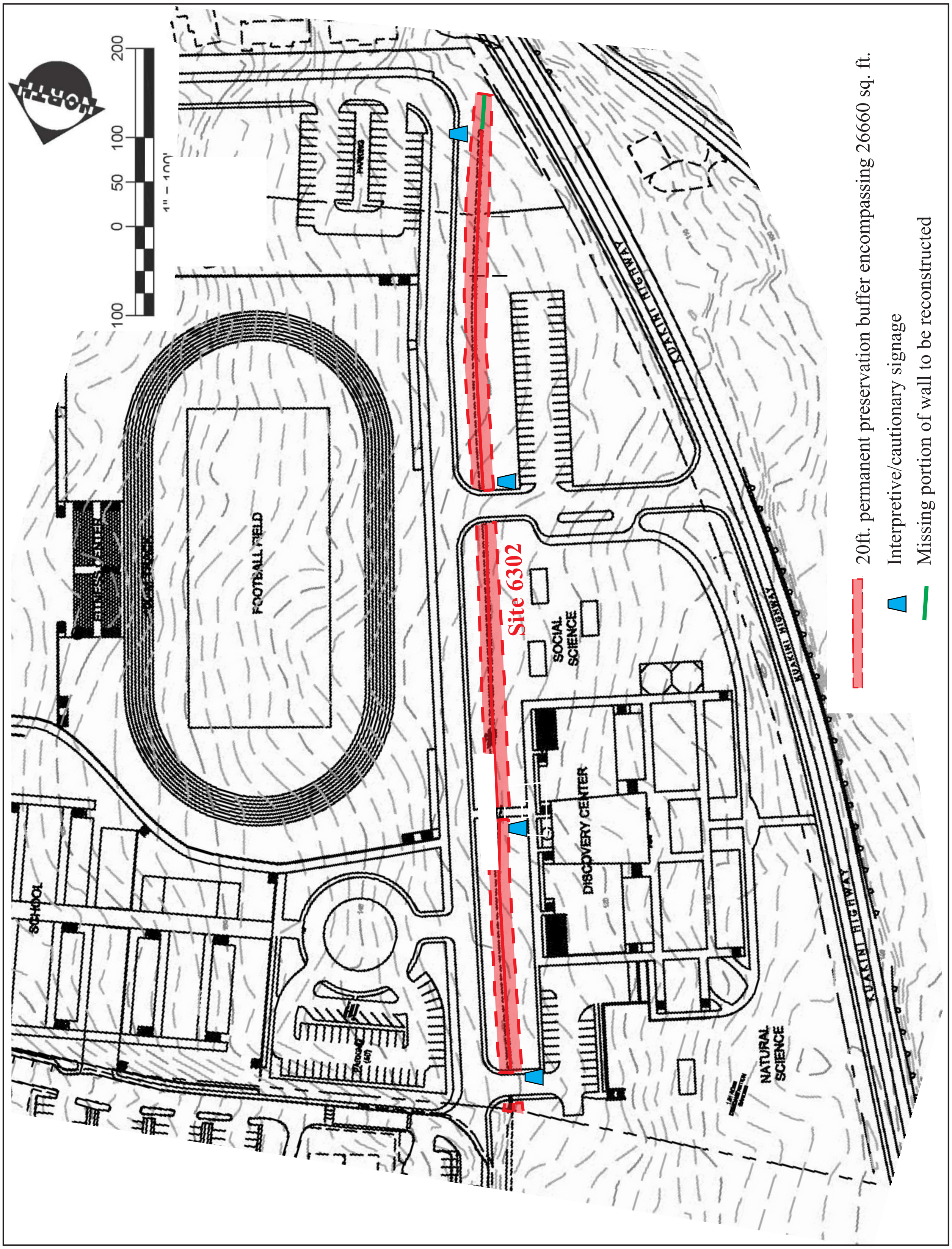

Figure 8. SIHP Site 6302 preservation treatment.

Kuakini Wall
(SIHP Site 6302)
Waiʻaha Ahupuaʻa
North Kona District

Known also as the Great Wall and *Pā Pipi* (the cattle wall), construction of this wall began sometime after 1825. The building of the wall is attributed to Kuakini (John Adams), the Governor of Hawaiʻi Island from 1820 to 1844. It is said that the wall was built to control feral animals, which during the nineteenth century were becoming an increasing nuisance in the upland gardens as well as in the coastal settlement area. This significant site has been determined eligible for listing in the Hawaiʻi Register of Historic Places as well as the National Register of Historic Places.

This is a culturally and historically significant site;
please show your respect by not removing rocks from this area.

Historic sites are protected under state law. Violation could result in a $10,000 fine.
(Chapter 6E-11, Hawaiʻi Revised Statutes)
DLNR-SHPD (808) 692-0015

Short-Term/Interim Protection Measures

Interim protection of the site will be achieved through the placement of orange construction fencing along the permanent preservation boundary. Proper placement of the fence will be checked by a qualified archaeologist and verified in writing to SHPD. Absolutely no construction activity will be allowed within the preservation easement. The location of the preservation site relative to the construction zone will be plotted on the appropriate construction plans. Prior to any construction activities, a qualified archaeologist will meet on-site with construction supervisors to point out the site and construction zone, and to review all preservation requirements needed to assure the protection of the site. Once the construction is complete, the protective fencing will be removed and the preservation buffer will be treated as per the above-described permanent preservation measures.

SIHP Site 23681

Preservation as a stabilized ruin and interpretation is the treatment proposed for Site 23681 (Figure 9). Preservation will be achieved through the establishment of a defined preservation easement, which is described below. No construction, land modification, or other unauthorized activities would be permitted to occur within the preservation easement.

Long-Term/Permanent Preservation Measures

Long-term preservation will be achieved through the establishment of a permanent preservation easement for the *heiau*. This easement will be recorded with the Bureau of Conveyances and will be attached to the property deed.

Buffer

A twenty-foot buffer zone surrounding Site 23681 will be established. No construction will be allowed within this buffer zone. The boundaries of the buffer zone will be defined by a stone wall constructed of local basalt boulders and cobbles. The wall would be built so as to be typically traditional Hawaiian in appearance. The wall will have a dry stacked appearance with a hidden concrete core for stability. Wall height will be a minimum of three feet and width will be approximately 2 feet. An inconspicuously situated narrow gated opening will be left through the enclosing wall to allow access for appropriate visitation and for maintenance purposes.

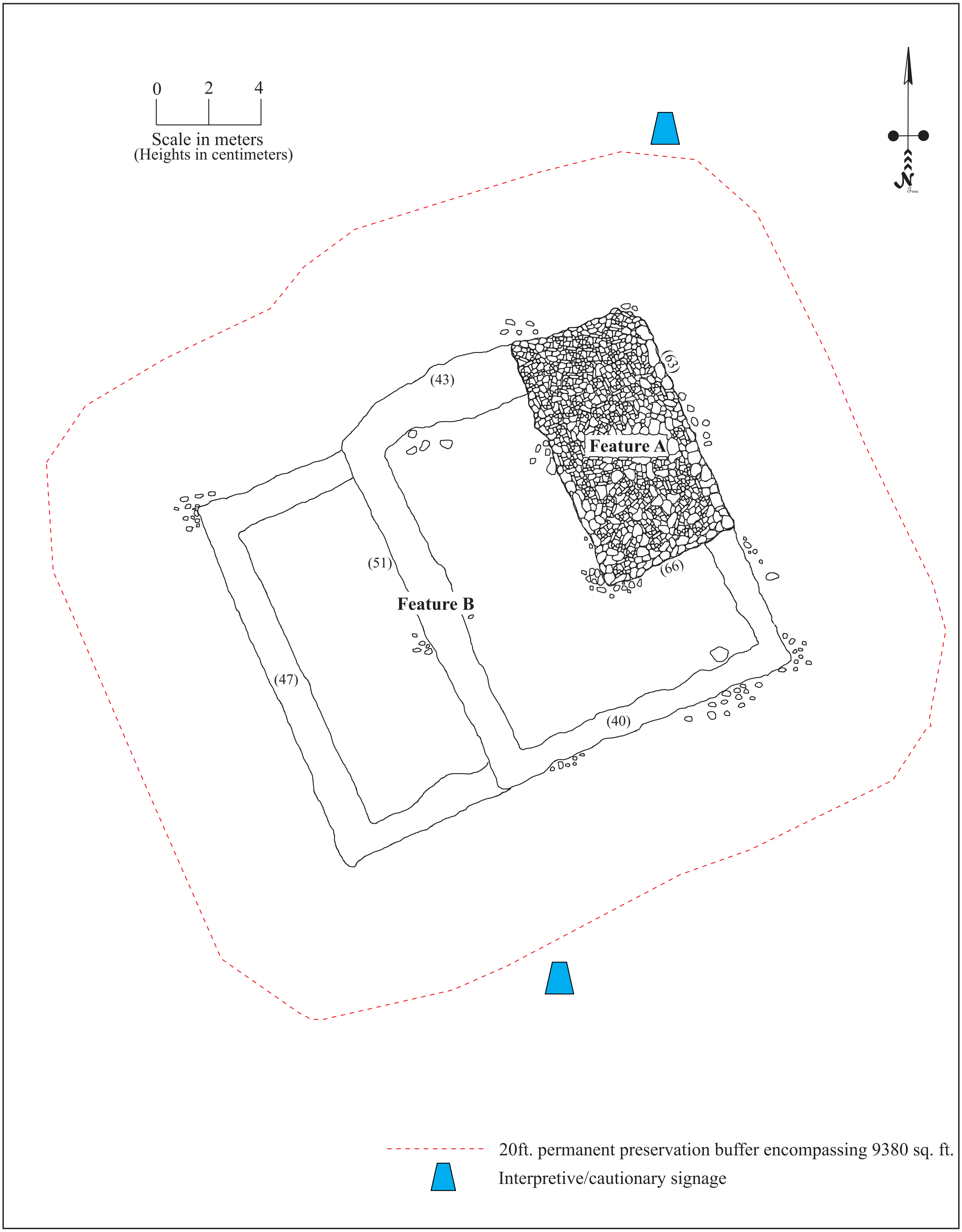

Figure 9. SIHP Site 23681 preservation treatment.

Landscaping and Stabilization

Invasive vegetation will be removed by hand from within the preservation buffer and collapsed portions of Site 23681 will be restacked. If any vegetation is introduced into the buffer zone it will consist of shallow rooted native and Polynesian-introduced species.

Interpretation

At least one interpretive/cautionary sign will be established along the preservation buffer zone boundary. The proposed language for the signs reads as follows:

Agricultural Heiau
(SIHP Site 23681)
Wai‘aha Ahupua‘a
North Kona District

Ceremonial sites like this one were traditional places of worship, referred to as *heiau ho‘oūluulu ‘ai* or *heiau ho‘oūluulu ua* where Hawaiians would conduct rituals to insure agricultural fertility and/or to induce rain. This site was associated with the immediate surrounding area, which during Precontact times was extensively planted with crops such as sweet potato, dryland taro, gourds, and *wauke* for making tapa cloth.

This is a culturally and historically significant site;
please show your respect by not removing rocks from this area.

Historic sites are protected under state law. Violation could result in a $10,000 fine.
(Chapter 6E-11, Hawai‘i Revised Statutes)
DLNR-SHPD (808) 692-0015

Short-Term/Interim Protection Measures

Interim protection of the site will be achieved through the placement of orange construction fencing along the permanent preservation boundary. Proper placement of the fence will be checked by a qualified archaeologist and verified in writing to SHPD. Absolutely no construction activity will be allowed within the preservation easement. The location of the preservation site relative to the construction zone will be plotted on the appropriate construction plans. Prior to any construction activities, a qualified archaeologist will meet on-site with construction supervisors to point out the site and construction zone, and to review all preservation requirements needed to assure the protection of the site. Once the construction is complete, the protective fencing will be removed and the preservation buffer will be treated as per the above-described permanent preservation measures.

CONSULTATION

On June 27, 2013, an earlier version of this preservation plan was presented at a board meeting of the Kona Hawaiian Civic Club. Among those present, comments on the plan were offered by Maurice Kahawaii, Aka DeMesa, Teresa Nakama, and Chuck Flaherty. The earlier version of this plan indicated that as much as 75 feet of the Kuakini Wall might be impacted during development of the property. This was disturbing to those that commented and as a result, the roadways and other infrastructure have been redesigned to utilize existing gaps in the wall, which will greatly lessen the amount of potential direct impact to Site 6302. Those assembled at the board meeting asked if a site visit be conducted of the area. The landowner consented to such a visit, but attempts to organize such a visit have been unsuccessful as there has no further contact from the Kona Hawaiian Civic Club despite several attempted efforts to make such contact.

As part of the preservation planning (Rechtman 2005) for section of this same site on a portion of TMK:3-7-5-009:054 and TMK: 3-7-009:067 in Heinaloli 6th and ‘Auhaukea‘ē 1st *ahupua‘a*, to the north of the current project area, two individuals of prominence in the community were consulted (Ruby McDonald [now deceased] and J. Curtis Tyler III). For that proposed development these individual concurred with a buffer zone of 15 feet (5 feet small than that proposed for the current development area) as well as both the short-term and long-term measures that area similar to those proposed in the current plan. Mr. Tyler was contacted with respect to the current preservation effort to share his *mana‘o*. He agreed with the proposed treatments as outlined above.

IMPLEMENTATION OF PRESERVATION PLAN

U of N BENCORP will implement the preservation measures described in this plan, and insure that all requirements and restrictions associated with the perpetual easements are incorporated into the property deed. They will also retain the management responsibilities associated with the perpetual preservation of these sites. The interim protection measures described above will govern the development activities until such time as the permanent preservation measures are implemented.

REFERENCES CITED

Baker, A.
1915 Between the Bays in Kona. In: *Thrum’s Hawaiian Annual for the Year 1916.*

Clark, M., and R. Rechtman
2003 An Archaeological Inventory Survey of TMKs: 3-7-5-10:85 and 3-7-5-17:06, Wai‘aha Ahupua‘a, North Kona District, Island of Hawai‘i. Rechtman Consulting Report RC-0153. Prepared for U of N BENCORP, Kailua-Kona, Hawai‘i.

Handy, E.S.C., E.G. Handy, with M. Pukui
1972 *Native Planters in Old Hawaii, Their Life, Lore, and Environment*. B.P. Bishop Museum Bulletin 233. B.P. Bishop Museum Press.

Kelly, M.
1983 *Na Mala O Kona*: Gardens of Kona. A History of Land Use in Kona, Hawai‘i. *Departmental Report Series* 83-2. Department of Anthropology, B. P. Bishop Museum, Honolulu. Prepared for the Department of Transportation, State of Hawai‘i.

O’Hare, C., and T. Wolforth
1998 Archaeological Inventory Survey of the Gomes Property Parcel (TMK:3-7-5-19:5,38,40) Land of Kahului 1st North Kona Island of Hawai‘i. Paul H. Rosendahl, Ph.D., Inc., Report 1807-090998, Hilo, Hawaii. Prepared for Towne Development of Hawaii, Inc., Honolulu, Hawai‘i.

Rechtman. R.
2003 Burial Treatment Plan for Three Sites in the Proposed Hualālai Village Development Area (TMKs: 3-7-5-10:85 and 3-7-5-17:06), Waiʻaha Ahupuaʻa, North Kona District, Island of Hawaiʻi. Rechtman Consulting Report RC-0175. Prepared for U of N BENCORP, Kailua-Kona, Hawaiʻi.

Rechtman, R.
2005 Preservation Plan for a Portion of the Kuakini Wall SIHP Site 6302, TMK: 3-7-5-09:67, Heinaloli 6th and ʻAuhaukeaʻē 1st *ahupuaʻa*, North Kona District, Island of Hawaiʻi. Rechtman Consulting Report RC-0304. Prepared for CSV Hospitality Management LLC, Hilo, Hawaiʻi.

Rechtman R., and J. Loubser
2007 Archaeological Data Recovery at Ten sites on TMKs: 3-7-5-10:85 and 3-7-5-17:06, Waiʻaha Ahupuaʻa, North Kona District, Island of Hawaiʻi. Rechtman Consulting Report RC-0223. Prepared for U of N BENCORP, Kailua-Kona, Hawaiʻi.

Rechtman R., and J. Nelson
2012 Archaeological Monitoring Report for the Ane Keohokālole Highway Project (TMKs: 3-7-3-09: 064; 3-7-4-08: 082, 083; 3-7-4-20:027, 029) Keahuolū, Kealakehe, Honokōhau and Kaloko *ahupuaʻa*, North Kona District, Island of Hawaiʻi. Rechtman Consulting Report RC-0671.Prepared for Nan, Inc., Honolulu, Hawaiʻi.

Rechtman, R., M. Clark, and A. Ketner
2005 An Archaeological Inventory Survey of TMKs:3-7-5-03:2, 25 and 3-7-5-22:173, Honuaʻula and Heinaloli 1st *ahupuaʻa*, North Kona District, Island of Hawaiʻi. Rechtman Consulting Report RC-0211. Prepared for The Laniākea Foundation, Honolulu, Hawaiʻi.

Sato, H., W. Ikeda, R. Paeth, R. Smythe, and M. Takehiro, Jr.
1973 *Soil Survey of the Island of Hawaii, State of Hawaii.* U.S. Department of Agriculture, Soil Conservation Service and University of Hawaii Agricultural Experiment Station. Washington, D.C.: Government Printing Office.

Schilt, A.
1984 Subsistence and Conflict in Kona, Hawaii. An Archaeological Study of the Kuakini Highway Realignment Corridor. *Departmental Report Series* 84-1. Department of Anthropology, B.P. Bishop Museum, Honolulu. Prepared for Department of Transportation, State of Hawaii.

Stokes, J., and T. Dye
1991 *Heiau* of the Island of Hawaiʻi: A Historic Survey of Native Hawaiian Temple Sites. *Bishop Museum Bulletin in Anthropology* 2. Bishop Museum Press, Honolulu.

Tulchin, J., and M. McDermott
2009 Mitigation Plan for SIHP # 50-10-27-6302 (Kuakini Wall), Ane Keohokālole Highway Project, Keahuolū Ahupuaʻa, North Kona District, Hawaiʻi Island TMK: [3] 7-4-008:063 por. Cultural Surveys Hawaiʻi report KEAHUOLU 7.Prepared for Belt Collins Hawaii, Ltd., Honolulu.

Thurston, L.
1882 *Life and times, of Mrs. Lucy G. Thurston, wife of Rev. Asa Thurston, pioneer missionary to the Sandwich islands, gathered from letters and journals of extending over a period of more than fifty years. Selected and arranged by herself*. S.C. Andrews: Ann Arbor Michigan.

Wolfe, E., and J. Morris
1996 Geologic Map of the Island of Hawaiʻi. *Geologic Investigations Series Map* 1-2524-A. U.S. Department of the Interior, U.S. Geological Survey.

Appendix J.7

SHPD Acceptance of the Revised Archaeological Preservation Plan for the University of Nations, June 2014

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

JESSE K. SOUKI
FIRST DEPUTY

WILLIAM M. TAM
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

June 19, 2014

Robert B. Rechtman, Ph. D.
ASM Affiliates Inc.
507-A East Lanikaula Street
Hilo, Hawai`i 96720

LOG NO: 2014.2843
DOC NO: 1406MV15
Archaeology

Dear Dr. Rechtman:

SUBJECT: **Chapter 6E-42 Historic Preservation Review –**
Revised Archaeological Preservation Plan for the University of Nations
Waiaha Ahupua'a, North Kona District, Island of Hawai'i
TMK: (3) 7-5-010:085 and 7-5-017:006 (portion)

Thank you for submitting the revised draft report titled *Preservation Plan for SIHP Site 6032 and Site 23681 TMK: 3-7-5-10:085 and 3-7-5-17:006 Waiaha 1st Ahupua'a, North Kona District, Island of Hawai'i* RC-0783 (R. B. Rechtman, October, 2013). We received your submittal March 10, 2014. We apologize for the delayed review and thank you for your patience. Our records indicate that that an archaeological inventory survey was conducted for this parcel by Clark and Rechtman (2003) and 26 historic properties were recorded. Eleven of these sites are recommended for no further work, ten sites are subject to data recovery (Rechtman and Loubster 2007), three sites are preserved under a burial treatment plan (Rechtman 2003) and two sites - the Kuakini Wall (SIHP 50-10-27-6032) and an agricultural heiau (SIHP 23681) are recommended for preservation. The subject plan proposes detailed preservation measures for these two sites. A draft of this plan was previously reviewed by SHPD and revisions were requested (Log 2013.6311, Doc 1402MV16).

According to the plan, the form of preservation proposed for the Kuakini Wall is "preservation as is" which is analogous to avoidance and protection, for the un-impacted portions of the wall; restoration and stabilization for collapsed portions of the wall; and reconstruction for the missing southern portion of the wall. The plan indicates that a separate dismantling/restoration plan will be submitted to SHPD for the restoration, stabilization, and reconstruction portions of the project. This information should include documentation of the areas that will be restored and a description of the work that will be done in order to retain the integrity of this historic property. SHPD agrees with the remaining aspects of the plan such as the interpretive signage, the proposed 20ft. buffers for both sites, and recordation of the preservation areas with the bureau of conveyances. This plan meets the requirements of Hawaii Administrative Rule §13-277 and is accepted by SHPD. Please send one hardcopy of the document, clearly marked **FINAL**, along with a copy of this review letter and a text-searchable PDF version on CD to the Kapolei SHPD office, attention SHPD Library.

Please contact Mike Vitousek at (808) 652-1510 or Michael.Vitousek@Hawaii.gov if you have any questions or concerns regarding this letter.

Aloha,

Theresa K. Donham
Archaeology Branch Chief

Appendix J.8

Dismantling/Restoration Plan for a Portion of the Kuakini Wall, September 2019

Dismantling/Restoration Plan for a Portion of the Kuakini Wall (SIHP 50-10-28-6302)

TMKs: (3) 7-5-010:085 and (3) 7-5-017:006

Waiʻaha 1st Ahupuaʻa
North Kona District
Island of Hawaiʻi

DRAFT VERSION

Prepared By:

Benjamin Barna, Ph.D.

Prepared For:

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September 2019

ASM affiliates
Archaeology • History • Anthropology • Architectural History

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ASM Project Number 33040.00

Dismantling/Restoration Plan for a Portion of the Kuakini Wall (SIHP 50-10-28-6302)

TMKs: (3) 7-5-010:085 and (3) 7-5-017:006

Wai‘aha 1st Ahupua‘a
North Kona District
Island of Hawai‘i

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CHAPTERS

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APPENDIX

1. INTRODUCTION

At the request of Mr. Tom Waddle, on behalf of University of the Nations Kona, ASM Affiliates (ASM) has prepared this Dismantling/Restoration Plan for a portion of Kuakini Wall located on Tax Map Keys: (3) 7-5-010:085 and 3-7-5-017:006 in Waiʻaha 1st Ahupuaʻa, North Kona District, Island of Hawaiʻi (Figures 1 and 2). This portion of Kuakini Wall is included in the State Inventory of Historic Places (SIHP) as Site 50-10-28-6032. It was documented during an Archaeological Inventory Survey (Clark and Rechtman 2003) and determined to be significant under Criteria a, c, and d. This portion of the site is subject to an Archaeological Preservation Plan (Rechtman 2013) that has been accepted (Log No. 2014.2843, Doc. No. 1406MV15) by the Department of Land and Natural Resources-State Historic Preservation Division (DLNR-SHPD). The Archaeological Preservation Plan stipulated, among other measures, that the collapsed portions of Site 6032 will be restored and stabilized, and that the missing southern portion of the wall will be reconstructed to the extent possible given availability of appropriate stones. In their acceptance letter for the Archaeological Preservation Plan (Appendix A), the DLNR-SHPD required that a separate dismantling/restoration plan be submitted to DLNR-SHPD for approval prior to the implementation. The current plan was prepared in response to that requirement.

A multi-modal preservation approach has been adopted for the portion of Kuakini Wall (Site 6302) within the current project area (see Figure 5). The overall preservation will be achieved through the establishment of a 20-foot wide preservation easement, with allowances for three breaches (Figure 4). Additionally, the stable intact portions of the wall will be conserved through avoidance and protection, collapsed portions of the wall will be restored and stabilized, the missing southern portion of the wall will be reconstructed to the extent possible given availability of appropriate stones, and the site will be interpreted for the public (Rechtman 2013). No construction, land modification, or other unauthorized activities would be permitted to occur within the preservation easement.

Construction of an access roadway and parking lots (see Figure 4), however, will require the creation of a new 40 foot wide gap in Site 6302 to accommodate emergency vehicles, curb and gutter, sidewalks, and landscaping. Also, at the northern end of the Kuakini Wall within the proposed development area, an existing gap in the wall will be widened by no more than 15 feet (roughly 5 meters) to facilitate the installation of sewer line and driveway (see Figure 4). A third, centrally located gap (see Figure 4) will be used for pedestrian ingress and egress across the property; the wall terminations at this breach have been previously stabilized. All rocks taken from the existing gaps, and during the creation of the new breach, will be removed by hand and used to repair existing collapsed sections of the wall within the project area, and to restore the missing portion of the wall beginning at its current southern termination and extending southward. The new wall terminations will be stabilized consistent with the recent treatment of this site in the vicinity of Palani Road (Rechtman and Nelson 2012). The current plan presents background information on the Kuakini Wall (Site 6302), with a detailed description of the portion of the wall located within the project area. This is followed by a description of the procedures to be followed during dismantling, stabilization, and restoration work, along with procedures for on-site guidance, supervision, and documentation of the work by a qualified archaeological monitor, as well as general monitoring provisions, instructions for the treatment of recovered remains and the curation of recovered items, and reporting requirements upon completion of the work.

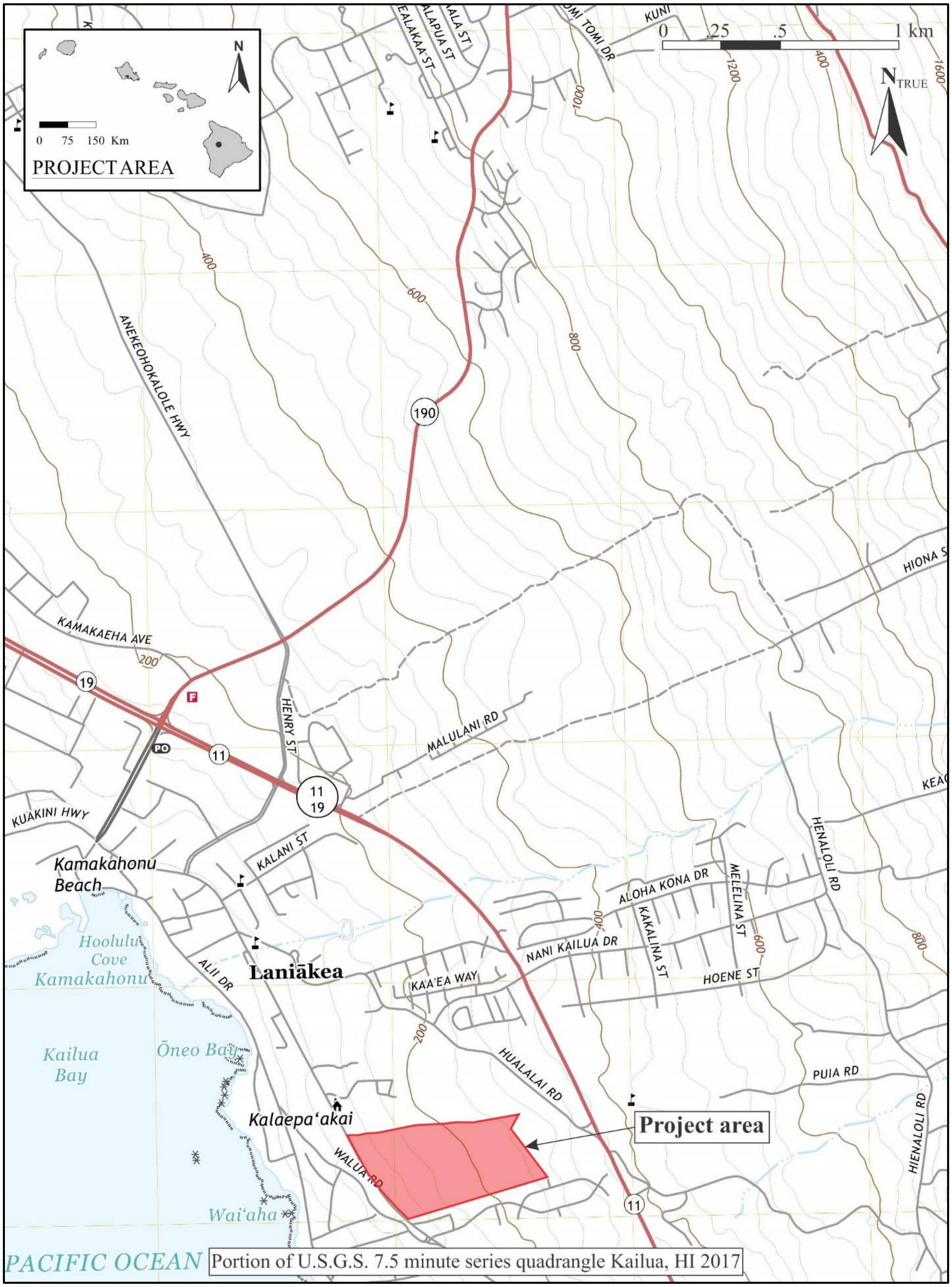

Figure 1. Project area location.

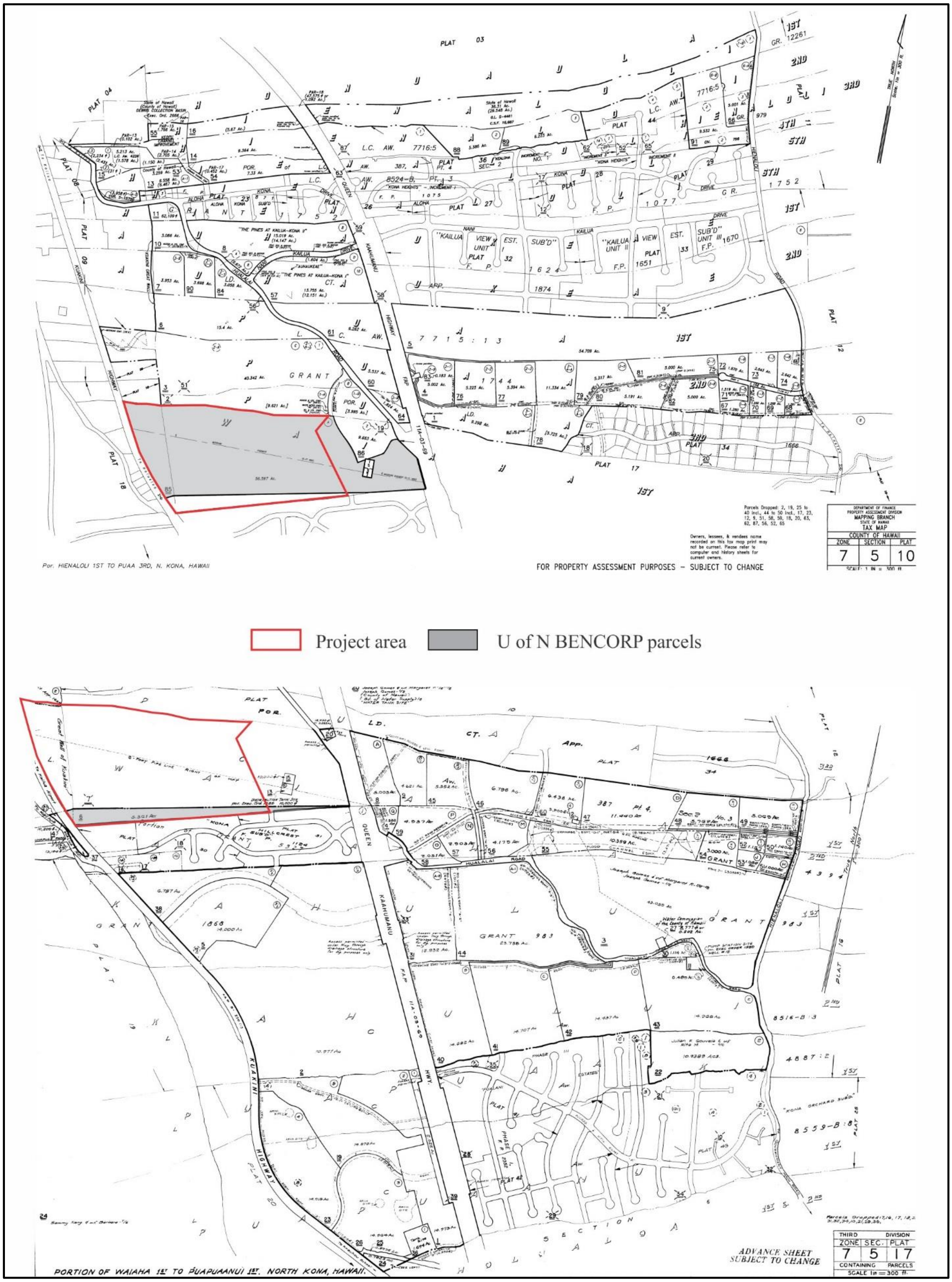

Figure 2. Tax Map Key plats (3) 7-5-10 and (3) 7-5-17 with the project area indicated.

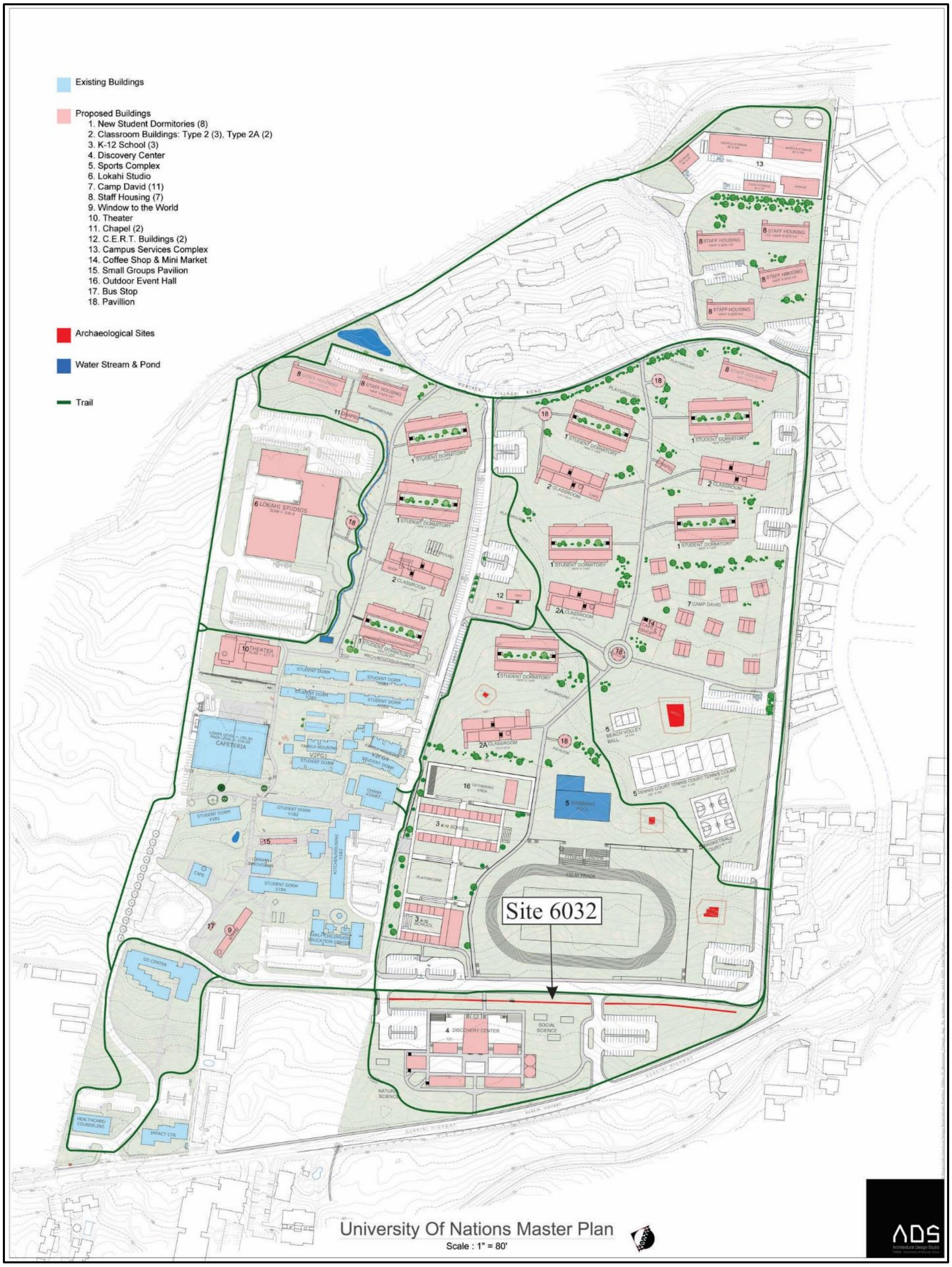

Figure 3. Development plan.

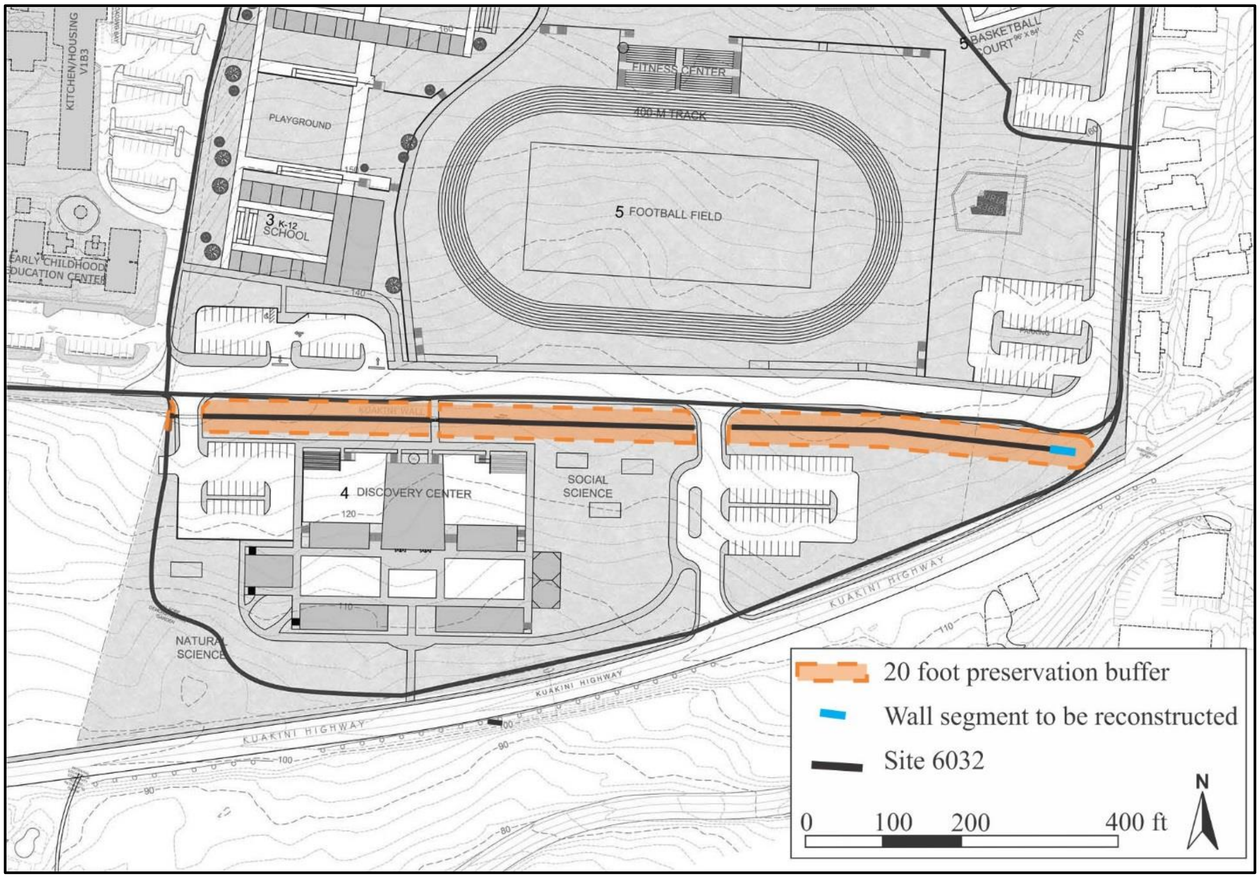

Figure 4. Detail of development plan with Site 6032 and preservation buffer indicated.

2. KUAKINI WALL (SITE 50-10-28-6302)

Site 6302 is the Statewide Inventory of Historic Places (SIHP) designation for Kuakini Wall, which extends through the western portion of the current project area. It is generally stated in the archaeological literature (e.g., O'Hare and Wolforth 1998) that the construction of the Great Wall of Kuakini began in the early 1800s as a response to the growing number of feral animals (e.g. cattle, goats, and pigs) running rampant in Kona. Although no record exists of Governor Kuakini having ordered the wall built, its final configuration is attributed to him. John Adams Kuakini was governor of Hawaiʻi Island between 1820 and 1844. According to Kelly (1983), prior to 1855 this wall was simply known as the Great Wall or the Great Stone Wall. Records of the Māhele of 1848 for *kuleana* parcels awarded bordering the wall also refer to it this way. Its current name is perhaps a result of the Reverend Albert Baker's (1915:83) description the wall:

> Just a little above [the stone church at Kahaluʻu], and continuing all the way to Kailua, is a huge stone wall built in Kuakini's time to keep pigs from the cultivated lands above.

Archival research helps shed some light on the timing of the construction of the Great Wall (Rechtman et al. 2005). In Lucy Thurston's (1882) writings, she states that a stone wall was built in 1825 that completely surrounded the 5-acre property that was given to them; presumably the Great Wall had not yet been built. It was also recorded that the portion of the Great Wall extended north from the northeast corner of the Thurston's property was constructed against the pre-existing Thurston residential compound wall. These facts indicate that the Kuakini Wall was not built as a single construction but rather likely incorporated many preexisting property boundary walls along its course. It is clear from historical records that construction of the wall did not begin until after 1825 and that significant portions of the wall were completed by 1850. It is also interesting to note that the wall's originally cited function—to protect the cultivated fields *mauka* of the wall from feral animals—has been inverted over the years with the purpose becoming the protection of the coastal settlement areas *makai* of the wall.

3. THE DISMANTLING/RESTORATION EFFORT

A qualified archaeological monitor, under the direction of a Principal Investigator, will be present on-site to observe and document the dismantling of the wall, and will then conduct periodic monitoring (once a week) during the reconstruction and stabilization process. Dismantling will be conducted first, followed immediately by stabilization of the newly created wall ends. This will be followed by stabilization of the existing portions of the wall, and then by the reconstruction of the southern end of the wall across the University of Nations property. The dismantling, stabilization, and reconstruction effort will be conducted by skilled rock masons familiar with the construction techniques used historically to build rock walls in Kona. Specific procedures to be followed during the dismantling, reconstruction, and stabilization are described below, along with general monitoring procedures to be followed throughout the project.

DISMANTLING PROCDURES

Prior to any dismantling, the archaeological monitor will meet with the construction team to ensure that they are aware of the plan and to discuss the procedures to be followed. It will be explained that the monitoring archaeologist has the authority to halt work activities in the event that undocumented cultural resources are encountered. The portions of the wall to be dismantled will be cleared of vegetation, and then photographed by the archaeological monitor. The extent of the portions of the wall to be dismantled will be clearly indicated in the field. A scaled plan view drawing of the area to be removed will be prepared prior to dismantling.

During dismantling, all rocks taken from the existing gap and the new breach will be removed by hand. All rocks will be retained for use during the stabilization and reconstruction efforts. Exterior rocks will be staged separately from the interior fill so that they can be used to face the repaired and reconstructed sections. After the rocks are removed from the existing gap and the new breach, the exposed interior of the wall on both sides of each breach will be photographed, and scaled cross-section drawings similar to that shown in Figure 5 will be prepared of each newly created wall end.

STABLIZATION

Stabilization of the newly created wall ends at the existing gap and the new breach will occur immediately after dismantling and required documentation is completed. The stabilized wall ends will be made to look (to the extent possible) like the dismantled ends. Photographs will be taken of the of the new wall terminations after they have been stabilized. Other partially collapsed sections of the wall will then be stabilized using rocks obtained during the dismantling phase of the project. The appearance of the stabilized portions of the wall will match that of the existing wall. All sections of the wall that will require stabilization will be photographed prior to and after any such work.

RESTORATION

Once stabilization has been completed, any remaining rocks obtained during the dismantling effort will be used to reconstruct the wall beginning at its current southern termination, and extending southward as far as the amount of collected rock material will allow. The reconstructed wall will be made to match the appearance of the existing wall. Upon completion of the reconstruction effort, the reconstructed portion of the wall will be photographed.

GENERAL MONITORING METHODS

When on site, the monitor will keep a daily log of activities performed and any discoveries made. The project area and dismantling/restoration/stabilization activities will be photographed over the course of the project, and these photographs will be included in the Dismantling/Restoration Report.

Cultural Deposits

The monitor will notify DLNR-SHPD if any previously undocumented, non-burial historic properties are identified. Any previously undocumented cultural deposits and sequences (including representative natural sequences) identified during the monitoring effort will be mapped, representative scaled profile drawings and plan views will be prepared, photographs will be taken, and the soils (if applicable) will be described in detail (using standard USDA soil descriptions and Munsell colors). If intact cultural deposits are discovered during monitoring, an assessment will be made as to their integrity and significance using the criteria enumerated in HAR 13§13-275-6(b). If the deposit is deemed significant and is likely to be further impacted by demolition activities, work in the affected area will be curtailed, and an appropriate mitigation strategy will be developed in consultation with DLNR-SHPD.

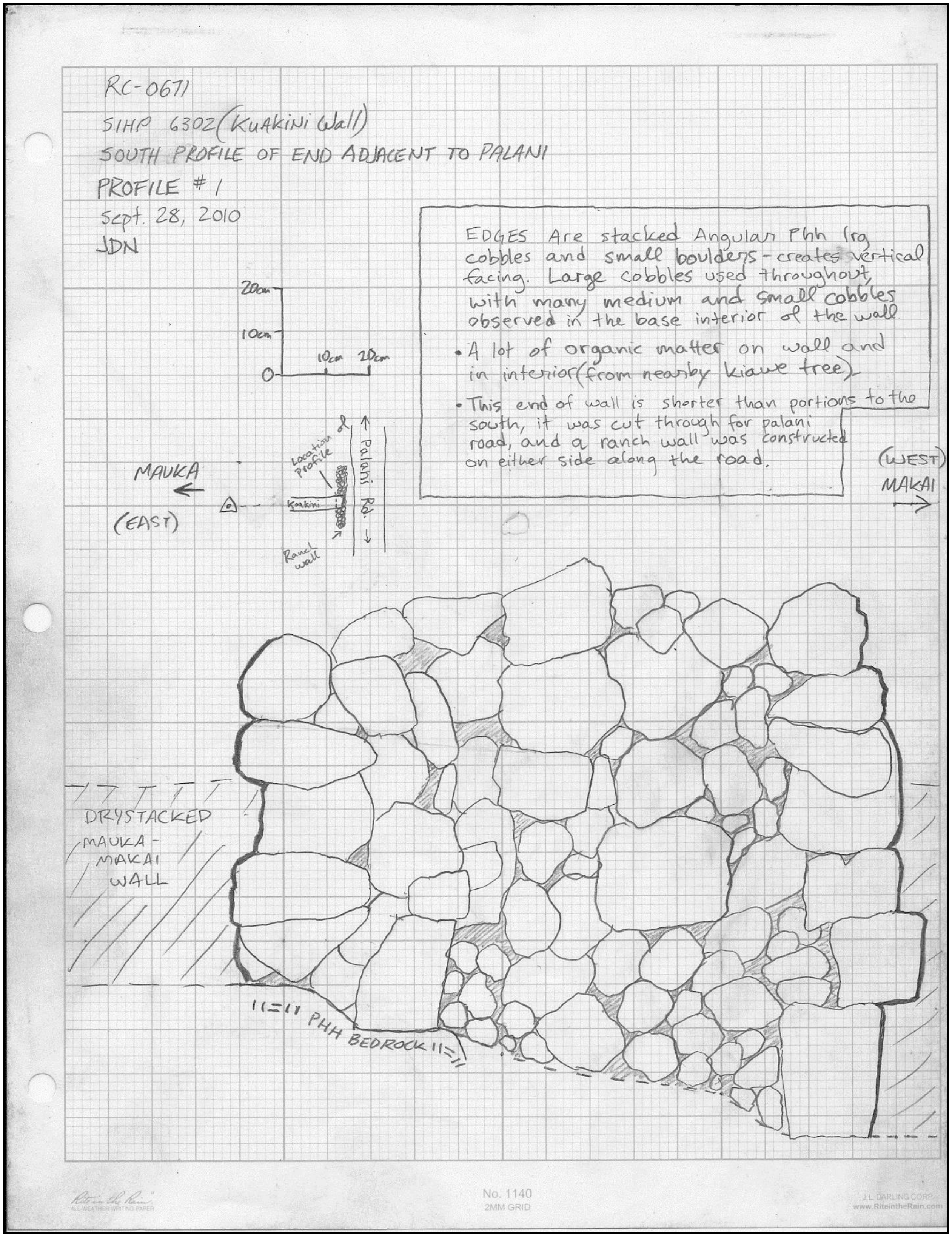

Figure 5. Example of scaled profile drawing and documentation of exposed wall interior (Rechtman and Nelson 2012).

Artifacts

Artifacts observed within the wall will be recovered and their general provenience recorded. All traditional Precontact Hawaiian artifacts and diagnostic post-Contact artifacts will be recovered for laboratory analysis. The precise locations of any items found *in situ* will be recorded and the items photographed and recovered for subsequent laboratory analysis. Any observed associations will also be documented, and the surrounding soil will be fully described using standard USDA soil descriptions and Munsell colors (if applicable).

Human Skeletal Remains

If human skeletal remains are encountered during the monitoring effort, the on-site monitor will halt work in the immediate area of the discovery, stabilize the remains, and contact the appropriate authorities. DLNR-SHPD staff from the Archaeology Branch and from the History and Culture Branch will be notified immediately, and the monitor will notify the appropriate on-site construction personnel. Either the monitor or the Principal Investigator will contact the Police and/or Medical Examiner, as appropriate. If the skeletal material is determined to be Historic or Precontact (as opposed to recent), the Principal Investigator will direct the applicant to seek DLNR-SHPD guidance on how to proceed with the discovery, and the human skeletal remains will be handled in compliance with HRS Chapter 43.6, HAR §13-300, and DLNR-SHPD directives.

TREATMENT OF RECOVERED REMAINS

All recovered material will be temporarily stored within a secure location. The recovered items will be recorded in a field catalog, and upon completion of the monitoring fieldwork the treatment of the items will be as follows:

Cultural Material

Artifacts from intact contexts will be analyzed. Analyzed items will be cleaned, weighed, measured, photographed, and illustrated (if appropriate). Analysis will include formal description and functional interpretation. The identification of artifacts, vertebrate faunal remains, and invertebrate faunal remains will include comparison with reference collections and materials, as needed.

Human Skeletal Remains

If DLNR-SHPD determines that the removal of buried human remains is an appropriate course of action, then a treatment/reburial plan will be developed in consultation with DLNR-SHPD and other consulted parties, as appropriate in accordance with Hawaii State law as outlined in HAR 13§13-300.

CURATION OF RECOVERED ITEMS

Any material recovered during the project will be temporarily stored for a period of no more than one year following submission of the final monitoring report, during which time arrangements will be made for permanent curation in consultation with the respective landowner and DLNR-SHPD. It will be the respective landowner’s responsibility to secure permanent curation in an acceptable facility; included in this responsibility are the costs associated with long-term curation.

REPORTING

Within 30 days following completion of the dismantling, stabilization, and reconstruction effort, a draft dismantling/restoration report will be prepared and submitted to DLNR-SHPD for review and acceptance. This report will follow the specifications contained in HAR 13§13-279-5. If any human skeletal remains are recovered as part of the monitoring project, they will be summarized in the final dismantling/restoration report following procedures contained in HAR 13§13-300.

REFERENCES CITED

Baker, A.

1915 Between the Bays in Kona. In *Thrum's Hawaiian Annual for 1916*, pp. 80-86. Thos. G. Thrum, Honolulu.

Clark, M. R. and R. B. Rechtman

2003 *An Archaeological Inventory Survey of TMKs: 3-7-5-10:85 and 3-7-5-17:06, Wai'aha Ahupua'a, North Kona District, Island of Hawai'i*. Rechtman Consulting RC-0153. Prepared for U of N BENCORP, Kailua-Kona, Hawai'i.

Kelly, M.

1983 *Na Mala O Kona: Gardens of Kona. A History of Land Use in Kona, Hawai'i*. Department of Anthropology, B.P. Bishop Museum, Honolulu Departmental Report Series 83-2. Prepared for Department of Transportation, State of Hawaii.

O'Hare, C. and T. Wolforth

1998 *Archaeological Inventory Survey of the Gomes Property Parcel (TMK:3-7-5-19:5,38,40) Land of Kahului 1st, North Kona, Island of Hawai'i*. Paul H. Rosendahl, Ph.D., Inc. 1807-090998. Prepared for Towne Development of Hawaii, Inc., Honolulu.

Rechtman, R. B.

2013 *Preservation Plan for SIHP Site 6032 and Site 23681 (TMKs: 3-7-5-10:085 and 3-7-5-17:006), Wai'aha 1st Ahupua'a, North Kona District, Island of Hawai'i*. Rechtman Consulting, LLC RC-0783. Prepared for U of N BENCORP, Kailua-Kona, HI.

Rechtman, R. B., M. R. Clark and A. Ketner

2005 *An Archaeological Inventory Survey of TMKs: 3-7-5-03:2, 25 and 3-7-5-22:173, Honua'ula and Heinaloli 1st ahupua'a, North Kona District, Island of Hawai'i*. Rechtman Consulting RC-0211. Prepared for The Laniākea Foundation, Honolulu.

Rechtman, R. B. and J. D. Nelson

2012 *Archaeological Monitoring Report for the Ane Keohokālole Highway Project (TMKs: 3-7-3-09: 064; 3-7-4-08: 082, 083; 3-7-4-20:027, 029) Keahuolū, Kealakehe, Honokōhau and Kaloko ahupua'a, North Kona District, Island of Hawai'i*. Rechtman Consulting LLC RC-0671. Prepared for Nan, Inc., Honolulu.

Thurston, L.

1882 *Life and times, of Mrs. Lucy G. Thurston, wife of Rev. Asa Thurston, pioneer missionary to the Sandwich islands, gathered from letters and journals of extending over a period of more than fifty years. Selected and arranged by herself*. S.C. Andrews, Ann Arbor, Michigan.

APPENDIX A

SHPD CORRESPONDENCE

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

JESSE K. SOUKI
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WILLIAM M. TAM
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AQUATIC RESOURCES
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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

June 19, 2014

Robert B. Rechtman, Ph. D.
ASM Affiliates Inc.
507-A East Lanikaula Street
Hilo, Hawai`i 96720

LOG NO: 2014.2843
DOC NO: 1406MV15
Archaeology

Dear Dr. Rechtman:

SUBJECT: **Chapter 6E-42 Historic Preservation Review –**
Revised Archaeological Preservation Plan for the University of Nations
Waiaha Ahupua'a, North Kona District, Island of Hawai'i
TMK: (3) 7-5-010:085 and 7-5-017:006 (portion)

Thank you for submitting the revised draft report titled *Preservation Plan for SIHP Site 6032 and Site 23681 TMK: 3-7-5-10:085 and 3-7-5-17:006 Waiaha 1st Ahupua'a, North Kona District, Island of Hawai'i* RC-0783 (R. B. Rechtman, October, 2013). We received your submittal March 10, 2014. We apologize for the delayed review and thank you for your patience. Our records indicate that that an archaeological inventory survey was conducted for this parcel by Clark and Rechtman (2003) and 26 historic properties were recorded. Eleven of these sites are recommended for no further work, ten sites are subject to data recovery (Rechtman and Loubster 2007), three sites are preserved under a burial treatment plan (Rechtman 2003) and two sites - the Kuakini Wall (SIHP 50-10-27-6032) and an agricultural heiau (SIHP 23681) are recommended for preservation. The subject plan proposes detailed preservation measures for these two sites. A draft of this plan was previously reviewed by SHPD and revisions were requested (Log 2013.6311, Doc 1402MV16).

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Please contact Mike Vitousek at (808) 652-1510 or Michael.Vitousek@Hawaii.gov if you have any questions or concerns regarding this letter.

Aloha,

Theresa K. Donham
Archaeology Branch Chief

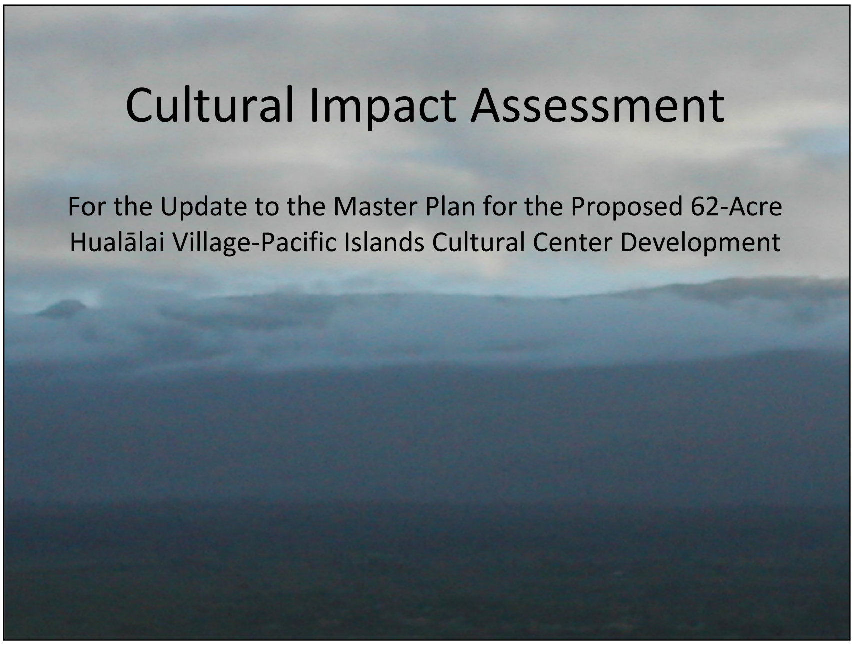
Appendix K

Cultural Impact Assessment for the Update to the Master Plan for the Proposed 62-Acre Hualālai Village-Pacific Islands Cultural Center Development, February 2020

U of N Bencorp

Waiʻaha, Kona District, Island of Hawaiʻi

TMK (3)-7-5-10:085; 7-5-17:006



Prepared for:

U of N Bencorp, A Hawaiʻi Non-Profit Corporation
78-165 Hualālai Road, 2nd Floor
Kailua Kona, HI 96740

Draft February 2020

(updated by ASM Affiliates)

Group 70 International, Inc. • Architecture • Planning • Interior Design • Environmental Services •
925 Bethel Street, Fifth Floor • Honolulu, Hawaii 96813 • Phone (808) 523-5866 FAX (808) 523-5874

1.0 PROJECT SUMMARY

While the regulatory requirements of Act 50 are not triggered by the proposed project, this Cultural Impact Assessment (CIA) has been prepared in accordance with the substantive components in Chapter 343, Hawaiʻi Revised Statutes, as amended by H.B. No. 2895, H.D. 1 of the State of Hawaiʻi Twentieth Legislature and approved as Act 50. The purpose of this Act is to "require that environmental impact statements include the disclosure of the effects of proposed actions on the cultural practices of the community and the State," specifically addressing the effects on Hawaiʻi's culture, and traditional and customary rights.

1.1 OVERVIEW OF THE PROPOSED PROJECT

The U of N Bencorp, a Hawaii 501(c)(2) non-profit benefit corporation, is proposing to develop two of its fee-simple parcels (TMK: (3) 7-5-010:085 and (3) 7-5-017:006), as shown in Figure 1-1. The U of N Bencorp financially supports the University of the Nations-Kona (U of N), a Hawaii 501(c)(3) non-profit corporation whose purpose is to educate men and women and prepare them spiritually, intellectually and culturally for Christian service throughout the world, but especially in the Pacific and Asia.

As illustrated in Figures 1-2 and 1-3, the project site is situated in the *ahupuaʻa* of Waiʻaha, in the *moku o loko* (interior district) of North Kona, on the island of Hawaiʻi. Located on the lower western slopes of Mount Hualālai and bordered by Kuakini Highway on the west, Hualālai Road to the east, the University of the Nations-Kona campus to the north and the Kona Hillcrest subdivision on the south, the U of N project area consist of approximately 62 acres, as shown in Figure 1-4. One of the salient features of the project area is its topography. The property is moderately sloped, ranging from approximately 100 feet above sea level at Kuakini Highway to 325 feet at its highest point, with the steepest slopes on the upper *mauka* side just below Hualālai Road, as illustrated in Figure 1-5 and 1-6.

The proposed expansion of infrastructure within the overall U of N project area includes the development of eight new student dormitories, five classroom buildings, three K-12 school buildings, seven staff housing structures, eleven buildings that will comprise Camp David, two chapels, two Community Emergency Response Team (C.E.R.T.) buildings, a campus services complex, a coffee shop and mini market, a small groups pavilion and additional pavilion, an outdoor event hall, a bus stop, a theater, a discovery center, a sports complex, a Window to the World building, the Lokahi Studios complex, and a network of pedestrian trails that facilitate access between the existing and proposed buildings, parking lots, and recreational areas (Figure 1-7). Additionally, expansion plans for the University of the Nations Kona include the development of a roadway extending *mauka* from Kuakini Highway in the south-central portion of the property (see Figure 1-7).

The Pacific Islands Cultural Center (PICC) is intended to serve as a venue that highlights and demonstrates the cultural diversity within the Pacific Rim, through the development of programs and demonstrations that provide both educational and entertainment value. These activities would be conducted in an indoor main performance auditorium, situated in a beautifully landscaped park setting. It is anticipated that the facilities of the PICC, including the auditorium, will also be made available for community use and will benefit Kailua-Kona by providing a new and exciting visitor attraction that respects, educates, and tells the story of Hawaii's multiple cultural groups, with an emphasis placed upon the host culture of *Nā Kanaka Maoli*. Plans for the center include the development of programs that will appeal to families and across generations while contributing significantly to both regional university growth and the overall economic base of the Kailua-Kona region.

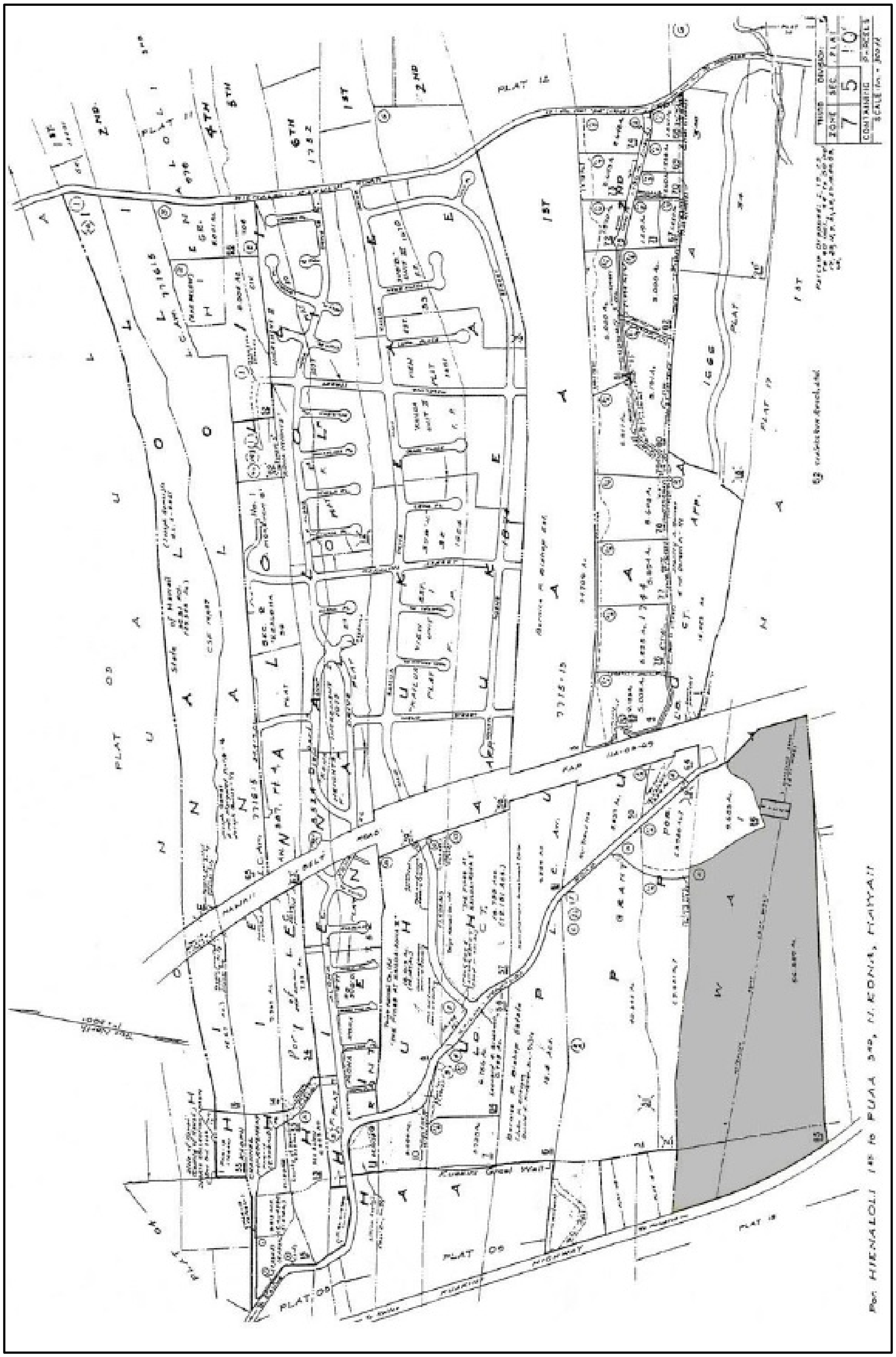


Figure 1-1. Tax Map Key (3) 7-5-010:085.

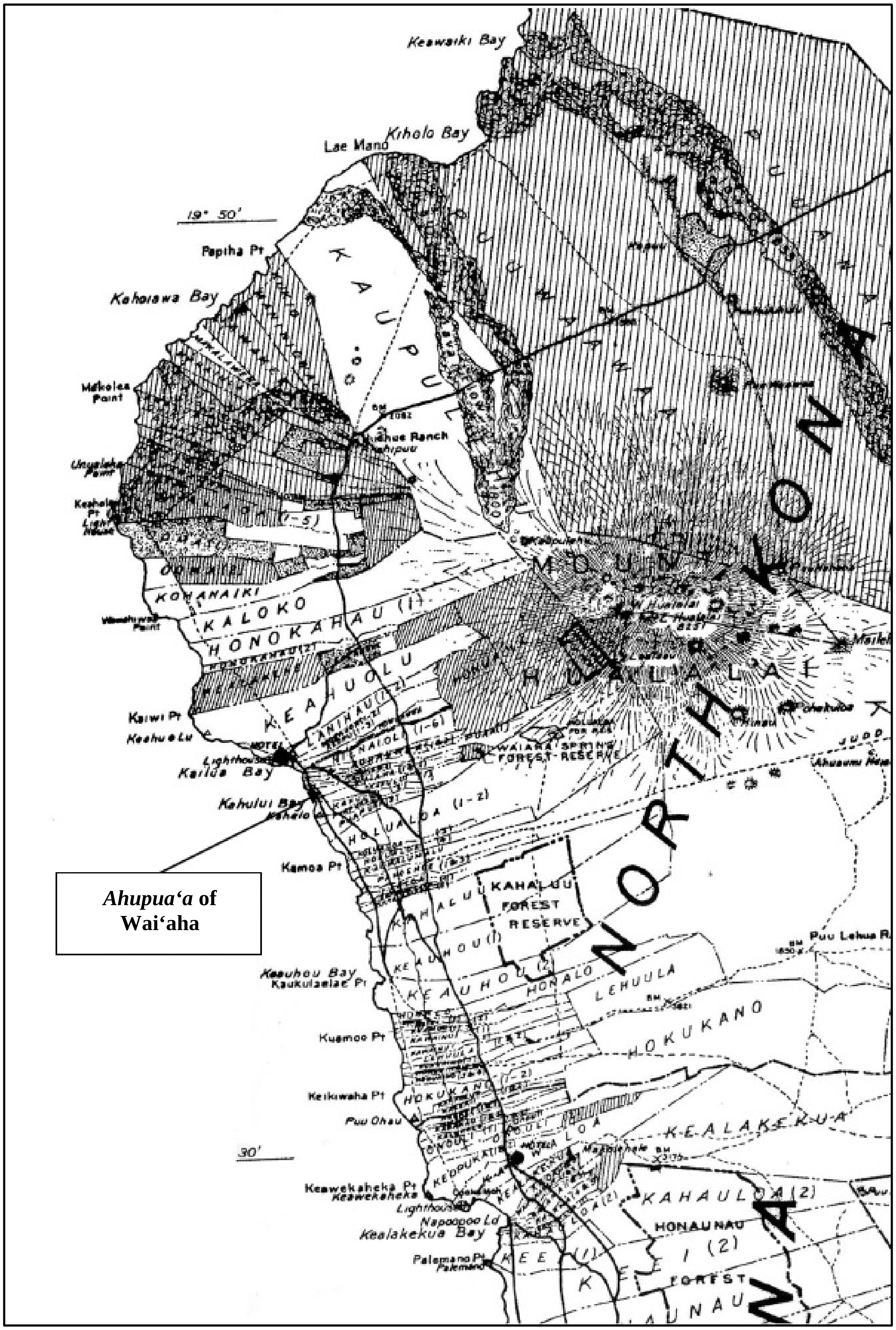


Figure 1-2. Hawai‘i Territory Survey Map of North Kona, 1928.

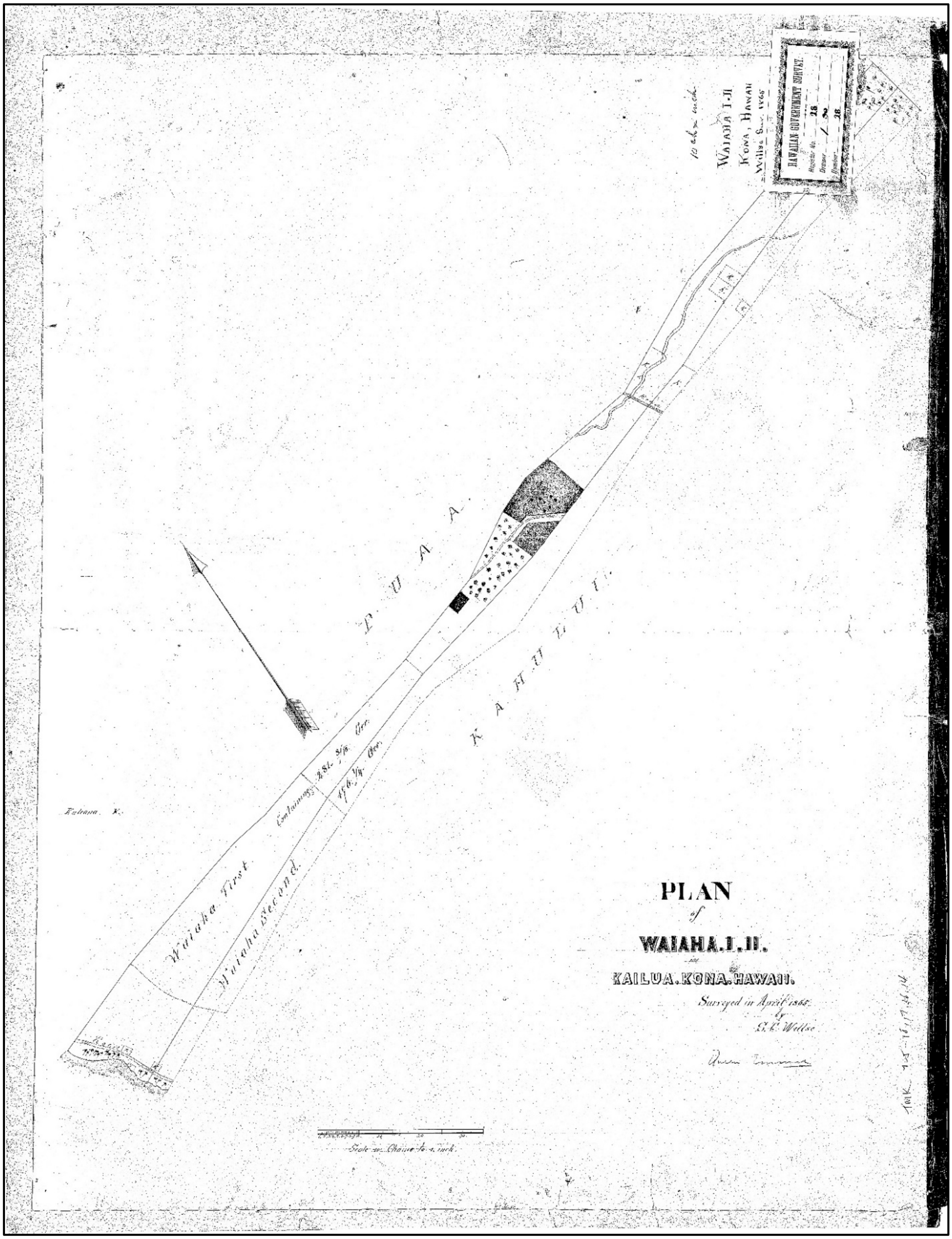


Figure 1-3. 1865 Hawai'i Registered Map No. 0028 by S.C. Wiltse showing "Plan of Waiaha.I.II".

Figure 1-4. Aerial photo of project area (courtesy of U of N Bencorp).

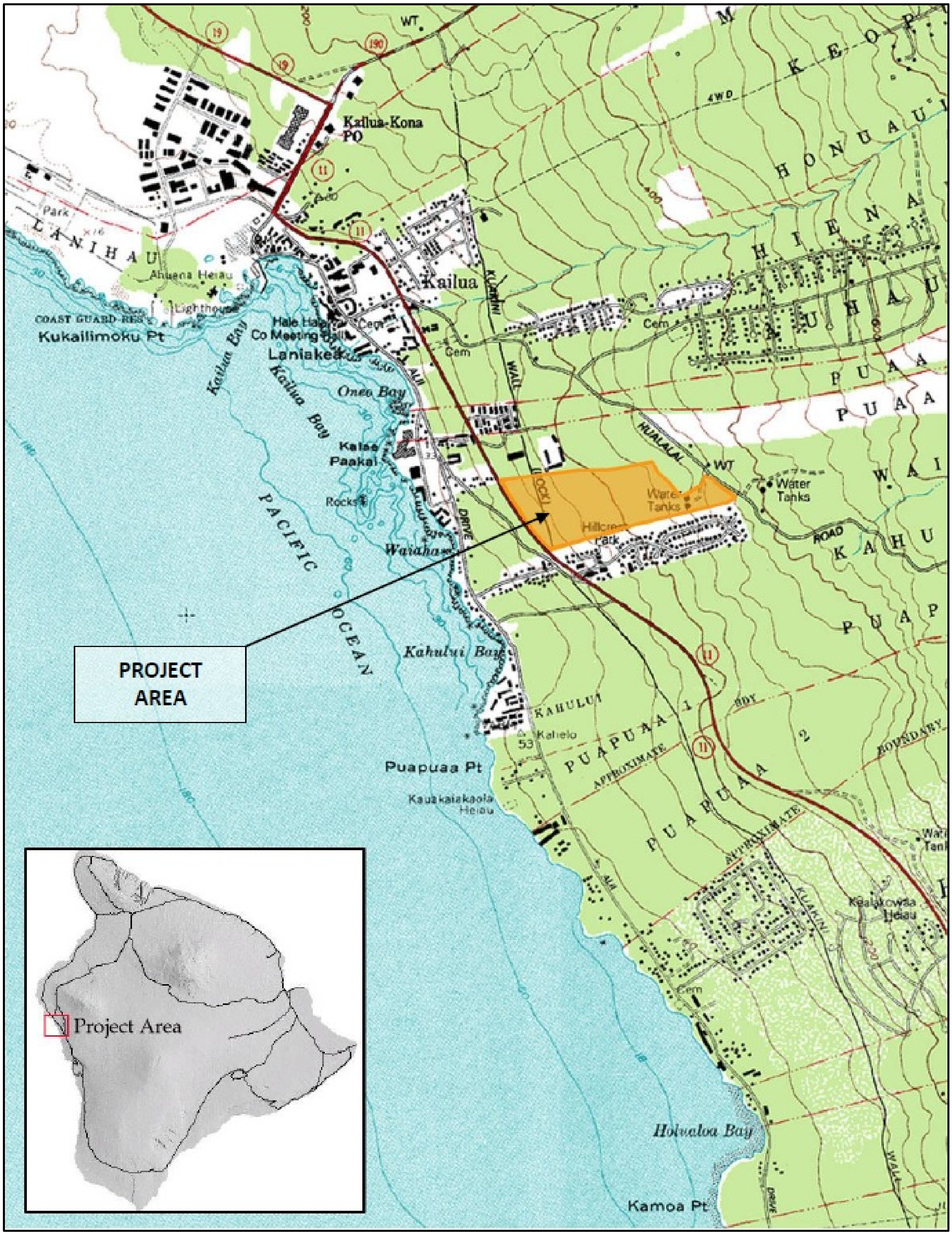


Figure 1-5. Project location map, USGS Kailua quad.

Figure 1-6. Aerial photo of Wai‘aha Ahupua‘a (project area shown).

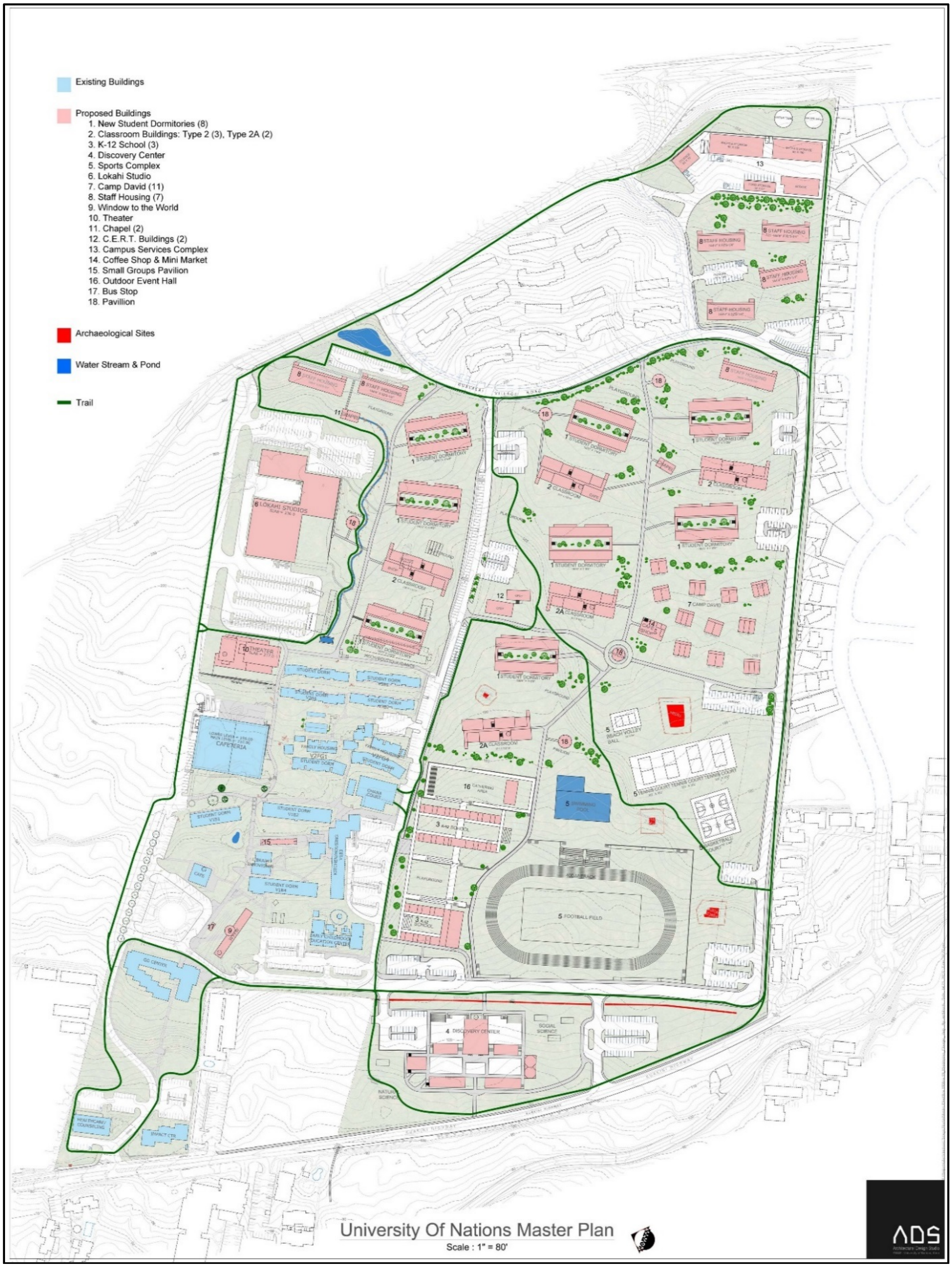

Existing Buildings
Proposed Buildings
1. New Student Dormitories (8)
2. Classroom Buildings: Type 2 (3), Type 2A (2)
3. K-12 School (3)
4. Discovery Center
5. Sports Complex
6. Lokahi Studio
7. Camp David (11)
8. Staff Housing (7)
9. Window to the World
10. Theater
11. Chapel (2)
12. C.E.R.T. Buildings (2)
13. Campus Services Complex
14. Coffee Shop & Mini Market
15. Small Groups Pavilion
16. Outdoor Event Hall
17. Bus Stop
18. Pavillion
Archaeological Sites
Water Stream & Pond
Trail
University Of Nations Master Plan
Scale : 1" = 80'
ADS

Figure 1-7. University of Nations 2017 master plan.

1.2 CULTURAL IMPACT ASSESSMENT METHODOLOGY

Several references were used in deriving the methodology to conduct this cultural impact assessment. The applied methodology was derived from guidelines and protocols that were provided from two distinctive sources: 1) those mandated in existing regulations, agency guidelines, draft administrative rules, and court decisions; and 2) those mandated from protocol training as taught by recognized *kūpuna* (elders) and *kumu hula* (sources of indigenous and historical knowledge). The methodology for this cultural impact assessment was primarily based upon identifying those project-specific factors that contributed in developing an appropriate level of research scope including:

a) the physical and cultural characteristics of the specific area that define the landscape, including the levels of land use transition and modification that has occurred;

b) the existing land use patterns for the specific project area;

c) the known cultural properties, features, resources, practices, and beliefs within or associated with the specific project area;

d) the known or identified individuals and organizations with expertise in the identified cultural practices and beliefs or that possess specific historical and cultural knowledge of the area in question;

e) the associative linkages between family names, place names, and cultural properties;

f) the availability of recorded historical and cultural information for the specific area;

g) the potential effects of the proposed project on known cultural properties, features, resources, practices, or beliefs associated within or to the specific area.

Parameters in defining the level of impact upon the identified cultural properties, resources, practices, and beliefs were established based upon an analysis of information obtained through both informal discussions and formal interviews, as well as a review and summary of previously conducted archaeological work and historical documentation of the project area.

1.2.1 Review of Known Written Records

A review of historical documents, maps, and photographs was conducted at the Department of Land and Natural Resources-State Historic Preservation Division library, the Bernice Pauahi Bishop Museum Archives, the Kona Historical Society, the Hawaiʻi State Library, the Kailua-Kona Public Library, the State Bureau of Conveyances, the Hawaiʻi State Archives, the Hawaiʻi State Survey Office, the City and County of Honolulu Real Property Assessment Division, the County of Hawaiʻi Real Property Assessment Division, the County of Hawaiʻi Planning Office, the University of Hawaiʻi Hamilton Library, and the library resources of Group 70 International, Inc.

The assessment included a review of Land Commission Awards, Boundary Commission awards, testimonies from the Native and Foreign Register, recorded journal logs, 19^{th} and 20^{th} century Hawaiian language newspapers, recorded historical texts and personal field notes, government letters and memorandums, and archived photographs. The scope of research included a review of archaeological studies, inventories, and surveys previously conducted within or near the project area. The study encompassed a review of known and existing maps that delineated the region of Kona, with an emphasis placed upon examining both the mountainous and coastal geographical features and place names within the Waiʻaha Ahupuaʻa and its adjoining land districts.

An effort was also made to identify various recorded oral traditions of *Nā Kanaka Maoli* including *nā oli* (chants), *nā mele* (musical compositions), and *nā moʻolelo* (associative stories) and *nā kāʻao* (legendary accounts) that mentioned specific place names associated with the northern region of Kona District and with the *ahupuaʻa* of Waiʻaha. Several of these recorded accounts were documented in Hawaiian text, whereupon translations and preliminary interpretative analysis of each composition's *kaona* (a narrative technique employed by the composer that infuses multi-layers of contextual meanings into the particular chant or *mele*) was conducted, as appropriate.

1.22 Knowledgeable Individuals and Organizations

Various agencies, organizations, community members, and cultural/lineal descendants with ties to Wai‘aha were initially contacted to identify those individuals with cultural expertise and knowledge of the project area and the surrounding vicinity. As contacts were established, further inquiry was conducted to assess the primary cultural concerns associated to the Wai‘aha Ahupua‘a and the potential impacts relative to the project.

Attempts were made to contact several organizations that included the Department of Land and Natural Resources State Historic Preservation Division, the Hawai‘i Island Burial Council, the Hawai‘i-Pacific Studies Department of the Bernice Pauahi Bishop Museum, the Office of Hawaiian Affairs, the Kona Hawaiian Civic Club, the Kona Historical Society, the QLCC-Kona Division, Kamehameha Schools, as well as several *hula hālau* (traditional educational centers for *hula* practitioners).

Efforts were made to identify those individuals that either grew up in the Wai‘aha area or the greater Kona District, and that were potentially knowledgeable of traditional cultural properties, traditional and customary practices, as well as any established contemporary cultural uses near or within the project area.

Within predetermined limitations, a conscious effort was made to contact *nā kūpuna*, *nā kumu hula* and *nā kua‘āina* (literally translated as “the backbone of the land”, referring to those individuals or families that have strong associative ties to a specific place) that potentially would be able to share some *‘ike* (knowledge) of Wai‘aha Ahupua‘a.

Upon identifying those individuals that were knowledgeable of the cultural features, resources, beliefs, and practices, pre-interviews were conducted via informal telephone discussions or informal in-person talk story sessions. Depending upon the level of detailed information provided in response to pre-interview questions, a determination was made whether to conduct a formal interview with the individual. Decisions regarding the most appropriate time and manner to conduct the interview were left to the discretion of the interviewee. As determined by the interviewee, appropriate methods of recordation were employed and included note- taking during personal and telephone interviews, copies of email correspondence, and review of personal notes.

To complement the on-going development of discussions with potential knowledgeable individuals, information derived from interviews previously conducted and recorded by other agencies or organizations were included in this report with the consent of the original interviewer. In these specific cases, the interviewees were recognized *kūpuna* and as such, a respect for their time and energy was considered paramount in determining if subsequent interviews were warranted. Thus, if the information could be obtained from transcripts that detailed previously conducted interviews, it was determined that only those subject areas requiring further inquiry would be discussed.

A summary of those organizations and individuals contacted during the course of the cultural impact assessment and the informal format of questions is presented in Appendix A and B, respectively.

1.3 SCOPE OF WORK

The following scope of work was proposed in preparing this cultural impact assessment study:

1) Conduct a review and summary of historical documentation for purposes of identifying potential traditional cultural properties, features, resources, beliefs, and practices within or near the project area.

2) Conduct an analysis of information provided in archaeological reports and known oral traditions of areas near or within the project area as a means of identifying traditional land use activities, cultural resources, and associative practices and beliefs.

3) Compile and summarize information obtained from informal discussions and formal interviews with identified knowledgeable individuals regarding historic and traditional practices that are site-specific and inclusive of the *ahupua‘a* of Wai‘aha.

4) Prepare a report that summarizes the information obtained from research conducted from which an evaluation of the potential cultural impacts related to proposed development area will be provided. As necessary, recommendations to mitigate potential impacts will also be included.

2.0 LEGACY IN THE LANDSCAPE

2.1 NATURAL SETTING

Aloha Kona, hau o Māʻihi *ʻO ka hoʻokaumaha a ke kēhau* *ʻOia makani kei hoene* *Hoene ana i ka pua o ka niu* *Niu a nā maka i ʻike ʻole ai* *Aloha au o ka uka o Ahuʻena ē* *ʻO ka ʻena i ala luʻu i ke kai* *Hoʻāʻike i ke oho* *ʻO Keohokālole o huli mai ā*	*Love to Kona, land of the Hau of Māʻihi* *Laden down with the drops of dew* *There the breezes murmur softly, Murmur to the blossoms of the coconut* *High up, almost out of sight,* *Love to the upland of Ahuʻena* *So warm that one wishes to dive into the sea* *Mention shall be made of the hair* *O Keohokālole, turn hither to me* (Pukui 1995, 124-125)

Composed as a *mele inoa* (name song) for Keohakālole, the mother of King David Kalākaua and Queen Liliʻuokalani, these words of adoration also exemplify the natural beauty of the surrounding *moku o loko*, the interior land district of Kona on the Island of Hawaiʻi. The *moku o loko* of Kona is one of six interior land districts that divide up the *mokupuni* (island) of Hawaiʻi, originally called Lononuiākea, and includes the districts of Kaʻū, Puna, Hilo, Hāmākua, and Kohala. These *moku o loko* were traditionally subdivided into smaller tracts of land called *ahupuaʻa* that varied in size depending upon the natural resource yields that existed within a particular region and the population density that could be sustained by these yields (Lake: Ms).

The boundary definitions of an *ahupuaʻa* were traditionally demarcated by *nā ahu*, cairns used in ceremony primarily during Makahiki season that included a *kiʻi*, an image of a *puaʻa*, a pig carved out of *kukui* (*Aleurites moluccana*, candlenut) and stained with the red-brown hues of the *ʻalaea* (Ocherous earth). These land divisions included both mountainous (*mauka*) and coastal (*makai*) resources and were often subdivided into smaller tracts of land with varying degrees of intended use, purpose, shape, and function (Kamakau: 1992 (b), 6-10; Malo: 1951,16-18; Kamehameha Schools: 1994, 4).

In general, traditional land management of these districts was defined as a principle that land should be governed from the sea to the mountains, thus affording to the *aliʻi ʻai moku*, the royal land steward and his people a fishery residence at the warm seaside, together with the products of the high lands, such as fuel, canoe timber, mountain birds, and the right of way to the same, and all the varied products of the intermediate landscape and mountainous regions.

The divisions of an *ahupuaʻa* were called *ʻiliʻāina*, which were divided into *moʻo ʻāina* that were further subdivided in *paukū ʻāina*. *Kīhāpai* were patches of farmland that were subdivisions of *paukū ʻāina*. The various subdivisions of land parcels included the *ʻili, ʻili lele*, *kīhāpai*, *māla*, *kōʻele*, *moʻo*, *paukū*, and *kuaiwi*. These were all detached and singular parcels comprised of various resources and situated in different environmental zones. These lands were worked by the *makaʻāinana*, the common residents but there are recorded accounts of royal tenure, including Kamehameha I tending to the fields of Kūāhewa (Malo: 1951, 16).

The district of Kona covers an area that is approximately 60 miles long and whose picturesque beauty is accentuated with the quiet rumble of the ocean surf along the shore, the delicate rustle of gentle breezes through a majestic overhang of coconut trees, and a diversity of flora that are imbued with a multiple palette of colors and fragrances. Given its leeward location on the island, the seasonal patterns of rainfall are heaviest during the summer months, with arid conditions during the winter months.

Due to its vast expanse of land acreage, the district is partitioned into a northern and southern region, with Puʻu Ohau, a cinder cone between Kealakekua and Keauhou, demarcating the boundary (Clark: 1985, 107). As stated in the *ʻōlelo noʻeau* (Hawaiian proverb), *Kona ʻākau, mai Keahualono a Puʻuohau*, the northern region of Kona is subdivided into 82 *ahupuaʻa* whose boundaries are between the areas of Keahualono to the north and Puʻu Ohau to the south (Pukui:1983, 198). As early as the 15th century, the northern district of Kona, particularly between Keauhou and Kailua, served as a major population and political center until the mid- 1800s (Van James 1995:86).

The project area is located within the *ahupuaʻa* of Waiʻaha, which translates to "gathering water" and is noted in various oral traditions and written records as an area that is abundant with mountainous and coastal resources. However, its only major tributary system is Wai'aha Stream. The headwaters of the stream lie in the upper mountain regions of Hualālai, the majestic volcanic dome that emanated from a series of volcanic eruptions during the Pleistocene Era (1.8 million to 11,000 years ago). Early historical records attest to the issue that although this region was a developing population center, the provision of freshwater was a primary concern:

> *Kairua [sic], though healthy and populous, is destitute of freshwater, except what is found in pools, or small streams, in the mountains, four or five miles from the shore (Ellis: 1979, 29)*

> *The drinking water of the people was very brackish, from numerous caves that reached below the sea level. The white people, and some chiefs had their water from up the mountain where were numerous depressions in the lava, full of clear, sweet rain water. Twice a week one of our ohuas or native dependents went up the mountain with two huewai, or calabash bottles, suspended by nets from the ends of his mamaki or yoke. These he filled with sweet water and brought home, having first covered the bottles with fresh ferns, to attest his having been well inland. The content of the two bottles filled a five-gallon demijohn twice a week (Winne: 1928, 8).*

With only a limited water supply stemming from intermittent rainfall, a series of underground dike systems, and the outflow of the stream, there was an applied approach to water conservation and management to ensure that drought conditions were not prevalent. Thus, to effectively manage the area's water supply, innovative irrigation and dryland agricultural production methods were derived in order to provide a yield of food and water that could sustain the expanding population within the region.

The gentle sloping contours of the Wai'aha uplands were a complement to its level coastal plains, with the former providing an ideal environment for the cultivation of dryland *kalo* (*Colocasia esulenta*, taro). The general soil characteristics of decomposing lava mixed with organic material, provided ideal terrain conditions for planting *'uala* (*Ipomoea batatas*, sweet potato), *'ulu* (*Artocarpus altilis*, breadfruit), *wauke* (*Broussonetia papyrifera*, paper mulberry), and *ipu* (*Lagenaria siceraria*, gourd), thereby providing adequate food, clothing, and storage resources. Toward the uplands, open vistas expanded for miles, unveiling a diversified landscape of forest and fruit trees, which included *koa* (*Acacia koa subsp. Koa*), *kou* (*Cordia subcordata*), *hala* (*Pandanus tectorius*, screwpine), and *'ōhi'a 'ai* (*Syzygium malaccense*, mountain apple). As shared in the *'ōlelo no'eau*, *Kona, mauna uliuli*, *Kona mauna ulupō*, the lands of Kona are distinguished by its green mountains and dense forest. (Abbot: 1974, 174; Handy, Handy, & Pukui: 1972, 522-523; Pukui: 1983, 199).

For the region of Kona, there are four traditional vegetation zones that characterize the natural landscape from *makai* to *mauka*, which include the *kula*, *kalu'ulu*, *'āpa'a*, and *'ama'u* zones. *Kula* lands are defined as those that are comprised of "plains, fields, open country, or pasture" lands (Pukui, Elbert: 1986, 178). For the Kona region, *kula* lands were characterized as those lands on the coastal plain and due to prevalent arid conditions, these lands required the design of elaborate irrigation methods to provide an adequate supply of freshwater to its agricultural parcels. The natural environment of the *kula* lands immediately *mauka* of Kailua Bay were described to Reverend William Ellis by the Reverend Asa Thurston when a group traversed through the upland region:

> *The houses, which are neat, are generally built on the seashore, shaded with coconut and kou trees, which greatly enliven the scene...Small gardens were seen among the barren rocks on which the houses are built, wherever soil could be found sufficient to nourish the sweet potato, the watermelon, or even a few plants of tobacco, and in many places these seemed to be growing literally in the fragments of lava, collected in small heaps around the roots (Ellis: 1979, 31)*

The cultivation of the *kula* lands was much more labor- intensive and often did not yield the same quantity or quality in agricultural production as compared to its wetland counterpart. *Kula* lands that were utilized for cultivation but under the management of the *ali'i* (chief) were called *kō'ele*, *hakuone*, or *kuakua* while those of the *maka'āinana* (commoner) were called *mahina'ai*. A *kō'ele* was a parcel of land cultivated by the *maka'āinana*, but upon which the land and its resources were still retained by the *ali'i 'ai moku*. A *hakuone* was similar to a *kō'ele* with the difference being that the *konohiki* or *haku'āina*, the designated land managers under the aegis of the *ali'i 'ai moku*, retained these lands. The *kuakua* was a broad *kuāuna* or embankment, normally between two wetland parcels with dispersed plants of *kī* (*Cordyline terminalus*, ti) and *kō* (*Saccharum officinarum*, sugarcane). Various gardens of *'uala* and dryland *kalo* were cultivated in this region. It is noted that the Pā a

Kuakini (wall of Kuakini) is situated along this zone. (Malo: 1951,18; Kelly: 1983, 47).

As a cultural practice, native farmers did not think of breaking up the whole surface of the soil; but only a spot here or there, where the seed, whether it was potatoes, bananas, cane, or any other plant that was planted. Various dry planting methods including *pu'epu'e* (planting mounds), *mākālua* (planting in mulched holes), and *'umokī* (planting taro shoots in small holes made with a stick) were utilized in the extensive cultivation of primary and supplemental crop supplies within the Kona environment (Handy, Handy, and Pukui: 1972, 105-109; Maly: 1999, 13

The characterization of *kalu'ulu* lands was unique to the region of Kona. These lands were part of a cultivated zone, approximately a half-mile in width, which was considered "luxuriant in growth" and comprised of a vast acreage of *'ulu* plantings. As described by Reverend Ellis, these lands were abundant with breadfruit and mountain apple:

> *...walked toward the mountains, to visit the high and cultivated parts of the district. After traveling over the lava for about a mile, the hollows in the rocks began to be filled with a light brown soil...Here they enjoyed the agreeable shade of breadfruit and 'ōhi'a trees...The trees are elegant in form, and grow to the height of twenty or thirty feet (Ellis: 1979, 31)*

In the journal logs of Archibald Menzies, a surgeon and naturalist who was part of Captain George Vancouver's entourage in 1793, another description of the vast agricultural productivity that occurred with this zone was noted:

> *[we] entered their breadfruit plantations, the trees of which were a good distance apart, so as to give room to their boughs to spread out vigorously on all sides, which was not the case in the crowded groves of Tahiti, where we found them planted on the plains along the sea cliffs. But here the size of the trees, the luxuriancy of their crop and foliage, sufficiently showed that they thrive equally well on an elevated situation. The space between these trees did not lay idle. As we advance beyond the breadfruit plantation, the country became more and more fertile, being in a high state of cultivation…in clearing the ground, the stones are heaped up in ridges between the little fields planted on each side, either with a row of sugarcane or sweet root of these islands. (Menzies: 1920, 74-77).*

According to the journal records of Captain Charles Wilkes, of the American Exploring Expedition, the *kalu'ulu* zone of breadfruit trees was located approximately two miles back from the coast:

> *...a mile back from the shore, the surface is covered with herbage, which maintains cattle, etc... two miles in the interior there is sufficient moisture to keep up a constant verdure. Here, in a belt a mile wide, the breadfruit is met in abundance, above this the taro is cultivated with success (Wilkes: 1845, 4-95).*

Although characterized as an arid region, the *'āpa'a* zone was the most cultivated of the four vegetation zones. Due to its upper elevation, the area was subjected to more incidental rainfall, providing the necessary irrigation of these upland fields. The Reverend Ellis describes this area as viewed by other traveling congregational members:

> *The path now lay through a beautiful part of the country, quite a garden compared with that through which they had passed on first leaving the town. It was generally divided into small fields, about 15 rods square, fenced with low stone walls, built with fragments of lava gathered from the surface of the enclosures. These fields were planted with bananas, sweet potatoes, mountain taro, paper mulberry plants, melon, and sugar cane, which flourished luxuriantly in every direction (Ellis: 1979, 32)*

The *'ama'u* zone is characterized as the upland zone of cultivation that extends above the *'āpa'a* until the edge of the forest reserve. Within this zone are the *hāpu'u* and *'ama'u* ferns, utilized for fabric and in times of famine, the latter as food source. As indicated in the journal records of Reverend Ellis, this area also had more pooled regions of freshwater that were part of the overall tributary system:

> *Having traveled about three or four miles through this delightful region, and passed several valuable pools of fresh water, they arrived at the thick wood, which extend several miles up the sides of the lofty mountain that rises immediately behind Kairua (Ellis: 1979, 32)*

As illustrated in the following *'ōlelo no'eau, Kona i ke kai mā'oki'oki,* and *Kona, kai malino a 'Ehu,* the mirroring waters of ‘Ehu, the coastal waters of Kona, are instilled with innumerable streaks of blue-green hues, indicating the varying ocean depths and channels. The coastal fisheries are abundant with schools of *a‘u* (*Istiophoridae*, marlin or spearfish), *ono* (*Acanthocybium solandri*, wahoo), *aku* (*Katsuwonus pelamis*, bonito or skipjack), *ahi* (*Thunnus albacares*, yellow-fin tuna), *mahimahi* (*Coryphaena hippurus*, dolphin-fish), *kāhala* (*Seriola dumerilii*, amberjack or yellow-tail), and *ulua* (*Family Carangidae*, jack crevalle). (Pukui:1955,144; Winne: 1928, 21).

2.2 HISTORICAL BACKGROUND

He inoa e Kaluaikauka	*A name chant for Kaluaikauka*
Aloha o uka o Wai‘aha	*Adoration for the uplands of Wai‘aha*
‘Oia nahele paoa i ke ala	*It is a fragrant forest*
Ke kuia maila e ka wahine i ka la‘i	*Hindered by the woman in the calm*
La‘i malino ihola ke kai o ‘Ehu	*Serene and peaceful is the sea of ‘Ehu*
‘Oia kai nene lea i ka mālie	*The joyous waters in the quiet repose*
Mālie o hiki mai ku‘u aloha	*Peace brought with my love*
Ehe e ku‘u ipo lei e (Boki)	*Indeed, my beloved one*

Prior to the arrival of Captain Cook in 1778 to the Hawaiian Islands, much of the early documentation of Hawaiian history was preserved in oral traditions, as the early Hawaiians possessed no form of writing. These oratories consisted of chants, poems, riddles, legends, myths, and songs, which were passed down from generation to generation. The cultural significance of the Kona district and the *ahupua‘a* of Wai‘aha in the conscience of native Hawaiians is illustrated in several oral traditions associated both with the *moku o loko* and the *ahupua‘a* as being an area of residence for ruling *ali‘i* (often referred to as “chiefs” but are considered living *akua* who bear the *kuleana* of developing and practicing appropriate land and coastal stewardship practices).

In various traditions, the *moku o loko* of Kona is associated with the *akua*, Lono, who is considered to be the source of agriculture, fertility, and abundant rains. The land use practices and cultural protocols associated with the practices of agriculture in Kona have been well documented. As provided in an overview of historical references and native accounts, honorific tributes to the *akua* Lono were a part of the cultural practices within the district that were perpetuated from time antiquity:

> *The most interesting mythological and legendary materials relating to Kona have to do directly or indirectly with the god Lono…the origin of the Makahiki rain and harvest festival. From Kona, we have the written record of a myth of Kumuhonua (Earth Foundation, 36 generations before Wākea and Papa, who was the first man fashioned by the gods.), whose writer says that Lono was a fisherman and yet ends his story by stating that the events related occurred before men peopled the earth. Lono is credited with introducing the main food plants, taro, breadfruit, yams, sugarcane, and bananas to Hawai‘i and also ‘awa (Handy, Handy, & Pukui: 1972, 522).*

> *The sweet potato and gourd were suitable for cultivation in the drier areas of the islands...Lono was important in these areas, particularly in Kona on Hawai‘i and ‘Ulupalakua on Māui. At both of these places, 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 Kū which was a ritual identified with Kū as god of battle (Handy, Handy, & Pukui: 1972, 14)*

2.2.1 *Ka Wā Kahiko*

ʻO Wākea noho iā Papahānaumoku	*Wākea joins in union with Papahānaumoku*
Hānau o Hawaiʻi, he moku	*Born is Hawaiʻi, an island*
Hānau o Māui, he moku	*Born is Māui, an island*
Hoi hou ʻo Wākea noho iā Hoʻohōkūkalani	*Wākea returns to join in union with Hoʻohōkūkalani*
Hānau o Molokaʻi, he moku	*Born is Molokaʻi, an island*
Hānau o Lānaʻikaula, he moku	*Born is Lānaʻikaula, an island*
Liliopū punalua ʻo Papa iā Hoʻohōkūkalani	*Papa possesses a jealous rage towards Hoʻohōkūkalani*
Hoʻi hou ʻo Papa, noho iā Wakea	*Returning thereafter to Wākea*
Hānau o Oʻahu, he moku	*Born is Oʻahu, an island*
Hānau o Kauaʻi, he moku	*Born is Kauaʻi, an island*
Hānau o Niʻihau, he moku	*Born is Niʻihau, an island*
He ʻula a o Kahoʻolawe	*A reddish hue that is of Kahoʻolawe*

In one of the cosmogenic genealogical traditions of native Hawaiians, known as the *Kumulipo*, the creatures of the water are born first, establishing the first tier of ancestral identity. This *Pule Hoʻolaʻa Aliʻi* (the sanctifying prayer of a ruling chief) was first chanted at the birth of Kalaninuiʻīamamao, later renamed Lonoikamakahiki, as a prayer that consecrated the chief through the recital of his genealogical line. Over two thousand lines in length, the *Kumulipo* divides the beginnings of the world in sixteen *wā* (time periods) that unfold the creation of all natural elements through a specific genealogical procession. Understanding and being able to demonstrate the concept and application of the *moʻokūʻauhau* (genealogical line), for an *aliʻi* became of primary importance in establishing social order in traditional times Of direct pertinence to the district of Kona, the *Kumulipo* acknowledges the genealogical lineages of Wākea and Papahānaumoku, in the twelfth and thirteen *wā*, respectively. The emergence of these two lineages comes from such a time of antiquity that these ancestral figures are attributed to the cultural identity of being Sky Father and Earth Mother. In multiple variations of this oratory, the union of these two figures results in the birth of Hāloa, considered to be the progenitor of all native Hawaiians thereby providing evidence that all chiefly genealogical lines are descended from the same source.

Various oral traditions recount the lineage of Līloa and ʻEhunuikaimalino, *aliʻi nui* (ruling stewards) of Hawaiʻi Island during the Consolidation Period (1180-1450 A.D.) During this period, the establishment of political consolidation through applied concepts of sovereignty and hereditary rule by particular families was emphasized, thereby providing opportunities for individual islands to become politically, economically, and socially prosperous (Barrere: 1971, 1-5; Kelly: 1983; 1; Kamakau: 1992 (c), 170; Lake: Ms.).

The ascension of Līloa's son, ʻUmialīloa, in the mid-15th century, marks the end of the Consolidation Period. It is ʻUmialīloa who establishes peace and prosperity on the Island of Hawaiʻi, as well as instituting and strengthening existing associations with the ruling Maui and Oʻahu chiefs, particularly through his marriage with Piʻikeaapiʻilani, the daughter of a powerful Maui *aliʻi*. Through subsequent generations, ʻUmialīloa is the progenitor for other *aliʻi nui* including the aforementioned Kalaninuiʻīamamao, the father of Kalaniʻōpuʻu, who was the father of Kīwalaʻō and uncle to Kamehameha I.

Oral traditions recount that it is Kalaniʻōpuʻu who places the *kapu* for the war *akua* (god) Kūkaʻilimoku with Kamehameha instead of Kīwalaʻō, which has a significant impact on the socio-political events that lead to the eventual and successful campaign and reign of Kamehameha I. As recorded in journal accounts, during this transitional period of socio-political conflict, the district of Kona continued to have a distinct functional role as a government center for several societal regimes:

> *Kona lands were the coveted lands among the chiefs…there were calm seas teeming with fish; rolling waves for endless sport at Kealakekua; cooler uplands and fertile regions for sugarcane, fruit, and taro. Protecting mountain slopes made it a land of tropic calm without a trade wind. But always the gentle sea breeze blew over its quiet sunny bays and dry lava shores. In the midst of coconut and kou were nestled many villages of thatched houses, and on the water rode the canoes of many people, canoes hewn in the great koa forest of the mountain slopes. (Winne: 1928, 5).*

The primary lesson derived from these cosmogenic and genealogical accounts is that the Hawaiian conception of the world is defined through associative birth with all natural elements derived from an indivisible genealogical line. Thus, the *ʻāina* (often defined as "land" but in its literal translation means "that which feeds") is characterized as an ancestral and familial member, serving as the *kuaʻana*, the older sibling whose responsibilities in the traditional *ʻohana* structure, a distinctive social and familial unit, was to *hoʻomalu* (protect), *hānai* (nurture and feed), and to *kauoha* (give instruction).

Concomitantly, it is those individuals in the present generation that are given the responsibilities over the *kaikaina*, the younger siblings, who were to *mālama* (care for), *aloha* (extend love to), and *hoʻolohe* (listen intently) to their elders. Therefore, as applicable to traditional land tenure management, the cultural values of *mālama ʻāina* and *aloha ʻāina* are derived from this established relationship between the individual, the *ʻāina*, and in native Hawaiian epistemology, the *akua*, the spiritual interpretation, and actualization of the natural environment. Thus, for the area of Kona, agricultural and horticultural methodology were specifically derived with an emphasis on maximizing the survivability of a particular plant species through an applied knowledge of the area's variant terrain, soil, and meteorological conditions with a cultural conscience and value-driven approach (Kameʻeleihiwa: 1992, 2; 36).

2.2.2 Pre-Contact to the Early 1800s

Since the time of ʻUmialīloa, the abundance of resources made the district of Kona a favorable place of residence for *aliʻi* with lands designated for agricultural production, aquaculture cultivation, and habitation. As such, the district became a population center with increased patterns of settlement through Post-Contact. The journals of Reverend Ellis provides population estimates based upon observations of houselots from a journey from Kailua to Keauhou around the early 1800s:

> *During our walk from Kairua to this place we counted six hundred and ten houses, allowed one hundred or more for those who live among the plantations on the sides of the hills. Reckoning five persons to each house, which we think not far from a correct calculation, the population of the tract through which we have traveled today will be about 3,550 souls. We also passed nineteen heiaus, of different dimensions, some of which we carefully examined (Ellis: 1979, 76)*

One of the earliest known records of western contact in the district comes from a journal log of Captain Charles Clerke, who sailed into Kealakekua Bay on February 27th, 1779. As noted by Captain Clerke, the entire district of Kona was considered abundant with fertile land and coastal resources:

> *At the back of the villages upon the brow of the hill are the plantations of plantains, potatoes, tarrow [sic], sugar canes, each mans particular property is fenced in with a stone wall; they had a method of making the sugar cane grow about the walls so that the stones are not conspicuous at any distance, but the whole has the appearance of fine green fences. These plantations in many places they carry six or seven miles up the side of the hill, when the woods begin to take place which diffuse themselves from hence to the height of the eminence (Beaglehole: 1967, 592).*

The journal logs of Archibald Menzies also detail the vast agricultural productivity that extended from Kealakekua to the northern area of Kailua:

> *We came to a village among the upper plantations, where we took up our residence for the night about nine or ten miles northeast of Kealakekua Bay, and we were surrounded by the most exuberant fields of the esculent vegetables of these islands, which for the industry of cultivation and agricultural improvements could scarcely be exceeded in any country in the world, and we were happy to find their labor here rewarded by such productive crops of these vegetables (Menzies: 1920, 167-168).*

The recorded accounts of Reverend Ellis describe the verdant landscape of the surrounding *kula* lands, including those of Waiʻaha:

> *Leaving Kairua, we passed through the villages thickly scattered along the shore to the southward. The country around looked unusually green and cheerful, owing to the frequent rains, which for some months past have fallen on this side of the island. Even the barren lava, over which we traveled, seemed to veil its sterility beneath frequent tufts of tall waving grass, or spreading shrubs and flowers. The sides of the hills laid out for a considerable extent in gardens*

> *and fields, and generally cultivated in potatoes, and other vegetables were beautiful (Ellis: 1979, 78-79).*

Within the district of Kona, the extensive acreage of agricultural production is characterized as one of the most significant cultural features. The agricultural field system exemplified the adaptation of traditional native planters to various climatic, terrain, and soil conditions. T.S. Newman provides a description of the framework for the field system in terms of rainfall, elevation levels, and soil conditions:

1) Sweet Potato & Wauke Zone: This zone extends from sea level to approximately 500 feet. The annual rainfall in this region is seasonal and averages 30 to 50 inches. Wauke and ʻuala are grown in very rocky areas.
2) Breadfruit, Sweet Potato, & Wauke Zone: This zone extends from 500 to approximately 1000 feet. The annual rainfall is between 30 to 60 inches. Breadfruit trees are planted with ʻuala and wauke interspersed between them.
3) Sweet Potato & Dryland Kalo Zone: This zone extends from 1,000 to 2,000 feet with annual rainfall between 60 to 80 inches. No breadfruit trees were planted in this region. Dryland kalo was planted along the upper slope with field boundaries of ti and sugarcane planted in-between each respective field.
4) Plantains & Banana Zone: This zone extends from 2,000 to 3,000 feet with annual rainfall between 80 to 100 inches. Bananas and plantains were planted just below the forest line (Kelly: 1983, 73).

Native historians account that Kona was the part of Hawaiʻi Island that was frequently subjected to hot and dry climatic conditions that often created famine-like periods within the district. To contend with these severe conditions, the *mahiʻai* (farmers) of Kona would carefully develop a cultivation schedule that was based upon an analytical interpretation of lunar and seasonal phases, meteorological conditions, as well as maintaining their spiritual *kuleana* to those religious practices that were essential to producing a prosperous and abundant supply of crops (Abbott, 1974: 32-35; Malo: 1951, 204-206).

2.2.3 Transition in the Early 1800s

Records indicate that after the unification of the islands in 1812, Kamehameha appointed several of his advisors as district *aliʻi* to establish jurisdictional oversight in restoring efficient levels of agricultural production on all the islands. The last seven years of Kamehameha’s life were in Kailua at his principal residence of Kamakahonu nearby the *heiau* of Ahuʻena, thereby shifting the political and spiritual governance from Oʻahu back to Hawaiʻi Island. Figure 2-1 details the location of Kamakahonu in relationship to the area of Kailua.

After the passing of Kamehameha, the events of the *ʻainoa*, the expression of “free eating”, which symbolized the abolition of the traditional *ʻaikapu* system had transpired in Kailua during the rule of Liholiho, his son, and Kaʻahumanu, his wife who proclaimed herself with the right and political status of the *Kuhina Nui*.

On October 23, 1819, the American Board of Commissioners for Foreign Missions sent the first company of missionaries to the islands. As described by Reverend Ellis during his tour of the district in 1823, these Protestant missionaries arriving from the Boston headquarters aboard the *Thaddeus* in Kailua began to establish political and social relationships with ruling *aliʻi*:

> *The attention of the American churches was at length directed to the Sandwich Islands...under the name of the American Board of Commissioners for Foreign Missions, the chief seat of whose operations was in the city of Boston, Massachusetts...In the autumn of 1819, a select and efficient Band of missionaries was appointed by this society to establish a mission in the Sandwich Islands. They landed at Kairua, in Hawaiÿi, on the 4th of February, 1820... (Ellis: 1979: 20-21).*

As a result, the early 1800s were becoming a time of political and economic change as illustrated with the abolition of the *kapu* system by Liholiho and Kaʻahumanu and the increasing ventures in commercial activity. The bays of Kawaihae, Kealakekua, and Kailua were evolving as the three major trading centers along the leeward coast of Hawaiʻi.

Following the death of Kamehameha in 1819, Kaluaikonahale John Adams Kuakini was appointed by the Queen Regent Kaʻahumanu to the position of *kiaʻāina*, governor for the Island of Hawaiʻi. Governor Kuakini was the younger brother of Kaʻahumanu and the son of Namahana and Keʻeaumoku. Although trained in the traditional cultural practices of the Kū priesthood, Kuakini was one of the first *aliʻi* that mastered the English language, even prior to the arrival of missionaries in 1820.

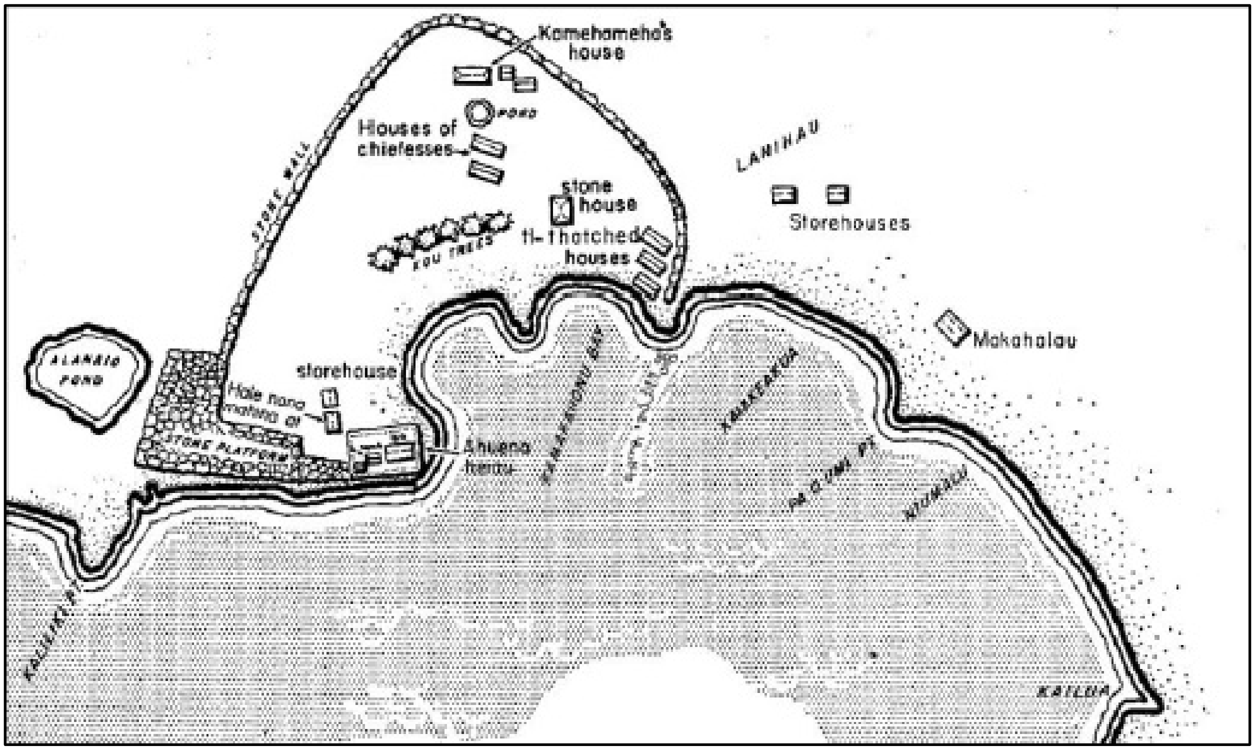


Figure 2.1. Area of Kamakahonu, circa 1813-1819 (source: ʻĪʻī, *Fragments of Hawaiian History*).

Remaining loyal to the traditional ways of the people but respecting Kaʻahumanu's new affirmation to the Christian faith, Kuakini was considered to be a *pono aliʻi* by traditional Hawaiian standards, maintaining a commitment to address the needs of the people while preserving and protecting the natural resources within the Kona region. In 1837, Kuakini built his permanent residence, now known as Huliheʻe Palace as well as began the construction of Mokuʻaikaua, the first and oldest Christian church in Hawaiʻi.

During this time, the Pā a Kuakini (wall of Kuakini) was constructed along the entire length of North and South Kona to protect the productive agricultural uplands from being inundated by free-roaming domesticated animals. A stone building was also built by Kuakini to be used as a cotton factory. By 1839, nearly 400 yards of cloth had been manufactured in this cotton mill but production dwindled the following year. Kuakini had a definitive role in shaping the natural and social landscape of Kona by promoting various construction endeavors designed to enhance the quality of life for his people during the time directly following the overthrow of the traditional *kapu* system (Winne: 1928, 17-20; Kameʻeleihiwa: 1992, 119). After his death in December 1844, Kuakini bestowed his position of *Kiaʻāina* and all of his lands to his *hānai keiki*, William Pitt Leleiōhoku. Leleiōhoku's inheritance included Huliheʻe Palace, which was passed to Princess Ruth Keʻelikōlani, upon his death in 1848.

In 1848, during the reign of Kauikeaouli (Kamehameha III), the *Māhele*, a western concept of land tenure was derived into legislation, which created a massive reformation of the existing land system in Hawaiʻi. It was the first time a system of separation and identification of the associative rights of the king and the chiefs to the land was established. The result of the *Māhele* led to the division and distribution of land, thus creating a system of possession rights and private title to land. During this process, all lands were placed into one of three categories: Crown Lands (for the occupant of the throne), Government Lands, and *Konohiki* Lands (lands for the lesser chiefs and landlords).

2.2.4 Disposition of Waiʻaha at the Time of the 1848 Māhele

As shown in Figure 2-2 through 2-4, the lands of Waiʻaha were divided into two sections. Waiʻaha 1 was the most northern section and comprised of approximately 260 acres, situated adjacent to the *ahupuaʻa* of Puaʻa. Conversely, Waiʻaha 2 was comprised of approximately 170¼ acres with its southern boundaries adjacent to the *ahupuaʻa* of Kahului. The northern coastal boundary of the *ahupuaʻa* was a bay was called Kalaeloa, meaning "the long point." Kāʻilipunahele demarcated the southern coastal boundary. The whole area fronting the cove at Waiʻaha, between the point of Kalaeloa on the north and that of Kāʻilipunahele on the south once belonged to Grace Kamaʻikuʻi Rooke, daughter of John Young and Mary Kuamoʻo and who later adopted her niece, Queen Emma, who had a strong affinity for the *ahupuaʻa* of Waiʻaha.

Immediately south of Kalaeloa stood a *koʻa heiau*, called Piopio. *Koʻa heiau* were either situated near the coastline or in some cases built in the nearshore waters for purposes of stimulating an abundant supply of fishery stock within the coastal region. To the north stood Makakūaliʻi Heiau, which was classified as a *hoʻoulu ʻai*, an agricultural *heiau* while in the middle of the cove stood Maʻo Heiau, a *heiau kālua ua*, a rain-inducing *heiau*. A trifle inland from Kaʻilikiʻi Point was the spring called Waiākekea on the upland side of which are a few stones of a house foundation which one report states as the birthplace of Queen Emma. However, according to a recorded oral tradition, *Hānau ke aliʻi, Kaleleonālani*, composed for Queen Emma shortly after her passing, the 3rd stanza cites that she was born "i ke one o Kakuhihewa," born on the sands of Kakuhihewa, a poetical reference to the island of Oʻahu. As such, there are cultural directives that are associated with the composition of honorific chants, particularly those of royal birth. Thus, this oral tradition supports the argument of other recorded historical journal and newspaper accounts that although the Queen did have family associations within the areas of Kawaihae and Waiʻaha, she was born on Oʻahu (Kanahele: 1999, 8; Pukui: 1955, 48; Kekahuna: Ms.).

2.2.5 Land Commission Awards & *Māhele* Claims

On March 8th 1848, Kauikeaouli divided his reserved lands into two categories: the King's lands (later to be renamed as the Crown Lands), considered to be his own private lands and the Government lands, intended to be used as public lands. As such, any income derived from the Crown lands would go toward the support of whoever ruled the kingdom. Crown lands could not be sold nor could they be leased for more than 30 years. Conversely, Government lands were made of lands that were set aside as public lands and those lands that were surrendered to the government by *aliʻi* instead of being subjected to a possible penalty.

However, all lands that were identified as Crown Lands, Government Lands, and *Konohiki* Lands were "subject to the rights of native tenants." To clarify the definition of these rights, the Privy Council adopted resolutions, which authorized the Land Commission to award fee simple titles to all native tenants who could demonstrate that they either occupied or improved any portion of these lands. Those awarded lands can be characterized as a small representation of the overall population. The majority of awardees were comprised of the local elite that possessed the financial and social authority to sustain further occupancy and usage of the property in question.

Awards issued by the Land Commission to the *makaʻāinana* were and still are called *kuleana* awards or *kuleana* lands. Native and foreign testimonies were provided to verify the legitimacy of an applicant that claimed residency upon a particular piece of land prior to 1839. Although the *makaʻāinana* did not have to pay a commutation fee, they did have to pay for the survey of their awarded parcels. During the *Māhele*, only 14,195 *kuleana* claims were made of which only 8,421 of those claims were awarded. The total acreage of those lands included in these claims equated to approximately 28,658 acres, which consisted of only lands under direct cultivation and did not include lands that were fallow (Kameʻeleihiwa: 1992, 295-297; Chinen: 1958).

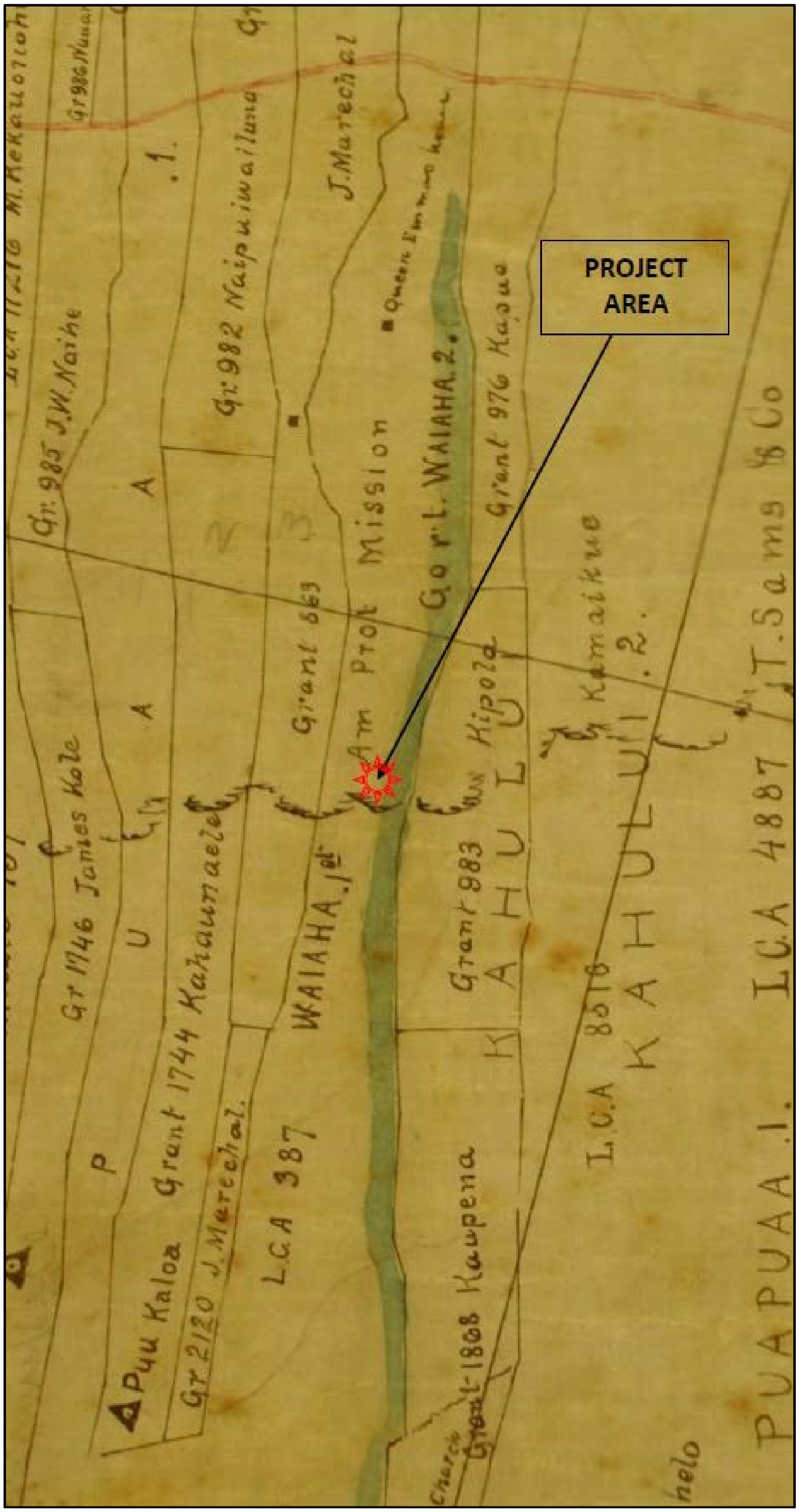


Figure 2-2. Portion of J.S. Emerson map, circa 1891 (source: Hawai‘i State Archives).

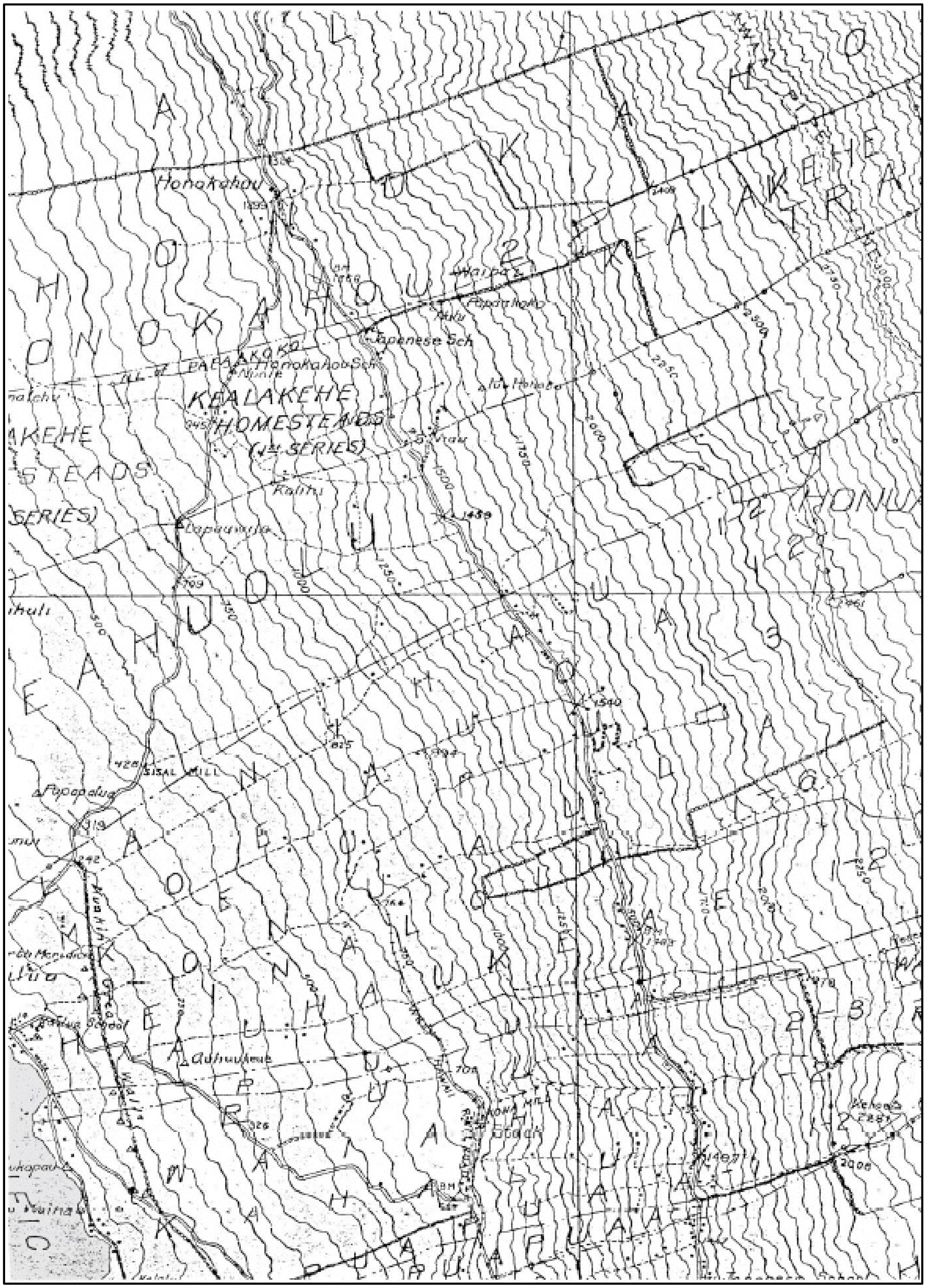


Figure 2-3. USGS, Kailua Quad, 1924.

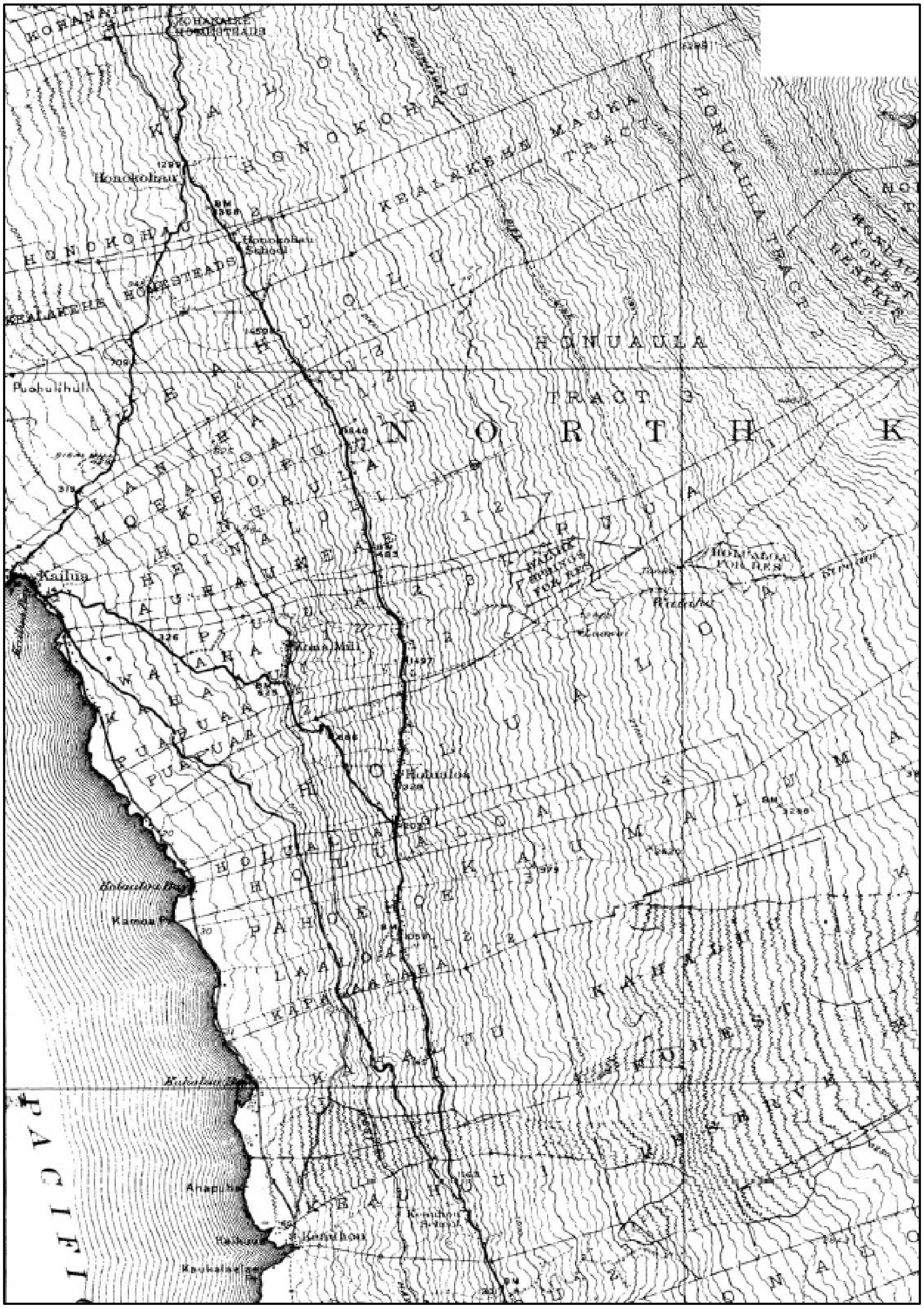


Figure 2-4. USGS, Kailua quad, 1928.

2.2.5.1 Wai‘aha 1

In the *Māhele*, the lands of Wai‘aha 1 were initially awarded to the American Board of Commissioners of Foreign Missions (ABCFM) as LCA 387 after a petition was sent to the Ministry of the Interior by the ABCFM to request that a commutation for a fee simple title be granted for these lands, as illustrated in Figure 2-5. Within this LCA, lands were also awarded to the ABCFM for the Laniākea estate of Asa Thurston in Hienaloli (5.26 acres), a houselot for Dr. Seth Andrews in Kailua (1.48 acres), the aforementioned lands of Wai‘aha 1 (273.50 acres), and lands in Hienaloli (121.80 acres).

July 9, 1853

To His Highness, The Hon. John Young, Minister of the Interior Department of the Hawaiian Government,

May It Please Your Highness,

The undersigned agents of the American Board of Commissioners for Foreign Missions, chartered by the Legislature of the State of Massachusetts in the United States of America in the month of June 1812. Acting for on in behalf of the Said Board at the Sandwich Islands be respectfully to request that His Majesty the King conformably to the laws of His Kingdom will grant to the said American Board to free a commutation of a fee simple title to the lands now in the possession and occupation of those who are and have been missionaries of the Said Board, and which have awarded to the said Am. Board by His Majesty's Board of Land Commissioners, but not in fee simple, and are indicated by the accompanying schedule.

The undersigned beg leave to state that they are encouraged to present this petition and anticipate a gracious reply from the long residence and labor in His Majesty's dominions of the Said Missionaries, and with which He is too well acquainted to render it necessary to reiterate them here and also in view of the fact that many of them are already His naturalized subjects and most if not all with their families expect to continue to reside at the Islands.

Likewise, the strong probability that the Said American Board will soon convey their right title and interest in money of the Said lands and properties to the Said Resident Missionaries and Ex- Missionaries. In view of the above consideration, the undersigned are led to hope that their petition will receive the early and favorable attention of His Majesty's Government and as in duty bound your petitioners will ever pray.

Samuel N. Castle, Amos J. Cooke,
Agents of the American Board of Commissions for Foreign Missions Honolulu

July 9, 1853

Figure 2-5. 1853 petition letter regarding lands of Wai‘aha 1.

Kealakekua May 8. 1843. Mark Ives.

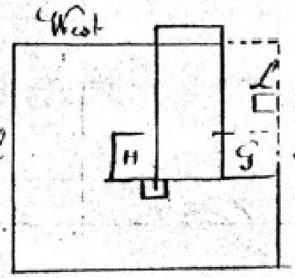
Continued page 126.

Kailua Hawaii

D. Bro: Sept 14th

1 I occupy a land, ahupuaa, received from Mr. Bishop. It is called Waiaha: bounded N. by Puaa S. by Waiaha iki & extends from the Sea shore back indefinitely.
2d A Cow Yard 67 ft. square, situated upon Hianaloli
3d My house lot. situated upon Hianaloli & Honuaula. The whole is enclosed by stone walls; & contains 1 acre, 1 rood, & 31 Rods. The whole except about 30 Rods, I received from Mr. Bishop; I must refer you to him for evidence of title. The 30 Rods were a school house yard adjoining mine, the people left it for a new location, & by their consent, I added it to my yard. There is a small corner of about 35 Rods added to notched into my yard, which ought to come into it; it lies common and is of no use to any one else: being little but Rocks & a lime Kiln: part of it is the high way into my Yard. This plan will make it plain

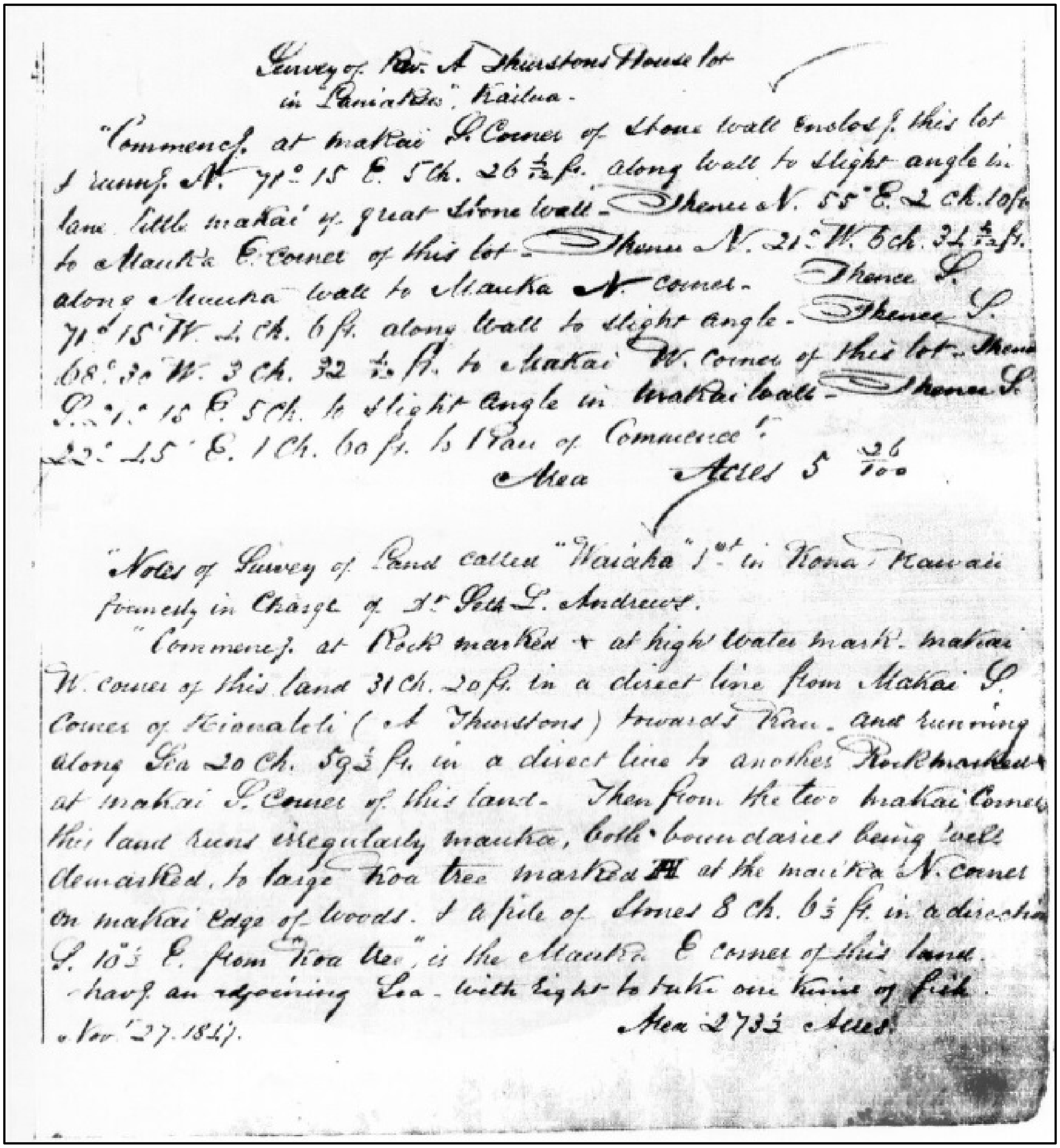
H. House
G. Entrance to Yard
L. Lime Kiln



The full lines represent my boundary walls, the dotted lines represent the space I wish to add to my Yard. It is not occupied by any one so much as by myself. & is of no value to any one else. It is upon Honuaula which belongs to Kanuha, who is at Honolulu. I should be glad to have it included in receiving the claim & probably no difficulty would occur in obtaining it from Kanuha

Seth L. Andrews.

Figure 2-6. Letter of testimony submitted by Seth L. Andrews.



Survey of Rev. A. Thurstons House lot
in "Laniakea", Kailua.

"Commencg. at makai S. Corner of stone wall enclosg. this lot & runng. N. 71° 15' E. 5 Ch. 26 1/2 ft. along wall to slight angle in lane little makai of great stone wall — Thence N. 55° E. 2 ch. 10 ft. to Mauka E. Corner of this lot — Thence N. 21° W. 5 ch. 34 1/2 ft. along Mauka wall to Mauka N. corner. Thence S. 71° 15' W. 4 Ch. 6 ft. along wall to slight angle — Thence S. 68° 30' W. 3 Ch. 32 1/2 ft. to Makai W. Corner of this lot — Thence S. 71° 15' E. 5 Ch. to slight angle in makai wall — Thence S. 22° 45' E. 1 Ch. 60 ft. to Place of Commencet."

Area Acres 5 26/100

"Notes of Survey of Land called "Waiaha" 1st in Kona, Hawaii formerly in Charge of Dr. Seth L. Andrews.

"Commencg. at Rock marked + at high water mark — makai W. corner of this land 31 Ch. 20 ft. in a direct line from Makai S. Corner of Kionaole (A. Thurstons) towards Kau — and running along Sea 20 Ch. 59 1/2 ft. in a direct line to another Rock marked + at makai S. Corner of this land. Then from the two makai Corners this land runs irregularly mauka, both boundaries being well demarked, to large Koa tree marked H at the mauka N. corner on makai edge of woods. & a pile of stones 8 Ch. 6 1/2 ft. in a direction S. 10 1/2 E. from Koa tree" is the Mauka E corner of this land. having an adjoining Sea — with right to take one kind of fish.

Nov. 27. 1847. Area 273 1/2 Acres.

Figure 2-7. LCA 387 Survey Record for Wai'aha 1.

For the lands of Waiʻaha 1, several native tenants made claims for lands, petitioning as long- standing residents. The lands that were awarded are detailed in Table 2-1, with a quick synopsis of testimonies, registers, and awards for each respective claimant provided below.

Table 2-1
Land Commission Awards in the *Ahupuaʻa* of Waiʻaha 1

Awardee	LCA	Royal Patent	Register (N): Native (F): Foreign	Testimony: (N): Native (F): Foreign	Acres
ABCFM	387	1600	(F) 47v.2	(F) 142v.3	281.80
Kalae	7481	3682	(N) 442v.8	(N) 513v.4	1.61
Kalama	7241-B	6672	(N) 419v.8	(N) 514v.4	0.29
Kaulua	7083	N/A	(N) 418v.8	N/A	.16
Lumaawe	6699	N/A	(N) 413v.8	(N) 549v.4	1.00

LCA 7481: Kalae

Native Register: To the Commissioners who quiet land titles of the Hawaiian Islands, greetings and peace to you all. In accordance with the directions, I hereby state my claim as follows: it is in the *ahupuaʻa* of Waiʻaha, *ʻili* of Kamuku, and it is 50 fathoms longs by 5 fathoms wide. I have had a right to this land for 10 years, until the present, from the *luna* of the *konohiki*. (442, 26 Jan 1848)

Native Testimony: Lumaawe (*Konohiki*) sworn he has seen in Kamuku *ʻili*, the land of Waiʻaha 1 Ahupuaʻa.

Section 1		*Section 2 – in the kaluulu zone*	
Mauka	*Moonuiohua ʻili*	*Mauka*	*Walaohia well*
Kaʻū	*Kamuku 4 land*	*Kaʻū*	*Moonuiohua ʻili*
Makai	*Land enclosure*	*Makai*	*Konohiki*
Kohala	*Kamuku 5 land*	*Kohala*	*Kamuku 5 land*

1 partially cultivated land section. Land from Lumaawe in 1838, no objections. (22 Dec 1848)

LCA 7241-B: Kalama

Native Register: Greetings to the Land Commissioners: I hereby state my house lot and land claim, which are in the *ahupuaʻa* of Waiʻaha and Kahului in Kailua, Kona. The size of my house lot is 62 fathoms by 22 fathoms, and the size of my land is 240 fathoms by 20 fathoms, that is the size of my *kula* land. The *paukū mauka* of this is 430 fathoms by 20 fathoms. The land was received in the time of Kamehameha I and has been held until the present. Here is my claim for land in the *ahupuaʻa* of Kahului, which is 240 fathoms by 8 fathoms. I have had this land for 6 years. I have another parcel of land farther *mauka* in this same *ahupuaʻa*, 800 fathoms by 12 fathoms that is another claim of my mine, which is stated to you. (419-420, 26 Jan 1848)

Native Testimony: Nalawaia sworn he has seen in *ʻili* land, Halewaʻa of Kahului 1 Ahupuaʻa

Section 1

Mauka	*Popolu Pana*
Ka'ū	*Kahului 2*
Makai	*Papalanui*
Kohala	*Wai'aha*

ahupua'a
1 section of land cultivated

Section 2

Mauka	*Kaalapahee Pana*
Ka'ū	*Nalawaia's land*
Makai	*Street*
Kohala	*Wai'aha*

ahupua'a
1 cultivated section of land

Section 3 Land at Wai'aha

Mauka	*Keaie well*
Ka'ū	*Kamuku 'ili*
Makai	*Kanakaumalu*
Kohala	*Kapahukauila*

1 section of land cultivated

Section 4 Pasture

Mauka	*Popolu land*
Ka'ū	*Kamuku land*
Makai	*Kapuili land*
Kohala	*Kapahukauila*

Section 5 House lot

Mauka	*Idle Land*
Ka'ū	*Idle Land*
Makai	*Government*
Kohala	*Idle Land*

No fence, Kalama is residing there with one house. Kahului 1 section is from Nalawaia. Old land at Wai'aha since Kamehameha I, from Kalama's wife. House lot had been vacant until Kalama built a house there, no one objected to this day.

Keaweehu sworn they (Keaweehu and Nalawaia) have known in the same way everything concerning Kalama's land. (22 Dec 1848)

LCA 7083: Kaulua

Native Register: Greetings to the Land Commissioners: I hereby state my house lot claim, which is *makai* in the *ahupua'a* of Kahului 1 and is 75 fathoms in circumference. Furthermore, my land claim is in the *ahupua'a* of Wai'aha 1, explained as follows: Seven *kīhāpai* are *mauka* of the cattle fence. Seven *kīhāpai* are at *kalu'ulu*. Six *kīhāpai* are *mauka* of *kalu'ulu*. Four *kīhāpai* are *mauka* of the *'āpa'a*. Four *kīhāpai* are *mauka* of Waiki'i. This land is bounded by Pu'ukou on the north, by Wai'aha 2 on the south, by the cattle fence on the west, and by Papalanui on the east. A *paukū 'āina* at Wai'aha 2 named Kanawai. A *kīhāpai* measuring 3 fathoms in length by 13 fathoms in width and another, named Kaaipuaa is 61 fathoms in length by 12 fathoms in width. These *kīhāpai* are bounded by Kaaihailoa on the north, by Kahului 1 on the south, by Koaie on the west, and by Ililoa on the east. These are my *kīhāpai* which have been cultivated from ancient times to the present. (Jan 1848)

Native Testimony: Kalama sworn he has seen:

Section 5 Wai'aha 2 land

Mauka	*Manohae kīhāpai*
Ka'ū	*Kahului 1 Land*
Makai	*Idle Land*
Kohala	*Kamuku Land*

Section 6 Wai'aha 2 kīhāpai

Mauka	*Konohiki*
Ka'ū	*Kapahukauila*
Makai	*Kaulua's land*
Kohala	*Kamuku 'ili*

Section 7

Mauka	*Papalanui land*
Ka'ū	*Wai'aha 2 land*
Makai	*Waikii*

Interest from Lumaawe in 1839, no objections. Lumaawe, *konohiki*, sworn everything mentioned above is correct. Lumaawe had given the interest, he will not object to him again (514, 21 Dec 1848)

LCA 6699: Lumaawe

Native Register: Greetings to the Land Commissioners. I hereby explain to you that I have land in the *'ili* named Puuko. It is at Wai'aha in the land of L.L. Andrews, medical doctor. The adjacent land holders are: on the north, the *'ili* of Naihe, on the south, the *'ili* of Kaulua. Furthermore, I have a house lot at Wai'aha on the east side of the road along the seashore. Its size is: on the north and south, 13 fathoms, on the east and west, 18 fathoms. Furthermore, I have two *kīhāpai* within an *'ili* named Muku, and the rest of that *'ili* is for a woman, Nawaa. (413, 25 Jan 1848)

Native Testimony: Kalama sworn he has seen the place Lumaawe had cultivated (it was wrong to include the whole *'ili* of Puukou in his claim, yet he had cultivated an area there, Wai'aha 1 Ahupua'a).

Section 1

Mauka	*Maiahuna ea maia*
Ka'ū	*Wai'aha 2 land*
Makai	*Kaneohilunu kiowai*
Kohala	*Moonuiohua land*

1 cultivated section of land

Section 2

Mauka	*Kaalaea kīhāpai kō'ele*
Ka'ū	*Kameku land*
Makai	*Moonuiohua*
Kohala	*Kamuku land*

1 cultivated section of land

Section 3

Mauka	*Hanamauloa*
Ka'ū	*Wai'aha 2 land*
Makai	*Aihiahine land*
Kohala	*Moonuiohua 'ili*

1 partially cultivated section

Section 4

Mauka	*Nakukui land*
Ka'ū	*Wai'aha 2 land*
Makai	*Cattle Corral*
Kohala	*Kamuku 4*

1 cultivated section

Section 5 In the 'ili of Kamuku 3

Mauka	*Koele*
Ka'ū	*Kamuku 2 land*
Makai	*Cattle Corral*
Kohala	*Kamuku 4 land*

Section 6 House Lot Mauka

Mauka	*Idle Land*
Ka'ū	*To the uplands*
Makai	*Government Rd*
Kohala	*Idle Land*

Lumaawe built an enclosure, 2 houses there are for him and he lives there. Old land from Lumaawe's grandparents at the time of Kamehameha I. No has objected to him. Kawaha sworn to have known alike (550, 9 Jan 1849).

2.2.5.2 Wai'aha 2

Upon the death of Liholiho in 1824, Kauikeaouli (Kamehameha III) inherited the rule to the kingdom at the age of 10. Born at Keauhou and raised in 'O'oma, North Kona, Kauikeaouli married Kalama, whereupon they adopted the youngest son of Kekūanaō'a and Kīna'u, namely Alexander Kalanikualiholihokekapu 'Iolani, who would later rule as Kamehameha IV.

For the lands of Wai'aha 2, Kauikeaouli classified these lands as part of the Crown lands, whereupon a protest was filed by local native tenants, requesting a review of the subject lands to be held as Government lands. A review of this dispute is provided in Section 2.2.7 of this report. A review of those awarded land claims reviewed within Wai'aha 2 is provided below and listed in Table 2-2.

Table 2-2
Land Commission Awards in the *Ahupuaʻa* of Waiʻaha 2

Awardee	LCA	Royal Patent	Register (N): Native (F): Foreign	Testimony: (N): Native (F): Foreign	*Acres*
Kaanehe	7913	5221; 7815	(N) 453v.8	(N) 533v.9	3.12
Kanahele	6402	5214	(N) 413v.8	(N) 555v.4	1.70
Kaniu	7912	7923	(N) 514v.8	(N) 649v.8	1.20
Liawahine	7912-C	N/A	N/A	(N) 649v.8	1.30
Lono	6736	6709	(N) 394v.5	(N) 675v.8	1.20

<u>LCA 6699: Lumaawe</u>

LCA: Greetings to the Land Commissioners: I hereby state my house lot claim. It is makai, in the ahupuaʻa of Waiʻaha 2. The circumference is 91 fathoms. My land claim is in this same ahupuaʻa, in two ʻili, Pahukauila, and Kamuku 1; however these are not completely cultivated by me. They are bounded on the north by Hanamauloa, on the south by Kamoku 2, on the west by Paupuhi, and on the east by Makaihuliwaa. (453, 31 Jan 1848)

Testimony: Kekipi sworn he has seen in the Pahukauila ʻili, land of Waiÿaha ahupuaʻa (error in including the whole ʻili in the claim. The place Kaanehe (this is correct) had cultivated.

Section 1

Mauka	*Konohiki*	*Mauka*	*Konohiki*
Kaʻū	*Kauailoa ʻili land*		*(29 Dec 1848)*
Makai	*Cattle Corral*		
Kohala	*Kanamauloa ʻili*		
1 section of land			

Section 2

<u>LCA 7912: Kaniu</u>

LCA: Greetings to the Land Commissioners: I hereby state my claim for land in the ahupuaʻa of Waiʻaha 2. The name of the ʻili is Kauailoa. This ʻili is bounded by Pahukauila on the north, Haleuwaawaa on the south, Punaio on the west, and Makaihuwaa on the east. (513, 31 Jan 1848)

Testimony: Liawahine & Lumaʻawe sworn that they have seen his ʻili section of Kanailoa in Waiÿaha 2 ahupuaʻa that Liawahine had given Kaniu in 1839. (12 Jan 1850)

<u>LCA 7912-C: Liawahine</u>

Testimony: Kaniu and Lumaʻawe sworn that they have seen his section in the ʻili of Hanamauʻuloa, an ʻili of Waiʻaha 2 from Kaaea in 1824. No one objected to him. Boundaries are surrounded by land of the konohiki. (12 Jan 1850)

<u>LCA 6736: Lono</u>

LCA: Greetings to the Land Commissioners: I have a small house lot, at Pauaʻa, and Waiʻaha. I am, respectfully, Lono. (393, 4 Feb 1848)

Testimony: Lumaawe, sworn, says he knows the land claimed by Lono in Waiʻaha nui, Kona. It consisted of 2 kihapais and a house lot. The house lot is enclosed but there is no house on it (now). Lono is dead and Kepahoni (Cape Horn) is his heir. The two kihapais are bounded on Kohala side by Nawaa's land, mauka by Kaulua's land, makai by witness land. Claimant derived this land from Kaulua in the time of Kuakini and has held it without dispute.

2.2.6 Commission of Boundary Awards

Further documentation of historic land use is found in the records of the Commission of Boundaries, formed in 1862 to define the boundaries of all the *ahupuaʻa* that had been awarded as part of the *Māhele*. In 1874, the Commission was authorized to certify the boundary divisions. Most of the testimony provided during the certification process was provided by local inhabitants of the lands in question, many of who had also been claimants for *kuleana* during the *Māhele*. The following excerpts provided additional information regarding the land use patterns of Waiʻaha, as recorded by the local inhabitants of the time:

A) <u>The Ahupuaʻa of Waiʻaha 2d District of North Kona, Island of Hawaiʻi 3d J.C.</u>
On this day the 9th day of June A.D. 1874, the Commission of Boundaries for the Island of Hawaiʻi 3 J.C. met at Kailua, North Kona on the application of J.O. Dominis Acting for Her Highness Emma Leleolani, Queen Dowager, for the settlement of the boundaries of Waiʻaha 2d situated in the District of North Kona, Island of Hawaiʻi. Notice of hearing served by publication in the Hawaiian Gazette of May 20th, 1874 and due notice personally served on owners or agents of adjoining lands as far as known. Present are J.G. Hoapili for applicant etc. also present. Kapuhui and others, all say land belongs to Queen Emma.

B) <u>For Petition see Folio 453 Book A</u>
Note: For Boundaries of Waiʻaha 1st See Land Commission Award No. 387. Mission Book 3, page 148. J.G. Hoapili & T.K. Kaai states that the land of Waiʻaha 2 is owned by Queen Emma. Mr. Kaai made this statement at different times when I was staying at his in house in August 1873.

C) <u>Testimony</u>

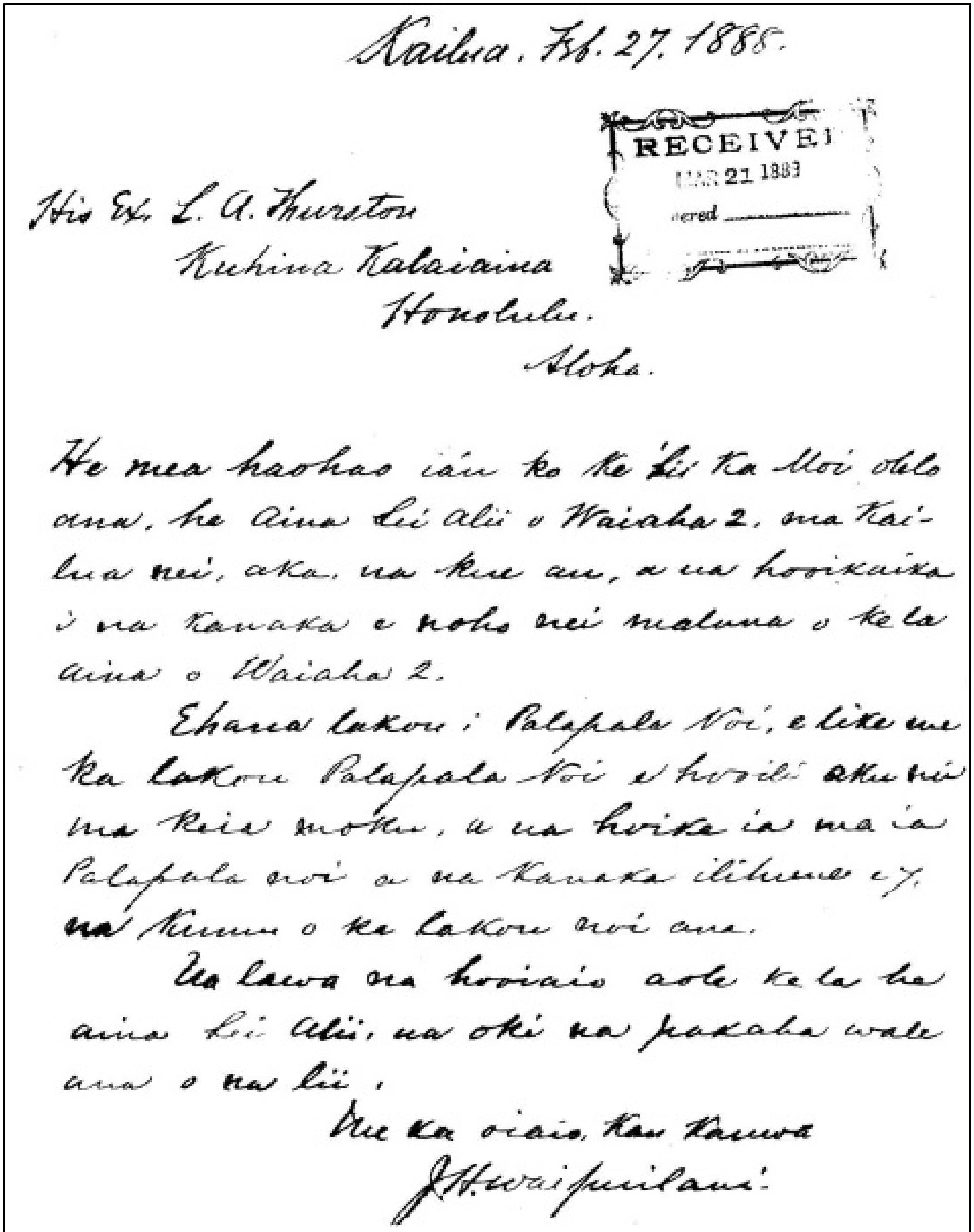
Peahi k. Sworn: I was born at Kohala at the time of Kiholo, when I was married I came here and have lived here ever since. Know the land of Waiʻaha, lived there sixteen years. A water hole called Waialipi is on the boundary between the two Waiahas. Waiʻaha 2d is bounded by Waiʻaha 1st to a banana grove at the edge of the woods called Maiahuna. Waiʻaha 2d is bounded on the South side by Kahului. The land is sold to Kapae (k.) from shore to above the Government road. Thence along Kahului 2d to Puuokaloa where I have heard it is cut off by Hōlualoa. Waiʻaha 1st was surveyed from shore to Maiahuna and I do not think it extends far beyond there. Waiʻaha 2d is bounded makai by the sea. Ancient fishing rights extending out to the sea.

Mahiehie k. Sworn: I was born at Puaʻa Kona, at the time of Kumoalii, so my parents told me. I know the boundaries of Waiʻaha. Have always lived on these lands, my father told me the boundaries. Waiʻaha 2d is bounded on the north side by Waiʻaha 1st. Saw Fuller survey Waiʻaha 1st from the shore to Maiahuna, the mauka end of it. Kahalui 1st bounds Waiʻaha 2 on the south side. A place called Pamakani is the mauka corner of Kapae's land. It is a resting place thence to Papalanui, between Kahului Aupuni and Waiʻaha 2d thence to Makahulewaa, an old resting place, thence to Popoula, the mauka corner of Kahului 1st from thence the boundary turns and Waiʻaha is cut off by Puaʻa to Maiahuna. (as recorded and certified by R.A. Lyman, Commissioner of Boundaries 3d J.C.)

Waiʻaha Land Classification Dispute

On February 27th, 1888, a letter was filed with Lorrin A. Thurston, the *Kuhina Kālaiʻāina* (Ministry of the Interior) by Waipuilani, acting spokesperson for a group of native tenants that were opposed to the classification of Waiʻaha 2 lands as belonging to the Crown lands. A subsequent letter, written by the tenants themselves, was also drafted on the same day. The letters stipulate that since portion of lands were already held in fee simple title for a period of more than 30 years, which according to the civil laws of the time could not then be classified as Crown lands.

The original protest letters are provided in Figure 2-8 and 2-9, with translations provided. As illustrated in Figure 2-10, in a letter dated November 9th to the Minister of the Interior, the lands of Waiʻaha 2 were "surrendered" to the government by the Commissioner of Crown Lands, as part of a group of lands omitted during the 1848 *Māhele*.



Kailua, Feb. 27, 1888.

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His Ex. L. A. Thurston
Kuhina Kalaiaina
Honolulu.

Aloha.

He mea haohao iau ko ke 'Lii Ka Moi olelo ana, he aina Lei Alii o Waiaha 2, ma Kailua nei, aka, ua Kue au, a ua hooikaika i na Kanaka e noho nei maluna o kela aina o Waiaha 2.

Ehana lakou i Palapala Noi, e like me ka lakou Palapala Noi e hoolei aku nei ma keia moku, a ua hoike ia mai ia Palapala noi a na Kanaka ilihune e 7, na Kumu o ka lakou noi ana.

Ua lawa na hooiaio aole kela he aina Lei Alii, ua oki na pakaha wale ana o na lii.

Me ka oiaio, kau Kauwa
J.H. Waipuilani.

Figure 2-8 (a). Waipuilani petition letter, 1888.

To His Excellency L.A. Thurston, Ministry of the Interior, Honolulu

Greetings. The words of His Royal Highness are an astonishing to me as it relates to the said Royal Crown Lands of Waiʻaha 2 at Kailua; but, I protest and attest on behalf of those native tenants who reside on the land of Waiʻaha 2.

They have filed in this petition, similar to their own petition to transfer the said lands within this district, duly noting that represented with this petition are those individuals that are destitute and are the motivating factors for this request.

The truth to the matter will suffice: these lands are not of the Crown, and this singular attempt of cheating by His Excellency should be dismissed.

With truth, Your Servant,
J.H. Waipuilani

Figure 2-8 (b). Translation of Waipuilani petition letter, 1888.

2.2.8 Post *Māhele* Period: The Advent of Contemporary Agricultural Production

In 1899, the Kona Sugar Company established itself with the intent to become an emerging leader in the Hawaiʻi's sugar industry. In 1901, the plantation built its first sugar mill, which was situated at an elevation of 764 feet in Waiʻaha, as shown in Figure 2-3. Under the auspices of the West Hawaiʻi Railway Co., a railroad was built to haul sugarcane from the upland regions of the Kona District, extending 11 miles to Onouli.

Although the mill site was built near Waiʻaha Stream to access the upland spring waters, inconsistent volume rates of water flow created problems in cane processing and production. By 1903, only four years after its formation, the company went bankrupt. James B. Castle bought out the plantation and railroad in 1906. In 1916, the company, renamed the Kona Development Company, was purchased by interested Japanese investors, availing an opportunity for a resurgence in regional cane production. Production continued at the mill site until 1926, marking the closure of sugar operations in Kona (KHS: 1998, 18; Kelly: 1983, 90-91).

In previously conducted interviews with local informants, information was shared regarding the establishment and operation of the Kona Development Company Railroad. Owned by a man named Kondo now buried at the Hōlualoa Cemetery, the Kona Development Company constructed and operated an 11-mile railroad line that extended from Keōpuka, South Kona to the mill site that was situated at Waiʻaha. The railroad line was built at approximately the 700- foot elevation level. Stone trestles were constructed as high as 20 feet. Sugarcane was transported from the upland fields to the railway via triggered cables, whereupon it was hauled to the railroad site just above Kailua. By 1918, the Kona Development Company had harvested over 4,500 tons of sugar from approximately 1,553 acres. By 1919, over 2,500 acres of land were being cultivated under contract for the production of sugarcane. (Maly: 1999, 170-172; Kelly: 1983, 91; Thrum: 1917; 83-85).

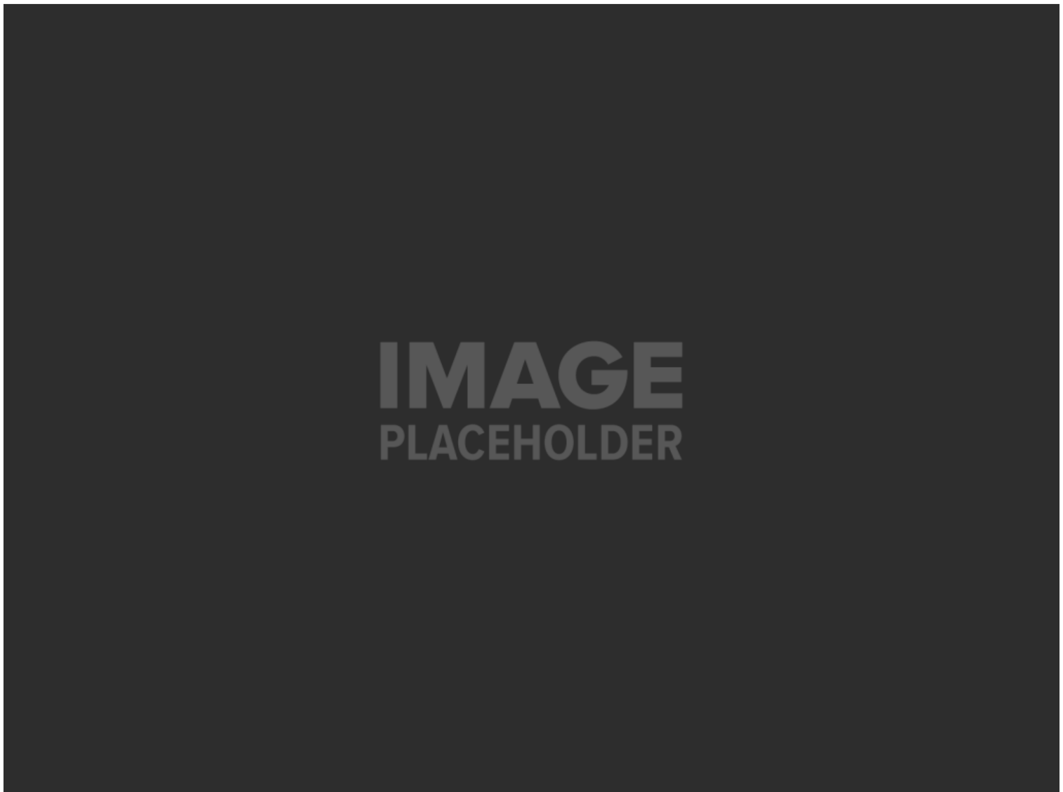


Figure 2-9 (b). Translation of native tenant petition letter, 1888. (entire figure missing from original pdf).

To the Honorable Lorrin A. Thurston, Minister of the Interior:

With humility:

We, the undersigned, residing at Wai‘aha, Kailua, North Kona, Island of Hawai‘i, hereby, make known, that we ask that the land of Wai‘aha 2, be surveyed and sold, according to the law of A.D. 1884 as follows:

> *2. We have lived a long time on the land of the Chiefs, that is at Wai‘aha 1 and Kahului, and whereas, it was stated that five hundred dollars ($500) was the rent of said lands of the Chiefs, per annum, and we are unable to pay the five hundred per annum, and for that reason will leave the land of the chiefs.*
>
> *3. We, because of having lived a long time on the land of the chiefs above set forth, from the time of our ancestors, therefore, we are deprived of any land, and are living in want.*
>
> *4. We have cultivated on the land of Wai‘aha 2, such as tobacco, coffee, and other growing crops to make living comfortable.*

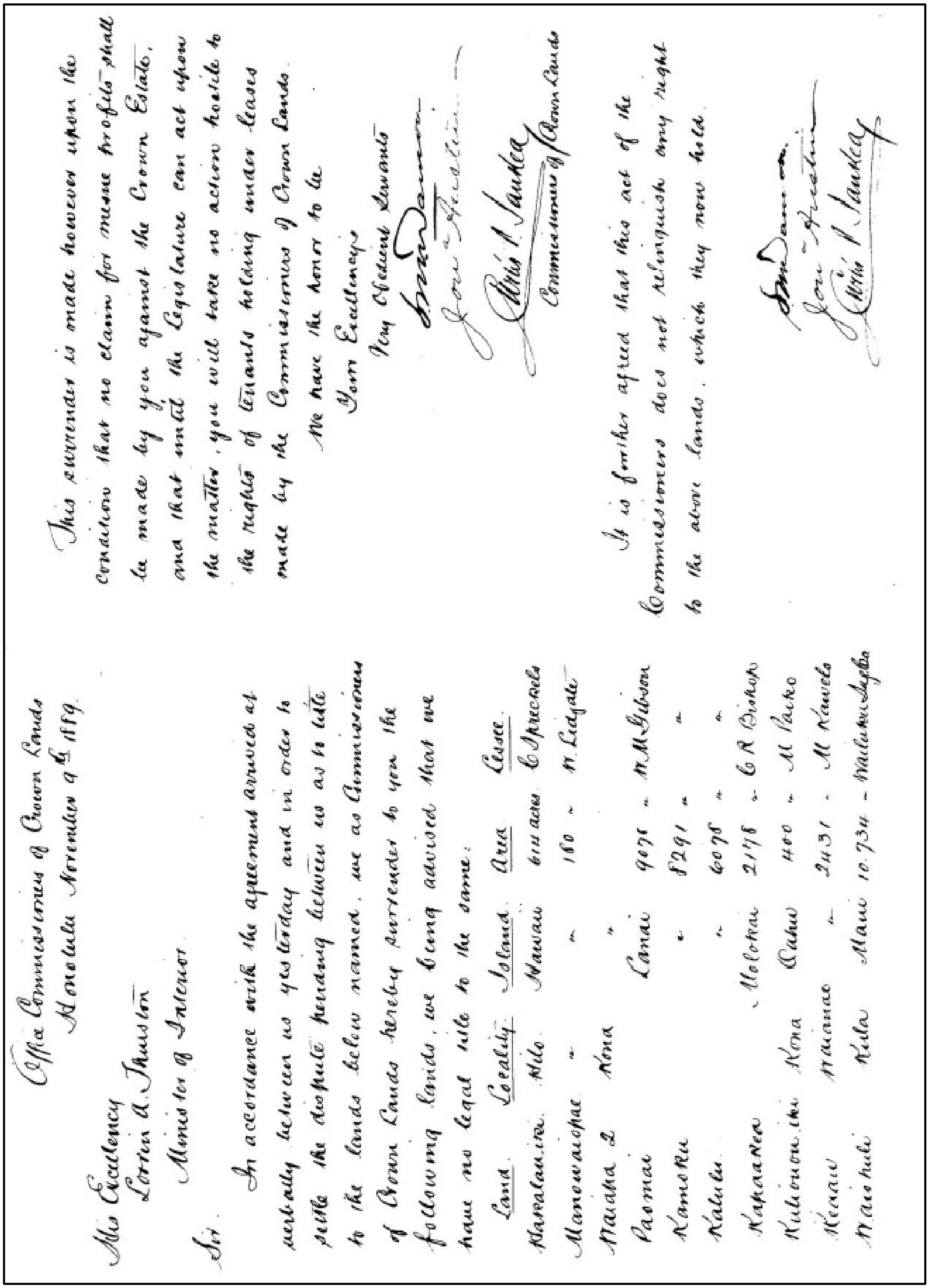
Honorable one, we are glad to report, that the land of Wai‘aha 2 aforesaid, is land taken by the chiefs as Crown land, but, with the hope that you will be gracious and look at this:

> *1. The land of Wai‘aha 2 is not Crown land, but, it is land belonging to the Government, because, there are some fee simple lands on Wai‘aha 2, which were conveyed by the Government, and that is why it is proven to be Governent land.*
>
> *2. In about A.D. 1864, there was surveyed way up 100 acres for Kanahele (k), by S.C. Wiltse, a Government land surveyor, and because money was not paid, this is the reason the land was not conveyed to Kanahele.*
>
> *3. What is well known to the natives is that Wai‘aha 2 is Government land, and there is now living some persons who know for sure that it is land belonging to the Government.*
>
> *4. By our civil laws, it is shown there, that Wai‘aha belongs to the Government, and is not land belonging to the Crown.*

Wherefore, we humbly pray to you, that your honor will kindly reply to James H. Waipuilani, our duly elected Committee Chair. Signed by us this 27th day of February, A.D. 1888, at Kailua, North Kona, Island of Hawai‘i, Hawaiian Islands:

Respectfully:
Name: Kaililua
Kualo Opio
Makahiehie
Paueono
Pi
Papa
Kapana

Figure 2-9 (b). Translation of native tenant petition letter, 1888.



Office Commissioners of Crown Lands
Honolulu November 9th 1889.

His Excellency
Lorrin A. Thurston
Minister of Interior.

Sir.

In accordance with the agreement arrived at verbally between us yesterday and in order to settle the dispute pending between us as to title to the lands below named, we as Commissioners of Crown Lands hereby surrender to you the following lands, we being advised that we have no legal title to the same:

Land.	Locality.	Island.	Area	Lessee.
Kaaalau.iki.	Hilo.	Hawaii	614 acres	C Spreckels
Manowaiopae	"	"	180 "	W. Ledgate
Waiaha 2	Kona	"		
Paomai		Lanai	9076 "	W M Gibson
Kamoku		"	8291 "	"
Kalulu.		"	6078 "	"
Kapaakea		Molokai	2178 "	C R Bishop
Kuliouou.iki	Kona	Oahu	400 "	M Paiko
Keaau	Waianae	"	2431 "	M Kawelo
Waiohuli	Kula	Maui	10.734 "	Wailuku Sugar Co

This surrender is made however upon the condition that no claim for mesne profits shall be made by you against the Crown Estate, and that until the Legislature can act upon the matter, you will take no action hostile to the rights of tenants holding under leases made by the Commissioners of Crown Lands.

We have the honor to be
Your Excellency's
Very Obedient Servants

Jno. M. Dowsett [?]
Jon. Austin
Curtis P. Iaukea
Commissioners of Crown Lands

It is further agreed that this act of the Commissioners does not relinquish any right to the above lands, which they now hold.

Jno. M. Dowsett [?]
Jon. Austin
Curtis P. Iaukea

Figure 2-10. Letter from the Commissioners of Crown Lands, 1889.

In the early 1800s, coffee plants were originally brought from Brazil and the Philippines and were originally planted in the kona area of Oʻahu but introduced at Onouli, South Kona by the Reverend Samuel Ruggles. (Clark: 1985, 107; Kelly: 1983, 67). In Kona, early foreign settlers, primarily from the United States and Europe, observed that the best production yields of coffee occurred on the leeward slopes of Hualālai and Mauna Loa, within a 1 to 2-mile-wide belt of land located approximately between 800 to 1700 feet above sea level, as shown in Figure 2-11. Between the years of 1836 to 1855, coffee plantations in Hawaiʻi were primarily under the control of Americans and Europeans. However, between 1860 and 1885, native Hawaiians were tending to a large number of scattered coffee trees, usually grown in small clusters under the shade of *kukui* nut trees. These native farmers would travel by horse to the uplands and pack bags of coffee to be transported back to the coastal area, where they would be laid out to dry.

Between 1885 and 1924, an immigration of Japanese laborers arrived to Hawaiʻi to help support the expanding industry of sugarcane production. By 1905, most large operation coffee plantations were eventually divided into smaller farms approximately 5 acres each and leased to individual families. Several young Japanese families, upon completing contractual obligations to primary sugar plantations, ventured into the coffee industry as independent farmers. Around the early 1900s, the family of Jindero and Hatsuyo Inaba arrived in Kona, working for the failing Kona Sugar Company. Within a few years, interest in coffee prompted Mr. Inaba to plant some of the first coffee trees in the *ahupuaʻa* of Waiʻaha, following the example of other Japanese immigrants that were striving to establish a livelihood as independent coffee farmers (Goto: 1982, 117-118).

However, interest in the coffee trade expanded to other ethnic groups. During the height of the coffee boom, it is estimated that there were nearly 500 Chinese immigrant laborers working within the Kona region, involved in various phases of the coffee industry including field labor, farm operations and processing, wholesale distribution and merchandising. Likewise, by 1896, there was a large population of Portuguese families settling in the upland regions of Waiʻaha and Hōlualoa, working as coffee farmers.

Figure 2-11. Coffee plantation in the uplands of Waiʻaha.

The trademark of quality coffee emerging out of Hawai‘i into the international market was attributable to several traders and independent farmers, including H.N. Greenwell, who selected only the highest quality of coffee for his market. However, the industry of coffee slumped in the 1860s due to several attributable island economic and socio-political factors but emerged in a boom market in the 1890s, due to vested U.S. and foreign interests that saw potential investment opportunity pending from the overthrow of Queen Lili‘uokalani in 1893. American and European capitalists, owners, managers returned with a fervor to stimulate the production and market interest. Some of the American and European owners of coffee plantations in North Kona included Dr. McWayne, F.W. Bartels, George McDougal, N.F. Scott, and Emil Mueller (Goto: 1982, 116-117).

By 1918, coffee was the principal industry of Kona with over 5,000 acres of land dedicated to its cultivation, producing over 2400 pounds of dry coffee per acre annually. During this time, other major industries that defined the economic character of the Kona region included: cattle, sugar, sisal, cotton, oranges, bananas, pineapples, limes, lemons, tobacco, and *koa* lumber.

Commercial crops of cigar tobacco were produced from 1908 to 1913. However, in 1912, the Kona based industry suffered a major loss of two crops and a packing and distribution house to a fire. As a result, there were fewer vested interests by potential investors to assist the promotional years of this industry. In 1916, W.R. Castle purchased the mortgages and creditors’ claims against the old Kona Tobacco Co.; Ltd., from H. Hackfield & Co., Ltd., which had been the primary financial backer for the tobacco companies within the region. (Thrum: 1920, 97-99).

2.2.9 Development of Trade, Cattle, and Ranching Industry

With an embayment that provided safe anchor, the town of Kailua developed into a major seaport for exploring captains, traders, and whalers. As time progressed, the town served as a major port-of-call for initial shipping vessels and steam ships. Boat days became an intricate part of the social fabric for Kailua, as it served as a primary means of shipping goods, products, and livestock being cultivated, processed, or raised within the Kona region.

Between 1880 through 1956, local ranchers used Kaiakeakua (Kailua) Bay to move cattle to the Honolulu markets. Prior to the introduction of the tug and barge, traditional transportation of livestock involved the various paniolo on horseback to lasso individual bullocks and pull them into the ocean waters, whereupon the would be lashed to the gunwales of whaleboats that rowed out to deeper water and then hoisted aboard the inter-island steamers.

The development of large parcels of *kula* lands encouraged an expanding import of cattle from Scotland, Australia, and England. In 1918, there were approximately 10 major ranching operations that tended to nearly 14,000 cattle. By the 1920s, three of these ranches emerged along the Kona coast as the primary producers of cattle: the Frank Greenwell Ranch at Honokōhau, Hualālai Ranch, and the Arthur Greenwell Ranch in South Kona. As shown in Figure 2-12, grazing lands were also provided for horses, which were steadily utilized for cattle operations (KHS: 1998, 23; Kelly: 1983, 81).

Figure 2-12. Ranch land in the upper slopes of Wai‘aha.

2.2.10 U of N Bencorp Property

Ranching began to evolve in the late 1800s, whereupon introduced cattle were pushed to the uplands where pastures could provide adequate food and water for them. As stated in a previously conducted interview with Joseph Gomes, his father Manuel Gomes, was able to purchase the lands of Wai‘aha, including those of the project area, and Kahului from the defunct Kona Development Company. This purchase availed to Gomes the most important source of water at the time from Wai‘aha Springs.

According to land records, the project lands in Wai‘aha were partially held in title by Thomas Gouveia, local rancher and butcher, and Sam Liftee. Thomas Gouveia used to raise pigs that ran wild within the project area, but had a house and butcher shop in the upper region of Hōlualoa, as shown in Figure 2-13. Ownership was transferred in the names of Josephine Duarte and Sam Liftee. In 1952, the land came under the ownership of Thomas Duarte, who a year later sold the property to Manuel Gomes. By 1959, the pastoral and agricultural lands were then conveyed to Joseph and Margaret Gomes.

Born at Hōlualoa in 1916, Joseph Gomes was the son of Manuel Gomes, who emigrated from Portugal around 1883. After moving from Ka‘ū to Kona, Manuel Gomes leased land out of Keahuolū and Honua‘ula and later purchased the lands of Kahalui and Wai‘aha upon the closure of the Kona Development Company in 1927. Manuel Gomes developed these lands as part of his extensive ranching operation. Upon his father’s passing in 1959, Joseph Gomes inherited the family’s Kona ranch lands.

In a previously conducted interview with Kepā Maly, Mr. Joseph Gomes shared that family lands near and including the project area extended to the upland forest reserve area and comprised of approximately 1500 acres. Approximately 90 acres within the two *ahupua‘a* of Kahului and Wai‘aha were purchased from George Heeches, a German businessman who married a Hawaiian woman from the Kahului area. At any given time, approximately 2,000 cattle were tended to, both in the *mauka* and *makai* portions of the *ahupua‘a* (Maly: 1999, 37-41; Kelly: 1983, 81).

In 1953, the remaining project lands were under ownership by Manuel Gomes and later transferred to Joseph and

Margaret Gomes. Both parcels of lands were conveyed to PACU Bencorp, the profit arm for the University of Nations, in August of 2000 via the Gomes Family Limited Partnership.

2.3 CULTURAL RESOURCES AND PRACTICES

2.3.1 *Ka ʻAno o Ka Poʻe Kahiko*

For any cultural landscape, the interpretative analysis of form, function, and role of the inherent cultural mores and traditions must be conducted within the epistemological context and framework of the host culture. As such, a guiding principle that characterizes the cognitive relationship of native Hawaiians with the natural environment is understanding that all natural areas possess *mana*, a divine power that exists because these areas are comprised of specific elements that are personifications or manifestations of the *akua* (spiritual deities).

The presence of the *akua* and *ʻaumakua* (family guardians) are exemplified through the natural elements of rain, wind, sun, earth, cloud formations, and ocean forms that are intrinsic to a specific geographical space. Ancestral knowledge of the land and its resources was recorded and passed down intergenerationally through the derivation and establishment of place names, as well as the development of several oratory forms. These recorded forms of ancestral knowledge provided insights as to "best management" practices that were employed in traditional times and are perpetuated in contemporary uses through the invocation of identifiable subsistence practices. Further, an inherent aspect of native Hawaiian stewardship in relation to any given area's natural and cultural landscape is the continuance of established cultural values of conservation and management to ensure the sustainability of the area's natural resources for generations to come.

The survivability of traditional Hawaiian practices is defined by understanding, physically and spiritually, the assumed roles of man and the natural elements in creating a sustainable environment. Therefore, in conducting this cultural impact assessment, a review of known and shared traditional cultural knowledge as applicable to understanding the beliefs, customs, and practices that occurred within the *ahupuaʻa* of Waiʻaha was conducted.

2.3.2 *Wahi Pana* – Legendary Places

The concept of "*wahi pana*" is a cultural interpretation of spatially defined areas. *Wahi pana* are sacred spaces that include such cultural properties as *heiau* sites, sacred *pōhaku* (stones), burial grounds, weather phenomenon, or any natural or geographical features that are associated with deities or significant natural, cultural, or historical events. In native Hawaiian thought, even if the tangible features of a particular cultural property or site no longer exists, there is a distinct imprint that is left upon the natural and cultural landscape, whereby the *mana* (divine power) of all previous persons and activities associated to a defined space still manifests itself. A review of known *wahi pana* in the *ahupuaʻa* of Waiʻaha is provided below.

<u>The Summer Home of Queen Emma and Kamehameha IV</u>

Born on the 2nd of January in 1836, Emma Kalanikaumakaamano Kaleleonālani Naʻea was the daughter of Fanny Kekelaokalani Young and George Naeʻa. Through the cultural practice of *hānai*, to formerly take the *kuleana* or responsibility of nurturing and raising a child as your own, Emma was raised by Grace Kamaʻikuʻi and Dr. Thomas Charles Byde Rooke.

Through the *moʻokūʻauhau* of both her natural parents, Emma possessed royal blood that established ties to *aliʻi* from Kauaʻi, Māui, and Oʻahu. Further, her matriarchal grandmother was Kuamoʻo Kaʻōanaʻeha, the daughter of Keliimaikai, Kamehameha's younger brother.

She married Alexander Kalanikualiholihokekapu ʻIolani, Kamehameha IV, on May 18, 1856. Nearly two years later, on May 20, 1858, Emma gave birth to the "Prince of Hawaiʻi," Albert Edward Kauikeaouli Leiopapa a Kamehameha (Kanahele: 1999, 2-4, 84).

During the autumn of 1861, Kamehameha IV, Queen Emma, the prince and a small staff spent several months at Waiʻaha. The king, an asthmatic, was concerned about his health. While there, he established an interest in cotton and coffee, creating a plantation around there home in Waiʻaha, located on the mountainside above Kailua (JGC: Ms.).

Near the latter part of June in 1861, the Queen and the Prince traveled with a small retinue to the king's summer home situated approximately 2,000 feet above Kailua, along the slopes of Hualālai, in the *ahupuaʻa* of Waiʻaha.

The royal estate was originally built by Governor B.W. Kapeau, and later bought by the Reverend T.E. Taylor, who expanded the facilities in the existing house. Kamehameha IV purchased the home from the Reverend. Serving as a royal retreat, the house was bordered by groves of coffee, orange, breadfruit, and cotton trees, and was considered to be one of the preeminent homes in all the islands, as shown in Figure 2-14. The family returned to Honolulu in December of the same year. (Kanahele: 1999, 134; Rappolt: 1991).

On August 19, 1862, the young Prince became severely ill while residing in Honolulu, suffering from a series of spasm attacks. On August 27th, 1862, the young Prince passed away, with the likely cause of death attributable to acute appendicitis (Kanahele: 1999, 139; Morris: 1994, 80).

In honor of the young prince's death, Emma took the name, Kaleleokalani, meaning the "flight of the royal or heavenly one." However, within approximately 15 months, the Queen would suffer another tragic death of her husband, Alexander Liholiho, who died in her arms on November 30, 1863. The queen took on another new name, Kaleleonālani, the "flight of the royal ones," reflecting the quick events of the passing of both her son and husband in nearly a year's time.

As it was a common cultural practice, a series of *mele makena*, or *kanikau*, lamentation chants were composed in memory of the young royal prince and the reigning king. Drawn from printed sources, some of the most eloquent compositions were those written by Queen Emma herself. In these *mele makena*, several layers of *kaona*, contextualized meaning are hidden in poetic metaphors, which include lines that reflect on the peace and serenity once shared amongst the royal family in Wai'aha and the greater Kona region. In these lamentation chants, the Queen draws attention to the uplands of Wai'aha, with inferences that this place was indeed a place of quiet repose and held a special place in the hearts of both she and her departed loved ones (Kanahele: 1999, 143; Rappolt: 1991, 117; Nogelmeier: 2001, 315).

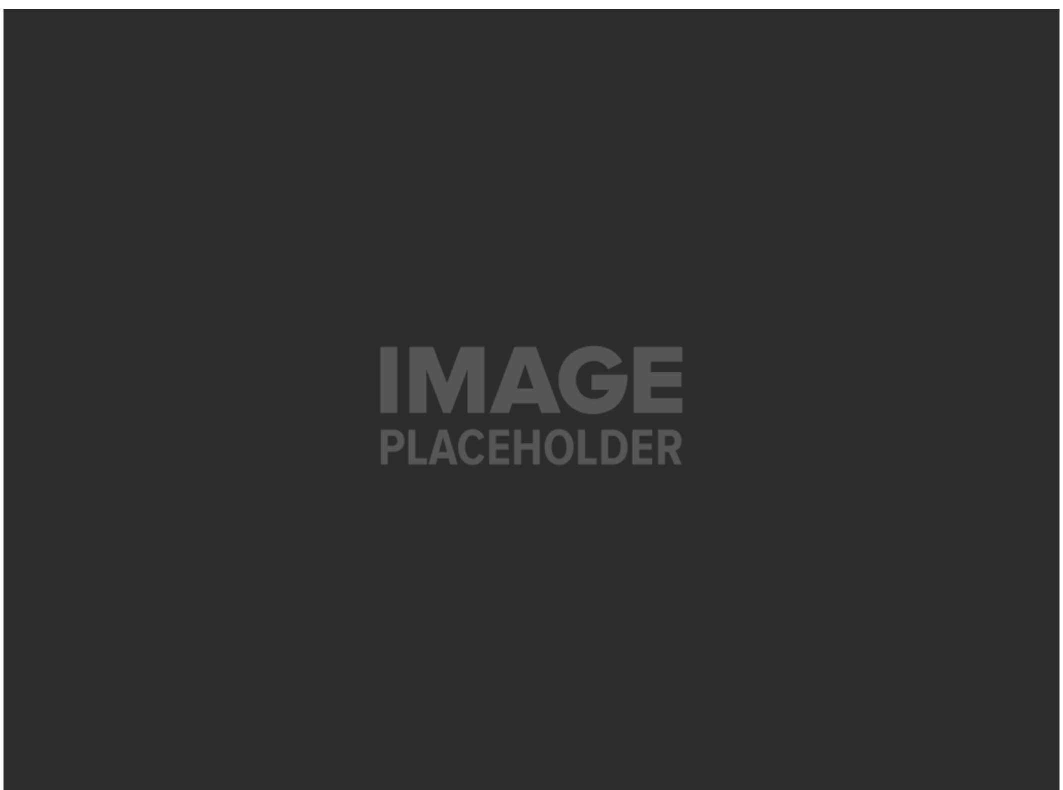


Figure 2-14. missing from pdf

He ʻUhane he alohi kēia nou *E Kaleiopapa he inoa* *He aloha ka ʻUhane i ka hele ana* *Ka nīʻau hoʻokahi ʻaʻohe lua* *Kuʻi aku ka lono i nā Paemoku* *ʻO Kalanimealahaÿole ua hele* *Ka wehena ʻana mai o ke alaula* *Kahea o Ukali o Hōkūloa* *E Kalani ē, eia e kō ala* *ʻO ke ʻānuenue piʻo i ka lewa* *ʻO ke alakoʻiʻula piʻi i ka lani* *ʻIke e o Kāne me Kanaloa* *Hoʻouna e mai i kua ua koko* *I kapa ʻaʻahu no ka ʻuhane* *I ka hele hoʻokahi i ke ao ana* *I ka hora ʻewalu kakahiaka* *Ka ʻakua ʻIolani ka mea aloha* *Ka uwē kanikau i ke keiki* *Hoapili o ka laʻi e Kailua* *Huli hāliu nā maka o Kalani* *Nānāi ka uka la o e Waiʻaha* *ʻOia uka anoano ʻiuʻiu* *ʻAuwē kuʻu lei, kuʻu keiki* *Kuʻu mea minamina la e noho nei*	*A song of lamentation, a glimmering reflection for you,* *Kaleiopapa, a name* *A love for the spirit that has left* *The only royal child, there is no other* *The news spread over the archipelago* *The royal one, with out equal, has passed* *The opening up of light from early dawn* *Ukali and Hōkūloa beckon* *O royal chief, here is your essence* *The arching rainbow in the sky* *The path of the rainbow-hued mist climbing to the heavens,* *recognized by Kāne and Kanaloa* *Sending the sacred blood rain image* *The regal attire for the spirit Departing* *at once in the dawning* *At eight ʻo clock in the morning* *ʻIolani, the father is the beloved one* *The lamenting chant for the child* *A companion of peace, there at Kailua* *The eyes of the royal one are inclined to turn* *Gazing upon the uplands of Waiʻaha* *It is a sacred and solitary plain in the uplands* *Alas, my precious beloved, my darling child* *My endearing precious one that resides here*

As recorded in the archival records, the following excerpt is taken from a lamentation that speaks to her son who has passed on, reflecting on the deaths of both her beloved child and husband. This chant is accredited to Queen Emalani Kaleleonālani:

Eia kō hoa lā *Me he lama lā ka pua lena o ke koʻolau* *Ka palaluhi ma uka o Kaʻako* *Ua pua nono i ka wai i Wailua* *I kiʻi mai nei e uhoʻi ʻolua e moe i ka uka o Waiʻaha* *E nānā i ke kai māʻokiʻoki* *I hoa luana i ke kai o Kailua* *lā Anuanu* *Anuanu mai nei ke aloha iā ʻoukou* *Iā lāua ala aku hoʻi me ka lei o mākou ā* *Aloha ʻoe ā*	*Here is your companion* *Like a torch is the yellow blossom of the koʻokoʻolau The golden yellow in the uplands of Kaʻako* *It bloomed glowing red in the waters of Wailua* *Having fetched you two to return and rest in the uplands of Waiʻaha* *Observing the sea of many hues* *As a companion in leisure there at the sea of Kailua* *Cold* *Chilling is the affection for all of you* *For the two of them there and the cherished one of ours, Love to you, ah...*

As recorded in *Ka Hoku o ka Pakipika*, a Hawaiian language newspaper, on September 11, 1862, the following excerpt is taken from a chant published under the title, *He Kanikau no Ka Haku o Hawaiʻi*, was composed and signed by the Queen:

Aloha ʻino kākou i ka lā nui o Kona *ʻO kona ia o kai malino a ʻEhu lā* *ʻEu ʻole* *Eu ole ke kai, hanu ʻole i ka pohu* *Mālie iho ihola ke Kona a ke Kailua,* *Laʻi aku la, hā ka pokiʻi a ʻUmi ā, ʻUmi*	*Pity upon us in the powerful sun of Kona* *Kona of the mirroring sea of ʻEhu* *Unstirring* *Unstirring is the sea, holding its breath in the stillness* *Those of Kona and Kailua are hushed* *Becalmed, the younger siblings of ʻUmi, suppressed*

As recorded in *Ka Nupepa Kuokoa* on January 2, 1864, the following excerpt is taken from a chant published under the title, *He Kanikau no ka Moi Iolani Kamehameha IV*, and was signed by "Emmalani":

Kuʻu kāne, e kuʻu kāne hoʻi *Kuʻu kāne mai ka lā laʻilaʻi o Kona* *Mai ka makani Kēlehua o Lehuakona* *ʻO Kona ia o ke kai malino a ʻEhu ē* *Ke ala a ʻEhu, ke ala a kāua i hele ai* *I ke ao i ka pō, pōwehiwehi i ka ua Nāulu a weli* *He weliweli, he maluhia i ke aloha iā ʻoe* *ʻIā oe, ʻiā oe e Kalopelekei i ka lā ē* *ʻOia wahi aloha ia* *Na wai hoʻi ka ʻole o ke aloha ē* *Nāna nō ē (Kanahele: 1999, 179).*	*My beloved husband, my dear husband indeed* *My dear one from the peaceful days of Kona* *From the Kēlehua wind of Lehuakona* *Oh Kona it is of the mirroring sea of ʻEhu* *The path of ʻEhu, the path you and I traveled* *In the day and evening, darkened by the Nāulu rains that storm* *Frightful, peaceful in this love for you* *For you, for you, oh Kalopelekei of the day* *It is the same adoration* *Whoever could deny such love* *For him, indeed...*

<u>*Kahawai* o Waiʻaha</u>

One native historical account translated by Kepā Maly, a noted *kumu hula* and cultural and historical specialist, entitled "Kaʻao Hoʻoniua Puʻuwai no Kamiki" speaks of how the stream of Waiʻaha ran from the uplands of the said *ahupuaʻa* and flowed into the adjacent ahupuaʻa of Kahului, providing freshwater for the "taro mounds of the sacred prostration chiefs Kaleiʻeha, Kapahualoʻi, Kaʻalaea, who possessed the *kapu* of Lonomakahiki." The *moʻolelo* also refers to a *māla ʻuala*, a sweet potato garden that extended from Niumalu to Hinakahua, including the lands of Waiʻaha.

<u>*Moʻo* o Waiʻaha</u>

Haliʻa was the name for a "magical pool" of water at Waiʻaha believed to be inhabited by a water spirit, probably a *moʻo*. The name refers to the restorative and healing powers that these waters possessed. Knowledge shared by knowledgeable sources concur that the waters of Waiʻaha Stream was the residence of an *akua moʻo*, whose name is not known (JGC: Ms).

Several associative cultural inferences can be derived with the local residence of an akua moo in the waters of Waiʻaha. From a cultural perspective, persons that are deified with specific *kinolau* (body forms) attributes have to possess a familial relationship to that deity form. Therefore, any honorific tribute to the *moʻo akua* within Waiÿaha would suggest that there is a distinctive genealogical association between this *moʻo* and the initial settlers of Waiʻaha. Further, this association and the applied cultural practice of *kākūʻai ʻana* would indicate that there is a definitive set of *kuleana* that are inherently recognized and perpetuated. Venerated for their ability to sustain the health, welfare, and productive resource yields for all freshwater sources within the Hawaiian islands, akua *moʻo* were and are integral elements of cultural identification and definition for communities like Waiʻaha, which exhibit such natural features.

<u>Kona Field System and Kūāhewa Plantation</u>

After Kamehameha's victory over Kalanikūpule's forces at Nuʻuanu in 1795, a major rehabilitative effort of reviving agricultural production ensued. During the eminent rule of Kamehameha between 1797 and 1811, a time of peace was introduced and fortified through a conscious application of government interventions designed to return the islands to efficient levels of sustainability and productivity. According to some accounts, the upper slopes of Keōpū, just north of Waiʻaha were part of an extensive plantation called Kūāhewa, which belonged to Kamehameha I.

As illustrated in native historical accounts, it was the intent of Kamehameha to ensure that resources were available, and their use appropriately regulated to ensure that sustainable and productive yields were achieved in helping to rejuvenate a native population that had been subjected to years of decline as a result of battle deaths:

> *ʻŌlelo aku ʻoia i nā aliʻi a me nā makaʻāinana, e mahi nui i ka ʻāina i ka ʻai. ʻO Kamehameha nō kekahi i hana i ka mahi ʻai; aia kana mahina ʻai ma uka o Kailua ma Kona, a ua hana pū nō ʻoia me kona mau ʻaialo. I ka pau ana o ke pulu, ua kīpulu ʻia me ka uhi ʻana i ke ʻamaʻumaʻu a paʻa.*

Ua ʻōlelo ʻia hoʻi, o kēlā māla a Kamehameha i hana ai, ua lōʻihi nā makahiki o ka waiho ʻana me ka ulu ʻole o ka nāhelehele; ʻo ke kalo nō ke lawe mai, ulu nō ka ʻohā, a nunui, uhuki ʻia, ulu mai nō ka waʻe, a pēlā aku; ulu mai nō ka maʻu, a ulu mai nō ka palili, a pēlā no ka mamauea a me ka ʻae. ʻO Kūāhewa ka inoa o ua māla nei (Kamakau: Kuokoa, 24 Augate 1867, Helu 38)

He (Kamehameha) instructed both the aliʻi and commoners to vigorously tend to the land in farming production. Kamehameha himself tended to some of the farming duties, with his plantation there in the uplands of Kailua in Kona, there he worked together with his royal attendants. When the water was done, a covering of ʻamaʻumaʻu was applied as fertilizer. It was also said, that garden of Kamehameha's tenure, the years of tilling and preventing forest overgrowth were long; taro was taken there; the young taro stalks would grow immensely, and when harvested, they would provide ample supply for subsequent generations of kalo plantings; and so forth, the sprouts would grow, the weak taro root would grow, thereby with the mamauea kalo and the ʻae. Kūāhewa was the name of this garden area.

In 1822, Kuakini restored this unique garden feature, clearing out eight *ʻili* in two days for the replanting of *kalo*. Other recorded sources highlight that Kūāhewa was indeed a unique and abundant garden system. (Kelly: 1983, 74-74; Desha: 2000, 347-349; ʻĪʻī: 1995, 114).

Burials

In Hawaiian language, the word "*kanu*" means to plant, to cultivate, and to bury a deceased person. Thus the use of symbolism in language provides an important cultural lesson. When native Hawaiians traditionally buried those that "*hala i make*", passed on to death, it was the ancestral remains that were "planted" and in turn provide those in the living with spiritual and physical growth. When returned to the *ʻāina*, it is the ancestors that have passed on that become the physical and spiritual nourishment to all that grows and thrives thereby contributing to the sustainability of life itself through their respective death.

The *iwi*, the ancestral remains of a deceased person were guarded, respected, treasured, venerated, loved or even deified by associated family member with the *iwi* of departed chiefs being held in the highest regard. The preservation of an ancestor's *iwi* was a sacred *kuleana* and obligation. The *hūnākele*, the traditional practice of guardianship and concealment of the *iwi* by a close family friend or family attendant, included extensive preparation and inherent protocols (Beckwith: 1940: 274; Rose: 1992, 9; Fornander, 1919: IV:105; Pukui, et al: 1972, 107).

Burial methods and locations varied, depending upon each individual death. One form of burial included the construction of a cist, a stone structure built around or on top of the body. During his travels around the Kailua district in 1823, Reverend Ellis documented the burial practice of burying the dead with the use of stone monuments:

The number of heiaus, and depositories of the dead, which we passed, convinced us that this part of the island must formerly have been populous. The latter were built with fragments of lava, laid up evenly and on the outside, generally about eight feet long, from four to six abroad, and about four feet high. Some appeared very ancient, others had been evidently been standing but a few years (Ellis: 1979, 79).

Traditional Surfing Grounds

The coastal area of Waiʻaha is also noted for its strong and prevalent offshore conditions that make for ideal surf conditions. The art of canoe surfing has been documented as taking place at two famous surf spots called Koʻokā, located in the *ahupuaʻa* of Puaʻa just north of Waiʻaha, and Koʻokā. Native accounts detail how Kamehameha I and Kaʻahumanu, both expert canoe surfers, had mastered the challenging surf of Huiha:

The surf at Huiha at Honuaʻula in Kailua proper, directly above the place where ships anchored and just seaward of Keikipuʻipuʻi, was rough when it rose. The land place for this surf was a circle of sand, where the water swirled gently as it went out from the shallows. (ʻĪʻī: 1995, 133)

Native accounts detail that in addition to the areas of Koʻokā and Huiha, two other spots called Kāmoa, at Keolonahihi, and Puʻu in Hōlualoa were also famous for surfing.

Keikipuʻipuʻi

Constructed as a *luakini heiau*, Keikipuʻipuʻi was situated just south of Hoʻolulu Cove, along the coastal shores of Honuaʻula. This *heiau* was originally constructed sometime between 1797 and 1811, as stated in following recorded account:

> *Kūkulu aʻela o Kamehameha i nā heiau mōhai kānaka no kona mau akua puni koko, ʻoia hoʻi ʻo Puʻukoholā a me Mailekini ma Kawaihae, ʻo Keikipuʻipuʻi a me ʻAhuʻena ma Kailua (Kuokoa: 6 Iulai 1867, 32)*
>
> *Kamehameha constructed several heiau that required human sacrifice for his surrounding warrior akua, specifically those of Puʻukoholā and Mailekini at Kawaihae, and Keikipuʻipuʻi and Ahuʻena at Kailua*

During the latter years of Kamehameha's life, between 1811 and 1819, Kamehameha revisited several of these *heiau* and restored them, as depicted in the following account:

> *ʻO ka hoʻōla i nā heiau o ke akua kekahi hana nui a Kamehameha; ua hana ʻoia iā Keikipuʻipuʻi ma Kailua; he hana nui, me ke kūkulu i nā kiʻi hoʻonani ma waho o ka paehumu; he kiʻi lāʻau ʻōhiʻa i kālai ʻia a ʻolēʻolē ka waha, a hoʻolōʻihi ʻia ke poʻo, a mahiole i luna, a ua hoʻopoepoe ʻia nā ʻūhā me nā wāwae, a ma lalo o nā wāwae, o ka paukū wahie ʻokoʻa no ka lōʻihi, i paʻa ke kūkulu ʻana i lalo o ka lepo; he mau kanahā ka nui o nā kiʻi o kekahi heiau, a he lau ko kekahi mau heiau nui. Ua kūkulu ʻia ʻo waho a ka paehumu a puni ʻo ka heiau, a ma ke alanui e hele mai ai a hiki i ka pahu kapu, ua kūkulu lālani ʻia ke kiʻi, a ʻo ke kiʻi e kū ana i ka pahu kapu, o Kūkalepaʻōniʻoni ʻoia. (Kuokoa: 24 Augate 1867, 38).*
>
> *A restoration of heiau for several important akua for Kamehameha took place; he worked on Keikipuʻipuʻi at Kailua; a great task with the construction of adorned images outside of the enclosed area of the heiau that was under kapu; ʻōhiʻa images with their mouths carved with a wide-mouthed grin, the head prolonged, with a helmet on top; the thighs and feet were rounded, and beneath the feet, a firewood section for the entire length; the post was secured beneath the soil; approximately 40 images were made for these heiau; some in greater numbers for other heiau. These were constructed outside of the enclosure that was kapu and surrounding the entire heiau, and along the path to the sacred drum, the images were posted in rank, with a single image placed erect for the sacred pahu, it being Kūkalepaʻōniʻoni.* (Kamakau: 1992(b): 145; ʻĪʻī: 1995:121).

Pā a Kuakini

In 1794, Captain George Vancouver presented Kamehameha I with a gift of a young bull, two cows, and two bull calves at Kealakekua Bay, marking the initial settlement of cattle in Hawaiʻi. However, this introduction of domestic livestock did create some new problems. In response to cattle roaming freely over the landscape, one explanation of the construction and expansion of the Pā a Kuakini was that the wall served as a barrier to prevent cattle from roaming and stampeding down to the coastal residences. Several recorded historical accounts concur that the construction of the Pā a Kuakini occurred in the early 1800s as a response to prevent cattle, goats, and the European boar from damaging the agricultural field systems.

It was not until during the reign of Kauikeaouli (Kamehameha III) in the 1830s, that Mexican- Spanish *vaqueros* (cowboys) were brought to Hawaiʻi to provide training in the arts of horseback riding, cattle roping, saddle making, and lariat braiding to local ranchers. It was through this training that a new cultural practice, embraced by the paniolo, the Hawaiian cowboy, was born. Further, the use of lava rocks also continued as cultural practice in the construction of holding pens and gates, paddock walls, boundary walls, and shelters during the advent of ranching, as shown in Figure 2-15. (KHS: 1998, 20).

Kamakahonu

Kamakahonu was comprised of an approximately four-acre enclosure, which served as the royal residence for Kamehameha during the last seven years of his life, until he passed away in 1819. Kamakahonu was also the residence of Keaweamahi, the *kahu* of Keaweaheulu. At Kamakahonu, Kamehameha built three thatched houses, including a *hale moe* (sleeping house), a *hale ʻāina* (eating house) and a *hale mua* (meeting house for men). The location of Kamakahonu along the outer edge of the embayment made it ideal for observing canoes that would travel from South Kona.

In preparation for his departure to Honolulu in 1820, Liholiho appointed Kuakini to serve as the *kiaʻāina*, the governor of Hawaiʻi island. Further, on April 4th of the same year, the first company of Congregational missionaries arrived at Kona, landing at Kamakahonu, which served as the residence for Kuakini until 1838. After a shift in political residence from Kailua to Kona in 1855 during the reign of Keʻelikōlani, the area of Kamakahonu began to fall into disarray.

In 1898, the German ship chandlery, H. Hackfield & Co., transformed Kamakahonu into their primary headquarters. The firm was seized by the Alien Property Custodian, a division of the United States Department of Justice, during World War I and auctioned off to a group of Hawaiʻi businessmen who changed the name to American Factors (Amfac). In 1959, Amfac redeveloped this area, building the first high-rise hotel called the King Kamehameha Hotel (KHS: 1998, 25; Weiner: 1982, 15-17; Clark: 1985, 109; ʻĪʻī: 1995, 120-121).

<u>Ahuʻena Heiau</u>

Ahuʻena, which translates to the "fire-hot mound," was considered to be a *poʻokanaka* class, or luakini class heiau built around 15th century, later being utilized by Kamehameha to honor his war *akua*, Kūkaʻilimoku. The purpose of constructing such a *heiau* was for either political or government affairs, especially concerning matters of war and often included human sacrifice.

Kamehameha erected *kiʻi*, carved wooden images that stood very tall, called *keikipuʻipuʻi*, for the various *heiau* he restored within the Kailua district. Depending upon the size of the *heiau*, anywhere between 40 and 400 hundred of these *kiʻi* were erected outside the *paehumu*, an enclosure that was *kapu* for only the *aliʻi* to reside, and set up leading to the *kapu pahu*. One recorded account describes the sacred drum of Apahou, which was adorned with human teeth, residing at Ahuʻena.

However, after Kamehameha I had settled at Kamakahonu, the heiau was rededicated for the *akua* Lono, considered to be the *akua* for peace, agriculture, and prosperity. During the last few years of Kamehameha's life, the *heiau* site served as his permanent residence and the training center for Liholiho in learning the ways of becoming a *pono aliʻi*. However, upon the death of Kamehameha I on May 8, 1819, the *heiau* was destroyed during the abolishment of the *ʻaikapu* system, which was instigated by Liholiho and Kaʻahumanu.

As shown in Figure 2-16, the heiau was restored in 1975 at a much smaller scale and currently is designated as a National Historic Landmark. The features of the *heiau* include a *hale mana*, which once served as the central spiritual center; a *lele; a ʻanuʻu* tower and the associative *kiʻi*, including that of Kōleamoku, whose was considered to be an *akua* for navigators (Kamakau: 1992 (c), 201-203; Van James: 1995, 105; Crowe & Crowe: 2002, 22; Thrum: 1920, 85; ʻĪʻī: 1995,122-123).

<u>Maʻo Heiau</u>

Maʻo Heiau was a small *heiau* situated in the *ahupuaʻa* of Waiʻaha. The *heiau*, classified as a *heiau hoʻoulu ʻai*, *hōʻuluʻulu ua*, or *kālua ua*, was described as being in poor condition in the early 1900s, with the old government road cutting into its *mauka* edge.

The inner division was comprised of a series of holes in the platform, where was "rain was baked." The consecration of the *heiau hoʻoulu ʻai* served to increase the general food supply of the surrounding area. Typically, *Heiau maʻo* were designed to promote rainfall and abundance in time of drought Additionally, *heiau* called Ipuolono were constructed to revive the agricultural productivity of the land. A subset of Ipuolono Heiau was the *houluulu ua*, those *heiau* whose function was to inspire rainfall (Van James: 1995:25; Kamakau: 1992(b): 129, 133; Thrum: 1908, 43-46).

Figure 2-15. Portion of Kuakini Wall in project area.

Figure 2-16. Ahu‘ena Heiau from Kamakahonu view.

Hulihe‘e Palace

Built by Kuakini in 1838, Hulihe‘e Palace served as the principal residence of Kuakini until his death in 1844, whereupon it was used as a royal retreat and hosting venue by several other *ali‘i*, including Princess Ruth Ke‘elikōlani. In the case of Ke‘elikōlani, she resided on the palace grounds but had a traditional *hale* built next to the Palace as her sleeping quarters.

Hulihe‘e Palace is approximately 60 feet long by 30 feet wide, with two floors and six rooms. The residence of Hulihe‘e was named after Kuakini's brother Ke‘eaumoku II. The rooms were originally paneled in *koa*, with much of its ornate and elegant furniture made out of *kou*. As recorded by the Reverend Cheever, the house and its surrounding area was ornately adorned and landscaped:

> *The Governor's house is a handsome two-story building of stone; the doors, window stools and all the woodwork of beautiful koa. An elegant koa center table of a German mechanic, veneered, finished and jointed with great beauty, adorns the reception room or hall entrance. Two large bedrooms lead out of this, one of which the governor occupies, but the handsome curtained bedstead he leaves to its own repose and sleeps on a raised platform strewn with mats…a tasteful gothic window over the front door and balcony, and in the rear a pillared veranda which shows to advantage in coming into the harbor. Within the same enclosure is a long narrow house for the accommodation of attendants and other chiefs. Nearby under the spreading shade of some fine koa trees, is a boathouse, where a little schooner is on the stocks (Winne: 1928, 19).*

After the passing of Kuakini in 1844, the Palace was inherited by William Pitt Leleiōhoku, and later inherited by Ke‘elikōlani after Leleiōhoku had passed away in 1848. When Princess Ruth passed away in 1883, Princess Bernice Pauahi Bishop, who passed away a year later in 1884, inherited the property. The residence was sold to King David Kalākaua, whereupon the palace underwent extensive remodeling, transforming the Palace from its original design with the use of native lava rock, coral lime mortar, *koa* and *‘ōhi‘a* wood to more of a structure that was indicative of late 19th Century Victorian architecture, including the addition of gold leaf picture moldings, a stucco exterior, and redwood pillars, as shown in Figure 2-17 (KHS: 1998, 27; Zambuka: 1992, 26; DOH: 1996).

Situated at the southern end of the sea wall near Hulihe‘e Palace is Kanuha beach, a small pocket of white sand with a rocky shelf fronting its shores. The beach is named after the Kanuha family, who descended from a line of Kailua *ali‘i*, who owned a parcel of property *mauka* of the shoreline.

Moku‘aikaua Church

Finished in 1836, Moku‘aikaua Church is the original stone edifice that replaced a thatched structure that was destroyed by fire. The old thatched church was one of the preeminent buildings in the Kona district:

> *In February 1826, Governor Adams and the people of Kona went into the forest, cut and drew down the timber for the large native church. In the summer some thousands were several weeks engaged in erected it and thatching it. Its dimensions were 180 feet by 78 feet, covering an area of 14,040 feet, and capable of containing 4,800 hearers. This new and magnificent temple had its tall strong posts inserted firmly in the rocks of Kailua, its large roof, sides and ends thatched and its corners ornamented, and made an imposing appearance (Winne: 1928, 13).*

Although not as immense as its original, the stone church was just as immaculate as its predecessor, measuring at 120 feet by 48 feet, and stands today as the oldest church in Hawai‘i. Reverend Asa Thurston worked with the local natives in the design and location of the building, maximizing the natural air ventilation of the nearby ocean breeze. The interior posts of the church were made out of *‘ōhi‘a*, which grows in the upland areas of Hualālai at higher elevations that provide more rainfall. The interior furnishings were constructed out of koa. The walls were constructed with lava rock and coral lime, which was gathered from the nearby coastline. As shown in Figure 2-18, the steeple measures at 112 feet in height, serving as a prominent landmark.

Figure 2-17. Hulihe‘e Palace in Kailua-Kona town.

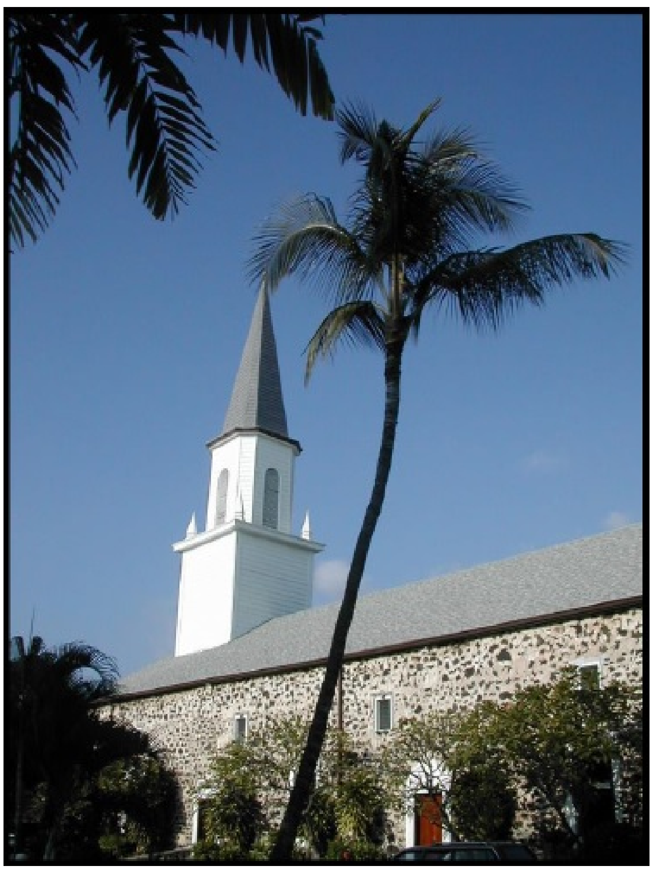


Figure 2-18. Moku‘aikaua Church.

2.3.3 Contemporary Uses

The development of luxury resorts, vacation timeshares, and condominiums have contributed to the area's growth in the tourism market as a major popular destination in Hawai‘i. The Kailua-Kona region serves as the primary venue for a number of competitive sporting events including the Hawai‘i International Billfish Tournament, originally held in 1959, and the Ironman Triathlon World Championship, held in Kona since 1981. Coffee still continues to be the major economic stimulus in the agricultural industry within the district.

2.3.4 Previous Studies

There have been a number of archaeological and cultural studies conducted within Wai‘aha Ahupua‘a in the vicinity of the current project area within the coastal *kula* areas of Kailua-Kona (Table 1). These studies have included Archaeological Inventory Surveys (AIS), Archaeological Data Recovery projects, subsurface testing, and burial treatment planning. Collectively, these studies have identified a range of both late Precontact and early Historic residential sites, many of which were associated with elite members of Hawaiian society. Also prevalent in the region are features associated with transportation, opportunistic and more formalized agriculture, temporary and permanent habitation, burials, and ceremony. The extent, distribution, and temporal affiliation of archaeological sites within the project area represents a microcosm land use, exemplifying a much broader settlement and subsistence pattern for Kona and any other given region in Hawai‘i. Typical agricultural features in Wai‘aha have proven to be mostly, but not always, associated with habitation sites within the agricultural fields of the *ahupua‘a* which are generally lumped into the recognized confines of the Kona Field System (a large portion of which is designated as State Inventory of Historic Places [SIHP] Site 50-10-37-6601 and eligible for inclusion in the National Register of Historic Places [NRHP]). Ceremonial sites such as *heiau* have also been identified within coastal Wai‘aha, including Ma‘o Heiau, a *heiau kālua ua* intended for controlling rainfall. Additionally, burial sites are common elements of the cultural landscape within Wai‘aha, both in dedicated monument settings and also in settings where they coincide with habitation features.

Collectively, the findings of previous archaeological and cultural investigations conducted within and in the general vicinity of the project area allow for a holistic portrayal of past land use and settlement patterns for Kailua-Kona's *kula* lands and other contributing factors to the overall cultural landscape, including lands that are the focus of this study. Data that has been derived from the existing archaeological record has undoubtedly contributed to the budding corpus of knowledge concerning Precontact use of Kona's *kula* zone. Furthermore, these studies document the gradual yet dramatic shift away from a traditionally rooted subsistence economy to a market economy developed primarily for trade and export of goods, the acceleration of which was exacerbated by privatization of lands subsequent to the *Māhele ‘Āina* of 1848. As a result, land use within Wai‘aha, and elsewhere throughout Hawai‘i continued to transform during the Historic Period, fueled by promise held by burgeoning economic ventures such as commercial sugar cultivation and ranching. This shift is reflected in the archaeological record as evidence of stone walls (such as the Kuakini Wall) and cattle enclosures were constructed to ward off free-ranging feral animals that were infiltrating the countryside, resulting in contributing tangible elements to the Historic vernacular landscape of the region.

Table 1. Previous studies conducted in the vicinity of the current project area.

Year	*Author*	*Type of Study*
1994	Head et al.	Inventory Survey
1996	Walker et al.	Data Recovery
2000	Rechtman	Inventory Survey
2002	Corbin and Rosendahl	Archaeological Assessment
2002	Rosendahl	Burial Site Testing
2002	McKeague	Cultural Impact Assessment
2003	Clark and Rechtman	Inventory Survey
2003	Rechtman	Burial Treatment
2007	Rechtman and Loubser	Data Recovery
2013	Rechtman	Preservation Plan
2019	Barna	Dismantling/Restoration Plan

One of the most proximate studies to the current project area was an AIS (Head et al. 1994) conducted by Paul H. Rosendahl, Inc. (PHRI) for the proposed Aliʻi Drive Sewer Project within the *ahupuaʻa* of Waiʻaha 1st and 2nd and Puaʻa 2nd and 3rd (see Table 1). As a result of the study, a total of 20 archaeological sites comprised of at least 38 associated features were identified. A variety of formal site types were documented during the study including but not limited to mounds, alignments, walls, enclosures, trails, and lava blisters and caves, and were assigned functional interpretations relating to agriculture, temporary and permanent habitation, transportation, animal husbandry, landscape clearance, and potential ceremonial and burial functions. It was recommended by Head et al. (1994) that data recovery be conducted at 17 of the sites, all of which were assessed as significant under Criterion d and five of which were recommended for preservation. The remaining three sites were recommended for no further work, and it was proposed that although they contained only limited potential with regards to future potential research, they be integrated into the then-proposed landscaping of the project area. It was determined that while construction activities for the then-proposed development did not threaten the integrity of 17 of the sites, three could not be avoided.

In 1996, PHRI conducted data recovery (Walker and Rosendahl 1996) at selected sites identified during the AIS conducted by Head et al. (1994). Data recovery was conducted on three archaeological sites that were purported to be unavoidable during construction activities: Site 15507, two modified outcrops and a terrace; Site 15511, a small lava tube and two additional adjacent caves; and Site 15526, originally assigned as a coral and waterworn cobble-paved area with scattered midden and reinterpreted during the Phase II work as a platform. A total of 20 units (four each in Sites 15507 and 15511 and 12 in Site 15526) were excavated within the data recovery sites. Cultural material and portable remains (e.g. charcoal, *kukui*, gourd, and coconut fragments, marine shell, lithic and volcanic glass debitage and shatter, basalt hammerstones, possible adze fragments, echinoid and coral abraders, a bone awl and pick, fishhooks, shell ornament, historic glass and metal fragments, and a stone pendant) were recovered ealong with varying amounts of mammal, bird, turtle, lizard, rat, mouse, pig, and fish bone. Additionally, and more importantly, human skeletal remains were recovered from all three sites, although the remains recovered from 15511 and 15526 were likely deposited secondarily as a result of natural processes rather than being in an *in situ* context. The human skeletal remains associated with Site 15507, however, were determined to be representative with an articulated individual *in situ* and were ultimately recommended for preservation in place.

In 2000, Rechtman Consulting, LLC conducted an AIS (Rechtman 2000) of a 19-acre parcel *makai* of Kuakini Highway within Waiʻaha (see Table 1). Small portions of this property had also been previously surveyed by Head et al. (1994) and data recovered by Walker and Rosendahl (1996) as part of a sewer easement mitigation project. Of the 29 sites previously recorded in the project area, 28 were extant at the time of the Rechtman (2000) study. Of these, one (Site 15525) was reevaluated as non-cultural. Twelve of the remaining sites were assessed as likely deriving from the Precontact Period: two were agricultural in nature (Sites 21992 and 22065), nine were associated with habitation (Sites 15517, 15518, 15521, 15524, 21991, 22067, 22068, 22069, and 22070), and one was a habitation/burial site (Site 15507). Three of the identified sites (Sites 21194, 21196, and 22063) were concluded to date to the late Precontact/early Historic Period and may have been associated with one another. Rechtman (2000) opined that these three sites appeared to be of religious significance, and noted the presence of human remains at one of them (Site 22063). Twelve of the 28 sites dated to the Historic Period, all of which consisted of stone walls or enclosures likely associated with cattle ranching practices during the early to mid-twentieth century.

In 2002, PHRI conducted an Archaeological Assessment (AA) survey (Corbin and Rosendahl 2002) of the project area (see Table 1). As a result of the fieldwork, 28 archaeological sites encompassing 45 features were documented, and a single previously identified site, the Kuakini Wall (Site 6302), was relocated. Other recorded feature types included walls, terraces, mounds, modified outcrops, platforms, enclosures, and lava blister caves. Identified site types were assigned various functions including habitation, ranching, agricultural, and burial. Later that same year, PHRI conducted subsurface testing (Rosendahl 2002) of a sample of possible burial features. Eleven features at eleven different sites were tested for the presence of burials, however this investigation yielded negative results. A small amount of cultural material including a coral abrader, adze fragment, and marine shell fragments were documented during these excavations but appeared to never have been collected.

In 2003, Rechtman Consulting, LLC conducted an AIS (Clark and Rechtman 2003) of the roughly 62-acres of land within the U of N Bencorp project area comprising Tax Map Key (TMK) (3) 7-5-010:085 and (3) 7-5-017:006, which included the current project area (see Table 1). As a result of the study, twenty-five previously unrecorded sites and a single previously recorded site were identified (see Table 2 and Figure 2-19. Site types identified during the study were both Historic and Precontact in nature and were grouped into seven categories: Historic ranching related sites and boundary walls, Precontact habitation sites, trails, ceremonial sites, game boards, burials, and agricultural sites. As part of the investigation, twenty-two 1 x 1 meter test units (TUs) were excavated at ten sites (Sites 23668, 23670 Feature B, 23672 Features A and B, 23673 Feature A, 23675, 23676, 23677, 23681 Feature A, 23683, 23684, 23685, and at 23686 Features 183, 187, 189, 201, 204, 239, 262, 266, 271, and 297. Subsurface testing of multiple sites/features yielded numerous examples of cultural material including volcanic glass flakes and shatter, charcoal fragments, groundstone, waterworn, and fire cracked basalt, branch and waterworn coral, marine shell (*Cellana* sp., *Conus* sp., *Drupa* sp., *Nerita* sp., *Echinoidea* sp., *Cypraea* sp., *Strombina* sp., *Venus* sp., and *Cantharus* sp.), *kukui* and an unidentified seed, shark teeth, a mostly intact *lūheʻe* lure, as well as dog, rodent and fish bone. Additionally, human skeletal remains identified during excavation of Sites 23683, 23684, and 23685.

All sites were assessed as significant under Criterion d, with eleven being recommended for no further work (Sites 23662 through 23669, 23679 and 23680, and 23682). Four of the sites were also assessed as significant under both Criteria d and e and recommended for preservation (Sites 23681 and Sites 23683 through 23685), one was assessed as significant under Criteria a, c, and d and also recommended for preservation (Site 6302), and ten were recommended for data recovery (Sites 23670 through 23678 and 23686).

Table 2. Archaeological sites recorded during the Clark and Rechtman (2003) study.

Site No.	***Formal Type***	***Functional Type***	***Age***	***Significance***	***Treatment***
6302	Wall	Kuakini Wall	Historic	a, c, d	Preservation
23662	Enclosure	Ranching	Historic	d	No further work
23663	Wall	Ranching	Historic	d	No further work
23664	Wall	Ranching	Historic	d	No further work
23665	Wall	Landscape marker	Historic	d	No further work
23666	Wall	Landscape marker	Historic	d	No further work
23667	Wall	Landscape marker	Historic	d	No further work
23668	Lava blister	Temporary habitation	Precontact	d	No further work
23669	Modified outcrop	Temporary habitation	Precontact	d	No further work
23670	Platform complex	Permanent Habitation	Precontact	d	Data recovery
23671	Platform	Temporary habitation	Precontact	d	Data recovery
23672	Enclosure complex	Temporary habitation	Precontact	d	Data recovery
23673	Platform/enclosure	Permanent habitation	Precontact	d	Data recovery
23674	Platform/enclosure	Temporary habitation	Precontact	d	Data recovery
23675	Platform	Temporary habitation	Precontact	d	Data recovery
23676	Platform	Temporary habitation	Precontact	d	Data recovery
23677	Platform/enclosure	Temporary habitation	Precontact	d	Data recovery
23678	Enclosure	Temporary habitation	Precontact	d	Data recovery
23679	Trail	Trail	Precontact	d	No further work
23680	Trail	Trail	Precontact	d	No further work
23681	Platform/enclosure	Ceremonial	Precontact	d, e	Preservation
23682	Game board	Game board	Precontact	d	No further work
23683	Platform	Burial	Precontact	d, e	Preservation
23684	Platform/enclosure	Burial	Precontact	d, e	Preservation
23685	Platform	Burial	Precontact	d, e	Preservation
23686	Complex	Agricultural	Precontact	d	Data recovery

***SIHP Site numbers are preceded by the state, island, and U.S.G.S. quad prefix 50-10-28-**

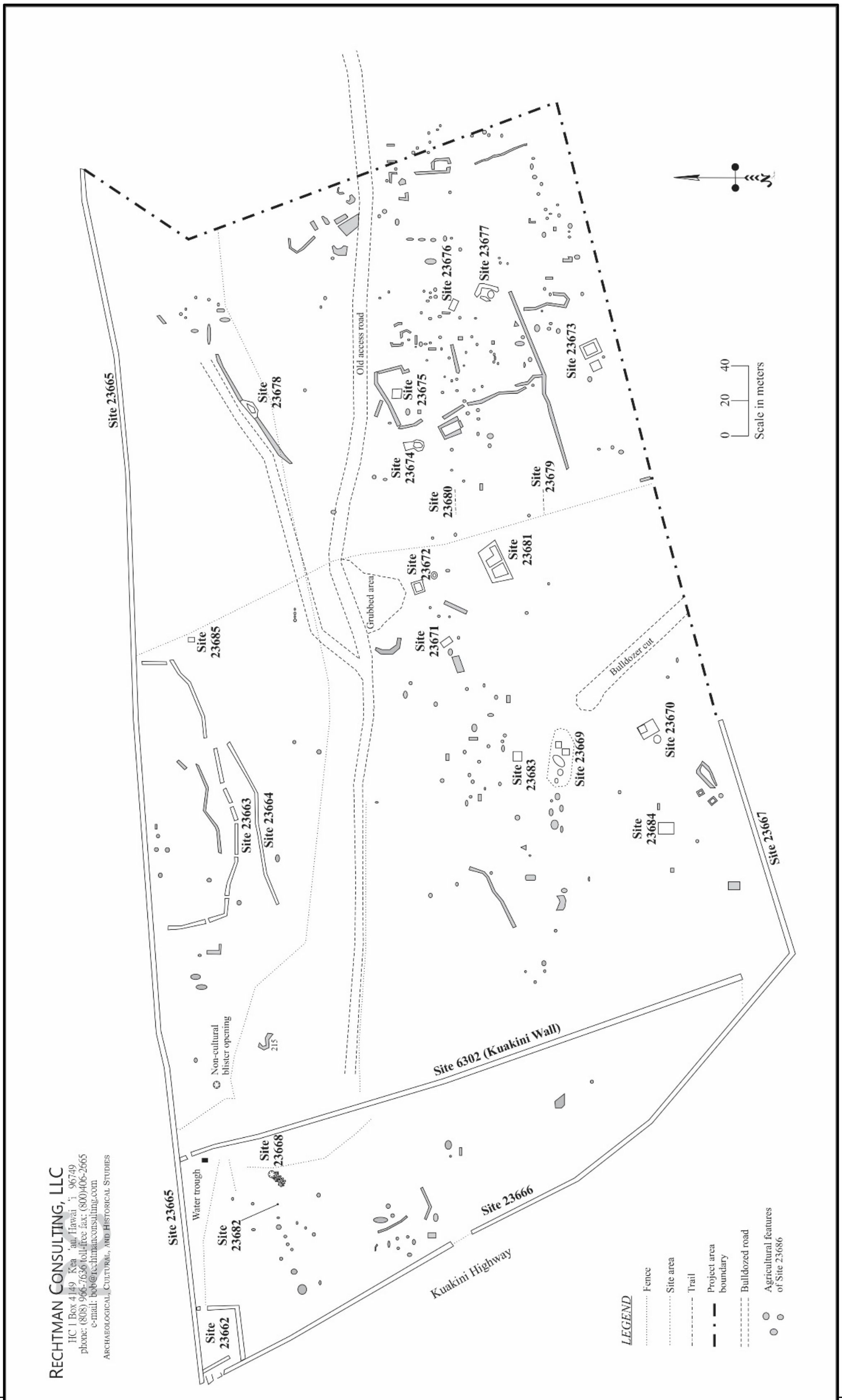


Figure 2-19. Site plan from Clark and Rechtman (2003:16).

Later that same year, Rechtman Consulting, LLC prepared a Burial Treatment Plan (Rechtman and Ketner 2003) for the three burial sites (Sites 23683 through 23685) identified during the Clark and Rechtman (2003) AIS that were assessed as significant under Criteria d and e (see Table 2 and Figures 2-19 and 2-20). All three sites consisted of square or rectangular stone platforms constructed of *ʻaʻā* and/or *pāhoehoe* boulders and cobbles. Unlike the other two burial sites which were determined to function solely as burial monuments, Site 23684 consisted of a platform and an attached enclosure, and it was concluded by Rechtman (2003) that the both features may have been utilized for habitation purposes prior to the internment of the deceased individual. As previously mentioned, Site 23683 was also previously subject to burial testing in June 2002 by Rosendahl (2002) but yielded negative results. As part of the fieldwork conducted during the Clark and Rechtman (2003) AIS, a 1 x 1 meter test unit was excavated in the central interior portion of the platform, and the presence of a burial was confirmed. Similarly, single 1 x 1-meter test units were excavated in the central interior sections of the Site 23684 and 23685 platforms yielding identical results. In the case of Sites 23684, pockets of deliberately and carefully cached branch coral were observed throughout the architectural layer, and cultural material (e.g. marine shell, coral, and waterworn pebbles) were observed in strata below the architectural layer. With respect to Site 23685, a possible hearth was identified, the remains of which included a scant amount of cultural materials including various marine shell, *wana* (sea urchin), and *kukui* (candlenut; *Aleurites mollucana*). Immediately following the discovery of human skeletal remains in all three test units, excavation ceased, the remains were stabilized and left in their original positions and were reburied (along with any identified cultural material and/or artifacts) using excavated soils, and the architectural layer was rebuilt on top of the burial as close to original specifications as possible.

The approved burial treatment for Sites 23683, 23684, and 23685 by Rechtman (2003) was preservation in place which would be achieved through the establishment of a minimum 20-foot permanent preservation easement buffer for each respective site. These preservation easements were to be defined by stone walls (traditionally Hawaiian in appearance) constructed of dry-stacked local basalt boulders and cobbles and discretely core-filled with smaller cobbles. It was also suggested that inconspicuously situated narrow gated openings be incorporated into each easement wall to facilitate access for site maintenance and appropriate visitation by cultural and/or lineal descendants, and that appropriate native foliage be planted along the exterior perimeter of the easement walls. An additional 10-foot buffer zone beyond the 20-foot buffer was also set aside as a no construction zone as part of the plan for the installation of three interpretive/cautionary signs, one to be placed immediately adjacent to each respective walled preservation easement. Finally, accepted treatment for the burial sites included a provision provided by Rechtman (2003) for the development and submittal of a formal landscaping plan to the DLNR-SHPD Burial Sites Program for approval, which would lay out measures that the respective sites be cleared of all non-native/non-Polynesian introduced vegetation prior to their reconstruction.

Four years later in 2007, ten of the sites (Sites 23670 through 23678 and 23686) identified during the Clark and Rechtman (2003) AIS (see Table 2 and Figure 2-19) were the subject of data recovery investigations (Rechtman and Loubser 2007) conducted by Rechtman Consulting, LLC. Nine of the sites subject to data recovery were inferred to have been utilized for habitation (four with permanent habitation and five with temporary habitation) and one was associated with agricultural use. All of the sites dated to the Precontact period. The primary objectives of the data recovery were centered around establishing the sequence of Precontact land use within the project area and within the general *kula* lands of Kona, refining the precise nature of data recovery sites associated with habitation, and refining the age estimate and functional interpretation of the documented agricultural features. It was proposed by Rechtman and Loubser (2007) that conducting data recovery of these sites would establish whether or not short-term habitation and associated opportunistic agriculture was indeed followed by recurrent habitation and associated formal agriculture, and finally by more consistent habitation with associated household gardens and animal pens.

The data recovery effort was accomplished by conducting thorough redocumentation of the data recovery sites, the process of which included clearance of vegetation to assess the then-current conditions of the sites, site photography, and the illustration or update of existing site plan views from the Clark and Rechtman (2003) AIS to show the placement of the excavation units, and subsurface testing to determine the presence or absence of buried cultural deposits. As part of the fieldwork, a total of 39 Excavation Units (EU) and 17 Test Units (TU) were excavated. These units ranged in configuration from 1 x 1 meters, 1 x 2 meters, and 2 x 2 meters, and generally, multiple units were excavated into each site. With respect to the habitation sites (Sites 23670 through 23678), there were a total of 22 EU and 7 TU excavated. For Site 23686, 17 EU and 10 TU were excavated. As a result of excavations, a wide assemblage of cultural material was collected including intact and fragmented marine shell (e.g. *Cypraea*, sp., *Conus* sp., *Drupa* sp., *Cellana* sp., *Morula* sp., *Isognomon* sp., *Fimbria* sp., *Brachiodontes* sp., *Turbo* sp., *Nerita* sp., *Mitra* sp., *Terebra* sp., *Cantharus* sp., *Chama* sp., *Venus* sp., *Nassarius* sp., *Strombina*, sp., *Serpuloris variabilis*, *Thais* sp., *Cymatium* sp., *Fimbria* sp., and an unidentifiable bivalve fragment), echinoderms, a crustacean fragment, and both branch and waterworn coral pieces. Lithic assemblages identified during fieldwork included worked and unworked volcanic glass flakes and shatter, fire-cracked basalt, basalt flakes, waterworn and groundstone basalt fragments. Additionally, a variety of faunal remains were recovered including worked and unworked bones (e.g. rodent, pig, dog, cow, bird, and some which were unidentifiable) as well as bird, fish, dog, cow, and shark teeth. A variety of portable remains (artifacts) were also recovered during data recovery excavations including coral abraders, intact and fragmented echinoderm abraders, a fine-grained basalt adze fragment, a *lūheʻe* lure, an awl manufactured from unidentifiable materials, a bone awl, a .166 lead pellet, an iron horseshoe nail, a steel nail, a steel nut, rusted iron fragments, and fragments of brass buttons. Fragments of *kukui* (candlenut; *Aleurites moluccana)* and an unidentifiable seed and nut were also recovered during excavations, as were numerous charcoal samples: 17 of which were submitted for radiocarbon assaying.

Following the synthesis of field and laboratory results it was proposed by Rechtman and Loubser (2007) that the data recovered sites were collectively representative of four relatively arbitrary time periods which they assigned as phases A through D, each were interpreted as more extensive than the one preceding: Phase A from A.D. 1400 to A.D. 1460, Phase B from A.D. 1460 to A.D. 1580, Phase C from A.D. 1580 to A.D. 1680, and Phase D from A.D. 1680 to A.D. 1850. Phase A occupation encompassed Site 23686 Features 247, 293, and 294; Phase B occupation pertained to Site 23676, Site 23673 Features A and B; and Site 23671; Phase C related to Site 23686 Features 250, 254, 282, and 289; possibly Site 23674; Site 23672 Features A and B; and potentially Site 23674; and Phase D occupation was concluded to be associated with nine excavated features including Site 23675, Site 23670 Features A, B, and C, Site 23678, Site 23677 Features A and B, Site 23686 Feature 251, and potentially also the *kuaiwi* associated with Site 23686.

In 2013, Rechtman Consulting, LLC prepared a Preservation Plan (Rechtman et al. 2013) for two of the sites (see Table 2 and Figures 2-19 and 2-10) initially documented during the inventory survey conducted by Clark and Rechtman (2003). The first preservation site, a 340-meter-long section of the Kuakini Wall (Site 6302), was likely constructed during Governor Kuakini's administration (A.D. 1820-1844), coinciding with the latter portion of Phase D occupation previously hypothesized by Rechtman and Loubser (2007). Initially, the wall served to protect cultivated agricultural fields *mauka* of the wall from feral animals, however Rechtman (2013) opined that the function of the Kuakini Wall likely transformed over time, and in later years served primarily to protect coastal settlements situated *makai* of the wall. Site 6302 was assessed by Clark and Rechtman (2003) as significant under Criteria a, c, and d, and was determined to be eligible for listing (but is not formally listed) in the National Register of Historic Places (NRHP). Preservation measures were centered primarily around avoidance and protection (conservation) of the site, however the plan set forth by Rechtman (2013) also included provisions for stabilization/restoration, dismantling/restoration, and the installation of interpretive/cautionary signage at intervals around the twenty-foot permanent preservation easement buffer.

The second preservation site consisted of an agricultural *heiau* (shrine; Site 23681), a traditional ceremonial site referred to as *heiau hoʻoūluulu ʻai* or *heiau hoʻoūluulu ua* where Hawaiians would conduct rituals to ensure agricultural fertility and/or to induce rain. The proposed permanent preservation measures for Site 23681 were avoidance and protection (conservation) which was to be achieved through the establishment of a twenty-foot preservation easement buffer. Rechtman et al. (2013) recommended that this permanent buffer be marked by a stone wall (traditionally Hawaiian in appearance) constructed of dry-stacked local basalt boulders and cobbles and discretely core-filled with smaller cobbles, and recommended that an inconspicuously situated narrow gated opening be present to allow access for site maintenance and appropriate visitation.

Most recently in 2019, ASM Affiliates prepared a Dismantling/Restoration Plan (Barna 2019) for a portion of the Kuakini Wall (Site 6302) (see Table 2 and Figure 2-20). The plan outlined the measures to be followed during the process of dismantling/restoration of collapsed portions of and three breaches in Site 6302.

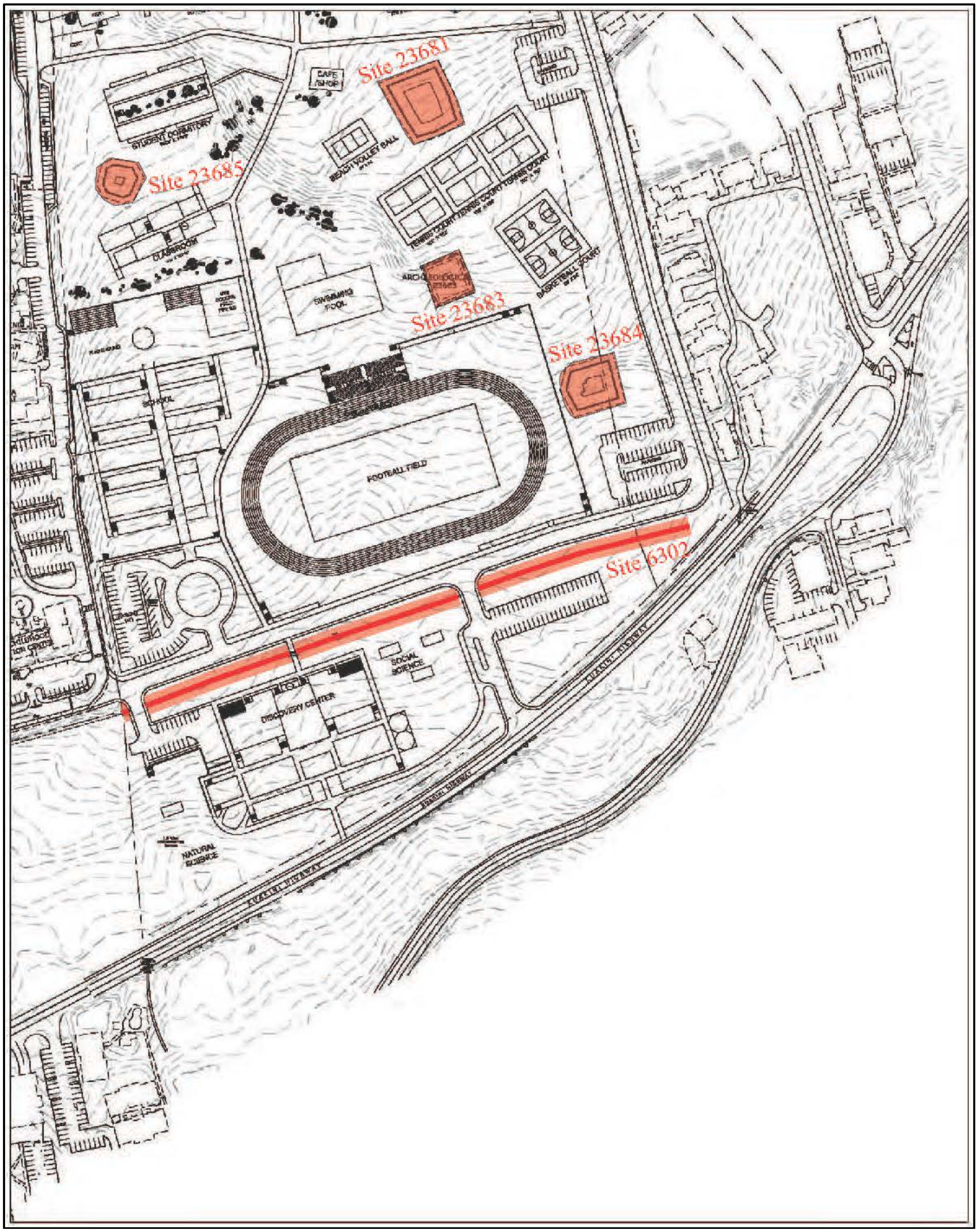


Figure 2-20. Plan view showing archaeological and burial sites and preserves (Rechtman et al. 2013:5).

3.0 FINDINGS AND RECOMMENDATIONS

3.1 SUMMARY OF FINDINGS & PROPOSED RECOMMENDATIONS

Based upon the information obtained from the review of historical documentation, archaeological reports, oral traditions, informal discussions, and formal interviews, the following is a summary of findings.

1) Regarding the native Hawaiian epistemological approach to "land use," three prevalent and generally applied principles that continue to be perpetuated are:
   a) Recognizing that all *ʻāina* (literally translated as "that which feeds", but commonly applied as a definition for "land") is born of Papahānaumoku (Earth Mother). This guiding principle is the foundation from which the cultural values of *aloha ʻāina* and *mālama ʻāina* are derived.
   b) Acknowledging that although traces of a physical imprint and its integrity of traditional cultural properties, resources, features, beliefs, and practices either may no longer remain, there is a thriving spiritual imprint that remains in the form of *mana*, the spiritual essence of those *kūpuna* and *nā mea loea* that have come before.
   c) Understanding that place names, like Waiʻaha, illustrate a collective history of a geographical region, reiterate community and familial genealogy, characterize and describe the natural resources within a prescribed physical space, and define recognized cultural mores and values of the existing community.

As such, it is recommended that the proposed development of the cultural center incorporate the guiding cultural principles in the physical design of the facility and the surrounding landscape in the selection of appropriate plantings and exterior features. Consideration should be given to applying these principles in the development of the center's programmatic themes.

2) The *moku o loko* was a recognized residence and political center for ruling *aliʻi* as early as the 15th century. The *mauka* region of Waiʻaha, west of the existing project area, includes the cultural landscape that once defined the royal residence of Kamehameha IV and Queen Emma and the former site of the old Kona sugar mill. Portions of the project area illustrate the influence of the cattle and ranching industry that emerged within the region. The coastal waters along the *makai* portion of the *ahupuaʻa* are part of two traditional surfing grounds, called Koʻokā and Kahopuka, which extended from the *ahupuaʻa* of Puaʻa, situated just north of Waiʻaha. Additionally, several other traditional and historic sites including identified springs, enclosures, and mounds, which have been recorded within the general vicinity of the project area.

As a cultural landscape, the *ahupuaʻa* of Waiʻaha reveals a kaleidoscope of historical and cultural features and properties. It is recommended that programmatic themes for the proposed cultural center incorporate the unique historical and cultural legacy specific to the Waiʻaha Ahupuaʻa and the greater Kona region.

3) Beginning in 2003, Rechtman Consulting, LLC conducted a series of archaeological investigations within the project area, the first of which consisted of an AIS. As part of the AIS study, two preservation sites (Sites 6302 and 23681) were documented within the project area. Additionally, the presence of three burial sites were confirmed within the project area (Sites 23683, 23684, and 23685). Prior to the establishment of the burial laws (specifically the Native American Graves Protection and Repatriations Act of 1990 and State of Hawaiʻi burial laws (1990), there was no generally agreed upon methodology to the effective treatment of both identified burial sites and inadvertent discoveries. However, the establishment of these laws has helped to facilitate a process that provides a guideline for agencies and communities to derive an appropriate plan of action in the protection and preservation of ancestral remains.

As human burials have been documented within the project area, the appropriate effectual treatment of the identified burial sites will be applied. The interim and permanent preservation measures set forth in the approved burial treatment plan prepared by Rechtman (2003) for Sites 23683, 23684, and 23685 shall be implemented under the direct supervision of a qualified archaeologist. Additionally, cultural concerns that were expressed by those in the Hawaiian community of Kona regarding recommendation protocols in properly handling *iwi*, ancestral remains, as well as consultation with appropriate parties and final disposition any burial, shall be taken into consideration. It is stressed that utmost sensitivity, caring, and understanding be employed when dealing with burial issues and *iwi*.

1) In the event of an inadvertent discovery of ancestral remains, the applicable processes outlined in existing State regulations, specifically those provided in the Hawaiʻi Administrative Rules, Title 13, Chapter 300, Section 40 and Section 33, will be employed.
2) If for some reason, *iwi* must be moved or touched, it is highly recommended that an identified cultural monitor, a lineal/cultural descendant or someone of Hawaiian ancestry work in conjunction with a qualified archaeological monitor to complete this task. It is highly recommended that the U of N Bencorp coordinate the selection of a cultural monitor with known lineal and cultural descendants as well as other appropriate cultural entities or organizations.
3) Notify and consult with known and potential lineal and cultural descendants as it relates to any burial relocation or inadvertent discovery.
4) Consult with the appropriate agencies and organizations including: State Department of Land and Natural Resources, Historic Preservation Division (DLNR/SHPD), SHPD Burial staff, the Hawaiʻi Island Burial Council (HIBC), the Office of Hawaiian Affairs (OHA), and other interested Hawaiian organizations.
5) Implementation of the interim and permanent preservation measures set forth in the approved burial treatment plan for Sites 23683, 23684, and 23685.
6) Implementation of the interim and permanent preservation measures set forth in the approved preservation plan for Sites 6302 and 23681.
7) Implementation of the measures to be followed during the process of dismantling/restoring of collapsed portions of and three breaches in Site 6302.
8) Archaeological monitoring is recommended for all ground-disturbing activities associated with the proposed development within the project area.

4.0 REFERENCES

______
2001 *Nā Mele Aimoku, Nā Mele Kūpuna, a me Nā Mele Pono‘i o ka Mō‘ī Kalākaua I*. Honolulu: Hawaiian Historical Society.

______
1862 “He Kanikau Kēia No Ka Prince Albert Edward Kauikeaouli Kaleiopapa a Kamehameha Haku o Hawai‘i,” *Nūpepa Ku‘oko‘a, Buke I, Helu 42*. Honolulu: Sepatemaba 13.

Abbot, I.
1974 *Lā‘au Hawai‘i: Traditional Hawaiian Uses of Plants*. Honolulu: Bishop Museum Press.

Barna, B.
2019 Dismantling/Restoration Plan for a Portion of Kuakini Wall (SIHP 50-10-28-6302), TMKs: (3) 7-5-010:085 and (3) 7-5-017:006, Wai‘aha 1st Ahupua‘a, North Kona District, Island of Hawai‘i. ASM Affiliates Project Number 33040.00. Prepared for Paul Childers, University of the Nations Kona, Kailua-Kona.

Barrere, D.
1971 “Glimpses of History.” *Archaeological Survey, Kahalu‘u, Keauhou, North Kona, Hawai‘i.* Report 71-4, Prepared for Kamehameha Development Corporation. Honolulu: Bernice P. Bishop Museum.

Beaglehole, J.
1967 *The Journals of Captain James Cook on His Voyages of Discovery*. London: The Hakluyt Society.

Beckwith, M.
1940 *Hawaiian Mythology*. Honolulu: University of Hawai‘i Press.

Boki, 1787-1830
______ *He Inoa e Kaluaikauka, Aloha Au o Ka Uka o Wai‘aha*. Forms part of: Mele Manuscript Collection, HI.M.20. This is the 5th of 9 parts of a mele for Kaluaikauka and Kaluaikawanakoa. Bishop Museum Archives.

CFR (Code of Federal Regulations)
1986 36 CFR Part 800: Protection of Historic Properties.

1981 36 CFR Part 60: National Register of Historic Places.

Chinen, J.
1958 *The Great Māhele: Hawai‘i’s Land Division of 1848*. Honolulu: University of Hawai‘i Press.

Clark, J.
1985 *Beaches of the Big Island.* Honolulu: University of Hawai‘i Press.

Clark, M., and R. Rechtman
2003 An Archaeological Inventory Survey of TMKs: 3-7-5-10:85 and 3-7-5-17:06, Wai‘aha Ahupua‘a, North Kona District, Island of Hawai‘i. Rechtman Consulting report RC-0153. Prepared for U of N BENCORP, Kailua-Hona, Hawai‘i.

Commissioner of Public Lands
1929 *Indices of Awards Made by the Board of Commissioners to Quiet Land Titles in the Hawaiian Islands. Alphabetical Index of Awards by Land*. Honolulu: Star-Bulletin Press.

Corbin, A., and P. Rosendahl
2002 Archaeological Assessment Survey U of N BENCORP Development, Lands of Waiaha 1st and 2nd, North Kona District, Island of Hawaiʻi (TMK:3-7-5-17:6; 3-75-18:73). Paul H. Rosendahl, Ph.D. Inc.(PRHI) Report 2235-041102. Prepared for U of N Bencorp, Kailua-Kona.

Cordy, Ross
2000 *Exalted Sits the Chief: The Ancient History of Hawaiʻi Island*. Honolulu: Mutual Publishing.

Crowe, E., and W. Crowe
2001 *Exploring Lost Hawaiʻi: Places of Power, History, Mystery, & Magic*. Hong Kong: Island Heritage.

Desha, S.
2000 *Kamehameha and His Warrior, Kekuhaupiÿo*. Honolulu: Kamehameha School Press.

The Daughters of Hawaiʻi
1996 *Huliheʻe Palace*. Pamphlet, revised 2002.

Elbert, S., and N. Mahoe
1970 *Nā Mele o Hawaiʻi Nei*. Honolulu: University of Hawaiʻi Press.

Ellis, W.
1979 *Journal of William Ellis*. Reprint of the London 1827 Edition and the Hawaiʻi 1917 Edition. Rutland, VT & Tokyo, Japan: Charles E. Tuttle Co.

Emerson, N.
1965 *Unwritten Literature of Hawaiʻi: The Sacred Songs of the Hula*. Rutland, VT & Tokyo, Japan: Charles E. Tuttle Co.

1915 *Pele and Hiʻiaka: A Myth of Hawaiʻi*. Honolulu: ʻAi Pohaku Press. Fitzpatrick, Gary L.

1986 *The Early Mapping of Hawaiʻi*. Honolulu: Editions Limited.

Foote, D., E. Hill, S. Nakamura, and F. Stephens
1972 *Soil Survey of the Islands of Kauaʻi, Oʻahu, Maui, Molokaʻi and Lānaʻi, State of Hawaiʻi.* Washington D.C.: U.S. Government Printing Office.

Fornander, A.
1919 *Fornander Collection of Hawaiian Antiquities & Folklore", Memoirs of Bernice Pauahi Bishop Museum of Polynesian Ethnology & Natural History Vol. IV-VI*. Honolulu: Bishop Museum Press.

Goto, B.
1982 "Ethnic Groups and the Coffee Industry in Hawaiʻi." *The Hawaiian Journal of History*. Volume 16: 112-124. Honolulu: Hawaiian Historical Society.

Grant, G., and B. Hymer
2000 *Hawaiʻi Looking Back: An Illustrated History of the Islands*. Honolulu: Mutual Publishing Co.

Greenwell, J.
Ms. *Personal Collection of Notes Regarding the Ahupuaʻa of Waiʻaha.*

Han, T., S. Collins, S. Clark, and A. Garland
1986 *Moe kau a hoʻoilo, Hawaiian Mortuary Practices at Keōpū, Kona, Hawaiʻi.* Department Report Series 86-1. Honolulu: Bernice Pauahi Bishop Museum.

Handy, E.S.C., E. Handy, and M.
1972 *Native Planters in Old Hawaiʻi: Their Life, Lore, and Environment.* Bernice P. Bishop Museum Bulletin 223. Honolulu: Bishop Museum Press.

Handy, E.S.C.
1940 *The Hawaiian Planter, Volume I: His Plants, Methods, and Areas of Cultivation*. Bernice P. Bishop Museum, Bulletin 61. Honolulu: The Museum.

Head, J., S. Goodfellow, and P. Rosendahl
1994 Archaeological Inventory Survey, Alii Drive Sewer Project, Lands of Puaa 2nd and 3rd, and Waiaha 1st and 2nd, North Kona District, Island of Hawaii (TMK:7-5-18:7,8). Paul H. Rosendahl, Ph.D., Inc. Report 937-070194. Prepared for Mr. Edward Harada, M & E Pacific, Inc.

ʻĪʻī, J.
1995 *Fragments of Hawaiian History*. 6th print. Honolulu: Bishop Museum Press.

James, V.
1995 *Ancient Sites of Hawaiʻi: Archaeological Places of Interest on the Big Island*. Honolulu: Mutual Publishing.

Kalākaua, D.
1992 *The Legends and Myths of Hawaiʻi* (22nd print). Vermont: Charles E. Tuttle Co.

Kamakaʻeha, L.
1999 T*he Queen Songbook*. Text and Music Notation by Dorothy Kahananui Gillet. Honolulu: Hui Hānai.

Kamakau, S.
1996 *Ke Kumu Aupuni*. Honolulu: ʻAhahui ʻŌlelo Hawaiʻi.

1992(a) *Tales and Traditions of the People of Old: Nā Moʻolelo o Ka Poʻe Hawaiʻi*. (Revised ed.) Honolulu: Bishop Museum Press.

1992(b) *Nā Hana o Ka Poʻe Kahiko* (revised ed.) Honolulu: Bishop Museum Press. 1992(c) *Ruling Chiefs of Hawaiʻi* (revised ed.) Honolulu: Kamehameha Schools Press.

Kameʻeleihiwa, L.
1999 *Kumulipo: Hānau Ka Pō: The Hawaiian World is Born (Paper).* Honolulu: University of Hawaiʻi at Mānoa.

1992 *Native Lands and Foreign Desires: Pehea La E Pono Ai?* Honolulu: Bishop Museum Press.

Kamehameha Schools Bernice Pauahi Bishop Estate
1994 *Life in Early Hawaiʻi: The Ahupuaʻa*. Honolulu: Kamehameha School Press.

Kanahele, G.
1999 *Emma, Hawaiʻi's Remarkable Queen*. Honolulu: The Queen Emma Foundation.

Kawaharada, D.
1999 *Storied Landscapes: Hawaiian Literature and Place*. Honolulu: Kalamakū Press.

Kekahuna, H.
Ms. File M-455, folders 33, 34, 36, 47, 50, review of years 1949-1956. Hawai‘i State Archives.

Kelly, M.
1983 *Nā Māla o Kona: Gardens of Kona, A History of Land Use in Kona, Hawai‘i.* Honolulu: Department of Anthropology Report 83-2, Bernice Pauahi Bishop Museum.

Kikumura, A.
1995 *The Kona Coffee Story: Along the Hawai‘i Belt Road*. Los Angeles: Japanese American National Museum.

Kona Historical Society
1998 *A Guide to Old Kona*. Kalukalu: Kona Historical Society.

Lake, J.
Ms. *Personal Collection of Notes regarding Traditional Hawaiian Society and Practices*

Lind, A.
1975 *Kona: A Community of Hawai‘i*. Report for the Board of Education, State of Hawai‘i.

Malo, D.
1951 *Hawaiian Antiquities* (Nathaniel B. Emerson, trans.). Special Publication Honolulu: Bishop Museum Press.

MacKenzie, M. (editor)
1991 *Native Hawaiian Rights Handbook*. Honolulu: Native Hawaiian Legal Corporation.

Maguire, E.
1966 *Kona Legends*. Hilo: The Petroglyph Press Ltd.

Maly, K.
1999 *A Report on Archival-Historical Documentary Research, Oral History Interviews, and Assessment of Cultural Impacts, He Wahi Mo‘olelo no Kona, Nā Ahupua‘a Keauhou 2nd, Honalo, Mā‘ihi 1-2, Kuamo‘o 1-3, Kawanui 1-2, Lehu‘ula 1-2, Honua‘ino 1-4, Hōkūkano 1-2, Kanāueue 1-2, Haleki‘i, Ke‘eke‘e 1-2, ‘Ilikahi, Kanakau 1-2, Kalukalu, Onouli 1-2, Keōpuka 1-2, & Ka‘awaloa, Districts of North and South Kona, Island of Hawai‘i.* Prepared for Oceanside 1250 Partners. Hilo: Kumu Pono Associates.

1998 *Wai‘aha, Ma Kona, Hawai‘i: A Limited Cultural Assessment Study of Historic and Ethnographic Documentation, Ahupua‘a of Wai‘aha, District of North Kona, Island of Hawai‘i.* Prepared for Roy A. Vitousek III, Cades Schutte Flemming Wright. Hilo: Kumu Pono Associates.

1998 *“Kekaha Wai ‘Ole o Nā Kona”, A Report on Archival and Historical Documentary Research, and Oral History Interviews for Kekaha Kai State Park, Ahupua‘a of Kaulana, Mahai‘ula, Makalawena, Awake‘e, Manini‘ōwali, and Kūki‘o, District of North Kona, Island of Hawai‘i (TMK Overview: 7-2).* Prepared for Group 70 International, Inc. Hilo: Kumu Pono Associates.

1997 *“Mauna Kea- Kuahiwi Kū Ha‘o i ka Mālie”, A Report on Archival and Historical Documentary Research, Ahupua‘a of Humu‘ula, Ka‘ohe, Districts of Hilo and Hāmākua, Island of Hawai‘i.* Prepared for Native Lands Institute: Research and Policy Analysis. Hilo: Kumu Pono Associates.

Menzies, A.
1920 *Hawai'i Nei 128 Years Ago*. Honolulu: W.F. Wilson, editor.

Morris, A.
1994 "The Death of the Prince of Hawai'i: A Retrospective Diagnosis." *The Hawaiian Journal of History*. Volume 28: 79-85. Honolulu: Hawaiian Historical Society.

Nakuina, M.
1991 *Mo'olelo Hawai'i o Paka'a a me Kuapaka'a, Nā Kahu Iwi Kuamo'o o Keawenuiaumi, Ke Ali'i o Hawai'i a o Nā Mo'opuna Ho'i a La'amaomao*. Reprint from 1902 Publication. Honolulu: Kalamaku Press.

Nogelmeir, M.
2001 *He Lei No Emalani: Chants for Queen Emma Kaleleonālani*. Honolulu: Bishop Museum Press

Parker, P., and T. King
1990 *Guidelines for Evaluating and Documenting Traditional Cultural Properties. National Register Bulletin. No. 38*. Washington D.C.: U.S. Department of the Interior, National Park Service.

Pukui, M., and C. Curtis
1996 *Hawai'i Island Legends: Pīkoi, Pele, and Others*. Honolulu: Kamehameha School Press.

Pukui, M., and S. Elbert
1986 H*awaiian Dictionary*. Honolulu: University of Hawai'i Press.

1974 *Place Names of Hawai'i*. Honolulu: University of Hawai'i Press.

Pukui, M., E. Haertig, and C. Lee
1972 *Nānā I Ke Kumu: Volume 1*. Honolulu: Queen Lili'uokalani Children's Center.

Pukui, M., and A. Korn
1973 *The Echo of Our Song: Chants & Poems of the Hawaiians*. Honolulu: University of Hawai'i Press.

Pukui, M.
1983 *'Ōlelo No'eau: Hawaiian Proverbs and Poetical Sayings*. Honolulu: University of Hawai'i Press.

1955 *Nā Mele Welo*. Honolulu: University of Hawai'i Press.

Rappolt, M.
1991 *Queen Emma: A Woman of Vision*. Kailua: Press Pacifica, Ltd.

Rechtman, R.
2000 An Archaeological Inventory Survey of TMK: 3-7-5-18:08, Wai'aha 1st Ahupua'a, North Kona District, Island of Hawai'i. Rechtman Consulting, LLC Project Number RC-0001. Prepared for Dan Bolton, Kailua-Kona.

2003 Burial Treatment Plan for Three Sites in the Proposed Hualālai Village Development Area (TMKs: 3-7-5-10:85 and 3-7-5-17:06, Wai'aha Ahupua'a, North Kona District, Island of Hawai'i. Rechtman Consulting, LLC Report RC-0175. Prepared for U of N BENCORP, Kailua-Kona.

2013 Preservation Plan for SIHP Site 6032 and Site 23681 (TMKs: 3-7-5-10:085 and 3-7-5-17:006), Waiʻaha 1st Ahupuaʻa, North Kona District, Island of Hawaiʻi. Rechtman Consulting Report RC-0783. Prepared for U of N BENCORP, Kailua-Kona.

Rechtman, R., and J. Loubser
2007 Archaeological Data Recovery at Ten sites on TMKs: 3-7-5-10:85 and 3-7-5-17:06, Waiʻaha Ahupuaʻa, North Kona District, Island of Hawaiʻi. Rechtman Consulting, LLC. RC-0223. Prepared for U of N BENCORP, Kailua-Kona.

Rose, R.
1991 *Reconciling the Past: Two Basket Kāʻai and the Legendary Līloa and Lonoikamakahiki*. Honolulu: Bishop Museum Press.

Rosendahl, P.
2002 Interim Report: Testing of Possible Burial Features Archaeological Inventory Survey—Phase 1, U of N BENCORP Development, Lands of Waiaha 1st and 2nd, North Kona District, Island of Hawaiʻi (TMK:3-7-5-17:6; 3-75-18:73). Paul H. Rosendahl, Ph.D., Inc. Letter Report 2257-070302. Prepared for U of N Bencorp, Kailua-Kona.

State of Hawaiʻi, Department of Land and Natural Resources
1998(a) *Chapter 284: Rules Governing Procedures for Historic Preservation Review to Comment on Section 6E-42 Projects*. Hawaiʻi Administrative Rules, Title 13, Department of Land and Natural Resources, Subtitle 13, State Historic Preservation Division Rules (draft).

1998(b) *Chapter 280: Rules Governing General Procedures During Inadvertent Discoveries of Historic Properties During a Project Covered by the Historic Preservation Review Process.* Hawaiʻi Administrative Rules, Title 12, Department of Land and Natural Resources, Subtitle 13, State Historic Preservation Division Rules (draft).

1998(c) *Chapter 275: Rules Governing Procedures for Historic Preservation Review for Governmental Project Covered Under Section 6E-7 and 6E-8*. Hawaiʻi Administrative Rules, Title 12, Department of Land and Natural Resources, Subtitle 13, State Historic Preservation Division Rules (draft)

State of Hawaiʻi, Office of Environmental Quality Control
1998 *Guidelines for Assessing Cultural Impacts*. As adopted by the Environmental Council.

Stokes, J.
1991 *Heiau of the Island of Hawaiʻi: A Historic Survey of Native Hawaiian Temple Sites.* Honolulu: Bishop Museum Press. Reprint.

Thrum, T.
1920 *Hawaiian Almanac and Annual for 1921*. "The Kona Coast, A Sequel to "Between the Bays in Kona," 1916 Annual" by Albert S. Baker, M.A., M.D.; B.D. Honolulu.

1917 *Hawaiian Almanac and Annual for 1918*. "Kona Conditions" by Albert S. Baker, M.A., M.D.; B.D. Honolulu.

1907 *Hawaiian Folk Tales: A Collection of Native Legends*. Chicago: A.C. McClurg & Co.

Vancouver, G.
1798 *A Voyage of Discovery to the North Pacific Ocean, and Round the World, performed in the years 1790-1795.* London: Robinsons and Edwards.

Walker, A., and P. Rosendahl
1996 Ali‘i Drive Sewer Project Mitigation Program – Phase II Archaeological Data Recovery. Lands of Pua‘a 2nd and 3rd, and Wai‘aha 1st and 2nd, North Kona District, Island of Hawai‘i (TMK:7-5-18:7,8). Paul H. Rosendahl, Ph.D., Inc. Report 1556-020796. Prepared for Mr. Harold Sugiyama, Chief, Wastewater Division, Hawai‘i County, Department of Public Works.

Westervelt, W.
1923 *Hawaiian Historical Legends*. London & Edinburgh: Fleming H. Revell Company.

Wiener, F.
1982 “German Sugar’s Sticky Fingers.” *The Hawaiian Journal of History*. Volume16: 15-47. Honolulu: Hawaiian Historical Society.

Wilcox, C.
1996 *Sugar Water: Hawai‘i’s Plantation Ditches*. Honolulu: University of Hawai‘i Press.

Wilkes, C.
1845 Narrative of the United States Exploring Expedition. 1838-1842. Philadelphia: Lea & Blanchard.

Winne, J.
1928 *Kuakini and Hulihe‘e: The Story of the Kailua Palace, Kona, Hawai‘i*. Annual Social Meeting for the Daughters of Hawai‘i, April 30th.

Zambucka, K.
1992 *The High Chiefess Ruth Ke‘elikōlani*. Honolulu: Green Grass Productions.

Acknowledgement

The stories of this *pae ʻāina* continues on through the pulse of time because there is always someone given the *kuleana*, the responsibility to insure that the knowledge of our people, of who we are, where we are from, and what distinguishes us as *ʻŌiwi*, is preserved, perpetuated, and continued for subsequent generations to embrace as their own. My desire is that the work compiled here is pleasing to our ancestors, my hope is that in a small way, this piece positively contributes to that perpetuation of knowledge. With that, it must be acknowledged that the *ʻike* shared was done so by the true keepers of our cultural heritage, whether recorded in oral traditions or shared in informal *walaʻau*, talk story sessions. I humbly thank those *kūpuna*, those sources of new growth, that gave of their time and thoughts, but more importantly, entrusted me to share those words here.

Ka pō nui hoʻolakolako, ke ao nui hoʻohemahema- it is the great night that provides and the great day that neglects. This *ʻōlelo noʻeau* reveals that ancestral knowledge is revealed in our dreams. As part of our individual spiritual interpretation of the natural environment, sometimes this knowledge is either neglected or misunderstood because the individual receiving that knowledge failed to absorb all that was shared by the ancestors. For purposes of this report, this is the *kuleana* that I carry as my own.

ʻO au iho nō me ka haʻahaʻa...

Kāwika McKeague

Appendix L

University of Nations TMKs: (3) 7-5-010:085 and (3) 7-5-017:006 Ka Pa‘akai o Ka ‘Āina Analysis, February 2020

Archaeology • History • Ethnography • Architectural History

University of Nations
TMKs: (3) 7-5-010:085 and (3) 7-5-017:006

Ka Pa'akai O Ka 'Aina Analysis

February 2020

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At the request of the U of N Bencorp (landowner), in support of a motion to amend being submitted to the State of Hawai'i Land Use Commission LUC) to amend the project description in LUC Docket A02-737 to reflect the 2020 U of N Kona Master Plan Update, as well as to support a corresponding request to the County for change of zone from Agricultural land (A1-a) to an appropriate zoning classification, ASM Affiliates (ASM) conducted a *Ka Pa'akai O Ka 'Aina* analysis of a 62-acre project area comprising two fee-simple parcels (TMKs: (3) 7-5-010:085 and (3) 7-5-017:006) located in Wai'aha Ahupua'a, North Kona District, Island of Hawai'i (Figures 1, 2, 3, and 4).

Article XII, Section 7 of the Hawai'i Constitution obligates the State and its agencies, such as the LUC, "to protect the reasonable exercise of customarily and traditionally exercised rights of native Hawaiians to the extent feasible when granting a petition for reclassification of district boundaries." (*Ka Pa'akai O Ka 'Aina* v Land Use Commission, 94 Hawai'i 31, 7 P.3d 1068 [2000]). Under Article XII, Section 7, the State shall protect all rights, customarily and traditionally exercised for subsistence, cultural and religious purposes and possessed by *ahupua'a* tenants who are descendants of native Hawaiians who inhabited the Hawaiian Islands prior to 1778, subject to the right of the State to regulate such rights. In the context of land use permitting, these issues are commonly addressed when the LUC is asked to approve a petition for the reclassification of district boundaries, as such an action most often initiates activities that precede initial intensive development.

In the September 11, 2000 Hawai'i Supreme Court landmark decision (*Ka Pa'akai O Ka 'Aina* v Land Use Commission), an analytical framework for addressing the preservation and protection of customary and traditional native practices specific to Hawaiian communities was created. 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 by the proposed action; and third, to specify the feasible action, if any, to be taken by the regulatory body to reasonably protect native Hawaiian rights if they are found to exist.

In an effort to identify whether any valued cultural, historical, or natural resources are present within the proposed project area, and to identify the extent to which any traditional and customary native Hawaiian rights are, or have been, exercised (the first part of the analytical framework); historical archival information was investigated, and prior cultural studies that included consultation and oral-historical interviews were reviewed and summarized below. This is followed by a discussion describing the extent to which the valued cultural, historical or natural resources and customary native Hawaiian rights will be impacted by the proposed project. Finally, part three of this analytical process summarizes these findings and recommends feasible actions and mitigative measures that may be taken by the Land Use Commission to reasonably protect native Hawaiian rights, if they are found to exist within the proposed project area.

A Concise Culture-Historical Background for Waiʻaha

The project area is located on the lower western slopes of Hualālai within the *ahupuaʻa* of Waiʻaha (lit., "gathering water") in the *moku o loko* (interior district) of North Kona on the *mokupuni* (island) of Hawaiʻi (Pukui et al. 1974:219) (Figure 5). The *moku o loko* of Kona is one of six interior land districts that divide up the *mokupuni* of Hawaiʻi, originally called Lononuiākea, Kona covers an area that is approximately 60 miles long. Due to its vast expanse of land acreage, the district is partitioned into a northern and southern region, with Puʻu Ohau, a cinder cone between Kealakekua and Keauhou, demarcating the boundary (Clark 1985:107). As stated in the *ʻōlelo noʻeau* (Hawaiian proverb), *Kona ʻākau, mai Keahualono a Puʻuohau*, the northern region of Kona is subdivided into 82 *ahupuaʻa* whose boundaries are between the areas of Keahualono to the north and Puʻu Ohau to the south (Pukui 1983:198).

The cultural significance of the Kona District and the *ahupuaʻa* of Waiʻaha in the conscience of native Hawaiians is illustrated in several oral traditions associated both with the *moku o loko* and the *ahupuaʻa* as being an area of residence for ruling *aliʻi* (often referred to as "chiefs" but are considered living *akua* who bear the *kuleana* of developing and practicing appropriate land and coastal stewardship practices). Numerous native oral traditions and foreign accounts illustrate that the *ahupuaʻa* of Waiʻaha was part of a larger and significant political and population center that was primarily sustained by a variety of dryland agricultural practices. Generally speaking, the *moku o loko* of Kona is associated with the god Lono, who is considered to be the source of agriculture, fertility, and abundant rains. The land use practices and cultural protocols associated with the practices of agriculture in Kona have been well documented. As provided in an overview of historical references and native accounts, honorific tributes to Lono were a part of the cultural practices within the district that were perpetuated from time antiquity:

> The most interesting mythological and legendary materials relating to Kona have to do directly or indirectly with the god Lono…the origin of the Makahiki rain and harvest festival. From Kona, we have the written record of a myth of Kumuhonua (Earth Foundation, 36 generations before Wākea and Papa, who was the first man fashioned by the gods.), whose writer says that Lono was a fisherman and yet ends his story by stating that the events related occurred before men peopled the earth. Lono is credited with introducing the main food plants, taro, breadfruit, yams, sugarcane, and bananas to Hawaiʻi and also ʻawa (Handy and Handy 1972:522)
>
> The sweet potato and gourd were suitable for cultivation in the drier areas of the islands...Lono was important in these areas, particularly in Kona on Hawaiʻi and ʻUlupalakua on Māui. At both of these places, 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 Kū which was a ritual identified with Kū as god of battle. (Handy and Handy 1972:14)

Within the district of Kona, the extensive acreage of agricultural production is characterized as one of the most significant cultural features. The agricultural field system exemplified the adaptation of traditional native planters to various climatic, terrain, and soil conditions. There are four traditional vegetation zones in Kona that characterize the natural landscape from *makai* to *mauka* which include the *kula*, *kaluʻulu*, *ʻāpaʻa*, and *ʻamaʻu* zones. The project area is situated along the coastal edge of the Kona Field System within the *kula* zone, the lowest elevation zone ranging from sea level to 150 meters in elevation, traditionally associated with habitation and cultivation of sweet potatoes, paper mulberry, and gourds. Agricultural features such as clearing mounds, planting mounds, planting depressions, modified outcrops, pavements, enclosures, and planting terraces, are common throughout much of this zone (Hammatt and Clark 1980; Hammatt and Folk 1980; Haun et al. 1998; Schilt 1984). Dwellings were scattered throughout the agricultural portion of the *kula* but are more commonly concentrated along the shoreline (Cordy 1981; Hammatt 1980). Within Kona's arid *kula* lands, it was necessary to develop elaborate irrigation methods in order to provide an adequate supply of freshwater to its agricultural parcels.

In Precontact and early Historic times the people of Kona lived primarily in small settlements along the coast with access to fresh water, where they subsisted on marine resources and agricultural products. Within Kona's coastal fisheries, the waters are instilled with innumerable streaks of blue-green hues, indicating the varying ocean depths and channels that are abundant with schools of pelagic fish such as *aʻu* (*Istiophoridae*, marlin or spearfish), *ono* (*Acanthocybium solandri*, wahoo), *aku* (*Katsuwonus pelamis*, bonito or skipjack), *ahi* (*Thunnus albacares*, yellow-fin tuna), *mahimahi* (*Coryphaena hippurus*, dolphin-fish), *kāhala* (*Seriola dumerilii*, amberjack or yellow-tail), and *ulua* (*Family Carangidae*, jack crevalle) (Pukui 1955; Winne 1928). In addition to the plethora of pelagic fish, Kona is also recognized for its fringing reef that teem with a wide variety of nearshore marine species.

Following the unification of the islands in 1812, Kamehameha appointed several of his advisors as district *ali'i* to establish jurisdictional oversight in restoring efficient levels of agricultural production on all the islands. The last seven years of Kamehameha's life were in Kailua at his principal residence of Kamakahonu near the *heiau* of Ahu'ena, thereby shifting the political and spiritual governance from O'ahu back to Hawai'i Island. After the passing of Kamehameha in 1819, the events of the *'ainoa*, the expression of "free eating", which symbolized the abolition of the traditional *'aikapu* system had transpired in Kailua during the rule of Liholiho, his son, and Ka'ahumanu, his wife who proclaimed herself with the right and political status of the *Kuhina Nui*. Not long after Kamehameha's death, Kaluaikonahale John Adams Kuakini was appointed by his sister, Ka'ahumanu, to the position of *Kia'āina* (governor) for the Island of Hawai'i. Remaining loyal to the traditional ways of the people but respecting Ka'ahumanu's new affirmation to the Christian faith, Kuakini was considered to be a *pono ali'i* by traditional Hawaiian standards, maintaining a commitment to address the needs of the people while preserving and protecting the natural resources within the Kona region.

In 1823, British missionary William Ellis and members of the American Board of Commissioners for Foreign Missions (ABCFM) toured the island of Hawai'i seeking out communities in which to establish church centers for the growing Calvinist mission and began to establish political and social relationships with ruling *ali'i.* When Ellis visited the vicinity of the project area in 1823, he described the following:

> Leaving Kairua [Kailua], we passed through the villages thickly scattered along the shore to the southward. The country around looked unusually green and cheerful, owing to the frequent rain, which for some months past have fallen on this side of the island. Even the barren lava, over which we traveled, seemed to veil its sterility beneath frequent tufts of tall waving grass, or spreading shrubs and flowers.
>
> The side of the hills, laid out for a considerable extent in gardens and fields, and generally cultivated with potatoes, and other vegetables, were beautiful.
>
> The number of heiaus, and depositories of the dead, which we passed, convinced us that this part of the island must formerly have been populous. The latter were built with fragments of lava, laid up evenly on the outside, generally about eight feet long, from four to six broad, and about four feet high. Some appeared very ancient, other had evidently been standing but a few years. (1963:72-73)

Fourteen years later in 1837, Kuakini built his permanent residence, now known as Hulihe'e Palace as well as began the construction of Moku'aikaua, the first and oldest Christian church in Hawai'i. Also during this time, the Pā a Kuakini (wall of Kuakini) was constructed along the entire length of North and South Kona to protect the productive agricultural uplands from being inundated by free-roaming domesticated animals. A stone building was also built by Kuakini to be used as a cotton factory. By 1839, nearly 400 yards of cloth had been manufactured in this cotton mill, but production dwindled the following year. Kuakini had a definitive role in shaping the natural and social landscape of Kona by promoting various construction endeavors designed to enhance the quality of life for his people during the time directly following the overthrow of the traditional *kapu* system (Kame'eleihiwa 1992; Winne 1928). After his death in December 1844, Kuakini bestowed his position of *Kia'āina* and all of his lands to his *keiki hānai*, William Pitt Leleiōhoku. Leleiōhoku's inheritance included Hulihe'e Palace, which was passed to Princess Ruth Ke'elikōlani, upon his death in 1848.

By the 19th century, the ever-growing population of Westerners in the Hawaiian Islands forced socioeconomic and demographic changes that promoted the establishment of a Euro-American style of land ownership, and the *Māhele 'Āina* (Land Division) of 1848 became the vehicle for determining the ownership of native lands within the island kingdom. During the *Māhele*, native tenants could also claim, and acquire title to, *kuleana* parcels that they actively lived on or farmed. The lands of Wai'aha were divided into two sections: Wai'aha 1st, in which the current project area is situate, was the most northern section and comprised of approximately 260 acres, situated adjacent to the *ahupua'a* of Pua'a. Conversely, Wai'aha 2nd was comprised of approximately 170¼ acres with its southern boundaries adjacent to the *ahupua'a* of Kahului. As a result of the *Māhele*, Wai'aha 1st Ahupua'a was initially awarded to the American Board of Commissioners of Foreign Missions (ABCFM) as Land Commission Award (LCAw.) 387 after a petition was sent to the Ministry of the Interior by the ABCFM to request that a commutation for a fee simple title be granted for these lands. Within this LCAw., lands were also awarded to the ABCFM for the Laniākea estate of Asa Thurston in Hienaloli (5.26 acres), a houselot for Dr. Seth Andrews in Kailua (1.48 acres), the aforementioned lands of Wai'aha 1st (273.50 acres), and lands in Hienaloli (121.80 acres). Within Wai'aha 1st Ahupua'a, five native tenants made claims for lands petitioning as long-standing residents. Of these, four were awarded (LCAw. 6699 to Lumaawe, LCAw. 7083 to Kaulua, LCAw. 7241B to Kalama, and LCAw. 7481 to Kalae). The awarded lands totaled 3.06 acres and ranged in size from 0.16 to 1.61 acres. Three of the awarded *kuleana* are situated west of the current project area near the shoreline, while the remaining *kuleana* parcel is located well to the east in the upper reaches of the *ahupua'a*. None of the *kuleana* were awarded for lands within the project area or the subject parcels.

Wai'aha was also a favored retreat for Emma Naea Rooke and her husband, Alexander Kalanikualiholihokekapu 'Iolani Kamehameha IV), who acquired land in the upland regions of the *ahupua'a*, and their son Prince Albert Edward Kauikeaouli Leiopapa a Kamehameha. Upon the king's death in 1865, the dowager Queen Emma purchased the land of Wai'aha from the estate of her late husband, where she retained a home on the estate until her death in 1885. Several recorded oral accounts, one composed by the Queen herself, speak of the verdant uplands of Wai'aha and the general Kona region in a poetic and honorific tribute through the compositions of *nā kanikau* (lamentation chants) that marked the death of the young Prince Albert, who died at the age of four from acute appendicitis.

Sources suggest that by the late 1890s, much of the land within the Wai'aha Ahupua'a was utilized by the Kona Sugar Company to support the sugarcane industry that was emerging within the region. Following the closure of the plantation and the mill site in 1926, much of the land within Wai'aha, including a large portion of the project area, was purchased by Manuel Gomes from the failed sugar company as part of an immense cattle and ranching operation. The upper slopes of Wai'aha are utilized today for ranching and diversified agriculture and coffee production. The coastal regions are part of an ever-growing tourism with a wide variety of vacation rentals, timeshares, and visitor accommodations, serving as a venue for major sporting events like the Billfish Tournament and Ironman Triathlon.

Identification of Valued Cultural, Historical, or Natural Resources

Records on file at DLNR-SHPD indicate that several previous archaeological studies have been conducted in the vicinity of the project area. These studies have identified a variety of formal site types including but not limited to mounds, alignments, walls, enclosures, trails, lava blisters and caves, and were assigned functional interpretations relating to agriculture, temporary and permanent habitation, transportation, animal husbandry, landscape clearance, and potential ceremonial and burial functions. The current project area been the subject of seven previously conducted studies.

In 2002, Paul H. Rosendahl Inc. (PHRI) conducted an Archaeological Assessment (AA) survey (Corbin and Rosendahl 2002) of the project area. As a result of the fieldwork, twenty-eight archaeological sites encompassing forty-five features were documented, and a single previously identified site, the Kuakini Wall (Site 6302), was recorded. Other recorded feature types included walls, terraces, mounds, modified outcrops, platforms, enclosures, and lava blister caves. Identified site types were assigned various functions including habitation, ranching, agricultural, and burial. Later that same year, PHRI conducted subsurface testing (Rosendahl 2002) of a sample of possible burial features. Eleven features at eleven different sites were tested for the presence of burials, however this investigation yielded negative results. A small amount of cultural material including a coral abrader, adze fragment, and marine shell fragments were documented during these excavations but appeared to never have been collected.

In 2003, Rechtman Consulting, LLC conducted an Archaeological Inventory Survey (AIS) (Clark and Rechtman 2003) of the roughly 62-acres of land comprising TMKs: (3) 7-5-010:085 and (3) 7-5-017:006, which included the U of N Bencorp project area in its entirety. As a result of the study, twenty-five previously unrecorded sites and a single previously recorded site were identified (Table 1 and Figure 6). Site types identified during the study were both Historic and Precontact in nature and were grouped into seven categories: Historic ranching related sites and boundary walls, Precontact habitation sites, trails, ceremonial sites, game boards, burials, and agricultural sites. As part of the investigation, twenty-two 1 x 1 meter test units (TUs) were excavated at ten sites (Sites 23668, 23670 Feature B, 23672 Features A and B, 23673 Feature A, 23675, 23676, 23677, 23681 Feature A, 23683, 23684, 23685, and at 23686 Features 183, 187, 189, 201, 204, 239, 262, 266, 271, and 297. Subsurface testing of multiple sites/features yielded numerous examples of cultural material including volcanic glass flakes and shatter, charcoal fragments, groundstone, waterworn, and fire cracked basalt, branch and waterworn coral, marine shell (*Cellana* sp., *Conus* sp., *Drupa* sp., *Nerita* sp., *Echinoidea* sp., *Cypraea* sp., *Strombina* sp., *Venus* sp., and *Cantharus* sp.), *kukui* and an unidentified seed, shark teeth, a mostly intact *lūhe'e* lure, as well as dog, rodent and fish bone. Additionally, human skeletal remains identified during excavation of Sites 23683, 23684, and 23685.

All sites were assessed as significant under Criterion d, with eleven being recommended for no further work (Sites 23662 through 23669, 23679 and 23680, and 23682). Four of the sites were also assessed as significant under both Criteria d and e and recommended for preservation (Sites 23681, Sites 23683, 23684, and 23685), one was assessed as significant under Criteria a, c, and d and also recommended for preservation (Site 6302), and ten were recommended for data recovery (Sites 23670 through 23678 and 23686).

Table 1. Archaeological sites recorded by Clark and Rechtman 2003.

SIHP No.	*Function*	*Temporal Association*	*Significance*	*Recommended Treatment*
6302	Ranching/boundary	Historic	a, c, d	Preservation
23662	Ranching	Historic	d	No further work
23663	Ranching	Historic	d	No further work
23664	Ranching	Historic	d	No further work
23665	Boundary	Historic	d	No further work
23665	Boundary	Historic	d	No further work
23667	Boundary	Historic	d	No further work
23668	Temporary habitation	Precontact	d	No further work
23669	Temporary habitation	Precontact	d	No further work
23670	Permanent habitation	Precontact	d	Data recovery
23671	Temporary habitation	Precontact	d	Data recovery
23672	Temporary habitation	Precontact	d	Data recovery
23673	Permanent habitation	Precontact	d	Data recovery
23674	Temporary habitation	Precontact	d	Data recovery
23675	Temporary habitation	Precontact	d	Data recovery
23676	Temporary habitation	Precontact	d	Data recovery
23677	Temporary habitation	Precontact	d	Data recovery
23678	Temporary habitation	Precontact	d	Data recovery
23679	Trail	Precontact	d	No further work
23680	Trail	Precontact	d	No further work
23681	Ceremonial	Precontact	d, e	Preservation
23682	Game board	Precontact	d	No further work
23683	Burial	Precontact	d, e	Preservation
23684	Burial	Precontact	d, e	Preservation
23685	Burial	Precontact	d, e	Preservation
23686	Agriculture	Precontact	d	Data recovery

The approved treatment for Sites 23683, 23684, and 23685 is preservation in place (Rechtman 2003), which will be achieved through the establishment of a minimum 20-foot permanent preservation easement buffer for each respective site. These preservation easements are to be defined by stone walls (traditionally Hawaiian in appearance) constructed of dry-stacked local basalt boulders and cobbles and discretely core-filled with smaller cobbles. An inconspicuously situated, narrow, gated openings will be incorporated into each wall to facilitate access to the site for maintenance purposes and a visitation by cultural and/or lineal descendants. Appropriate native foliage will be planted along the exterior perimeter of the preservation buffer walls. An additional 10-foot buffer zone beyond the 20-foot buffer has also been set aside as a no construction zone. Interpretive/cautionary signs will be placed immediately adjacent to each respective walled preservation easement. Finally, the accepted treatment for the burial sites also includes a provision for the development and submittal of a formal landscaping plan to the DLNR-SHPD Burial Sites Program for approval, which will lay out measures that the respective sites be cleared of all non-native/non-Polynesian introduced vegetation prior to their reconstruction.

In 2007, ten of the sites (Sites 23670 through 23678 and 23686) identified during the Clark and Rechtman (2003) AIS were the subject of data recovery investigations (Rechtman and Loubser 2007). Nine of the sites that were subject to data recovery were inferred to have been utilized for habitation (four with permanent habitation and five with temporary habitation) and one was associated with agricultural use. All of the sites dated to the Precontact Period. The primary objectives of the data recovery were centered around (1) establishing the sequence of Precontact land use within the project area and within the general *kula* lands of Kona, (2) refining the precise nature of data recovery sites associated with habitation, and (3) refining the age estimate and functional interpretation of the documented agricultural features. It was proposed by Rechtman and Loubser (2007) that conducting data recovery of these sites would establish whether or not short-term habitation and associated opportunistic agriculture was indeed followed by recurrent habitation and associated formal agriculture, and finally by more consistent habitation with associated household gardens and animal pens.

The data recovery effort was accomplished by conducting thorough redocumentation of the data recovery sites, the process of which included clearance of vegetation to assess the then-current conditions of the sites, site photography, and the illustration or update of existing site plan views from the Clark and Rechtman (2003) AIS to show the placement of the excavation units, and subsurface testing to determine the presence or absence of buried cultural deposits. As part of the fieldwork, a total of 39 Excavation Units (EU) and 17 Test Units (TU) were excavated. These units ranged in configuration from 1 x 1 meters, 1 x 2 meters, and 2 x 2 meters, and generally, multiple units were excavated into each site. With respect to the habitation sites (Sites 23670 through 23678), there were a total of 22 EU and 7 TU excavated. For Site 23686, 17 EU and 10 TU were excavated. As a result of excavations, a wide assemblage of cultural material was collected including intact and fragmented marine shell (e.g. *Cypraea*, sp., *Conus* sp., *Drupa* sp., *Cellana* sp., *Morula* sp., *Isognomon* sp., *Fimbria* sp., *Brachiodontes* sp., *Turbo* sp., *Nerita* sp., *Mitra* sp., *Terebra* sp., *Cantharus* sp., *Chama* sp., *Venus* sp., *Nassarius* sp., *Strombina*, sp., *Serpuloris variabilis*, *Thais* sp., *Cymatium* sp., *Fimbria* sp., and an unidentifiable bivalve fragment), echinoderms, a crustacean fragment, and both branch and waterworn coral pieces. Lithic assemblages identified during fieldwork included worked and unworked volcanic glass flakes and shatter, fire-cracked basalt, basalt flakes, waterworn and groundstone basalt fragments. Additionally, a variety of faunal remains were recovered including worked and unworked bones (e.g. rodent, pig, dog, cow, bird, and some which were unidentifiable) as well as bird, fish, dog, cow, and shark teeth. A variety of portable remains (artifacts) were also recovered during data recovery excavations including coral abraders, intact and fragmented echinoderm abraders, a fine-grained basalt adze fragment, a *lūhe'e* (octopus lure), an awl manufactured from unidentifiable materials, a bone awl, a 0.166 lead pellet, an iron horseshoe nail, a steel nail, a steel nut, rusted iron fragments, and fragments of brass buttons. Fragments of *kukui* (candlenut; *Aleurites moluccana)* and an unidentifiable seed and nut were also recovered during excavations, as were numerous charcoal samples, 17 of which were submitted for radiocarbon assay.

Following the synthesis of field and laboratory results it was proposed by Rechtman and Loubser (2007) that the data recovered sites were collectively representative of four time periods, which they assigned as phases A through D: Phase A from A.D. 1400 to A.D. 1460, Phase B from A.D. 1460 to A.D. 1580, Phase C from A.D. 1580 to A.D. 1680, and Phase D from A.D. 1680 to A.D. 1850. Phase A occupation encompassed Site 23686 Features 247, 293, and 294; Phase B occupation pertained to Site 23676, Site 23673 Features A and B; and Site 23671; Phase C related to Site 23686 Features 250, 254, 282, and 289; possibly Site 23674; Site 23672 Features A and B; and potentially Site 23674; and Phase D occupation was concluded to be associated with nine excavated features including Site 23675, Site 23670 Features A, B, and C, Site 23678, Site 23677 Features A and B, Site 23686 Feature 251, and potentially also the *kuaiwi* associated with Site 23686.

In 2013, Rechtman Consulting, LLC prepared a Preservation Plan (Rechtman 2013) for two of the sites initially documented during the inventory survey conducted by Clark and Rechtman (2003). The first preservation site, a 340-meter-long section of the Kuakini Wall (Site 6302), was likely constructed during Governor Kuakini's administration (A.D. 1820-1844), coinciding with the latter portion of Phase D occupation previously hypothesized by Rechtman and Loubser (2007). Initially, the wall served to protect cultivated agricultural fields *mauka* of the wall from feral animals, however Rechtman et al. (2013) opined that the function of the Kuakini Wall likely transformed over time, and in later years served primarily to protect coastal settlements situated *makai* of the wall. Site 6302 was assessed by Clark and Rechtman (2003) as significant under Criteria a, c, and d, and was determined to be eligible for listing (but is not formally listed) on the National Register of Historic Places (NRHP). Preservation measures were centered primarily around avoidance and protection (conservation) of the site, however the plan set forth by Rechtman et al. (2013) also included provisions for stabilization/restoration, dismantling/restoration, and the installation of interpretive/cautionary signage at intervals around the twenty-foot permanent preservation easement buffer.

The second preservation site consisted of an agricultural *heiau* (Site 23681), a traditional ceremonial site referred to as *heiau ho'oūluulu 'ai* or *heiau ho'oūluulu ua* where Hawaiians would conduct rituals to ensure agricultural fertility and/or to induce rain. The proposed permanent preservation measures for Site 23681 were avoidance and protection (conservation) which was to be achieved through the establishment of a twenty-foot preservation easement buffer. Rechtman (2013) recommended that this permanent buffer be marked by a stone wall (traditionally Hawaiian in appearance) constructed of dry-stacked local basalt boulders and cobbles and discretely core-filled with smaller cobbles and recommended that an inconspicuously situated narrow gated opening be present to allow access for site maintenance and appropriate visitation.

Most recently in 2019, ASM Affiliates prepared a Dismantling/Restoration Plan (Barna 2019) for a portion of the Kuakini Wall (Site 6302). The plan outlined the measures to be followed during the process of dismantling/restoration of collapsed portions of and three breaches in Site 6302.

A Cultural Impact Assessment (CIA) in support of the update to the Master Plan for the proposed 62-acre Hualālai Village Pacific Islands Cultural Center Development was prepared by Group 70 in 2003, and updated by ASM in 2020. As part of that study archival-historical research was conducted, including a review of Land Commission and Boundary Commission awards, Native and Foreign Register testimonies, recorded journal logs, 19th and 20th century Hawaiian language newspapers, recorded historical texts and personal field notes, government letters and memorandums, and archived photographs. The scope of research also included a review of archaeological studies, inventories, and surveys previously conducted within or near the project area, with special emphasis placed on the examination of mountainous and coastal geographical features and places within Waiʻaha and adjoining land districts. Additionally, an effort was also made to identify various recorded oral traditions of *Nā Kanaka Maoli* including *nā oli* (chants), *nā mele* (musical compositions), and *nā moʻolelo* (associative stories) and *nā kāʻao* (legendary accounts) that mentioned specific place names associated with the northern region of Kona District and with the *ahupuaʻa* of Waiʻaha. Several of these recorded accounts were documented in Hawaiian text, whereupon translations and preliminary interpretative analysis of each composition's *kaona* (a narrative technique employed by the composer that infuses multi-layers of contextual meanings into the particular chant or *mele*) was conducted, as appropriate.

Potential Effects on Traditional and Customary Rights

As part of the 2003 CIA, various agencies and organizations (e.g. OHA, Hawaiʻi Island Burial Council, Queen Liliʻuokalani Trust, etc.), community members, and cultural/lineal descendants with ties to Waiʻaha were contacted in order to identify traditional cultural properties, practices, and contemporary cultural uses associated with the current project area and surrounding lands. A total of thirty-four individuals were contacted for consultation based on their potential to provide intimate knowledge of Waiʻaha, in particular *nā kupuna*, *nā kumu hula*, and *nā kuaʻāina*. Twenty-one individuals responded to the request, although several declined to be interviewed, directed consultation to other individuals (besides themselves), or expressed that they did not have intimate knowledge of Waiʻaha.

There were three primary guiding principles that were the theme of consultation. The first being that *ʻāina* (literally translated as "that which feeds", but commonly applied as a definition for "land") is born of Papahānaumoku (Earth Mother). This guiding principle is the foundation from which the cultural values of *aloha ʻāina* and *mālama ʻāina* are derived. Also, that it is necessary to acknowledge that although traces of a physical imprint and its integrity of traditional cultural properties, resources, features, beliefs, and practices may no longer remain, there is a thriving spiritual imprint that remains in the form of *mana*, the spiritual essence of those *kūpuna* and *nā mea loea* that have come before. Finally, the understanding that place names, like Waiʻaha, illustrate a collective history of a geographical region, reiterate community and familial genealogy, characterize and describe the natural resources within a prescribed physical space, and define recognized cultural mores and values of the existing community.

Collectively, the individuals relayed similar concerns regarding the potential impacts of the proposed project on the known archaeological and burial sites, and the potential for encountering previously unidentified burials. Also expressed was the concern for proper stewardship of the lands by the landowner in order to maintain its cultural integrity, and the need for involvement in the proposed project by cultural and lineal descendants, particularly *kūpuna*. These concerns and recommendations expressed in 2003 were synthesized (with consent) with those expressed during previously conducted consultations and were then used to formulate a set of project-specific recommendations.

The CIA concluded that the cultural landscape in the *ahupuaʻa* of Waiʻaha possesses a kaleidoscope of historical and cultural features and properties. Thus, it was recommended that the proposed development incorporates the unique historical and cultural legacy specific to the project area, Waiʻaha Ahupuaʻa and the greater Kona region, and that the proposed development incorporates the guiding cultural principles in the physical design of the facilities and the surrounding landscape in the selection of appropriate plantings and exterior features. Furthermore, it was recommended that the cultural concerns expressed by those in the Hawaiian community of Kona regarding recommendation protocols in properly handling *iwi*, ancestral remains, proper consultation with appropriate parties, and the final disposition of any burial, be taken into consideration, and that the utmost sensitivity, caring, and understanding be employed when dealing with burial issues and *iwi*.

Feasible Actions to Reasonably Protect Native Hawaiian Rights

The archaeological research previously conducted within the subject property, combined with the culture-historical information collected in the CIA previously prepared for the project, attests to the presence of significant cultural resources within the project area, including sites that were associated with specific historical activities such as agriculture, temporary and permanent habitation, transportation, animal husbandry, ceremony, and burial. The archaeological studies have demonstrated cultural use of the subject parcels that spanned both the Precontact and Historic Periods, as demonstrated by the diverse cultural materials found at the identified sites. The findings and recommendations provided in the DLNR-SHPD accepted AIS (Log No.: 2003.2356; Doc No. 0311PM04; Figures 7 and 8) for the project area (Clark and Rechtman 2003) led to three subsequent studies that were intended to mitigate the impacts of the proposed project to the documented sites.

A Burial Treatment Plan (BTP) prepared by Rechtman (2003) established the preservation measures for three of the identified sites (Sites 23683, 23684, and 23685). The DLNR-SHPD accepted treatment measures (Log No.: 2019.01527; Doc No. 1908CJO01; Figure 9) require that each site be preserved in place with a minimum 20-foot permanent preservation easement buffer, in addition to an inconspicuous, narrow, gated opening designed to facilitate maintenance of the sites and visitation by cultural and/or lineal descendants. The approved BTP also established that an additional 10-foot buffer (beyond the 20-foot buffer) be set aside as a no construction zone, and interpretive/cautionary signs will be placed adjacent to each of the walled easements to further help protect the burial sites.

Rechtman and Loubser (2007) completed a data recovery at 10 of the identified sites (Sites 23670 through 23678 and Site 23686). The data recovery excavations conducted within the project area helped establish the sequence of Precontact land use within the project area and within the general *kula* lands of Kona, refine the precise nature of past habitation that occurred there, and establish age estimates and functional interpretations for the documented agricultural features. The data recovery report was submitted to DLNR-SHPD in 2007, but has not yet been reviewed. It was resubmitted on September 9, 2019 (DLNR-SHPD Log No.: 2019.01980), and review and acceptance are currently pending.

Rechtman (2013) prepared a preservation plan for two sites within the project area (Sites 6302 and 23681). The preservation measures established for Site 6302 call for stabilization/restoration, dismantling/restoration, and the installation of interpretive/cautionary signage at intervals around the twenty-foot permanent preservation easement buffer. A Dismantling/Restoration Plan has also been prepared by ASM Affiliates (Barna 2019) for Site 6302 as requested by DLNR-SHPD in their review of the 2013 preservation plan, but it has not yet been submitted to DLNR-SHPD for review. The preservation measures for Site 23681 call for avoidance and protection through the creation of a 20-foot preservation easement buffer marked by a wall and fitted with a narrow, gated opening to facilitate maintenance and appropriate visitation of the site. The preservation plan was accepted by DLNR-SHPD in 2014 (Log No.: 2014.2843; Doc No. 1406MV15; Figure 10). Additionally, the Office of Hawaiian Affairs (OHA) requested that one of two trails previously recorded by Clark and Rechtman (2003) within the project area (Site 23679 or 23680) be re-established as part of the proposed development, to which the landowner has agreed.

The CIA previously prepared for the project in 2003, did not identify any specific past or ongoing traditional cultural practices, however, the consulted parties expressed concern for the potential impacts the proposed project would have on burial sites, and the possibility of encountering unidentified burials during the construction process. The consulted parties also shared their concerns for the proper stewardship of the land by the landowner and the importance of maintaining the property's cultural integrity and the inclusion of cultural and lineal descendants in the stewardship of the property's cultural sites. Given that the subject property has known burial sites, and that the potential of encountering additional burial sites during land clearing activities was a concern emphasized by parties consulted in the 2003 CIA, it was recommended in the recently updated CIA that an archaeological and/or cultural monitor be present during all ground-disturbing activities associated with the proposed development, and that an archaeological monitoring plan be prepared in accordance with Hawai'i Revised Statutes 13§13-279-4 and submitted to DLNR-SHPD for review and acceptance prior to project implementation.

Summary

In summary, the previous archaeological studies conducted within the subject property have identified significant, valued cultural resources, including sites traditionally used for ceremonial, habitation, agricultural, burial, and transportation purposes. Although the 2003 CIA did not identify any specific past or ongoing traditional or customary practices occurring within the project area, concerns were expressed by the consulted parties regarding the presence of burials on the property, the possibility of encountering additional *iwi kupuna* during development activities, and the potential effects that the proposed development would have on the ability of the descendant community to care for those ancestral remains. This concern is legitimate given that the proposed project will alter the traditional cultural landscape of the subject parcels and as a result have an effect on the valued cultural resources located therein. Such landscape alteration also has the potential to adversely affect the ability of the descendant communities to access and care for their ancestral remains.

Several measures have already been undertaken by the landowner to reasonably mitigate and protect the cultural resources located on the property and to ensure that the rights of the descendant community to access and care for their *iwi kupuna* are not impinged. These mitigation measures included archaeological data recovery, and the establishment of permanent preservation easements with associated access rights for any identified lineal and cultural descendants to the three known burial sites, a *heiau*, and the Kuakini wall. Also, at the recommendation of OHA, the landowner has agreed to preserve a portion of a historic trail across the property. If all of the conditions and measures (both interim and permanent) set forth in the Burial Treatment Plan and Preservation Plan are adhered to and implemented as part of the proposed project, then there will be no anticipated adverse impacts to the three burial sites (Sites 23683, 23684, and 23685) and the two preservation sites (Sites 6302 and 23681). To further avoid potential impacts to valued cultural resources, the Land Use Commission can condition any approvals to include the recommended archaeological/cultural precautionary monitoring measures as additional mitigation during all ground-disturbing development activities.

References Cited

Barna, B.
2019 Draft: Dismantling/Restoration Plan for a Portion of Kuakini Wall (SIHP 50-10-28-6302), TMKs: (3) 7-5-010:085 and (3) 7-5-017:006, Wai'aha 1st Ahupua'a, North Kona District, Island of Hawai'i. ASM Affiliates Project Number 33040.00. Prepared for Paul Childers, University of the Nations Kona, Kailua-Kona.

Clark, J. R. K.
1985 *Beaches of the Big Island*. University of Hawaii Press, Honolulu.

Clark, M. R., and R. B. Rechtman
2003 *An Archaeological Inventory Survey of TMKs: 3-7-5-10:85 and 3-7-5-17:06, Wai'aha Ahupua'a, North Kona District, Island of Hawai'i.* Rechtman Consulting Report RC-0153. Prepared for U of N BENCORP, Kailua-Kona, Hawai'i.

Corbin, A., and P. H. Rosendahl
2002 *Archaeological Assessment Survey U of N BENCORP Development, Lands of Waiaha 1st and 2nd, North Kona District, Island of Hawai'i TMK:3-7-5-17:6; 3-75-18:73).* Paul H. Rosendahl, Ph.D. Inc. 2235-041102. Prepared for U of N Bencorp, Kailua-Kona, HI.

Cordy, R.
1981 *A Study of Prehistoric Social Change: The Development of Complex Societies in the Hawaiian Islands*. Academic Press, New York.

Ellis, W.
1963 *Journal of William Ellis, Narrative of a Tour of Hawaii, or Owhyee; with remarks on the History, Traditions, Manners, Customs and Language of the Inhabitants of the Sandwich Islands*. Advertiser Publishing Co., Ltd., Honolulu.

Hammatt, H.
1980 *Archaeological Surface Survey of a 178 Acre Parcel in Nā Ahupua'a, Kaumalumalu, Pahoehoe, Kona, Hawai'i Island.* Archaeological Research Center Hawaii, Inc. 14-203 II. Prepared for Farms and Ranches, Inc., Lawa'i, HI.

Hammatt, H., and S. Clark
1980 *Archaeological Testing and Salvage Excavations of a 155 Acre (Ginter Parcel in Nā Ahupua'a Pahoehoe, La'aloa and Kapala'aea, Kona, Hawai'i Island.* Archaeological Research Center Hawaii, Inc. ARCH 14-152 III. Prepared for Pacific Basin Resorts, Inc., Lawa'i, HI.

Hammatt, H., and W. Folk
1980 *Archaeological Surface Survey and Excavations of Coastal Sites, Ouli, Kohala, Hawai'i Island.* Archaeological Research Center Hawaii Report 14-185 II. Prepared for Mauna Kea Properties, Inc.

Handy, E. S. C., and E. G. Handy
1972 *Native Planters in Old Hawaii: Their Life, Lore, and Environment*. Bernice P. Bishop Museum Bulletin 233. Bishop Museum Press, Honolulu.

Haun, A., J. Henry, J. Jimenez, and M. Kirkendall
1998 *Ali'i Highway Phased Mitigation Program Phase I - Archaeological Intensive Survey, North Kona District, Island of Hawai'i, Volume IIa, Site Descriptions.* Paul H. Rosendahl, Ph.D., Inc. Report 1320-052798. Prepared for County of Hawai'i, Honolulu.

Kame'eleihiwa, L.
1992 *Native Land and Foreign Desires: Ko Hawaii 'Āina a Me Nā Koi Pu'umake a Ka Po'e Haole, Pehea lā e Pono ai? How Shall We Live in Harmony?* Bishop Museum Press, Honolulu.

Pukui, M. K.
1955 *Nā Mele Welo*. University of Hawai'i Press, Honolulu.

1983 *'Ōlelo No'eau: Hawaiian proverbs & poetical sayings*. Bishop Museum Press, Honolulu.

Pukui, M. K., S. H. Elbert, and E. Mo'okini
1974 *Place Names of Hawaii*. Revised and Expanded ed. University of Hawaii Press, Honolulu.

Rechtman, R. B.
2003 *Burial Treatment Plan for Three Sites in the Proposed Hualālai Village Development Area (TMKs: 3-7-5-10:85 and 3-7-5-17:06), Wai'aha Ahupua'a, North Kona District, Island of Hawai'i.* Rechtman Constulting, LLC Report RC-0175. Prepared for U of N BENCORP, Kailua-Kona, HI.

2013 *Preservation Plan for SIHP Site 6032 and Site 23681 (TMKs: 3-7-5-10:085 and 3-7-5-17:006), Wai'aha 1st Ahupua'a, North Kona District, Island of Hawai'i.* Rechtman Consulting, LLC Report RC-0783. Prepared for U of N BENCORP, Kailua-Kona, HI.

Rechtman, R. B., and J. Loubser
2007 *Archaeological Data Recovery at Ten sites on TMKs: 3-7-5-10:85 and 3-7-5-17:06, Wai'aha Ahupua'a, North Kona District, Island of Hawai'i.* Rechtman Consulting, LLC Report RC-0223. Prepared for U of N BENCORP, Kailua-Kona, HI.

Rosendahl, P. H.
2002 *Interim Report: Testing of Possible Burial Features Archaeological Inventory Survey—Phase 1, U of N BENCORP Development, Lands of Waiaha 1st and 2nd, North Kona District, Island of Hawai'i (TMK:3-7-5-17:6; 3-75-18:73).* Paul H. Rosendahl, Ph.D., Inc. 2257-070302. Prepared for U of N Bencorp, Kailua-Kona, HI.

Schilt, R.
1984 *Subsistence and Conflict in Kona, Hawaii: An Archaeological Study of the Kuakini Highway Realignment Corridor.* Department of Anthropology, B.P. Bishop Museum, Honolulu Departmental Report Series. 84-1. Prepared for Department of Transportation, State of Hawaii.

Winne, J. L.
1928 Kuakini and Hulihe'e: The Story of the Kailua Palace, Kona, Hawai'i. Annual Social Meeting for the Daughters of Hawai'i, April 30th

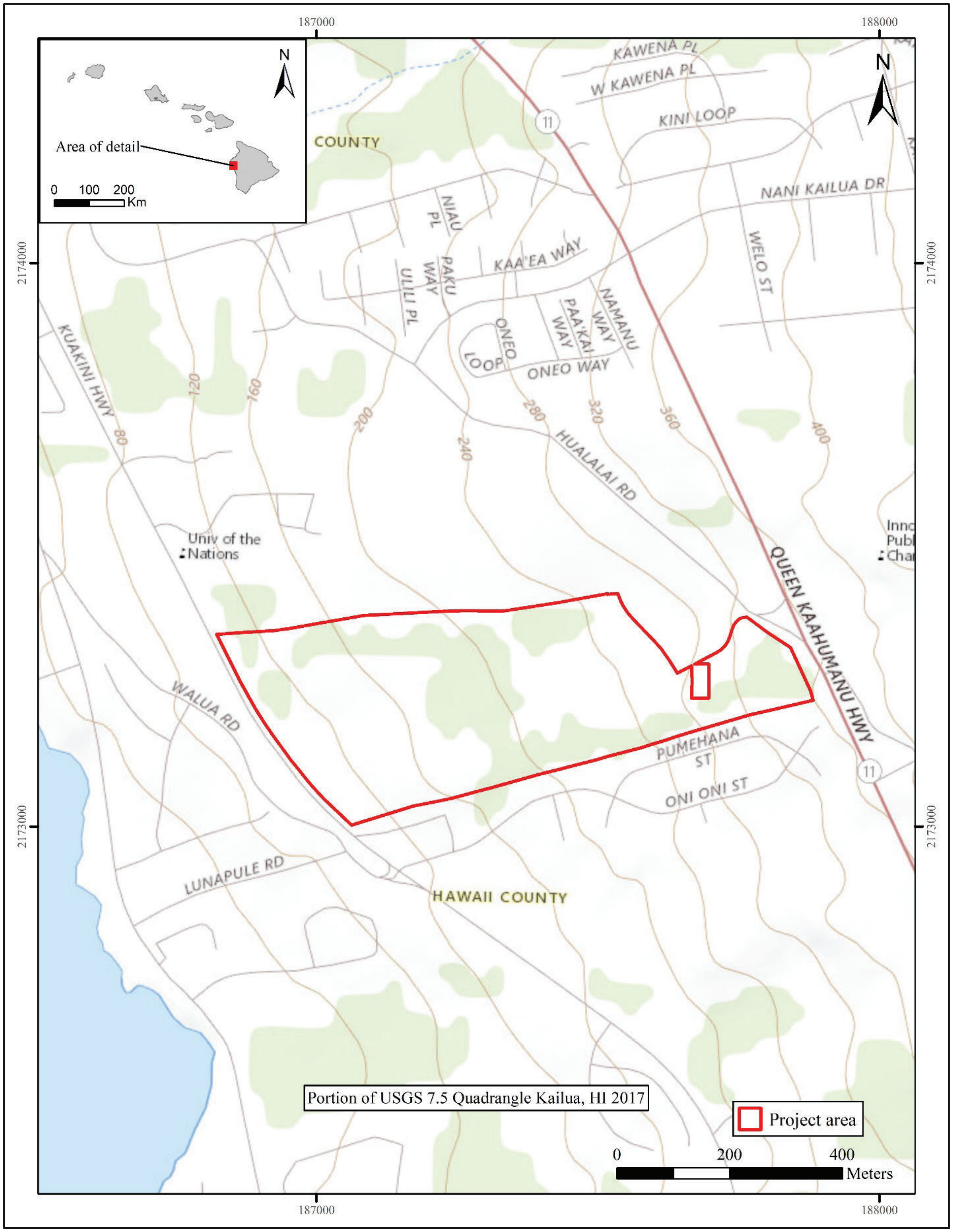

Figure 1. Location of project area within subject parcels.

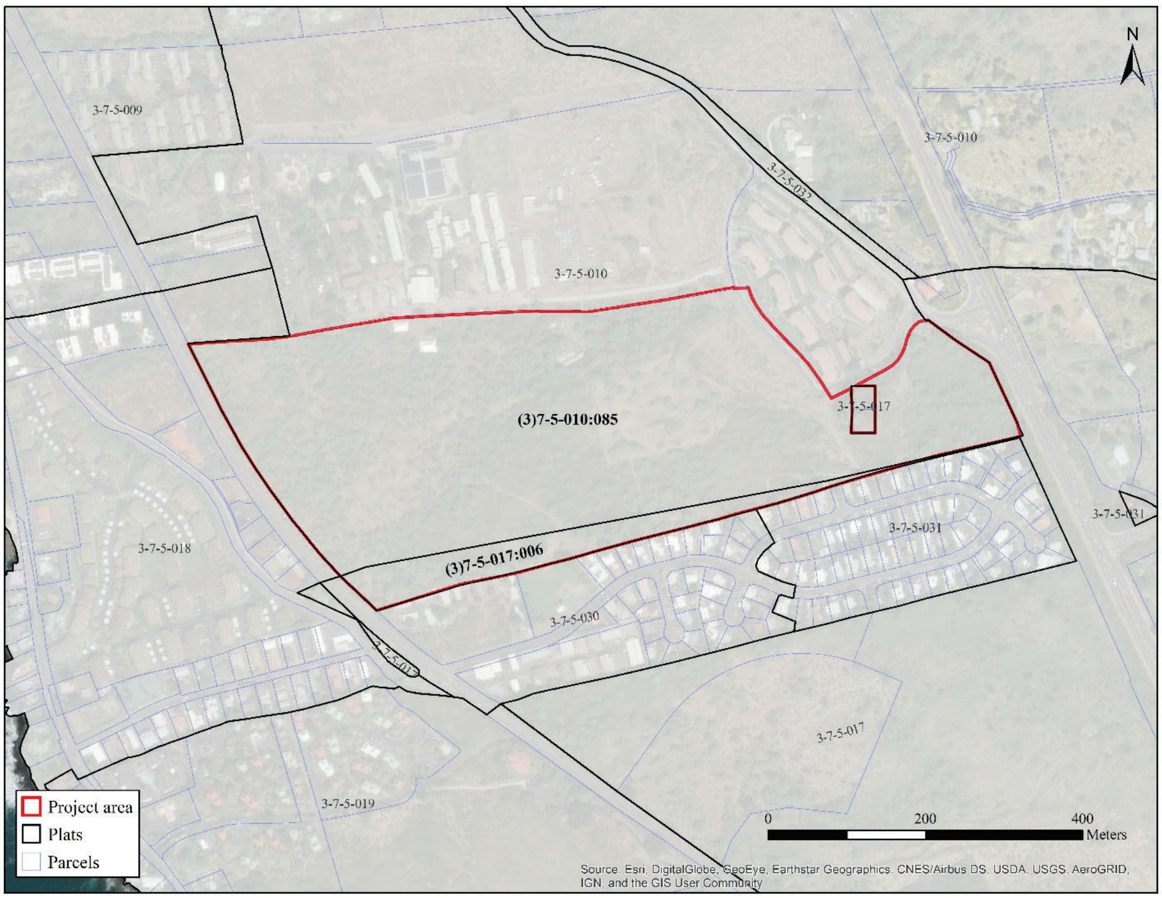

Figure 2. Map showing the project area (TMKs: (3) 7-5-010:085 and (3) 7-5-017:006) and surrounding tax map parcels.

Figure 3. Google Earth™ aerial image showing the project area location.

University of the Nations, Kona
2020 Master Plan Update

DRAFT Environmental Planning Report
December 2019

Figure 2-1 **Conceptual Master Plan (DRAFT December 27, 2019)**

2-3 G70

Figure 4. Univeristy of Nations conceptual master plan.

Figure 5. A portion of Hawai'i Registered Map No. 2060 by J. M. Donn in 1901 showing the ahupua'a of Wai'aha and others in the Kona District, Island of Hawai'i.

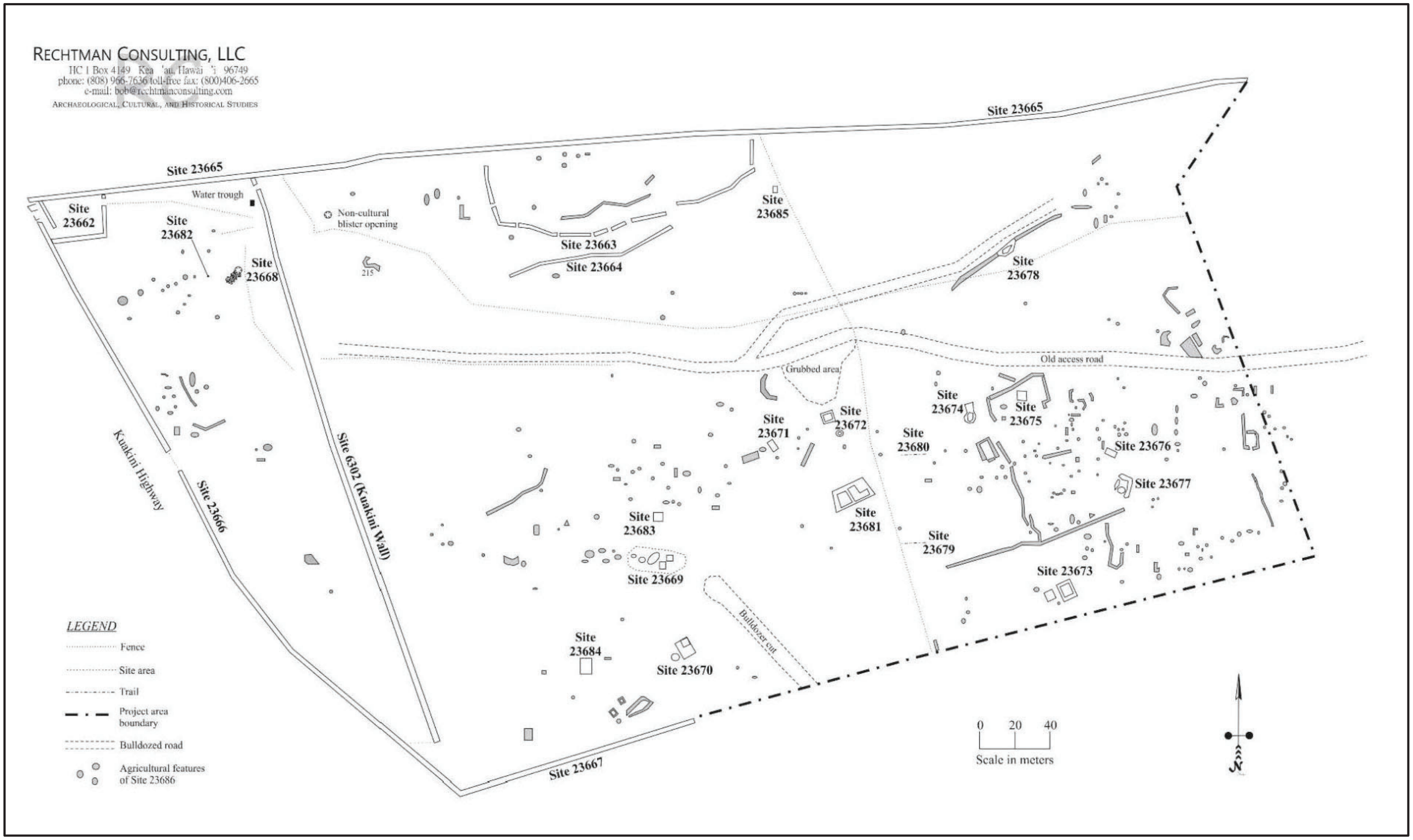

Figure 6. Site plan from Clark and Rechtman (2003:16).

Rc-0153

LINDA LINGLE
GOVERNOR OF HAWAII

PETER T. YOUNG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

DAN DAVIDSON
DEPUTY DIRECTOR - LAND

ERNEST Y.W. LAU
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
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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
HISTORIC PRESERVATION DIVISION
KAKUHIHEWA BUILDING, ROOM 555
601 KAMOKILA BOULEVARD
KAPOLEI, HAWAII 96707

November 17, 2003

Robert Rechtman, Ph.D.
Rechtman Consultant Services, Inc.
HC1, Box 4149
Kea'au, Hawaii 96749

LOG NO: 2003.2356
DOC NO: 0311PM04

Dear Dr. Rechtman:

SUBJECT: Chapter 6E-42 Historic Preservation Review of a Final Report RC-0153: "An Archaeological Inventory Survey of TMK's: 3-7-5-10:85 and 3-7-5-17:06" (Clark and Rechtman 2003)
Wai'aha, North Kona, Hawaii Island

Thank you for the opportunity to review and comment on the above referenced draft report, which was received in our office August 20, 2003. The report was revised to address the comments in our review letter of May 7, 2003 (Log No. 2003. 0238; Doc. No. 0304PM05).

As indicated in our previous letter, we believe that the archaeological inventory survey of the roughly 62-acre project area was adequate in terms of the identification of significant historic sites. One previously identified site (the Kuakini Wall) and 25 new sites were identified in the survey.

In our review of the first draft report we also concurred with your proposed site significance evaluations and recommended site treatments. All 26 sites in the project area have yielded information important for an understanding of local prehistory or history and are thus significant under Criterion "d." Five sites are significant under multiple criteria. These include the Kuakini Wall site (6302), three burial sites (23683, 23684, and 23685), and one ceremonial site (23681). All five of the sites evaluated as significant under multiple criteria are recommended for preservation. Ten sites are recommended for data recovery. No further work is recommended for the other eleven sites, which include all of the historic ranch walls, the two trail segments, and two of the sites interpreted as temporary habitations.

Your letter notes that you have made all of the revisions to the report we had requested, except for eight specific comments that are discussed in your letter. We will accept your explanations for why you couldn't address these particular comments, but with regard to your comment about previously approved reports, you realize, of course, that approval of a report does not mean that

Figure 7. Archaeological Inventory Survey acceptance letter, page 1 of 2.

Robert Rechtman, Ph.D.
Page 2

we accept or approve of all of the information or conclusions contained in a report. We still do not agree, for example, with your definition of features and we don't believe that "landscape markers" is a particularly useful umbrella term for such things as cairns and walls, including ranch walls.

Your report meets with our approval. The next step in the historic preservation review process is the preparation and implementation of a data recovery plan, a preservation plan, and a burial treatment plan for sites in the project area.

As a reminder, you need to remember to submit a second copy of all reports, plans, and correspondence to our Kona office. In the future we will not begin a review unless the Kona office has a copy. If you or your client should have any questions about this project please contact our Hawaii Island archaeologist, Patrick McCoy, at 692-8029.

Aloha,

P. Holly McEldowney

P. Holly McEldowney, Acting Administrator
State Historic Preservation Division

c. Chris Yuen, County of Hawaii Planning Department
Kai Emler, County of Hawaii Department of Public Works
Kai Markell, SHPD Burial Sites Program
Mary Lou Kobayashi, Office of Planning
Anthony Ching, Land Use Commission

PM:ak

Figure 8. Archaeological Inventory Survey acceptance letter, page 2 of 2.

DAVID Y. IGE
GOVERNOR OF HAWAII

Department of Land and Natural Resources
State of Hawaii

STATE OF HAWAII 1959

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
FIRST DEPUTY

M. KALEO MANUEL
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
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CONSERVATION AND COASTAL LANDS
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FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHO'OLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION
KAKUHIHEWA BUILDING
601 KAMOKILA BLVD, STE 555
KAPOLEI, HAWAII 96707

August 20, 2019

U of N Bencorp
C/O Tom Waddle
75-165 Hualālai Road
Kailua-Kona, HI 96740

LOG NO: 2019.01527
DOC NO: 1908CJO01

Aloha e Mr. Waddle,

SUBJECT: DRAFT Burial Treatment Plan for Three Sites in the Proposed Hualālai Village Development Area Located in Wai'aha Ahupua'a, North Kona District, Island of Hawai'i, TMK: (3) 7-5-010:085 and (3) 7-5-017:006.

We apologize for the delay of this notification. At its monthly meeting on November 20, 2003, the Hawai'i Island Burial Council (HIBC) reached a unanimous decision to **preserve in place** the above burial sites. Additionally, the HIBC recommended that the State Historic Preservation Division (SHPD) accept the DRAFT Burial Treatment Plan.

Following the recommendation of the HIBC, the *DRAFT Burial Treatment Plan for Three Sites in the Proposed Hualālai Village Development Area Located in Wai'aha Ahupua'a, North Kona District, Island of Hawai'i, TMK: (3) 7-5-010:085 and (3) 7-5-017:006* is accepted by the SHPD. Please change the language in the title from "DRAFT Burial Treatment Plan" to "Burial Site Component of a Preservation Plan" and submit hard copies with a copy of this letter and text-searchable PDF CD to both our Kapolei and Hilo offices.

Should you have any additional questions or concerns, please contact our Hawai'i Island Burial Sites Specialist, Chris Omerod at (808) 430-5709 or via email at Christian.Omerod@Hawaii.gov.

Sincerely,

Hinano Rodrigues

Mr. Hinano Rodrigues, B.A., J.D.
History & Culture Branch Chief

CC: Matt Clark, ASM Affiliates, Inc.

Figure 9. Burial Treatment Plan acceptance letter.

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

JESSE K. SOUKI
FIRST DEPUTY

WILLIAM M. TAM
DEPUTY DIRECTOR - WATER

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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

June 19, 2014

Robert B. Rechtman, Ph. D.
ASM Affiliates Inc.
507-A East Lanikaula Street
Hilo, Hawai`i 96720

LOG NO: 2014.2843
DOC NO: 1406MV15
Archaeology

Dear Dr. Rechtman:

SUBJECT: **Chapter 6E-42 Historic Preservation Review –**
Revised Archaeological Preservation Plan for the University of Nations
Waiaha Ahupua'a, North Kona District, Island of Hawai'i
TMK: (3) 7-5-010:085 and 7-5-017:006 (portion)

Thank you for submitting the revised draft report titled *Preservation Plan for SIHP Site 6032 and Site 23681 TMK: 3-7-5-10:085 and 3-7-5-17:006 Waiaha 1st Ahupua'a, North Kona District, Island of Hawai'i* RC-0783 (R. B. Rechtman, October, 2013). We received your submittal March 10, 2014. We apologize for the delayed review and thank you for your patience. Our records indicate that that an archaeological inventory survey was conducted for this parcel by Clark and Rechtman (2003) and 26 historic properties were recorded. Eleven of these sites are recommended for no further work, ten sites are subject to data recovery (Rechtman and Loubster 2007), three sites are preserved under a burial treatment plan (Rechtman 2003) and two sites - the Kuakini Wall (SIHP 50-10-27-6032) and an agricultural heiau (SIHP 23681) are recommended for preservation. The subject plan proposes detailed preservation measures for these two sites. A draft of this plan was previously reviewed by SHPD and revisions were requested (Log 2013.6311, Doc 1402MV16).

According to the plan, the form of preservation proposed for the Kuakini Wall is "preservation as is" which is analogous to avoidance and protection, for the un-impacted portions of the wall; restoration and stabilization for collapsed portions of the wall; and reconstruction for the missing southern portion of the wall. The plan indicates that a separate dismantling/restoration plan will be submitted to SHPD for the restoration, stabilization, and reconstruction portions of the project. This information should include documentation of the areas that will be restored and a description of the work that will be done in order to retain the integrity of this historic property. SHPD agrees with the remaining aspects of the plan such as the interpretive signage, the proposed 20ft. buffers for both sites, and recordation of the preservation areas with the bureau of conveyances. This plan meets the requirements of Hawaii Administrative Rule §13-277 and is accepted by SHPD. Please send one hardcopy of the document, clearly marked **FINAL**, along with a copy of this review letter and a text-searchable PDF version on CD to the Kapolei SHPD office, attention SHPD Library.

Please contact Mike Vitousek at (808) 652-1510 or Michael.Vitousek@Hawaii.gov if you have any questions or concerns regarding this letter.

Aloha,

Theresa K. Donham
Archaeology Branch Chief

Figure 10. Preservation plan acceptance letter.

Appendix M

Scoping Meeting Presentation

University of the Nations, Kona
EIS Scoping Meeting

March 25, 2021

6:00-8:00PM

House Rules

- Please hold your comments throughout the presentation
- There is a comment section at the end of the presentation for those who wish to speak
- Please remain muted throughout the presentation

Scoping Meeting Agenda

- Introduction

  Paul Childers

  University of the Nations, Kona

- EIS Scoping Presentation

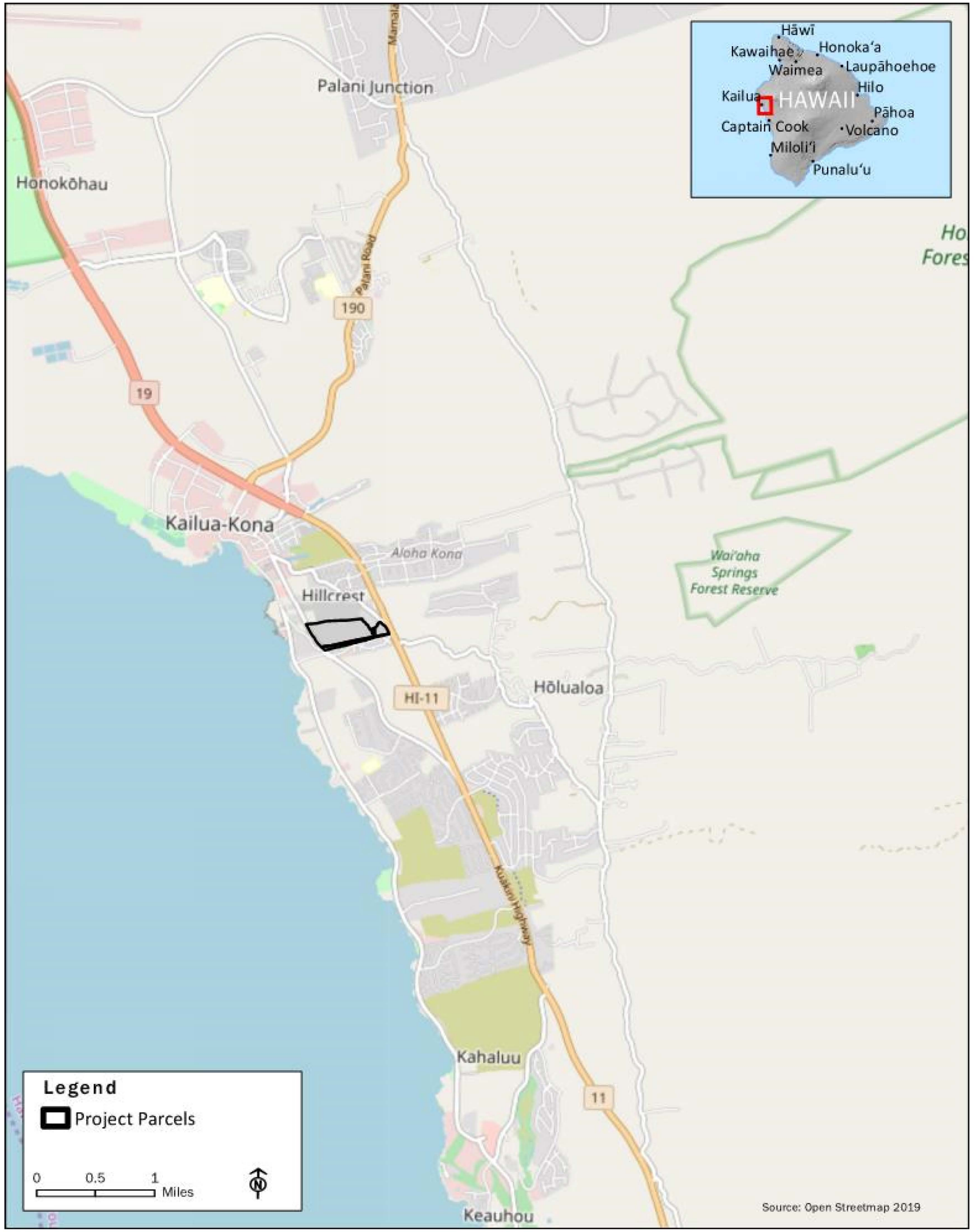
  Jeff Overton

  Principal Planner, G70

EIS Process

As part of the environmental review process for an EIS, the applicant is required to hold a public scoping meeting (*HAR 200.1-23)*

> *The purpose of the public scoping meeting is to attain public feedback on the proposed action, alternatives to be analyzed in the EIS, and impacts to focus on in the EIS.*



Hāwī
Kawaihae
Honoka'a
Waimea
Laupāhoehoe
Kailua
HAWAII
Hilo
Pāhoa
Captain Cook
Volcano
Miloli'i
Punalu'u
Palani Junction
Honokōhau
Palani Road
190
19
Kailua-Kona
Aloha Kona
Hillcrest
Hōlualoa
HI-11
Wai'aha Springs Forest Reserve
Kahaluu
11
Keauhou
Legend
Project Parcels
0 0.5 1 Miles
Source: Open Streetmap 2019

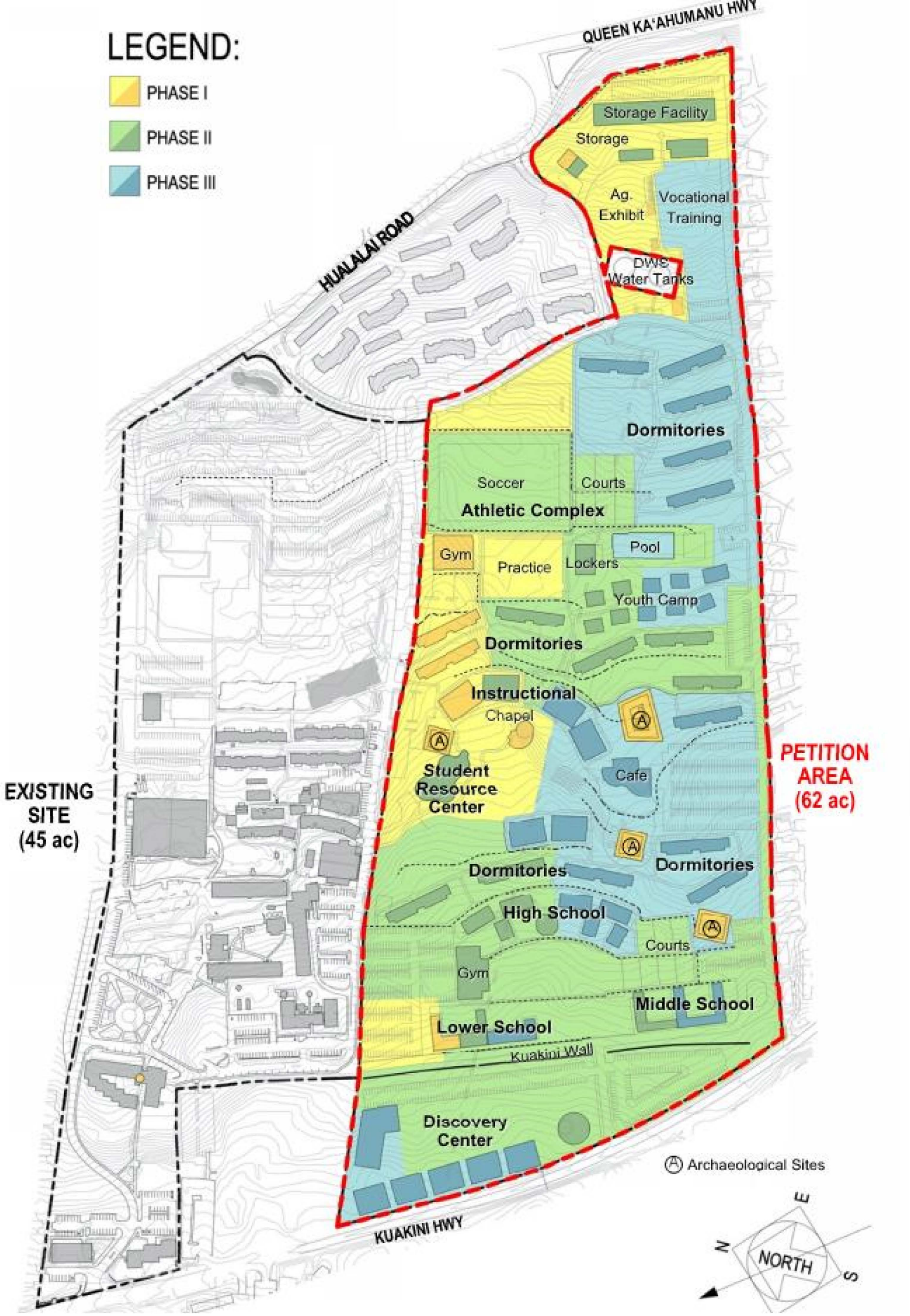
ALOHA KONA DR
NANI KAILUA DR
KAKALINA ST
KAA'EA WAY
ONEO LOOP
11 19
HUALALAI RD
KUAKINI HWY
Existing Campus
KAHAKAI RD
WALUA RD
7-5-010:085
7-5-017:006
ONI ONI ST
11
ALII DR
Legend
Project Parcels
0 500 1,000 Feet
Source: TMK Parcels, County of Hawaii 2019

2020 Master Plan Update

The Master Plan Update reflects the University of the Nations – Kona's current and upcoming mission-based learning priorities for its campus over the next 20+ years.

- Integrated Campus Community
- Entrances and Arrival Areas
- Central Gathering Spaces
- Outdoor Courtyards & Pathways
- Preserved Archaeological Sites
- New Instructional Buildings
- New Dormitories
- New Athletic Facilities
- Design & Landscape: Kona Setting
- Sustainable Design Throughout

2020 CONCEPT MASTER PLAN
UNIVERSITY OF THE NATIONS - KONA



U of N Kona Central Gathering Place

Environmental Analysis for the Draft EIS

The Draft EIS will address existing conditions, potential impacts & mitigation measures.

- Geology, Topography, and Soils
- Surface Waters and Groundwater Resources
- Archaeological, Historic, and Cultural Resources
- Public Facilities and Services
- Utilities, Infrastructure, and Drainage
- Traffic and Mobility Analysis
- Socio-Economic Characteristics
- Noise
- Climate
- Biological Resources
- Air Quality
- Natural Hazards
- Visual Resources

Technical Studies for the Draft EIS

The Draft EIS will include technical studies to analyze project area resources, the potential for impacts, and mitigative measures to be implemented.

- Biological Natural Resources Survey - AECOS Inc.
- Traffic Mobility Analysis Report - Fehr & Press, Inc.
- Infrastructure Assessment - G70 Civil Engineering
- Water Supply Study - Tom Nance Water Resources Engineering
- Archaeological Inventory Study & Preservation Plan - ASM Affiliates
- Cultural Impact Assessment - ASM Affiliates

Alternatives to the Proposed Action

- No Action Alternative
- Alternative Development Density
- Alternative Land Uses
- Deferral of the Proposed Action

State and County Policies and Plans

State:

- Hawaiʻi State Plans
- Hawaiʻi State Functional Plan
- Hawaiʻi State Land Use District Boundaries
- Hawaiʻi Coastal Zone Management Program

County:

- County of Hawaiʻi General Plan
- County of Hawaiʻi Zoning
- County of Hawaiʻi Water Use and Development Plan
- Kona Community Development Plan
- Kailua-Kona Master Plan

How to Comment on EISPN ?

Comments on the EISPN must be sent by April 7, 2021

Mail Letter to:

G70

Attn: Jeff Overton

111 S. King Street, Suite 170

Honolulu, HI 96813

**Take screenshot of this slide, if necessary*

Or send Email:

UofNkona@g70.design

Or provide oral comments:

Please provide tonight…

Link to EISPN:

http://oeqc2.doh.hawaii.gov/The_Environmental_Notice/2021-03-08-TEN.pdf

Guidance for Scoping Comments

- In compliance with *HAR Chapter 11-200.1*
- This part of the meeting is for participants to comment on the scope of the EIS
- Although this is a virtual meeting, please provide oral comments pertaining to the scope of study for the Draft EIS

How to provide a comment:

- Please type **"1"** in the chat function to speak after the presentation
- We will call your name in the order requests are received in the chat function
- Un-mute yourself when your turn is called
- Speak clearly, state your name & hometown

To allow everyone a chance to speak, please be concise with your remarks.

Mahalo

Thank you for participating in the environmental review process

Appendix N

EISPN Comment Letters

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawai‘i 96850

In Reply Refer To:
01EPIF00-2021-TA-0229

April 12, 2021

Mr. Jeff Overton
G70
111 South King Street, Suite 170
Honolulu, Hawai‘i 96813

Subject: USFWS Response to Request for Technical Assistance for University of the Nations, Kona, Inc. Environmental Impact Statement Preparation Notice for Proposed Campus Expansion

Dear Mr. Overton:

Thank you for your recent correspondence requesting technical assistance on species biology, habitat, or life requisite requirements. The Pacific Islands Fish and Wildlife Office (PIFWO) of the U.S. Fish and Wildlife Service (Service) appreciates your efforts to avoid or minimize effects to protected species associated with your proposed actions. We provide the following information for your consideration under the authorities of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 *et seq*.), as amended.

Due to significant workload constraints, PIFWO is currently unable to specifically address your information request. The table below lists the protected species most likely to be encountered by projects implemented within the Hawaiian Islands. Based on your project location and description, we have noted the species most likely to occur within the vicinity of the project area, in the ‘**Occurs In or Near Project Area’** column. Please note this list is not comprehensive and should only be used for general guidance. We have added to the PIFWO website, located at https://www.fws.gov/pacificislands/promo.cfm?id=177175840 recommended conservation measures intended to avoid or minimize adverse effects to these federally protected species and best management practices to minimize and avoid sedimentation and erosion impacts to water quality. If your project occurs on the island of Hawai‘i, we have also enclosed our biosecurity protocol for activities in or near natural areas.

If you are representing a federal action agency, please request an official species list following the instructions at our PIFWO website https://www.fws.gov/pacificislands/articles.cfm?id=149489558. You can find out if your project occurs in or near designated critical habitat here: https://ecos.fws.gov/ipac/.

Under section 7 of the ESA, it is the Federal agency's (or their non-Federal designee) responsibility to make the determination of whether or not the proposed project "may affect" federally listed species or designated critical habitat. A "may affect, not likely to adversely affect" determination is appropriate when effects to federally listed species are expected to be discountable (*i.e.*, unlikely to occur), insignificant (minimal in size), or completely beneficial. This conclusion requires written concurrence from the Service. If a "may affect, likely to adversely affect" determination is made, then the Federal agency must initiate formal consultation with the Service. Projects that are determined to have "no effect" on federally listed species and/or critical habitat do not require additional coordination or consultation.

Implementing the avoidance, minimization, or conservation measures for the species that may occur in your project area will normally enable you to make a "may affect, not likely to adversely affect" determination for your project. If it is determined that the proposed project may affect federally listed species, we recommend you contact our office early in the planning process so that we may assist you with the ESA compliance. If the proposed project is funded, authorized, or permitted by a Federal agency, then that agency should consult with us pursuant to section 7(a)(2) of the ESA. If no Federal agency is involved with the proposed project, the applicant should apply for an incidental take permit under section 10(a)(1)(B) of the ESA. A section 10 permit application must include a habitat conservation plan that identifies the effects of the action on listed species and their habitats and defines measures to minimize and mitigate those adverse effects.

We appreciate your efforts to conserve endangered species. We regret that we cannot provide you with more specific protected species information for your project site. If you have questions that are not answered by the information on our website, you can contact PIFWO at (808) 792-9400 and ask to speak to the lead biologist for the island where your project is located.

Sincerely,

LINDSY ASMAN Digitally signed by LINDSY ASMAN
Date: 2021.04.16 12:18:08 -10'00'

Island Team Manager
Pacific Islands Fish and Wildlife Office

Enclosures (3)

The table below lists the protected species most likely to be encountered by projects implemented within the Hawaiian Islands. For your guidance we marked species that may occur in the vicinity of your project, this list is not comprehensive and should only be used for general guidance. We have also attached our biosecurity protocol for projects in or near natural areas.

Enclosure 1. Federal Status of Animal Species

Scientific Name	Common Name / Hawaiian Name	Federal Status	May Occur In Project Area
Mammals			
Lasiurus cinereus semotus	Hawaiian hoary bat/ʻōpeʻapeʻa	E	☒
Reptiles			
Chelonia mydas	green sea turtle/honu - Central North Pacific distinct population segment (DPS)	T	☐
Eretmochelys imbricata	Hawksbill sea turtle/honu ʻea	E	☐
Birds			
Anas wyvilliana	Hawaiian duck/koloa	E	☐
Branta sandvicensis	Hawaiian goose/nēnē	T	☒
Fulica alai	Hawaiian coot/ʻalae kea	E	☒
Gallinula galeata sandvicensis	Hawaiian gallinule/ʻalae ʻula	E	☐
*Himantopus mexicanu*s *knudseni*	Hawaiian stilt/aeʻo	E	☒
Oceanodroma castro	band-rumped storm-petrel Hawaiʻi DPS/ʻakēʻakē	E	☒
Pterodroma sandwichensis	Hawaiian petrel/ʻuaʻu	E	☒
Puffinus auricularis newelli	Newell's shearwater/ʻaʻo	T	☒
Ardenna pacificus	wedge-tailed shearwater/ʻuaʻu kani	MBTA	☐
Buteo solitarius	Hawaiian hawk/ʻio	MBTA	☒
Gygis alba	white tern/manu-o-kū	MBTA	☐
Insects			
Manduca blackburni	Blackburn's sphinx moth	E	☒
Megalagrion pacificum	Pacific Hawaiian damselfly	E	☐
Megalagrion xanthomelas	orangeblack Hawaiian Damselfly	E	☐
Megalagrion nigrohamatum nigrolineatum	blackline Hawaiian damselfly	E	☐

Enclosure 2. Federal Status of Plant Species

Plants				
Scientific Name	**Common Name or Hawaiian Name**	**Federal Status**	**Locations**	**May Occur In Project Area**
Abutilon menziesii	koʻoloaʻula	E	O, L, M, H	☐
Achyranthes splendens var. *rotundata*	ʻewa hinahina	E	O	☐
Bonamia menziesii	no common name	E	K, O, L, M, H	☐
Canavalia pubescens	ʻāwikiwiki	E	Ni, K, L, M	☐
Colubrina oppositifolia	kauila	E	O, M, H	☐
Cyperus trachysanthos	puʻukaʻa	E	K, O	☐
Gouania hillebrandii	no common name	E	Mo, M	☐
Hibiscus brackenridgei	maʻo hau hele	E	O, Mo, L, M, H	☐
Ischaemum byrone	Hilo ischaemum	E	K, O, Mo, M, H	☐
Isodendrion pyrifolium	wahine noho kula	E	O, H	☐
Marsilea villosa	ʻihiʻihi	E	Ni, O, Mo	☐
Mezoneuron kavaiense	uhiuhi	E	O, H	☐
Nothocestrum breviflorum	ʻaiea	E	H	☐
Panicum fauriei var. *carteri*	Carter's panicgrass	E	Molokini Islet (O), Mo	☐
Panicum niihauense	lauʻehu	E	K	☐
Peucedanum sandwicense	makou	E	K, O, Mo, M	☐
Pleomele (Chrysodracon) hawaiiensis	halapepe	E	H	☐
Portulaca sclerocarpa	ʻihi	E	L, H	☐
Portulaca villosa	ʻihi	E	Le, Ka, Ni, O, Mo, M, L, H, Nihoa	☐
Pritchardia affinis (maideniana)	loulu	E	H	☐
Pseudognaphalium sandwicensium var. *molokaiense*	ʻenaʻena	E	Mo, M	☐
Scaevola coriacea	dwarf naupaka	E	Mo, M	☐
Schenkia (*Centaurium*) *sebaeoides*	ʻāwiwi	E	K, O, Mo, L, M	☐
Sesbania tomentosa	ʻōhai	E	Ni, Ka, K, O, Mo, M, L, H, Necker, Nihoa	☐
Tetramolopium rockii	no common name	T	Mo	☐

Vigna o-wahuensis	no common name	E	Mo, M, L, H, Ka	☐

Location key: O=O‘ahu, K=Kaua‘i, M=Maui, H=Hawai‘i Island, L=Lāna‘i, Mo=Moloka‘i, Ka=Kaho‘olawe, Ni=Ni‘ihau, Le=Lehua

Enclosure 3. BIOSECURTY PROTOCOL – HAWAIʻI ISLAND

The following biosecurity protocol (based on National Park Service, State of Hawaiʻi, U.S. Fish and Wildlife, U.S. Geological Survey, and the DOI Office of Native Hawaiian Relations guidance) should be followed when operating on the island of Hawaiʻi to prevent the introduction of harmful invasive species including frogs, ants, weeds, and fungi into local natural areas (e.g., Hawaiʻi Volcanoes National Park, Hakalau Forest National Wildlife Refuge, State of Hawaiʻi "Natural Areas") and areas with native habitat (habitat that is primarily composed of native vegetation), other islands in Hawaiian archipelago, or the U.S. mainland. The protocol also includes suggestions for keeping field staff safe from certain invasive species.

1. **All work vehicles, machinery, and equipment should be cleaned, inspected by its user, and found free of mud, dirt, debris, and invasive species prior to entry into the natural areas or native habitat.**
    a. Vehicles, machinery, and equipment must be thoroughly pressure washed in a designated cleaning area and visibly free of mud, dirt, plant debris, insects, frogs (including frog eggs) and other vertebrate species such as rats, mice and non-vegetative debris. A hot water wash is preferred. Areas of particular concern include bumpers, grills, hood compartments, areas under the battery, wheel wells, undercarriage, cabs, and truck beds (truck beds with accumulated material [intentionally placed or fallen from trees] are prime sites for unwanted invasives).
    b. The interior and exterior of vehicles, machinery, and equipment must be free of rubbish and food. The interiors of vehicles and the cabs of machinery must be vacuumed clean. Floor mats shall be sanitized with a solution of >70% isopropyl alcohol or a freshly mixed 10% bleach solution.
    c. Any machinery, vehicles, equipment, or other supplies found to contain ants or other invasive species must not enter natural areas or native habitat. Treatment is the responsibility of the equipment or vehicle owner and operator.

2. **Little Fire Ants – All work vehicles, machinery, and equipment should be inspected for invasive ants prior to entering the natural areas or native habitat.**
    a. A visual inspection for little fire ants should be conducted prior to entry into natural areas or native habitat.
    b. Hygiene is paramount but even the cleanest vehicle can pick up a little fire ant. Place MaxForce Complete Brand Granular Insect Bait (1.0% hydramethylnon) into refillable tamper resistant bait stations. An example of a commercially available refillable tamper resistant bait station is the Ant Café Pro (https://www.antcafe.com/). Place a bait station (or stations) in vehicle. Note larger vehicles, such as trucks, may require multiple stations. Monitor bait stations frequently (every week at a minimum) and replace bait as needed. If the station does not have a sticker to identify the contents, apply a sticker listing contents to the station.

c. Any machinery, vehicles, equipment, or other supplies found to contain ants or other invasive species must not enter natural areas or native habitat until it is sanitized and re-tested following a resting period. Infested vehicles must be sanitized following recommendations by the Hawaiʻi Ant Lab (http://www.littlefireants.com/) or other ant control expert and in accordance with all State and Federal laws. Treatment is the responsibility of the equipment or vehicle owner.

d. Gravel, building materials, or other equipment such as portable buildings should be baited using MaxForce Complete Brand Granular Insect Bait (1.0% hydramethylnon) or AmdroPro (0.73% hydramethylnon) following label guidance.

e. Storage areas that hold field tools, especially tents, tarps, and clothing should be baited using MaxForce Complete Brand Granular Insect Bait (1.0% hydramethylnon) or AmdroPro (0.73% hydramethylnon) following label guidance.

3. **Base yards and staging areas inside and outside project sites must be kept free of invasive species.**
   a. Base yards and staging areas should be inspected at least weekly for invasive species and any found invasive removed immediately. Pay particular attention to where vehicles are parked overnight, keeping areas within 10-meters of vehicles free of debris. Parking on pavement and not under trees, while not always practical is best.

   b. Project vehicles or equipment stored outside of a base yard or staging area, such as a private residence, should be kept in a pest free area.

4. **All cutting tools must be sanitized to prevent the Rapid ʻŌhiʻa Death (ROD) disease.**
   a. Avoid wounding ʻōhiʻa trees and roots with mowers, chainsaws, weed eaters, and other tools. Cut only the minimal number of trees and branches as approved for the project.

   b. All cutting tools, including machetes, chainsaws, and loppers must be sanitized to remove visible dirt and other contaminants prior to entry into natural areas or areas with native habitat, and when moving to a new project area within the native habitat area. Tools may be sanitized using a solution of >70 percent isopropyl alcohol or a freshly mixed 10 precent bleach solution. One minute after sanitizing, you may apply an oil-based lubricant to chainsaw chains or other metallic parts to prevent corrosion.

   c. Only dedicated tools and chainsaws should be used to sample known or suspected ROD infected trees.

   d. Vehicles, machinery, and equipment must be cleaned as described in (1) above.

5. **Imported firewood, logs, and ‘ōhi‘a parts:**
    a. ‘Ōhi‘a firewood, ‘ōhi‘a logs, and ‘ōhi‘a parts should not be transported.

6. **For individuals working in the field:**
    a. Before going into the field, visually inspect and clean your clothes, boots, pack, radio harness, tools and other personal gear and equipment, for seeds, soil, plant parts, insects, and other debris. A small brush is handy for cleaning boots, equipment and gear. Soles of shoes should be sanitized using a solution of >70 percent isopropyl alcohol or a freshly mixed 10 percent bleach solution.

    b. Immediately before leaving the field, visually inspect and clean your clothes, boots, pack, radio harness, tools, and other personnel gear and equipment, for seeds, soil, plant parts, insects, and other debris. Soles of shoes should be sanitized using a solution of >70 percent isopropyl alcohol or a freshly mixed 10% bleach solution.

    c. Little fire ants nest in trees. If you are under a tree and that tree is bumped or somehow stressed, the threat response of the ants is to fall from the leaves and sting the person under the tree. If you are subject to an ant attack, do not panic. The ants are extremely small, but their stings are painful, so make sure you remove all ants from your body and clothing. The stings cause inch long welts that are itchy and painful and can last for weeks. Treat stings as you would other insect stings. In some persons, stings can produce life-threatening reactions. Stocking antihistamine in the first aid kit is a reasonable precaution.

    d. Rat Lungworm disease is caused by a parasite that can infect humans who consume raw or undercooked infected snails or slugs or consume raw produce that contains a small infected snail or slug. Infection is rare but can be serious. Symptoms can include severe headache, neck stiffness, low-grade fever, nausea, and vomiting anywhere from 1 to 6 weeks after exposure. The disease is not spread person to person. Anyone who handles snails or slugs should wear gloves and/or wash hands. Eating unwashed produce is discouraged.

Standard Comments for Land Use Reviews
Clean Air Branch
Hawaii State Department of Health

If your proposed project:

Requires an Air Pollution Control Permit

You must obtain an air pollution control permit from the Clean Air Branch and comply with all applicable conditions and requirements. If you do not know if you need an air pollution control permit, please contact the Permitting Section of the Clean Air Branch.

Includes construction or demolition activities that involve asbestos

You must contact the Asbestos Abatement Office in the Indoor and Radiological Health Branch.

Has the potential to generate fugitive dust

You must control the generation of all airborne, visible fugitive dust. Note that construction activities that occur near to existing residences, business, public areas and major thoroughfares exacerbate potential dust concerns. It is recommended that a dust control management plan be developed which identifies and mitigates all activities that may generate airborne, visible fugitive dust. The plan, which does *not* require Department of Health approval, should help you recognize and minimize potential airborne, visible fugitive dust problems.

Construction activities must comply with the provisions of Hawaii Administrative Rules, §11-60.1-33 on Fugitive Dust. In addition, for cases involving mixed land use, we strongly recommend that buffer zones be established, wherever possible, in order to alleviate potential nuisance complaints.

You should provide reasonable measures to control airborne, visible fugitive dust from the road areas and during the various phases of construction. These measures include, but are not limited to, the following:

a) Planning the different phases of construction, focusing on minimizing the amount of airborne, visible fugitive dust-generating materials and activities, centralizing on-site vehicular traffic routes, and locating potential dust-generating equipment in areas of the least impact;
b) Providing an adequate water source at the site prior to start-up of construction activities;
c) Landscaping and providing rapid covering of bare areas, including slopes, starting from the initial grading phase;
d) Minimizing airborne, visible fugitive dust from shoulders and access roads;
e) Providing reasonable dust control measures during weekends, after hours, and prior to daily start-up of construction activities; and
f) Controlling airborne, visible fugitive dust from debris being hauled away from the project site.

If you have questions about fugitive dust, please contact the Enforcement Section of the Clean Air Branch

Clean Air Branch (808) 586-4200 cab@doh.hawaii.gov	Indoor Radiological Health Branch (808) 586-4700

April 1, 2019

DAVID Y. IGE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

JADE T. BUTAY
DIRECTOR

Deputy Director
LYNN A.S. ARAKI-REGAN
DEREK J. CHOW
ROSS M. HIGASHI
EDWIN H. SNIFFEN

IN REPLY REFER TO:
DIR 0248
HWY-PS 2.5394

April 5, 2021

Mr. Jeffrey Overton
Principal
Group 70, Inc.
111 South King Street, Suite 170
Honolulu, Hawaii 96813

Dear Mr. Overton:

Subject: Request for Comments for Environmental Impact Statement
Environmental Impact Statement Preparation Notice (EISPN)
University of Nations Kona Masterplan Update
Kailua-Kona, Hawaii
Tax Map Key Nos.: (3) 7-5-010: 085 and 7-5-017: 006

Thank you for your letter dated March 9, 2021 and the opportunity to review the project, which referenced Land Use Commission (LUC) Docket No. A02-737. This relates to a recent filing for a request to amend the Decision and Order due to proposed revisions to the Masterplan previously approved by the LUC for Land Use District Boundary Amendment in 2003. This also relates to a Mobility Analysis Report (MAR), dated February 18, 2020 previously provided by the Office of Planning that will be part of the Draft Environmental Assessment (DEA) as explained on item 2 below. The preparation of an upcoming DEA required by Chapter 343, Hawaii Revised Statutes is due to the land use and infrastructure improvements within public roadways.

To accommodate future growth of the campus currently operating as a training center, the University of Nations Kona proposes to revise its Masterplan to be developed under 3 phases for a period of 30 years. The revised land use includes new facilities to support preschool thru Kindergarten-12th grade educational programs, student dormitories, sports athletic training complex, youth camp, and various other supportive facilities.

The 62-acre project site is bounded by the Kuakini Highway (County-owned) to the west/State Queen Kaahumanu Highway (Route 11) and Hualalai Road (County roadway) to the east. The site's primary access for the initial phase will be on Kuakini Highway and a second access will be on Hualalai Road.

The Hawaii Department of Transportation (HDOT) has the following comments:

1. We find that the MAR lacks detailed conclusions on traffic improvements and recommendations to be made for local and regional impacts by the development. Therefore, the HDOT recommends that the MAR should be revised.

   1.1. The MAR should be revised to include the development's specific recommendations on mitigation measures on the traffic impacts identified or provide additional studies to address each of the following findings in the study:

      1.1.1. In Section 1.2 Phase 1 (2030) Plus Project Intersection Level of Service, it states that "the addition of project traffic would cause operations at each location to degrade further."

      1.1.2. In Section 1.2 Future Phase 2 and Phase 3 Assessment it states that "Intersection conditions (for Queen Kaahumanu Highway and Nani Kailua Drive) would likely continue to degrade with the addition of ambient and project-related traffic in Phase 2."

      1.1.3. In Section 7.2 Phase 2 Hot Spot Assessment relating to the Queen Kaahumanu Highway/Hualalai Road and Queen Kaahumanu Highway/Kuakini Highway, it states that "The Phase 2 campus development is anticipated to contribute additional traffic and exacerbate the delay in intersection movements."

      1.1.4. In Section 7.2 Phase 2 Hot Spot Assessment relating to the Queen Kaahumanu Highway and Nani Kailua Drive, it states that "The anticipation of intersection conditions would likely continue to degrade with the addition of ambient and project-related traffic in Phase 2."

2. We have initially reviewed the MAR and an Environmental Planning Report (EPR) included in the Motion to Amend the Decision and Order, which was received on April 13, 2020 from the Office of Planning. Our review comments for the MAR on April 27, 2020 sent to them remain applicable as follows:

   2.1. Although the proposed land use trips generated and access points to the petition area have changed in the interim, the 2003 Decision and Order conditions remain relevant to the 2020 Master Plan as follows:

   2.2. Condition 9. Transportation: Petitioner shall participate in the pro-rata funding and construction of local and regional transportation improvements and programs necessitated by the proposed development in designs and schedules accepted and determined by HDOT and County of Hawaii Department of Public Works (DPW). Agreement between the Petitioner and the DOT and DPW as to the level of funding and participation shall be obtained prior to the Petitioner obtaining County zoning, or prior to the Petitioner securing County building permits if County zoning is not required.

2.3. Condition 10. Traffic: Petitioner shall, prior to the Petitioner obtaining County zoning, submit a revised Traffic Impact Analysis Report for the review and approval of the HDOT and DPW, which shall include an analysis of the entire development of the existing/proposed University of the Nations-Kona, Hualalai Village project, and the Cultural Center, as well as existing and potential future developments in the immediate area as required by the HDOT and DPW.

2.4. The MAR appears to be consistent with Condition 10 and addresses potential impacts of the traffic generated by the entire development area (3 parcels), not just the petition area. However, the estimates of students and staff living on-campus versus off-campus for 2030 appears to differ between the EPR (Page 2-15) and the MAR (Table 5-1). Clarify the population/enrollment assumptions for the phases. For example, Phase I appears to fully build-out the Discipleship Learning Center and partially build-out the lower school campus. Will all enrollment in 2030 be adult or will enrollment include lower school children that require drop-off and pick-up during peak traffic hours?

2.5. Clarify the need for 2 parallel internal east-west roads (MAR, Page 6), one of which would extend east to a new University of the Nations driveway on Hualalai Road and the other would extend to Hualalai Village Road, which intersects with Hualalai Road. The EPR does not include this discussion. The Preliminary Infrastructure Assessment, included in the EPR, includes a figure (Attachment 2) that identifies the central "Spine" Road Phase 1, but no further details are shown.

2.6. Minor edit: MAR Page 29, Section 5.1, second paragraph, first sentence, change one of the 2 "off-campus" to "on-campus."

2.7. The 3 phases of implementation span 20 years or more. An updated MAR shall be prepared before county zoning (Condition 9), prior to executing each phase, and when there is a significant change in the proposed land use, trip generation, or roadway network.

2.8. We appreciate the consideration of impacts to multimodal transportation. The MAR includes recommendations that are not directly relevant to HDOT roadways and we defer to others for comment. However, we recommend the 2020 Master Plan include a conceptual plan identifying opportunities for internal campus paths to connect with the with existing and proposed public roadway routes in the vicinity, as well as adjacent residential communities. The demand for bicycle and pedestrian routes will increase with each phase of development.

If you have any questions, please contact Jeyan Thirugnanam, Systems Planning Engineer, Highways Division, Planning Branch at (808) 587-6336 or by email at jeyan.thirugnanam@hawaii.gov. Please reference file review number PS 2021-047.

Sincerely,

JADE T. BUTAY
Director of Transportation

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

April 6, 2021

G70
Attention: Mr. Jeff Overton
111 South King Street, Suite 170
Honolulu, Hawaii 96813

via email: UofNkona@g70.design

Dear Mr. Overton:

SUBJECT: Environmental Impact Statement Preparation Notice for the Proposed University of the Nations, Kona, Inc. 2020 Master Plan Update located at Kailua-Kona, Island of Hawaii; TMK: (3) 7-5-010:085 and (3) 7-5-017:006 on behalf of **University of the Nations, Kona, Inc.**

Thank you for the opportunity to review and comment on the subject matter. The Land Division of the Department of Land and Natural Resources (DLNR) distributed or made available a copy of your request pertaining to the subject matter to DLNR's Divisions for their review and comments.

At this time, enclosed are comments from the (a) Engineering Division, (b) Division of Forestry & Wildlife, (c) Commission on Water Resource Management, and (d) Land Division-Hawaii District on the subject matter. Should you have any questions, please feel free to contact Darlene Nakamura at (808) 587-0417 or email: darlene.k.nakamura@hawaii.gov. Thank you.

Sincerely,

Russell Tsuji

Russell Y. Tsuji
Land Administrator

Enclosures
cc: Central Files

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

March 16, 2021

MEMORANDUM

FROM:

~~TO:~~ **DLNR Agencies:**
__Div. of Aquatic Resource
__Div. of Boating & Ocean Recreation
X Engineering Division (DLNR.ENGR@hawaii.gov)
X Div. of Forestry & Wildlife (rubyrosa.t.terrago@hawaii.gov)
__Div. of State Parks
X Commission on Water Resource Management (DLNR.CWRM@hawaii.gov)
__Office of Conservation & Coastal Lands
X Land Division – Hawaii District (gordon.c.heit@hawaii.gov)

TO:

~~FROM:~~ Russell Y. Tsuji, Land Administrator *Russell Tsuji*
SUBJECT: Environmental Impact Statement Preparation Notice for the Proposed University of the Nations, Kona, Inc. 2020 Master Plan Update
LOCATION: Kailua-Kona, Island of Hawaii; TMK: (3) 7-5-010:085 and (3) 7-5-017:006
APPLICANT: G70 on behalf of **University of the Nations, Kona, Inc.**

Transmitted for your review and comment is information on the above-referenced subject matter. The EISPN was published on March 8, 2021 in the Office of Environmental Quality Control's periodic bulletin, The Environmental Notice, at the following link:

http://oeqc2.doh.hawaii.gov/The_Environmental_Notice/2021-03-08-TEN.pdf

Please submit any comments by **April 5, 2021.** If no response is received by this date, we will assume your agency has no comments. Should you have any questions, please contact Darlene Nakamura via email at darlene.k.nakamura@hawaii.gov. Thank you.

( ) We have no objections.
( ) We have no comments.
( ) We have no additional comments.
(✓) Comments are attached.

Signed: [signature]
Print Name: Carty S. Chang, Chief Engineer
Division: Engineering Division
Date: Mar 30, 2021

Attachments
cc: Central Files

DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

LD/Russell Y. Tsuji
Ref: Environmental Impact Statement Preparation Notice for the Proposed University of the Nations, Kona, Inc. 2020 Master Plan Update
Location: Kailua-Kona, Island of Hawaii
TMK(s): (3) 7-5-010:085 and (3) 7-5-017:006
Applicant: G70 on behalf of University of the Nations, Kona, Inc.

COMMENTS

The rules and regulations of the National Flood Insurance Program (NFIP), Title 44 of the Code of Federal Regulations (44CFR), are in effect when development falls within a Special Flood Hazard Area (high-risk areas). State projects are required to comply with 44CFR regulations as stipulated in Section 60.12. Be advised that 44CFR reflects the minimum standards as set forth by the NFIP. Local community flood ordinances may stipulate higher standards that can be more restrictive and would take precedence over the minimum NFIP standards.

The owner of the project property and/or their representative is responsible to research the Flood Hazard Zone designation for the project. Flood Hazard Zones are designated on FEMA's Flood Insurance Rate Maps (FIRM), which can be viewed on our Flood Hazard Assessment Tool (FHAT) (http://gis.hawaiinfip.org/FHAT).

If there are questions regarding the local flood ordinances, please contact the applicable County NFIP coordinating agency below:

- Oahu: City and County of Honolulu, Department of Planning and Permitting (808) 768-8098.
- Hawaii Island: County of Hawaii, Department of Public Works (808) 961-8327.
- Maui/Molokai/Lanai County of Maui, Department of Planning (808) 270-7253.
- Kauai: County of Kauai, Department of Public Works (808) 241-4896.

Signed: [signature]
CARTY S. CHANG, CHIEF ENGINEER

Date: Mar 30, 2021

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

March 16, 2021

MEMORANDUM

TO: **DLNR Agencies:**
__Div. of Aquatic Resource
__Div. of Boating & Ocean Recreation
X Engineering Division (DLNR.ENGR@hawaii.gov)
X Div. of Forestry & Wildlife (rubyrosa.t.terrago@hawaii.gov)
__Div. of State Parks
X Commission on Water Resource Management (DLNR.CWRM@hawaii.gov)
__Office of Conservation & Coastal Lands
X Land Division – Hawaii District (gordon.c.heit@hawaii.gov)

FROM: Russell Y. Tsuji, Land Administrator *Russell Tsuji*
SUBJECT: Environmental Impact Statement Preparation Notice for the Proposed University of the Nations, Kona, Inc. 2020 Master Plan Update
LOCATION: Kailua-Kona, Island of Hawaii; TMK: (3) 7-5-010:085 and (3) 7-5-017:006
APPLICANT: G70 on behalf of **University of the Nations, Kona, Inc.**

Transmitted for your review and comment is information on the above-referenced subject matter. The EISPN was published on March 8, 2021 in the Office of Environmental Quality Control's periodic bulletin, The Environmental Notice, at the following link:

http://oeqc2.doh.hawaii.gov/The_Environmental_Notice/2021-03-08-TEN.pdf

Please submit any comments by **April 5, 2021.** If no response is received by this date, we will assume your agency has no comments. Should you have any questions, please contact Darlene Nakamura via email at darlene.k.nakamura@hawaii.gov. Thank you.

( ) We have no objections.
( ) We have no comments.
( ) We have no additional comments.
(✔) Comments are attached.

Signed: [signature]
Print Name: DAVID G. SMITH, Administrator
Division: Division of Forestry and Wildlife
Date: Mar 19, 2021

Attachments
cc: Central Files

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
FIRST DEPUTY

M. KALEO MANUEL
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
DIVISION OF FORESTRY AND WILDLIFE
1151 PUNCHBOWL STREET, ROOM 325
HONOLULU, HAWAII 96813

March 18, 2021

MEMORANDUM

Log no. 3070

TO: RUSSELL Y. TSUJI, Administrator
Land Division

FROM: DAVID G. SMITH, Administrator
Division of Forestry and Wildlife

SUBJECT: Division of Forestry and Wildlife Comments for the Environmental Impact Statement Preparation Notice (EISPN) for the Proposed University of the Nations, Kona, Inc. 2020 Master Plan Update

The Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW) has received your inquiry regarding review of the EISPN for the University of the Nations, Kona, Inc. 2020 master plan update in North Kona on the Island of Hawai'i, Hawai'i, TMKs: (3) 7-5-010:85 and (3) 7-5-017:006. The proposed project consists of expanding the school, including classrooms, dormatories, storage and maintenance facilities, an athletic complex, chapel, agricultural area and other accessory uses on the 62-acre project area.

The State listed Hawaiian Hawk or 'Io (*Buteo solitarius*) is known to occur in the project vicinity. DOFAW recommends surveying the area to ensure no Hawaiian Hawk nests are present if trees are to be cut. 'Io nests might be present during the breeding season from March to September.

We note that artificial lighting can adversely impact seabirds that may pass through the area at night by causing disorientation. We appreciate the measures outlined in the permit application to minimize night time lighting impacts to seabirds such as fully shielding lights. Nighttime work that requires outdoor lighting should be avoided during the seabird fledging season from September 15 through December 15. This is the period when young seabirds take their maiden voyage to the open sea. For illustrations and guidance related to seabird-friendly light styles that also protect the dark, starry skies of Hawai'i please visit:
https://dlnr.hawaii.gov/wildlife/files/2016/03/DOC439.pdf.

The State listed Blackburn's Sphinx Moth (BSM; *Manduca blackburni*) has a historic range that encompasses the project area. Larvae of BSM feed on many nonnative hostplants that include tree tobacco (*Nicotiana glauca*) which grows in disturbed soil. We recommend contacting our Hawai'i Island DOFAW office at (808) 974-4221 for further information about where BSM may be present and whether a vegetation survey should be conducted to determine the presence of plants preferred by BSM. To avoid harm to BSM, DOFAW recommends removing plants less than one meter in height or during the dry time of the year. If you remove tree tobacco over one meter in height or disturb the ground around or within several meters of these plants they must be checked thoroughly for the presence of eggs and larvae.

DOFAW recommends minimizing the movement of plant or soil material between worksites, such as in fill. Soil and plant material may contain invasive fungal pathogens (e.g. Rapid ʻŌhiʻa Death), vertebrate and invertebrate pests (e.g. Little Fire Ants, Coconut Rhinoceros Beetles), or invasive plant parts that could harm our native species and ecosystems. We recommend consulting the Big Island Invasive Species Committee at (808) 933-3340 in planning, design, and construction of the project to learn of any high-risk invasive species in the area and ways to mitigate spread. All equipment, materials, and personnel should be cleaned of excess soil and debris to minimize the risk of spreading invasive species. Gear that may contain soil, such as work boots and vehicles, should be thoroughly cleaned with water and sprayed with 70% alcohol solution to prevent the spread of Rapid ʻŌhiʻa Death and other harmful fungal pathogens.

DOFAW recommends using native plant species for landscaping that are appropriate for the area (i.e. climate conditions are suitable for the plants to thrive, historically occurred there, etc.). Please do not plant invasive species. DOFAW recommends consulting the Hawaiʻi-Pacific Weed Risk Assessment website to determine the potential invasiveness of plants proposed for use in the project (https://sites.google.com/site/weedriskassessment/home). We recommend that you refer to www.plantpono.org for guidance on selection and evaluation for landscaping plants.

We appreciate your efforts to work with our office for the conservation of our native species. Should the scope of the project change significantly, or should it become apparent that threatened or endangered species may be impacted, please contact our staff as soon as possible. If you have any questions, please contact Paul Radley, Protected Species Habitat Conservation Planning Associate at (808) 587-0010 or paul.m.radley@hawaii.gov.

Sincerely,

DAVID G. SMITH
Administrator

DAVID Y. IGE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT
P.O. BOX 621
HONOLULU, HAWAII 96809

April 1, 2021

REF: RFD.5090.8

TO: Mr. Russell Tsuji, Administrator
Land Division

FROM: M. Kaleo Manuel, Deputy Director
Commission on Water Resource Management

SUBJECT: Environmental Impact Statement Preparation Notice University of the Nations, Kona, Inc. 2020 Master Plan Update

FILE NO.: RFD.5090.8
TMK NO.: (3) 7-5-010:085, (3) 7-5-017:006

Thank you for the opportunity to review the subject document. The Commission on Water Resource Management (CWRM) is the agency responsible for administering the State Water Code (Code). Under the Code, all waters of the State are held in trust for the benefit of the citizens of the State, therefore all water use is subject to legally protected water rights. CWRM strongly promotes the efficient use of Hawaii's water resources through conservation measures and appropriate resource management. For more information, please refer to the State Water Code, Chapter 174C, Hawaii Revised Statutes, and Hawaii Administrative Rules, Chapters 13-167 to 13-171. These documents are available via the Internet at http://dlnr.hawaii.gov/cwrm.

Our comments related to water resources are checked off below.

[X] 1. We recommend coordination with the county to incorporate this project into the county's Water Use and Development Plan. Please contact the respective Planning Department and/or Department of Water Supply for further information.

[ ] 2. We recommend coordination with the Engineering Division of the State Department of Land and Natural Resources to incorporate this project into the State Water Projects Plan.

[ ] 3. We recommend coordination with the Hawaii Department of Agriculture (HDOA) to incorporate the reclassification of agricultural zoned land and the redistribution of agricultural resources into the State's Agricultural Water Use and Development Plan (AWUDP). Please contact the HDOA for more information.

[X] 4. We recommend that water efficient fixtures be installed and water efficient practices implemented throughout the development to reduce the increased demand on the area's freshwater resources. Reducing the water usage of a home or building may earn credit towards Leadership in Energy and Environmental Design (LEED) certification. More information on LEED certification is available at http://www.usgbc.org/leed. A listing of fixtures certified by the EAP as having high water efficiency can be found at http://www.epa.gov/watersense.

[X] 5. We recommend the use of best management practices (BMP) for stormwater management to minimize the impact of the project to the existing area's hydrology while maintaining on-site infiltration and preventing polluted runoff from storm events. Stormwater management BMPs may earn credit toward LEED certification. More information on stormwater BMPs can be found at http://planning.hawaii.gov/czm/initiatives/low-impact-development/

[X] 6. We recommend the use of alternative water sources, wherever practicable.

[X] 7. We recommend participating in the Hawaii Green Business Program, that assists and recognizes businesses that strive to operate in an environmentally and socially responsible manner. The program description can be found online at http://energy.hawaii.gov/green-business-program.

[X] 8. We recommend adopting landscape irrigation conservation best management practices endorsed by the Landscape Industry Council of Hawaii. These practices can be found online at http://www.hawaiiscape.com/wp-content/uploads/2013/04/LICH_Irrigation_Conservation_BMPs.pdf.

☐ 9. There may be the potential for ground or surface water degradation/contamination and recommend that approvals for this project be conditioned upon a review by the State Department of Health and the developer's acceptance of any resulting requirements related to water quality.

☐ 10. The proposed water supply source for the project is located in a designated water management area, and a Water Use Permit is required prior to use of water. The Water Use Permit may be conditioned on the requirement to use dual line water supply systems for new industrial and commercial developments.

X 11. A Well Construction Permit(s) is (are) are required before the commencement of any well construction work.

X 12. A Pump Installation Permit(s) is (are) required before ground water is developed as a source of supply for the project.

☐ 13. There is (are) well(s) located on or adjacent to this project. If wells are not planned to be used and will be affected by any new construction, they must be properly abandoned and sealed. A permit for well abandonment must be obtained.

☐ 14. Ground-water withdrawals from this project may affect streamflows, which may require an instream flow standard amendment.

☐ 15. A Stream Channel Alteration Permit(s) is (are) required before any alteration can be made to the bed and/or banks of a steam channel.

☐ 16. A Stream Diversion Works Permit(s) is (are) required before any stream diversion works is constructed or altered.

☐ 17. A Petition to Amend the Interim Instream Flow Standard is required for any new or expanded diversion(s) of surface water.

☐ 18. The planned source of water for this project has not been identified in this report. Therefore, we cannot determine what permits or petitions are required from our office, or whether there are potential impacts to water resources.

X OTHER: Regulation - pg. 4-7 of the document refers to Keauhou HWUDP encouragement of developing future high-level wells for the DWS system in areas generally between 1,500-feet and 1,800-feet ground elevations mauka of Māmalahoa Highway. It should be state that the HWUDP document also discourages any new county development north of the of the Keahuolu QLT 1 4057-001 Well in that high-level aquifer and any new wells in the basal aquifer portions of the aquifer area. Also , it should be mentioned that there were 2 permitted basal wells the University was planning to drill that expired in May 2020 and the disposition of those wells should be mentioned. Dry wells are also a potential source of pollution to the aquifer which are under the water quality protection control of the Department of Health. All these issues should be evaluated for their impacts to ground water dependent ecosystems and consult with the Aha Moku Advisory Committee as well for traditional & customary impacts.

Planning - The proposed water source(s) and projected water demands for the project, both potable and non-potable, should be identified and the calculations used to estimate demands should be provided. A discussion of the potential impacts on water resources and other public trust uses of water should be included, and any proposed mitigation measures described. Water conservation and efficiency measures to be implemented should also be discussed.

If you have any questions, please contact W Roy Hardy of the Regulation Branch at 587-0225 or Neal Fujii of the Planning Branch 587-0216.

3/29/21

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

March 16, 2021

MEMORANDUM

TO: **DLNR Agencies:**
__Div. of Aquatic Resource
__Div. of Boating & Ocean Recreation
X Engineering Division (DLNR.ENGR@hawaii.gov)
X Div. of Forestry & Wildlife (rubyrosa.t.terrago@hawaii.gov)
__Div. of State Parks
X Commission on Water Resource Management (DLNR.CWRM@hawaii.gov)
__Office of Conservation & Coastal Lands
X Land Division – Hawaii District (gordon.c.heit@hawaii.gov)

FROM: Russell Y. Tsuji, Land Administrator *Russell Tsuji*
SUBJECT: Environmental Impact Statement Preparation Notice for the Proposed University of the Nations, Kona, Inc. 2020 Master Plan Update
LOCATION: Kailua-Kona, Island of Hawaii; TMK: (3) 7-5-010:085 and (3) 7-5-017:006
APPLICANT: G70 on behalf of **University of the Nations, Kona, Inc.**

Transmitted for your review and comment is information on the above-referenced subject matter. The EISPN was published on March 8, 2021 in the Office of Environmental Quality Control's periodic bulletin, The Environmental Notice, at the following link:

http://oeqc2.doh.hawaii.gov/The_Environmental_Notice/2021-03-08-TEN.pdf

Please submit any comments by **April 5, 2021.** If no response is received by this date, we will assume your agency has no comments. Should you have any questions, please contact Darlene Nakamura via email at darlene.k.nakamura@hawaii.gov. Thank you.

( ) ~~We have no objections.~~
(✓) We have no comments.
( ) We have no additional comments.
( ) Comments are attached.

Signed: [signature]
Print Name: GORDON C. HEIT
Division: Land Division
Date: 3/30/21

Attachments
cc: Central Files

DAVID Y. IGE
GOVERNOR
STATE OF HAWAII

JOSH GREEN
LT GOVERNOR
STATE OF HAWAII

WILLIAM J. AILA, JR
CHAIRMAN
HAWAIIAN HOMES COMMISSION

TYLER I. GOMES
DEPUTY TO THE CHAIRMAN

STATE OF HAWAII
DEPARTMENT OF HAWAIIAN HOME LANDS

P O BOX 1879
HONOLULU, HAWAII 96805

April 8, 2021 Ref.: PO-21-068

Jeffery Overton
G70
111 S. King Street, Suite 170
Honolulu, HI 96825

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN)
University of the Nations, Kona, Inc. 2020 Master Plan Update
South Kona, Hawai'i
TMK: (3) 7-5-010:085 and 7-5-017:006

Thank you for the opportunity to provide comments on this Environmental Impact Statement Preparation Notice (EISPN) for the University of the Nations, Kona, Inc. (U of N Kona) 2020 Master Plan Update.

The proposed action on a total of approximately 62 acres calls for phased implementation of the construction of a K-12 school with supporting facilities, additional instructional buildings, student dormitories, a chapel, a student resource center, a discovery center for research and documentation, a cafe with outdoor dining space, an athletic training complex, a youth camp, an agricultural exhibit, and supportive facilities.

The Department of Hawaiian Home Lands (DHHL) has reviewed the subject matter and offers the following comments:

1. The proposed action is situated in the Keauhou Aquifer System. The Department notes for the applicant that the Commission on Water Resource Management has reserved 3.389 MGD of groundwater from the Keauhou Aquifer System for future DHHL development needs. DHHL has concerns that the proposed action could potentially impact the Department's ability to provide water to our homesteads. Section 4.5 of the EISPN states that a new water source(s) will be needed to support the buildout of each phase and the expansion of the project area. The forthcoming Draft Environmental Impact Statement (DEIS) should identify the location of U of N Kona's future water development and detail the amount of water demand the applicant anticipates. Further, there should be an analysis and discussion of how these water plans and projections impact DHHL's ability to develop water for our homestead lands. We would also like to remind the applicant that DHHL

water use is one of four protected public trust uses of water under HRS 171, otherwise known as the State Water Code.

2. Groundwater flows within the Kaloko-Honokōhau National Historic Park are also connected to the Keauhou Aquifer System Area. DHHL also has concerns about future pumping activities in this basal aquifer, which may likely reduce the amount of freshwater flow to the coastline thereby impacting biota and Native Hawaiian traditional and customary practices that our beneficiaries may conduct in the vicinity of the park. The location of new ground water sources that will serve the campus development should be located in areas that will minimize impact to freshwater flow to the coastline. The DEIS should summarize the potential impacts to these environmental and cultural resources from construction activities, as well as the cumulative impacts of the proposed project as contemplated in the Master Plan Update.

3. DHHL strongly encourages the applicant to consult with DHHL beneficiaries in the Kona region during the EIS process.

We appreciate your efforts to work with our office to ensure the protection of Hawai'i's water resources and the acknowledgment of the rights of our beneficiaries. If you have any questions or require additional information, please contact Andrew Choy, Acting Planning Program Manager at (808) 620-9500 or andrew.h.choy@hawaii.gov.

Sincerely,

William J. Aila Jr., Chairman
Hawaiian Homes Commission

C: DHHL West Hawaii District Office (via email)
Villages of La'i'Ōpua (via email)
La'i'Ōpua 2020 (via email)

DAVID Y. IGE
GOVERNOR

DR. CHRISTINA M. KISHIMOTO
SUPERINTENDENT

STATE OF HAWAIʻI
DEPARTMENT OF EDUCATION
P.O. BOX 2360
HONOLULU, HAWAIʻI 96804

OFFICE OF FACILITIES AND OPERATIONS

RECEIVED
APR 12 2021
G70

April 7, 2021

Jeff Overton, AICP, LEED AP
G70
111 S. King Street, Suite 170
Honolulu, Hawaii 96813

Re: Environmental Impact Statement Preparation Notice for University of the Nations, Kona, Inc. 2020 Master Plan Update, TMK (3) 7-5-010:085 and (3) 7-5-017:006 Kailua-Kona, Hawaii

Dear Mr. Overton:

Thank you for your letter dated March 9, 2021. The Hawaii State Department of Education (HIDOE) has the following comments on the Environmental Impact Statement Preparation Notice for the preparation of a Draft Environmental Impact Statement (DEIS) for the University of the Nations, Kona, Inc. (Applicant) 2020 Master Plan Update (Project) for lands located at TMK (3) 7-5-010:085 and (3) 7-5-017:006, Kailua-Kona, Island of Hawaii. Project lands were reclassified to the State Land Use Urban District by the Hawaii State Land Use Commission in Docket No. A02-737.

The proposed Project will guide the expansion of the existing campus over the next 30 years. Applicant has filed a Motion to Amend Findings of Fact, Conclusions of Law and Decision and Order for a Land Use District Boundary Amendment, dated August 8, 2003, with the Hawaii State Land Use Commission. The DEIS will provide a revised land use plan and development proposal to support the Applicant's Motion to Amend.

A condition of approval for Docket No. A02-737 required a fair-share contribution to the development, funding, and/or construction of school facilities, as determined by and to the satisfaction of the HIDOE. A written agreement is to be executed prior to seeking building permits for any portion of the reclassified area. To date, no educational contribution agreement has been executed.

Further comments will be provided upon the review of the DEIS.

Thank you for the opportunity to comment. Should you require further information, please contact Robyn Loudermilk, School Lands and Facilities Specialist of the Facilities Development Branch, Planning Section, at 784-5093 or by email at Robyn.Loudermilk@k12.hi.us.

Respectfully,

Roy Ikeda
Public Works Manager TA
Planning Section

RI:rll

Harry Kim
Mayor

Paul K. Ferreira
Police Chief

Kenneth Bugado, Jr.
Deputy Police Chief

County of Hawai'i

POLICE DEPARTMENT

349 Kapi'olani Street • Hilo, Hawai'i 96720-3998
(808) 935-3311 • Fax (808) 961-2389

March 24, 2021

Mr. Jeff Overton
AICP, LEED AP
G70
111 S. King Street, Suite 170
Honolulu, HI 96813
UofNkona@g70.design

RECEIVED
MAR 30 2021
G70

Dear Mr. Overton:

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE
UNIVERSITY OF THE NATIONS, KONA, INC.
2020 MASTER PLAN UPDATE
TMK: (3) 7-5-010:085 AND (3) 7-5-017:006
(KAILUA-KONA, ISLAND OF HAWAI'I, HAWAI'I)

The above-referenced Environmental Impact Statement Preparation Notice has been reviewed and we offer no comments at this time.

Should you have any questions or concerns, please contact Captain Gilbert Gaspar Jr., Commander of the Kona District, at 326-4646, extension 299.

Sincerely,

PAUL K. FERREIRA
POLICE CHIEF

H4

CHAD BASQUE
ASSISTANT POLICE CHIEF
AREA II OPERATIONS

GG/jaj
21HQ0262

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAI'I
345 KEKŪANAŌ'A STREET, SUITE 20 • HILO, HAWAI'I 96720
TELEPHONE (808) 961-8050 • FAX (808) 961-8657

April 6, 2021

Mr. Jeffrey H. Overton, AICP, LEED AP
G70
111 South King Street, Suite 170
Honolulu, HI 96813

Dear Mr. Overton:

Subject: Environmental Impact Statement Preparation Notice
Applicant – University of the Nations, Kona, Inc.
Tax Map Key 7-5-010:085 and 7-5-017:006

We have reviewed the subject Environmental Impact Statement Preparation Notice (EISPN) and have the following comments.

Please be informed that the existing campus is supplied by two existing services. One from the 325 feet service area connected to an existing 8-inch waterline along Kuakini Highway and the other from the 601 feet service area connected to an existing 12-inch waterline along Hualālai Road. It should be noted that the current usage exceeds the total water allotment for Parcel 3 and Parcel 85. Also, there is an outstanding item from Phase 1-B and there are existing water system facilities within Parcel 85.

Currently, the Department's existing water system facilities are unable to support the proposed development. As stated in the subject EISPN, the Department's existing water system lacks adequate source and transmission capacity to provide the anticipated amount of water needed. In addition, the developer will also be required to construct the necessary storage facilities to provide for the estimated maximum daily water usage for the development.

The developer will also be required to enter into a Water Development Agreement with the Water Board, which will establish the necessary off-site water system improvements required to support the development and the allocation of water commitments from any new source(s) developed. Water service within the proposed development will not be granted until the necessary off-site and on-site water system improvements are completed and accepted by/dedicated to the Water Board.

In addition to the Water Supply Study, the Department would request a conceptual water master plan for the necessary off-site water system improvements, including any proposed phasing of the project, to better determine the scope of water system improvements that will be required. All uses of water would need to be factored when calculating water demand for a project.

The Department of Water Supply acknowledges that potable water is Hawai'i Island's most precious resource and encourages our communities to promote water conservation and reserve the highest quality of water for the most valuable end use, which is the sustenance of life. The Department requests the developer address the non-potable demand of water or irrigation by using alternate methods (i.e. reclaimed or reused water).

Should there be any questions, please contact Mr. Ryan Quitoriano of our Water Resources and Planning Branch at 961-8070, extension 256.

Sincerely yours,

Keith K. Okamoto, P.E.
Manager-Chief Engineer

RQ:dfg

copy – University of the Nations, Kona, Inc.

From: Lois Hodges <loishelenhodges1@gmail.com>
Sent: Wednesday, March 31, 2021 4:38 PM
To: University of the Nations
Subject: UNIVERSITY OF THE NATIONS, KONA, INC.2020 MASTER PLAN UPDATEKailua-Kona, Island of Hawaiʻi, HawaiʻiTMK (3) 7-5-010:085 and (3) 7-5-017:006ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE

I wish to enter a public comment regarding the above subject.

I believe that your assessment of the noise impact in item 4.10 of your report is an incomplete and incorrect assessment. I would like to request that you restudy this issue at a time when the University of the Nations is holding a large assembly/revival or other group gathering where there is amplified music involved. With Covid impact these loud gatherings do not seem to be as frequent but in non-pandemic times they are much too frequent and much too loud. The music is amplified so that it carries down into the Alii Drive & Walua Road area. During the summer there are week long gatherings and the noise continues from early morning until 10 p.m. There is not only music and singing but loud cheering, hooting, hollering and sounds similar to what one would expect to hear from an NFL Football stadium only for many hours longer than a football game.

The University has been made aware both verbally and in writing that the amplification is a nuisance to the area. They seem to have no regard for the mental health of the neighborhood. Their representative indicated that having a "radical man of Jesus" in town was the cause and also indicated that there will be joyful noise in heaven which seems to make it acceptable to have joyful noise in the neighborhood.

I request that you restudy the noise issue by contacting people who live in the condo complexes of Kona Pacific, Kona Mansions, & Alii Cove where we often have to tolerate the stadium effect for hours on end, particularly in the summer. I also request that you recommend a limitation of the amplification of the sound emitted from the campus as I am concerned that their proposed 4000 sq. ft. chapel, located closer to residential areas will be a source of further noise nuisance to the neighborhood.

Please acknowledge receipt of my comments.

Thank you, Lois Hodges

Appendix O

EISPN Participant Letter

G70

111 S. King Street
Suite 170
Honolulu, HI 96813
808.523.5866
www.g70.design

March 9, 2021

Subject: Environmental Impact Statement Preparation Notice
University of the Nations, Kona, Inc.
2020 Master Plan Update
TMK: (3) 7-5-010:085 and (3) 7-5-017:006
(Kailua-Kona, Island of Hawai‘i, Hawai‘i)

Dear Participant:

On behalf of University of the Nations, Kona, Inc., G70 is notifying you of the availability of the Environmental Impact Statement Preparation Notice (EISPN) for the University of the Nations, Kona, Inc. 2020 Master Plan Update located in Kailua-Kona, Island of Hawai‘i, Hawai‘i. The EISPN is available for public review and comment from March 8, 2021 and ending April 7, 2021.

For ease of sharing and to facilitate access, the EISPN document can be downloaded from the website of the Office of Environmental Quality Control:
http://oeqc2.doh.hawaii.gov/Doc_Library/2021-03-08-HA-EISPN-University-of-the-Nations-Kona.pdf.

Written comments may be submitted via email or via U.S. Mail as follows:

G70 111 S. King Street, Suite 170 Honolulu, HI 96813
Attn: Jeff Overton, AICP, LEED AP
Email: UofNkona@g70.design

A public scoping meeting will be held on Thursday, March 25, 2021 from 6:00 to 8:00 PM. The EIS scoping meeting allows for agencies and the public to assist the University of the Nations, Kona in determining the range of actions, alternatives, impacts, significant issues and proposed mitigation to be considered in the Draft EIS.

The scoping meeting will be a virtual meeting held via the Zoom platform at the following link: https://g70design.zoom.us/j/98510032177?pwd=a29OY3Ewek1DUThZL1dSVDFnOCtLZz09

If you are not familiar with the Zoom platform, we encourage you to download the application prior to the meeting. If you have questions regarding the virtual scoping meeting, please contact us at UofNkona@g70.design so we can assist you.

Thank you for your participation in the environmental review process.

Sincerely,
Group 70 International, Inc., dba G70

Jeffrey H. Overton, AICP, LEED AP
Principal

Appendix P

Draft EIS Comment Letters

Kira Ramos

From:	Javar-Salas, Chelsie <chelsie_javar-salas@fws.gov>
Sent:	Wednesday, March 6, 2024 12:50 PM
To:	University of the Nations
Subject:	U.S. Fish and Wildlife Service comments on the Draft Environmental Impact Statement for the University of the Nations, Kona Inc., Master Plan Update
Attachments:	IPaC Species List Instructions_PIFWO_19May2022_Final.pdf

Dear Jeffrey H. Overton,

Thank you for the opportunity to comment on the Draft Environmental Impact Statement for the University of the Nations, Kona Inc., Master Plan Update located at 75-5943 and 75-5911 Kuakini Highway, Kailua-Kona, Hawai‘i [TMKs (3) 7-5-010:085 and (3) 7-5-017:006].

The U.S. Fish and Wildlife Service (Service) has updated how we manage our technical assistance workload and process section 7 consultations.

The very first step in both our updated technical assistance and consultation processes is to obtain an Official Species List (OSL) in our new Information for Planning and Consultation (IPaC) online tool, for which a link can be found at the box in the top left corner of the below website:

https://ecos.fws.gov/ecp/

Please also see the attached pdf with detailed directions on how you can obtain an OSL in IPaC.

Once you have entered your basic project information, including a map of the project (you can use the map drawing tool or upload a GIS polygon that contains the project area[s]), you will need to formally submit the OSL. A copy will automatically be sent to our office. Each submitted project is assigned a unique Project Code in IPaC. This Project Code should be provided to our office with any correspondence relating to a given project.

Your IPaC generated OSL will include all federally listed species, critical habitat, migratory birds, and wetland habitat that occurs, or may transit through, the project area(s). Each species on your OSL will have a link directly below it that provides the Service's recommended avoidance and minimization measures (AMMs) for that species. **We recommend you include all of the AMMs for each of the species into your project description and impacts analysis, as applicable to the proposed project**.
These measures include the following:

1. implement avoidance and minimization measures for all species that may be impacted by the project,
2. adhere to Service recommendations for avoiding nighttime project-related and residential lighting that can impact seabirds,
3. avoid removal of trees and vegetation above 15 feet tall between June 15 and September 15 during the Hawaiian hoary bat pupping season,
4. incorporate all species conservation measures into the project description.

A few IPAC tips:

- If you choose to upload a polygon for your project area, please include all TMKs/sites in a single polygon. Otherwise, you will get a project code for every TMK/site. However, if your project spans distinct habitat types, you may want to obtain separate OSL to better distinguish which species/critical habitat/wetland habitat occurs at each site.

- At this time, unless you are a Federal agency with a programmatic consultation with us, you can ignore any requests to further your consultation in IPaC and prompts to use D Keys. The only thing you need to do is enter your basic project information and submit for an OSL.
- While the attached pdf of instructions will direct you to **https://ipac.ecosphere.fws.gov/** to access IPaC, several partners have gotten stuck at “create a Login.gov account.” We suggest first visiting **https://ecos.fws.gov/ecp/**, and accessing IPaC in the upper left hand corner, may resolve the Login.gov issue.
- Additional background information on IPaC:
    - Your official IPaC species list is based on species’ ranges. IPaC generates a list of all federally listed species and other trust resources that is/are or could potentially be in the project area.
    - If your IPaC species list includes a species you do not think would occur in the project area, explain why in your consultation letter.
    - Implementing surveys is a good way to determine if a species is present or not.
    - We recommend our partners incorporate all the species and their associated AMMs in their impacts analysis.
    - The AMMS are there to help you avoid and minimize effects to listed species, critical habitat, migratory birds, and wetland habitat.

Please contact me if you need further assistance or have questions pertaining to our recommendations.

Mahalo,
Chelsie Javar-Salas

Chelsie Javar-Salas (she/her) | Biologist, Maui Nui and Hawaiʻi Island Team | U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office | 300 Ala Moana Blvd., Room 3-122 Honolulu, HI 96850 | phone: 808-210-6131 | email: chelsie_javar-salas@fws.gov | website: https://www.fws.gov/office/pacific-islands-fish-and-wildlife

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaiʻi 96850

Subject: IPaC generated official species list for the Pacific Islands Fish and Wildlife Office

Dear Action Agency or Applicant:

Beginning March 21, 2022, the Pacific Island Fish and Wildlife Office (PIFWO) will be transitioning to the use of the Information for Planning and Consultation (IPaC) online portal, https://ipac.ecosphere.fws.gov/, for federal action agencies and non-federal agencies or individuals to obtain official species lists, including threatened and endangered species and designated critical habitat in your project area. IPaC has been used by continental USFWS offices to provide official species lists since 2017. Using IPaC expedites the process for species list distribution. Obtaining a species list in IPaC is relatively straightforward and takes minimal time to complete. Step by step instructions are included below.

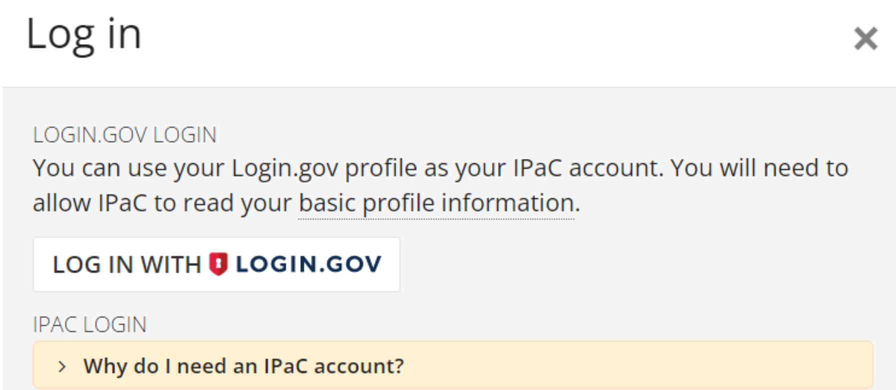
Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of your species list should be verified after 90 days. New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change the species list. Verification can be completed by visiting the IPaC website at regular intervals during project planning and implementation. An updated list may be requested through the IPaC system by completing the same process used to obtain the initial species list.

We hope this process provides efficiencies to our partners in obtaining a species list. For federal action agencies, it also opens additional IPaC functionality that the PIFWO office is still working on, such as the use of Determination Keys for informal section 7 programmatic consultations. We will let our agency partners know when that functionality becomes available.

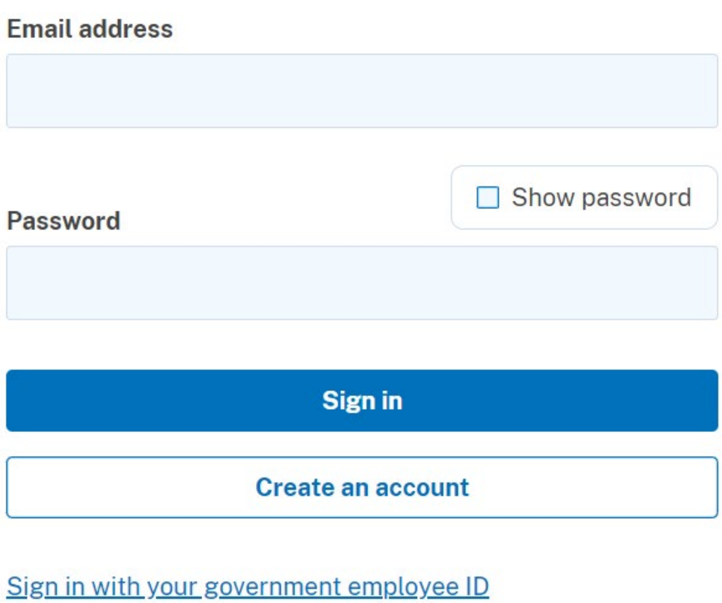
If you have questions about a species list obtained through the IPaC system or need assistance in completing an IPaC species list request, please contact the Service at 808-792-9400 or via email at pifwo_admin@fws.gov. We appreciate your efforts to conserve listed species across the Pacific Islands.

Instructions for Action Agencies and partners to obtain an official species list in IPaC

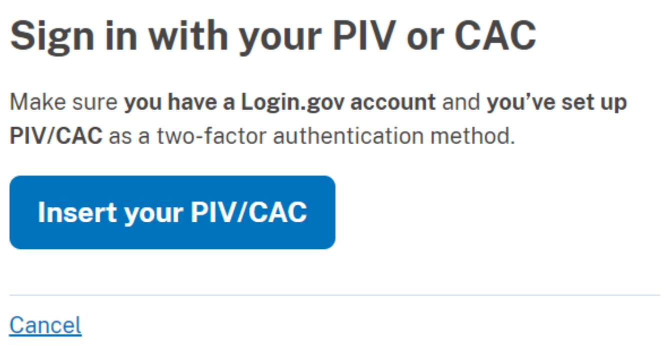
- Navigate to https://ipac.ecosphere.fws.gov/
- You can get an unofficial species list without logging in. However, if you want an official species list you will need to log in first using your Login.gov account. If you don't have an IPaC account, they are easy to create.



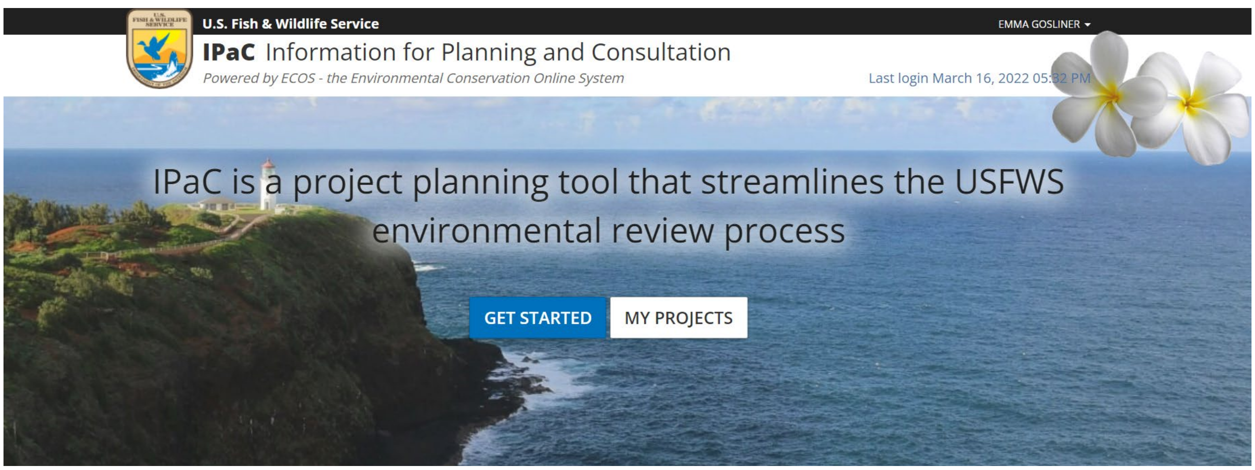
Select Log in with Login.gov and sign in using your email and password.



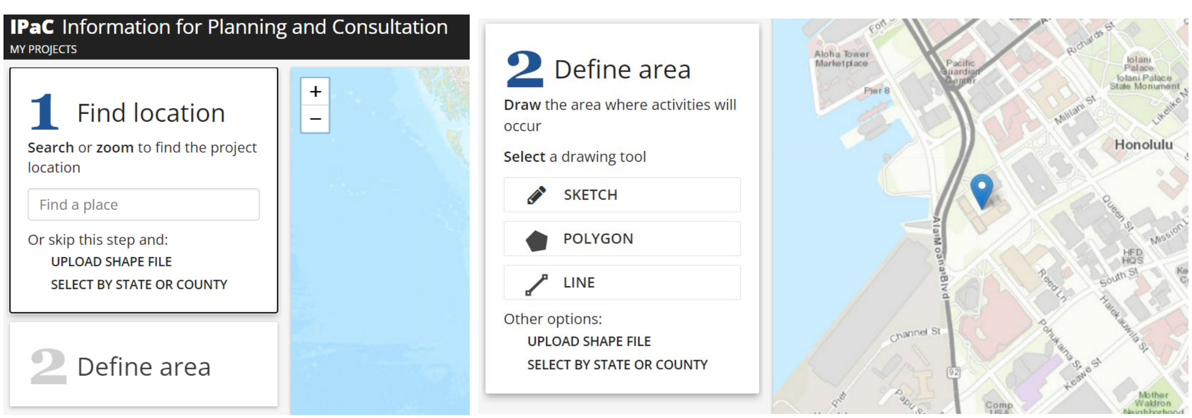
If you have a PIV or CAC card, you can sign in using that method as well.

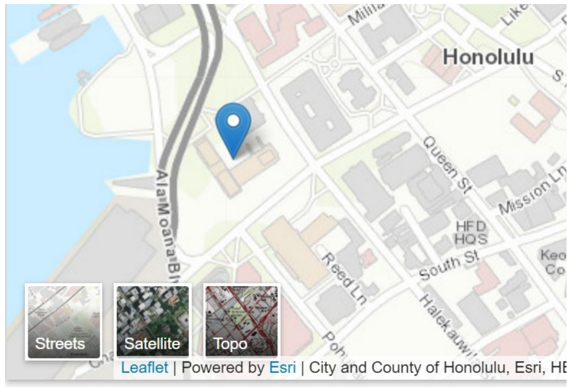


- Once you log in, select "Get Started".

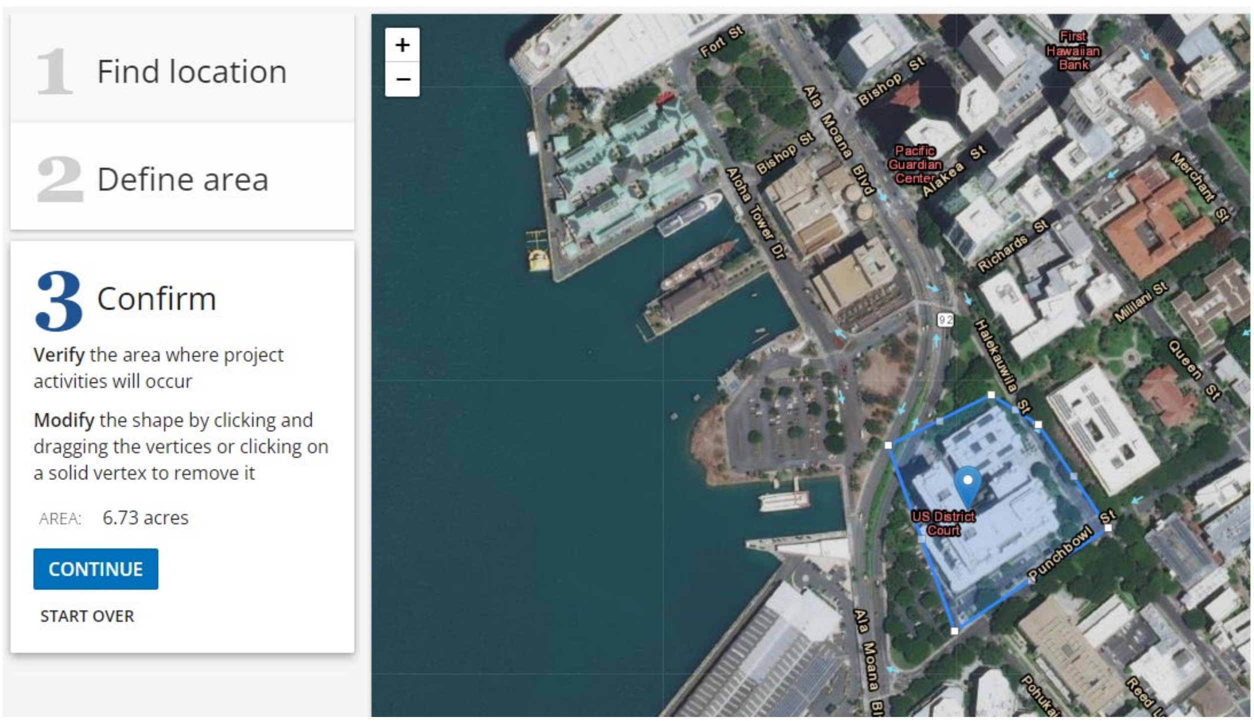


- Define the action area: Identify the location of the proposed action by uploading an existing shapefile or by entering an address or coordinates of the action area. Once identified on the map, you can manually draw the action area using the drawing tools.



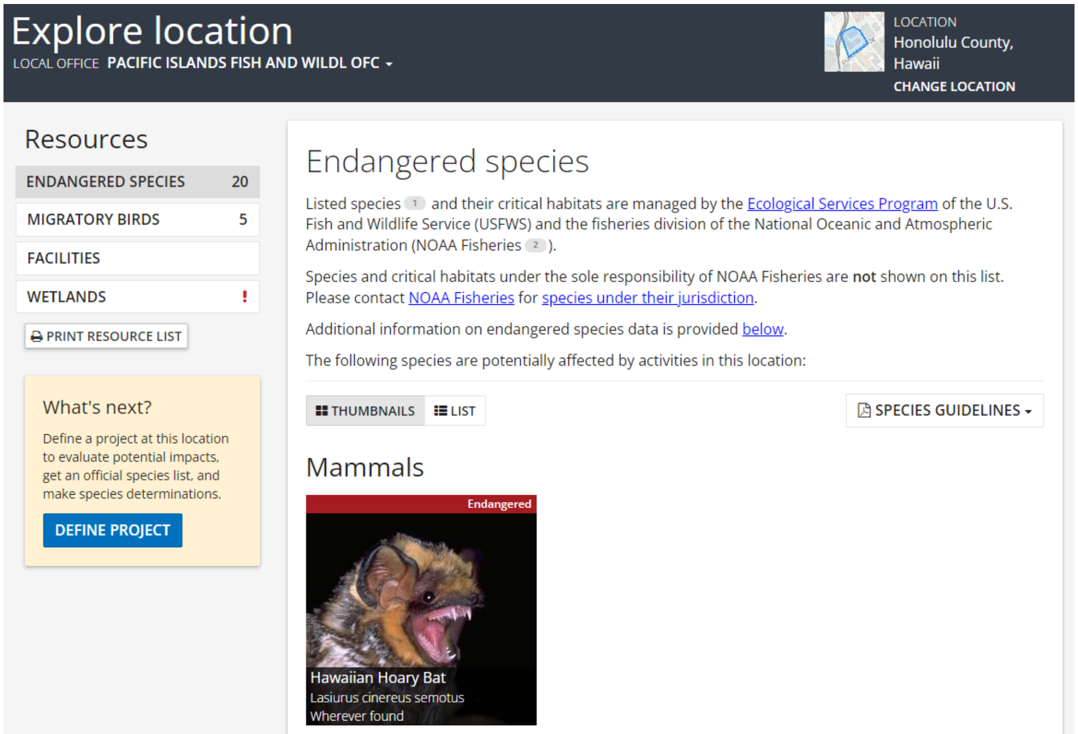


To help identify your action area you can choose between multiple base maps available.

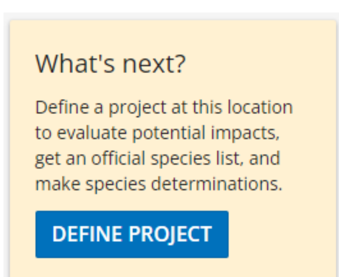


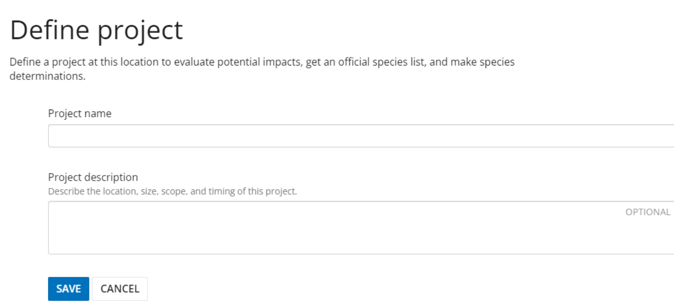
Press continue when you have finished drawing or uploading the action area location.

- The species information on the page that follows is <u>not</u> official. However, it identifies the project County, local Fish and Wildlife Field Office, species covered under NOAA Fisheries as well as Migratory Bird Treaty Act species. The list can be viewed in Thumbnail or List format.
- Once the species list populates you will see images of the species that may occur on, near, or transgress across your project. Click on SPECIES GUIDELINES on your top right to see Avoidance and Minimization measures to incorporate into your General Project Design Guidelines.



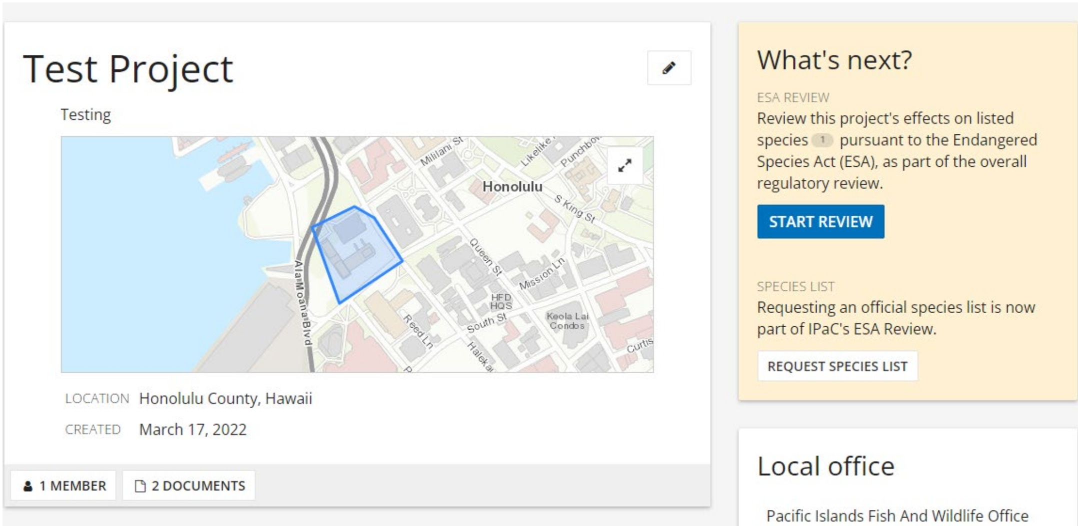
- Continue with the following steps to comply with the requirements of ESA section 7 to obtain an **official species list**.
- Select Define Project



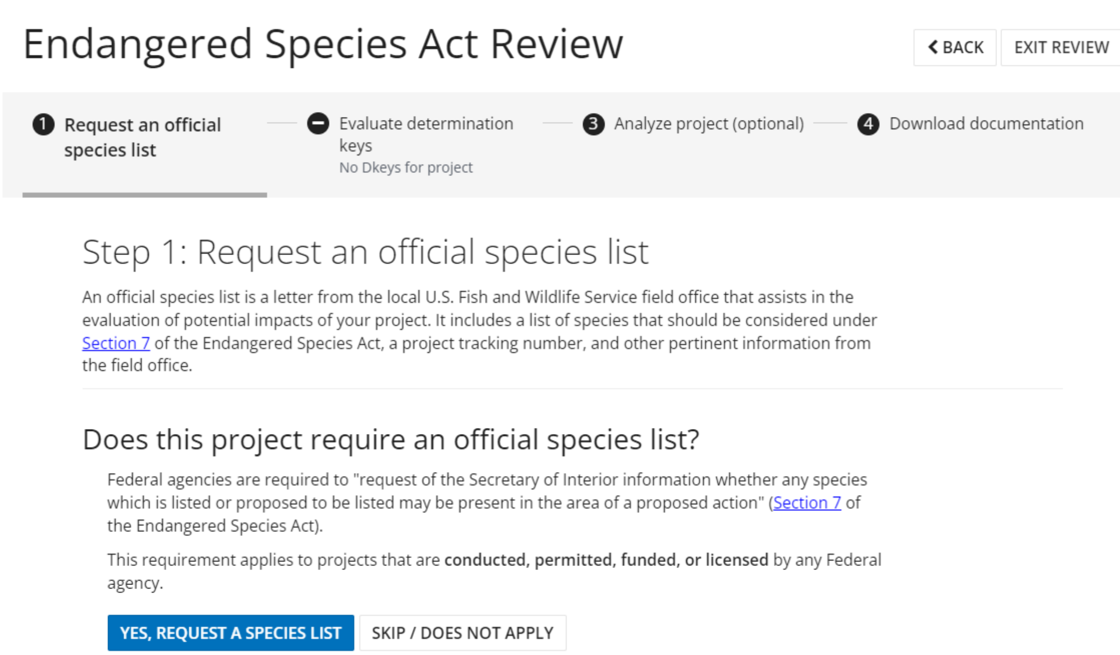


Enter the Project Name and a brief description of the project (a description is not mandatory, but recommended for future coordination with the Service). Click SAVE at bottom of page.

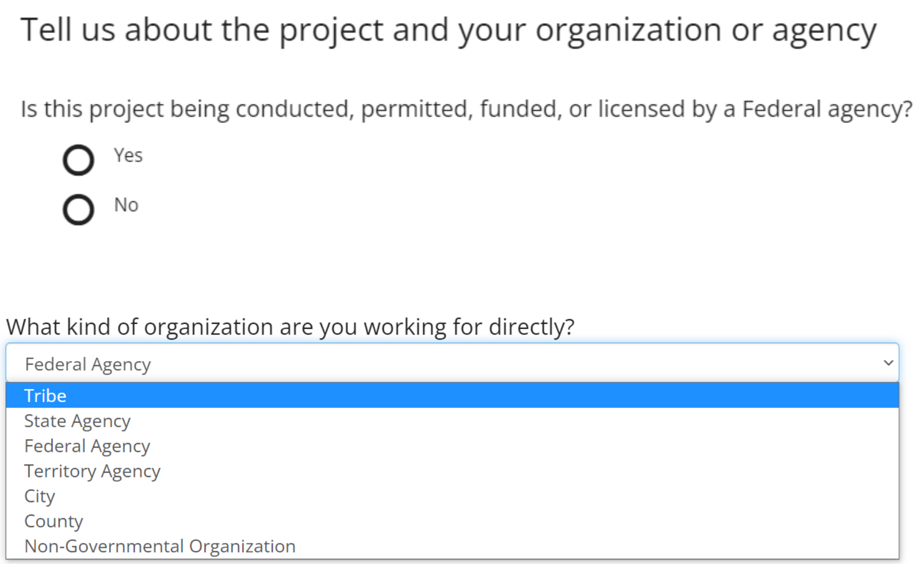
- At the bottom of the What's next box on the right, click Request Species List



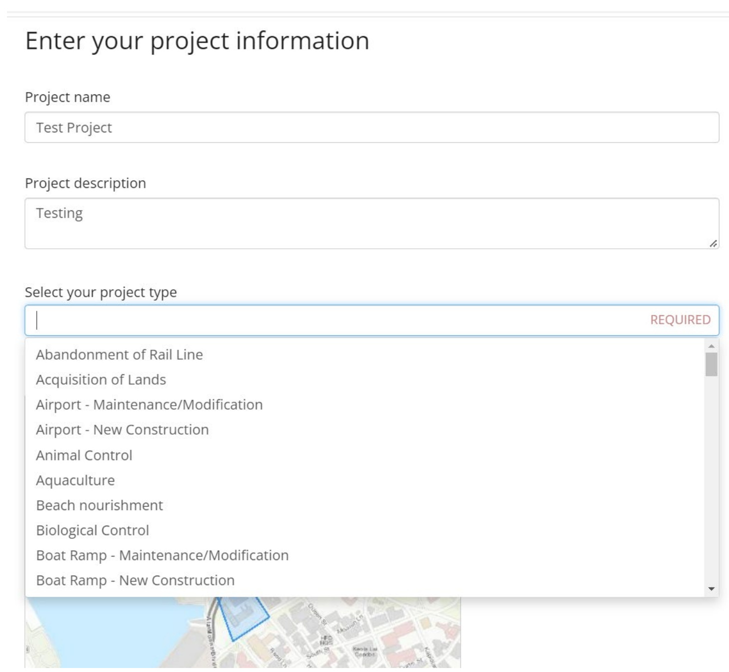
- on the following screen, click Yes, Request Species List



- Fill out the contact information for yourself or your agency. Contractors, state partners, and any other project proponents may request a species list and should be covered using the dropdown menus.



- From the pull-down menu for Classify Type of Project, select the project type that best fits the proposed action.



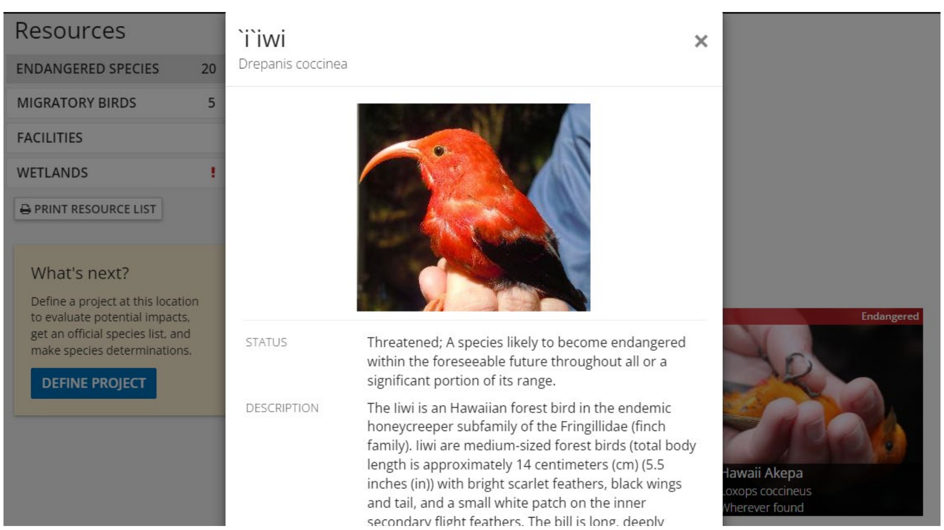
- Once all required sections are filled out, press SUBMIT OFFICIAL SPECIES LIST REQUEST

Location

SUBMIT OFFICIAL SPECIES LIST REQUEST

- An Official Species List should be generated and available for download in a couple of seconds.

- If you need additional information on a species, click on their name that is hot-linked to their species information page. A brief overview of the species' status, description and critical habitat will appear as well as a link to their ECOS species profile.



United States Department of the Interior
NATIONAL PARK SERVICE
Natural Resource Stewardship and Science
Water Resources Division
1201 Oakridge Drive, Suite 250
Fort Collins, Colorado 80525

March 18, 2024

Mary Alice Evans, Director
State of Hawaiʻi Office of Planning and Sustainable Development
Environmental Review Program
235 South Beretania Street, Suite 702
Honolulu, Hawaiʻi 96813

Jeffery H. Overton, AICP, LEED AP
Group 70 International, Inc.
111 South King Street, Suite 170
Honolulu, Hawaiʻi 96813

In reference to: University of the Nations, Kona, Inc. – 2020 Master Plan Update
Draft Environmental Impact Statement, February 2024
Kailua-Kona, Island of Hawaiʻi

Dear Director Evans and Mr. Overton;

The National Park Service (NPS) very much appreciates the opportunity to comment on the above-referenced Draft Environmental Impact Statement (DEIS). Our comments and recommendations are focused on the proposed groundwater supply for the project, specifically the deep confined freshwater zone that underlies at least a portion of the Hualalai Aquifer Sector Area.

The DEIS identifies two possible locations for drilling a water supply well into the deep confined freshwater zone, the Bolton Property and Wheelock Property, and the document suggests that the Bolton Property is the favored location. Our specific concerns are as follows.

Discrepancy Between Volume of Water Required for the Project and Planned Pumping Volume

Page 4-14 of the DEIS states that when “Fully built out, it is anticipated approximately 107,500 gallons of water per day (gpd) will be needed to support the Master Plan Update.” The volume of 107,500 gpd is equal to approximately 75 gallons per minute (gpm). However, in the same section the DEIS states on page 4-15 that a successful well on the Wheelock Property could be completed as a production well of 700 gpm capacity. Also, page 4-15 of the DEIS states that a well on the Bolton Property could be successfully developed to produce more than 1.0 million gpd, which is equal to approximately 700 gpm. However, the DEIS does not discuss why there is a need to pump 700 gpm, or possibly more, if the project only requires 75 gpm.

NPS Recommended Follow-up:

- An explanation of the discrepancy between water that is needed and the planned pumping rates. If a groundwater withdrawal rate of 700 gpm is truly planned the DEIS should identify the specific beneficial uses to which the water will be applied and the places of use.

Paucity of Information Regarding the Deep Confined Freshwater Zone

Neither the State nor the County can manage groundwater properly if they do not understand the properties of the deep confined freshwater zone and its connections to other aquifer systems or the impacts to those resources that are dependent on that groundwater. If implemented, this proposal, will be in essence a scientific experiment to determine the aquifer characteristics and sustainability of an unknown portion of the deep confined freshwater zone. The DEIS identifies four wells that have intersected the deep confined freshwater zone, but two of the wells (Kamakana and Kaloko Deep) were unable to be completed in the deep confined zone because of well construction difficulties. Recorded thicknesses of the deep confined zone range from about 25 feet to 100 feet and the areal extent is unknown. The 48-hour pumping test described in Appendix D of the DEIS provides good information but is not sufficient to evaluate the long-term effects of groundwater pumping at a rate of 700 gpm. The NPS suggests that much more information must be developed regarding the extent and hydrologic characteristics of the deep confined zone in order to understand what sustainable use could be and the potential impacts of this project. Uncertainties include the overall extent and physical characteristics, and how the deep confined zone is connected hydrologically to the basal and high level aquifer systems, and to the ocean. The potential for increased sea water intrusion that could be caused by pumping from the deep confined zone must be evaluated.

NPS Recommended Follow-up:

- The next version of the EIS should evaluate the effects of pumping from the deep confined zone and explain how exploration of the deep confined zone will be conducted to ensure collection of high-quality data that increases understanding of the resource for state and county agencies.

- The University of the Nations, Kona should consult with the Hawaiʻi Department of Land and Natural Resources, Commission on Water Resource Management and the US Geological Survey regarding best practices for exploration of the deep confined freshwater zone and development of data regarding sustainability of use.

Cumulative Effects

Planned projects that must be included in the cumulative effects analysis presented in the University of the Nations, Kona DEIS include:

North Kona Mid Level Deepwell Development – Phase 1. On November 16, 2020, the County of Hawaiʻi Department of Water Supply transmitted to the State of Hawaiʻi Office of Environmental Quality Control a Final Environmental Assessment and Finding of No Significant Impact for its proposed North Kona Mid Level Deepwell Development – Phase 1. The Department of Water Supply plans to drill an exploratory well into the deep confined freshwater zone at site TMK No. 7-5-003.001 and conduct a pumping test at a rate between 700 gpm and 1,000 gpm. Depending on the results of the drilling and test pumping, the Department of Water Supply may convert the test well into a production well. It appears that this proposed well location is very close, perhaps adjacent to the Wheeler Property mentioned above.

In a letter to the Kona area community dated August 8, 2003, the Department of Water Supply indicated that the "North Kona Mid-Elevation Deep Well project is another highly anticipated water source development project for DWS as it would tap a previously unutilized deep confined aquifer resulting in lower operational costs." This project is not included in the DEIS Chapter 5 discussion of cumulative impacts.

Liliʻuokalani Trust Makalapua Project District. On February 12, 2024, the County of Hawaiʻi Planning Department transmitted to the State of Hawaiʻi Office of Planning and Sustainable Development a Draft Environmental Assessment and Anticipated Finding of No Significant Impact for the Liliʻuokalani Trust Makalapua Project District in Kailua-Kona. The Liliʻuokalani Trust plans to develop a new regional groundwater source in conjunction with its project – a new well completed in the deep confined freshwater zone.

The well is planned to be located adjacent to Palani Road, northeast of downtown Kailua-Kona, approximately one mile from the Wheeler Property and approximately two miles from the Bolton Property. Liliʻuokalani Trust plans to pump about 1,500 gpm (2.16 million gallons per day) from the deep confined freshwater zone to supply potable water for current and future Liliʻuokalani Trust development plans. This project is not included in the DEIS Chapter 5 discussion of cumulative impacts.

NPS Recommended Follow-up:

- The next version of the EIS must evaluate the cumulative effects of all three groundwater development projects: Department of Water Supply, Liliʻuokalani Trust, and University of the Nations, Kona. The effects of long-term pumping from three separate but reasonably close locations in the deep confined freshwater zone at individual pumping rates ranging from 700 gpm to 1,500 gpm are unknown. Pumping at a conceivable combined rate approaching 3,000 gpm (4.32 million gallons per day) dramatically increases the uncertainty regarding long-term sustainability and decreases the margin for error with respect to unintended consequences of groundwater withdrawal from this zone.

- The next version of the EIS must identify all other groundwater development projects in the Hualalai Aquifer Sector Area that will target the deep confined freshwater zone for groundwater supply. It is critical for the County and State of Hawaiʻi to understand the potential scope of planned groundwater withdrawal from the deep confined freshwater zone to be able to manage the system sustainably and to model and predict possible outcomes.

The NPS looks forward to continuing discussions with the University of the Nations, Kona, and the State of Hawaiʻi regarding evaluation of groundwater supply options for this project. If you have questions regarding the above comments, please contact me directly (terry_fisk@nps.gov; 970-803-0692) or contact Dr. Jeff Zimpfer, Environmental Protection Specialist for Kaloko-Honokohau National Historic Park (jeff_ zimpfer@nps.gov; 808-329-6881 ex 1500).

Sincerely,

Terry T Fisk

Terry T Fisk, R.G., L.G., L.Hg.
Water Rights Branch Chief | NPS Water Resources Division

Cc: Dean Uyeno
Acting Deputy Director, Commission on Water Resource Management
1151 Punchbowl Street, Room 227
Honolulu, Hawaii 96813

JOSH GREEN, M.D.
GOVERNOR | KE KIAʻĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIAʻĀINA

DAWN N. S. CHANG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAIʻI | KA MOKUʻĀINA ʻO HAWAIʻI
DEPARTMENT OF LAND AND NATURAL RESOURCES
KA ʻOIHANA KUMUWAIWAI ʻĀINA
LAND DIVISION

P.O. BOX 621
HONOLULU, HAWAII 96809

March 22, 2024

G70
Attention: Mr. Jeff Overton
111 South King Street, Suite 170
Honolulu, Hawaii 96813

via email: UofNkona@g70.design

Dear Mr. Overton:

SUBJECT: Draft Environmental Impact Statement (DEIS) for the Proposed **University of the Nations, Kona, Inc. 2020 Master Plan Update** located at South Kona, Island of Hawaii; TMKs: (3) 7-5-010:085 and (3) 7-5-017:006 on behalf of University of the Nations, Kona, Inc.

Thank you for the opportunity to review and comment on the subject matter. The Land Division of the Department of Land and Natural Resources (DLNR) distributed or made available a copy of your request pertaining to the subject matter to DLNR's Divisions for their review and comments.

At this time, enclosed are comments from the (a) Engineering Division and (b) Land Division-Hawaii District on the subject matter. Should you have any questions, please feel free to contact Darlene Nakamura at (808) 587-0417 or email: darlene.k.nakamura@hawaii.gov. Thank you.

Sincerely,

Russell Tsuji

Russell Y. Tsuji
Land Administrator

Enclosures
cc: Central Files

JOSH GREEN, M.D.
GOVERNOR | KE KIAʻĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIAʻĀINA

DAWN N. S. CHANG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAIʻI | KA MOKUʻĀINA ʻO HAWAIʻI
DEPARTMENT OF LAND AND NATURAL RESOURCES
KA ʻOIHANA KUMUWAIWAI ʻĀINA
LAND DIVISION

P.O. BOX 621
HONOLULU, HAWAII 96809

February 13, 2024

MEMORANDUM

FROM: ~~TO:~~ **DLNR Agencies:**
___Div. of Aquatic Resources
___Div. of Boating & Ocean Recreation
_X_ Engineering Division (DLNR.ENGR@hawaii.gov)
_X_ Div. of Forestry & Wildlife (rubyrosa.t.terrago@hawaii.gov)
___Div. of State Parks
_X_ Commission on Water Resource Management (DLNR.CWRM@hawaii.gov)
___Office of Conservation & Coastal Lands
_X_ Land Division – Hawaii District (gordon.c.heit@hawaii.gov)
_X_ Aha Moku Advisory Committee (leimana.k.damate@hawaii.gov)

TO: ~~FROM:~~ Russell Y. Tsuji, Land Administrator *Russell Tsuji*
SUBJECT: Draft Environmental Impact Statement (DEIS) for the Proposed **University of the Nations, Kona, Inc. 2020 Master Plan Update**
LOCATION: South Kona, Island of Hawaii; TMKs: (3) 7-5-010:085 and (3) 7-5-017:006
APPLICANT: G70 on behalf of

Transmitted for your review and comment is information on the above-referenced subject matter. The DEIS was published on February 8, 2024, by the State Environmental Review Program (formerly the Office of Environmental Quality Control) at the Office of Planning and Sustainable Development in the periodic bulletin, The Environmental Notice, available at the following link:

https://files.hawaii.gov/dbedt/erp/The_Environmental_Notice/2024-02-08-TEN.pdf

Please submit any comments by **March 22, 2024**. If no response is received by this date, we will assume your agency has no comments. Should you have any questions, please contact Darlene Nakamura directly via email at darlene.k.nakamura@hawaii.gov. Thank you.

BRIEF COMMENTS:

( ) We have no objections.
( ) We have no comments.
(✓) We have no additional comments.
( ) Comments are included/attached.

Signed: ____________________
Print Name: Carty S. Chang, Chief Engineer
Division: Engineering Division
Date: Feb 15, 2024

Attachments
cc: Central Files

3/15/24

JOSH GREEN, M.D.
GOVERNOR | KE KIAʻĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIAʻĀINA

DAWN N. S. CHANG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAIʻI | KA MOKUʻĀINA ʻO HAWAIʻI
DEPARTMENT OF LAND AND NATURAL RESOURCES
KA ʻOIHANA KUMUWAIWAI ʻĀINA
LAND DIVISION

P.O. BOX 621
HONOLULU, HAWAII 96809

February 13, 2024

MEMORANDUM

TO: **DLNR Agencies:**
__Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
X Engineering Division (DLNR.ENGR@hawaii.gov)
X Div. of Forestry & Wildlife (rubyrosa.t.terrago@hawaii.gov)
__Div. of State Parks
X Commission on Water Resource Management (DLNR.CWRM@hawaii.gov)
__Office of Conservation & Coastal Lands
X Land Division – Hawaii District (gordon.c.heit@hawaii.gov)
X Aha Moku Advisory Committee (leimana.k.damate@hawaii.gov)

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BRIEF COMMENTS:

( ) We have no objections.
(✓) We have no comments.
( ) We have no additional comments.
( ) Comments are included/attached.

Signed: [signature]
Print Name: GORDON C. HEIT
Division: Land Division
Date: 3/18/24

Attachments
cc: Central Files

JOSH GREEN, M.D.
GOVERNOR | KE KIAʻĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIAʻĀINA

DAWN N. S. CHANG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAIʻI | KA MOKUʻĀINA ʻO HAWAIʻI
DEPARTMENT OF LAND AND NATURAL RESOURCES
KA ʻOIHANA KUMUWAIWAI ʻĀINA
LAND DIVISION

P.O. BOX 621
HONOLULU, HAWAII 96809

April 4, 2024

G70
Attention: Mr. Jeff Overton — via email: UofNkona@g70.design
111 South King Street, Suite 170
Honolulu, Hawaii 96813

Dear Mr. Overton:

SUBJECT: Draft Environmental Impact Statement (DEIS) for the Proposed **University of the Nations, Kona, Inc. 2020 Master Plan Update** located at South Kona, Island of Hawaii; TMKs: (3) 7-5-010:085 and (3) 7-5-017:006 on behalf of University of the Nations, Kona, Inc.

Thank you for the opportunity to review and comment on the subject matter. In addition to our previous comments dated March 22, 2024, enclosed are comments from the Division of Forestry & Wildlife on the subject matter. Should you have any questions, please feel free to contact Darlene Nakamura at (808) 587-0417 or email: darlene.k.nakamura@hawaii.gov. Thank you.

Sincerely,

Russell Tsuji

Russell Y. Tsuji
Land Administrator

Enclosures
cc: Central Files

JOSH GREEN, M.D.
GOVERNOR | KE KIAʻĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIAʻĀINA

DAWN N. S. CHANG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAIʻI | KA MOKUʻĀINA ʻO HAWAIʻI
DEPARTMENT OF LAND AND NATURAL RESOURCES
KA ʻOIHANA KUMUWAIWAI ʻĀINA
LAND DIVISION

P.O. BOX 621
HONOLULU, HAWAII 96809

February 13, 2024

MEMORANDUM

FROM: **DLNR Agencies:**
__Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
X Engineering Division (DLNR.ENGR@hawaii.gov)
X Div. of Forestry & Wildlife (rubyrosa.t.terrago@hawaii.gov)
__Div. of State Parks
X Commission on Water Resource Management (DLNR.CWRM@hawaii.gov)
__Office of Conservation & Coastal Lands
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X Aha Moku Advisory Committee (leimana.k.damate@hawaii.gov)

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BRIEF COMMENTS:

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( ) We have no additional comments.
(☑) Comments are included/attached.

Signed:
Print Name: JASON D. OMICK, Acting Wildlife Prog. Mgr.
Division: Forestry and Wildlife
Date: Apr 4, 2024

Attachments
cc: Central Files

JOSH GREEN, M.D.
GOVERNOR | KE KIAʻĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIAʻĀINA

DAWN N.S. CHANG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RYAN K.P. KANAKAʻOLE
FIRST DEPUTY

DEAN D. UYENO
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 HAWAIʻI | KA MOKUʻĀINA ʻO HAWAIʻI
DEPARTMENT OF LAND AND NATURAL RESOURCES
KA ʻOIHANA KUMUWAIWAI ʻĀINA

DIVISION OF FORESTRY AND WILDLIFE
1151 PUNCHBOWL STREET, ROOM 325
HONOLULU, HAWAII 96813

April 3, 2024

Log no.4436

MEMORANDUM

TO: RUSSELL Y. TSUJI, Administrator
Department of Land and Natural Resources

FROM: JASON D. OMICK, Acting Wildlife Program Manager
Division of Forestry and Wildlife

SUBJECT: **Request for Consultation on the Draft Environmental Impact Statement for the Proposed University of the Nations, Kona, Inc. 2020 Master Plan Update, Hawai'i.**

The Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW) has received your request for consultation regarding the Draft Environmental Impact Statement (DEIS) for the proposed University of the Nations, Kona, Inc. 2020 Master Plan Update, located on the island of Hawai'i; TMK: (3) 7-5-010:085 and (3) 7-5-017:006. The proposed Master Plan Update intends to revise the land use plan for the Petition Area to reflect and fulfill the long-term vision of the University of the Nations Kona's Faith-based mission. The work will include but is not limited to expanding the existing campus along the highway, expanding the existing on-site spine road that bisects the Existing Campus and Petition area, the addition of a secondary access point off Kuakini Highway, and other upgrades to the existing utilities. The Master Plan Update addresses current and projected space and activity needs. The Master Plan is designed over a 30-year planning program, in three development phases with 5-10 years allocated for each phase.

DOFAW concurs with the measures included in the DEIS intended to avoid construction and operational impacts to State-listed species including Blackburn's Sphinx moth (*Manduca blackburni)*, ʻio or Hawaiian Hawk (*Buteo solitarius*), and seabirds. For illustrations and guidance related to seabird-friendly light styles that also protect the dark, starry skies of Hawaiʻi please visit https://dlnr.hawaii.gov/wildlife/files/2016/03/DOC439.pdf. We also appreciate the measures outlined to use native plants for landscaping, minimize the movement of plant and soil material to prevent the spread of invasive species and for the use of native plant species, and the use of Best Management Practices during and after construction to contain any soils and sediment with the purpose of preventing damage to near-shore waters and marine ecosystems. DOFAW provides the following additional comments regarding the potential for the proposed work to affect listed species in the vicinity of the project area.

The State listed ʻōpeʻapeʻa or Hawaiian Hoary Bat (*Lasiurus cinereus semotus*) could potentially occur at or in the vicinity of the project and may roost in nearby trees. Any required site clearing should be timed to avoid disturbance to bats during their birthing and pup rearing season (June 1 through September 15). During this period woody plants greater than 15 feet (4.6 meters) tall should not be disturbed, removed, or trimmed. Barbed wire should also be avoided in any construction as bats can become ensnared and killed by such fencing material during flight.

The State listed nēnē or Hawaiian Goose (*Branta sandvicensis*) could potentially occur in the vicinity of the proposed project site. It is against State law to harm or harass these species. If any are present during construction, all activities within 100 feet (30 meters) should cease and the bird or birds should not be approached. Work may continue after the bird or birds leave the area of their own accord. If a nest is discovered at any point, please contact the Hawaiʻi Island Branch DOFAW Office at (808) 974-4221 and establish a buffer zone around the nest.

The endemic pueo or Hawaiian Short-Eared Owl (*Asio flammeus sandwichensis*) could potentially nest in the project area. Pueo nest on the ground and active nests have been found year-round. Before any potential vegetative alteration, especially ground-based disturbance, we recommend that line transect surveys are conducted during crepuscular hours through the project area. If a pueo nest is discovered, a minimum buffer distance of 100 meters from the nest should be established until chicks are capable of flight.

The invasive Coconut Rhinoceros Beetle (CRB) or *Oryctes rhinoceros* is found on the islands of O'ahu, Hawai'i Island, Maui and Kaua'i. On July 1, 2022, the Hawaiʻi Department of Agriculture (HDOA) approved Plant Quarantine Interim Rule 22-1. This rule restricts the movement of CRB-host material within or to and from the island of Oʻahu, which is defined as the Quarantine Area. Regulated material (host material or host plants) is considered a risk for potential CRB infestation. Host material for the beetle specifically includes a) entire dead trees, b) mulch, compost, trimmings, fruit and vegetative scraps, and c) decaying stumps. CRB host plants include the live palm plants in the following genera: *Washingtonia*, *Livistona*, and *Pritchardia* (all commonly known as fan palms), *Cocos* (coconut palms), *Phoenix* (date palms), and *Roystonea* (royal palms). When such material or these specific plants are moved there is a risk of spreading CRB because they may contain CRB in any life stage. For more information regarding CRB, please visit https://dlnr.hawaii.gov/hisc/info/invasive-species-profiles/coconut-rhinoceros-beetle/.

DOFAW is concerned about impacts to vulnerable birds from nonnative predators such as cats, rodents, and mongooses. We recommend taking action to minimize predator presence; remove cats, place bait stations for rodents and mongoose, and provide covered trash receptacles.

Due to the arid climate and risks of wildfire to listed species, we recommend coordinating with the Hawaiʻi Wildfire Management Organization at (808) 850-0900 or admin@hawaiiwildfire.org, on how wildfire prevention can be addressed in the project area. When engaging in activities that have a high risk of starting a wildfire (i.e. welding in grass), it is recommended that you:

- Wet down the area before starting your task,
- Continuously wet down the area as needed,
- Have a fire extinguisher on hand, and
- In the event that your vision is impaired, (i.e. welding goggles) have a spotter to watch for fire starts.

We appreciate your efforts to work with our office for the conservation of our native species. These comments are general guidelines and should not be considered comprehensive for this site or project. It is the responsibility of the applicant to do their own due diligence to avoid any negative environmental impacts. Should the scope of the project change significantly, or should it become apparent that threatened or endangered species may be impacted, please contact our staff as soon as possible. If you have any questions, please contact Kate Cullison, Protected Species Habitat Conservation Planning Coordinator via email at katherine.cullison@hawaii.gov.

Sincerely,

JASON D. OMICK
Acting Wildlife Program Manager

LAND USE COMMISSION

Komikina Hoʻohana ʻĀina

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
Ka ʻOihana Hoʻomōhala Pāʻoihana, ʻImi Wai wai a Hoʻomākaʻikaʻi

JOSH GREEN, M.D.
GOVERNOR

SYLVIA LUKE
LT. GOVERNOR

DANIEL ORODENKER
LUC EXECUTIVE OFFICER

235 S. Beretania Street, RM 406, Honolulu, Hawaiʻi 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaiʻi 96804
Email Address: dbedt.luc.web@hawaii.gov

Telephone: (808) 587-3822
Fax: (808) 587-3827
Website: luc.hawaii.gov

February 26, 2024

Jeff Overton, AICP, LEED AP
G70
111 S. King Street, Suite 170
Honolulu, HI 96813

SUBJECT: A02-737 Bencorp Draft Environmental Impact Statement Comments

Dear Mr.Overton:

Thank you for providing the Land Use Commission ("LUC" or Commission") with the Draft Environmental Impact Statement ("DEIS") for the University of the Nations, Kona Inc. 2020 Master Plan Update.

LUC staff has internally reviewed the document twice, prior to the publication of the DEIS in the February 8, 2024, issue of the Environmental Notice. LUC staff provides the following comment(s):

Section 4.5 Groundwater Resources/ Hydrology
In the previous comment letter, LUC staff identified concerns with the unsecured water resource, the location and size of water lines proposed for the Petition Area has not been confirmed, nor has a Water Development Agreement been negotiated between the developer and proposed land/ well developers.

During the internal meeting between petitioner and staff on September 19, 2023, it was argued that the petitioner did not have to provide specific information on water sources in the EIS phase, but LUC Staff believe providing information on how petitioner plans to obtain water will provide a cohesive application.

Section 6.2.2 State Land Use Commission
In section 6.2.2's discussion section there is mention of the 2003 district boundary amendment granting the urbanization of the project area, it states that:

> The Master Plan Update for the Petition Area is consistent with Urban land usages as described in HRS Chapter 205 and will complement the surrounding urban area. U of N Kona acknowledges the Urban District designation of the Petition Area, and the Master Plan Update contemplates relocating the existing small farm and research center to the Existing Campus.

This section should include a statement that U of N Kona has the active 2020 motion to amend, to amend the current conditions and update the project description to reflect the Master Plan Update. Similarly, there should be mention of the motion to amend in the executive summary portion, as well as 3.3 Alternative Land Uses in the consistency paragraph.

The LUC Staff believe the other comments and suggestions that were listed in previous letters dated August 2, 2023, and January 24, 2024, have been adequately addressed at this time, but are subject to further comment and questioning by the Commission during the accepting authority proceedings.

Should you have any questions, please contact my office, at (808) 587-3823 or via email at dbedt.luc.web@hawaii.gov.

Sincerely,

Daniel Orodenker
Executive Officer
Land Use Commission
State of Hawaiʻi

JOSH GREEN, M.D.
GOVERNOR

KEITH T. HAYASHI
SUPERINTENDENT

STATE OF HAWAIʻI
DEPARTMENT OF EDUCATION
KA ʻOIHANA HOʻONAʻAUAO
P.O. BOX 2360
HONOLULU, HAWAIʻI 96804

OFFICE OF FACILITIES AND OPERATIONS

March 22, 2024

Mr. Jeff Overton, AICP, LEED AP
G70
111 South King Street, Suite 170
Honolulu, HI 96813

Re: Draft Environmental Impact Statement Notice of Availability
University of the Nations, Kona, Inc., Master Plan Update
TMK: (3)7-5-010:085 and (3)7-5-017:006
Kailua-Kona, Island of Hawaii, Hawaii

Dear Mr. Overton:

Thank you for your letter dated February 8, 2024. The Hawaii State Department of Education (Department) previously provided the enclosed comments, dated April 7, 2021. We encourage the developer to meet with the Department as early as possible to discuss executing an Educational Contribution Agreement.

Should you have any questions, please contact Cori China, Professional Worker for the Facilities Development Branch, Planning Section, at (808) 784-5080 or via email at cori.china@k12.hi.us.

We appreciate the opportunity to comment.

Sincerely,

Roy Ikeda
Interim Public Works Manager

RI:ctc
Enclosure

c: Janette Snelling, Complex Area Superintendent, Honokaa-Kealakehe-Kohala-Konawaena Complex Areas
Facilities Development Branch

DAVID Y. IGE
GOVERNOR

DR. CHRISTINA M. KISHIMOTO
SUPERINTENDENT

STATE OF HAWAIʻI
DEPARTMENT OF EDUCATION
P.O. BOX 2360
HONOLULU, HAWAIʻI 96804

OFFICE OF FACILITIES AND OPERATIONS

April 7, 2021

Jeff Overton, AICP, LEED AP
G70
111 S. King Street, Suite 170
Honolulu, Hawaii 96813

Re: Environmental Impact Statement Preparation Notice for University of the Nations, Kona, Inc. 2020 Master Plan Update, TMK (3) 7-5-010:085 and (3) 7-5-017:006 Kailua-Kona, Hawaii

Dear Mr. Overton:

Thank you for your letter dated March 9, 2021. The Hawaii State Department of Education (HIDOE) has the following comments on the Environmental Impact Statement Preparation Notice for the preparation of a Draft Environmental Impact Statement (DEIS) for the University of the Nations, Kona, Inc. (Applicant) 2020 Master Plan Update (Project) for lands located at TMK (3) 7-5-010:085 and (3) 7-5-017:006, Kailua-Kona, Island of Hawaii. Project lands were reclassified to the State Land Use Urban District by the Hawaii State Land Use Commission in Docket No. A02-737.

The proposed Project will guide the expansion of the existing campus over the next 30 years. Applicant has filed a Motion to Amend Findings of Fact, Conclusions of Law and Decision and Order for a Land Use District Boundary Amendment, dated August 8, 2003, with the Hawaii State Land Use Commission. The DEIS will provide a revised land use plan and development proposal to support the Applicant's Motion to Amend.

A condition of approval for Docket No. A02-737 required a fair-share contribution to the development, funding, and/or construction of school facilities, as determined by and to the satisfaction of the HIDOE. A written agreement is to be executed prior to seeking building permits for any portion of the reclassified area. To date, no educational contribution agreement has been executed.

Further comments will be provided upon the review of the DEIS.

Thank you for the opportunity to comment. Should you require further information, please contact Robyn Loudermilk, School Lands and Facilities Specialist of the Facilities Development Branch, Planning Section, at 784-5093 or by email at Robyn.Loudermilk@k12.hi.us.

Respectfully,

Roy Ikeda
Public Works Manager TA
Planning Section

RI:rll

JOSH GREEN, M.D.
GOVERNOR
KE KIAʻĀINA

KENNETH S. HARA
MAJOR GENERAL
ADJUTANT GENERAL
KA ʻAKUKANA KENELALA

STEPHEN F. LOGAN
BRIGADIER GENERAL
DEPUTY ADJUTANT GENERAL
KA HOPE ʻAKUKANA KENELALA

STATE OF HAWAIʻI
KA MOKUʻĀINA O HAWAIʻI
DEPARTMENT OF DEFENSE
KA ʻOIHANA PILI KAUA
OFFICE OF THE ADJUTANT GENERAL
3949 DIAMOND HEAD ROAD
HONOLULU, HAWAIʻI 96816-4495

March 8, 2024

Mr. Jeff Overton, AICP, LEED AP
G70
111 S. King Street, Suite 170
Honolulu, HI 96813

SUBJECT: Draft Environmental Impact Statement – Master Plan Update,
Kailua-Kona, Island of Hawaii, Hawaii
TMK: (3) 7-5-010:085 and (3) 7-5-017:006

Dear Mr. Overton:

Thank you for the opportunity to comment on the above project. The State of Hawaii Department of Defense would like to make note that portions of the University of the Nations lower campus sits within the Extreme Tsunami Inundation Zone.

Should there be any questions, please contact Mr. Tad T. Nakayama at 808-369-3490 or tad.t.nakayama@hawaii.gov.

Sincerely,

Shao Yu L. Lee, R.A.
Major, Hawaii National Guard
Chief Engineering Officer

JOSH GREEN, M.D.
GOVERNOR
KE KIAʻĀINA

EDWIN H. SNIFFEN
DIRECTOR
KA LUNA HOʻOKELE

Deputy Directors
Nā Hope Luna Hoʻokele
DREANALEE K. KALILI
TAMMY L. LEE
ROBIN K. SHISHIDO

STATE OF HAWAIʻI | KA MOKUʻĀINA ʻO HAWAIʻI
DEPARTMENT OF TRANSPORTATION | KA ʻOIHANA ALAKAU
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:
HWY-PL 24-2.35048

March 18, 2024

Mr. Jeff Overton, Principal
G70
111 South King Street, Suite 170
Honolulu, Hawaii 96813

Dear Mr. Overton:

Subject: Draft Environmental Impact Statement (DEIS)
University of the Nations, Kona, Inc. Master Plan Update
Kailua Kona, Hawaii
Tax Map Key No. (3) 7-5-010: 085 and (3) 7-5-017: 006

Thank you for submitting the University of the Nations Master Plan Update DEIS, including the Appendix H, Mobility Assessment Report (MAR), dated December 2023. We apologize for the delay in response.

Access to the site will be from Kuakini Highway, which is a County road. Queen Kaahumanu Highway, adjacent to the site's southeast corner, is the closest state highway. No direct access to the state highway is proposed. We concur with the MAR finding of no anticipated direct or indirect adverse impact on state highways during the construction or operation of Phase 1 of the proposed project. The applicant shall conduct a traffic warrant signal study at two intersections with Queen Kaahumanu Highway at Hualalai Road and Kuakini Highway before the certificate of occupancy of Phase 2.

If you have any questions, please contact Jeyan Thirugnanam, Land Use Planning Engineer, Planning Branch, at (808) 587-6336 or by email at jeyan.thirugnanam@hawaii.gov. Please reference file review number PL 2024-019.

Sincerely,

EDWIN H. SNIFFEN
Director of Transportation

G70

111 S. King Street
Suite 170
Honolulu, HI 96813
808.523.5866
www.g70.design

received
02/13/2024

February 8, 2024

Subject: Draft Environmental Impact Statement Notice of Availability
University of the Nations, Kona, Inc.
Master Plan Update
TMK: (3) 7-5-010:085 and (3) 7-5-017:006
Kailua-Kona, Island of Hawaiʻi, Hawaiʻi

Dear Participant:

On behalf of University of the Nations, Kona, Inc., G70 is notifying you of the availability of the Draft Environmental Impact Statement (EIS) for the University of the Nations, Kona, Inc. Master Plan Update located in Kailua-Kona, Island of Hawaiʻi, Hawaiʻi. The Draft EIS is available for public review and comment from February 8, 2024, and ending March 25, 2024.

For ease of sharing and to facilitate access, the Draft EIS document can be downloaded from the website of The Environmental Review Program (ERP):

https://files.hawaii.gov/dbedt/erp/Doc_Library/2024-02-08-HA-DEIS-University-of-the-Nations-Kona.pdf

The audio recording of the EIS Scoping Meeting dated March 25, 2021 can also be downloaded from ERP website:

https://files.hawaii.gov/dbedt/erp/Doc_Library/2024-02-08-HA-DEIS-University-of-the-Nations-Scoping-Mtg-Audio.m4a

Written comments may be submitted via email or via U.S. Mail as follows:

G70
111 S. King Street, Suite 170
Honolulu, HI 96813
Attn: Jeff Overton, AICP, LEED AP
Email: UofNkona@g70.design

Thank you for your participation in the environmental review process.

Sincerely,

Group 70 International, Inc., dba G70

Jeffrey H. Overton, AICP, LEED AP
Principal

STATE OF HAWAIʻI
OFFICE OF PLANNING
& SUSTAINABLE DEVELOPMENT

JOSH GREEN, M.D.
GOVERNOR

SYLVIA LUKE
LT. GOVERNOR

MARY ALICE EVANS
DIRECTOR

235 South Beretania Street, 6th Floor, Honolulu, Hawaiʻi 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaiʻi 96804

Telephone: (808) 587-2846
Fax: (808) 587-2824
Web: https://planning.hawaii.gov/

Coastal Zone Management Program

Environmental Review Program

Land Use Commission

Land Use Division

Special Plans Branch

State Transit-Oriented Development

Statewide Geographic Information System

Statewide Sustainability Branch

DTS 202402120847NA

April 3, 2024

Group 70 International, Inc. dba G70
111 S. King Street, Suite 170
Honolulu, HI 96813

Attn: Jeff Overton, AICP, LEED AP
Principal

Dear Mr. Overton:

Subject: Draft Environmental Impact Statement
University of the Nations, Kona, Inc.
2020 Master Plan Update
Kailua-Kona, Hawaiʻi

Thank you for the opportunity to provide comments on the subject Draft Environmental Impact Statement (DEIS).

The DEIS is intended to support the University of the Nations, Kona, Inc. (UNK) 2020 Master Plan Update (Plan). The Plan requires a new sewer connection under Kuakini Highway, a county roadway. Hence, an environmental review is required pursuant to Hawaiʻi Revised Statutes (HRS), Chapter 343.

Background
UNK is a 501(c)(3) non-profit corporation that operates a mission-based educational institution. It was founded in 1978 with its existing campus on 45 acres of land in Kailua-Kona, Hawaiʻi .

In 2002, UNK's benefit corporation, U of N Bencorp, filed a petition with the Land Use Commission (LUC) to reclassify two parcels totaling 62 acres adjacent to UNK's existing campus from the State Agricultural District to the Urban District. The purpose was to allow the construction of the Hualālai Village Development Project and generate revenue for UNK. The proposed project included market-rate condominiums, a for-profit Pacific Cultural Center, and a small educational facility. In 2003, the LUC approved the reclassification of the Petition Area.

However, the Project was never constructed and after several changes in ownership among UNK affiliates and an aborted 2006 Motion to Amend the LUC's 2003 Decision and Order, UNK took direct control of the Petition Area and filed a 2020 Motion to eliminate the previous development plan and instead use the entire Petition Area to expand UNK's existing campus.

Master Plan Update
The proposed plan includes:

- Dormitories for students and staff,
- Elementary, middle, and high schools,
- Disciple classrooms and student resource center,
- An athletic complex and training areas,
- Storage and maintenance facilities,
- A Discovery Center (science, technology, linguistics),
- A Chapel,
- Preservation and integration of archaeological sites, and
- Support facilities.

Current enrollment at the existing campus is approximately 774 students per quarter, with an estimated 609 students living on-campus. The full-time equivalent staff is approximately 602, with about 280 residing on campus. At full buildout, the expanded campus is expected to accommodate 1,000 K-12 students, 2,000 university students per quarter and 800 staff members. Construction will be done in three 10-year phases, encompassing 12, 29, and 21acres, respectively. The estimated total project cost over the 30-year development timeframe is approximately $157.5 million.

Petition Area
The Petition Area lies between Queen Kaahumanu Highway, State Route 11, to the east and the county's Kuakini Highway to the west. The lands to the north and south of the Petition Area are in the State Urban District, as are most of the lands to the west. Lands to the east across Queen Ka'ahumanu Highway are in the State Agricultural District. The Petition Area is outside the Special Management Area and is within the Kona Urban Area on the Kailua-Kona Community Development Map.

As stated previously, UNK's existing campus is adjacent to the Petition Area to the north. Five acres of UNK's 45-acre parcel have been subdivided for the Hualālai Village, on the Petition Area's northeast border. Hualālai Village consists of eight residential apartment buildings with a total of 105 condominium units. Units in three of the buildings have been sold at market rates, and the remaining buildings have been transferred to a non-profit land trust management company for the purpose of acquiring and providing affordable housing for UNK faculty and staff. Access to Hualālai Village is from Hualālai Road that intersects with Queen Ka'ahumanu Highway at the eastern border of the Petition Area and Kuakini Highway to the northwest.

The Petition Area is undeveloped and has no infrastructure, including on-site or off-site water sources or wastewater services. A spine road runs along the northern border of the Petition Area, separating it from the property line of the existing campus, and the intent is to use it to connect the existing campus and the expansion area.

Transportation
UNK's existing campus is accessed via a driveway on Kuakini Highway, and during the first phase of construction, a second access point along Kuakini Highway will be developed. The south driveway of the adjacent Hualālai Village subdivision is currently closed but can be accessed via the eastern portion of the Petition Area during emergencies.

A Mobility Analysis Report (MAR) for the Plan was completed in December 2023, and eight existing intersections were studied. The projected Level of Service (LOS) decreases mobility at all eight intersections with the proposed plan conditions, including three intersections with Queen Ka'ahumanu Highway. However, the MAR notes that the projected LOS for these intersections would have attained unacceptable levels under future conditions even without the plan.

County mass transit service to the area is provided by the Pāhala-Kona-South Kohala Route along Queen Kaahumanu Highway with two bus stops near UNK; the nearest bus stop is at least 2,000 feet from the campus. The MAR suggests that the proposed buildout is not anticipated to generate much transit ridership since most staff and university students are likely to live on campus.

Archaeological
An Archaeological Inventory Survey (AIS) of the Petition Area was prepared in 2003. During excavation work, human skeletal remains were identified at three sites. The AIS also identified 25 previously unrecorded sites and one previously known site. All 26 sites were evaluated as significant, 11 sites were recommended for no further work, five sites were recommended for preservation, and the remaining 10 sites were recommended for data recovery. The AIS was accepted by the Department of Land and Natural Resources (DLNR), State Historic Preservation Division (SHPD) on November 17, 2003.

Because of the discovery of the burial sites, a 2003 Burial Treatment Plan report was prepared to preserve the three burial sites in place and provide protective buffer zones during and after the Master Plan Update construction. The Burial Treatment Plan was approved by SHPD on August 20, 2019.

Following up on the AIS recommendations, an Archaeological Data Recovery Report was prepared for the 10 data recovery sites in 2007 and a Preservation Plan was prepared in 2013. The 2007 Data Recovery Report was originally submitted to SHPD in October 2007 and resubmitted in August 2019, and is currently under review by SHPD for acceptance. The 2013 Preservation Plan was given final acceptance from SHPD on June 19, 2014. In support of the Preservation Plan, a 2019 Dismantling and Restoration Plan was prepared and submitted to SHPD. It is currently under review for acceptance.

Cultural Impact
In support of the Master Plan Update, a Cultural Impact Assessment (2020 CIA) was prepared in 2020. The 2020 CIA updates a previous CIA conducted for the Petition Area in 2003. Thirty-four individuals were consulted in the 2020 CIA, with 21 responding. A Ka Pa'akai Analysis was also conducted in 2020. Given the accepted Burial Treatment Plan and Preservation Plan, and the measures in place to preserve and allow lineal descendants access, it is not anticipated that the Master Plan Update will impinge on access for the descendant community to access and care for their iwi kūpuna.

Water
The Petition Area is located within the Keauhou Aquifer System Area (ASYA) which is part of the Hualālai Aquifer Sector Area (ASEA) along with the Kīholo ASYA. The Hualālai ASEA has a sustainable yield of 56 million gallons per day (MGD). In March 2017, the *Hawai'i County Water Use and Development Plan Update, Keauhou Aquifer System* was finalized. The future water demand for the Keauhou ASYA includes the water needed to support the urban land use designation of the Petition Area under the previous plan. According to the update, the Keauhou ASYA has a sustainable yield of 38 MGD. As of June 2022, the existing groundwater pumpage within the Keauhou ASYA was 14.452 MGD or approximately 38% of the total sustainable yield.

Currently, the existing UNK campus receives water from the county Department of Water Supply (DWS) that operates the Kona Water System. However, the Petition Area does not.

At full buildout, the Master Plan Update is expected to need approximately 107,500 gallons of water per day (gpd), including the projected demand for irrigation purposes. This is an estimated .107 MGD, less than 1% of the total current demand. DWS suggests that a new water source will be required for the Petition Area. The Water Plan Update recommends development of future high-level wells for DWS systems in areas generally between 1,500 feet and 1,800 feet ground elevation mauka of Māmalahoa Highway. UNK has identified two potential locations for a new well and related infrastructure, the Wheelock Property and the Bolton Property. The potential sites are approximately 4.5 and 5 miles from the Kaloko-Honokōhau National Historic Park and are not expected to impact the freshwater flow to the coastline from the National Park.

Biological Resources
A Natural Resources Survey of the Petition Area was prepared in January 2020 that updated the biological survey of the Petition Area prepared in 2002. The 2020 Survey identified 49 plant species in the area; none are currently protected as threatened or endangered. Twenty-one avian

species were identified in the area; only one, the Hawaiian Hawk, is a species of concern. As of February 3, 2020, the Hawaiian Hawk has been delisted as an endangered species by the U.S. Fish and Wildlife Service but remains listed by the State of Hawaiʻi and protected under the Migratory Bird Treaty Act. The 2020 Survey found no threatened or endangered mammal species. Though not detected, the Blackburn's Sphinx Moth has a historic range that includes the Petition Area. No tree tobacco plants, the moths' natural habitat, were found during the Survey but if these are discovered later, the DLNR, Division of Forestry and Wildlife will be consulted prior to clearing of non-native vegetation.

Construction activity will be limited to daylight hours. If nighttime activity is required, lighting will be shielded. Exterior lighting installed as part of the plan will be shielded in compliance with the Hawaiʻi County Codes to reduce ambient glare reaching the astronomical observatories on Mauna Kea and to minimize impacts on seabirds.

Utilities

UNK currently discharges 33,324 gallons per day of wastewater to the county sewer system that conveys the wastewater to the Kealakehe Wastewater Treatment Plan. The total projected wastewater flow for the Master Plan Update at full buildout is 76,000 gallons of average daily flow. The flow is currently under review by the county's Department of Environmental Management's Wastewater Division. Electrical service is currently provided to the existing campus by Hawaiian Electric, and communications services by Hawaiian Tel and Spectrum, and these companies are also expected to serve the Petition Area.

Climate Change and Sustainability

The existing campus and the Petition Area are mauka of Kuakini Highway, outside the 3.2-foot Sea Level Rise Exposure Area.

A Greenhouse Gas Analysis was conducted for the Plan. Over the 30-year construction period, the Plan construction is projected to produce approximately 114,000 metric tons of CO_2 emissions, or about 3,800 metric tons annually. Global CO_2 emissions from the construction industry are estimated to account for approximately 2.3 gigatons of emissions annually. Upon completion of the Plan and over the next 100 years, it is anticipated that operations in the Petition Area will produce approximately 17,625 metric tons of CO_2 emissions annually.

To reduce the Plan's carbon footprint and promote more sustainable operations, xeriscape landscaping techniques, permeable pavements and sidewalks, low-flow plumbing fixtures, solar photovoltaic (PV) panels on buildings, and buildings designed to achieve Leadership in Energy and Environmental Design (LEED) will be utilized.

OPSD Comments

The Office of Planning and Sustainable Development (OPSD) offers the following comments:

1. The Final Environmental Impact Statement (FEIS) should confirm that the only access to UNK's existing north campus and the planned south campus will be through the existing driveway and a planned second driveway off Kuakini Highway; and that vehicular access to UNK's existing or the planned campuses via the Hualālai Village subdivision's driveways will only be allowed during emergencies.

2. The FEIS should confirm UNK's commitment to installing permeable pavements and sidewalks and solar PV panels on buildings. Some sections of the DEIS state that UNK "may" utilize permeable pavements and sidewalks or solar PV panels and other sections state that UNK "will" install these sustainability features.

3. The FEIS should confirm the total number of K-12 students, university students, and staff members at full buildout, the number of acres being developed in each phase, and the total water demand (gpd), including irrigation, at full buildout. There is a discrepancy between the figures given for these items in the DEIS narrative and Table 2-2, Table 4-4 and Table 4-5.

If you have any questions regarding our comments, please contact Aaron Setogawa of our Land Use Division at (808) 587-2883 or aaron.h.setogawa@hawaii.gov. If you wish to respond to this comment letter, please include DTS 202402120847NA in the subject line.

Mahalo,

Mary Alice Evans

Mary Alice Evans
Director

Mitchell D. Roth
Mayor

Deanna S. Sako
Managing Director

West Hawaiʻi Office
74-5044 Ane Keohokālole Hwy
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County of Hawaiʻi
PLANNING DEPARTMENT

Zendo Kern
Director

Jeffrey W. Darrow
Deputy Director

East Hawaiʻi Office
101 Pauahi Street, Suite 3
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Phone (808) 961-8288
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March 25, 2024

Mr. Jeffrey H. Overton, AICP, LEED AP
Group 70 International, Inc,. dba G70
111 South King Street, Suite 170
Honolulu, Hawaiʻi 96813

Dear Mr. Overton:

SUBJECT: Comments for Draft Environmental Impact Statement (DEIS)
University of the Nations, Kona, Inc. Master Plan Update
Tax Map Key: (3) 7-5-010:085 & 7-5-017:006 Kailua-Kona, Hawaiʻi

This is in response for comments for the Draft Environment Impact Statement prepared for University of the Nations, Kona, Inc. Master Plan Update.

1. The subject properties are 58.597 acres and 5.361 acres in size respectively. Parcel 85 is zoned Agricultural-1 acre (A-1a) and Parcel 6 is zoned Double-Family Residential (RD-3.75) & Single-Family Residential (RS-7.5) by the County of Hawaiʻi. Both properties are currently designated as Urban by the State Land Use Commission. It is our understanding that the petitioner will be seeking a rezoning to the Project District, which would provide flexibility in relocating elements within the Petition Area, or another appropriate zoning district.

   Based on the information below regarding the Kona Community Development Plan, the Project District zoning would be the appropriate zoning district for the proposed development.

2. The General Plan Land Use Pattern Allocation Guide (LUPAG) map designation for the project site is Medium Density Urban (mdu), which allows for Village and Neighborhood Commercial zoning, as well as Single-Family and Multiple-Family Residential and related functions. This designation allows for multiple-family residential units up to 35 units per acre. The proposed development is consistent with the General Plan LUPAG designation for the project site.

3. The properties are not located within the Special Management Area (SMA) but are situated within the Coastal Zone Management Area (CZMA). Please expand on the discussion of how the project will meet the objectives and policies of the CZMA that are applicable.

4. The property is in an area affected by the Kona Community Development Plan (KCDP), which was adopted by the Hawai'i County Council by Ordinance No. 08-131 and amended by Ordinance 19-91, among others.

   The project site is situated within the Kona Urban Area (KUA) and within the Puaa-Waiaha Village Neighborhood Traditional Oriented Development (TOD) Floating Zone identified on the Official Kona Land Use Map (Figure 4-7) within the KCDP.

   The process for establishing a TOD Floating Zone within the KUA is identified within the amended KCDP under Policy LU-2.4 of the Land Use Section. The development of TODs are encouraged within the extent and locations of the floating zones shown on the Official Kona Land Use Map (Figure 4-7). These locations are approximate and become fixed pursuant to the Project District rezoning procedures as modified and described under Policy LU-2.4(1 through 7).

We have no further comments at this time.

If you have any questions, please feel free to contact Jeff Darrow at 808-961-8158.

Sincerely,

Jeffrey W. Darrow
Jeffrey W. Darrow (Mar 25, 2024 10:21 HST)
for

ZENDO KERN
Planning Director

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cc w/copy of letter: Michelle Ahn, Deputy Corporation Counsel
Mr. Derek Simon, Carlsmith Ball

Mitchell D. Roth
Mayor

Benjamin T. Moszkowicz
Police Chief

Reed K. Mahuna
Deputy Police Chief

County of Hawai`i

POLICE DEPARTMENT

349 Kapi'olani Street • Hilo, Hawai'i 96720-3998
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March 1, 2024

Mr. Jeffrey H. Overton
AICP, LEEP AP
Principal
G70
111 S. King Street, Suite 170
Honolulu, HI 96813
UofNKona@g70.design

Aloha Mr. Overton:

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT NOTICE OF AVAILABILITY
UNIVERSITY OF THE NATIONS, KONA, INC.
MASTER PLAN UPDATES
TMK: (3) 7-5-010:085 and (3) 7-5-017:006
KAILUA-KONA, ISLAND OF HAWAI'I, HAWAI'I

This is in response to your letter dated February 8, 2024 regarding the above-referenced Draft Environmental Impact Statement (EIS) Notice of Availability.

Staff has reviewed the proposed draft EIS and has no comments or objections to offer at this time.

Should you have any questions or concerns, please contact Captain Calvin Delaries, Jr., Commander of the Kona District, at (808) 326-4646, ext. 299, or via email at calvin.delaries@hawaiicounty.gov.

Sincerely,

BENJAMIN T. MOSZKOWICZ
POLICE CHIEF

CHAD BASQUE
ASSISTANT POLICE CHIEF
AREA II OPERATIONS

CD/jaj
24HQ0181